ADAS2XX
FORTRAN

B1DATA

```
       SUBROUTINE B1DATA( IUNIT  , NDLEV  , NDTRN ,
     &                    TITLED , IZ     , IZ0   , IZ1   , BWNO  ,
     &                    IL     ,
     &                    IA     , CSTRGA , ISA   , ILA   , XJA   , WA ,
     &                    NV     , SCEF   ,
     &                    ITRAN  ,
     &                    I1A    , I2A    , AVAL  , SCOM
     &                  )
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B1DATA *********************
C
C  PURPOSE:  TO FETCH DATA FROM INPUT SPECIFIC Z EXCITATION FILE.
C            (ELECTRON IMPACT TRANSITIONS ONLY).
C
C  CALLING PROGRAM: ADAS201
C
C  DATA:
C           THE 'REAL' DATA IN THE FILE IS REPRESENTED IN AN ABBREVIATED
C           FORM WHICH OMITS THE "D" OR "E" EXPONENT SPECIFIER.
C           e.g. 1.23D-06 or 1.23E-06 IS REPRESENTED AS 1.23-06
C                6.75D+07 or 6.75E+07 IS REPRESENTED AS 6.75+07
C
C           THEREFORE THE FORM OF EACH 'REAL' NUMBER IN THE DATA SET IS:
C                        N.NN+NN or N.NN-NN
C
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C           RATE COEFFT.        : CM3 SEC-1
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = UNIT TO WHICH INPUT FILE IS ALLOCATED
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS THAT CAN BE READ
C  INPUT : (I*4)  NDTRN   = MAX. NUMBER OF TRANSITIONS THAT CAN BE READ
C
C  OUTPUT: (C*3)  TITLED  = ELEMENT SYMBOL.
C  OUTPUT: (I*4)  IZ      =  RECOMBINED ION CHARGE READ
C  OUTPUT: (I*4)  IZ0     =         NUCLEAR CHARGE READ
C  OUTPUT: (I*4)  IZ1     = RECOMBINING ION CHARGE READ
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  OUTPUT: (R*8)  BWNO    = IONISATION POTENTIAL (CM-1)
C
C  OUTPUT: (I*4)  IL      = INPUT DATA FILE: NUMBER OF ENERGY LEVELS
C
C  OUTPUT: (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  OUTPUT: (C*12) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  OUTPUT: (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  OUTPUT: (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  OUTPUT: (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  OUTPUT: (R*8)  WA()    = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C
C  OUTPUT: (I*4)  NV      = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR A GIVEN TRANSITION.
C  OUTPUT: (R*8)  SCEF()  = INPUT DATA FILE: ELECTRON TEMPERATURES (K)
C                           (INITIALLY JUST THE MANTISSA. SEE 'ITPOW()')
C                           (NOTE: TE=TP=TH IS ASSUMED)
C
C  OUTPUT: (I*4)  ITRAN   = INPUT DATA FILE: NUMBER OF ELECTRON IMPACT
C                                            TRANSITIONS.
C
C  OUTPUT: (I*4)  I1A()   = ELECTRON IMPACT TRANSITION:
C                             LOWER ENERGY LEVEL INDEX
C  OUTPUT: (I*4)  I2A()   = ELECTRON IMPACT TRANSITION:
C                             UPPER ENERGY LEVEL INDEX
C  OUTPUT: (R*8)  AVAL()  = ELECTRON IMPACT TRANSITION:
C                             A-VALUE (SEC-1)
C  OUTPUT: (R*8)  SCOM(,) = ELECTRON IMPACT TRANSITION:
C                             GAMMA VALUES
C                           1ST DIMENSION - TEMPERATURE 'SCEF()'
C                           2ND DIMENSION - TRANSITION NUMBER
C
C          (I*4)  NDTEM   = PARAMETER = MAX NUMBER OF INPUT FILE TEMPS.
C
C          (I*4)  I4UNIT  = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (I*4)  IQS     = X-SECT DATA FORMAT SELECTOR
C                           NOTE: IQS=3 ONLY ALLOWED IN THIS PROGRAM
C          (I*4)  I       = GENERAL USE.
C          (I*4)  J       = GENERAL USE.
C          (I*4)  J1      = INPUT DATA FILE - SELECTED TRANSITION:
C                             LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
```

```
C          (I*4)  J2      = INPUT DATA FILE - SELECTED TRANSITION:
C                             UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                             CAPTURING    LEVEL INDEX (CASE 'H' & 'R')
C          (I*4)  ILINE   = ENERGY LEVEL INDEX FOR CURRENT LINE
C          (I*4)  IAPOW   = EXPONENT OF 'AVALM'
C          (I*4)  IGPOW() = EXPONENT OF 'GAMMA()'
C          (I*4)  ITPOW() = TEMPERATURES - EXPONENT
C                           NOTE: MANTISSA INITIALLY KEPT IN 'SCEF()'
C
C          (R*4)  ZF      = SHOULD BE EQUIVALENT TO 'IZ1'
C
C          (R*8)  AVALM   = INPUT DATA FILE - SELECTED TRANSITION:
C                           MANTISSA OF:   ('IAPOW' => EXPONENT)
C                            A-VALUE (SEC-1)          (CASE ' ')
C                            NEUTRAL BEAM ENERGY      (CASE 'H')
C                            NOT USED                 (CASE 'P' & 'R')
C          (R*8)  GAMMA() = INPUT DATA FILE - SELECTED TRANSITION:
C                           MANTISSA OF: ('IGPOW()' => EXPONENT)
C                            GAMMA VALUES             (CASE ' ' & 'P')
C                            RATE COEFFT. (CM3 SEC-1) (CASE 'H' & 'R')
C                           DIMENSION => TEMPERATURE 'SCEF()'
C
C          (C*1)  TCODE   = TRANSITION: DATA TYPE POINTER:
C                           ' ' => Electron Impact   Transition
C                           'P' => Proton   Impact   Transition
C                           'H' => Charge   Exchange Recombination
C                           'R' => Free     Electron Recombination
C          (C*80) CLINE   = CURRENT ENERGY LEVEL INDEX PARAMETER LINE
C
C          (L*4)  LDATA   = IDENTIFIES  WHETHER  THE END OF AN  INPUT
C                           SECTION IN THE DATA SET HAS BEEN LOCATED.
C                           (.TRUE. => END OF SECTION REACHED)
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  16/11/90 - LEVEL LINE READ AS A CHARACTER*80 STRING FIRST
C                     (PE BRIDEN)
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C-----------------------------------------------------------------------
      INTEGER   NDTEM
C-----------------------------------------------------------------------
      PARAMETER ( NDTEM = 8 )
C-----------------------------------------------------------------------
      INTEGER   I4UNIT
      INTEGER   IUNIT       , NDLEV          , NDTRN      ,
     &          IZ          , IZ0            , IZ1        ,
     &          IL          , NV             , ITRAN
      INTEGER   ILINE
      INTEGER   IQS         , I              , J          , J1  , J2  ,
     &          IAPOW       , IGPOW(NDTEM)   , ITPOW(NDTEM)
      INTEGER   IA(NDLEV)   , ISA(NDLEV)     , ILA(NDLEV) ,
     &          I1A(NDTRN)  , I2A(NDTRN)
C-----------------------------------------------------------------------
      REAL*4    ZF
C-----------------------------------------------------------------------
      REAL*8    BWNO        , AVALM
      REAL*8    SCEF(NDTEM) , GAMMA(NDTEM)
      REAL*8    XJA(NDLEV)  , WA(NDLEV)      ,
     &          AVAL(NDTRN) , SCOM(NDTEM,NDTRN)
C-----------------------------------------------------------------------
      CHARACTER TITLED*3    , TCODE*1        , CSTRGA(NDLEV)*12
      CHARACTER CLINE*80
C-----------------------------------------------------------------------
      LOGICAL   LDATA
C-----------------------------------------------------------------------
```

B1OUT0

```
SUBROUTINE B1OUT0( IWRITE   , IL     , LFSEL , LOSEL ,
     &                   TITLE    , TITLX  , TITLM , DATE  ,
     &                   IZ0      , IZ1    , IZ    , BWNO  ,
     &                   MAXT     , LTRNG  ,
     &                              TOA    , GAMOA , DROA  , ROA    ,
     &                   AA       , LUPPER , LLOWER, EUPPER, ELOWER ,
     &                   IUPPER   , ILOWER ,
     &                   CSTRGA   , ISA    , ILA   , XJA   ,
     &                   KPLUS1   , COEF
     &                 )
       IMPLICIT NONE
```

```
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B1OUT0 *********************
C
C  PURPOSE:  TO  PRINT DATA CONCERNING THE SELECTED TRANSITION UNDER
C            ANALYSIS.
C
C  CALLING PROGRAM: ADAS201
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IWRITE  = OUTPUT UNIT FOR RESULTS
C  INPUT : (I*4)  IL      = NUMBER OF INDEX ENERGY LEVELS
C  INPUT : (L*4)  LOSEL   = .TRUE.  => INTERPOLATED   VALUES  FOR   ISPF
C                                      PANEL INPUT VALUES CALCULATED
C                           .FALSE  => INTERPOLATED   VALUES  FOR   ISPF
C                                      PANEL INPUT VALUES NOT CALCULATED
C  INPUT : (L*4)  LFSEL   = .TRUE.  => MINIMAX POLYNOMIAL FITTED.
C                           .FALSE. => MINIMAX POLYNOMIAL NOT FITTED
C
C  INPUT : (C*40) TITLE   = TITLE OF RUN (READ FROM ISPF PANEL)
CX INPUT : (C*80) TITLX   = INFORMATION STRING CONTAINING: INPUT DATA
CA INPUT : (C*120) TITLX  = INFORMATION STRING CONTAINING: INPUT DATA
C                           FILE-NAME, ELEMENT, CHARGE and  TRANSITION
C  INPUT : (C*80) TITLM   = DIAGNOSTIC LINE INFORMATION FROM 'MINIMAX'
C  INPUT : (C*8)  DATE    = CURRENT DATE (AS 'DD/MM/YY')
C
C  INPUT : (I*4)  IZ0     =         NUCLEAR CHARGE
C  INPUT : (I*4)  IZ1     = RECOMBINING ION CHARGE
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT : (I*4)  IZ      =  RECOMBINED ION CHARGE
C  INPUT : (R*8)  BWNO    = IONISATION POTENTIAL (CM-1)
C
C  INPUT : (I*4)  MAXT    = NUMBER OF ISPF ENTERED TEMPERATURE VALUES.
C  INPUT : (L*4)  LTRNG() = .TRUE.  => TEMPERATURE 'TOA()' IN RANGE
C                           .FALSE. => TEMPERATURE 'TOA()' OUT OF RANGE
C                           (RANGE = INPUT TEMPERATURE RANGE)
C
C  INPUT : (R*8)  TOA()   = ISPF ENTERED TEMPERATURES (kelvin)
C  INPUT : (R*8)  GAMOA() = SPLINE INTEROPLATED GAMMA VALUE AT 'TOA()'
C  INPUT : (R*8)  ROA()   = EXCITATION RATE COEFF.(cm**3/s) AT 'TOA()'
C  INPUT : (R*8)  DROA()  = DEEXCITATION RATE COEF.(cm**3/s) AT 'TOA()'
C
C  INPUT : (R*8)  AA      = SELECTED TRANSITION A-VALUE (SEC-1)
C  INPUT : (I*4)  LUPPER  = SELECTED TRANSITION: UPPER INDEX LEVEL
C  INPUT : (I*4)  LLOWER  = SELECTED TRANSITION: LOWER INDEX LEVEL
C  INPUT : (R*8)  EUPPER  = SELECTED TRANSITION: UPPER ENERGY LEVEL
C                           RELATIVE TO INDEX LEVEL 1. (CM-1)
C  INPUT : (R*8)  ELOWER  = SELECTED TRANSITION: LOWER ENERGY LEVEL
C                           RELATIVE TO INDEX LEVEL 1. (CM-1)
C
C  INPUT : (I*4)  IUPPER  = SELECTED TRANSITION: UPPER LEVEL ARRAY INDEX
C  INPUT : (I*4)  ILOWER  = SELECTED TRANSITION: LOWER LEVEL ARRAY INDEX
C
C  INPUT : (C*18) CSTRGA()= LEVEL CONFIGURATION FOR INDEX LEVELS
C  INPUT : (I*4)  ISA()   = MULTIPLICITY FOR INDEX LEVELS
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT : (I*4)  ILA()   = QUANTUM NUMBER (L) FOR INDEX LEVELS
C  INPUT : (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR INDEX LEVELS
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C
C  INPUT : (I*4)  KPLUS1  = NUMBER OF MINIMAX COEFFICIENTS
C  INPUT : (R*8)  COEF()  = COEFFICIENTS OF FITTED MINIMAX POLYNOMIAL
C
C          (I*4)  I       = GENERAL USE - ARRAY ELEMENT INDEX
C
C          (R*8)  WN2RYD  = WAVE NUMBER (CM-1) TO RYDBERG CONVERSION
C          (R*8)  TK2EV   = KELVINS TO ELECTRON VOLTS CONVERSION
C          (R*8)  TK2RT   = KELVINS TO REDUCED TEMPERATURE CONVERSION
C          (R*8)  EDIF    = TRANSITION ENERGY IN WAVE NUMBERS (CM-1)
C
C          (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXADAS     ADAS      GATHERS ADAS HEADER INFORMATION
C
C AUTHOR  : PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C           K1/0/81
C           JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  08/01/91 - PE BRIDEN: ADDED 'LFSEL' & 'LOSEL' AS  THIRD  AND
C                                FOURTH ARGUMENTS OF THIS SUBROUTINE.
C                                USED THESE TWO ARGUMENTS TO DECIDE  IF
C                                MINIMAX OR ISPF PANEL INPUT VALUES ARE
C                                TO BE OUTPUT.
C
C UPDATE:  16/01/91 - PE BRIDEN: ADDED HEADER INFORMATION TO OUTPUT
C
C UPDATE:  17/01/91 - PE BRIDEN: RENAMED SUBROUTINE (ORIGINALLY B1OUTR)
C
C UPDATE:  23/01/91 - PE BRIDEN: INTRODUCE 'LTRNG()'
C
C UPDATE:  29/01/91 - PE BRIDEN: SET 'CADAS' TO BLANK AT START (VIA DATA
C                                STATEMENT) AND ADDED 'SAVE CADAS'.
```

```
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 21/03/95
C MODIFIED: L. JALOTA (TESSELLA SUPPORT SERVICES PLC)
C               - FIRST VERSION
C
C VERSION: 1.2                          DATE: 24-03-95
C MODIFIED: L. JALOTA
C               - INCREASED SIZE OF CSTRGA ARRAY FROM 12
C                 TO 18 BYTES. (STILL ONLY OUTPUT FIRST 12 BYTES.)
C               - INCREASED SIZE OF TITLX TO 120 BYTES
C                  FOR UNIX AND MODIFIED FORMAT STATEMENT 1003
C
C VERSION: 1.3                          DATE: 13-05-96
C MODIFIED: TIM HAMMOND(TESSELLA SUPPORT SERVICES PLC)
C               - REMOVED HOLLERITH CONSTANTS FROM OUTPUT AND
C                 TIDIED UP HEADER COMMENTS.
C
C-----------------------------------------------------------------------
      REAL*8     WN2RYD             , TK2EV
C-----------------------------------------------------------------------
      PARAMETER( WN2RYD=9.11269D-06 , TK2EV=8.6167D-05 )
C-----------------------------------------------------------------------
      INTEGER    I           , IWRITE     , IL          ,
     &           IZ0         , IZ1        , IZ          ,
     &           MAXT        , KPLUS1     ,
     &           LUPPER      , LLOWER     ,
     &           IUPPER      , ILOWER
C-----------------------------------------------------------------------
      REAL*8     EUPPER      , ELOWER     ,
     &           TK2RT       , EDIF       ,
     &           BWNO        , AA
C-----------------------------------------------------------------------
      LOGICAL    LFSEL       , LOSEL
C-----------------------------------------------------------------------
      CHARACTER  TITLE*(*)   , TITLX*(*)  , TITLM*(*)   , DATE*8    ,
     &           TEXTU*5     , TEXTL*5    , CADAS*80
C-----------------------------------------------------------------------
      INTEGER    ISA(IL)     , ILA(IL)
C-----------------------------------------------------------------------
      REAL*8     XJA(IL)     ,
     &           TOA(MAXT)   , GAMOA(MAXT) , DROA(MAXT) , ROA(MAXT) ,
     &           COEF(KPLUS1)
C-----------------------------------------------------------------------
      LOGICAL    LTRNG(MAXT)
C-----------------------------------------------------------------------
      CHARACTER  CSTRGA(IL)*18
C-----------------------------------------------------------------------
      SAVE       CADAS
C-----------------------------------------------------------------------
      DATA       TEXTU       , TEXTL       , CADAS
     &         / 'UPPER'     , 'LOWER'     , ' '         /
C-----------------------------------------------------------------------
```

B1OUTG

```
      SUBROUTINE B1OUTG( LGHOST ,
     &                   TITLE  , TITLX , TITLM , DATE ,
     &                   TEMP   , RATE  , NENER ,
     &                   TOMA   , ROMA  , NMX   ,
     &                   TOSA   , ROSA  , NPSPL ,
     &                   LGRD1  , LDEF1 , LFSEL ,
     &                   XMIN   , XMAX  , YMIN  , YMAX
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B1OUTG *********************
C
C  PURPOSE:  GRAPHIC ROUTINE FOR SELECTED TRANSITION USING IDL.
C
C            PROVIDES COMPARATIVE GRAPH OF:
C                                ORIGINAL <SE>LIKE.DATA    (CROSSES    )
C                                SPLINE INTERPOLATED DATA  (FULL CURVE)
C                                MINIMAX FIT TO DATA       (DASH CURVE )
C
C            PLOT IS LOG10(RATE(CM**3/SEC))  VERSUS LOG10(TEMP(KELVIN))
C
C  CALLING PROGRAM: ADAS201
C
C  SUBROUTINE:
C
CA UNIX PORT - LGHOST USED TO KEEP ARGUMENT LIST THE SAME.
CA
C  INPUT : (L*4)  LGHOST  = .TRUE.  => GHOST80 INITIALISED
C                           .FALSE. => GHOST80 NOT INITIALISED
C
C  INPUT : (C*40) TITLE   = TITLE OF RUN (READ FROM ISPF PANEL)
C  INPUT : (C*120)TITLX   = INFORMATION STRING CONTAINING: INPUT DATA
C                           FILE-NAME, ELEMENT, CHARGE and  TRANSITION
C  INPUT : (C*80) TITLM   = DIAGNOSTIC LINE INFORMATION FROM 'MINIMAX'
C  INPUT : (C*8)  DATE    = CURRENT DATE (AS 'DD/MM/YY')
C
```

```
C  INPUT : (R*8)  TEMP()  = INPUT DATA FILE: TEMPERATURES (kelvin)
C  INPUT : (R*8)  RATE()  = INPUT DATA FILE: SELECTED TRANSITION -
C                           EXCITATION RATE COEFF. (cm**3/s) AT 'TEMP()'
C  INPUT : (I*4)  NENER   = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR THE SELECTED TRANSITION.
C
C  INPUT : (R*8)  TOMA()  = MINIMAX: SELECTED TEMPERATURES (kelvin)
C  INPUT : (R*8)  ROMA()  = EXCITATION RATE COEFF.(cm**3/s) AT 'TOMA()'
C  INPUT : (I*4)  NMX     = NUMBER OF MINIMAX  GENERATED   GAMMA/TEMP.
C                           PAIRS FOR GRAPHICAL DISPLAY.
C
C  INPUT : (R*8)  TOSA()  = SPLINE: SELECTED TEMPERATURES (kelvin)
C  INPUT : (R*8)  ROSA()  = EXCITATION RATE COEFF.(cm**3/s) AT 'TOSA()'
C  INPUT : (I*4)  NPSPL   = NUMBER  OF SPLINE INTERPOLATED GAMMA/TEMP.
C                           PAIRS FOR GRAPHICAL DISPLAY.
C
CA UNIX PORT - LGRD1 USED ONLY TO KEEP ARGUMENT LIST THE SAME.
CA
C  INPUT : (L*4)  LGRD1   = .TRUE.  => PUT GRAPH IN GRID FILE
C                           .FALSE. => DO NOT PUT GRAPH IN GRID FILE
C  INPUT : (L*4)  LDEF1   = .TRUE.  => USE DEFAULT GRAPH SCALING
C                           .FALSE. => DO NOT USE DEFAULT GRAPH SCALING
C  INPUT : (L*4)  LFSEL   = .TRUE.  => CARRY OUT MINIMAX POLYNOMIAL
C                                      FITTING
C                           .FALSE. => - DO NOT DO THE ABOVE -
C
C  INPUT : (R*8)  XMIN    = GRAPH: LOWER LIMIT FOR TEMPERATURE (K)
C  INPUT : (R*8)  XMAX    = GRAPH: UPPER LIMIT FOR TEMPERATURE (K)
C  INPUT : (R*8)  YMIN    = GRAPH: LOWER LIMIT FOR RATE COEFF. (cm**3/s)
C  INPUT : (R*8)  YMAX    = GRAPH: UPPER LIMIT FOR RATE COEFF. (cm**3/s)
C
C
C          (I*4)  I4UNIT  = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (I*4)  I       = GENERAL USE - ARRAY INDEX
C          (I*4)  IKEY    = NUMBER OF 'KEY()' VALUES TO BE OUTPUT
C          (I*4)  ICOUNT  = NUMBER OF POINTS PLOTTED FOR GRAPH CURVE
C
C          (C*12) DNAME   = '      DATE: '
C          (C*9)  KEY0    = '    KEY: '
C          (C*9)  MNMX0   = 'MINIMAX: '
C          (C*8)  ADAS0   = 'ADAS   :'
C          (C*22) KEY()   = DESCRIPTIVE KEY FOR GRAPH (3 TYPES)
C
C          (C*1)  GRID    = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*1)  PIC     = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*3)  C3BLNK  = BLANK 3 BYTE STRING
C          (C*7)  C7      =  7 BYTE STRING = 'TITLX(1:4)'//'C3BLNK'
C           (I*4)  PIPEOU  = PARAMETER : UNIT NUMBER OF PIPE
C           (I*4)  ONE       = PARAMETER : VARIABLE USED AS LOGICAL FOR IDL
C           (I*4)  ZERO    = PARAMETER : VARIABLE USED AS LOGICAL FOR IDL
C           (I*4)  IFIRST  = POSITION OF FIRST NO-BLNK CHARACTER IN STRING
C           (I*4)  ILAST   = POSITION OF LAST  NO-BLNK CHARACTER IN STRING
C
C
C ROUTINES:
C          ROUTINE     SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXADAS      ADAS      GATHERS ADAS HEADER INFORMATION
C          I4UNIT      ADAS      GET UNIT NUMBER FOR OUTPUT OF MESSAGES
C           XXSLEN      ADAS      GET POSITION OF NON-BLANK CHARACTERS.
C
C AUTHOR:  L. JALOTA (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    08/03/95
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
       INTEGER I4UNIT
       INTEGER NENER      , NMX         , NPSPL    ,
     &                    I           , IKEY     , ICOUNT  ,
     &                      IFIRST      , ILAST    ,
     &                    PIPEOU      , ONE      ,  ZERO
          PARAMETER (PIPEOU = 6, ONE = 1, ZERO = 0)
C-----------------------------------------------------------------------
       REAL*8 TEMP(NENER) , RATE(NENER) ,
     &        TOMA(NMX)   , ROMA(NMX)   ,
     &        TOSA(NPSPL) , ROSA(NPSPL) ,
     &        XMIN        , XMAX        ,
     &        YMIN        , YMAX
C-----------------------------------------------------------------------
       CHARACTER TITLE*40 , TITLX*120   , TITLM*80  , DATE*8
       CHARACTER DNAME*12 ,
     &           MNMX0*9  , KEY0*9      , ADAS0*8   , KEY(3)*22
       CHARACTER GRID*1   , PIC*1       , C3BLNK*3  , C7*7
C-----------------------------------------------------------------------
       LOGICAL   LGHOST   , LGRD1       , LDEF1     , LFSEL
C-----------------------------------------------------------------------
       DATA DNAME/'      DATE: '/
       DATA ADAS0/'ADAS   :'/
     &      MNMX0/'MINIMAX: '/,
     &      KEY0 /'KEY    : '/,
     &      KEY(1)/'(CROSSES - INPUT DATA)'/,
     &      KEY(2)/' (FULL LINE - SPLINE) '/,
     &      KEY(3)/'(DASH LINE - MINIMAX) '/
       DATA GRID  /' '/   ,
     &      PIC   /' '/   ,
     &      C3BLNK/'   '/
```

```
C-----------------------------------------------------------------------
```

B1RATE

```
      SUBROUTINE B1RATE( NARR  , TEMP   , GAMMA  ,
     &                           EUPPER , ELOWER ,
     &                           WUPPER , WLOWER ,
     &                           RATE   , DRATE
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B1RATE *********************
C
C  PURPOSE: TO CALCULATE THE EXCITATION AND DE-EXCIATATION RATE COEFFI-
C           CIENTS FOR A SET OF INPUT TEMPERATURE(kelvin)/ GAMMA PAIRS.
C
C  CALLING PROGRAM:  ADAS201
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NARR    = NUMBER OF INPUT TEMPERATURE/GAMMA PAIRS
C  INPUT :  (R*8)  TEMP()  = TEMPERATURE VALUES (kelvin)
C  INPUT :  (R*8)  GAMMA() = GAMMA VALUES
C
C  INPUT :  (R*8)  EUPPER  = SELECTED TRANSITION - UPPER ENERGY LEVEL
C                            RELATIVE TO INDEX LEVEL 1 (CM-1).
C  INPUT :  (R*8)  ELOWER  = SELECTED TRANSITION - LOWER ENERGY LEVEL
C                            RELATIVE TO INDEX LEVEL 1 (CM-1).
C
C  INPUT :  (R*8)  WUPPER  = SELECTED TRANSITION - UPPER ENERGY LEVEL
C                            STATISTICAL WEIGHT.
C  INPUT :  (R*8)  WLOWER  = SELECTED TRANSITION - LOWER ENERGY LEVEL
C                            STATISTICAL WEIGHT.
C
C  OUTPUT:  (R*8)  RATE    = EXCITATION RATE COEFFS (cm**3/s)
C  OUTPUT:  (R*8)  DRATE   = DEEXCITATION RATE COEFS (cm**3/s)
C
C           (R*8)  TK2ATE  = PARAMETER = EQUATION CONSTANT = 1.5789D+05
C           (R*8)  R2GAM   = PARAMETER = EQUATION CONSTANT = 2.17161D-08
C           (R*8)  WN2RYD  = PARAMETER =
C                            WAVE NUMBER (CM-1) TO RYDBERG CONVERSION
C
C           (I*4)  I       = GENERAL ARRAY INDEX
C
C           (R*8)  SUPPER  = 1/(UPPER LEVEL STATISTICAL WEIGHT)
C           (R*8)  SLOWER  = 1/(LOWER LEVEL STATISTICAL WEIGHT)
C           (R*8)  RYDDIF  = NEGATIVE TRANSITION ENERGY IN RYDBERGS
C                            ( NOTE: 1 Rydberg = 1.09737E5 cm-1)
C           (R*8)  ATE     = EQUATION PARAMETER
C           (R*8)  GVAL    = EQUATION PARAMETER
C
C ROUTINES:  NONE
C
C NOTES:
C            EQUATIONS USED -
C
C                      2.17161E-8 x GAMMA x SQRT(157890 / TEMP)
C            RATE = ---------------------------------------------
C                   WLOWER x EXP(1.4388 x (EUPPER-ELOWER) / TEMP)
C
C                      2.17161E-8 x GAMMA x SQRT(157890 / TEMP)
C            DRATE = ---------------------------------------------
C                                        WUPPER
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      REAL*8     TK2ATE          , R2GAM           , WN2RYD
C-----------------------------------------------------------------------
      PARAMETER( TK2ATE=1.5789D+5, R2GAM=2.17161D-8, WN2RYD=9.11269D-6 )
C-----------------------------------------------------------------------
      INTEGER    NARR            , I
C-----------------------------------------------------------------------
      REAL*8     ATE             , GVAL
      REAL*8     EUPPER          , ELOWER          ,
     &           WUPPER          , WLOWER          ,
     &           SUPPER          , SLOWER          , RYDDIF
C-----------------------------------------------------------------------
      REAL*8     TEMP(NARR)      , GAMMA(NARR)     ,
     &           RATE(NARR)      , DRATE(NARR)
C-----------------------------------------------------------------------
```

B1SPF0

```
      SUBROUTINE B1SPF0( REP  , DSFULL, LDSEL)

      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B1SPF0 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS201
C
C  SUBROUTINE:
C
C  OUTPUT: (C*3)   REP     = 'YES' => TERMINATE PROGRAM EXECUTION.
C                          = 'NO ' => CONTINUE PROGRAM EXECUTION.
C
C  OUTPUT: (C*80)  DSFULL  = INPUT DATA SET NAME , INCLUDING PATH
C
CA - UNIX PORT : LDSEL ONLY USED TO KEEP ARGUMENT LIST THE SAME.
CA               IT'S ORIGINAL FUNCTION IS CARRIED OUT IN IDL NOW
CX  OUTPUT: (L*4)   LDSEL   = .TRUE.  => COPASE DATA SET INFORMATION
CX                                       TO BE DISPLAYED BEFORE RUN.
CX                          = .FALSE. => COPASE DATA SET INFORMATION
CX                                       NOT TO BE DISPLAYED BEFORE RUN.
C
C          (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C
C AUTHOR:  LALIT JALOTA (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    28/02/95
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      CHARACTER    REP*3        , DSFULL*80
C-----------------------------------------------------------------------
      LOGICAL      LDSEL
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU
      PARAMETER( PIPEIN=5  , PIPEOU=6)
C-----------------------------------------------------------------------
```

B1SPF1

```
      SUBROUTINE B1SPF1( DSFULL     , ISTRN      , LFSEL    , LDEF1 ,
     &                   LGRAPH     , L2FILE     , SAVFIL   ,
     &                   XMIN       , XMAX       , YMIN     ,
     &                   YMAX       , LPEND      , LREP
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B1SPF1 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS201
C
C  SUBROUTINE:
C
C  INPUT :   (C*80)  DSFULL   = DATA FILE NAME
C  INPUT :   (I*4)   ISTRN    = SELECTED INPUT TRANSITION FOR ANALYSIS
C  INPUT :   (L*4)   LFSEL    = .TRUE.  => POLYNOMIAL FIT SELECTED
C                               .FALSE. => NO POLYNOMIAL FIT SELECTED
C  OUTPUT:   (L*4)   LDEF1    = .TRUE.  => USER SLECTED AXES LIMITS
C                               .FALSE. => NO USER SUPPLIED LIMITS
C  OUTPUT:   (L*4)   LGRAPH   = .TRUE.  => SELECT GRAPHICAL OUTPUT
C                               .FALSE. => DO NOT SELECT GRAPHICAL OUTPUT
C  OUTPUT:   (L*4)   L2FILE   = .TRUE.  => SAVE DATA TO FILE
C                               .FALSE. => DO NOT SAVE DATA TO FILE
C  OUTPUT:   (C*80)  SAVFIL   = FILENAME FOR SAVING DATA
C  OUTPUT:   (R*8)   XMIN     = LOWER LIMIT FOR TEMP OR DENSITY UNITS
C  OUTPUT:   (R*8)   XMAX     = UPPER LIMIT FOR TEMP OR DENSITY UNITS
C  OUTPUT:   (R*8)   YMIN     = LOWER LIMITS IONIZATIONS/PHOTON
C  OUTPUT:   (R*8)   YMAX     = UPPER LIMIT IONIZATIONS/PHOTON
C  OUTPUT:   (L*4)   LPEND    = .TRUE.  => PROCESS OUTPUT OPTIONS
C                               .FALSE. => CANCEL OUTPUT OPTIONS
C  OUTPUT:   (L*4)   LREP     = .TRUE.  => REPLACE PAPER.TXT
C                               .FALSE. => DON'T
C
C            (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C            (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT FROM PIPE
```

```
C            (I*4)   ONE      = PARAMETER = 1  : USED AS FLAG TO IDL
C            (I*4)   ZERO     = PARAMETER = 0  : USED AS FLAG TO IDL
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C           XXFLSH     IDL-ADAS  CALLS FLUSH TO CLEAR PIPES.
C
C AUTHOR:  Lalit Jalota (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    7/3/95
C
C VERSION: 1.2                    DATE: 19-11-96
C MODIFIED: WILLIAM OSBORN
C           ADDED LREP PARAMETER AND CORRESPONDING PIPE READ
C
C-----------------------------------------------------------------------
      REAL*8       XMIN        , XMAX        , YMIN        , YMAX
C-----------------------------------------------------------------------
      CHARACTER    DSFULL*80   , SAVFIL*80
C-----------------------------------------------------------------------
      LOGICAL      LPEND       , LGRAPH      , L2FILE      ,
     &             LFSEL       , LDEF1       , LREP
C-----------------------------------------------------------------------
      INTEGER      ISTRN       , ILOGIC      ,
     &             PIPEIN      , PIPEOU      , ONE         , ZERO
      PARAMETER( PIPEIN=5      , PIPEOU=6    , ONE=1       , ZERO=0)
```

B1TRAN

```
       SUBROUTINE B1TRAN( NDLEV  , NDTRN  , NDTEM ,
     &                    IL     , ISTRN  , NV    ,
     &                    IA     , WA     , XJA   ,
     &                    I1A    , I2A    , AVAL  , SCOM ,
     &                    IUPPER , ILOWER ,
     &                    LUPPER , LLOWER ,
     &                    WUPPER , WLOWER ,
     &                    EUPPER , ELOWER ,
     &                    AA     , GAMMA
     &                  )
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B1TRAN *********************
C
C  PURPOSE:  TO SET UP SELECTED TRANSITION PARAMETERS.
C
C  CALLING PROGRAM: ADAS201
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF INDEX LEVELS
C  INPUT : (I*4)  NDTRN   = MAXIMUM NUMBER OF TRANSITIONS
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF INPUT FILE TEMPERATURES
C
C  INPUT : (I*4)  IL      = NUMBER OF INDEX LEVELS
C  INPUT : (I*4)  ISTRN   = SELECTED TRANSITION INDEX.
C  INPUT : (I*4)  NV      = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR THE SELECTED TRANSITION.
C
C  INPUT : (I*4)  IA()    = LEVEL INDEX NUMBER ARRAY
C  INPUT : (R*8)  WA()    = LEVEL ENERGIES RELATIVE TO LEVEL 1 (CM-1)
C  INPUT : (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C
C  INPUT : (I*4)  I1A()   = LOWER LEVEL INDEX FOR ELECTRON IMPACT
C                           TRANSITION
C  INPUT : (I*4)  I2A()   = UPPER LEVEL INDEX FOR ELECTRON IMPACT
C                           TRANSITION
C  INPUT : (I*4)  AVAL()  = A-VALUE FOR ELECTRON IMPACT TRANSITION
C  INPUT : (I*4)  SCOM(,) = GAMMA VALUES FOR ELECTRON IMPACT TRANSITION
C                            1st DIMENSION: TEMPERATURE INDEX
C                            2nd DIMENSION: TRANSITION INDEX
C
C  OUTPUT: (I*4)  IUPPER  = SELECTED TRANSITION: UPPER LEVEL ARRAY INDEX
C  OUTPUT: (I*4)  ILOWER  = SELECTED TRANSITION: LOWER LEVEL ARRAY INDEX
C
C
C  OUTPUT: (I*4)  LUPPER  = SELECTED TRANSITION: UPPER INDEX LEVEL
C  OUTPUT: (I*4)  LLOWER  = SELECTED TRANSITION: LOWER INDEX LEVEL
C
C  OUTPUT: (R*8)  WUPPER  = SELECTED TRANSITION: UPPER LEVEL STAT. WT.
C  OUTPUT: (R*8)  WLOWER  = SELECTED TRANSITION: LOWER LEVEL STAR. WT.
C                           (NOTE: STAT. WT. = STATISTICAL WEIGHT)
C
C  OUTPUT: (R*8)  EUPPER  = SELECTED TRANSITION: UPPER ENERGY LEVEL
C                           RELATIVE TO INDEX LEVEL 1. (CM-1)
C  OUTPUT: (R*8)  ELOWER  = SELECTED TRANSITION: LOWER ENERGY LEVEL
C                           RELATIVE TO INDEX LEVEL 1. (CM-1)
C
C  OUTPUT: (R*8)  GAMMA() = INPUT DATA FILE: SELECTED TRANSITION -
C                                            GAMMA VALUE AT 'TEMP()'
C  OUTPUT: (R*8)  AA      = SELECTED TRANSITION A-VALUE (SEC-1)
C
```

```
C          (I*4)  I       = GENERAL USE.
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
      INTEGER  NDLEV  , NDTRN  , NDTEM ,
     &         IL     , ISTRN  , NV    ,
     &         IUPPER , ILOWER ,
     &         LUPPER , LLOWER
      INTEGER  I
C-----------------------------------------------------------------------
      REAL*8   WUPPER , WLOWER ,
     &         EUPPER , ELOWER ,
     &         AA
C-----------------------------------------------------------------------
      INTEGER  IA(NDLEV)   ,
     &         I1A(NDTRN)  , I2A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8   WA(NDLEV)   , XJA(NDLEV)   ,
     &         AVAL(NDTRN) , GAMMA(NDTEM) , SCOM(NDTEM,NDTRN)
C-----------------------------------------------------------------------
```

B2GSPC

```
       SUBROUTINE B2GSPC(XA,N,C1,C2,C3,C4)
C
       IMPLICIT REAL*8(A-H,O-Z)
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE : B2GSPC ********************
C
C PURPOSE:
C  SUBROUTINE TO GENERATE PRECURSORS OF SPLINE COEFFICIENTS SUITABLE
C  FOR BOTH FORWARD AND BACKWARD INTERPOLATION
C
C
C
C  INPUT
C      XA(I)=SET OF KNOTS
C      N=NUMBER OF KNOTS  (N.LE.20)
C  OUTPUT
C      C1(I,J)=1ST SPLINE COEFFICIENT PRECURSOR
C      C2(I,J)=2ND SPLINE COEFFICIENT PRECURSOR
C      C3(I,J)=3RD SPLINE COEFFICIENT PRECURSOR
C      C4(I,J)=4TH SPLINE COEFFICIENT PRECURSOR
C
C NOTES: THIS ROUTINE IS NOT YET PROPERLY ANNOTATED
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 06-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C-----------------------------------------------------------------------
C
       DIMENSION HA(10),XA(10),W(10,10),C1(10,9)
       DIMENSION C2(10,9),C3(10,9),C4(10,9)
```

B2NFAS

```
       SUBROUTINE B2NFAS(X,XA,N,YA,Y,DY,C1,C2,C3,C4,FORM,IFORMS)
C
       IMPLICIT REAL*8(A-H,O-Z)
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B2NFAS *********************
C
C PURPOSE:
C  SUBROUTINE TO PROVIDE A SPLINE INTERPOLATE MAKING USE OF SPECIFIED
C  ASYMPTOTIC BEHAVIOUR
C
C
C  USES LABELLED COMMON /SPL3/
C
C  INPUT
C      X=REQUIRED X-VALUE
C      X(I)=KNOTS
C      N=NUMBER OF KNOTS
C      C1(I,J)=1ST SPINE COEFFICIENT PRECURSOR
C      C2(I,J)=2ND SPINE COEFFICIENT PRECURSOR
C      C3(I,J)=3RD SPINE COEFFICIENT PRECURSOR
```

```
C      C4(I,J)=4TH SPINE COEFFICIENT PRECURSOR
C      FORM=EXTERNAL FUNCTION SPECIFYING ASYMPTOTIC FORMS
C      IFORMS=INDEX OF REQUIRED FORM
C  OUTPUT
C      Y=RETURNED Y-VALUE
C      DY=RETURNED DERIVATIVE
C
C NOTES: THIS ROUTINE IS NOT YET PROPERLY ANNOTATED
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 06-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C---------------------------------------------------------------------
C
       DIMENSION XA(10),YA(10),C1(10,9),C2(10,9),C3(10,9),C4(10,9)
       COMMON /SPL3/IEND(2),G(2),AB(4),PQ(12),ABRY(40)
```

B2NFIT

```
       SUBROUTINE B2NFIT(X,XA,N,YAA,Y,DY,I0,C1,C2,C3,C4,ISW)
C
       IMPLICIT REAL*8(A-H,O-Z)
C---------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B2NFIT *********************
C
C PURPOSE:
C  SUBROUTINE TO PERFORM SPLINE INTERPOLATION.
C
C
C  INPUT
C      X       = REQUIRED X-VALUE
C      XA(I)   = X-VALUES
C      N       = NUMBER OF VALUES
C      YAA(I)  = Y-VALUES (POSSIBLY STORED AS MULTIPLE SETS)
C      I0      = STARTING INDEX(-1) IN YAA ARRAY OF REQUIRED INPUT SET
C      C1(I,J) = 1ST SPLINE COEFFICIENT PRECURSOR
C      C2(I,J) = 2ND SPLINE COEFFICIENT PRECURSOR
C      C3(I,J) = 3RD SPLINE COEFFICIENT PRECURSOR
C      C4(I,J) = 4TH SPLINE COEFFICIENT PRECURSOR
C      ISW     = .LE.0  ORDINARY     SPLINE INTERPOLATION
C              = .GT.0  LOGARITHMIC  SPLINE INTERPOLATION
C  OUTPUT
C      Y       = RETURNED Y-VALUE
C      DY      = RETURNED DERIVATIVE
C
C NOTES: THIS ROUTINE IS NOT YET PROPERLY ANNOTATED
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 06-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C---------------------------------------------------------------------
C
       DIMENSION YAA(10),TA(10),XA(10)
       DIMENSION C1(10,9),C2(10,9),C3(10,9),C4(10,9)
       DIMENSION CT1(9),CT2(9),CT3(9),CT4(9)
```

B2NGAS

```
       SUBROUTINE B2NGAS(X,DX,FORM,IFORMS,IENDS)
C
       IMPLICIT REAL*8(A-H,O-Z)
C---------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B2NGAS *********************
C
C PURPOSE:
C  SUBROUTINE INITIALISES COMMON ARRAYS REQUIRED FOR SPLINING WITH
C  SMOOTH FITTING TO AN ASYMPTOTIC FORM
C
C
C  USES LABELLED COMMON /SPL3/
C
C  IF IENDS=1,MATCHING IS AT FIRST KNOT(GIVEN BY X)
C          =2,MATCHING IS AT  LAST KNOT(GIVEN BY X)
C  ASYMPTOTIC FORMS ARE GIVEN IN THE EXTERNAL FUNCTION FORM(I,X)
C  WHERE I=4*IFORMS-5+2*IENDS POINTS TO FIRST PART OF ASYMP. FORM
C         =4*IFORMS-4+2*IENDS POINTS TO SECOND PART OF ASYMP. FORM
C  THUS A SERIES OF ASYMPTOTIC FORMS MAY BE PRESENT IN FORM
C
C  INPUT
C      COMMON /SPL3/ PROVIDES INPUT IN VECTOR IEND WHICH SPECIFIES
C                    CHOICE OF END CONDITION AT FIRST IEND(1) OR LAST
```

```
C                    IEND(2) KNOT OF SPLINE
C      X=X-VALUE OF END POINT
C      DX=DISPLACEMENT FROM X-VALUE FOR DERIVATIVE EVALUATION
C      FORM=EXTERNAL FUNCTION SPECIFYING ASYMPTOTIC FORMS
C      IFORMS=SELECTED FORM
C      IENDS=1,MATCHING IS AT FIRST KNOT(GIVEN BY X)
C           =2,MATCHING IS AT  LAST KNOT(GIVEN BY X)
C  OUTPUT
C      COMMON /SPL3/ IS SET BY THIS ROUTINE
C
C NOTES: THIS ROUTINE IS NOT YET PROPERLY ANNOTATED
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 06-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C-----------------------------------------------------------------------
C
       COMMON /SPL3/IEND(2),G(2),AB(4),PQ(12),ABRY(40)
```

B2SORT

```
       SUBROUTINE B2SORT(XA,YA,N)
C
       IMPLICIT REAL*8(A-H,O-Z)
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B2SORT *********************
C
C PURPOSE : TO SORT AN ARRAY SO THAT XA IS IN INCREASING ORDER.
C
C  N.B.  INPUT VALUES ARE ALTERED BY THIS ROUTINE !!!!
C
C  INPUT
C      XA(I)=X-VALUES
C      YA(I)=Y-VALUES
C      N=NUMBER OF VALUES
C  OUTPUT
C      XA(I)=SORTED X-VALUES
C      YA(I)=SORTED Y-VALUES
C
C NOTES: THIS ROUTINE IS NOT YET PROPERLY ANNOTATED
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 06-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C-----------------------------------------------------------------------
C
       DIMENSION XA(10),YA(10)
```

B2SPIJ3

```
       SUBROUTINE B2SPIJ3(N,H,W)
C
       IMPLICIT REAL*8(A-H,O-Z)
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B2SPIJ3 ********************
C
C PURPOSE:
C  SUBROUTINE TO CALCULATE SPLINES WITH VARIOUS END CONDITIONS.
C
C
C  USES LABELLED COMMON  /SPL3/
C
C  CONDITIONS AT 1ST NODE AND NTH NODE CONTROLLED BY IEND1 AND IENDN
C      IEND=1 : SPECIFIED D LOG(Y) IE. DY/Y AT NODE STORED IN
C               APPROPRIATE VECTOR
C           =2 : ZERO CURVATURE
C           =3 : CONSTANT CURVATURE
C           =4 : MATCHED TO SPECIFIED FUNCTIONAL FORM IN TERMS OF
C               TWO PARAMETERS A AND B SUCH THAT
C                        FUNCT = P(1)*A+Q(1)*B
C                    1ST DERIV. = P(2)*A+Q(2)*B
C                    2ND DERIV. = P(3)*A+Q(3)*B
C               WHERE A1,B1,P1,Q1 ARE USED FOR 1ST NODE AND
C               AN,BN,PN,QN FOR NTH NODE
C
C  INPUT
C      N=NUMBER OF KNOTS
C      H(I)=INTERVALS BETWEEN KNOTS
C  OUTPUT
C      W=SPLINE MATRIX
C
```

```
C NOTES: THIS ROUTINE IS NOT YET PROPERLY ANNOTATED
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 06-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C-----------------------------------------------------------------------
C
       DIMENSION A(10),B(10),C(10),H(10),W(10,10)
       COMMON /SPL3/IEND1,IENDN,G1,GN,A1,B1,AN,BN,P1(3),Q1(3),
     &PN(3),QN(3),A1RY(10),B1RY(10),ANRY(10),BNRY(10)
```

B3DATA

```
       SUBROUTINE B3DATA( IUNIT , NDLEV , NDTRN , NDTEM , IZDIMD,
     &                    SEQSYM, IZMAX , Z1A   , IZA   , IZ0A  , IZ1A,
     &                    BWNOA , IL    ,
     &                    IA    , CSTRGA, NA    , ISA   , ILA   , XJA  ,
     &                    WAA   , ITRAN ,
     &                    NVA   , SCEFA ,
     &                    I1A   , I2A   , N1A   , N2A   , W1A   , W2A,
     &                    IEC1A , IAC1A , IAC2A , FAC2A , IGC1A , FGC2A,
     &                    CTSTRA, WDEA  , AVALA , SCOMA , LADJA
     &                  )
C
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3DATA *********************
C
C  PURPOSE:  TO FETCH DATA FROM INPUT GENERAL Z EXCITATION FILE.
C            (ELECTRON IMPACT TRANSITIONS ONLY).
C
C  CALLING PROGRAM: ADAS203
C
C  DATA:
C
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C
C
C  SUBROUTINE:
C
C          (I*4)  NDZ     = PARAMETER = MAXIMUM NUMBER OF IONS IN
C                                       A GENERAL Z FILE
C
C  INPUT : (I*4)  IUNIT   = UNIT TO WHICH INPUT FILE IS ALLOCATED
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS THAT CAN BE READ
C  INPUT : (I*4)  NDTRN   = MAX. NUMBER OF TRANSITIONS THAT CAN BE READ
C  INPUT : (I*4)  NDTEM   = MAX NUMBER OF INPUT FILE TEMPS.
C  INPUT : (I*4)  IZDIMD  = MAX. NUMBER OF SEQUENCE MEMBERS ALLOWED
C
C  OUTPUT: (C*2)  SEQSYM  = ELEMENT SYMBOL.
C  OUTPUT: (I*4)  IZMAX   = NUMBER OF SEQUENCE MEMBERS
C  OUTPUT: (R*8)  Z1A()   = SEQUNCE RECOMBINING ION CHARGES READ
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C  OUTPUT: (I*4)  IZA()   = SEQUENCE RECOMBINED ION CHARGES
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C  OUTPUT: (I*4)  IZ0A()  = SEQUENCE NUCLEAR CHARGES
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C  OUTPUT: (I*4)  IZ1A()  = SEQUNCE RECOMBINING ION CHARGES READ
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  OUTPUT: (R*8)  BWNOA() = IONISATION POTENTIALS (CM-1)
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C
C  OUTPUT: (I*4)  IL      = INPUT DATA FILE: NUMBER OF ENERGY LEVELS
C
C  OUTPUT: (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  OUTPUT: (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  OUTPUT: (I*4)  NA()    = PRINCIPAL QUANTUM NUMBER OF VALENCE ELECTRON
C  OUTPUT: (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  OUTPUT: (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  OUTPUT: (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  OUTPUT: (R*8)  WAA()   = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C                           1ST DIMENSION - LEVEL INDEX
C                           2ND DIMENSION - SEQUENCE MEMBER INDEX
C  OUTPUT: (I*4)  ITRAN   = INPUT DATA FILE: NUMBER OF ELECTRON IMPACT
C                                            TRANSITIONS.
C
C  OUTPUT: (I*4)  NVA()   = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR A GIVEN TRANSITION.
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C  OUTPUT: (R*8)  SCEFA(,)= INPUT DATA FILE: Z-SCALED ELEC. TEMPS.(K)
```

```
C                           1ST DIMENSION - TEMPERATURE 'SCEF()'
C                           2ND DIMENSION - TRANSITION NUMBER
C
C
C  OUTPUT: (I*4)  I1A()   = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  I2A()   = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  N1A()   = ELECTRON IMPACT TRANSITION:
C                            LOWER LEVEL PRINCIPAL QUANTUM NUMBER
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  N2A()   = ELECTRON IMPACT TRANSITION:
C                            UPPER LEVEL PRINCIPAL QUANTUM NUMBER
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  W1A()   = ELECTRON IMPACT TRANSITION:
C                            LOWER LEVEL STATISTICAL WEIGHT
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  W2A()   = ELECTRON IMPACT TRANSITION:
C                            UPPER LEVEL STATISTICAL WEIGHT
C                           1ST DIMENSION - TRANSITION NUMBER
C
C  OUTPUT: (I*4)  IEC1A() = TRANSITION ENERGY INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=>1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  IAC1A() = TRANSITION PROB. INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=> 1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  IAC2A() = TRANSITION TYPE
C                           (1=>DIPOLE, 2=>NON-DIPOLE, 3=>SPIN CHANGE,
C                            4=>OTHER)
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  FAC2A() = TRANSITION PROB. Z1 SCALING POWER
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  IGC1A() = UPSILON INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=> 1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (I*4)  FGC2A() = UPSILON Z1 SCALING POWER
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (C*18) CTSTRA()= TRANSITION DESCRIPTOR
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (R*8)  WDEA()  = TRANSITION ENERGY (CM-1)
C                           1ST DIMENSION - TRANSITION NUMBER
C
C  OUTPUT: (R*8)  AVALA()  = ELECTRON IMPACT TRANSITION:
C                             A-VALUES (SEC-1)
C                           1ST DIMENSION - TRANSITION NUMBER
C                           2ND DIMENSION - SEQUENCE MEMBER INDEX
C  OUTPUT: (R*8)  SCOMA(,,)=ELECTRON IMPACT TRANSITION:
C                            GAMMA VALUES
C                           1ST DIMENSION - TEMPERATURE 'SCEF()'
C                           2ND DIMENSION - TRANSITION NUMBER
C                           3RD DIMENSION - SEQUENCE MEMBER INDEX
C  OUTPUT: (L*4)  LADJA()  = .FALSE. INITIALISATION NO TRANSITIONS
C                                     ADJUSTED YET
C                           1ST DIMENSION - TRANSITION NUMBER
C
C
C          (I*4)  I       = GENERAL USE.
C          (I*4)  IAC1    = CURRENT VALUE OF IAC1 PARAMETER
C          (I*4)  IAC2    = CURRENT VALUE OF IAC2 PARAMETER
C          (I*4)  IEC1    = CURRENT VALUE OF IEC1 PARAMETER
C          (I*4)  IGC1    = CURRENT VALUE OF IGC1 PARAMETER
C          (I*4)  ILINE   = ENERGY LEVEL INDEX FOR CURRENT LINE
C          (I*4)  ITEMP   = GENERAL USE.
C          (I*4)  IZ      = CURRENT ION CHARGE
C          (I*4)  IZS     = ISOELECTRONIC SEQUENCE CHARGE (1ST MEMBER)
C          (I*4)  I4EIZ0  = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (I*4)  I4UNIT  = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (I*4)  J       = GENERAL USE.
C          (I*4)  J1      = INPUT DATA FILE - SELECTED TRANSITION:
C                            LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C          (I*4)  J2      = INPUT DATA FILE - SELECTED TRANSITION:
C                            UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            CAPTURING    LEVEL INDEX (CASE 'H' & 'R')
C          (I*4)  IPOS    = GENERAL POSITION IN STRING MARKER.
C          (I*4)  K       = GENERAL USE.
C          (I*4)  NI      = CURRENT LOWER LEVEL PRINCIPAL QUANTUM NUMBER
C          (I*4)  NJ      = CURRENT UPPER LEVEL PRINCIPAL QUANTUM NUMBER
C
C          (R*8)  FAC2    = CURRENT VALUE OF FAC2 PARAMETER
C          (R*8)  FGC2    = CURRENT VALUE OF FGC2 PARAMETER
C          (R*8)  WI      = CURRENT LOWER LEVEL STATISTICAL WEIGHT
C          (R*8)  WJ      = CURRENT UPPER LEVEL STATISTICAL WEIGHT
C
C          (C*2)  CHEQSYM = EXTRA STRING USED FOR SYMBOL CHECKING
C          (C*1)  CMINUS  = STRING OF MINUS SYMBOL USED TO CHECK FOR
C                           SINGLE CHARACTER ELEMENT SYMBOLS
C          (C*80) CLINE   = CURRENT ENERGY LEVEL INDEX PARAMETER LINE
C          (C*18) STRING  = GENERAL USE
C
C          (L*4)  LDATA   = IDENTIFIES  WHETHER  THE END OF AN  INPUT
C                           SECTION IN THE DATA SET HAS BEEN LOCATED.
C                           (.TRUE. => END OF SECTION REACHED)
C
C
C ROUTINES:
```

```
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          --------------------------------------------------------------
C          I4EIZ0     ADAS      RETURN NUCLEAR CHARGE OF ELEMENT SYMBOL
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C
C AUTHOR:  H. P. SUMMERS, JET
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    17/08/94
C
C UPDATE:  03/07/95 - HPS  ALTER LENGTH OF CSTRGA ARRAY TO 18 AND
C                          USE NEW POSITION FOR INPUT/OUTPUT
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 29-02-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C VERSION: 1.2                          DATE: 29-02-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - CORRECTED ERROR MESSAGES
C               - ADDED ABILITY TO HANDLE SINGLE LETTER ELEMENT
C                 SYMBOLS FOLLOWED BY DASH. E.G. IN HYDROGEN LIKE
C                 FILES THE FIRST TWO CHARACTERS IN THE FILE ARE 'H-'
C                 AND THIS WAS CAUSING PROBLEMS FOR I4EIZ0 BEFORE.
C
C-----------------------------------------------------------------------
      INTEGER   NDZ
C-----------------------------------------------------------------------
      PARAMETER ( NDZ = 7 )
C-----------------------------------------------------------------------
      INTEGER   I4UNIT , I4EIZ0
      INTEGER   IUNIT       , NDLEV          , NDTRN      , IZDIMD    ,
     &          NDTEM       , IL             , ITRAN      ,
     &          IZMAX       , IZS            , IZ
      INTEGER   ILINE       , ITEMP
      INTEGER   I           , J              , K
      INTEGER   J1          , J2             , NI         , NJ        ,
     &          IEC1        , IAC1           , IAC2       , IGC1
C-----------------------------------------------------------------------
      REAL*4    WI          , WJ             , FAC2       , FGC2
C-----------------------------------------------------------------------
      CHARACTER SEQSYM*2    , CSTRGA(NDLEV)*18
      CHARACTER CLINE*80
      CHARACTER STRING*18   , CTSTRA(NDTRN)*18
      CHARACTER CHEQSYM*2   , CMINUS*1
C-----------------------------------------------------------------------
      LOGICAL   LDATA
C-----------------------------------------------------------------------
      INTEGER   IPOS
      INTEGER   IZA(IZDIMD) , IZ0A(IZDIMD)   , IZ1A(IZDIMD)
      INTEGER   NVA(NDTRN)
      INTEGER   IA(NDLEV)   , NA(NDLEV)      ,
     &          ISA(NDLEV)  , ILA(NDLEV)     ,
     &          I1A(NDTRN)  , I2A(NDTRN)     ,
     &          N1A(NDTRN)  , N2A(NDTRN)     ,
     &          IEC1A(NDTRN), IAC1A(NDTRN)   ,
     &          IAC2A(NDTRN), IGC1A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8    Z1A(IZDIMD)         , BWNOA(IZDIMD)
      REAL*8    SCEFA(NDTEM,NDTRN)
      REAL*8    W1A(NDTRN)          , W2A(NDTRN)          ,
     &          FAC2A(NDTRN)        , FGC2A(NDTRN)
      REAL*8    XJA(NDLEV)          , WAA(NDLEV,IZDIMD)   ,
     &          WDEA(NDTRN,IZDIMD)  , AVALA(NDTRN,IZDIMD) ,
     &          SCOMA(NDTEM,NDTRN,IZDIMD)
C-----------------------------------------------------------------------
      LOGICAL   LADJA(NDTRN)
C-----------------------------------------------------------------------
```

B3LEVE

```
       SUBROUTINE B3LEVE( NDLEV , IZDIMD,
     &                    IZMAX , Z1A   , IZA   , IZ0A  , IZ1A,
     &                    BWNOA , IL    ,
     &                    IA    , NA    , WAA   ,
     &                    IZS   , IZ0   ,
     &                    BWNO  , WAO )
C
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3LEVE *********************
C
C  PURPOSE:  TO EVALUATE IONISATION AND LEVEL ENERGIES FOR A SELECTED
C            MEMBER OF AN ISOELECTRONIC SEQUENCE FROM THE GENERAL Z DATA
C
C  CALLING PROGRAM: ADAS203
C
C  DATA:
C
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
```

```
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C
C
C  SUBROUTINE:
C
C          (I*4)  NDSPLN  = PARAMETER = MAXIMUM NUMBER OF SPLINE KNOTS
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS THAT CAN BE READ
C  INPUT : (I*4)  IZDIMD  = MAX. NUMBER OF SEQUENCE MEMBERS ALLOWED
C
C  INPUT : (I*4)  IZMAX   = NUMBER OF SEQUENCE MEMBERS
C  INPUT : (R*8)  Z1A()   = SEQUNCE RECOMBINING ION CHARGES READ
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C  INPUT : (I*4)  IZA()   = SEQUENCE RECOMBINED ION CHARGES
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C  INPUT : (I*4)  IZ0A()  = SEQUENCE NUCLEAR CHARGES
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C  INPUT : (I*4)  IZ1A()  = SEQUNCE RECOMBINING ION CHARGES READ
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT : (R*8)  BWNOA() = IONISATION POTENTIALS (CM-1)
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C
C  INPUT : (I*4)  IL      = INPUT DATA FILE: NUMBER OF ENERGY LEVELS
C
C  INPUT : (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  INPUT : (I*4)  NA()    = PRINCIPAL QUANTUM NUMBER OF VALENCE ELECTRON
C  INPUT : (R*8)  WAA()   = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C                           1ST DIMENSION - LEVEL INDEX
C                           2ND DIMENSION - SEQUENCE MEMBER INDEX
C  INPUT : (I*4)  IZS     = NUCLEAR CHARGE OF NEUTRAL SEQUENCE MEMBER
C  INPUT : (I*4)  IZ0     = NUCLEAR CHARGE OF SELECTED ION
C
C  OUTPUT: (R*8)  BWNO    = IONISATION ENERGY OF SELECTED ION (CM-1)
C  OUTPUT: (R*8)  WAO()   = LEVEL ENERGIES RELATIVE TO LOWEST (CM-1)
C
C          (I*4)  I       = GENERAL USE.
C          (I*4)  IENDN   = SPLINE END CONDITION SWITCH AT LAST POINT
C          (I*4)  IEND1   = SPLINE END CONDITION SWITCH AT FIRST POINT
C          (I*4)  IFORMS  = SPLINE INDEPENDENT VARIABLE FORM SWITCH
C          (I*4)  K       = GENERAL USE.
C
C          (R*8)  C1(,)   = 1ST SPLINE COEFFICIENT MATRIX
C          (R*8)  C2(,)   = 2ND SPLINE COEFFICIENT MATRIX
C          (R*8)  C3(,)   = 3RD SPLINE COEFFICIENT MATRIX
C          (R*8)  C4(,)   = 4TH SPLINE COEFFICIENT MATRIX
C          (R*8)  DY      = GRADIENT OF SPLINE AT POINT
C          (R*8)  ENI     = LEVEL PRINCIPAL QUANTUM NUMBER
C          (R*8)  EN1     = LOWEST LEVEL PRINCIPAL QUANTUM NUMBER
C          (R*8)  E1I     = LEVEL ENERGY (RYDBERGS)
C          (R*8)  FORM    = EXTERNAL FUNCTION (SEE SUBROUTINE SECTION)
C          (R*8)  REN     = GENERAL USE
C          (R*8)  XI      = GENERAL USE
C          (R*8)  XSA()   = SPLINE INDEPENDENT VARIABLE AT KNOTS
C          (R*8)  Y       = SPLINE INTERPOLATED VALUE
C          (R*8)  YSA()   = SPLINE DEPENDENT VARIABLE AT KNOTS
C          (R*8)  Z1      = CURRENT ION CHARGE +1
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          B2GSPC     ADAS      GENERATES SPLINE COEFFICIENT MATRICES
C          B2NFAS     ADAS      SETS SPLINE ASYMPTOTIC CONDITIONS
C          FORM       ADAS      INDEPENDENT VARIABLE FUNCTION FOR SPLINE
C          B2SORT     ADAS      SORTS VECTOR INTO INCREASING ORDER
C
C AUTHOR:  H. P. SUMMERS, JET
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    08/01/95
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C               - REPLACED CALLS TO NSORT ROUTINE WITH CALLS TO B2SORT.
C                 NSORT IS USED TO SORT A REAL ARRAY AND ASSOCIATED
C                 INTEGER ARRAY WHEREAS WHAT WAS BEING PASSED TO IT WAS
C                 A REAL ARRAY AND ANOTHER, ASSOCIATED REAL ARRAY. B2SORT
C                 TAKES 2 REAL ARRAYS AS INPUT AND PERFORMS A BUBBLE SORT
C                 ON THEM.
C
C-----------------------------------------------------------------------
      INTEGER   NDSPLN
C-----------------------------------------------------------------------
      PARAMETER ( NDSPLN = 10 )
C-----------------------------------------------------------------------
      INTEGER   NDLEV       , IZDIMD    ,
     &          IL          ,
     &          IZMAX       , IZS            , IZ0
      INTEGER   I           , K
      INTEGER   IEND1       , IENDN          , IFORMS
C-----------------------------------------------------------------------
      REAL*8    Z1          ,
```

```
     &          BWNO
      REAL*8    EN1         , ENI           , REN        , XI         ,
     &          E1I
      REAL*8    Y           , DY            , FORM
C-----------------------------------------------------------------------
      INTEGER   IZA(IZDIMD) , IZ0A(IZDIMD)   , IZ1A(IZDIMD)
      INTEGER   IA(NDLEV)   , NA(NDLEV)
C-----------------------------------------------------------------------
      REAL*8    Z1A(IZDIMD)         , BWNOA(IZDIMD)
      REAL*8    WAA(NDLEV,IZDIMD)
      REAL*8    WAO(NDLEV)
      REAL*8    XSA(NDSPLN)         , YSA(NDSPLN)
      REAL*8    C1(NDSPLN,NDSPLN-1) , C2(NDSPLN, NDSPLN-1)    ,
     &          C3(NDSPLN,NDSPLN-1) , C4(NDSPLN, NDSPLN-1)
C-----------------------------------------------------------------------
      EXTERNAL  FORM
C-----------------------------------------------------------------------
```

B3OTG1

```
      SUBROUTINE B3OTG1( DATE   ,
     &                   NDTRN  , IZDIMD ,
     &                   SEQSYM , IZS    , TITLE , DSFULL ,
     &                   IZMAX  , ZA     ,
     &                   IZ0    , ISTRN , CTSTR  ,
     &                   N1     , N2     , WDEA   , WDE
     &                 )
C
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3OTG1 *********************
C
C  PURPOSE:  COMMUNICATES GRAPHICS DATA TO IDL
C
C            PROVIDES  GRAPH OF INTERPOLATED TRANSITION ENERGY
C            INCLUDING COMPARATIVE SOURCE DATA FROM
C            GENERAL Z EXCIT. FILE
C
C            PLOT IS (TR. WAVE NO./109737.0*Z1*Z1/(1/N1**2-1/N2**2))/Z1)
C                    VERSUS (Z1)      IF N1 < N2 OTHERWISE
C                    (TR. WAVE NO.)/Z1  VERSUS  (Z1)
C
C  CALLING PROGRAM: ADAS203
C
C  SUBROUTINE:
C
C  INPUT : (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C
C  INPUT : (I*4)  NDTRN   = MAXIMUM NUMBER OF TRANSITIONS ALLOWED
C  INPUT : (I*4)  IZDIMD  = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (C*2)  SEQSYM  = ISOELECTRONIC SEQUENCE SYMBOL
C  INPUT : (I*4)  IZS     = NUC. CHG. OF ISOELEC. SEQUENCE 1ST MEMBER
C  INPUT : (C*40) TITLE   = ISPF ENTERED GENERAL TITLE FOR PROGRAM RUN
C  INPUT : (C*44) DSFULL  = INPUT COPASE DATA SET NAME (MVS DSN)
C
C  INPUT : (I*4)  IZMAX   = NUMBER OF IONS (STAGES) IN SOURCE FILE
C  INPUT : (R*8)  ZA()    = RECOMBINING ION CHARGES IN SOURCE FILE
C
C  INPUT : (I*4)  IZ0     = NUCLEAR CHARGE OF SELECTED ION
C  INPUT : (I*4)  ISTRN   = SELECTED TRANSITION INDEX FROM INPUT FILE
C  INPUT : (C*18) CTSTR   = SELECTED TRANSITION TITLE STRING
C
C  INPUT : (I*4)  N1      = LOWER PRINC. QU. NO. OF SELECTED TRANS.
C  INPUT : (I*4)  N2      = UPPER PRINC. QU. NO. OF SELECTED TRANS.
C  INPUT : (R*8)  WDEA(,) = TRANSITION WAVE NOS. FOR SOURCE IONS
C  INPUT : (R*8)  WDE     = TRANSITION WAVE NO. OF INTERPOLATED ION
C
C          (I*4)  NDIM2   = PARAMETER = MAXIMUM NUMBER OF IONS
C                           (MUST NOT BE LESS THAN 'IZDIMD')
C          (I*4)  NGION   = PARAMETER = MAXIMUM NUMBER OF IONS
C                           WHICH CAN BE LISTED ON THE GRAPH.
C
C          (R*4)  CUTMIN  = PARAMETER = IN DEFAULT GRAPH SCALING IS THE
C                           MINIMUM Y-VALUE THAT IS ALLOWED.
C                           (NOTE: 'CUTMIN' MUST BE > THAN 'GHZERO')
C          (R*4)  GHZERO  = PARAMETER = VALUE BELOW WHICH GHOST80 TAKES
C                           NUMBERS AS BEING ZERO = 1.0E-36
C
C          (I*4)  IZ      = STAGE INDEX NUMBER FOR ARRAY USE
C          (I*4)  IZ1     = ION CHARGE +1
C          (I*4)  IMMAX   = MINIMUM OF: NO. OF STAGES OR NGION'
C
C          (R*4)  X()     = X-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                           ELECTRON TEMPERATURES
C          (R*4)  X0()    = GENERAL USE
C                           1ST DIMENSION = 1
C          (R*4)  Y(,)    = Y-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                           INPUT SCALED TRANSITION ENERGIES
C                           1ST DIMENSION = ION INDEX
C                           2ND DIMENSION = 1
C          (R*4)  Z(,)    = Y-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                           OUTPUT INTERPOLATED TRANSITION ENERGY
```

```
C                           1ST DIMENSION = 1
C                           2ND DIMENSION = 1
C          (R*4)  Z1      = ION CHARGE+1
C
C          (C*80) ISPEC   = GRAPH TITLE (INCORPORATES 'ELEMT,IZ0').
C          (C*12) ENAME   = ELEMENT NAME
C          (C*3)  CNAM()  = 3 BYTE STRING FOR INTERP. AND APPROX. COEFFT
C          (C*13) DNAME   = '       DATE: '
C          (C*23) XTIT    = X-AXIS UNITS/TITLE
C          (C*23) YTIT    = Y-AXIS UNITS/TITLE
C          (C*9)  KEY0    = '    KEY: '
C          (C*9)  MNMX0   = 'MINIMAX: '
C          (C*9)  FILE0   = 'FILE   : '
C          (C*8)  ADAS0   = 'ADAS   :'
C          (C*28) KEY()   = DESCRIPTIVE KEY FOR GRAPH (2 TYPES)
C
C          (C*1)  GRID    = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*1)  PIC     = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*3)  C3BLNK  = BLANK 3 BYTE STRING
C          (C*30) HEAD1   = HEADING FOR LEVEL ASSIGNMENTS
C          (C*30) STRG1   = HEADING FOR LEVEL ASSIGNMENTS
C          (C*30) STRGA() = STRING OF GENERAL Z FILE ELEMENT CHARGES
C                           1ST DIM. - MAXIMUM NO OF ELEMENTS (NDIM2)
C
C
C ROUTINES:
C          ROUTINE     SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXELEM      ADAS      SETS UP ELEMENT NAME AS STRING
C
C
C AUTHOR:  H. P. SUMMERS, JET
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    03/01/95
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 21-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - FIRST VERSION
C
C VERSION: 1.2                          DATE: 01-04-96
C MODIFIED: TIM HAMMOND
C               - REMOVED SUPERFLUOUS VARIABLES
C
C VERSION: 1.3                             DATE: 23-05-96
C MODIFIED: WILLIAM OSBORN
C               - USED MODULUS OF ENERGY DIFFERENCE :
C  ( UPDATE: 21/05/96  HP SUMMERS - PLOT MODULUS(SCALED WAVE NUMBER) +
C                                   GHZERO TO AVOID PROBLEMS OF LEVEL ORDER
C                                   CHANGE ALONG ISOELECTRONIC SEQUENCE )
C VERSION: 1.4                             DATE: 10-07-96
C MODIFIED: WILLIAM OSBORN
C               - REMOVED REFERENCE TO I OUTSIDE OF LOOP 'FOR I=1,IZMAX'
C                 Z(I,1) = ABS(Z(I,1))+ ...-> Z(1,1) = ABS(Z(I,1))+ ...
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDIM2    , NGION
      INTEGER   PIPEIN   , PIPEOU
      PARAMETER( PIPEIN=5      , PIPEOU=6  )
C-----------------------------------------------------------------------
      REAL*4    CUTMIN   , GHZERO
C-----------------------------------------------------------------------
      PARAMETER ( NDIM2=15         , NGION = 55 )
      PARAMETER ( CUTMIN = 1.0E-20 , GHZERO = 1.0E-36 )
C-----------------------------------------------------------------------
      INTEGER   NDTRN    , IZDIMD
      INTEGER   IZMAX    ,
     &          IZ0      , IZS      , IZ1      , ISTRN    ,
     &          N1       , N2
      INTEGER   IZ       ,
     &          IMMAX    , I
C-----------------------------------------------------------------------
      REAL*8    WDE      , Z1
C-----------------------------------------------------------------------
      CHARACTER ELEM*2   , TITLE*40 , DSFULL*44, ENAME*12
      CHARACTER SEQSYM*2 , XFESYM*2 , CTSTR*18
      CHARACTER GRID*1   , PIC*1    , C3BLNK*3 , DATE*8   ,
     &          FILE0*9  , MNMX0*9  , KEY0*9   , ADAS0*8  ,
     &          DNAME*13 , GNAME*8  ,
     &          XTIT*25  , YTIT*23  ,
     &          HEAD1*30 ,
     &          STRG1*30 ,
     &          ISPEC*80 , GTIT1*40
C-----------------------------------------------------------------------
      REAL*4    X(NDIM2)           , Y(NDIM2,1)          , Z(1,1)
      REAL*4    XO(1)
C-----------------------------------------------------------------------
      CHARACTER KEY(3)*22          , STRGA(NDIM2)*30
      CHARACTER CNAM(2)*3
C-----------------------------------------------------------------------
      REAL*8    ZA(IZDIMD)         , WDEA(NDTRN,IZDIMD)
C-----------------------------------------------------------------------
      DATA ISPEC(1:40)
```

```
     &          /'SCALED TRANS. WAVE NO. VS ION CHARGE+1  '/
      DATA (CNAM(IZ),IZ=1,2)
     &          / 'INT' , 'APX' /
      DATA XTIT  /'ION CHARGE +1           '/
      DATA YTIT  /'SCALED TRANS. WAVE NO. '/
      DATA ADAS0 /'ADAS   :'/               ,
     &     FILE0 /'FILE   : '/              ,
     &     MNMX0 /'MINIMAX: '/              ,
     &     KEY0  /'KEY    : '/              ,
     &     KEY(1)/'(CROSS - INTERPOL.   )'/  ,
     &     KEY(2)/' (DASH LINE - SOURCE )'/  ,
     &     KEY(3)/'                    ) '/
      DATA GRID  /' '/   ,
     &     PIC   /' '/    ,
     &     C3BLNK/'   '/
      DATA DNAME /'       DATE: '/,
     &     GNAME /'SPECIES:'/
      DATA HEAD1 /'------ SEQUENCE MEMBERS ------'/
      DATA STRG1 /'INDX  NUC.CHG. RECD.ION.  ELEM'/
C-----------------------------------------------------------------------
```

B3OTG2

```
      SUBROUTINE B3OTG2( DATE   ,
     &                   NDTRN  , IZDIMD ,
     &                   SEQSYM , IZS    , TITLE , DSFULL ,
     &                   IZMAX  , ZA     ,
     &                   IZ0    , ISTRN , CTSTR  ,
     &                   FAC2   , AVALA  , AVAL
     &                 )
C
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3OTG2 *********************
C
C  PURPOSE:  COMMUNICATES GRAPHICS DATA TO IDL
C
C            PROVIDES  GRAPH OF INTERPOLATED TRANSITION ENERGY
C            INCLUDING COMPARATIVE SOURCE DATA FROM
C            GENERAL Z EXCIT. FILE
C
C            PLOT IS   (A-VALUE/Z1**FAC2)  VERSUS  (Z1)
C
C  CALLING PROGRAM: ADAS203
C
C  SUBROUTINE:
C
C  INPUT : (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C
C  INPUT : (I*4)  NDTRN   = MAXIMUM NUMBER OF TRANSITIONS ALLOWED
C  INPUT : (I*4)  IZDIMD  = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (C*2)  SEQSYM  = ISOELECTRONIC SEQUENCE SYMBOL
C  INPUT : (I*4)  IZS     = NUC. CHG. OF ISOELEC. SEQUENCE 1ST MEMBER
C  INPUT : (C*40) TITLE   = ISPF ENTERED GENERAL TITLE FOR PROGRAM RUN
C  INPUT : (C*44) DSFULL  = INPUT COPASE DATA SET NAME (MVS DSN)
C
C  INPUT : (I*4)  IZMAX   = NUMBER OF IONS (STAGES) IN SOURCE FILE
C  INPUT : (R*8)  ZA()    = RECOMBINING ION CHARGES IN SOURCE FILE
C
C  INPUT : (I*4)  IZ0     = NUCLEAR CHARGE OF SELECTED ION
C  INPUT : (I*4)  ISTRN   = SELECTED TRANSITION INDEX FROM INPUT FILE
C  INPUT : (C*18) CTSTR   = SELECTED TRANSITION TITLE STRING
C
C  INPUT : (R*8)  FAC2    = Z-SCALING POWER FOR A-VALUES
C
C  INPUT : (R*8)  AVALA(,)= TRANSITION A-VALUES FOR SOURCE IONS
C  INPUT : (R*8)  AVAL    = TRANSITION A-VALUE OF INTERPOLATED ION
C
C           (I*4)  NDIM2   = PARAMETER = MAXIMUM NUMBER OF IONS
C                            (MUST NOT BE LESS THAN 'IZDIMD')
C           (I*4)  NGION   = PARAMETER = MAXIMUM NUMBER OF IONS
C                            WHICH CAN BE LISTED ON THE GRAPH.
C
C           (R*4)  CUTMIN  = PARAMETER = IN DEFAULT GRAPH SCALING IS THE
C                            MINIMUM Y-VALUE THAT IS ALLOWED.
C                            (NOTE: 'CUTMIN' MUST BE > THAN 'GHZERO')
C           (R*4)  GHZERO  = PARAMETER = VALUE BELOW WHICH GHOST80 TAKES
C                            NUMBERS AS BEING ZERO = 1.0E-36
C
C           (I*4)  IZ      = STAGE INDEX NUMBER FOR ARRAY USE
C           (I*4)  IMMAX   = MINIMUM OF: NO. OF STAGES OR NGION'
C
C           (R*4)  X()     = X-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                              ELECTRON TEMPERATURES
C           (R*4)  Y(,)    = Y-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                             LEVEL POPULATIONS.
C                             1ST DIMENSION = ELECTRON TEMP. INDEX
C                             2ND DIMENSION = STAGE  INDEX
C
C           (C*80) ISPEC   = GRAPH TITLE (INCORPORATES 'ELEMT,IZ0').
C           (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
C           (C*12) ENAME   = ELEMENT NAME
```

```
C          (C*3)  CNAM()  = 3 BYTE STRING FOR INTERP. AND APPROX. COEFFT
C          (C*13) DNAME   = '       DATE: '
C          (C*23) XTIT    = X-AXIS UNITS/TITLE
C          (C*23) YTIT    = Y-AXIS UNITS/TITLE
C          (C*9)  KEY0    = '    KEY: '
C          (C*9)  MNMX0   = 'MINIMAX: '
C          (C*9)  FILE0   = 'FILE   : '
C          (C*8)  ADAS0   = 'ADAS   :'
C          (C*28) KEY()   = DESCRIPTIVE KEY FOR GRAPH (2 TYPES)
C
C          (C*1)  GRID    = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*1)  PIC     = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*3)  C3BLNK  = BLANK 3 BYTE STRING
C          (C*30) HEAD1   = HEADING FOR LEVEL ASSIGNMENTS
C          (C*30) STRG1   = HEADING FOR LEVEL ASSIGNMENTS
C
C          (I*4)    PIPEIN  = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)    PIPEOU  = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C
C
C ROUTINES:
C          ROUTINE     SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXELEM      ADAS      SETS UP ELEMENT NAME AS STRING
C          XXFLSH      IDL_ADAS  FLUSHES OUT UNIX PIPE
C
C AUTHOR:  H. P. SUMMERS, JET
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    03/01/95
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 01-04-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - FIRST VERSION
C
C VERSION: 1.2                          DATE: 01-04-96
C MODIFIED: TIM HAMMOND
C               - REMOVED SUPERFLUOUS VARIABLES
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDIM2    , NGION
      INTEGER   PIPEIN   , PIPEOU
      PARAMETER( PIPEIN=5      , PIPEOU=6  )
C-----------------------------------------------------------------------
      REAL*4    CUTMIN   , GHZERO
C-----------------------------------------------------------------------
      PARAMETER ( NDIM2=15         , NGION = 55 )
      PARAMETER ( CUTMIN = 1.0E-20 , GHZERO = 1.0E-36 )
C-----------------------------------------------------------------------
      INTEGER   NDTRN    , IZDIMD
      INTEGER   IZMAX    ,
     &          IZ0      , IZS      , IZ1      , ISTRN
      INTEGER   IZ       ,
     &          IMMAX    , I
C-----------------------------------------------------------------------
      REAL*8    FAC2     , AVAL     , Z1
C-----------------------------------------------------------------------
      CHARACTER ELEM*2   , TITLE*40 , DSFULL*44, ENAME*12
      CHARACTER SEQSYM*2 , XFESYM*2 , CTSTR*18
      CHARACTER GRID*1   , PIC*1    , C3BLNK*3 , DATE*8   ,
     &          FILE0*9  , MNMX0*9  , KEY0*9   , ADAS0*8  ,
     &          DNAME*13 , GNAME*8  ,
     &          XTIT*25  , YTIT*23  ,
     &          HEAD1*30 ,
     &          STRG1*30 ,
     &          ISPEC*80 , CADAS*80 , GTIT1*40
C-----------------------------------------------------------------------
      REAL*4    X(NDIM2)           , Y(NDIM2,1)          , Z(1,1)
      REAL*4    XO(1)
C-----------------------------------------------------------------------
      CHARACTER KEY(3)*22          , STRGA(NDIM2)*30
      CHARACTER CNAM(2)*3
C-----------------------------------------------------------------------
      REAL*8    ZA(IZDIMD)         , AVALA(NDTRN,IZDIMD)
C-----------------------------------------------------------------------
      SAVE      CADAS
C-----------------------------------------------------------------------
      DATA ISPEC(1:40)
     &          /'SCALED A-VALUE VS ION CHARGE+1 :'/
      DATA (CNAM(IZ),IZ=1,2)
     &          / 'INT' , 'APX' /
      DATA XTIT  /'ION CHARGE +1           '/
      DATA YTIT  /'SCALED A-VALUE (SEC-1) '/
      DATA ADAS0 /'ADAS   :'/               ,
     &     FILE0 /'FILE   : '/              ,
     &     MNMX0 /'MINIMAX: '/              ,
     &     KEY0  /'KEY    : '/              ,
     &     KEY(1)/'(CROSS - INTERPOL.   )'/  ,
     &     KEY(2)/' (DASH LINE - SOURCE )'/  ,
     &     KEY(3)/'                     ) '/
      DATA GRID  /' '/   ,
     &     PIC   /' '/    ,
     &     C3BLNK/'   '/ ,
```

```
     &     CADAS /' '/
      DATA DNAME /'       DATE: '/,
     &     GNAME /'SPECIES:'/
      DATA HEAD1 /'------ SEQUENCE MEMBERS ------'/
      DATA STRG1 /'INDX  NUC.CHG. RECD.ION.  ELEM'/
```

B3OTG3

```
      SUBROUTINE B3OTG3( DATE   ,
     &                   NDTRN  , NDTEM  , IZDIMD ,
     &                   SEQSYM , IZS    , TITLE  , DSFULL ,
     &                   IZMAX  , ZA     ,
     &                   IZ0    , ISTRN  , CTSTR  , LIBPT  ,
     &                   NVA    , SCEFA  ,
     &                   MAXT   , TEA    ,
     &                   FGC2   , SCOMA  , SCOM
     &                 )
C
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3OTG3 *********************
C
C  PURPOSE:  COMMUNICATES GRAPHICS DATA TO IDL
C
C            PROVIDES  GRAPH OF INTERPOLATED EXCITATION RATE PARAMETER
C            COEFFICIENTS, INCLUDING COMPARATIVE SOURCE DATA FROM
C            GENERAL Z EXCIT. FILE
C
C            PLOT IS  (RATE PARM/Z1**FGC2)  VERSUS  (TE)K)/Z1**2)
C
C  CALLING PROGRAM: ADAS203
C
C  SUBROUTINE:
C
C  INPUT : (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C
C  INPUT : (I*4)  NDTRN   = MAXIMUM NUMBER OF TRANSITIONS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  IZDIMD  = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (C*2)  SEQSYM  = ISOELECTRONIC SEQUENCE SYMBOL
C  INPUT : (I*4)  IZS     = NUC. CHG. OF ISOELEC. SEQUENCE 1ST MEMBER
C  INPUT : (C*40) TITLE   = ISPF ENTERED GENERAL TITLE FOR PROGRAM RUN
C  INPUT : (C*44) DSFULL  = INPUT COPASE DATA SET NAME (MVS DSN)
C
C  INPUT : (I*4)  IZMAX   = NUMBER OF IONS (STAGES) IN SOURCE FILE
C  INPUT : (R*8)  ZA()    = RECOMBINING ION CHARGES IN SOURCE FILE
C
C  INPUT : (I*4)  IZ0     = NUCLEAR CHARGE OF SELECTED ION
C  INPUT : (I*4)  ISTRN   = SELECTED TRANSITION INDEX FROM INPUT FILE
C  INPUT : (C*18) CTSTR   = SELECTED TRANSITION TITLE STRING
C
C  INPUT : (I*4)  LIBPT   = .FALSE. => BAD POINT OPTION NOT USED
C                           = .TRUE.  => BAD POINT OPTION USED
C  INPUT : (L*4)  LGRD1   = .TRUE.  => PUT GRAPH IN GRID FILE
C                           = .FALSE. => DO NOT PUT GRAPH IN GRID FILE
C  INPUT : (L*4)  LDEF1   = .TRUE.  => USE GRAPH DEFAULT SCALING
C                           = .FALSE. => DO NOT USE DEFAULT SCALING
C
C  INPUT : (I*4)  NVA()   = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR A GIVEN TRANSITION.
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C
C  INPUT : (I*4)  SCEFA(,)=REDUCED TEMPS. FROM SOURCE FILE (K)
C
C  INPUT : (I*4)  MAXT    = NUMBER OF OUTPUT ELECTRON TEMPERATURES
C  INPUT : (R*8)  TEA()   = OUTPUT ELECTRON TEMPERATURES (K)
C
C  INPUT : (R*8)  FGC2    = Z-SCALING POWER FOR RATE PARAMETERS
C  INPUT : (R*8)  SCOMA(,)= SOURCE FILE RADIATIVE COEFFICIENTS
C  INPUT : (R*8)  SCOM()  = OUTPUT INTERPOLATED COEFFT FOR SELECTED ION
C
C          (I*4)  NDIM1   = PARAMETER = MAXIMUM NUMBER OF TEMP. VALUES
C                           (MUST NOT BE LESS THAN 'NDTEM')
C          (I*4)  NDIM2   = PARAMETER = MAXIMUM NUMBER OF STAGES
C                           (MUST NOT BE LESS THAN 'IZDIMD')
C          (I*4)  NGPIC   = PARAMETER = MAXIMUM NUMBER OF IONS
C                           TO BE DISPLAYED ON A SINGLE GRAPH.
C          (I*4)  NGION   = PARAMETER = MAXIMUM NUMBER OF IONS
C                           WHICH CAN BE LISTED ON THE GRAPH.
C
C          (R*4)  CUTMIN  = PARAMETER = IN DEFAULT GRAPH SCALING IS THE
C                           MINIMUM Y-VALUE THAT IS ALLOWED.
C                           (NOTE: 'CUTMIN' MUST BE > THAN 'GHZERO')
C          (R*4)  GHZERO  = PARAMETER = VALUE BELOW WHICH GHOST80 TAKES
C                           NUMBERS AS BEING ZERO = 1.0E-36
C
C          (I*4)  IT      = TEMP. INDEX NUMBER FOR ARRAY USE
C          (I*4)  IZ      = STAGE INDEX NUMBER FOR ARRAY USE
C          (I*4)  IMMAX   = MINIMUM OF: NO. OF IONS OR NGION'
C
C          (R*4)  X()     = X-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                           ELECTRON TEMPERATURES
```

```
C          (R*4)  Y(,)    = Y-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                            LEVEL POPULATIONS.
C                            1ST DIMENSION = ELECTRON TEMP. INDEX
C                            2ND DIMENSION = ION  INDEX
C
C          (C*80) ISPEC   = GRAPH TITLE (INCORPORATES 'ELEMT,IZ0').
C          (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
C          (C*12) ENAME   = ELEMENT NAME
C          (C*3)  CNAM()  = 3 BYTE STRING FOR INTERP. AND APPROX. COEFFT
C          (C*13) DNAME   = '       DATE: '
C          (C*23) XTIT    = X-AXIS UNITS/TITLE
C          (C*23) YTIT    = Y-AXIS UNITS/TITLE
C          (C*9)  KEY0    = '    KEY: '
C          (C*9)  MNMX0   = 'MINIMAX: '
C          (C*9)  FILE0   = 'FILE   : '
C          (C*8)  ADAS0   = 'ADAS   :'
C          (C*28) KEY()   = DESCRIPTIVE KEY FOR GRAPH (2 TYPES)
C
C          (C*1)  GRID    = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*1)  PIC     = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*3)  C3BLNK  = BLANK 3 BYTE STRING
C          (C*30) HEAD1   = HEADING FOR LEVEL ASSIGNMENTS
C          (C*30) STRG1   = HEADING FOR LEVEL ASSIGNMENTS
C
C          (I*4)  PIPEIN  = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)  PIPEOU  = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C          (I*4)  ONE     = PARAMETER = 1  : USED AS FLAG TO IDL
C          (I*4)  ZERO    = PARAMETER = 0  : USED AS FLAG TO IDL
C
C ROUTINES:
C          ROUTINE     SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXELEM      ADAS      SETS UP ELEMENT NAME AS STRING
C          XXFLSH      IDL_ADAS  FLUSHES OUT UNIX PIPE
C
C
C AUTHOR:  H. P. SUMMERS, JET
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    03/01/95
C
C UPDATE:  06/07/95 - PE BRIDEN: - Changed NVA from scalar to ARRAY
C                                  (as it should be).
C                                - Changed references to NVA in code
C                                  to ITEMP.
C                                - Declared ITEMP as INTEGER*4 and set
C                                  it equal to NVA(ISTRN).
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 01-04-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - FIRST VERSION
C
C VERSION: 1.2                          DATE: 01-04-96
C MODIFIED: TIM HAMMOND
C               - REMOVED SUPERFLUOUS VARIABLES
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDIM1    , NDIM2    , NGPIC    , NGION
      INTEGER   PIPEIN   , PIPEOU   , ONE      , ZERO
      PARAMETER( PIPEIN=5      , PIPEOU=6  , ONE=1       , ZERO=0)
C-----------------------------------------------------------------------
      REAL*4    CUTMIN   , GHZERO
C-----------------------------------------------------------------------
      PARAMETER ( NDIM1= 20  , NDIM2=15         , NGPIC=8 , NGION = 55 )
      PARAMETER ( CUTMIN = 1.0E-20 , GHZERO = 1.0E-36 )
C-----------------------------------------------------------------------
      INTEGER   NDTRN    , NDTEM    , IZDIMD
      INTEGER   IZMAX    , ITEMP    , MAXT     ,
     &          IZ0      , IZS      , IZ1      , ISTRN
      INTEGER   IT       , IZ       ,
     &          IMMAX    , I
C-----------------------------------------------------------------------
      REAL*8    FGC2     , Z1
C-----------------------------------------------------------------------
      LOGICAL   LIBPT
C-----------------------------------------------------------------------
      CHARACTER ELEM*2   , TITLE*40 , DSFULL*44, ENAME*12
      CHARACTER SEQSYM*2 , XFESYM*2 , CTSTR*18
      CHARACTER GRID*1   , PIC*1    , C3BLNK*3 , DATE*8   ,
     &          FILE0*9  , MNMX0*9  , KEY0*9   , ADAS0*8  ,
     &          DNAME*13 , GNAME*8  ,
     &          XTIT*25  , YTIT*23  ,
     &          HEAD1*30 ,
     &          STRG1*30 ,
     &          ISPEC*80 , CADAS*80 , GTIT1*40
C-----------------------------------------------------------------------
      INTEGER   NVA(NDTRN)
C-----------------------------------------------------------------------
      REAL*4    X(NDIM1)           , Y(NDIM1,NDIM2)      , Z(NDIM1,2)
      REAL*4    XO(NDIM1)
C-----------------------------------------------------------------------
      CHARACTER KEY(3)*22          , STRGA(NDIM2)*30
      CHARACTER CNAM(2)*3
```

```
C-----------------------------------------------------------------------
      REAL*8    ZA(IZDIMD)
      REAL*8    SCEFA(NDTEM,NDTRN)  , TEA(NDTEM)
      REAL*8    SCOMA(NDTEM,NDTRN,IZDIMD) ,
     &          SCOM(NDTEM)
C-----------------------------------------------------------------------
      SAVE      CADAS
C-----------------------------------------------------------------------
      DATA ISPEC(1:40)
     &          /'SCALED RATE PARAAMETER VS SCALED TEMP.: '/
      DATA (CNAM(IZ),IZ=1,2)
     &          / 'INT' , 'APX' /
      DATA XTIT  /'Z-SCALED ELEC. TEMP. (K) '/
      DATA YTIT  /'SCALED RATE PARAMETER  '/
      DATA ADAS0 /'ADAS   :'/               ,
     &     FILE0 /'FILE   : '/              ,
     &     MNMX0 /'MINIMAX: '/              ,
     &     KEY0  /'KEY    : '/              ,
     &     KEY(1)/'(FULL LINE - INTERP. )'/  ,
     &     KEY(2)/' (DASH LINE - SOURCE )'/  ,
     &     KEY(3)/'                     ) '/
      DATA GRID  /' '/   ,
     &     PIC   /' '/    ,
     &     C3BLNK/'   '/ ,
     &     CADAS /' '/
      DATA DNAME /'       DATE: '/,
     &     GNAME /'SPECIES:'/
      DATA HEAD1 /'------ SEQUENCE MEMBERS ------'/
      DATA STRG1 /'INDX  NUC.CHG. RECD.ION.  ELEM'/
```

B3OUT0

```
      SUBROUTINE B3OUT0( IUNIT  , DATE   , DSFULL ,
     &                   IZDIMD , NDLEV  , NDTRN  , NDTEM  ,
     &                   SEQSYM , IZMAX  , IZ0A   ,
     &                   IZS    , IZ0    , BWNO   ,
     &                   IL     , ITRAN  ,
     &                   IA     , CSTRGA , ISA    , ILA    , XJA    ,
     &                   WAO    ,
     &                   NV     , SCEFA  ,
     &                   MAXT   , TOA    ,
     &                   I1A    , I2A    ,
     &                   IEC1A  , IAC1A  , IAC2A  ,
     &                   FAC2A  , IGC1A  , FGC2A  ,
     &                   LBPTS  , LADJA  , CADAS  , DSOUT0
     &                 )
C
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3OUT0 *********************
C
C  PURPOSE: TO OUTPUT SUMMARY DATA ON INTERPOLATED SPECIFIC ION FILE
C           AND SOURCE GENERAL Z EXCITATION FILE TO STREAM 'IUNIT'.
C
C  CALLING PROGRAM: ADAS203
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  IUNIT  = OUTPUT STREAM NUMBER
C  INPUT :  (C*8)  DATE   = CURRENT DATE AS 'DD/MM/YY'
C  INPUT :  (C*80) DSFULL = INPUT COPASE DATA SET NAME
C
C  INPUT :  (C*2)  SEQSYM = ISOELECTRONIC SEQUENCE SYMBOL
C  INPUT :  (I*4)  IZS    = NUCLEAR CHARGE OF NEUTRAL SEQ. MEMBER
C  INPUT :  (I*4)  IZ0    = NUCLEAR CHARGE OF SELECTED ION
C  INPUT :  (R*8)  BWNO   = IONISATION POTENTIAL (CM-1)
C
C  INPUT :  (I*4)  ITRAN  = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C
C  INPUT :  (I*4)  IL     = NUMBER OF ENERGY LEVELS
C
C  INPUT :  (I*4)  IA()   = ENERGY LEVEL INDEX NUMBER
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  INPUT :  (I*4)  ISA()  = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT :  (I*4)  ILA()  = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT :  (R*8)  XJA()  = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT :  (R*8)  WAO()  = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C  INPUT :  (C*80) DSOUT0 = FILENAME FOR OUTPUT
C
C
C          (R*8)  WN2RYD  = PARAMETER =
C                           WAVE NUMBER (CM-1) TO RYDBERG CONVERSION
C
C          (R*8)  BRYDO   = IONISATION POTENTIAL (RYDBERGS)
C          (R*8)  BWN     = ENERGY RELATIVE TO IONISATION POTENTIAL IN
C                           WAVE NUMBERS (CM-1).
C          (R*8)  BRYD    = ENERGY RELATIVE TO IONISATION POTENTIAL IN
C                           RYDBERGS.
C
C          (I*4)  I       = GENERAL USE
```

```
C
C INPUT:   (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          -------------------------------------------------------------
C
C AUTHOR:  H. P. SUMMERS, JET
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    13/01/95
C
C UPDATE:  03/07/95 - HPS  ALTER LENGTH OF CSTRGA ARRAY TO 18 AND
C                          USE NEW POSITION FOR INPUT/OUTPUT
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C VERSION: 1.2                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND
C               - REMOVED CALL TO XXADAS AS THIS IS NOW HANDLED IN THE
C                 ROUTINE B3SPF1 AND CADAS IS PASSED INTO THIS
C                 ROUTINE AS A PARAMETER.
C               - TIDIED UP THE FORMAT OF THE PRINTED OUTPUT
C
C VERSION: 1.3                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND
C               - ENSURED OUTPUT FILE IS CLOSED AT END OF EACH RUN
C
C-----------------------------------------------------------------------
      REAL*8     WN2RYD        , WN2EV
C-----------------------------------------------------------------------
      PARAMETER( WN2RYD = 9.11269D-06 , WN2EV = 1.23982D-04 )
C-----------------------------------------------------------------------
      INTEGER    IZDIMD        , NDTRN          , NDLEV      , NDTEM
      INTEGER    I
      INTEGER    IUNIT         , IZMAX          ,
     &           IZ            , IZ0            , IZ1        , IZS    ,
     &           ITRAN         ,
     &           IL            , NV             , MAXT
C-----------------------------------------------------------------------
      REAL*8     BWNO          , BWN            , BRYDO      , BRYD   ,
     &           ER
C-----------------------------------------------------------------------
      CHARACTER  SEQSYM*2      , DATE*8         , XFESYM*2   ,
     &           DSFULL*80     , CADAS*80       , DSOUT0*80
C-----------------------------------------------------------------------
      INTEGER    IA(IL)        , ISA(IL)        , ILA(IL)
      INTEGER    IZ0A(IZDIMD)
      INTEGER    I1A(NDTRN)    , I2A(NDTRN)     ,
     &           IEC1A(NDTRN)  , IAC1A(NDTRN)   ,
     &           IAC2A(NDTRN)  , IGC1A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8     XJA(IL)       , WAO(IL)
      REAL*8     SCEFA(NV)     , TOA(MAXT)
      REAL*8     FAC2A(NDTRN)  , FGC2A(NDTRN)
C-----------------------------------------------------------------------
      CHARACTER  CSTRGA(IL)*18
C-----------------------------------------------------------------------
      LOGICAL     LADJA(NDTRN)        ,
     &            LBPTS(NDTRN)
C-----------------------------------------------------------------------
```

B3REAC

```
       SUBROUTINE B3REAC( NDTRN , NDTEM , IZDIMD,
     &                    IZMAX , Z1A   ,
     &                    ITRAN ,
     &                    NVA   , SCEFA ,
     &                    I1A   , I2A   , N1A   , N2A   , W1A   , W2A,
     &                    IEC1A , IAC1A , IAC2A , FAC2A , IGC1A , FGC2A,
     &                    CTSTRA, WDEA  , AVALA , SCOMA ,
     &                    IZS   , IZ0   , ISTRN , LIBPT ,
     &                    MAXT  , TEA   ,
     &                    WDE   , AVAL  , SCOM
     &                  )
C
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3REAC *********************
C
C  PURPOSE:  TO INTERPOLATE DATA FOR A SINGLE TRANSITION FROM A
C            GENERAL Z EXCITATION FILE TO A SELECTED SEQUENCE MEMBER
C
C  CALLING PROGRAM: ADAS203
C
C  DATA:
C
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
```

```
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NDTRN   = MAX. NUMBER OF TRANSITIONS THAT CAN BE READ
C  INPUT : (I*4)  NDTEM   = MAX NUMBER OF INPUT FILE TEMPS.
C  INPUT : (I*4)  IZDIMD  = MAX. NUMBER OF SEQUENCE MEMBERS ALLOWED
C
C  INPUT : (I*4)  IZMAX   = NO. OF SEQUENCE MEMBERS IN GENERAL Z FILE
C  INPUT : (R*8)  Z1A()   = ION CHARGE +1  FOR SEQUENCE MEBERS IN
C                           GENERAL Z FILE
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C
C  INPUT : (I*4)  ITRAN   = INPUT DATA FILE: NUMBER OF ELECTRON IMPACT
C
C
C  INPUT : (I*4)  NVA()   = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR A GIVEN TRANSITION.
C                           1ST DIMENSION - SEQUENCE MEMBER INDEX
C  INPUT : (R*8)  SCEFA(,)= INPUT DATA FILE: Z-SCALED ELEC. TEMPS.(K)
C                           1ST DIMENSION - TEMPERATURE 'SCEF()'
C                           2ND DIMENSION - TRANSITION NUMBER
C                                           TRANSITIONS.
C
C
C  INPUT : (I*4)  I1A()   = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  I2A()   = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  N1A()   = ELECTRON IMPACT TRANSITION:
C                            LOWER LEVEL PRINCIPAL QUANTUM NUMBER
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  N2A()   = ELECTRON IMPACT TRANSITION:
C                            UPPER LEVEL PRINCIPAL QUANTUM NUMBER
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  W1A()   = ELECTRON IMPACT TRANSITION:
C                            LOWER LEVEL STATISTICAL WEIGHT
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  W2A()   = ELECTRON IMPACT TRANSITION:
C                            UPPER LEVEL STATISTICAL WEIGHT
C                           1ST DIMENSION - TRANSITION NUMBER
C
C  INPUT : (I*4)  IEC1A() = TRANSITION ENERGY INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=>1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  IAC1A() = TRANSITION PROB. INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=> 1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  IAC2A() = TRANSITION TYPE
C                           (1=>DIPOLE, 2=>NON-DIPOLE, 3=>SPIN CHANGE,
C                            4=>OTHER)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  FAC2A() = TRANSITION PROB. Z1 SCALING POWER
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  IGC1A() = UPSILON INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=> 1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  FGC2A() = UPSILON Z1 SCALING POWER
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (C*18) CTSTRA()= TRANSITION DESCRIPTOR
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (R*8)  WDEA()  = TRANSITION ENERGY (CM-1)
C                           1ST DIMENSION - TRANSITION NUMBER
C
C  INPUT : (R*8)  AVALA() = ELECTRON IMPACT TRANSITION:
C                            A-VALUES (SEC-1)
C                           1ST DIMENSION - TRANSITION NUMBER
C                           2ND DIMENSION - SEQUENCE MEMBER INDEX
C  INPUT : (R*8)  SCOMA(,,)=ELECTRON IMPACT TRANSITION:
C                            GAMMA VALUES
C                           1ST DIMENSION - TEMPERATURE 'SCEF()'
C                           2ND DIMENSION - TRANSITION NUMBER
C                           3RD DIMENSION - SEQUENCE MEMBER INDEX
C
C  INPUT : (I*8)  MAXT    = NUMBER OF OUTPUT TEMPERATURES
C  INPUT : (R*8)  TEA()   = OUTPUT TEMPERATURES (K)
C
C  OUTPUT: (R*8)  WDE()   = ENERGY OF TRANSITIONS (CM-1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (R*8)  AVAL()  = A-VALUE OF TRANSITIONS (SEC-1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  OUTPUT: (R*8)  SCOM(,) = SELECTED TRANSITION GAMMA VALUES:
C                            GAMMA VALUES
C                           1ST DIMENSION - OUTPUT TEMPERATURE
C                           2ND DIMENSION - TRANSITION NUMBER
C
C
C          (I*4)  I       = GENERAL USE.
C          (I*4)  J       = GENERAL USE.
C          (I*4)  J1      = INPUT DATA FILE - SELECTED TRANSITION:
```

```
C                              LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C          (I*4)  J2       = INPUT DATA FILE - SELECTED TRANSITION:
C                              UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                              CAPTURING    LEVEL INDEX (CASE 'H' & 'R')
C
C          (R*8)  AVALM    = INPUT DATA FILE - SELECTED TRANSITION:
C                            MANTISSA OF:   ('IAPOW' => EXPONENT)
C                             A-VALUE (SEC-1)          (CASE ' ')
C                             NEUTRAL BEAM ENERGY      (CASE 'H')
C                             NOT USED                 (CASE 'P' & 'R')
C
C          (R*8)  EIJMOD   = MODULUS OF EIJ
C
C          (C*80) CLINE    = CURRENT ENERGY LEVEL INDEX PARAMETER LINE
C
C          (L*4)  LDATA    = IDENTIFIES  WHETHER  THE END OF AN  INPUT
C                            SECTION IN THE DATA SET HAS BEEN LOCATED.
C                            (.TRUE. => END OF SECTION REACHED)
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          B2SORT     ADAS      PERFORMS BUBBLE SORT OF 2 REAL ARRAYS
C
C AUTHOR:  H. P. SUMMERS, JET
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    17/08/94
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 06-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C VERSION: 1.2                          DATE: 06-03-96
C MODIFIED: TIM HAMMOND
C               - REPLACED CALLS TO NSORT ROUTINE WITH CALLS TO B2SORT.
C                 NSORT IS USED TO SORT A REAL ARRAY AND ASSOCIATED
C                 INTEGER ARRAY WHEREAS WHAT WAS BEING PASSED TO IT WAS
C                 A REAL ARRAY AND ANOTHER, ASSOCIATED REAL ARRAY. B2SORT
C                 TAKES 2 REAL ARRAYS AS INPUT AND PERFORMS A BUBBLE SORT
C                 ON THEM.
C
C VERSION: 1.3                          DATE: 01-04-96
C MODIFIED: TIM HAMMOND
C               - REMOVED SUPERFLUOUS VARIABLES
C
C VERSION: 1.4                          DATE: 01-04-96
C MODIFIED: TIM HAMMOND
C               - CORRECTED MINOR SYNTAX ERROR
C
C VERSION: 1.5                          DATE: 23-05-96
C MODIFIED: WILLIAM OSBORN + HUGH SUMMERS
C               - REPLACED EIJ BY MOD(EIJ) IN DETERMINING LINE STRENGTHS
C                  AND UPSILON FIT
C
C-----------------------------------------------------------------------
      INTEGER   NDSPLN
C-----------------------------------------------------------------------
      PARAMETER ( NDSPLN = 10 )
C-----------------------------------------------------------------------
      INTEGER   NDTRN       , IZDIMD    ,
     &          NDTEM       , ITRAN     ,
     &          ISTRN       , MAXT      ,
     &          IZMAX       ,
     &          IZS         ,IZ0
      INTEGER   K           , IT
      INTEGER   IEND1       , IENDN           , ITEMP     ,
     &          IFAIL       , IXOPT           , IFORMS    , IENDS
C-----------------------------------------------------------------------
      REAL*8    Z1
      REAL*8    ENI         , ENJ             , REN       , XI        ,
     &          EIJ         , S               , EIJMOD    ,
     &          TE1         , TE2             , GAM1      , GAM2      ,
     &          FXC2        , FXC3            , TE        ,
     &          X           ,
     &          X1          , XN              , DX1       , DXN       ,
     &          G1          , GN              , G         , DG
      REAL*8    Y           , DY              , FORM      , FORM2     ,
     &          EEI         , EE2
C-----------------------------------------------------------------------
      LOGICAL   LIBPT
C-----------------------------------------------------------------------
      INTEGER   NVA(NDTRN)
      INTEGER   I1A(NDTRN)  , I2A(NDTRN)     ,
     &          N1A(NDTRN)  , N2A(NDTRN)     ,
     &          IEC1A(NDTRN), IAC1A(NDTRN)   ,
     &          IAC2A(NDTRN), IGC1A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8    Z1A(IZDIMD)
      REAL*8    SCEFA(NDTEM,NDTRN)  , TEA(NDTEM)
      REAL*8    W1A(NDTRN)          , W2A(NDTRN)          ,
     &          FAC2A(NDTRN)        , FGC2A(NDTRN)
      REAL*8    WDEA(NDTRN,IZDIMD)  , AVALA(NDTRN,IZDIMD)  ,
     &          SCOMA(NDTEM,NDTRN,IZDIMD)
```

```
      REAL*8    WDE(NDTRN)          , AVAL(NDTRN)
      REAL*8    SCOM(NDTEM,NDTRN)
      REAL*8    XSA(NDSPLN)         , YSA(NDSPLN)             ,
     &          XOS(NDSPLN)         , GSA(NDSPLN)         ,
     &          GOS(NDSPLN)         , GOA(NDSPLN)             ,
     &          XPA(NDSPLN)         , APGOA(NDSPLN)
      REAL*8    C1(NDSPLN,NDSPLN-1) , C2(NDSPLN, NDSPLN-1)    ,
     &          C3(NDSPLN,NDSPLN-1) , C4(NDSPLN, NDSPLN-1)
C-----------------------------------------------------------------------
      CHARACTER CTSTRA(NDTRN)*18
C-----------------------------------------------------------------------
      EXTERNAL  FORM        , FORM2
C-----------------------------------------------------------------------
```

B3SPF0

```
      SUBROUTINE B3SPF0( REP    , DSFULL)
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3SPF0 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS203
C
C  SUBROUTINE:
C
C  OUTPUT: (C*3)   REP     = 'YES' => TERMINATE PROGRAM EXECUTION.
C                          = 'NO ' => CONTINUE PROGRAM EXECUTION.
C
C  OUTPUT: (C*80)  DSFULL  = INPUT DATA SET NAME (FULL MVS DSN)
C                            (IN FORM SUITABLE FOR DYNAMIC ALLOCATION)
C
C          (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C AUTHOR:  TIM HAMMOND    (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    29-02-96
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 29-02-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - FIRST VERSION
C
C-----------------------------------------------------------------------
      CHARACTER    REP*3        , DSFULL*80
C-----------------------------------------------------------------------
      INTEGER     PIPEIN        , PIPEOUT
      PARAMETER(  PIPEIN=5      , PIPEOUT=6)
C-----------------------------------------------------------------------
```

B3SPF1

```
      SUBROUTINE B3SPF1( LGPH, IGRAPH, IPEND, LCOPS, L2FILE, DSOUT0,
     &                   DSCOPS, CADAS, USERID)
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B3SPF1 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS203
C
C  SUBROUTINE:
C
C  OUTPUT:   (L*4)   LGPH     = .TRUE.  => SELECT GRAPHICAL OUTPUT
C                             = .FALSE. => DO NOT SELECT GRAPHICAL OUTPUT
C  OUTPUT:   (I*4)   IGRAPH   = INDEX OF GRAPH TO BE PLOTTED:
C                               1=TRANSITION WAVE NO.
C                               2=SCALED A-VALUE
C                               3=SCALED RATE PARAMETER
C  OUTPUT:   (I*4)   IPEND    = 0 => IMMEDIATE EXIT FROM THE PROGRAM
C                             = 1 => BACK TO PROCESSING SCREEN
C                             = 2 => VIEW GRAPHS
C                             = 3 => PRODUCE OUTPUT AND EXIT PROGRAM
C                             = 4 => PRODUCE OUTPUT AND RETURN TO OUTPUT
C                                    SCREEN
C  OUTPUT:   (L*4)   LCOPS    = .TRUE.  => PRODUCE COPASE FILE
C                               .FALSE. => DO NOT PRODUCE COPASE FILE
C  OUTPUT:   (L*4)   L2FILE   = .TRUE.  => PRODUCE SUMMARY FILE
C                               .FALSE. => DO NOT PRODUCE SUMMARY FILE
```

```
C  OUTPUT:   (C*80)  DSOUT0   = FILENAME FOR SUMMARY OUTPUT
C  OUTPUT:   (C*80)  DSCOPS   = FILENAME FOR COPASE OUTPUT
C  OUTPUT:   (C*80)  CADAS    = HEADER FOR TEXT OUTPUT
C  OUTPUT:   (C*20)  USERID   = USER ID
C
C            (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C            (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT FROM PIPE
C            (I*4)   ONE      = PARAMETER = 1  : USED AS FLAG TO IDL
C            (I*4)   ZERO     = PARAMETER = 0  : USED AS FLAG TO IDL
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXFLSH     IDL-ADAS  CALLS FLUSH TO CLEAR PIPES.
C          XXADAS     IDL_ADAS  GATHERS ADAS HEADER INFORMATION
C
C AUTHOR:  Tim Hammond  (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    8th March 1996
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 08-03-96
C MODIFIED: TIM HAMMOND
C               - FIRST RELEASE
C
C-----------------------------------------------------------------------
      CHARACTER    DSOUT0*80   , DSCOPS*80   , CADAS*80    , USERID*20
C-----------------------------------------------------------------------
      LOGICAL      L2FILE      , LGPH        , LCOPS
C-----------------------------------------------------------------------
      INTEGER      ILOGIC      ,
     &             PIPEIN      , PIPEOU      , ONE         , ZERO
      INTEGER      IGRAPH      , IPEND
      PARAMETER( PIPEIN=5      , PIPEOU=6    , ONE=1       , ZERO=0)
C-----------------------------------------------------------------------
```

B3WR10

```
      SUBROUTINE B3WR10( IUNIT  , DSFULL  ,
     &                   NDLEV  , NDTRN   , NDTEM  ,
     &                   IL     , ITRAN   ,
     &                   IZS    , IZ0     ,
     &                   IA     , CSTRGA  , NA     ,
     &                   ISA    , ILA     , XJA    ,
     &                   I1A    , I2A     ,
     &                   IEC1A  , IAC1A   , IAC2A  ,
     &                   FAC2A  , IGC1A   , FGC2A  ,
     &                   LBPTS  , LADJA   ,
     &                   MAXT   , TOA     ,
     &                   BWNO   , WAO     , AVAL   , SCOM ,
     &                   DATE   , USERID  , DSCOPS
     &                 )
C
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B3WR10 ******************
C
C  PURPOSE:  TO OUTPUT DATA TO A SPECIFIC ION (COPASE) FILE
C
C  CALLING PROGRAM: ADAS203
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT NUMBER FOR RESULTS
C  INPUT : (I*4)  NDLEV   = MAX. NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTRN   = MAX. NO. OF TRANSITIONS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM OF INPUT DATA FILE TEMPS
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY INDEX LEVELS.
C  INPUT : (I*4)  ITRAN   = NUMBER OF ELECTRON IMPACT TRANSITIONS
C  INPUT : (I*4)  IZS     = NUCLEAR CHARGE OF NEUTRAL SEQ. MEMBER
C  INPUT : (I*4)  IZ0     = NUCLEAR CHARGE OF SELECTED ION
C  INPUT : (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  INPUT : (I*4)  NA()    = PRINCIPAL QUANTUM NUMBER OF VALENCE ELECTRON
C  INPUT : (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT : (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT : (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT : (I*4)  I1A()   = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  INPUT : (I*4)  I2A()   = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C
C  INPUT : (I*4)  IEC1A() = TRANSITION ENERGY INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=>1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  IAC1A() = TRANSITION PROB. INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=> 1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
```

```
C  INPUT : (I*4)  IAC2A() = TRANSITION TYPE
C                           (1=>DIPOLE, 2=>NON-DIPOLE, 3=>SPIN CHANGE,
C                            4=>OTHER)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  FAC2A() = TRANSITION PROB. Z1 SCALING POWER
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  IGC1A() = UPSILON INTERPOLATION VARIABLE
C                           (1=>Z1 ; 2=> 1/Z1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*4)  FGC2A() = UPSILON Z1 SCALING POWER
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (L*4)  LBPTS() = .FALSE. => BAD POINT OPT. NOT SET FOR TRANS.
C                         = .TRUE.  => BAD POINT OPT. SET FOR TRANS.
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (L*4)  LADJA() = .FALSE. => TRANSITION NOT ADJUSTED
C                                      (DEFAULT SETTINGS USED)
C                         = .TRUE.  => TRANSITION ADJUSTED
C                                      (DEFAULT SETTINGS MODIFIED)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (I*8)  MAXT    = NUMBER OF OUTPUT TEMPERATURES
C  INPUT : (R*8)  TOA()   = OUTPUT TEMPERATURES (K)
C
C  INPUT : (R*8)  BWNO    = IONISATION POTENTIAL (CM-1)
C  INPUT : (R*8)  WAO()   = ENERGY OF LEVELS (CM-1)
C                           1ST DIMENSION - LEVEL NUMBER
C  INPUT : (R*8)  WDE()   = ENERGY OF TRANSITIONS (CM-1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (R*8)  AVAL()  = A-VALUE OF TRANSITIONS (SEC-1)
C                           1ST DIMENSION - TRANSITION NUMBER
C  INPUT : (R*8)  SCOM(,) = SELECTED TRANSITION GAMMA VALUES:
C                            GAMMA VALUES
C                           1ST DIMENSION - OUTPUT TEMPERATURE
C                           2ND DIMENSION - TRANSITION NUMBER
C  INPUT : (C*8)  DATE    = CURRENT DATE
C  INPUT : (C*20) USERID  = USER ID
C  INPUT : (C*80) DSCOPS  = OUTPUT FILE NAME
C
C
C          (I*4) I         = GENERAL USE
C          (I*4) PIPEIN    = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XFESYM     ADAS      FETCHES ELEMENT SYMBOL
C
C
C AUTHOR:  H. P. SUMMERS, JET
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    10/01/95
C
C UPDATE:  03/07/95 - HPS  ALTER LENGTH OF CSTRGA ARRAY TO 18 AND
C                          USE NEW POSITION FOR INPUT/OUTPUT
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C VERSION: 1.2                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND
C               - CHANGED SO THAT USERID IS READ FROM THE UNIX PIPE.
C               - ALSO MODIFIED FILENAME LENGTHS AND OUTPUT FORMATS
C                 SLIGHTLY
C
C VERSION: 1.3                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND
C               - MOVED USERID AND DATE TO INPUT PARAMETERS
C
C VERSION: 1.4                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND
C               - ADDED OUTPUT FILENAME DSCOPS AS AN INPUT PARAMETER
C
C VERSION: 1.5                          DATE: 20-03-96
C MODIFIED: TIM HAMMOND
C               - ADDED OPENING AND CLOSING OF OUTPUT FILE
C
C VERSION: 1.6                          DATE: 01-04-96
C MODIFIED: TIM HAMMOND
C               - REMOVED SUPERFLUOUS VARIABLES
C
C-----------------------------------------------------------------------
      INTEGER     NDOUT       , L3          , PIPEIN
C-----------------------------------------------------------------------
      PARAMETER ( NDOUT = 14   , L3 = 3      , PIPEIN = 5)
C-----------------------------------------------------------------------
      INTEGER     IUNIT
      INTEGER     NDLEV       , NDTRN       , NDTEM
      INTEGER     IZ          , IZ0         , IZ1       , IZS      ,
     &            I           ,
     &            IL          , IT          , ITRAN     ,
     &            MAXT        , NTOUT
C-----------------------------------------------------------------------
      REAL*8      BWNO        , Z1
```

```
C-----------------------------------------------------------------------
      CHARACTER   DATE*8       , DSFULL*80 , USERID*20  ,
     &            ESYM*2       , XFESYM*2
      CHARACTER   CLINE*133    , BLANKS*133   , CNUM*9
      CHARACTER   DSCOPS*80
C-----------------------------------------------------------------------
      INTEGER     IA(NDLEV)    , NA(NDLEV)    , ISA(NDLEV)   ,
     &            ILA(NDLEV)
      INTEGER     I1A(NDTRN)   , I2A(NDTRN)   ,
     &            IEC1A(NDTRN) , IAC1A(NDTRN) ,
     &            IAC2A(NDTRN) , IGC1A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8      FAC2A(NDTRN)        , FGC2A(NDTRN)
      REAL*8      XJA(NDLEV)   , WAO(NDLEV)   , AVAL(NDTRN)
      REAL*8      TOA(NDTEM)
      REAL*8      SCOM(NDTEM,NDTRN)
C-----------------------------------------------------------------------
      LOGICAL     LADJA(NDTRN)        ,
     &            LBPTS(NDTRN)
C-----------------------------------------------------------------------
      CHARACTER   CSTRGA(NDLEV)*18
C-----------------------------------------------------------------------
      DATA        BLANKS/' '/
C-----------------------------------------------------------------------
```

B4DATD

```
       SUBROUTINE B4DATD ( XRMEMB    , NPMNCL , IMAXX  ,
     &                     NREPX     , MAXTM  , TEM    ,
     &                     NDBFILM   , NBFIL  , NCUTMC ,
     &                     AUGM      , DRM    , DRMSF  ,
     &                     PWSAT     , DSNXRT , OPEN17 ,
     &                     dsnin     , adas_c , adas_u
     &                   )
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ************** FORTRAN77 SUBROUTINE: B4DATD  ************************
C
C  VERSION:  1.1
C
C  PURPOSE:  PROCESS  DIELECTRONIC DATA FILES TO PREPARE
C            DIELECTRONIC AND AUGER DATA FOR ADAS204
C
C            THE DR FILE LAYOUT IS SPECIFIED BY THE ADF09 FORMAT
C
C  DATA:     THE SOURCE DATA IS ACCESSED THROUGH A CROSS-REFERENCE FILE
C                 /../adas/adf18/a09_p204/<ion>n.dat
C            WHERE <ION> DENOTES THE RECOMBINED ION (EG. C4)
C
C            THE PARENT CROSS-REFERENCING IS BASED ON THE ADAS204
C            DRIVING INPUT DATA FILE SPECIFIED BY THE ADF25 FORMAT
C                /../adas/adf25/bns<yr>#<seq>/bns<yr>#<seq>_<code>.dat
C            WHERE <yr>   IS A TWO DIGIT YEAR NUMBER
C                  <seq>  IS THE ISO=ELECTRONIC SEQUENCE SYMBOL
C                  <code> IS AN ION CODE (eg. c4) OR ELEMENT CODE
C                         (EG. c ) IF A NUMBER OF IONS OF THE
C                         ISO-ELECTRONIC SEQUENCE ARE STACKED
C                         SEQUENTIALLY.
C
C            THE FILE NAMES ARE ANALYSED BY ADAS204 AND WARNINGS ISSUED
C            IF APPROPRIATE.  THESE WARNINGS ARE NOT NECESSARILY FATAL.
C            FOR EXAMPLE, THE ADF18 FILE CONTAINS THE NAME OF ITS
C            EXPECTED DRIVING ADF25 FILE.  THESE DIFFER IF THE ADF25
C            FILE IS DRIVING A COMPLETE ISO-ELECTRONIC SEQUENCE CALC.
C            RATHER THAN JUST A SINGLE ION CASE.
C
C
C  INPUT:  (C*8)  XRMEMB  = CROSS-REFERENCE PARTITIONED DATA SET MEMBER
C          (I*4)  IMAXX   = NUMBER OF REPRESENTATIVE LEVELS IN THE
C                               EXTENDED SET REQUIRED FOR THE MAIN CODE
C          (I*4)  NREPX() = REPRESENTATIVE N-SHELLS FOR THE MAIN CODE
C          (I*4)  NPMNCL  = NUMBER OF PARENTS INCLUDED IN THE MAIN CODE
C                               ( GIVEN BY THE <INMEMB> FILE )
C          (I*4)  MAXTM   = NUMBER OF TEMPERATURES USED IN MAIN CODE
C          (R*8)  TEM()   = TEMPERATURES (K) USED IN THE MAIN CODE
C          (I*4)  NDBFILM = PARAMETER = MAXIMUM NUMBER OF DR FILES
C                                       MUST BE GREATER THAN NDBFIL
C          (C*120)DSNXRT  = FIRST PART OF CROSS REFERENCE FILE NAME
C            (L)    OPEN17  = .FALSE. -OUTPUT TO UNIT=17 SWITCHED OFF.
C
C  OUTPUT: (I*4)  NCUTMC(,) = N-SHELL CUT FOR AUGER RATES (AUGER CHANNEL
C                             OPENS AT NCUTMC+1)
C                                1ST. INDEX = INITIAL PARENT
C                                2ND. INDEX = FINAL PARENT
C          (R*8)  AUGM(,,,) = AUGER RATES (SEC-1)
C                                1ST INDEX =  REPRESENTATIVE LEVEL
C                                2ND INDEX =  INITIAL PARENT
C                                3RD INDEX =  INITIAL SPIN SYSTEM
C                                4TH INDEX =  FINAL PARENT
C          (R*8)  DRM(,,,,) = DIELECTRONIC RATE COEFFTS. (CM3 SEC-1)
C                                1ST INDEX =  REPRESENTATIVE LEVEL
C                                2ND INDEX =  TEMPERATURE
C                                3RD INDEX =  INITIAL PARENT
```

```
C                                4TH INDEX =  INITIAL SPIN SYSTEM
C                                5TH INDEX =  FINAL PARENT
C          (I*4)  NBFIL     = NUMBER OF DR FILES
C
C  PROGRAM:(I*4)  NDREP    = PARAMETER = MAXIMUM NUMBER OF
C                                         REPRESENTATIVE LEVELS
C          (I*4)  NDPRT    = PARAMETER = MAXIMUM NUMBER OF PARENTS
C          (I*4)  NDSYS    = PARAMETER = MAXIMUM NUMBER OF SPIN SYSTEMS
C          (I*4)  NDT      = PARAMETER = MAXIMUM NUMBER OF TEMPERATURES
C          (I*4)  NDBFIL   = PARAMETER = MAXIMUM NUMBER OF DR FILES
C          (I*4)  NDPAIR   = PARAMETER = MAXIMUM NUMBER OF AUGER RATE
C                                         PARENT PAIRS
C          (I*4)  NDREP    = PARAMETER = MAXIMUM NUMBER OF MAIN CODE
C                                         REPRESENTATIVE LEVELS
C          (I*4)  NDBREP   = PARAMETER = MAXIMUM NUMBER OF DR
C                                         REPRESENTATIVE LEVELS
C
C          (C*1)  CHARS1   = ONE CHARACTER
C          (C*4)  CHARS4   = FOUR CHARACTERS
C          (C*120)DSNBD()  = DR DIELECTRONIC DATA FILE MEMBER NAMES
C          (C*30) BPDS     = DR PARENT STATE DESCRIPTOR
C          (C*30) BPDSC()  = DR PARENT STATE DESCRIPTOR ARRAY
C          (C*120)DSNMC    = MAINCL CODE INPUT FILE MEMBER NAME
C          (C*120)DSNMCO   = MAINCL CODE OUTPUT FILE MEMBER NAME
C          (C*120)DSN      = CHARACTER FILE NAME WORKSPACE
C          (C*120)DSHORT   = CURRENT FILE NAME WITH SYMBOLIC NAMES
C          (C*8)  MEMBER   = FILE MEMBER NAME WORKSPACE
C          (C*80) STRING   = LINE OUT STRING
C          (C*133)LSTRNG   = LINE IN STRING
C          (C*89) LSTRGO   = LONG LINE OUT STRING
C          (L*4)  OPEN12   = 'TRUE' IF OPEN
C          (L*4)  OPEN13   = 'TRUE' IF OPEN
C          (L*4)  OPEN14   = 'TRUE' IF OPEN
C          (L*4)  LEXIST   = 'TRUE' IF FILE EXISTS
C          (L*4)  LSJ      = 'TRUE' IF FILE EXISTS
C          (L*4)  LSETX    = 'TRUE' IF SPLINE UNINITIATED
C
C          (I*4)  I          = RUNNING INDEX
C          (I*4)  IBDPA()    = PARENT INDEX IN THE COMPLETE DR LIST
C          (I*4)  IBFIL      = RUNNING INDEX FOR DR FILES
C          (I*4)  IBREP      = RUNNING REPRESENTATIVE SHELL INDEX
C          (I*4)  IBMAX()    = NUMBER OF DR REPRESENTATIVE LEVELS
C                                   1ST. INDEX = DR FILE INDEX
C          (I*4)  IBPR       = CURRENT PARENT READ FROM DR FILE
C          (I*4)  IBPRIA(,)  = INITIAL PARENT INDEX FROM LIST FOR A FILE
C                                   1ST. INDEX = LEVEL INDEX
C                                   2ND. INDEX = DR FILE INDEX
C          (I*4)  IBPRFA(,)  = FINAL   PARENT INDEX FROM LIST FOR A FILE
C                                   1ST. INDEX = LEVEL INDEX
C                                   2ND. INDEX = DR FILE INDEX
C          (I*4)  IBREP      = RUNNING INDEX FOR REPRESENTATIVE LEVELS
C          (I*4)  IC         = COUNTER OF N-SHELLS BELOW AUGER CUT
C          (I*4)  IF         = RUNNING INDEX ON TOTAL PARENT LIST
C          (I*4)  II         = RUNNING INDEX ON TOTAL PARENT LIST
C          (I*4)  IMNPA()    = PARENT INDEX CORRESPONDING TO MAIN CODE
C          (I*4)  IND        = CHARACTER INDEX POSITION MARKER ON STRING
C          (I*4)  IOPT       =  SPLINE END CONDITION OPTION (SET =-1)
C          (I*4)  IP         = RUNNING INDEX ON TOTAL PARENT COUNT FROM
C                              DR FILES
C          (I*4)  IPI        = INITIAL PARENT OF SUPPL. AUGERING STATE
C          (I*4)  IPF        = FINAL PARENT AFTER SUPPL. AUGER
C          (I*4)  ISYSI      = INITIAL SPIN INDX. OF SUPPL.AUGERING STATE
C          (I*4)  IS         = RUNNING INDEX
C          (I*4)  ISREP      = SUPPLEMENTARY REPRESENTATIVE LEVEL INDEX
C          (I*4)  ISUPPLE    = NUMBER OF SUPPLE. AUGER RATES
C          (I*4)  IPAIRS     = RUNNING INDEX FOR AUGER RATE PARENT PAIRS
C          (I*4)  IPARM1     = DR FILE PARAMETER - PRTI
C          (I*4)  IPARM2     = DR FILE PARAMETER - TRMPRT
C          (I*4)  IPARM3     = DR FILE PARAMETER - SPNPRT
C          (I*4)  IPARM4     = DR FILE PARAMETER - PRTF
C          (I*4)  IPARM5     = DR FILE PARAMETER - TRMPRT
C          (I*4)  IPARM6     = DR FILE PARAMETER - SPNPRT
C          (I*4)  IPARM7     = DR FILE PARAMETER - NSYS
C          (I*4)  IPARM8     = DR FILE PARAMETER - SYS
C          (I*4)  IPARM9     = DR FILE PARAMETER - SPNSYS
C          (I*4)  IPRT       = RUNNING INDEX FOR PARENTS
C          (I*4)  IPT        = RUNNING INDEX ON TOTAL PARENT COUNT FROM
C                              DR FILES
C          (I*4)  IR         = UNSPECIFIED LINE COUNTER
C          (I*4)  IREAD      = FLAG FOR READ OPTION
C          (I*4)  IREFI()    = INITIAL PARENT FOR AUGER RATE IN FULL LIST
C          (I*4)  IREFF()    = FINAL PARENT FOR AUGER RATE IN FULL LIST
C          (I*4)  IREP       = MAIN CODE REPRESENTATIVE LEVEL COUNTER
C          (I*4)  IRFF       = POINTER TO FINAL PARENT IN FULL LIST
C          (I*4)  IRFI       = POINTER TO INITIAL PARENT IN FULL LIST
C          (I*4)  IS         = SPIN SYSTEM INDEX
C          (I*4)  ISET(,,)   = FLAG FOR INPUT OF SUPP. AUGER DATA
C                                   ISET = 0  NO SUPP. DATA
C                                   ISET = 1  SUPP. DATA
C                                   1ST INDEX - IPRT
C                                   2ND INDEX - ISYS
C                                   3RD INDEX - JPRT
C          (I*4)  ISPF       = FINAL PARENT SPIN FOR AUGER RATE
C          (I*4)  ISPFA(,)   = FINAL PARENT SPIN FOR AUGER RATE
C                                   1ST. INDEX = AUGER PARENT PAIR
C                                   2ND. INDEX = DR FILE INDEX
C          (I*4)  ISPI       = INITIAL PARENT SPIN FOR AUGER RATE
C          (I*4)  ISPIA(,)   = FINAL PARENT SPIN FOR AUGER RATE
```

```
C                                1ST. INDEX = AUGER PARENT PAIR
C                                2ND. INDEX = DR FILE INDEX
C          (I*4)  IST1    = PARAMETER = MAIN OUTPUT STREAM
C          (I*4)  ISYS      = RUNNING INDEX FOR SPIN SYSTEMS
C          (I*4)  IT        = RUNNING INDEX FOR TEMPERATURES
C          (I*4)  JPRT      = RUNNING INDEX FOR PARENTS
C          (I*4)  LEN1      = FIRST NON-BLANK CHARACTER IN MEMBER NAME
C          (I*4)  LEN2      = LAST NON-BLANK CHARACTER IN MEMBER NAME
C          (I*4)  MP()      = INITIAL PARENT INDEX FOR AUGER RATE
C          (I*4)  MPA()     = FINAL PARENT INDEX FOR AUGER RATE
C          (I*4)  NBCUT(,)  = N-SHELL CUT FOR AUGER RATES (AUGER CHANNEL
C                             OPENS AT NBCUT+1)
C                                1ST. INDEX = AUGER PARENT PAIR
C                                2ND. INDEX = DR FILE INDEX
C          (I*4)  NBFIL     = NUMBER OF DR FILES TO BE INCLUDED
C          (I*4)  NBREP(,)  = DR REPRESENTATIVE LEVEL N -VALUE
C                                1ST. INDEX = LEVEL INDEX
C                                2ND. INDEX = DR FILE INDEX
C          (I*4)  NBT       = NUMBER OF DR TEMPERATURES
C          (I*4)  NCUTS     = FIRST OPENING NSHELL FOR SUPPL. AUGER
C          (I*4)  NDAUG     = PARAMETER = MAXIMUM N-SHELL OF SPECIFIC
C                                         AUGER DATA
C          (I*4)  NPAIRS    = NUMBER OF AUGER RATE PARENT PAIRS
C          (I*4)  NPRNT     =
C          (I*4)  NPRNTF()  = NUMBER OF FINAL DR PARENTS FOR FILE
C          (I*4)  NPRNTI()  = NUMBER OF INITIAL DR PARENTS FOR FILE
C          (I*4)  NPTOT     = TOTAL NUMBER OF PARENTS ACCUMULATED FROM
C          (I*4)  NREP      = VALUE OF REPRESENTATIVE N-SHELL NREPX(IREP)
C                             DR FILES
C          (I*4)  NSREP()   = SUPPLEMENTARY AUGER REPRESENT. N-SHELLS
C          (I*4)  NTOP      = MARKS DRM ARRAY ZERO FOR N>NTOP
C
C          (R*8)  AA()      = SET OF AUGER RATES ON A LINE
C          (R*8)  AAS       = SUPPL. AUGER COEFFT. AT NCUTS (SEC-1)
C          (R*8)  AUGTMP(N)  = TEMPORARY STORE OF SUPP. AUGER RATES
C                                         1ST INDEX - N-SHELL VALUE
C          (R*8)  DDRROUT() = SCALED DIELECTRONIC DATA FOR SPLINE IN N
C          (R*8)  DELTAE    = SATELLITE ENERGY LEVEL ( K)
C          (R*8)  DRRIN()   = SCALED DIELECTRONIC DATA FOR SPLINE IN N
C          (R*8)  DRMSF(,,,,)  SUMMED DR COEFFICIENT
C                                         1ST INDEX - FILE
C                                         2ND INDEX - TEMPERATURE
C                                         3RD INDEX - INITIAL PARENT
C                                         4TH INDEX - SPIN SYSTEM
C                                         5TH INDEX - FINAL PARENT
C          (R*8)  DRMS()       TEMPORARY STORE OF SUMMED DR RATES
C                                         1ST INDEX - TEMPERATURE
C          (R*8)  DRMF(,)      TEMPORARY STORE OF DR RATES FOR NBREP
C                                         1ST INDEX - REPRESENTATIVE LEVEL
C                                         2ND INDEX - TEMPERATURE
C          (R*8)  DTMP()    = TEMPORARY STORE OF DIEL. COEFFICIENTS
C          (R*8)  DRROUT()  = SCALED DIELECTRONIC DATA FOR SPLINE IN N
C          (R*8)  DY()      = WORK VECTOR FOR SPLINE
C          (R*8)  SLOPE     = N POWER FOR SUPPL. AUGER RATE ABOVE NCUTS
C          (R*8)  SYSFAC(,) = SPIN SYSTEM RESOLUTION OF AUGER RATES
C                                1ST. INDEX = AUGER RATE INDEX ON LINE
C                                2ND. INDEX = SPIN SYSTEM
C          (R*8)  TEB()     = DR TEMPERATURES (K)
C          (R*8)  XIN()     = WORK VECTOR FOR SPLINES
C          (R*8)  XOUT()    = WORK VECTOR FOR SPLINE
C          (R*8)  XNBREP()  = DR REPRES. LEVEL N -VALUE AS A REAL
C                                1ST. INDEX = LEVEL INDEX
C          (R*8)  XNREPX()  = REPRES. LEVEL N-VALUE FROM MAIN CODE AS A
C                                REAL
C          (R*8)  YIN()     = WORK VECTOR FOR SPLINES
C          (R*8)  YOUT()    = WORK VECTOR FOR SPLINE
C
C
C          (R*8)  XNREP    = REAL VARIABLE FORM OF NREP
C
C          (R*8)  XICENH   = IC ENHANCEMENT FACTOR FOR SPECIFIC
C                            N-SHELL
C
C
C  ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C           B4FLNM      ADAS    EXPAND FILENAME SYMBOLIC PART IF PRESENT
C           B4SUMD      ADAS    SUMS DR COEFFICIENTS OVER ALL N-SHELLS
C           FINTB       HPS     CONVERTS X-VALUES FOR N SHELL SPINE
CX           FINTX       HPS     CONVERTS X-VALUES FOR TEMPERATURE SPLINE
C           XXSLEN      ADAS    FINDS LENGTH OF NON-BLANK PART OF STRINGS
C           XXSPLN      ADAS    GENERAL CUBIC SPLINE
C
C
C  AUTHOR:  HUGH P. SUMMERS, JET
C           K1/1/57
C           JET EXT. 4941
C
C  DATE:    12/05/92
C
C  UPDATE:  04/06/92,  WILLIAM J. DICKSON , JET
C           ADJUSTED FORMAT STATEMENTS FROM ORIGINAL SPEC.
C           TO READ DR FILES WITH CHARACTERS SHIFTED ONE
C           SPACE TO THE LEFT.
C           DEFINED OUTPUT STREAM BY PARAMETER IST1
C
C  UPDATE:  07/92,  WILLIAM J. DICKSON , JET
```

```
C           DEFINE VALUE OF LSETX AT BEGINNING OF CODE
C
C  UPDATE:  27/08/92,  WILLIAM J. DICKSON , JET
C           (1)  ALLOW FOR SPECIFIC DATA FOR LOWEST N-SHELLS WHEN
C           INPUTING SUPPLEMENTARY AUGER TRANSITION PROBABILITIES
C           (2)  DEFINE VARIABLE ISET TO MARK SUPPLEMENTARY DATA INPUT
C
C  UPDATE:  06/09/92,  WILLIAM J. DICKSON , JET
C           XREF FILES NOW STORED UNDER JETXLE
C
C  UPDATE:  14/12/92,  WILLIAM J. DICKSON , JET
C           SET UP ROUTINE TO SUM DR COEFFICIENTS OVER
C           REPRESENTATIVE SET
C  UPDATE:  13/11/93,  WILLIAM J. DICKSON , JET
C           (1)  ALLOW FOR IC ENHANCEMENT FACTOR TO BE READ IN AS PART
C                FILE AND SUBSEQUENT ADJUSTMENT OF DR RATE COEFFICIENT
C                  CHECK CODING AROUND FORMAT STATEMENT 1036.
C                  (NOTE THAT 1037 WAS ADDED AT THIS STAGE)
C
C  UPDATE:  29/05/96  HP SUMMERS - COMPLETED UNIX FILE NAME PROCUREMENT
C                                  WITH ENVIRONMENT VARIABLE SYMBOL
C                                  SUBSTITUTION USING B4FLNM
C  UPDATE:  22/01/97  HP SUMMERS - CHANGED NAME TO B4DATD FROM BDMNCL1
C                                  AND SUBROUTINE BDDRSM2 TO B4SUMD
C  UPDATE:  11/02/97  HP SUMMERS - IMPROVED INTERPOLATION OF SUPPLE.
C                                  AUGER DATA FROM X-REF FILE.
C  UPDATE:  17/02/97  HP SUMMERS - IMPROVED INTERPOLATION OF DR. DATA
C                                  WITH N, TO ENSURE ABSOLUTE ZEROS
C                                  ABOVE CUT-OFF N-SHELL
C-----------------------------------------------------------------------
C
C UNIX-IDL CONVERSION:
C
C VERSION: 1.1                                      DATE: 05-03-98
C MODIFIED: H. SUMMERS
C                    - MODIFIED VESION OF BDMNCL1.FOR v 1.1
C
C  UPDATE:  26/11/98  M O'Mullane
C                   - redefine DSNXRT as the full DR supplement file
C                     name. It is now given in the adf25 dataset and
C                     passed through to here.
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
       INTEGER     NDREP     , NDPRT     , NDSYS    , NDBFIL   ,
     &             NDT       , NDPAIR   , NDBREP    , NDAUG    ,
     &             IST1      , NPRINT
C-----------------------------------------------------------------------
       PARAMETER ( NDREP  = 50   , NDPRT = 12  , NDSYS  = 2 )
       PARAMETER ( NDBFIL = 6    , NDT   = 24  , NDPAIR = 9 )
       PARAMETER ( NDBREP = 50   , NDAUG = 550              )
       PARAMETER ( IST1   = 17   , NPRINT= 10               )
C-----------------------------------------------------------------------
       INTEGER     NPMNCL    , IMAXX     , MAXTM    , NDBFILM  ,
     &             NBFIL     , IOPT      , IPRT     , JPRT     ,
     &             ISYS      , IBREP     , IT       , IBFIL    ,
     &             IREP      , LEN1      , LEN2     , LEN5     ,
     &             LEN4      , LEN6      , I4UNIT   , I        ,
     &             NPRNT     , ISUPPLE   , NREP     , IREAD    ,
     &             IPI       , ISYSI     , IPF      , NCUTS    ,
     &             NPTOT     , IND       , IP       , IBPR     ,
     &             IPT       , IPAIRS    , NPAIRS   , ISPI     ,
     &             II        , ISPF      , IR       , IPARM1   ,
     &             IPARM2    , IPARM3    , IRFI     , NBT      ,
     &             IPARM4    , IPARM5    , IPARM6   , IPARM7   ,
     &             IRFF      , IPARM8    , IPARM9   , IC       ,
     &             IREPMAX   , IS        , IF       , ISREP    ,
     &             NTOP
C-----------------------------------------------------------------------
       REAL*8      AAS       , SLOPE     , XNCUTS   , XNREP    ,
     &             XICENH    , DELTAE
C-----------------------------------------------------------------------
       INTEGER     IMNPA(NDPRT)         , IBDPA(NDPRT,NDBFIL)
       INTEGER     IBPRIA(NDPRT,NDBFIL) , IBPRFA(NDPRT,NDBFIL)
       INTEGER     ISPFA(NDPAIR,NDBFIL) , ISPIA(NDPAIR,NDBFIL)
       INTEGER     IREFI(NDPAIR)        , IREFF(NDPAIR)
       INTEGER     MPA(NDPAIR)          , MP(NDPAIR)
       INTEGER     NBCUT(NDPAIR,NDBFIL) , IBMAX(NDBFIL)
       INTEGER     NCUTMC(NDPRT,NDPRT)  , NBREP(NDBREP,NDBFIL)
       INTEGER     NREPX(NDREP)         , NPRNTI(NDBFIL)
       INTEGER     NPRNTF(NDBFIL)       , NSREP(NDREP)
       INTEGER     ISET(NDPRT,NDSYS,NDPRT)
C-----------------------------------------------------------------------
       REAL*8      AA(NDPAIR)
       REAL*8      DRROUT(NDREP) , DDRROUT(NDREP)
       REAL*8      XNREPX(NDREP)
       REAL*8      XNBREP(NDBREP) , DRRIN(NDBREP)
       REAL*8      SYSFAC(NDPAIR,2)
       REAL*8      TEM(NDT)
       REAL*8      TEB(NDT) , XIN(NDT) , YIN(NDT) , DTMP(NDT)
       REAL*8      XOUT(NDT) , YOUT(NDT) , DY(NDT)
       REAL*8      AUGM(NDREP,NDPRT,NDSYS,NDPRT)
       REAL*8      DRM(NDREP,NDT,NDPRT,NDSYS,NDPRT)
       REAL*8      AUGTMP(NDAUG)
       REAL*8      DRMSF(NDBFILM,NDT,NDPRT,NDSYS,NDPRT)
       REAL*8      DRMS(NDT)
       REAL*8      DRMF(NDREP,NDT)
       REAL*8      EIJN(NDREP) ,  PWTEMP(NDT)
       REAL*8      PWSAT(NDBFILM,NDT,NDPRT,NDSYS,NDPRT)
```

```
C-----------------------------------------------------------------------
      CHARACTER   DSNBD(NDBFIL)*120
      CHARACTER   BPDSC(NDPRT)*30 , BPDS*30
      CHARACTER   DSNXR*120 , DSNMC*120 , DSNMCO*120   , DSHORT*120
      CHARACTER   DSN*120   , XRMEMB*8  , MEMBER*8
      CHARACTER   DSNXRT*120
      CHARACTER   STRING*80 , LSTRNG*133
      CHARACTER   CHARS1*1  , CHARS4*4
      CHARACTER   DSNIN*120 , ADAS_C*80 , ADAS_U*80
C-----------------------------------------------------------------------
      LOGICAL     OPEN12   , OPEN13  , OPEN14,   OPEN17
      LOGICAL     LEXIST   , LSETX
C-----------------------------------------------------------------------
      DATA  OPEN12/.FALSE./ , OPEN13/.FALSE./ , OPEN14/.FALSE./
      DATA  LEXIST/.FALSE./ , LSETX/.TRUE./
      DATA  IOPT/-1/
C-----------------------------------------------------------------------
      EXTERNAL FINTB
C-----------------------------------------------------------------------
```

B4FLNM

```
      SUBROUTINE B4FLNM ( adas_c, adas_u, dsnin, dsnful, lexist)
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B4FLNM *********************
C
C  PURPOSE: TO PREPARE A UNIX DATASET NAME FROM A STRING WHICH MAY
C           INCLUDE AN ADAS ENVIRONMENT VARIABLE AND COMMENTS.
C           THE ADAS ENVIRONMENT VARIABLE MUST BE FIRST AND IN DOUBLE
C           QUOTES.  THE COMMENTS MUST EITHER FOLLOW A COLON.
C
C  CALLING PROGRAM: GENERAL USE
C
C  SUBROUTINE:
C
C  INPUT : (C120) DSNIN    = INPUT STRING FOR INTERROGATION
C  INPUT : (C*80) ADAS_C   = CENTRAL ADAS LOCATION (FROM IDL)
C  INPUT : (C*80) ADAS_U   = USER ADAS LOCATION (FROM IDL)
C
C  OUTPUT: (C120) DSNFUL   = THE FULL EXPANDED FILE NAME WITHOUT
C                            EXTRANEOUS MATERIAL
C  OUTPUT: (L*4)  LEXIST   = .TRUE. => NAME FORMED AND FILE EXISTS
C                            .FALSE.=> FAILED TO FORM NAME OR FIND FILE
C
C          (C*120) DSN1     = WORK STRING
C          (C*120) DSNTEMP  = WORK STRING
C          (C*120) BLANK    = BLANK STRING
C          (I*4)   LEN1     = STRING INDEX
C          (I*4)   LEN2     = STRING INDEX
C          (I*4)   LEN3     = STRING INDEX
C          (I*4)   LEN4     = STRING INDEX
C
C ROUTINES:
C          ROUTINE    SOURCE   BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXSLEN     ADAS     FIND BEGINNING AND END OF A STRING
C          I4UNIT     ADAS     FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C
C AUTHOR:  H. P. SUMMERS, UNIVERSITY OF STRATHCLYDE
C          JA8.08
C          TEL. 0141-553-4196
C
C DATE  :  22/08/96
C
C MODIFIED: M.O'MULLANE
C           - Pass in ADAS environment variables
C
C-----------------------------------------------------------------------
      INTEGER I4UNIT
      INTEGER LEN1   , LEN2 , LEN3 , LEN4 , len5  , len6
      INTEGER P1     , P2   , p3   , p4
C-----------------------------------------------------------------------
      CHARACTER DSNIN*120  , DSNFUL*120 , DSN1*120,  DSNTEMP*120
      CHARACTER source*8   , BLANK*120
      CHARACTER ADAS_C*80  , ADAS_U*80
C-----------------------------------------------------------------------
      LOGICAL LEXIST
C-----------------------------------------------------------------------
```

B4MATV

```
      SUBROUTINE B4MATV(A,N,B,M,DETERM)
       IMPLICIT REAL*8 (A-H,O-Z)
C-----------------------------------------------------------------------
C
C  ************** FORTRAN77 SUBROUTINE: B4MATV ************************
C
```

```
C  VERSION:  1.0
C
C  PURPOSE:
C     MATRIX INVERSION WITH ACCOMPANYING SOLUTION OF LINEAR EQUATIONS
C
C  THIS SUBROUTINE IS NOT YET PROPERLY DOCUMENTED
C
C-----------------------------------------------------------------------
C
C UNIX-IDL CONVERSION:
C
C VERSION: 1.1                          DATE: 05-03-98
C MODIFIED: RICHARD MARTIN
C               - RENAMED FROM V2MATIV.FOR V1.1
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C
      PARAMETER(NREPDM =50)
      DIMENSION IPIVOT(NREPDM),  A(NREPDM,NREPDM), B(NREPDM)
      DIMENSION INDEX(NREPDM,2), PIVOT(NREPDM)
```

B4PROJ

```
SUBROUTINE B4PROJ ( W1     , JTE    , JDENS  ,
     &                    NMIN   , NMAX   , NREP   , IMAX   ,
     &                    NRESU  , ARED   , RHS    , CIONPT ,
     &                    TRECPT , DRECPT , RRECPT , XRECPT ,
     &                    NPRT   , NMAXI  , NREPI  ,
     &                    IMAXI  , AREDI  , RHSI   ,
     &                    CIONRI , CIONRA , RHSIRC ,
     &                    IEDMAT , IECION , IETREC ,
     &                    IEDREC , IERREC , IEXREC ,
     &                    IERSYS , SSYSWT , IPRTCAL,
     &                    DVEC   , ACNST  , A1CNST , OPEN20 ,
     &                    PRB
     &                  )
      IMPLICIT NONE

C-----------------------------------------------------------------------
C
C  ************** FORTRAN77 SUBROUTINE: B4PROJ  ************************
C
C  VERSION:  1.1
C
C  PURPOSE:
C
C  SUBROUTINE TO ESTABLISH THE PROJECTED INFLUENCE OF HIGH N-SHELLS IN
C  THE BUNDLE-N COLLISIONAL DIELECTRONIC MODEL ON A LOW N-SHELLS
C
C  BOTH THE RECOMBINATION AND IONISATION PATHWAYS THROUGH THE HIGH
C  LEVELS ARE TAKEN INTO ACCOUNT AS WELL AS THE INDIRECT COUPLINGS OF
C  LOW RESOLVED LEVELS VIA THE HIGH BUNDLE-N LEVELS.
C
C  THE SUBROUTINE IS USED AS AN ARBITRARY CALL FROM WITHIN THE
C  CONVENTIONAL BNDLEN ROUTINE FOLLOWING ESTABLISHMENT OF THE
C  CONDENSED COLLISIONAL-DIELECTRONIC MATRIX AND RIGHT-HAND SIDE
C
C  THE ROUTINE PROVIDES TABULAR OUTPUT AND FOR THE MOMENT PREPARES A
C  PASSING FILE FOR FURTHER PROCESSING IN THE A-D-A-S STRUCTURE
C
C
C  INPUT:
C      W1       = GROUND STATE RADIATION DILUTION FACTOR
C      JTE      = TEMPERATURE INDEX
C      JDENS    = DENSITY INDEX
C      NMIN     = LOWEST N-SHELL
C      NMAX     = HIGHEST N-SHELL
C      NREP(I)  = SET OF REPRESENTATIVE LEVELS
C      IMAX     = NUMBER OF REPRESENTATIVE LEVELS
C      NRESU    = UPPER LIMIT OF PROJECTED N-SHELLS
C
C      ARED(I,J)= CONDENSED COLLISONAL-DIELECTRONIC MATRIX (CN SOLUTION)
C                 (EXCLUDES AUTO-IONISATION RATES FOR LEVELS LE NRESU)
C      RHS(I)   = CONDENSED RIGHT-HAND-SIDE               (CN SOLUTION)
C                 (EXCLUDES AUTO-IONISATION RATES FOR LEVELS LE NRESU)
C      CIONPT(I)= COLLISIONAL IONISATION CONTRIBUTION TO ARED(I,I)
C      TRECPT(I)= THREE BODY   RECOMBINATION CONTRIBUTION TO RHS(I)
C      DRECPT(I)= DIELECTRONIC RECOMBINATION CONTRIBUTION TO RHS(I)
C      RRECPT(I)= RADIATIVE    RECOMBINATION CONTRIBUTION TO RHS(I)
C      XRECPT(I)= CHARGE EXCHANGE RECOMB.    CONTRIBUTION TO RHS(I)
C
C      NPRT     = NUMBER OF PARENT STATES
C      IMAXI
C      NMAXI
C      NREPI(I)   DATA FOR PROJECTION OF IONISATION VECTORS
C      AREDI(I,J)           SMALL (40X40) MATRIX , CN SOLUTION
C      RHSI(I)
C      RHSIRC(I)= RECOMBINATION CONTRIBUTION TO RHS
C      CIONRI   = DIRECT IONISATION DATA, PARENT RESOLVED
C      CIONRA   = AUTO-IONISATION DATA,   PARENT RESOLVED
C
C      SSYSWT   = SPIN SYSTEM WEIGHT
C      IPRTCAL  = INDEX OF PARENT FOR CALCULATION
```

```
C
C       DVEC(I)  = CONVERSION FACTOR FOR BN --> POPULATION
C       ACNST    = 1.03928D-13*Z*ATE*DSQRT(ATE)
C       A1CNST   = 6.60074D-24*DENS*(157890.0/TE)**1.5
C
C       PCION(I) = DIRECT IONISATION RATE FROM LOW LEVEL SET
C                         POPULATION REPRESENTATION
C       PRB      = RECOM/CASCADE/BREMS. POWER COEFFT.
C
C       OUTPUT - POPULATION REPRESENTATION (WRITTEN TO FILE CBNM.PASS)
C       ------------------------------------------------------------
C       PCRMAT(I,J) = PROJECTED INFLUENCE OF HIGH LEVELS ON LOW LEVEL SET
C       PCRL(I,J)   = DIRECT EXCIT/RADIATIVE COUPLING IN LOW LEVEL SET
C       PCIONRP(IPRT,I)  = PROJECTED IONISATION VECTOR (PARENT RESOLVED)
C       PCIONRI(IPRT,I)  = DIRECT IONISATION VECTOR FROM LOW LEVEL SET
C                                                  (PARENT RESOLVED)
C       PCQINRP(IPRT)    = INDIRECT PARENT CROSS COUPLING COEFFICIENT
C                                                  (PARENT RESOLVED)
C       PCRRHS(I)  = PROJECTED INFLUENCE OF HIGH LEVELS ON RHS
C       PTREC(I)   = DIRECT THREE BODY RECOMBINATION RATE
C       PDREC(I)   = DIRECT DIELECTRONIC RECOMBINATION RATE
C       PRREC(I)   = DIRECT RADIATIVE RECOMBINATION RATE
C       PXREC(I)   = DIRECT CX RECOMBINATION RATE
C       PRB        = RECOM/CASCADE/BREMS. POWER COEFFT.
C
C
C       OUPUT CONTROL CHARACTERS
C       ------------------------
C       IEDMAT   = 0 PCRL ADDED ONTO PCRMAT
C                  1 PCRL NOT ADDED ON
C       IECION   = 0 PCION  ADDED ONTO TO PCRMAT
C                    PCIONRI ADDED ONTO PCIONRP
C                  1 PCION NOT ADDED ON
C                    PCIONRI NOT ADDED ON
C       IETREC   = 0 PTREC ADDED ONTO PCRRHS
C                  1 PTREC NOT ADDED ON
C       IEDREC   = 0 PDREC ADDED ONTO PCRRHS
C                  1 PDREC NOT ADDED ON
C       IERREC   = 0 PRREC ADDED ONTO PCRRHS
C                  1 PRREC NOT ADDED ON
C       IEXREC   = 0 PXREC ADDED ONTO PCRRHS
C                  1 PXREC NOT ADDED ON
C       IERSYS   = 0 RECOMBINATION AND INDIRECT PARENT CROSS COUPLING
C                    RATES MULTIPLIED BY SPIN SYSTEM WEIGHT
C                  1 RECOMBINATION AND INDIRECT PARENT CROSS COUPLING
C                    RATES NOT MULTIPLIED BY SPIN SYSTEM WEIGHT
C
C
C  AUTHOR:  WILLIAM J. DICKSON, JET JOINT UNDERTAKING
C
C  DATE:  24TH AUGUST 1992
C
C  UPDATE:  30/01/97  HP SUMMERS - CHANGED NAME TO B4PROJ FROM V2CLDBN
C
C  UPDATE:  29/04/97  HP SUMMERS - ADJUSTMENTS DURING RE-VALIDATION
C
C  UPDATE:  09/07/97  HP SUMMERS - INTRODUCE IOUT18 AND IOUT19 FOR CBNM
C                                  AND CBNMPR PASSING FILES
C
C  UPDATE:  09/03/98  HP SUMMERS - RECOM/CASCADE/BREMS. POWER NOW
C                                  FETCHED AS INPUT PRB AND RELAYED TO
C                                  CBNM FILE.  CONVERTED TO EXPLICIT
C                                  TYPE DECLARATIONS.
C
C-----------------------------------------------------------------------
C
C  VERSION: 1.1                                            DATE: 05-03-98
C  MODIFIED: H.SUMMERS, L.HORTON, M.O'MULLANE
C               - BASED ON v2cldbc.for v1.2.
C  VERSION: 1.2                                            DATE: 09-03-98
C  MODIFIED: H.SUMMERS, L.HORTON, M.O'MULLANE
C               - RECOM/CASCADE/BREMS. POWER NOW FETCHED AS INPUT PRB AND
C                 RELAYED TO CBNM FILE.  CONVERTED TO EXPLICIT TYPE DECLARATIONS.
C  VERSION: 1.3                                            DATE: 08-12-98
C               HP SUMMERS & RICHARD MARTIN
C               - REMOVED TWO OBSOLETE WRITE STATEMENTS.
C
C-----------------------------------------------------------------------
      INTEGER   NDIM    , NLDIM    , NDMAX    , NDMET    ,
     &          IOUT20  , IOUT18   , IOUT19
C-----------------------------------------------------------------------
      PARAMETER ( NDIM   = 50 , NLDIM  = 30 , NDMAX = 550 , NDMET = 4 )
      PARAMETER ( IOUT20 = 20 , IOUT18 = 18 , IOUT19 = 19 )
C-----------------------------------------------------------------------
      INTEGER   JTE     , JDENS    , NMIN     , NMAX     , IMAX
      INTEGER   NRESU   , NPRT     , NMAXI    , IMAXI
      INTEGER   IEDMAT  , IECION   , IETREC   , IEDREC   , IERREC
      INTEGER   IERSYS  , IPRTCAL
      INTEGER   IHI      , ILOW     , ILOWK
      INTEGER   ILOWJ   , K        , IHJ      , IHMAX    , IH
      INTEGER   IPRT    , ILMAXI   , IHMAXI   , IREP     , IUI
      INTEGER   ILI     , ITOTI    , IMINI    , ILMAX    , NPARNT
      INTEGER   NLEV    , NSHEL    , IEXREC   , IPASS    , I
      INTEGER   IU      , IL       , ITOT     , IMIN     , J
      INTEGER   NRESL
C-----------------------------------------------------------------------
      REAL*8    W1      , SSYSWT   , ACNST    , ACNST1   , PRB
      REAL*8    DETERM  , A1CNST   , PHSFAC   , RPHSFC
```

```
C-----------------------------------------------------------------------
       LOGICAL   OPEN20
C-----------------------------------------------------------------------
       CHARACTER SEQ*2       , REFMEM*8
       CHARACTER LSTRING*133 , STRNG2*64
       CHARACTER STRNG3*11   , STRNG4*85 , STRNG5*68 , STRNG6*68
C------------------------------------------------- --------------------
       INTEGER   NREP(NDIM+1)    , NREPI(NDIM+1)    , IPOINTA(NDMAX)
C-----------------------------------------------------------------------
       REAL*8    ARED(NDIM,NDIM) , RHS(NDIM)        , DVEC(NDIM)
       REAL*8    AREDI(NDIM,NDIM), RHSI(NDIM)       , RHSIRC(NDIM)
       REAL*8    AEFF(NDIM,NDIM) , AREDEX(NDIM,NDIM), RHSEX(NDIM)
       REAL*8    FEX(NDIM,NDIM)  , REX(NDIM)
       REAL*8    CIONPT(NDIM)    , CIONRI(NDMET,NDIM)
       REAL*8    CIONRA(NDMET,NDIM) , CQINRP(NDMET)
       REAL*8    CIONRT(NDMET,NDIM) , CIONRP(NDMET,NDIM)
       REAL*8    TRECPT(NDIM)       , DRECPT(NDIM)
       REAL*8    RRECPT(NDIM)       , XRECPT(NDIM)
       REAL*8    AREDL(NDIM,NDIM), AREDH(NDIM,NDIM) , RHSL(NDIM)
       REAL*8    RHSH(NDIM)      , BREDL(NDIM,NDIM) , VEC(NDIM)
       REAL*8    AMAT(NDIM,NDIM) , RS(NDIM)         , CHMAT(NDIM,5)
       REAL*8    RH(NDIM)
       REAL*8    PCRMAT(NDIM,NDIM)  , PCRRHS(NDIM) , PCRL(NDIM,NDIM)
       REAL*8    PEXMAT(NLDIM,NLDIM), PEXRHS(NLDIM), PCIONRI(NDMET,NDIM)
       REAL*8    PCIONRA(NDMET,NDIM), PCQINRP(NDMET)
       REAL*8    PCION(NDIM)        , PCIONRP(NDMET,NDIM)
       REAL*8    PTREC(NDIM)        , PDREC(NDIM)  , PRREC(NDIM)
       REAL*8    PXREC(NDIM)
       REAL*8    TEST(NDIM,NDIM)    , ARED2(NDIM,NDIM), RHS2(NDIM)
C-----------------------------------------------------------------------
       CHARACTER SYMBA(30)*2
C-----------------------------------------------------------------------
       NAMELIST /SEQINF/ SEQ, REFMEM, NPARNT, NSHEL, NLEV

C-----------------------------------------------------------------------
       DATA LSTRING/'
     &
     &               '/
       DATA IPASS/0/
       DATA SYMBA/'H ','HE','LE','BE','B ','C ','N ','O ','F ','NE',
     &            'NA','MG','AL','SI','P ','S ','CL','AR','K ','CA',
     &            'SC','TI','V ','CR','MN','FE','CO','NI','CU','ZN'/
C-----------------------------------------------------------------------
```

B4SPF0

```
      SUBROUTINE B4SPF0( REP, DSNIN, PASSDIR, LBTSEL, ADAS_C, ADAS_U)
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B4SPF0 *********************
C
C  PURPOSE: TO DISPLAY AND FETCH VALUES FROM IDL OR THE INFO FILE SET
C           UP FOR BATCH EXECUTION FOR INPUT AND OUTPUT FILE NAMES
C
C  NOTE : REPLACES B4SPFX.FOR
C         Rationalised input. Cross reference file is now read in
C         from the driver adf25 file.
C
C  CALLING PROGRAM: ADAS204
C
C  SUBROUTINE:
C
C  OUTPUT: (C*120) DSNIN   = INPUT FILE NAME
C  OUTPUT: (C*80)  PASSDIR = DIRECTORY NAME FOR PASSING FILES
C  OUTPUT: (C*120) DSNXRT  = FIRST PART OF CROSS REFERENCE FILE NAME
C  OUTPUT: (C*3)   REP     = 'YES' => CANCEL SELECTED FROM INPUT SCREEN
C                            'NO'  => NOT SELECTED
C  OUTPUT: (L*4)   LBTSEL  = .TRUE. => 'RUN IN BATCH' SELECTED
C                            .FALSE. => 'RUN NOW' SELECTED
C  OUTPUT: (C*80)  ADAS_C  = CENTRAL ADAS LOCATION
C  OUTPUT: (C*80)  ADAS_U  = USER ADAS LOCATION
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C
C AUTHOR:  Martin O'Mullane
C
C DATE:    26-11-98
C
C VERSION: 1.1                          DATE: 26-11-98
C MODIFIED:  Martin O'Mullane
C     - FIRST VERSION.
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
      INTEGER     PIPEIN
      PARAMETER ( PIPEIN = 5  )

      CHARACTER   DSNIN*120 , PASSDIR*80, REP*3
      CHARACTER   ADAS_C*80 , ADAS_U*80

      LOGICAL     LBTSEL
```

```
      INTEGER     IPEND
C-----------------------------------------------------------------------
```

B4SPFX

```
      SUBROUTINE B4SPFX( REP, DSNIN, PASSDIR, DSNXRT,
     &                   LBTSEL, USERID)
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B4SPFX *********************
C
C  PURPOSE: TO DISPLAY AND FETCH VALUES FROM IDL OR THE INFO FILE SET
C           UP FOR BATCH EXECUTION FOR INPUT AND OUTPUT FILE NAMES
C
C  CALLING PROGRAM: MAINBN
C
C  SUBROUTINE:
C
C  OUTPUT: (C*120) DSNIN   = INPUT FILE NAME
CX  OUTPUT: (C*120) DSNPAP  = TEXT OUTPUT FILE NAME
C  OUTPUT: (C*80)  PASSDIR = DIRECTORY NAME FOR PASSING FILES
C  OUTPUT: (C*120) DSNXRT  = FIRST PART OF CROSS REFERENCE FILE NAME
CX  OUTPUT: (L*4)   LPAPER  = .TRUE. => TEXT OUTPUT SELECTED
CX                            .FALSE.=> NOT SELECTED
C  OUTPUT: (C*3)   REP     = 'YES' => CANCEL SELECTED FROM INPUT SCREEN
C                             'NO'  => NOT SELECTED
C  OUTPUT: (L*4)   LBTSEL  = .TRUE. => 'RUN IN BATCH' SELECTED
C                            .FALSE. => 'RUN NOW' SELECTED
C  OUTPUT: (C*80)  USERID  = SOURCE DATA USER ID (CENTRAL ADAS OR USER)
C                            FOR USE IN XXUID
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    09TH AUGUST 1996
C
C VERSION: 1.1                          DATE: 09-08-96
C MODIFIED: WILLIAM OSBORN
C     - FIRST VERSION.
C
C VERSION: 1.2                          DATE: 22-10-96
C MODIFIED: WILLIAM OSBORN
C     - ADDED USERID PARAMETER AND PIPE READ
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
      INTEGER     PIPEIN
      PARAMETER ( PIPEIN=5          )
C
      CHARACTER   DSNIN*120, PASSDIR*80, DSNXRT*120, REP*3, USERID*80
      LOGICAL     LBTSEL
      INTEGER     IPEND
C-----------------------------------------------------------------------
```

B4SPLN

```
      SUBROUTINE B4SPLN( ITA    , ITVAL   ,
     &                   BWNO   ,
     &                   TETA   , TEVA    ,
     &                   SZD    ,
     &                   SZDA   , ESZDA   ,
     &                   LTRNG
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B4SPLN *********************
C
C  PURPOSE:
C          PERFORMS CUBIC SPLINE ON LOG(TEMPERATURE <EV> ) VERSUS
C          LOG(SCALED IONIZATION RATE COEFFICIENTS).
C          INPUT DATA FOR A GIVEN IONZING ION COMBINATION DATA-BLOCK.
C
C          USING  ONE-WAY SPLINES  IT  CALCULATES  THE  IONIZATION  RATE
C          COEFFICIENT  FOR  'ITVAL'  ELECTRON  TEMPERATURE VALUES  FROM
C          THE LIST OF ELECTRON TEMPERATURES READ IN FROM THE INPUT FILE
C
C          IF A  VALUE  CANNOT  BE  INTERPOLATED  USING  SPLINES  IT  IS
C          EXTRAPOLATED VIA 'XXSPLE'. (SEE NOTES BELOW).
C
C  CALLING PROGRAM: ADAS204/B4SSZD
C
C
C  SUBROUTINE:
C
```

```
C  INPUT : (I*4)  ITA     = INPUT DATA FILE: NUMBER OF ELECTRON TEMPERA-
C                           TURES READ FOR THE DATA-BLOCK BEING ASSESSED
C  INPUT : (I*4)  ITVAL   = NUMBER OF ISPF ENTERED ELECTRON TEMPERATURE
C                           VALUES FOR  WHICH  IOINIZATION RATE COEFFTS
C                           ARE REQUIRED FOR TABULAR/GRAPHICAL OUTPUT.
C
C  INPUT : (R*8)  BWNO    = INPUT DATA FILE: IONIZATION POTENTIAL (cm-1)
C                           FOR THE DATA-BLOCK BEING ASSESSED.
C
C  INPUT : (R*8)  TETA()  = INPUT DATA FILE: ELECTRON TEMPERATURES (EV)
C                           FOR THE DATA-BLOCK BEING ASSESSED.
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
C  INPUT : (R*8)  TEVA()  = USER ENTERED: ELECTRON TEMPERATURES (EV)
C                           DIMENSION: TEMPERATURE/DENSITY PAIR INDEX
C
C  INPUT : (R*8)  SZD()    =INPUT DATA FILE: FULL SET OF ZERO DENSITY
C                           IONIZATION RATE COEFFTS FOR THE DATA-BLOCK
C                           BEING ANALYSED.
C                           1ST DIMENSION: ELECTRON TEMPERATURE INDEX
C  OUTPUT: (R*8)  SZDA()  = SPLINE INTERPOLATED OR  EXTRAPOLATED  ZERO
C                           DENSITY IONIZATION RATE COEFFICIENTS FOR
C                           THE USER ENTERED ELECTRON TEMPERATURES.
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
C  OUTPUT: (R*8)  ESZDA() = EXP((BWNO/109737.3)*(IH/KTE))*SZDA()
C
C  OUTPUT: (L*4)  LTRNG()=  .TRUE.  => OUTPUT 'SZDA()' VALUE WAS INTER-
C                                      POLATED  FOR  THE  USER  ENTERED
C                                      ELECTRON TEMPERATURE 'TEVA()'.
C                           .FALSE. => OUTPUT 'SZDA()' VALUE WAS EXTRA-
C                                      POLATED  FOR  THE  USER  ENTERED
C                                      ELECTRON TEMPERATURE 'TEVA()'.
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
C
C          (I*4)  NIN     = PARAMETER = MAX. NO. OF INPUT  TEMPERATURE
C                                       VALUES. MUST BE >= 'ITA'
C          (I*4)  NOUT    = PARAMETER = MAX. NO. OF OUTPUT TEMPERATURE
C                                       PAIRS.  MUST BE >= 'ITVAL'
C          (I*4)  L1      = PARAMETER = 1
C
C          (R*8)  BCONST  = PARAMETER = 1/(SCALED BOLTZMANN'S CONSTANT)
C
C          (I*4)  IET     = ARRAY SUBSCRIPT USED INPUT  FILE  ELECTRON
C                           TEMPERATURES.
C          (I*4)  IT      = ARRAY  SUBSCRIPT  USED  FOR  USER  ENTERED
C                           TEMPERATURE VALUES.
C          (I*4)  IOPT    = DEFINES THE BOUNDARY DERIVATIVES FOR THE
C                           SPLINE ROUTINE 'XXSPLE', SEE 'XXSPLE'.
C                           (VALID VALUES = <0, 0, 1, 2, 3, 4)
C
C          (L*4)  LSETX   = .TRUE.  => SET UP SPLINE PARAMETERS RELATING
C                                      TO 'XIN' AXIS.
C                           .FALSE. => DO NOT SET UP SPLINE PARAMETERS
C                                      RELATING TO 'XIN' AXIS.
C                                      (I.E. THEY WERE SET IN A PREVIOUS
C                                            CALL )
C                           (VALUE SET TO .FALSE. BY 'XXSPLE')
C
C          (R*8)  R8FUN1  = FUNCTION - (SEE ROUTINES SECTION BELOW)
C          (R*8)  SCONST  = SCALING CONSTANT USED TO SCALE THE IONIZA-
C                           TION RATE COEFFT. WHEN SPLINNING.
C                           = IONIZATION POTENTIAL / BOLTZMANN CONST.
C
C          (R*8)  XIN()   = LOG( DATA FILE ELECTRON TEMPERATURES )
C          (R*8)  YIN()   = LOG( DATA FILE SCALED ION. RATE COEFFTS.)
C          (R*8)  XOUT()  = LOG( USER ENTERED ELECTRON TEMPS.)
C          (R*8)  YOUT()  = LOG( OUTPUT GENERATED SCALED ION. RATE COEF)
C          (R*8)  DF()    = SPLINE INTERPOLATED DERIVATIVES
C
C
C NOTE:
C
C          ONE-DIMENSIONAL SPLINE CARRIED OUT BY THIS SUBROUTINE:
C
C           LOG( EXP(<ion.pt.>/<k>.<Te>) . Szd )  vs. LOG( Te )
C
C           ion.pt. = ionization potential (units: cm-1)
C           k       = Boltzmann's constant (= 1/1.23977E-04)
C           Te      = electron temperature (units: eV)
C           Szd     = zero density ionization rate coefficient
C                                       (units: cm**3/sec)
C
C           Extrapolation criteria:
C
C           Low  Te: zero gradient  extrapolation (i.e. DY(1)  = 0.0)
C           High Te: zero curvature extrapolation (i.e. DDY(N) = 0.0)
C
C           (These criteria are met by calling XXSPLE with IOPT=4)
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXSPLE     ADAS      SPLINE SUBROUTINE (EXTENDED DIAGNOSTICS)
C          R8FUN1     ADAS      REAL*8 FUNCTION: ( X -> X )
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 2620
```

```
C
C DATE:    07/06/91
C
C UPDATE:  17/02/97 HP SUMMERS - ADDED EXP(IP/KTE)*SZD AS AN OUTPUT
C                                PARAMETER.
C
C VERSION: 1.1                              DATE: 05-03-98
C MODIFIED: H.SUMMERS, L.HORTON, M.OMULLANE, R.MARTIN
C            - BASED ON E2SPLN.FOR v1.2. PUT UNDER SCCS CONTROL.
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NIN                   , NOUT            , L1
C-----------------------------------------------------------------------
      REAL*8     BCONST
C-----------------------------------------------------------------------
      PARAMETER( NIN    = 24           , NOUT = 35       , L1 = 1     )
C-----------------------------------------------------------------------
      PARAMETER( BCONST = 1.23977D-04  )
C-----------------------------------------------------------------------
      INTEGER    ITA                   , ITVAL
      INTEGER    IET                   , IT              , IOPT
C-----------------------------------------------------------------------
      REAL*8     R8FUN1                , BWNO            , SCONST
C-----------------------------------------------------------------------
      LOGICAL    LSETX
C-----------------------------------------------------------------------
      REAL*8     TETA(ITA)             , TEVA(ITVAL)     ,
     &           SZD(ITA)              , SZDA(ITVAL)     ,
     &           ESZDA(ITVAL)
      REAL*8     DF(NIN)               ,
     &           XIN(NIN)              , YIN(NIN)        ,
     &           XOUT(NOUT)            , YOUT(NOUT)
C-----------------------------------------------------------------------
      LOGICAL    LTRNG(ITVAL)
C-----------------------------------------------------------------------
      EXTERNAL   R8FUN1
C-----------------------------------------------------------------------
```

B4SSZD

```
      SUBROUTINE B4SSZD( dsname , IBSEL  , IZ0IN  ,
     &                   ITVAL  , TVAL   ,
     &                   BWNO   , IZ     , IZ1  ,
     &                   METI   , METF   ,
     &                   SZDA   , ESZDA  , LTRNG  ,
     &                   TITLX  , IRCODE , OPEN17
     &                )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B4SSZD *******************
C
C  PURPOSE: TO EXTRACT AND  INTERPOLATE  ZERO-DENSITY  IONIZATION  RATE-
C           COEFFICIENTS FOR GIVEN ELEMENT NUCLEAR CHARGE AND DATA-BLOCK
C           FOR AN INPUT SET OF ELECTRON TEMPERATURES (eV).
C
C
C  CALLING PROGRAM: GENERAL USE
C
C  SUBROUTINE:
C
C  INPUT : (C*80) DSNAME  = ADF07 DATAFILE NAME UNDER UNIX INCLUDING PATH
C  INPUT : (I*4)  IBSEL   = INDEX OF DATA-BLOCK SELECTED FOR ANALYSIS
C  INPUT : (I*4)  IZ0IN   = NUCLEAR CHARGE OF REQUIRED ELEMENT
C
C  INPUT : (I*4)  ITVAL   = NUMBER OF ELECTRON TEMPERATURE VALUES
C  INPUT : (R*8)  TVAL()  = ELECTRON TEMPERATUIRES (UNITS: EV)
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
C
C  OUTPUT: (R*8)  BWNO    = INPUT FILE - SELECTED DATA-BLOCK:
C                           EFFECTIVE IONIZATION POTENTIAL (cm-1).
C  OUTPUT: (I*4)  IZ      = INPUT FILE - SELECTED DATA BLOCK:
C                           IONIZING ION - INITIAL CHARGE
C  OUTPUT: (I*4)  IZ1     = INPUT FILE - SELECTED DATA BLOCK:
C                           IONIZING ION - FINAL   CHARGE
C
C  OUTPUT: (I*4)  METI    = INPUT FILE - SELECTED DATA-BLOCK:
C                           INITIAL STATE METSTABLE INDEX
C  OUTPUT: (I*4)  METF    = INPUT FILE - SELECTED DATA-BLOCK:
C                           FINAL   STATE METSTABLE INDEX
C
C  OUTPUT: (R*8)  SZDA()  = ZERO-DENSITY IONIZATION RATE-COEFFICIENTS
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
C  OUTPUT: (R*8)  ESZDA() = EXP((BWNO/109737.3)*(IH/KTE))*SZDA()
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
C  OUTPUT: (L*4)  LTRNG() =.TRUE.  => OUTPUT 'SZDA()'  VALUE WAS INTER-
C                                     POLATED  FOR  THE  USER  ENTERED
C                                     ELECTRON TEMPERATURE 'TVAL()'.
C                          .FALSE. => OUTPUT 'SZDA()'  VALUE WAS EXTRA-
C                                     POLATED  FOR  THE  USER  ENTERED
C                                     ELECTRON TEMPERATURE 'TVAL()'.
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
```

```
C
C  OUTPUT: (C*120)TITLX   = INFORMATION STRING (DSN ETC.)
C  OUTPUT: (I*4)  IRCODE  = RETURN CODE FROM SUBROUTINE:
C                           0 => NORMAL COMPLETION - NO ERROR DETECTED
C                           2 => DISCREPANCY BETWEEN REQUESTED CHARGES
C                                AND THOSE IN INPUT FILE.
C                           3 => THE SELECTED DATA-BLOCK 'IBSEL' IS OUT
C                                OF RANGE OR DOES NOT EXIST.
C                           4 => INVALID VALUE FOR 'IZ0IN' ENTERED.
C                                ('IZ0MIN' <= 'IZ0IN' <= 'IZ0MAX')
C                           9 => ERROR ENCOUNTERED WHEN TRYING TO OPEN
C                                INPUT DATA-SET.
C
C          (I*4)  NSTORE  = PARAMETER= MAXIMUM NUMBER  OF  DATA-BLOCKS
C                                      WHICH CAN BE READ FROM THE INPUT
C                                      DATA-SET.
C          (I*4)  NTDIM   = PARAMETER= MAXIMUM NUMBER OF ELECTRON TEMP-
C                                      ERATURES THAT CAN BE READ  FROM
C                                      AN INPUT DATA-SET DATA-BLOCK.
C          (I*4)  IZ0MIN  = PARAMETER: MIN. ALLOWED VALUE FOR 'IZ0IN'
C          (I*4)  IZ0MAX  = PARAMETER: MAX. ALLOWED VALUE FOR 'IZ0IN'
C
C          (I*4)  IZ0LST  = LAST VALUE OF 'IZ0IN' FOR  WHICH  INPUT
C                           DATA WAS READ.
C          (I*4)  IUNIT   = UNIT TO WHICH INPUT DATA SET IS ALLOCATED
C          (I*4)  NBSEL   = TOTAL NUMBER OF DATA-BLOCKS READ FROM INPUT
C                           DATA SET.
C          (I*4)  IZ0     = INPUT FILE - EMITTING ION - NUCLEAR CHARGE
C
C          (L*4)  LOPEN   = .TRUE.  => INPUT DATA SET OPEN.
C                           .FALSE. => INPUT DATA SET CLOSED.
C
C          (C*2)  ESYM    = INPUT FILE - IONIZING ION - ELEMENT SYMBOL
C          (C*3)  EXTIN   = CURRENT ADAS SOURCE DATA FILE EXTENSION
C          (C*3)  EXTLST  = ADAS SOURCE DATA FILE EXT. USED LAST TIME
C                           DATA WAS READ.
C
C          (I*4)  ISELA() = INPUT DATA FILE: DATA-BLOCK ENTRY INDICES.
C                           DIMENSION: DATA-BLOCK INDEX
C          (I*4)  ITA()   = INPUT DATA SET-NUMBER OF ELECTRON TEMPERA-
C                           TURES.
C                           DIMENSION: DATA-BLOCK INDEX
C          (I*4)  IZOUT() = INPUT DATA FILE: IONIZING ION INITIAL CHARGE
C                           DIMENSION: DATA-BLOCK INDEX
C          (I*4)  IZ1OUT()= INPUT DATA FILE: IONIZING ION FINAL   CHARGE
C                           DIMENSION: DATA-BLOCK INDEX
C
C          (R*8)  BWNOUT()= INPUT DATA FILE: EFFECTIVE IONIZATION POT.
C                           (UNITS: cm-1).
C                           DIMENSION: DATA-BLOCK INDEX
C          (R*8)  TETA(,) = INPUT DATA SET -
C                           ELECTRON TEMPERATURES (UNITS: eV)
C                           1st DIMENSION: ELECTRON TEMPERATURE INDEX
C                           2nd DIMENSION: DATA-BLOCK INDEX
C          (R*8)  SZD(,)    =INPUT DATA SET -
C                            FULL SET OF IONIZATIONS RATE-COEFFICIENTS
C                            1st DIMENSION: ELECTRON TEMPERATURE INDEX
C                            3rd DIMENSION: DATA-BLOCK INDEX
C
C          (C*2)  CICODE()= INPUT DATA FILE - INITIAL STATE META. INDEX
C                           DIMENSION: DATA-BLOCK INDEX
C          (C*2)  CFCODE()= INPUT DATA FILE - FINAL   STATE META. INDEX
C                           DIMENSION: DATA-BLOCK INDEX
C          (C*6)  CIION() = INPUT DATA FILE - INITIAL ION
C                           DIMENSION: DATA-BLOCK INDEX
C          (C*6)  CFION() = INPUT DATA FILE - FINAL   ION
C                           DIMENSION: DATA-BLOCK INDEX
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          E2DATA     ADAS      FETCH INPUT DATA FROM SELECTED DATA SET
C          B4SPLN     ADAS      INTERPOLATE DATA WITH ONE-WAY SPLINES
C          E2TITL     ADAS      CREATE DESCRIPTIVE TITLE FOR OUTPUT
C
C
C Original version
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 6023
C
C DATE:    07/06/91
C
C
C UPDATE:    17/02/97 - H P SUMMERS: RENAME SSZD AS B4SSZD. EXTRACT
C                                    Exp(I/KTE) * S AS WELL AS S
C
C UPDATE:    04-03-97 - R. MARTIN: ADDED OPEN17 FOR SWITCHING OUTPUT TO
C                                  'adas204.pass1' ON AND OFF.
C
C UPDATE:    03-12-98 - Martin O'Mullane: rewritten to account for
C                       adf07 filename being included in the adf25
C                       namelist. It is now much simplified.
C
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
```

```
C
C-----------------------------------------------------------------------
      INTEGER     NSTORE         , NTDIM
      INTEGER     IZ0MIN         , IZ0MAX
      INTEGER     IUNIT
C-----------------------------------------------------------------------
      PARAMETER(  NSTORE = 160   , NTDIM  = 35       )
      PARAMETER(  IZ0MIN =   1   , IZ0MAX = 60       )
      PARAMETER(  IUNIT  =  16   )
C-----------------------------------------------------------------------
      INTEGER     IBSEL          , IZ0IN            , ITVAL       ,
     &            IZ             , IZ1              ,
     &            METI           , METF             ,
     &            IRCODE
      INTEGER     IZ0LST         , NBSEL            ,
     &            IZ0            , i4unit
C-----------------------------------------------------------------------
      REAL*8      BWNO
C-----------------------------------------------------------------------
      LOGICAL     LOPEN, OPEN17
C-----------------------------------------------------------------------
      CHARACTER   ESYM*2         , EXTIN*3          , EXTLST*3     ,
     &            titlx*120      , dsname*120       , dsntmp*80
C-----------------------------------------------------------------------
      INTEGER     ISELA(NSTORE)             , ITA(NSTORE)          ,
     &            IZOUT(NSTORE)             , IZ1OUT(NSTORE)
C-----------------------------------------------------------------------
      REAL*8      TVAL(ITVAL)               , SZDA(ITVAL)          ,
     &            BWNOUT(NSTORE)            , ESZDA(ITVAL)
      REAL*8      TETA(NTDIM,NSTORE)        , SZD(NTDIM,NSTORE)
C-----------------------------------------------------------------------
      LOGICAL     LTRNG(ITVAL)
C-----------------------------------------------------------------------
      CHARACTER   CICODE(NSTORE)*2          , CFCODE(NSTORE)*2     ,
     &            CIION(NSTORE)*6           , CFION(NSTORE)*6
C-----------------------------------------------------------------------
```

B4SUMD

```
      SUBROUTINE B4SUMD ( NDREP  , NDT     ,
     &                    MAXTM  , IREPMAX , IREP   , DRMF   , DRMS   ,
     &                    EIJN   , PWTEMP
     &                  )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C ***************** FORTRAN 77 SUBROUTINE: B4SUMD  **********************
C
C  VERSION: 2.0
C
C  PURPOSE: TO SUM BADNELL DIELECTRONIC RATE COEFFICIENT DATA OVER THE
C           REPRESENTATIVE SET TO GIVE ZERO DENSITY TOTAL AND
C           RADIATED POWER FROM SATELLITE LINES
C
C  CALLING PROGRAM: B4DATD
C
C
C  INPUT:
C  INPUT :  (I*4) NDREP    = MAXIMUM NUMBER OF REPRESENTATIVE LEVELS
C  INPUT :  (I*4) NDT      = MAXIMUM NUMBER OF TEMPERATURES
C  INPUT :  (I*4) DRMF(,)  = BADNELL DIELECTRONIC DATA (CM3 S-1)
C                            1ST DIM.: REPRESENTATIVE LEVEL INDEX
C                            2ND DIM.: TEMPERATURE INDEX
C  INPUT :  (I*4) NBT      = NO. OF TEMPERATURES
C  INPUT :  (I*4) IREPMAX  = NO OF REPRESENTATIVE LEVELS
C  INPUT :  (I*4) IREP()   = SET OF REPRESENTATIVE LEVELS
C  INPUT :  (R*8) EIJN()   = SATELLITE. ENERGY AS A FUNCTION OF
C                            REPRESENTATIVE LEVEL (K)
C
C  OUTPUT:  (R*8) DRMS()   = SUMMED DR RATE COEFFICIENTS (CM3 S-1)
C                            1ST DIM.: TEMPERATURE INDEX
C  OUTPUT:  (R*8) PWTEMP() = SAT. RADIATED POWER (UNITS ERG S-1 CM3)
C                            1ST DIM.: TEMPERATURE INDEX
C
C           (I*4) NREP     = GENERAL LEVEL INDEX
C           (I*4) IN       = GENERAL INDEX
C           (I*4) IT       = GENERAL INDEX
C           (R*8) V        = GENERAL VARIABLE FOR N-SHELL
C           (R*8) V1       = GENERAL VARIABLE FOR N-SHELL
C           (R*8) Y        = GENERAL VARIABLE FOR N-SHELL
C           (R*8) YP       = GENERAL VARIABLE FOR N-SHELL
C           (R*8) Y0       = GENERAL VARIABLE FOR N-SHELL
C           (R*8) Y1       = GENERAL VARIABLE FOR N-SHELL
C           (R*8) PW       = GENERAL VARIABLE FOR N-SHELL
C           (R*8) PW1      = GENERAL VARIABLE FOR N-SHELL
C
C
C  AUTHOR:   WILLIAM J. DICKSON, JET JOINT UNDERTAKING
C
C  DATE:     14TH DECEMBER 1992
C
C  UPDATE: 15/12/92  WJ DICKSON - REVISED ALGORITHM HAS BETTER
C                                 AGREEMENT WITH INTERNAL SUM
C                                 CALCULATED BY MAINCL
```

```
C
C  UPDATE: 31/01/97  HP SUMMERS - CHANGED NAME TO B4SUMD
C
C  VERSION: 1.1                                          DATE: 05-03-98
C  MODIFIED: RICHARD MARTIN
C                - PUT UNDER SCCS CONTROL.
C
C-----------------------------------------------------------------------
       REAL*8      DMIN
C-----------------------------------------------------------------------
       PARAMETER ( DMIN = 1.00D-70 )
C-----------------------------------------------------------------------
       INTEGER     IN        , IT      , MAXTM   , IBREP     ,
     &             NDREP     , NDT     , IREPMAX , NREP      ,
     &             N0        , N1
C-----------------------------------------------------------------------
       REAL*8      V         , V1      , Y       , YP        ,
     &             Y0        , Y1      ,
     &             PW        , PW1     , YP0     , YP1
C-----------------------------------------------------------------------
       INTEGER     IREP(NDREP)
C-----------------------------------------------------------------------
       REAL*8      DRMS(NDT)          ,  DRMF(NDREP,NDT)    ,
     &             EIJN(NDREP)        ,  PWTEMP(NDT)
C-----------------------------------------------------------------------
```

B5OUT1

```
      SUBROUTINE B5OUT1( IUNIT ,
     &                   NDLEV , NDTEM  , NDDEN , NDMET ,
     &                   IL    , NMET   , NORD  ,
     &                   MAXT  , MAXD   , ZEFF  ,
     &                   ICNTP , ICNTR  , ICNTH ,
     &                   LPSEL , LZSEL  , LISEL , LHSEL , LRSEL ,
     &                   LMETR , IMETR  , IORDR ,
     &                   STRGA ,
     &                   LTRNG , TEA    , TEVA  , TPVA  , THVA  ,
     &                   DENSA , DENSPA , RATHA , RATIA ,
     &                   POPAR ,
     &                   STCKM , STVR   , STVH  ,
     &                   STVRM , STVHM  , STACK
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B5OUT1 ******************
C
C  PURPOSE: OUTPUT OF MAIN RESULTS (METASTABLE POPULATIONS)
C
C  CALLING PROGRAM: ADAS205
C
C  DATA:
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C           NEUTRAL BEAM ENERGY :
C           RATE COEFFICIENTS   : CM3 SEC-1
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT FOR RESULTS
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES ( 1 <= NMET <= 5 )
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> 20)
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> 20)
C  INPUT : (R*8)  ZEFF    = PLASMA Z EFFECTIVE ( IF 'LZSEL' = .TRUE.)
C
C  INPUT : (I*4)  ICNTP   = NUMBER OF PROTON IMPACT TRANSITIONS INPUT
C  INPUT : (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT : (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  INPUT : (L*4)  LPSEL   = .TRUE.  => INCLUDE PROTON COLLISIONS
C                           = .FALSE. =>DO NOT INCLUDE PROTON COLLISIONS
C  INPUT : (L*4)  LZSEL   = .TRUE.  => SCALE PROTON COLLISIONS WITH
C                                      PLASMA Z EFFECTIVE'ZEFF'.
C                           = .FALSE. => DO NOT SCALE PROTON COLLISIONS
C                                      WITH PLASMA Z EFFECTIVE 'ZEFF'.
C                          (ONLY USED IF 'LPSEL=.TRUE.')
C  INPUT : (L*4)  LISEL   = .TRUE.  => INCLUDE IONISATION RATES
C                           = .FALSE. => DO NOT INCLUDE IONISATION RATES
C  INPUT : (L*4)  LHSEL   = .TRUE.  => INCLUDE CHARGE TRANSFER FROM
```

```
C                                   NEUTRAL HYDROGREN.
C                           = .FALSE. => DO NOT INCLUDE CHARGE TRANSFER
C                                   FROM NEUTRAL HYDROGREN.
C  INPUT : (L*4)  LRSEL   = .TRUE.  => INCLUDE FREE ELECTRON
C                                   RECOMBINATION.
C                           = .FALSE. => DO NOT INCLUDE FREE ELECTRON
C                                   RECOMBINATION.
C
C  INPUT : (L*4)  LMETR() = .TRUE.  => ELECTRON IMPACT TRANSITION EXISTS
C                                   TO THE METASTABLE LEVEL  GIVEN BY
C                                   'IMETR()'.
C                             .FALSE. => ELECTRON  IMPACT  TRANSITIONS  DO
C                                   NOT EXIST TO THE METASTABLE LEVEL
C                                   GIVEN BY 'IMETR()'.
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                             (ARRAY SIZE = 'NDMET')
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                             LIST.
C
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C
C  INPUT : (L*4)  LTRNG(,)= .TRUE.  => TEMPERATURE VALUE WITHIN RANGE
C                                   READ FROM INPUT COPASE DATA SET.
C                           = .FALSE. =>TEMPERATURE VALUE NOT WITHIN RANGE
C                                   READ FROM INPUT COPASE DATA SET.
C                             1st DIMENSION: TEMPERATURE INDEX.
C                             2nd DIMENSION: TEMPERATURE TYPE -
C                                         1) => ELECTRON
C                                         2) => PROTON
C                                         3) => NEUTRAL HYDROGEN
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (R*8)  TEVA()  = ELECTRON TEMPERATURES (UNITS: EV)
C  INPUT : (R*8)  TPVA()  = PROTON TEMPERATURES   (UNITS: EV)
C  INPUT : (R*8)  THVA()  = NEUTRAL HYDROGEN TEMPERATURES   (UNITS: EV)
C
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C  INPUT : (R*8)  DENSPA()= PROTON DENSITIES    (UNITS: CM-3)
C  INPUT : (R*8)  RATHA() = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C  INPUT : (R*8)  RATIA() = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C
C  INPUT : (R*8)  POPAR(,,) =  LEVEL POPULATIONS
C                               1st DIMENSION: LEVEL INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C
C  INPUT : (R*8) STCKM(,,) = METASTABLE POPULATIONS STACK
C                               1st DIMENSION: METASTABLE INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVR(,,)  = FREE ELECTRON RECOMBINATION COEFFICIENTS
C                               1st DIMENSION: ORDINARY LEVEL INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVH(,,)  =  CHARGE EXCHANGE COEFFICIENTS
C                               1st DIMENSION: ORDINARY LEVEL INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C
C  INPUT : (R*8) STVRM(,,) = METASTABLE FREE ELECTRON RECOMBINATION
C                             COEFFICIENTS.
C                               1st DIMENSION: METASTABLE INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVHM(,,) = METASTABLE CHARGE EXCHANGE COEFFICIENTS
C                               1st DIMENSION: METASTABLE INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*4) STACK(,,,)= POPULATION DEPENDENCE
C                               1st DIMENSION: ORDINARY LEVEL INDEX
C                               2nd DIMENSION: METASTABLE INDEX
C                               3rd DIMENSION: TEMPERATURE INDEX
C                               4th DIMENSION: DENSITY INDEX
C
C          (I*4)  PGLEN   = PARAMETER = NUMBER OF LINES PER OUTPUT PAGE
C
C          (I*4)  NBLOCK  = NUMBER OF LINES IN CURRENT OUTPUT BLOCK.
C          (I*4)  NLINES  = LAST PAGE LINE WRITTEN.
C                           IF 'NLINES+NBLOCK' > 'PGLEN' START NEW PAGE.
C          (I*4)  MIND    = MINIMUM OF 10 AND 'MAXD'
C          (I*4)  I       = GENERAL USE
C          (I*4)  J       = GENERAL USE
C          (I*4)  IT      = TEMPERATURE INDEX NUMBER FOR ARRAY USE
C          (I*4)  IN      = DENSITY INDEX NUMBER FOR ARRAY USE
C          (I*4)  IUSEP   = NUMBER OF PROTON IMPACT TRANSITIONS USED
C          (I*4)  IUSER   = NUMBER OF FREE ELECTRON RECOMBINATIONS USED
C          (I*4)  IUSEH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS USED
C
C          (L*4)  LPRNG   = .TRUE.  => PROTON INPUT PARAMETERS USED
C                           .FALSE. => PROTON INPUT PARAMETERS NOT USED
C          (L*4)  LHRNG   = .TRUE.  => NEUTRAL H INPUT PARAMETERS USED
C                           .FALSE. => NEUTRAL H INPUT PARMS. NOT USED
C          (L*4)  LRRNG   = .TRUE.  => FREE ELEC. RECOMB. PARMS USED
C                           .FALSE. => FREE ELEC. RECOMB. PARMS NOT USED
C
C          (C*32) C32     = GENERAL USE 32 BYTE CHARACTER STRING
C
C          (C*1)  CTRNG(6)= ' ' => OUTPUT VALUES FOR THIS TEMPERATURE
C                                  INTERPOLATED.
```

```
C                           = '*' => OUTPUT VALUES FOR THIS TEMPERATURE
C                                    EXTRAPOLATED.
C                           = '#' => NOT USED
C                             1st DIMENSION: TEMPERATURE TYPE -
C                                            1) => ELECTRON
C                                            2) => PROTON
C                                            3) => NEUTRAL HYDROGEN
C                                            DENSITY TYPE -
C                                            4) => PROTON
C                                            RATIO TYPE -
C                                            5) => 'RATHA'
C                                            6) => 'RATIA'
C
C NOTE:
C           ONLY THE FIRST TEN DENSITIES ARE OUTPUT.
C
C           AN 'OUTPUT BLOCK' IS A SINGLE CONTAINED OUTPUT TABLE
C
C
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C           XXSTNP     ADAS      STARTS NEW PAGE IF CURRENT PAGE FULL
C
C
C AUTHOR:   PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C           K1/0/81
C           JET EXT. 4569
C
C DATE:     09/10/90
C
C UPDATE:   17/01/91 - PE BRIDEN: RENAMED SUBROUTINE (ORIGINALLY B5WR7B)
C                                 - STARTED OUTPUT ON NEW PAGE
C
C UPDATE:   24/01/91 - PE BRIDEN: REFORMATTED OUTPUT. REMOVED 'SCEF' AND
C                                  'NV' FROM ARGUMENT LIST ETC.
C
C UPDATE:   28/01/91 - PE BRIDEN: REMOVED 'IZ1' FROM ARGUMENT LIST.
C
C UPDATE:   25/03/91 - PE BRIDEN: REFORMATTED OUTPUT (STATEMENTS 1012/3)
C
C UPDATE:   20/05/93- P BRIDEN: STACK ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C UNIX PORT:
C UPDATE:   25/10/95 - TIM HAMMOND          VERSION: 1.2
C                    - ALTERED FORMAT STATEMENTS TO REMOVE ALL
C                      HOLLERITH (eg. '1H0') AS THESE ARE NONSTANDARD
C                      IN FORTRAN 77 AND APPEAR TO ONLY PRODUCE
C                      UNWANTED ZEROES AND ONES IN THE OUTPUT
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   PGLEN
C-----------------------------------------------------------------------
      PARAMETER ( PGLEN = 63 )
C-----------------------------------------------------------------------
      INTEGER   IUNIT     ,
     &          NDLEV     , NDTEM     , NDDEN     , NDMET
      INTEGER   IL        ,
     &          NMET      , NORD      ,
     &          MAXT      , MAXD      ,
     &          ICNTP     , ICNTR     , ICNTH
      INTEGER   NBLOCK    , NLINES    , MIND      ,
     &          I         , J         , IN        , IT     ,
     &          IUSEP     , IUSER     , IUSEH
C-----------------------------------------------------------------------
      REAL*8    ZEFF
C-----------------------------------------------------------------------
      LOGICAL   LPSEL     , LZSEL     , LISEL     , LHSEL   , LRSEL
      LOGICAL   LPRNG     , LHRNG     , LRRNG
C-----------------------------------------------------------------------
      CHARACTER C32*32
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)    , IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8    TEVA(NDTEM)     , TPVA(NDTEM)      ,
     &          THVA(NDTEM)     , TEA(NDTEM)       ,
     &          DENSA(NDDEN)    , DENSPA(NDDEN)    ,
     &          RATHA(NDDEN)    , RATIA(NDDEN)
      REAL*8    POPAR(NDLEV,NDTEM,NDDEN)
      REAL*8    STVR(NDLEV,NDTEM,NDDEN)       , STVH(NDLEV,NDTEM,NDDEN)
      REAL*8    STCKM(NDMET,NDTEM,NDDEN)      ,
     &          STVRM(NDMET,NDTEM,NDDEN)      , STVHM(NDMET,NDTEM,NDDEN)
      REAL*4    STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      LOGICAL   LMETR(NDMET)    , LTRNG(NDTEM,3)
C-----------------------------------------------------------------------
      CHARACTER CTRNG(6)*1      , STRGA(NDLEV)*22
C-----------------------------------------------------------------------
```

```
      SUBROUTINE B5SPF0( REP    ,
     &                   DSNINP , DSNINC ,
     &                   LDSEL
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B5SPF0 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS205
C
C  SUBROUTINE:
C
C  OUTPUT: (C*3)   REP     = 'YES' => TERMINATE PROGRAM EXECUTION.
C                            = 'NO ' => CONTINUE PROGRAM EXECUTION.
C
C  OUTPUT: (C*80)  DSNINP  = INPUT PROTON DATA SET NAME (SEQUENTIAL)
C                            (IN FORM SUITABLE FOR DYNAMIC ALLOCATION)
C  OUTPUT: (C*80)  DSNINC  = INPUT COPASE DATA SET NAME (FULL MVS DSN)
C                            (IN FORM SUITABLE FOR DYNAMIC ALLOCATION)
C
C  OUTPUT: (L*4)   LDSEL   = .TRUE.  => COPASE DATA SET INFORMATION
C                                       TO BE DISPLAYED BEFORE RUN.
C                            = .FALSE. => COPASE DATA SET INFORMATION
C                                       NOT TO BE DISPLAYED BEFORE RUN.
C
C          (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C
C AUTHOR:  ANDREW BOWEN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    01/04/93
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      CHARACTER    REP*3        , DSNINP*80      , DSNINC*80
C-----------------------------------------------------------------------
      LOGICAL      LDSEL
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU
      PARAMETER( PIPEIN=5  , PIPEOU=6)
C-----------------------------------------------------------------------
```

B5SPF1

```
      SUBROUTINE B5SPF1( NDTEM  , TINE   , MAXT   , IFOUT  ,
     &                   LPEND  ,
     &                   LNEWPA , LPAPER , LCONT  , LPASS  ,
     &                   DSNPAP , DSNOUT , DSNPAS ,
     &                   LGPH   , ITSEL  , GTIT1
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B5SPF1 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS205
C
C  SUBROUTINE:
C
C  INPUT:  (I*4)   NDTEM    = PARAMETER = MAX. NO. OF TEMPERATURES
C                                         ALLOWED
CX INPUT:  (R*8)   TINE()   = ELECTRON TEMPERATURES (UNITS: SEE 'IFOUT')
CX INPUT:  (I*4)   MAXT     = NUMBER OF INPUT TEMPERATURES
CX                            ( 1 -> 'NDTEM')
CX INPUT:  (I*4)   IFOUT    = 1 => INPUT TEMPERATURES IN KELVIN
CX                          = 2 => INPUT TEMPERATURES IN EV
CX                          = 3 => INPUT TEMPERATURES IN REDUCED FORM
C  OUTPUT: (L*4)   LPEND    = .TRUE.  => OUTPUT OPTIONS CANCELLED.
C                             .FALSE. => PROCESS OUTPUT OPTIONS.
C
CX OUTPUT: (L*4)   LNEWPA   = .TRUE.  => NEW TEXT OUTPUT FILE OR
CX                                       REPLACEMENT OF EXISTING FILE
CX                                       REQUIRED.
CX                            .FALSE. => ALLOW APPEND ON EXISTING OPEN
CX                                       TEXT FILE.
C
CX OUTPUT: (L*4)   LPAPER   = .TRUE.  => OUTPUT DATA TO TEXT OUTPUT
CX                                       FILE.
CX                            .FALSE. => NO OUTPUT OF CURRENT DATA TO
CX                                       TEXT OUTPUT FILE.
C  OUTPUT: (L*4)   LCONT    = .TRUE.  => OUTPUT DATA TO CONTOUR PASSING
```

```
C                                       FILE.
C                                .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                           CONTOUR PASSING FILE.
C  OUTPUT: (L*4)   LPASS    = .TRUE.  => OUTPUT DATA TO METPOP PASSING
C                                           FILE.
C                                .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                           METPOP PASSING FILE.
C
C  OUTPUT: (C*80)  DSNPAP   = OUTPUT TEXT FILE NAME
C  OUTPUT: (C*80)  DSNOUT   = OUTPUT CONTOUR DATA SET NAME (SEQUENTIAL)
C  OUTPUT: (C*80)  DSNPAS   = OUTPUT PASSING FILE NAME (SEQUENTIAL)
CX OUTPUT: (L*4)   LGPH     = .TRUE.  => SELECT GRAPHICAL OUTPUT
CX                          = .FALSE. => DO NOT SELECT GRAPHICAL OUTPUT
CX OUTPUT: (I*4)   ITSEL    = INDEX OF TEMPERATURE SELECTED FOR GRAPH
CX                          (FROM INPUT LIST).
CX OUTPUT: (C*40)  GTIT1    = ENTERED TITLE FOR GRAPH
C
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C
C AUTHOR:  ANDREW BOWEN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    26/04/93
C
C MODIFIED:
C          05/04/95 TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C                   ADDED CALL TO XXFLSH ROUTINE TO FLUSH OUT THE PIPE AFTER
C                   IT HAS BEEN WRITTEN TO.
C
C-----------------------------------------------------------------------
      INTEGER    NDTEM     , MAXT      , IFOUT     ,
     &           ITSEL     , LOGIC     , I
C-----------------------------------------------------------------------
      REAL*8       TINE(NDTEM)
C-----------------------------------------------------------------------
      CHARACTER    DSNPAP*80   , DSNOUT*80   , DSNPAS*80   , GTIT1*40
C-----------------------------------------------------------------------
      LOGICAL      LPEND       , LPAPER      , LCONT       , LNEWPA  ,
     &             LPASS       , LGPH
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU     , ONE
      PARAMETER( PIPEIN=5  , PIPEOU=6   , ONE=1 )
C-----------------------------------------------------------------------
```

B5WR12

```
      SUBROUTINE B5WR12( IUNIT  , DATE   , IZ1   , IL    ,
     &                   NDMET  , NDTEM  , NDDEN ,
     &                   NMET   , IMETR  ,
     &                   IFOUT  , MAXT   , TINE  ,
     &                   IDOUT  , MAXD   , DINE  ,
     &                   CSTRGA , STCKM
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B5WR12 *********************
C
C  PURPOSE: TO OUTPUT METASTABLE POPULATION PARAMETERS TO THE PASSING
C           FILE ON STREAM 'IUNIT'.
C
C  CALLING PROGRAM: ADAS205
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  IUNIT   = OUTPUT STREAM NUMBER
C  INPUT :  (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C  INPUT :  (I*4)  IZ1     = RECOMBINING ION CHARGE
C                            (NOTE: IZ1 SHOULD EQUAL Z+1)
C  INPUT :  (I*4)  IL      = NUMBER OF INDEX ENERGY LEVELS
C
C  INPUT :  (I*4)  NDMET   = MAX. NO. OF METASTABLES ALLOWED
C  INPUT :  (I*4)  NDTEM   = MAX. NO. OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDDEN   = MAX. NUMBER OF DENSITIES ALLOWED
C
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLES ( 1 -> 5 )
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLES IN COMPLETE LEVEL LIST
C
C  INPUT :  (I*4)  IFOUT   = 1 => INPUT TEMPERATURES IN KELVIN
C                            2 => INPUT TEMPERATURES IN EV
C                            3 => INPUT TEMPERATURES IN REDUCED FORM
C  INPUT :  (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES (1 -> 20)
C  INPUT :  (R*8)  TINE()  = ELECTRON TEMPERATURES (UNITS: SEE 'IFOUT')
C
C  INPUT :  (I*4)  IDOUT   = 1 => INPUT DENSITIES IN CM-3
C                            2 => INPUT DENSITIES IN REDUCED FORM
C  INPUT :  (I*4)  MAXD    = NUMBER OF INPUT DENSITIES (1 -> 20)
C  INPUT :  (R*8)  DINE()  = ELECTRON DENSITIES (UNITS: SEE 'IFOUT')
C
C  INPUT :  (C*18) CSTRGA()= INDEX LEVEL CONFIGURATIONS
```

```
C  INPUT :  (R*8)  STCKM(,,)=METASTABLE STATE POPULATIONS:
C                             1ST DIMENSION = METASTABLE STATE INDEX
C                             2ND DIMENSION = TEMPERATURE INDEX
C                             3RD DIMENSION = DENSITY INDEX
C
C           (I*4)  L1      = PARAMETER = 1
C           (I*4)  L2      = PARAMETER = 2
C           (I*4)  L3      = PARAMETER = 3
C
C           (I*4)  I       = GENERAL USE
C           (I*4)  IM      = ARRAY INDEX POINTER FOR METASTABLE STATES
C           (I*4)  IT      = ARRAY INDEX POINTER FOR TEMPERATURES
C           (I*4)  ID      = ARRAY INDEX POINTER FOR DENSITIES
C
C           (R*8)  RDEN()  = ELECTRON DENSITIES (UNITS: REDUCED FORM)
C           (R*8)  RTEM()  = ELECTRON TEMPERATURES (UNITS: REDUCED FORM)
C
C           (C*1)  CSTAR   = '*'
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C           XXTCON     ADAS      CONVERTS ENTERED TEMP. VALUES TO EV.
C           XXDCON     ADAS      CONVERTS ENTERED DENSITY VALUES TO CM-3.
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  20/05/93 - ADAS91 PEB: TO REFLECT CHANGES IN BXDATA THE
C                                 CHARACTER ARRAY CSTRGA IS NOW 18 BYTES
C                                 INSTEAD OF 12.
C                                 NOTE: ONLY THE FIRST 12 BYTES ARE
C                                       OUTPUT TO THE PASSING FILE.
C
C-----------------------------------------------------------------------
      INTEGER   L1           , L2           , L3
C-----------------------------------------------------------------------
      PARAMETER ( L1=1 , L2=2 , L3=3 )
C-----------------------------------------------------------------------
      INTEGER   IUNIT        , IZ1          , IL         ,
     &          NDMET        , NDTEM        , NDDEN      ,
     &          NMET         ,
     &          IFOUT        , MAXT         ,
     &          IDOUT        , MAXD
      INTEGER   I            , IM           , IT         , ID
C-----------------------------------------------------------------------
      CHARACTER CSTAR*1      , DATE*8
C-----------------------------------------------------------------------
      INTEGER   IMETR(NMET)
C-----------------------------------------------------------------------
      REAL*8    RTEM(20)     , RDEN(20)
      REAL*8    TINE(MAXT)   , DINE(MAXD)    , STCKM(NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      CHARACTER CSTRGA(IL)*18
C-----------------------------------------------------------------------
      DATA      CSTAR/'*'/
C
C-----------------------------------------------------------------------
```

B6ISPC

```
      SUBROUTINE B6ISPC( NORD  , IORDR , ISULEV ,
     &                   IORDS
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B6ISPC *********************
C
C  PURPOSE: TO IDENTIFY IN THE ORDINARY LEVEL INDEX THE INDEX  FOR  THE
C           UPPER LEVEL OF THE SPECIFIC LINE POWER TRANSITION REQUESTED.
C
C  CALLING PROGRAM:  ADAS206
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS.
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                           LEVEL LIST.
C  INPUT : (I*4)  ISULEV  = UPPER ENERGY LEVEL OF SPECIFIC LINE POWER
C                           TRNSITION.
C  OUTPUT: (I*4)  IORDS   = INDEX OF SPECIFIC LINE POWER TRANSITION
C                           UPPER LEVEL IN ORDINARY LEVEL INDEX.
C
C           (I*4)  I4UNIT  = FUNCTION (SEE ROUTINE SECTION BELOW)
C           (I*4)  IO      = ORDINARY EXCITED LEVEL NUMBER COUNTER
C
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
```

```
C          XXTERM     ADAS      TERMINATES PROGRAM WITH MESSAGE
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    06/06/96
C
C VERSION: 1.1                                  DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
C           - FIRST VERSION
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER  I4UNIT
      INTEGER  NORD         , ISULEV         , IORDS
      INTEGER  IO
C-----------------------------------------------------------------------
      INTEGER  IORDR(NORD)
C-----------------------------------------------------------------------
```

B6LOSS

```
      SUBROUTINE B6LOSS( NDTRN  , NDLEV  ,
     &                   ICNTE  , ISTRN  ,
     &                   XJA    , ER     , AVAL  ,
     &                   IE1A   , IE2A   ,
     &                   SLOSS  , TLOSS
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6LOSS *********************
C
C  PURPOSE: TO CALCULATE THE DIRECT LINE POWER LOSS FOR EACH LEVEL AND
C           FOR THE SPECIFIC LINE POWER TRANSITION GIVEN BY 'ISTRN'.
C
C  CALLING PROGRAM:  ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTRN   = MAXIMUM NUMBER OF TRANSITIONS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C
C  INPUT :  (I*4)  ICNTE   = NUMBER OF ELERCTRON IMPACT TRANSITIONS
C  INPUT :  (I*4)  ISTRN   = SPECIFIC LINE POWER: SELECTED ELECTRON
C                            IMPACT TRANSITION INDEX. (FOR USE WITH
C                            'IE1A()' , 'IE2A()' AND 'AA()' ARRAYS)
C
C
C  INPUT :  (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR GIVEN LEVEL.
C                            NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT :  (R*8)  ER()    = ENERGY RELATIVE TO LEVEL 1 (RYDBERGS)
C                            DIMENSION: ENERGY LEVEL.
C  INPUT :  (R*8)  AVAL()  = ELECTRON IMPACT TRANSITION: A-VALUE (SEC-1)
C                            DIMENSION: ENERGY LEVEL.
C
C  INPUT :  (I*4)  IE1A()  = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  INPUT :  (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C
C  OUTPUT:  (R*8)  SLOSS    = DIRECT LINE POWER LOSS FOR SPECIFIC LINE
C                             POWER TRANSITION GIVEN BY 'ISTRN'.
C                             (UNITS: ERGS SEC-1)
C  OUTPUT:  (R*8)  TLOSS()  = DIRECT LINE POWER LOSS FOR EACH LEVEL.
C                             (UNITS: ERGS SEC-1)
C                             DIMENSION: LEVEL INDEX
C
C           (R*8)  R2LOSS  = PARAMETER = EQUATION CONSTANT = 2.17958D-11
C                            (CONVERTS RYDBERGS/SEC TO ERGS/SEC)
C
C           (I*4)  LLOWER  = SELECTED ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C           (I*4)  LUPPER  = SELECTED ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C           (I*4)  IC      = TRANSITION ARRAY INDEX
C
C
C ROUTINES:  NONE
```

```
C
C NOTES:
C            EQUATIONS USED -
C
C            FOR EACH TRANSITION - DIRECT LINE POWER LOSS IS GIVEN BY:
C
C            LOSS  = 'R2LOSS' x AVALUE x (ENERGY DIFFERENCE)
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    09/10/90
C
C UPDATE:  29/07/92 - CORRECT ERROR - ZERO TLOSS OVER NDLEV INSTEAD OF
C                                     ICNTE.
C
C UNIX-IDL PORT:
C
C DATE: UNKNOWN
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C DATE:    10-05-96
C
C VERSION: 1.1
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      REAL*8     R2LOSS
C-----------------------------------------------------------------------
      PARAMETER( R2LOSS = 2.17958D-11 )
C-----------------------------------------------------------------------
      INTEGER    NDTRN               , NDLEV        ,
     &           ICNTE               , ISTRN
      INTEGER    LLOWER              , LUPPER       ,
     &           IC
C-----------------------------------------------------------------------
      REAL*8     SLOSS
C-----------------------------------------------------------------------
      INTEGER    IE1A(NDTRN)         , IE2A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8     XJA(NDLEV)          , ER(NDLEV)    ,
     &           AVAL(NDTRN)         , TLOSS(NDLEV)
C-----------------------------------------------------------------------
```

B6LPWR

```
      SUBROUTINE B6LPWR( NDTEM  ,
     &                   IT     , ICNTE  , IL     , NMET  ,
     &                   IZ1    , IPROJ  ,
     &                            IE1A   , IE2A   , IMETR ,
     &                   TEMP   ,
     &                   ER     , XIA    , EXCRE  ,
     &                   TPL0   , TPLBA
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B6LPWR *********************
C
C  PURPOSE: TO CALCULATE ZERO DENSITY AND HIGH N PROJECTION LINE POWERS,
C           FOR A GIVEN TEMPERATURE.
C
C  CALLING PROGRAM:  ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C
C  INPUT :  (I*4)  IT      = INDEX OF TEMPERATURE VALUE BEING ASSESSED
C  INPUT :  (I*4)  ICNTE   = NUMBER OF SELECTED ELECTRON IMPACT TRANSTNS
C  INPUT :  (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (I*4)  IZ1     = RECOMBINING ION CHARGE
C  INPUT :  (I*4)  IPROJ   = SPECIFIES INDEX OF LOWEST  LEVEL FOR WHICH
C                            EXTRAPOLATION TO HIGHER N  OF THE RADIATED
C                            POWER IS TO BE PERFORMED. ALL LEVELS ABOVE
C                            AND INCLUDING 'IPROJ' ARE TREATED.
C                           IF 'IPROJ' > 'IL' => EXTRAP'TN SWITCHED OFF
C
C  INPUT :  (I*4)  IE1A()  = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX.
C                            DIMENSION: TRANSITION INDEX
C  INPUT :  (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX.
```

```
C                              DIMENSION: TRANSITION INDEX
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                              (ARRAY SIZE = 'NDMET' )
C
C  INPUT :  (R*8)  TEMP    = TEMPERATURE (KELVIN)
C
C  INPUT :  (R*8)  ER()    = ENERGY RELATIVE TO LEVEL 1 (RYDBERGS)
C                              DIMENSION: LEVEL INDEX
C  INPUT :  (R*8)  XIA()   = ENERGY RELATIVE TO ION. POT. (RYDBERGS)
C                              DIMENSION: LEVEL INDEX
C  INPUT :  (R*8)  EXCRE(,)= EXCITATION RATE COEFFS (cm**3/s)
C                              1st DIMENSION: TEMPERATURE INDEX
C                              2nd DIMENSION: TRANSITION INDEX
C
C  OUTPUT:  (R*8)  TPL0   = ZERO DENSITY LINE POWER ARISING FROM EXCI-
C                           TATION ONLY FROM THE GROUND LEVEL  FOR  A
C                           GIVEN TEMPERATURE 'TEMP'.
C                           (UNITS: ERGS CM3 SEC-1).
C  OUTPUT:  (R*8)  TPLBA()= HIGH N PROJECTED POWER BASED ON EXCITATIONS
C                           FROM A PARTICULAR METASTABLE TO LEVELS
C                           'IPROJ' UPWARDS FOR A GIVEN TEMPERATURE
C                           'TEMP'.
C                           (UNITS: ERGS CM3 SEC-1)
C                             DIMENSION: METASTABLE  INDEX
C
C           (R*8)  TK2ATE  = PARAMETER = EQUATION CONSTANT = 1.5789D+05
C           (R*8)  R2LOSS  = PARAMETER = EQUATION CONSTANT = 2.17958D-11
C                            (CONVERTS RYDBERGS/SEC TO ERGS/SEC)
C
C           (I*4)  LLOWER  = SELECTED ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C           (I*4)  LUPPER  = SELECTED ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C           (I*4)  IM      = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IC      = TRANSITION ARRAY INDEX
C
C           (R*8)  ATE     = EQUATION PARAMETER = 'TK2ATE'/'TEMP'
C           (R*8)  Z1      = 'IZ1'
C           (R*8)  Z2ATE   = 'Z1' * 'Z1' * 'ATE'
C           (R*8)  Z2ATE2  = 1.0 / ('Z1' * 'Z1' * 'ATE')
C           (R*8)  Z2ATEX  = SQRT( 1 / ('Z1' * 'Z1' * 'ATE' * 'ATE' ) )
C           (R*8)  V       = 'Z1' / SQRT('XIA()')
C           (R*8)  VP      = 'V'/(1+'V')
C           (R*8)  ATEL    = 'ATE' * 'XIA(LLOWER)'
C           (R*8)  ATEU    = 'ATE' * 'XIA(LUPPER)'
C           (R*8)  ATEUP   = 'ATEU' * 'VP' * 'VP'
C           (R*8)  PLB1    = USED IN CALCULATING 'PLB'
C           (R*8)  PLB2    = USED IN CALCULATING 'PLB'
C           (R*8)  PLB3    = USED IN CALCULATING 'PLB'
C           (R*8)  PLB     = HIGH N PROJECTED POWER BASED ON EXCITATIONS
C                            FROM A PARTICULAR METASTABLE LEVEL 'LLOWER'
C                            TO  THE  LEVEL  'LUPPER'  FOR  TEMPERATURE
C                            'TEMP'.
C                            (UNITS: ERGS CM3 SEC-1)
C
C ROUTINES: NONE
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  24/01/91 - PE BRIDEN: SERIOUS ERROR-'TPLBA()' WAS INCORRECTLY
C                                DECLARED AS INTEGER - IT MUST BE REAL*8
C                                - THEREFORE 'TPLBA()' NOW REAL*8 -
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    06/06/96
C
C VERSION: 1.1                                  DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
C            - FIRST VERSION
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      REAL*8     TK2ATE              , R2LOSS
C-----------------------------------------------------------------------
      PARAMETER( TK2ATE = 1.5789D+05 , R2LOSS = 2.17958D-11 )
C-----------------------------------------------------------------------
      INTEGER    NDTEM               ,
     &           IT                  , ICNTE               ,
     &           IL                  , NMET                ,
     &           IZ1                 , IPROJ
      INTEGER    LLOWER              , LUPPER              ,
     &           IM                  , IC
C-----------------------------------------------------------------------
      REAL*8     TEMP                , TPL0
      REAL*8     ATE                 , Z1                  ,
     &           Z2ATE               , Z2ATE2              ,
     &           Z2ATEX              , V                   ,
     &           VP                  , ATEL                ,
     &           ATEU                , ATEUP               ,
```

```
     &           PLB1                , PLB2                ,
     &           PLB3                , PLB
C-----------------------------------------------------------------------
      INTEGER    IE1A(ICNTE)         , IE2A(ICNTE)         ,
     &           IMETR(NMET)
C-----------------------------------------------------------------------
      REAL*8     ER(IL)              , XIA(IL)             ,
     &           TPLBA(NMET)         ,
     &           EXCRE(NDTEM,ICNTE)
C-----------------------------------------------------------------------
```

B6NORM

```
      SUBROUTINE B6NORM( NDLEV  , NDMET  ,
     &                   NORD   ,
     &                   STCK   ,
     &                   PLAX   , PLX    ,
     &                   PLASX  , PLSX
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6STOT *********************
C
C  PURPOSE: TO NORMALISE TOTAL/SPECIFIC LINE POWERS FOR LEVEL 1
C           AND TOTAL EQUILIBRIUM LINE POWERS TO STAGE TOTAL POPULATION.
C
C  CALLING PROGRAM:  ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C
C  INPUT :  (R*4)  STCK(,) = POPULATION MATRIX COVERING ALL NON-METAST-
C                            ABLE/ORDINARY EXCITED LEVELS AS FUNCTION
C                            OF METASTABLE INDEX.
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                            2nd DIMENSION: METASTABLE LEVEL INDEX
C
C  I/O   :  (R*8)  PLAX    = INPUT:
C                            TOTAL EQUILIBRIUM LINE POWER COEFFICIENTS.
C                            AT FIXED TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS CM3 SEC-1)
C                            OUTPUT:
C                            NORMALISED TO TOTAL STAGE POPULATION
C  I/O   :  (R*8)  PLX     = INPUT:
C                            TOTAL LINE POWERS FOR LEVEL 1 AT FIXED
C                            TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS SEC-1).
C                            OUTPUT:
C                            NORMALISED TO TOTAL STAGE POPULATION
C
C  I/O   :  (R*8)  PLASX   = INPUT:
C                            SPECIFIC EQULIBRIUM LINE PWR COEFFICIENTS.
C                            AT FIXED TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS CM3 SEC-1)
C                            OUTPUT:
C                            NORMALISED TO TOTAL STAGE POPULATION
C  I/O   :  (R*8)  PLSX    = INPUT:
C                            SPECIFIC LINE PWR FOR LEVEL 1 AT FIXED
C                            TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS SEC-1).
C                            OUTPUT:
C                            NORMALISED TO TOTAL STAGE POPULATION
C
C           (I*4)  IS1     = ORDINARY EXCITED LEVEL INDEX
C
C           (R*8)  STOTX   = VARIABLE USED TO SUM STAGE TOTAL POPULATN.
C                            (INITIAL VALUE = 1 => GROUND)
C
C ROUTINES: NONE
C
C NOTE:
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    18/05/93
C
C UPDATE:  20/05/93 - P BRIDEN: STCK ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    06/06/96
C
C VERSION: 1.1                                  DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
```

```
C           - FIRST VERSION
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDLEV              , NDMET             ,
     &           NORD               , IS1
C-----------------------------------------------------------------------
      REAL*8     PLAX               , PLX               ,
     &           PLASX              , PLSX              ,
     &           STOTX
C-----------------------------------------------------------------------
      REAL*4     STCK(NDLEV,NDMET)
C-----------------------------------------------------------------------
```

B6OUT1

```
      SUBROUTINE B6OUT1( IUNIT  , IZ1    ,
     &                   NDLEV  , NDTEM  , NDDEN , NDMET  ,
     &                   LNORM  ,
     &                   IL     , NMET   , NORD  ,
     &                   MAXT   , MAXD   , ZEFF  ,
     &                   ICNTP  , ICNTR  , ICNTH ,
     &                   IPROJ  , LLSEL  ,
     &                   LPSEL  , LZSEL  , LISEL , LHSEL  , LRSEL ,
     &                   LMETR  , IMETR  , IORDR ,
     &                   ILOWER , IUPPER ,
     &                   STRGA  ,
     &                   LTRNG  , TEA    , TEVA  , TPVA   , THVA   ,
     &                   DENSA  , DENSPA , RATHA , RATIA  ,
     &                   PLA1   , PL     , PLA   ,
     &                   PLAS1  , PLS    , PLAS  ,
     &                   PL0    , PLBA   ,
     &                   POPAR  ,
     &                   STCKM  , STVR   , STVH  ,
     &                   STVRM  , STVHM  , STACK
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B6OUT1 ******************
C
C  PURPOSE: OUTPUT OF MAIN RESULTS (LINE POWER)
C
C  CALLING PROGRAM: ADAS206
C
C  DATA:
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C           NEUTRAL BEAM ENERGY :
C           RATE COEFFICIENTS   : CM3 SEC-1
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT FOR RESULTS
C  INPUT : (I*4)  IZ1     = RECOMBINING ION CHARGE
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT :  (L*4) LNORM   = .TRUE.  => IF NMET=1 THEN TOTAL AND SPECIFIC
C                                      LINE POWER OUTPUT FILES PLT/PLS
C                                      NORMALISED TO STAGE TOT.POPULATN.
C                                      (** NORM TYPE = T)
C                           = .FALSE. => OTHERWISE NORMALISE TO IDENTIFIED
C                                      METASTABLE POPULATIONS.
C                                      (** NORM TYPE = M)
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES ( 1 <= NMET <= 5 )
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> 20)
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> 20)
C  INPUT : (R*8)  ZEFF    = PLASMA Z EFFECTIVE ( IF 'LZSEL' = .TRUE.)
C
C  INPUT : (I*4)  ICNTP   = NUMBER OF PROTON IMPACT TRANSITIONS INPUT
C  INPUT : (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT : (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  INPUT : (I*4)  IPROJ   = SPECIFIES INDEX OF LOWEST  LEVEL FOR WHICH
C                           EXTRAPOLATION TO HIGHER N  OF THE RADIATED
C                           POWER IS TO BE PERFORMED. ALL LEVELS ABOVE
C                           AND INCLUDING 'IPROJ' ARE TREATED.
C                           IF 'IPROJ' > 'IL' => EXTRAP'TN SWITCHED OFF
C  INPUT : (L*4)  LLSEL   = .TRUE.  => OUTPUT LINE POWER RATIOS FORMED
```

```
C                                       ACCORDING TO POWER  FOR  LOWEST
C                                       FIRST OF THE INPUT DENSITIES.
C                           = .FALSE. => OUTPUT LINE POWER RATIOS FORMED
C                                       ACCORDING TO ZERO DENSITY POWER
C
C  INPUT : (L*4)  LPSEL   = .TRUE.  => INCLUDE PROTON COLLISIONS
C                           = .FALSE. =>DO NOT INCLUDE PROTON COLLISIONS
C  INPUT : (L*4)  LZSEL   = .TRUE.  => SCALE PROTON COLLISIONS WITH
C                                       PLASMA Z EFFECTIVE'ZEFF'.
C                           = .FALSE. => DO NOT SCALE PROTON COLLISIONS
C                                       WITH PLASMA Z EFFECTIVE 'ZEFF'.
C                           (ONLY USED IF 'LPSEL=.TRUE.')
C  INPUT : (L*4)  LISEL   = .TRUE.  => INCLUDE IONISATION RATES
C                           = .FALSE. => DO NOT INCLUDE IONISATION RATES
C  INPUT : (L*4)  LHSEL   = .TRUE.  => INCLUDE CHARGE TRANSFER FROM
C                                       NEUTRAL HYDROGREN.
C                           = .FALSE. => DO NOT INCLUDE CHARGE TRANSFER
C                                       FROM NEUTRAL HYDROGREN.
C  INPUT : (L*4)  LRSEL   = .TRUE.  => INCLUDE FREE ELECTRON
C                                       RECOMBINATION.
C                           = .FALSE. => DO NOT INCLUDE FREE ELECTRON
C                                       RECOMBINATION.
C
C  INPUT : (L*4)  LMETR() = .TRUE.  => ELECTRON IMPACT TRANSITION EXISTS
C                                       TO THE METASTABLE LEVEL  GIVEN BY
C                                       'IMETR()'.
C                             .FALSE. => ELECTRON  IMPACT  TRANSITIONS  DO
C                                       NOT EXIST TO THE METASTABLE LEVEL
C                                       GIVEN BY 'IMETR()'.
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET' )
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST.
C
C  INPUT : (I*4)  ILOWER  = SPECIFIC LINE POWER: SELECTED ELECTRON
C                           IMPACT TRANSITION LOWER LEVEL INDEX
C  INPUT : (I*4)  IUPPER  = SPECIFIC LINE POWER: SELECTED ELECTRON
C                           IMPACT TRANSITION UPPER LEVEL INDEX
C
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C
C  INPUT : (L*4)  LTRNG(,)= .TRUE.  => TEMPERATURE VALUE WITHIN RANGE
C                                       READ FROM INPUT COPASE DATA SET.
C                           = .FALSE. =>TEMPERATURE VALUE NOT WITHIN RANGE
C                                       READ FROM INPUT COPASE DATA SET.
C                             1st DIMENSION: TEMPERATURE INDEX.
C                             2nd DIMENSION: TEMPERATURE TYPE -
C                                            1) => ELECTRON
C                                            2) => PROTON
C                                            3) => NEUTRAL HYDROGEN
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (R*8)  TEVA()  = ELECTRON TEMPERATURES (UNITS: EV)
C  INPUT : (R*8)  TPVA()  = PROTON TEMPERATURES   (UNITS: EV)
C  INPUT : (R*8)  THVA()  = NEUTRAL HYDROGEN TEMPERATURES   (UNITS: EV)
C
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C  INPUT : (R*8)  DENSPA()= PROTON DENSITIES    (UNITS: CM-3)
C  INPUT : (R*8)  RATHA() = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C  INPUT : (R*8)  RATIA() = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C
C  INPUT : (R*8)  PLA1()  = DIRECT LINE POWER LOSS FROM EACH LEVEL.
C                           (UNITS: ERGS SEC-1) (DIMENSION: LEVEL INDEX)
C  INPUT : (R*8)  PL(,,)  = TOTAL LINE POWERS FOR METASTABLES. THIS IS
C                           THE SUM OF ALL EMISSIONS ORGINATING IN THE
C                           COLLISIONAL-RADIATIVE   SENSE   FROM   THE
C                           METASTABLE.
C                            => P(TOTAL)/N(IMET)        (ERGS SEC-1)
C                              1st DIMENSION: METASTABLE  INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY     INDEX
C  INPUT : (R*8)  PLA(,)  = TOTAL EQUILIBRIUM LINE POWER COEFFICIENTS.
C                             => P(TOTAL)/(DENS*N(1))   (ERGS CM3 SEC-1)
C                              1st DIMENSION: TEMPERATURE INDEX
C                              2nd DIMENSION: DENSITY     INDEX
C
C  INPUT : (R*8)  PLAS1   = DIRECT LINE POWER LOSS FOR SPECIFIC LINE
C                           POWER TRANSITION GIVEN BY 'ISTRN'.
C                           (UNITS: ERGS SEC-1)
C  INPUT : (R*8)  PLS(,,) = SPECIFIC LINE POWERS FOR METASTABLES. THIS
C                           IS THE SPECIFIC EMISSION ORGINATING IN THE
C                           COLLISIONAL-RADIATIVE   SENSE   FROM   THE
C                           METASTABLE. (SEE 'ISTRN')
C                            => P(SPECIFIC)/N(IMET)  (ERGS SEC-1)
C                              1st DIMENSION: METASTABLE  INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY     INDEX
C  INPUT : (R*8)  PLAS(,) = SPECIFIC EQUILIBRIUM LINE PWR COEFFICIENTS.
C                            => P(SPECIFIC)/(DENS*N(1)) (ERGS CM3 SEC-1)
C                              1st DIMENSION: TEMPERATURE INDEX
C                              2nd DIMENSION: DENSITY     INDEX
C
C  INPUT : (R*8)  PL0()   = ZERO DENSITY LINE POWER ARISING FROM EXCI-
C                           TATION ONLY FROM THE GROUND LEVEL.
C                           (UNITS: ERGS CM3 SEC-1). (DIMENSION: TEMP.)
C                             => P/(DENS*N(1))
C  INPUT : (R*8)  PLBA(,) = HIGH N PROJECTED POWER BASED ON EXCITATIONS
C                           FROM A PARTICULAR METASTABLE TO LEVELS
C                           'IPROJ' UPWARDS. (UNITS: ERGS CM3 SEC-1)
```

```
C                              => P/(DENS*N(IMET))
C                              1st DIMENSION: METASTABLE  INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C
C  INPUT : (R*8)  POPAR(,,) =  LEVEL POPULATIONS
C                              1st DIMENSION: LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C
C  INPUT : (R*8) STCKM(,,) = METASTABLE POPULATIONS STACK
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVR(,,)  = FREE ELECTRON RECOMBINATION COEFFICIENTS
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVH(,,)  =  CHARGE EXCHANGE COEFFICIENTS
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C
C  INPUT : (R*8) STVRM(,,) = METASTABLE FREE ELECTRON RECOMBINATION
C                              COEFFICIENTS.
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVHM(,,) = METASTABLE CHARGE EXCHANGE COEFFICIENTS
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*4) STACK(,,,)= POPULATION DEPENDENCE
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: METASTABLE INDEX
C                              3rd DIMENSION: TEMPERATURE INDEX
C                              4th DIMENSION: DENSITY INDEX
C
C          (I*4)  PGLEN   = PARAMETER = NUMBER OF LINES PER OUTPUT PAGE
C
C          (I*4)  NBLOCK  = NUMBER OF LINES IN CURRENT OUTPUT BLOCK.
C          (I*4)  NLINES  = LAST PAGE LINE WRITTEN.
C                           IF 'NLINES+NBLOCK' > 'PGLEN' START NEW PAGE.
C          (I*4)  MIND    = MINIMUM OF 10 AND 'MAXD'
C          (I*4)  I       = GENERAL USE
C          (I*4)  J       = GENERAL USE
C          (I*4)  IT      = TEMPERATURE INDEX NUMBER FOR ARRAY USE
C          (I*4)  IN      = DENSITY INDEX NUMBER FOR ARRAY USE
C          (I*4)  IUSEP   = NUMBER OF PROTON IMPACT TRANSITIONS USED
C          (I*4)  IUSER   = NUMBER OF FREE ELECTRON RECOMBINATIONS USED
C          (I*4)  IUSEH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS USED
C          (I*4)  ITMID   = MID-TEMPERATURE INDEX = 0.5 * 'MAXT'
C
C          (R*8)  Z1R2    = 1.0/('IZ1' SQUARED)
C          (R*8)  Z1R7    = 1.0/('IZ1' TO THE POWER SEVEN)
C          (R*8)  THETA   = REDUCED TEMPERATURE VALUE
C          (R*8)  PLVAL   = LINE POWER COEFFTS (ZERO/LOWEST DENSITY)
C          (R*8)  PLRAT   = LINE POWER RATIO
C
C          (L*4)  LPRNG   = .TRUE.  => PROTON INPUT PARAMETERS USED
C                           .FALSE. => PROTON INPUT PARAMETERS NOT USED
C          (L*4)  LHRNG   = .TRUE.  => NEUTRAL H INPUT PARAMETERS USED
C                           .FALSE. => NEUTRAL H INPUT PARMS. NOT USED
C          (L*4)  LRRNG   = .TRUE.  => FREE ELEC. RECOMB. PARMS USED
C                           .FALSE. => FREE ELEC. RECOMB. PARMS NOT USED
C
C          (C*2)  CZ1     = 'IZ1' IN CHARACTER FORM WHEN 'IT'='ITMID'
C                           OTHERWISE IS BLANK.
C          (C*6)  CRATMX  = PARAMETER = ' > 100' (MAX. OUTPUT RATIO)
C          (C*32) C32     = GENERAL USE 32 BYTE CHARACTER STRING
C          (C*44) CLSEL   = IF (LLSEL=.TRUE.) =
C                          'LINE POWER FOR LOWEST OF THE INPUT DENSITIES'
C                           IF (LLSEL=.FALSE.) =
C                          'ZERO DENSITY LINE POWER                     '
C
C          (C*1)  CTRNG(6)= ' ' => OUTPUT VALUES FOR THIS TEMPERATURE
C                                  INTERPOLATED.
C                          = '*' => OUTPUT VALUES FOR THIS TEMPERATURE
C                                  EXTRAPOLATED.
C                          = '#' => NOT USED
C                           1st DIMENSION: TEMPERATURE TYPE -
C                                          1) => ELECTRON
C                                          2) => PROTON
C                                          3) => NEUTRAL HYDROGEN
C                                          DENSITY TYPE -
C                                          4) => PROTON
C                                          RATIO TYPE -
C                                          5) => 'RATHA'
C                                          6) => 'RATIA'
C          (C*6)  CROUT() = OUTPUT RATIO AS CHARACTER*6 AT A GIVEN TEMP-
C                           PERATURE.
C                           DIMENSION: DENSITY INDEX
C                           (IF RATIO > 99.999 => 'CROUT' = 'CRATMX')
C
C
C NOTE:
C          ONLY THE FIRST TEN DENSITIES ARE OUTPUT.
C
C          AN 'OUTPUT BLOCK' IS A SINGLE CONTAINED OUTPUT TABLE
```

```
C
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          -------------------------------------------------------
C          XXSTNP     ADAS      STARTS NEW PAGE IF CURRENT PAGE FULL
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 2520
C
C DATE:    09/10/90
C
C UPDATE:  21/11/90 - PE BRIDEN - CODING ADDED TO REMOVE THE POSSIBILITY
C                                 OF DIVISION BY ZERO  WHEN  CALCULATING
C                                 LINE POWER RATIOS. ALSO RATIOS GREATER
C                                 THAN 100 ARE LISTED AS BEING ' > 100'.
C
C                                 WHEN RATIOS ARE REQUIRED THEY ARE CAL-
C                                 CULATED AS 'X/Y' INSTEAD OF 'X*(1/Y)'.
C                                 THIS IS BECAUSE IN VS FORTRAN ALTHOUGH
C                                 'Y' MAY NOT CREATE AN UNDERFLOW  ERROR
C                                 '1/Y'  CAN  STILL  CREATE AN  OVERFLOW
C                                 ERROR (E.G. Y = 1.0D-77)
C
C                                 IN THIS PROGRAM 'X/Y' SHOULD NEVER BE
C                                 SUCH THAT AN OVERFLOW ERROR OCCURS.
C
C UPDATE:  17/01/91 - PE BRIDEN: RENAMED SUBROUTINE (ORIGINALLY B6WR7B)
C                               - STARTED OUTPUT ON NEW PAGE
C
C UPDATE:  31/01/91 - PE BRIDEN: REFORMATTED OUTPUT. REMOVED 'SCEF' AND
C                                 'NV' FROM ARGUMENT LIST ETC.
C
C UPDATE:  25/03/91 - PE BRIDEN: REFORMATTED OUTPUT (STATEMENTS 1012/3)
C
C UPDATE:  07/08/91 - PE BRIDEN: CHANGED 'DBLE(IZ1**7)' TO 'DBLE(IZ1)**7
C                                 TO AVOID INTEGER OVERFLOW IF IZ1>21.
C
C UPDATE:  18/05/93 - PE BRIDEN: SPECIFY NORMALISATION ON OUTPUT.
C                                 NEW ARGUMENT    - LNORM
C                                 CHANGED FORMATS - 1107, 1114
C
C UPDATE:  20/05/93- P BRIDEN: STACK ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    06/06/96
C
C VERSION: 1.1                                    DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
C            - FIRST VERSION
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   PGLEN
C-----------------------------------------------------------------------
      CHARACTER CRATMX*6
C-----------------------------------------------------------------------
      PARAMETER ( PGLEN  = 63       )
C-----------------------------------------------------------------------
      PARAMETER ( CRATMX = ' > 100' )
C-----------------------------------------------------------------------
      INTEGER   IUNIT     , IZ1       ,
     &          NDLEV     , NDTEM     , NDDEN     , NDMET
      INTEGER   IL        ,
     &          NMET      , NORD      ,
     &          MAXT      , MAXD      ,
     &          ICNTP     , ICNTR     , ICNTH
      INTEGER   ILOWER    , IUPPER    ,
     &          IPROJ
      INTEGER   NBLOCK    , NLINES    , MIND      ,
     &          I         , J         , IN        , IT      ,
     &          IUSEP     , IUSER     , IUSEH
      INTEGER   ITMID
C-----------------------------------------------------------------------
      REAL*8    ZEFF      , PLAS1
      REAL*8    Z1R2      , Z1R7      , THETA     , PLVAL   , PLRAT
C-----------------------------------------------------------------------
      LOGICAL   LLSEL     , LNORM
      LOGICAL   LPSEL     , LZSEL     , LISEL     , LHSEL   , LRSEL
      LOGICAL   LPRNG     , LHRNG     , LRRNG
C-----------------------------------------------------------------------
      CHARACTER CZ1*2     , C32*32    , CLSEL*44
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)    , IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8    TEVA(NDTEM)     , TPVA(NDTEM)      ,
     &          THVA(NDTEM)     , TEA(NDTEM)       ,
     &          DENSA(NDDEN)    , DENSPA(NDDEN)    ,
     &          RATHA(NDDEN)    , RATIA(NDDEN)
      REAL*8    PLA1(NDLEV)     , PL0(NDTEM)       ,
     &          PLA(NDTEM,NDDEN), PLAS(NDTEM,NDDEN) ,
```

```
     &          PLBA(NDMET,NDTEM)
      REAL*8    PL(NDMET,NDTEM,NDDEN)         ,
     &          PLS(NDMET,NDTEM,NDDEN)
      REAL*8    POPAR(NDLEV,NDTEM,NDDEN)
      REAL*8    STVR(NDLEV,NDTEM,NDDEN)       , STVH(NDLEV,NDTEM,NDDEN)
      REAL*8    STCKM(NDMET,NDTEM,NDDEN)      ,
     &          STVRM(NDMET,NDTEM,NDDEN)      , STVHM(NDMET,NDTEM,NDDEN)
      REAL*4    STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      LOGICAL   LMETR(NDMET)    , LTRNG(NDTEM,3)
C-----------------------------------------------------------------------
      CHARACTER CTRNG(6)*1      , STRGA(NDLEV)*22
      CHARACTER CROUT(10)*6
C-----------------------------------------------------------------------
```

B6SPCL

```
      SUBROUTINE B6SPCL( NDLEV   , NDMET   ,
     &                   IORDS   , NMET    ,
     &                   DENSX   ,
     &                   STCKMX  , STACKX ,
     &                   PLAS1   ,
     &                   PLASX   , PLSX
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6SPCL *********************
C
C  PURPOSE: TO  CALCULATE  SPECIFIC  LINE  POWERS  FOR  METASTABLES  AND
C           SPECIFIC EQUILIBRIUM LINE POWER.
C
C  CALLING PROGRAM:  ADAS206
C
C  SUBROUTINE:
C
C  INPUT : (I*4) NDLEV    = PARAMETER = MAX NO. OF ENERGY LEVELS ALLOWED
C  INPUT : (I*4) NDMET    = PARAMETER = MAX. NO. OF METASTABLES ALLOWED
C
C  INPUT : (I*4) IORDS    = INDEX OF SPECIFIC LINE POWER TRANSITION
C                           UPPER ENERGY LEVEL IN ORDINARY LEVEL ARRAY.
C  INPUT : (I*4) NMET     = NUMBER OF METASTABLES (1 <= NMET <= 'NDMET')
C
C  INPUT : (R*8) DENSX    = ELECTRON DENSITY (UNITS: CM-3)
C
C  INPUT : (R*8) STCKMX() = METASTABLE POPULATIONS STACK
C                           AT FIXED TEMPERATURE AND DENSITY.
C                            DIMENSION: METASTABLE INDEX
C  INPUT : (R*4) STACKX(,)= ORDINARY EXCITED LEVEL POPULAT'N DEPENDENCE
C                           ON METASTABLE LEVEL. AT FIXED TEMPERATURE
C                           AND DENSITY.
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: METASTABLE INDEX
C
C  INPUT : (R*8)  PLAS1   = DIRECT LINE POWER LOSS FOR SPECIFIC LINE
C                           POWER TRANSITION.
C                           (UNITS: ERGS SEC-1)
C
C  OUTPUT: (R*8)  PLASX   = SPECIFIC EQUILIBRIUM LINE PWR COEFFICIENTS.
C                           AT FIXED TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS CM3 SEC-1)
C  OUTPUT: (R*8)  PLSX()  = SPECIFIC LINE POWERS FOR METASTABLES. THIS
C                           IS THE SUM OF ALL EMISSIONS  ORGINATING IN
C                           THE  COLLISIONAL-RADIATIVE  SENSE FROM THE
C                           METASTABLE. AT FIXED TEMPERATURE AND DENSITY
C                           (UNITS: ERGS SEC-1 )
C                             DIMENSION: METASTABLE  INDEX
C
C          (I*4) IM       = METASTABLE LEVEL ARRAY INDEX
C
C
C
C ROUTINES: NONE
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    09/10/90
C
C UPDATE:  20/05/93-P BRIDEN: STACKX ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    06/06/96
C
C VERSION: 1.1                                  DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
C           - FIRST VERSION
C
C-----------------------------------------------------------------------
```

```
C
C-----------------------------------------------------------------------
      INTEGER    NDLEV         , NDMET              ,
     &           IORDS         , NMET
      INTEGER    IM
C-----------------------------------------------------------------------
      REAL*8     DENSX         , PLAS1              , PLASX
C-----------------------------------------------------------------------
      REAL*8     STCKMX(NDMET)       ,
     &           PLSX(NDMET)
      REAL*4     STACKX(NDLEV,NDMET)
C-----------------------------------------------------------------------
```

B6SPF0

```
      SUBROUTINE B6SPF0( REP    ,
     &                   DSNINP , DSNINC ,
     &                   LDSEL
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6SPF0 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS206
C
C  SUBROUTINE:
C
C  OUTPUT: (C*3)   REP     = 'YES' => TERMINATE PROGRAM EXECUTION.
C                            = 'NO ' => CONTINUE PROGRAM EXECUTION.
C
C  OUTPUT: (C*80)  DSNINP  = FULL INPUT PROTON DATA SET NAME
C  OUTPUT: (C*80)  DSNINC  = FULL INPUT COPASE DATA SET NAME
C
C  OUTPUT: (L*4)   LDSEL   = .TRUE.  => COPASE DATA SET INFORMATION
C                                       TO BE DISPLAYED BEFORE RUN.
C                            = .FALSE. => COPASE DATA SET INFORMATION
C                                       NOT TO BE DISPLAYED BEFORE RUN.
C
C          (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    27/02/91 - ADAS91 VERSION (DIFFERENT TO ADAS90 VERSION)
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    06/06/96
C
C VERSION: 1.1                                  DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
C           - FIRST VERSION
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      CHARACTER    REP*3        , DSNINP*80      , DSNINC*80
C-----------------------------------------------------------------------
      LOGICAL      LDSEL
C-----------------------------------------------------------------------
      INTEGER      PIPEIN   , PIPEOU
      PARAMETER (  PIPEIN=5 , PIPEOU=6)
C-----------------------------------------------------------------------
```

B6SPF1

```
      SUBROUTINE B6SPF1( NDTEM  , TINE   , MAXT   , IFOUT  ,
     &                   LPEND  ,
     &                   LNEWPA , LPAPER , LCONT  , LPTOT  ,
     &                   LPSPC  , DSNPAP , DSNOUT , DSNTOT , DSNSPC ,
     &                   LGPH   , ITSEL  , GTIT1
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6SPF1 *********************
C
```

```
C  PURPOSE: TO PASS AND RECEIVE DATA FROM THE IDL OUTPUT DISPLAY SCREEN
C           VIA THE PIPE
C
C  CALLING PROGRAM: ADAS206
C
C  SUBROUTINE:
C
C  INPUT:  (I*4)   NDTEM    = PARAMETER = MAX. NO. OF TEMPERATURES
C                               ALLOWED
C  INPUT:  (R*8)   TINE()   = ELECTRON TEMPERATURES (UNITS: SEE 'IFOUT')
C  INPUT:  (I*4)   MAXT     = NUMBER OF INPUT TEMPERATURES
C                             ( 1 -> 'NDTEM')
C  INPUT:  (I*4)   IFOUT    = 1 => INPUT TEMPERATURES IN KELVIN
C                           = 2 => INPUT TEMPERATURES IN EV
C                           = 3 => INPUT TEMPERATURES IN REDUCED FORM
C  OUTPUT: (L*4)   LPEND    = .TRUE.  => OUTPUT OPTIONS CANCELLED.
C                             .FALSE. => PROCESS OUTPUT OPTIONS.
C
C  OUTPUT: (L*4)   LNEWPA   = .TRUE.  => NEW TEXT OUTPUT FILE OR
C                                        REPLACEMENT OF EXISTING FILE
C                                        REQUIRED.
C                             .FALSE. => ALLOW APPEND ON EXISTING OPEN
C                                        TEXT FILE.
C
C  OUTPUT: (L*4)   LPAPER   = .TRUE.  => OUTPUT DATA TO TEXT OUTPUT
C                                        FILE.
C                             .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                        TEXT OUTPUT FILE.
C  OUTPUT: (L*4)   LCONT    = .TRUE.  => OUTPUT DATA TO CONTOUR PASSING
C                                        FILE.
C                             .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                        CONTOUR PASSING FILE.
C  OUTPUT: (L*4)   LPTOT    = .TRUE.  => OUTPUT DATA TO TOTAL LINE POWER
C                                        PASSING FILE.
C                             .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                        TOTAL LINE POWER PASSING FILE.
C  OUTPUT: (L*4)   LPSPC    = .TRUE.  => OUTPUT DATA TO SPECIFIC LNE PWR
C                                        PASSING FILE.
C                             .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                        SPECIFIC LNE PWR PASSING FILE.
C
C  OUTPUT: (C*80)  DSNPAP   = OUTPUT TEXT FILE NAME
C  OUTPUT: (C*80)  DSNOUT   = OUTPUT CONTOUR DATA SET NAME
C  OUTPUT: (C*80)  DSNTOT   = OUTPUT TOTAL LINE POWER PASSINF FILE NAME
C  OUTPUT: (C*80)  DSNSPC   = OUTPUT SPECIFIC LNE PWR PASSINF FILE NAME
C  OUTPUT: (L*4)   LGPH     = .TRUE.  => SELECT GRAPHICAL OUTPUT
C                           = .FALSE. => DO NOT SELECT GRAPHICAL OUTPUT
C  OUTPUT: (I*4)   ITSEL    = INDEX OF TEMPERATURE SELECTED FOR GRAPH
C                            (FROM INPUT LIST).
C  OUTPUT: (C*40)  GTIT1    = ENTERED TITLE FOR GRAPH
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  26/11/90 - ADAS91 - PE BRIDEN - AMENDED   'XXDISP'   ARGUMENT
C                                          LIST. IT NOW INCLUDES DISPLAY
C                                          RETURN CODES.
C                                          IF 'RETURN' OR 'END' ENTERED
C                                          ON A PANEL, EXCEPT VIA PFKEY,
C                                          PROGRAM TERMINATES.
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    06/06/96
C
C VERSION: 1.1                                  DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
C           - FIRST VERSION
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER      NDTEM  , MAXT , IFOUT , ITSEL , LOGIC , I , I4UNIT
C-----------------------------------------------------------------------
      REAL*8       TINE(NDTEM)
C-----------------------------------------------------------------------
      CHARACTER    DSNOUT*80   , DSNTOT*80 , DSNSPC*80 , GTIT1*40 ,
     &             DSNPAP*80
C-----------------------------------------------------------------------
      LOGICAL      LCONT       , LPTOT     , LPSPC    ,
     &             LPEND       , LPAPER    , LNEWPA   , LGPH
C-----------------------------------------------------------------------
      INTEGER      PIPEIN      , PIPEOU    , ONE
```

```
      PARAMETER( PIPEIN=5  , PIPEOU=6   , ONE=1 )
C-----------------------------------------------------------------------
```

B6TOTL

```
      SUBROUTINE B6TOTL( NDLEV   , NDMET  ,
     &                   NORD    , NMET   ,
     &                   IORDR   , IMETR  ,
     &                   DENSX   ,
     &                   STCKMX  , STACKX ,
     &                   PLA1    , PLBAX  ,
     &                   PLAX    , PLX
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6TOTL *********************
C
C  PURPOSE: TO  CALCULATE  TOTAL  LINE  POWERS FOR METASTABLES AND TOTAL
C           EQUILIBRIUM LINE POWERS.
C
C  CALLING PROGRAM:  ADAS206
C
C  SUBROUTINE:
C
C  INPUT : (I*4) NDLEV    = PARAMETER = MAX. NO. OF LEVELS ALLOWED
C  INPUT : (I*4) NDMET    = PARAMETER = MAX. NO. OF METASTABLES ALLOWED
C
C  INPUT : (I*4) NORD     = NUMBER OF ORD. LEVELS (1 <= NORD <= 'NDLEV')
C  INPUT : (I*4) NMET     = NUMBER OF METASTABLES (1 <= NMET <= 'NDMET')
C
C  INPUT : (I*4) IORDR()  = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST (ARRAY SIZE = 'NDLEV' )
C  INPUT : (I*4) IMETR()  = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET' )
C  INPUT : (R*8) DENSX    = ELECTRON DENSITY (UNITS: CM-3)
C
C  INPUT : (R*8) STCKMX() = METASTABLE POPULATIONS STACK
C                           AT FIXED TEMPERATURE AND DENSITY.
C                            DIMENSION: METASTABLE INDEX
C  INPUT : (R*4) STACKX(,)= ORDINARY EXCITED LEVEL POPULAT'N DEPENDENCE
C                           ON METASTABLE LEVEL. AT FIXED TEMPERATURE
C                           AND DENSITY.
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: METASTABLE INDEX
C
C  INPUT : (R*8)  PLA1()  = DIRECT LINE POWER LOSS FOR EACH LEVEL.
C                           (UNITS: ERGS SEC-1) (DIMENSION: LEVEL INDEX)
C  INPUT : (R*8)  PLBAX() = HIGH N PROJECTED POWER BASED ON EXCITATIONS
C                           FROM A PARTICULAR METASTABLE TO LEVELS
C                           'IPROJ' UPWARDS. (UNITS: ERGS CM3 SEC-1)
C                           AT FIXED TEMPERATURE.
C                             DIMENSION: METASTABLE  INDEX
C
C  OUTPUT: (R*8)  PLAX    = TOTAL EQUILIBRIUM LINE POWER COEFFICIENTS.
C                           AT FIXED TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS CM3 SEC-1)
C  OUTPUT: (R*8)  PLX()   = TOTAL LINE POWERS FOR METASTABLES. THIS IS
C                           THE SUM OF ALL EMISSIONS ORGINATING IN THE
C                           COLLISIONAL-RADIATIVE   SENSE   FROM   THE
C                           METASTABLE. AT FIXED TEMPERATURE AND DENSITY
C                           (UNITS: ERGS SEC-1 )
C                             DIMENSION: METASTABLE  INDEX
C
C          (I*4) IM       = METASTABLE LEVEL ARRAY INDEX
C          (I*4) IS       = ORDINARY LEVEL ARRAY INDEX
C
C
C
C ROUTINES: NONE
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    09/10/90
C
C UPDATE:  20/05/93-P BRIDEN: STACKX ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C UNIX-IDL PORT:
C
C UNIX-IDL PORT:
C
C DATE: UNKNOWN
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C VERSION: 1.1                    DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN
C            - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
```

```
C-----------------------------------------------------------------------
      INTEGER    NDMET         , NDLEV              ,
     &           NMET          , NORD
      INTEGER    IM            , IS
C-----------------------------------------------------------------------
      REAL*8     DENSX         , PLAX
C-----------------------------------------------------------------------
      INTEGER    IMETR(NMET)   , IORDR(NORD)
C-----------------------------------------------------------------------
      REAL*8     STCKMX(NDMET) ,
     &           PLA1(NDLEV)   , PLBAX(NDMET)       ,
     &           PLX(NDMET)
      REAL*4     STACKX(NDLEV,NDMET)
C-----------------------------------------------------------------------
```

B6WR12

```
      SUBROUTINE B6WR12( IUNIT  , DATE   , IZ1   , IL    ,
     &                   NDMET  , NDTEM  , NDDEN ,
     &                   LNORM  ,
     &                   NMET   , IMETR  ,
     &                   IFOUT  , MAXT   , TINE  ,
     &                   IDOUT  , MAXD   , DINE  ,
     &                   CSTRGA , PL
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6WR12 *********************
C
C  PURPOSE: TO OUTPUT TOTAL LINE POWER PARAMETERS TO THE PASSING
C           FILE ON STREAM 'IUNIT'.
C
C  CALLING PROGRAM: ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  IUNIT   = OUTPUT STREAM NUMBER
C  INPUT :  (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C  INPUT :  (I*4)  IZ1     = RECOMBINING ION CHARGE
C                            (NOTE: IZ1 SHOULD EQUAL Z+1)
C  INPUT :  (I*4)  IL      = NUMBER OF INDEX ENERGY LEVELS
C
C  INPUT :  (I*4)  NDMET   = MAX. NO. OF METASTABLES ALLOWED
C  INPUT :  (I*4)  NDTEM   = MAX. NO. OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDDEN   = MAX. NUMBER OF DENSITIES ALLOWED
C
C  INPUT :  (L*4)  LNORM   =.TRUE.  => IF NMET=1 THEN TOTAL AND SPECIFIC
C                                      LINE POWER OUTPUT FILES PLT/PLS
C                                      NORMALISED TO STAGE TOT.POPULATN.
C                                      (** NORM TYPE = T)
C                           =.FALSE. => OTHERWISE NORMALISE TO IDENTIFIED
C                                      METASTABLE POPULATIONS.
C                                      (** NORM TYPE = M)
C
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLES ( 1 -> 5 )
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLES IN COMPLETE LEVEL LIST
C
C  INPUT :  (I*4)  IFOUT   = 1 => INPUT TEMPERATURES IN KELVIN
C                            2 => INPUT TEMPERATURES IN EV
C                            2 => INPUT TEMPERATURES IN REDUCED FORM
C  INPUT :  (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES (1 -> 20)
C  INPUT :  (R*8)  TINE()  = ELECTRON TEMPERATURES (UNITS: SEE 'IFOUT')
C
C  INPUT :  (I*4)  IDOUT   = 1 => INPUT DENSITIES IN CM-3
C                            2 => INPUT DENSITIES IN REDUCED FORM
C  INPUT :  (I*4)  MAXD    = NUMBER OF INPUT DENSITIES (1 -> 20)
C  INPUT :  (R*8)  DINE()  = ELECTRON DENSITIES (UNITS: SEE 'IFOUT')
C
C  INPUT :  (C*18) CSTRGA()= INDEX LEVEL CONFIGURATIONS
C  INPUT :  (R*8)  PL(,,)  = TOTAL LINE POWERS FOR METASTABLES. THIS IS
C                            THE SUM OF ALL EMISSIONS ORGINATING IN THE
C                            COLLISIONAL-RADIATIVE   SENSE   FROM   THE
C                            METASTABLE.
C                             => P(TOTAL)/N(IMET)        (ERGS SEC-1)
C                              1st DIMENSION: METASTABLE  INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY     INDEX
C
C           (I*4)  L1      = PARAMETER = 1
C           (I*4)  L2      = PARAMETER = 2
C           (I*4)  L3      = PARAMETER = 3
C
C           (I*4)  I       = GENERAL USE
C           (I*4)  IM      = ARRAY INDEX POINTER FOR METASTABLE STATES
C           (I*4)  IT      = ARRAY INDEX POINTER FOR TEMPERATURES
C           (I*4)  ID      = ARRAY INDEX POINTER FOR DENSITIES
C
C           (R*8)  RDEN()  = ELECTRON DENSITIES (UNITS: REDUCED FORM)
C           (R*8)  RTEM()  = ELECTRON TEMPERATURES (UNITS: REDUCED FORM)
C
C           (C*1)  CSTAR   = '*'
C
C ROUTINES:
```

```
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C           XXTCON     ADAS      CONVERTS ENTERED TEMP. VALUES TO EV.
C           XXDCON     ADAS      CONVERTS ENTERED DENSITY VALUES TO CM-3.
C
C AUTHOR:   PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C           K1/0/81
C           JET EXT. 4569
C
C DATE:     09/10/90
C
C UPDATE:   18/05/93 - PE BRIDEN: ADDED NORMALISATION INFO TO OUTPUT.
C                                 NEW ARGUMENT   - LNORM
C                                 CHANGED FORMAT - 1011
C
C UPDATE:   20/05/93 - ADAS91 PEB: TO REFLECT CHANGES IN BXDATA THE
C                                  CHARACTER ARRAY CSTRGA IS NOW 18 BYTES
C                                  INSTEAD OF 12.
C                                  NOTE: ONLY THE FIRST 12 BYTES ARE
C                                        OUTPUT TO THE PASSING FILE.
C
C UNIX-IDL PORT:
C
C AUTHOR:   WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:     06/06/96
C
C VERSION: 1.1                                  DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
C            - FIRST VERSION
C
C-----------------------------------------------------------------------
      INTEGER   L1           , L2            , L3
C-----------------------------------------------------------------------
      PARAMETER ( L1=1 , L2=2 , L3=3 )
C-----------------------------------------------------------------------
      INTEGER   IUNIT        , IZ1           , IL         ,
     &          NDMET        , NDTEM         , NDDEN      ,
     &          NMET         ,
     &          IFOUT        , MAXT          ,
     &          IDOUT        , MAXD
      INTEGER   I            , IM            , IT         , ID
C-----------------------------------------------------------------------
      LOGICAL   LNORM
C-----------------------------------------------------------------------
      CHARACTER CSTAR*1       , DATE*8
C-----------------------------------------------------------------------
      INTEGER   IMETR(NMET)
C-----------------------------------------------------------------------
      REAL*8    RTEM(20)     , RDEN(20)
      REAL*8    TINE(MAXT)   , DINE(MAXD)    , PL(NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      CHARACTER CSTRGA(IL)*18
C-----------------------------------------------------------------------
      DATA      CSTAR/'*'/
C
C-----------------------------------------------------------------------
```

B6WR13

```
      SUBROUTINE B6WR13( IUNIT  , DATE   , IZ1    , IL    ,
     &                   NDMET  , NDTEM  , NDDEN  ,
     &                   LNORM  ,
     &                   NMET   , IMETR  ,
     &                   IFOUT  , MAXT   , TINE   ,
     &                   IDOUT  , MAXD   , DINE   ,
     &                   ILOWER , IUPPER ,
     &                   CSTRGA , PLS
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6WR13 *********************
C
C  PURPOSE: TO OUTPUT SPECIFIC LINE POWER PARAMETERS TO THE PASSING
C           FILE ON STREAM 'IUNIT'.
C
C  CALLING PROGRAM: ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  IUNIT   = OUTPUT STREAM NUMBER
C  INPUT :  (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C  INPUT :  (I*4)  IZ1     = RECOMBINING ION CHARGE
C                            (NOTE: IZ1 SHOULD EQUAL Z+1)
C  INPUT :  (I*4)  IL      = NUMBER OF INDEX ENERGY LEVELS
C
C  INPUT :  (I*4)  NDMET   = MAX. NO. OF METASTABLES ALLOWED
C  INPUT :  (I*4)  NDTEM   = MAX. NO. OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDDEN   = MAX. NUMBER OF DENSITIES ALLOWED
C
C  INPUT :  (L*4)  LNORM   =.TRUE.  => IF NMET=1 THEN TOTAL AND SPECIFIC
C                                      LINE POWER OUTPUT FILES PLT/PLS
C                                      NORMALISED TO STAGE TOT.POPULATN.
```

```
C                                   (** NORM TYPE = T)
C                          =.FALSE. => OTHERWISE NORMALISE TO IDENTIFIED
C                                   METASTABLE POPULATIONS.
C                                   (** NORM TYPE = M)
C
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLES ( 1 -> 5 )
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLES IN COMPLETE LEVEL LIST
C
C  INPUT :  (I*4)  IFOUT   = 1 => INPUT TEMPERATURES IN KELVIN
C                            2 => INPUT TEMPERATURES IN EV
C                            2 => INPUT TEMPERATURES IN REDUCED FORM
C  INPUT :  (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES (1 -> 20)
C  INPUT :  (R*8)  TINE()  = ELECTRON TEMPERATURES (UNITS: SEE 'IFOUT')
C
C  INPUT :  (I*4)  IDOUT   = 1 => INPUT DENSITIES IN CM-3
C                            2 => INPUT DENSITIES IN REDUCED FORM
C  INPUT :  (I*4)  MAXD    = NUMBER OF INPUT DENSITIES (1 -> 20)
C  INPUT :  (R*8)  DINE()  = ELECTRON DENSITIES (UNITS: SEE 'IFOUT')
C
C  INPUT :  (I*4)  ILOWER  = SPECIFIC LINE POWER: SELECTED ELECTRON
C                            IMPACT TRANSITION LOWER LEVEL INDEX
C  INPUT :  (I*4)  IUPPER  = SPECIFIC LINE POWER: SELECTED ELECTRON
C                            IMPACT TRANSITION UPPER LEVEL INDEX
C
C  INPUT :  (C*18) CSTRGA()= INDEX LEVEL CONFIGURATIONS
C  INPUT :  (R*8)  PLS(,,) = SPECIFIC LINE POWERS FOR METASTABLES. THIS
C                            IS THE SPECIFIC EMISSION ORGINATING IN THE
C                            COLLISIONAL-RADIATIVE   SENSE   FROM   THE
C                            METASTABLE. (SEE 'ISTRN')
C                             => P(SPECIFIC)/N(IMET)  (ERGS SEC-1)
C                              1st DIMENSION: METASTABLE  INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY     INDEX
C
C           (I*4)  L1      = PARAMETER = 1
C           (I*4)  L2      = PARAMETER = 2
C           (I*4)  L3      = PARAMETER = 3
C
C           (I*4)  I       = GENERAL USE
C           (I*4)  IM      = ARRAY INDEX POINTER FOR METASTABLE STATES
C           (I*4)  IT      = ARRAY INDEX POINTER FOR TEMPERATURES
C           (I*4)  ID      = ARRAY INDEX POINTER FOR DENSITIES
C
C           (R*8)  RDEN()  = ELECTRON DENSITIES (UNITS: REDUCED FORM)
C           (R*8)  RTEM()  = ELECTRON TEMPERATURES (UNITS: REDUCED FORM)
C
C           (C*1)  CSTAR   = '*'
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXTCON     ADAS      CONVERTS ENTERED TEMP. VALUES TO EV.
C          XXDCON     ADAS      CONVERTS ENTERED DENSITY VALUES TO CM-3.
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  18/05/93 - PE BRIDEN: ADDED NORMALISATION INFO TO OUTPUT.
C                                NEW ARGUMENT   - LNORM
C                                CHANGED FORMAT - 1011
C
C UPDATE:  20/05/93 - ADAS91 PEB: TO REFLECT CHANGES IN BXDATA THE
C                                  CHARACTER ARRAY CSTRGA IS NOW 18 BYTES
C                                  INSTEAD OF 12.
C                                  NOTE: ONLY THE FIRST 12 BYTES ARE
C                                        OUTPUT TO THE PASSING FILE.
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    06/06/96
C
C VERSION: 1.1                                  DATE:06/06/96
C MODIFIED: WILLIAM OSBORN
C            - FIRST VERSION
C
C-----------------------------------------------------------------------
      INTEGER   L1           , L2           , L3
C-----------------------------------------------------------------------
      PARAMETER ( L1=1 , L2=2 , L3=3 )
C-----------------------------------------------------------------------
      INTEGER   IUNIT        , IZ1          , IL         ,
     &          NDMET        , NDTEM        , NDDEN      ,
     &          NMET         ,
     &          IFOUT        , MAXT         ,
     &          IDOUT        , MAXD         ,
     &          ILOWER       , IUPPER
      INTEGER   I            , IM           , IT         , ID
C-----------------------------------------------------------------------
      LOGICAL   LNORM
C-----------------------------------------------------------------------
      CHARACTER CSTAR*1      , DATE*8
C-----------------------------------------------------------------------
      INTEGER   IMETR(NMET)
```

```
C-----------------------------------------------------------------------
      REAL*8    RTEM(20)     , RDEN(20)
      REAL*8    TINE(MAXT)   , DINE(MAXD)    , PLS(NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      CHARACTER CSTRGA(IL)*18
C-----------------------------------------------------------------------
      DATA      CSTAR/'*'/
C
C-----------------------------------------------------------------------
```

B7CDEF

```
      SUBROUTINE B7CDEF( LCFLOG , NCONTR  ,
     &                   RMIN   , RMAX    ,
     &                   ISEL   , CONTR
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B7CDEF *********************
C
C  PURPOSE: GRAPHICAL OPTION 1: SETTING UP OF DEFAULT CONTOUR VALUES
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  INPUT : (L*4)   LCFLOG   = (DEFAULT CONTOUR VALUES):
C                             .TRUE.  => LOGARITHMIC CONTOUR FORMAT
C                             .FALSE. => LINEAR CONTOUR FORMAT
C  INPUT : (I*4)   NCONTR   = NUMBER OF DEFAULT CONTOUR VALUES REQUIRED
C
C  INPUT : (R*8)   RMIN     = MINIMUM SPECTRUM LINE RATIO
C  INPUT : (R*8)   RMAX     = MAXIMUM SPECTRUM LINE RATIO
C
C  OUTPUT: (I*4)   ISEL     = NUMBER OF DEFAULT CONTOUR VALUES = NCONTR.
C  OUTPUT: (R*8)   CONTR()  = DEFAULT CONTOUR VALUES
C
C          (R*8)   MAXRNG   = PARAMETER = CONTOUR RANGE IF 'RMIN.LE.0'
C                                         (SEE NOTES ON 'RGAP')
C
C          (I*4)   IVAL     = CONTOUR VALUE INDEX NUMBER
C
C          (R*8)   RGAP     = IF LCFLOG=.TRUE.  =>LOG10 CONTOUR INTERVAL
C                             IF LCFLOG=.FALSE. =>CONTOUR INTERVAL
C                             NOTE: IF  'LCFLOG=.TRUE.' AND  'RMIN <= 0'
C                                   THEN 'RGAP' IS RESTRICTED TO A VALUE
C                                   WHICH WILL LEAD  TO  CONTOUR  VALUES
C                                   COVERING A RANGE 'MAXRNG'  I.E. FROM
C                                   '(RMAX/MAXRNG)' -> 'RMAX'.
C
C ROUTINES: NONE
C
C NOTE:
C          CONTOURS: DIVIDE RANGE COVERED BY LINE RATIOS INTO 'NCONTR+1'
C                    INTERVALS. THE MINMUM AND MAXIMUM VALUES THEMSELVES
C                    ARE NOT USED AS CONTOUR VALUES.
C
C          IF (LCFLOG) THEN TAKE EQUALLY SPACED CONTOUR VALUES ON LOG10
C          SCALE.
C
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    17/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      REAL*8     MAXRNG
C-----------------------------------------------------------------------
      PARAMETER( MAXRNG = 1.0D+20 )
C-----------------------------------------------------------------------
      INTEGER    NCONTR           , ISEL
      INTEGER    IVAL
C-----------------------------------------------------------------------
      REAL*8     RMIN             , RMAX
      REAL*8     RGAP
C-----------------------------------------------------------------------
      LOGICAL    LCFLOG
C-----------------------------------------------------------------------
      REAL*8     CONTR(NCONTR)
C-----------------------------------------------------------------------
```

B7CHKM

```
      SUBROUTINE B7CHKM( NMET   , IMETR , ICNTE , IE1A , LMETR )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B7CHKM *********************
C
C  PURPOSE: TO CHECK IF TRANSITIONS EXIST TO THE METASTABLE LEVELS.
C           (IDENTICAL TO: 'BXCHKM' )
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  INPUT : (I*4)   NMET    = NUMBER OF METASTABLES ( 1 <= NMET <= 5 )
C  INPUT : (I*4)   IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C  INPUT : (I*4)   ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C  INPUT : (I*4)   IE1A()  = ELECTRON IMPACT TRANSITION: LOWER ENERGY
C                            LEVEL INDEX.
C
C  OUTPUT: (L*4)   LMETR() = .TRUE.  =>ELECTRON IMPACT TRANSITION EXISTS
C                                      TO THE METASTABLE LEVEL  GIVEN BY
C                                       'IMETR()'.
C                            .FALSE. =>ELECTRON  IMPACT  TRANSITIONS  DO
C                                      NOT EXIST TO THE METASTABLE LEVEL
C                                      GIVEN BY 'IMETR()'.
C
C          (I*4)  I4UNIT   = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (I*4)   I       = GENERAL USE
C          (I*4)   J       = GENERAL USE
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   I4UNIT
      INTEGER   NMET        , ICNTE
      INTEGER   I           , J
      INTEGER   IMETR(NMET) , IE1A(ICNTE)
C-----------------------------------------------------------------------
      LOGICAL   LMETR(NMET)
C-----------------------------------------------------------------------
```

B7CNAM

```
       SUBROUTINE B7CNAM( NDLEV  , STRGA ,
     &                    ICNTE  , IE1A  , IE2A ,
     &                    NSTRN  , ISTRN ,
     &                    CSTRN
     &                  )
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B7CNAM *********************
C
C  PURPOSE: TO SET UP THE TITLES FOR COMPOSITE LINE ASSEMBLY TRANSITIONS
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C
C  INPUT : (I*4)  ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS
C  INPUT : (I*4)  IE1A()  = ELECTRON IMPACT TRANSITION:
C                           LOWER ENERGY LEVEL INDEX.
C  INPUT : (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                           UPPER ENERGY LEVEL INDEX.
C
C  INPUT : (I*4)  NSTRN   = NO. OF LINES CHOSEN FOR COMPOSITE ASSEMBLY
C  INPUT : (I*4)  ISTRN() = SELECTED TRANSITION INDEXES FOR COMPOSITE
C                           LINE ASSEMBLY
C
C  OUTPUT: (C*40) CSTRN() = SELECTED TRANSITION TITLE FOR COMPOSITE
C                           LINE ASSEMBLY
C
C          (I*4)  I       = GENERAL USE.
```

```
C          (I*4)  J       = GENERAL USE.
C          (I*4)  ILEV(1) = COMPOSITE LINE TRANSITION: LOWER LEVEL INDEX
C          (I*4)  ILEV(2) = COMPOSITE LINE TRANSITION: UPPER LEVEL INDEX
C
C          (C*18) CLEV(1) = COMPOSITE LINE TRANSITION: LOWER LEVEL TITLE
C                           (BRACKETS REMOVED FROM AROUND QUANTUM NOS.)
C          (C*18) CLEV(2) = COMPOSITE LINE TRANSITION: UPPER LEVEL TITLE
C                           (BRACKETS REMOVED FROM AROUND QUANTUM NOS.)
C          (C*22) C22     = GENERAL USE 22 BYTE CHARACTER STRING
C
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
      INTEGER   NDLEV           , ICNTE           , NSTRN
      INTEGER   I               , J
C-----------------------------------------------------------------------
      INTEGER   ILEV(2)
      INTEGER   ISTRN(NSTRN)    , IE1A(ICNTE)     , IE2A(ICNTE)
C-----------------------------------------------------------------------
      CHARACTER C22*22          , CLEV(2)*18
      CHARACTER STRGA(NDLEV)*22 , CSTRN(NSTRN)*40
C-----------------------------------------------------------------------
```

B7CTYP

```
      SUBROUTINE B7CTYP( NSTRN  , ISTRN  ,
     &                   ICNTE  , NMET   , NORD   ,
     &                   IE2A   , IMETR  , IORDR  ,
     &                   AVAL   ,
     &                   KSTRN  , LSTRN  , ASTRN
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B7CTYP *********************
C
C  PURPOSE: TO IDENTIFY COMPOSITE LINE UPPER-LEVEL-INDEXES AS EITHER
C           ORDINARY OR METASTABLE LEVELS AND TO FIND THEIR ORDINARY
C           OR METASTABLE LEVEL INDEXES. ALSO IDENTIFIES COMPOSITE
C           LINE A-VALUES.
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NSTRN   = NO. OF LINES CHOSEN FOR COMPOSITE ASSEMBLY
C  INPUT : (I*4)  ISTRN() = SELECTED TRANSITION INDEXES FOR COMPOSITE
C                           LINE ASSEMBLY
C
C  INPUT : (I*4)  ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES (1 <= NMET <= 'NDMET')
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C
C  INPUT : (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                           UPPER ENERGY LEVEL
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET' )
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                           LEVEL LIST.
C
C  INPUT : (I*4)  AVAL()  = ELECTRON IMPACT TRANSITION: A-VALUE (SEC-1)
C
C  OUTPUT: (I*4)  KSTRN() = ORDINARY/METASTABLE LEVEL INDEX OF UPPER
C                           LEVEL OF COMPOSITE LINE TRANSITION (SEE:
C                                                              'LSTRN()')
C  OUTPUT: (L*4)  LSTRN() = .TRUE.  => COMPOSITE LINE IS METASTABLE
C                           .FALSE. => COMPOSITE LINE IS ORDINARY
C  OUTPUT: (R*8)  ASTRN() = COMPOSITE LINE A-VALUE (SEC-1)
C
C          (I*4)  IULEV   = COMPOSITE LINE UPPER-LEVEL INDEX
C          (I*4)  I       = COMPOSITE LINE ARRAY INDEX
C          (I*4)  IM      = METASTABLE LEVEL ARRAY INDEX
C          (I*4)  IO      = ORDINARY LEVEL ARRAY INDEX
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
       INTEGER   NSTRN        , ICNTE        , NMET         , NORD
       INTEGER   I            , IM           , IO           , IULEV
C-----------------------------------------------------------------------
```

```
       INTEGER   ISTRN(NSTRN) , IE2A(ICNTE)  , IMETR(NMET) , IORDR(NORD)
       INTEGER   KSTRN(NSTRN)
C-----------------------------------------------------------------------
       REAL*8    ASTRN(NSTRN) , AVAL(ICNTE)
C-----------------------------------------------------------------------
       LOGICAL   LSTRN(NSTRN)
C-----------------------------------------------------------------------
```

B7DATA

```
      SUBROUTINE B7DATA( IUNIT  ,
     &                   NDLEV  , NDTEM  , NDDEN  , NDMET ,
     &                   DSNINC , TITLED ,
     &                   IZ     , IZ0    , IZ1    , BWNO  ,
     &                   IL     , NMET   , NORD   ,
     &                   MAXT   , MAXD   , ICNTR  , ICNTH ,
     &                   IA     , ISA    , ILA    , XJA   ,
     &                   CSTRGA ,
     &                   IMETR  , IORDR  , TEA    , DENSA ,
     &                   STCKM  , STVR   , STVH   ,
     &                   STVRM  , STVHM  , STACK
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B7DATA ******************
C
C  PURPOSE:  TO INPUT DATA FROM A CONTOUR PASSING FILE.
C            POPULATION  DATA  FOR DIAGNOSTIC USE.
C
C  CALLING PROGRAM: ADAS207
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = INPUT UNIT NUMBER FOR RESULTS
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
CX  OUTPUT: (C*44) DSNINC  = INPUT COPASE DATA SET NAME (IN QUOTES),
C  OUTPUT: (C*80) DSNINC  = INPUT COPASE DATA SET NAME (IN QUOTES),
C                           USED TO GENERATE 'CONTOUR' DATA.
C  OUTPUT: (C*3)  TITLED  = ELEMENT SYMBOL.
C
C  OUTPUT: (I*4)  IZ      =  RECOMBINED ION CHARGE
C  OUTPUT: (I*4)  IZ0     =         NUCLEAR CHARGE
C  OUTPUT: (I*4)  IZ1     = RECOMBINING ION CHARGE
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  OUTPUT: (R*8)  BWNO    = IONISATION POTENTIAL (CM-1)
C
C  OUTPUT: (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  OUTPUT: (I*4)  NMET    = NUMBER OF METASTABLES LEVELS: 1<=NMET<=NDMET
C  OUTPUT: (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C
C  OUTPUT: (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> 'NDTEM')
C  OUTPUT: (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> 'NDDEN')
C  OUTPUT: (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  OUTPUT: (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  OUTPUT: (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  OUTPUT: (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  OUTPUT: (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  OUTPUT: (R*8)  XJA()   = QUANTUM NUMBER FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C
C  OUTPUT: (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C
C  OUTPUT: (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C  OUTPUT: (I*4)  IORDR() = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST.
C  OUTPUT: (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  OUTPUT: (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C
C  OUTPUT: (R*8) STCKM(,,) = METASTABLE POPULATIONS STACK
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  OUTPUT: (R*8) STVR(,,)  = FREE ELECTRON RECOMBINATION COEFFICIENTS
C                            1st DIMENSION: LEVEL INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  OUTPUT: (R*8) STVH(,,)  =  CHARGE EXCHANGE COEFFICIENTS
C                            1st DIMENSION: LEVEL INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  OUTPUT: (R*8) STVRM(,,) = METASTABLE FREE ELECTRON RECOMBINATION
C                           COEFFICIENTS.
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
```

```
C  OUTPUT: (R*8) STVHM(,,) = METASTABLE CHARGE EXCHANGE COEFFICIENTS
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  OUTPUT: (R*8) STACK(,,,)= POPULATION DEPENDENCE
C                              1st DIMENSION: LEVEL INDEX
C                              2nd DIMENSION: METASTABLE INDEX
C                              3rd DIMENSION: TEMPERATURE INDEX
C                              4th DIMENSION: DENSITY INDEX
C
C          (I*4) I4UNIT    = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (I*4) I         = GENERAL USE
C          (I*4) J         = GENERAL USE
C          (I*4) K         = GENERAL USE
C          (I*4) L         = GENERAL USE
C
C NOTE:
C          THIS INPUT DATA IS FROM THE PROGRAM 'SPFPOPN/P'
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    09/10/90
C
C UPDATE:  22/10/92 - PEB: INCLUDED ERROR HANDLING FOR ARRAY OVERFLOWS
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C UPDATE:  28/01/94 - PE BRIDEN - ADAS91: INCREASED CSTRGA C*12 -> C*18
C                                        FORMAT 1003 CHANGED ACCORDINGLY
C
C UPDATE:  09/03/95 - SP BELLAMY -  UNIX: INCREASE DSNINC TO 80
C                                         AND CHANGE FORMAT 1000
C
C-----------------------------------------------------------------------
      INTEGER   I4UNIT
      INTEGER   IUNIT     ,
     &          NDLEV     , NDTEM      , NDDEN   , NDMET
      INTEGER   IZ        , IZ0        , IZ1     ,
     &          IL        , NMET       , NORD    ,
     &          MAXT      , MAXD       , ICNTR   , ICNTH
      INTEGER   I         , J          , K       , L
C-----------------------------------------------------------------------
      REAL*8    BWNO
C-----------------------------------------------------------------------
      CHARACTER TITLED*3         , DSNINC*80
      CHARACTER CSTRGA(NDLEV)*18
C-----------------------------------------------------------------------
      INTEGER   IA(NDLEV)        , ISA(NDLEV)       , ILA(NDLEV)
      INTEGER   IMETR(NDMET)     , IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8   XJA(NDLEV)        , TEA(NDTEM)       , DENSA(NDDEN)
      REAL*8   STCKM(NDMET,NDTEM,NDDEN)
      REAL*8   STVR(NDLEV,NDTEM,NDDEN)        , STVH(NDLEV,NDTEM,NDDEN)
      REAL*8   STVRM(NDMET,NDTEM,NDDEN)       , STVHM(NDMET,NDTEM,NDDEN)
      REAL*8   STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
```

B7DATC

```
       SUBROUTINE B7DATC( IUNIT  , NDLEV  , NDTRN ,
     &                    TITLED , IZ     , IZ0   , IZ1   , BWNO  ,
     &                    IL     ,
     &                    IA     , CSTRGA , ISA   , ILA   , XJA   ,
     &                    WA     ,
     &                    ICNTE  ,
     &                    IE1A   , IE2A   , AVAL
     &                  )
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B7DATC *********************
C
C  PURPOSE:  TO  FETCH ELECTRON IMPACT TRANSITION A-VALUES FROM COPASE
C            DATA SET WHOSE NAME APPEARED IN THE CONTOUR-PASSING FILE.
C            ALSO CHECKS HEADING & LEVEL DATA FOR CONSISTENCY WITH THE
C            CONTOUR PASSING FILE.
C
C  CALLING PROGRAM: ADAS207
C
C  DATA:
C           THE 'REAL' DATA IN THE FILE IS REPRESENTED IN AN ABBREVIATED
C           FORM WHICH OMITS THE "D" OR "E" EXPONENT SPECIFIER.
C           e.g. 1.23D-06 or 1.23E-06 IS REPRESENTED AS 1.23-06
```

```
C                6.75D+07 or 6.75E+07 IS REPRESENTED AS 6.75+07
C
C           THEREFORE THE FORM OF EACH 'REAL' NUMBER IN THE DATA SET IS:
C                        N.NN+NN or N.NN-NN
C
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C           RATE COEFFT.        : CM3 SEC-1
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = UNIT TO WHICH INPUT FILE IS ALLOCATED
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS THAT CAN BE READ
C  INPUT : (I*4)  NDTRN   = MAX. NUMBER OF TRANSITIONS THAT CAN BE READ
C
C  INPUT : (C*3)  TITLED  = CONTOUR FILE: ELEMENT SYMBOL.
C  INPUT : (I*4)  IZ      = CONTOUR FILE: RECOMBINED ION CHARGE READ
C  INPUT : (I*4)  IZ0     = CONTOUR FILE:         NUCLEAR CHARGE READ
C  INPUT : (I*4)  IZ1     = CONTOUR FILE: RECOMBINING ION CHARGE READ
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT : (R*8)  BWNO    = CONTOUR FILE: IONISATION POTENTIAL (CM-1)
C
C  INPUT : (I*4)  IL      = CONTOUR FILE: NUMBER OF ENERGY LEVELS
C
C  INPUT : (I*4)  IA()    = CONTOUR FILE: ENERGY LEVEL INDEX NUMBER
C  INPUT : (C*18) CSTRGA()= CONTOUR FILE:
C                           NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  INPUT : (I*4)  ISA()   = CONTOUR FILE: MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT : (I*4)  ILA()   = CONTOUR FILE:
C                           QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT : (R*8)  XJA()   = CONTOUR FILE:
C                           QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C
C  OUTPUT: (R*8)  WA()    = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C
C  OUTPUT: (I*4)  ICNTE   = INPUT DATA FILE: NUMBER OF ELECTRON IMPACT
C                           TRANSITIONS.
C
C  OUTPUT: (I*4)  IE1A()  = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  OUTPUT: (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C  OUTPUT: (R*8)  AVAL()  = ELECTRON IMPACT TRANSITION:
C                            A-VALUE (SEC-1)
C
C          (I*4)  IAPTH   = PARAMETER = THRESHOLD FOR A-VALUE EXPONENT
C
C          (I*4)  I4UNIT  = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (I*4)  IFIRST  = BYTE POSITION OF START OF NUMBER IN C56
C          (I*4)  ILAST   = BYTE POSITION OF END   OF NUMBER IN C56
C          (I*4)  IWORD   = THE WORD POSITION OF THE REQUIRED DATA IN
C                           A STRING TO BE INTERROGATED BY XXWORD.
C          (I*4)  JWORD   = GENERAL USE.
C          (I*4)  NWORDS  = NUMBER OF NUMBERS STORED IN C56
C          (I*4)  IABT    = RETURN CODE FROM 'R8FCTN' (0 => NO ERROR)
C                           OR FROM INTERROGATION OF 'C7'
C          (I*4)  I       = *NOT* GENERAL USE.
C          (I*4)  J       = *NOT* GENERAL USE.
C          (I*4)  K       = *NOT* GENERAL USE.
C          (I*4)  L       = GENERAL USE.
C          (I*4)  JJ      = GENERAL USE.
C          (I*4)  J1      = INPUT DATA FILE - SELECTED TRANSITION:
C                            LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C          (I*4)  J2      = INPUT DATA FILE - SELECTED TRANSITION:
C                            UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            CAPTURING    LEVEL INDEX (CASE 'H' & 'R')
C          (I*4)  IAPOW   = EXPONENT OF 'AVALM'
C
C          (R*8)  AVALM   = INPUT DATA FILE - SELECTED TRANSITION:
C                           MANTISSA OF:   ('IAPOW' => EXPONENT)
C                            A-VALUE (SEC-1)          (CASE ' ')
C                            NEUTRAL BEAM ENERGY      (CASE 'H')
C                            NOT USED                 (CASE 'P' & 'R')
C          (R*8)  DUMP    = GENERAL USE
C
C          (C*1)  TCODE   = TRANSITION: DATA TYPE POINTER:
C                           ' ' => Electron Impact   Transition
C                           'P' => Proton   Impact   Transition
C                           'H' => Charge   Exchange Recombination
C                           'R' => Free     Electron Recombination
C          (C*3)  C3      = GENERAL USE  3 BYTE CHARACTER STRING
C          (C*7)  C7      = GENERAL USE  7 BYTE CHARACTER STRING
C          (C*7)  CDELIM  = DELIMITERS FOR INPUT OF DATA FROM HEADERS
C          (C*7)  CFORM7  = FORMAT FOR INTERNAL READING OF REAL NUMBER
C          (C*18) C18     = GENERAL USE 18 BYTE CHARACTER STRING
C          (C*32) CERROR  = STRING USED IN CONSTRUCTING ERROR MESSAGE
C          (C*56) C56     = GENERAL 56 BYTE STRING FOR ERROR MESSAGES
C                           AND GENERAL STRING BUFFER STORAGE
C
```

```
C          (L*4)  LDATA   = IDENTIFIES  WHETHER  THE END OF AN  INPUT
C                           SECTION IN THE DATA SET HAS BEEN LOCATED.
C                           (.TRUE. => END OF SECTION REACHED)
C
C
C NOTE:
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C          R8FCTN     ADAS      CONVERTS FROM CHARACTER TO REAL VARIABLE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  11/12/90 - PE BRIDEN: ADAS91 REVISION -'IONISATION POTENTIAL'
C                     ALLOWED TO DIFFER BETWEEN CONTOUR AND COPASE FILES
C                     BY UP TO ONE CM-1 UNIT.   THIS ALLOWS FOR POSSIBLE
C                     ROUNDING ERRORS AS CONTOUR ONLY STORES  ITS  VALUE
C                     TO THE NEAREST CM-1,  WHEREAS COPASE  MAY  CONTAIN
C                     ITS VALUE TO A HIGHER ACCURACY.
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C UPDATE:  28/01/94 - PE BRIDEN - ADAS91: BROUGHT IN LINE WITH CXDATA
C                     ------------------------------------------------
C                   1.INPUT VARIABLE 'XJA' NOW ALLOWED TO HAVE A LENGTH
C                     OF BETWEEN 1 AND 6 STARTING AT COLUMN 30 - IT MUST
C                     BE FOLLOWED BY A ')' WHICH CANNOT BE PLACED AFTER
C                     COLUMN 36. INTRODUCED VARIABLE 'C7' TO PARSE VALUE
C                     AND USE FUNCTION R8FCTN TO INTERROGATE C7.
C                     - EDITED FORMAT STATEMENT 1003 ACCORDINGLY.
C                     - INTRODUCED FORMAT STATEMENTS 1010 and 1011.
C                   2. MAJOR REVISION -   MODIFIED TO READ IN NEW INPUT
C                                         DATA-SET STYLE AND ALSO ALLOW
C                                         THE OLD-STYLE TO BE READ.
C                                         CSTRGA INCREASED C*12 -> C*18
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 20-03-96
C MODIFIED: LALIT JALOTA (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER S.C.C.S. CONTROL
C
C VERSION: 1.2                          DATE: 03/05/95
C MODIFIED: TIM HAMMOND/HP SUMMERS
C               - RESTRICTED INCLUDED ELECTRON TRANSITIONS TO THOSE
C                 WITH NON-ZERO A-VALUE AND EXPONENT ABOVE A
C                 THRESHOLD (=IAPTH).
C
C VERSION: 1.3                          DATE: 03-04-96
C MODIFIED: TIM HAMMOND/PAUL BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C               - TIDIED UP HEADER COMMENTS
C               - INSTEAD OF USING FORMAT SPECIFIER F15.0 WHEN
C                 INTERNALLY READING A FLOATING POINT NUMBER CREATE
C                 THE APPROPRIATE SPECIFIER WITHIN CFORM7 AND USE THIS.
C
C VERSION: 1.4                          DATE: 03-04-96
C MODIFIED: TIM HAMMOND
C               - CORRECTED PROBLEM INTRODUCED BY PREVIOUS CHANGE AS
C                 VARIABLE J WAS USED BY VARIOUS PARTS OF THE CODE
C                 WHEN IN FACT ITS VALUE IS IMPORTANT. THESE 'NEW'
C                 VALUES OF J HAVE BEEN REPLACED BY JJ.
C
C-----------------------------------------------------------------------
      INTEGER   IAPTH
      PARAMETER(IAPTH = -10 )
C-----------------------------------------------------------------------
      INTEGER   I4UNIT
      INTEGER   IUNIT       , NDLEV          , NDTRN      ,
     &          IZ          , IZ0            , IZ1        ,
     &          IL          , ICNTE
      INTEGER   IFIRST(1)   , ILAST(1)       , IWORD      , JWORD     ,
     &          NWORDS      , IABT
      INTEGER   I           , J              , K          , L         ,
     &          J1          , J2             , IAPOW      , JJ
      INTEGER   IA(NDLEV)   , ISA(NDLEV)     , ILA(NDLEV) ,
     &          IE1A(NDTRN) , IE2A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8    R8FCTN
      REAL*8    DUMP
      REAL*8    BWNO        , AVALM
      REAL*8    XJA(NDLEV)  , WA(NDLEV)      ,
     &          AVAL(NDTRN)
C-----------------------------------------------------------------------
      CHARACTER TITLED*3    , TCODE*1        , C3*3       , C7*7      ,
     &          CFORM7*7    ,
     &          CDELIM*7    , C18*18         , CERROR*32  , C56*56
      CHARACTER CSTRGA(NDLEV)*18
C-----------------------------------------------------------------------
      LOGICAL   LDATA
C-----------------------------------------------------------------------
```

```
      DATA      CFORM7 / '(F??.0)' /
      DATA      CDELIM /' ()<>{}'/
      DATA      CERROR /'CONTOUR/COPASE FILE DISCREPANCY:'/
C-----------------------------------------------------------------------
      SAVE      CDELIM      , CFORM7         , CERROR
C-----------------------------------------------------------------------
```

B7LRAT

```
      SUBROUTINE B7LRAT( EM1    , EM2    ,
     &                   RMIN   , RMAX   ,
     &                   RAT
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B7LRAT *********************
C
C  PURPOSE: TO CALCULATE THE SPECTRUM-LINE INTENSITY RATIO FOR TWO
C           COMPOSITE LINES FROM THEIR INDIVIDUAL SPECTRUM LINE
C           INTENSITIES. INTENSITIES AT FIXED TEMPERATURE AND DENSITY.
C           'RMIN' AND 'RMAX' CONTAIN MINIMUM AND MAXIMUM RATIO VALUES.
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  INPUT : (R*8)  EM1     = FIRST COMPOSITE ASSEMBLY SPECTRUM-LINE
C                           INTENSITY, AT FIXED TEMPERATURE & DENSITY.
C  INPUT : (R*8)  EM2     = SECOND COMPOSITE ASSEMBLY SPECTRUM-LINE
C                           INTENSITY, AT FIXED TEMPERATURE & DENSITY.
C
C  I/O   : (R*8)  RMIN    = MINIMUM SPECTRUM-LINE INTENSITY RATIO VALUE
C  I/O   : (R*8)  RMAX    = MAXIMUM SPECTRUM-LINE INTENSITY RATIO VALUE
C
C  OUTPUT: (R*8)  RAT     = SPECTRUM-LINE INTENSITY RATIO
C
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
      REAL*8    EM1          , EM2
      REAL*8    RMIN         , RMAX        ,
     &          RAT
C-----------------------------------------------------------------------
```

B7OUT0

```
      SUBROUTINE B7OUT0( IUNIT  , DATE   , DSNP44 , DSNC44 ,
     &                   TITLED , IZ     , IZ0    , IZ1    , BWNO ,
     &                   IL     ,
     &                   IA     , CSTRGA , ISA    , ILA    , XJA  , WA ,
     &                   ICNTR  , ICNTH  ,
     &                   NMET   , IMETR  , LMETR  , STRGA  ,
     &                   MAXT   , TEA    ,
     &                   MAXD   , DENSA
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B7OUT0 *********************
C
C  PURPOSE: TO OUTPUT ION SPECIFICATIONS, INDEXED ENERGY LEVELS ,
C           WAVE NUMBERS RELATIVE  TO GROUND AND OTHER DATA STORED
C           IN THE CONTOUR PASSING FILE. OUTPUT TO STREAM 'IUNIT'.
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT    = OUTPUT STREAM NUMBER
C  INPUT : (C*8)  DATE     = CURRENT DATE AS 'DD/MM/YY'
CX UNIX/IDL PORT - MAKE FILE NAME VARIABLES 80 CHARACTERS
CX  INPUT : (C*44) DSNP44   = INPUT CONTOUR-PASSING FILE DSN
CX  INPUT : (C*44) DSNC44   = ASSOCIATED COPASE FILE DSN
CX INPUT : (C*80) DSNP44   = INPUT CONTOUR-PASSING FILE DSN
CX INPUT : (C*80) DSNC44   = ASSOCIATED COPASE FILE DSN
C
C  INPUT : (C*3)  TITLED  = ELEMENT SYMBOL.
C  INPUT : (I*4)  IZ      =  RECOMBINED ION CHARGE
C  INPUT : (I*4)  IZ0     =         NUCLEAR CHARGE
C  INPUT : (I*4)  IZ1     = RECOMBINING ION CHARGE
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
```

```
C  INPUT : (R*8)  BWNO    = IONISATION POTENTIAL (CM-1)
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS
C
C  INPUT : (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  INPUT : (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT : (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT : (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT : (R*8)  WA()    = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C
C  INPUT : (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS
C  INPUT : (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS
C
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C  INPUT : (L*4)  LMETR() = .TRUE.  => ELECTRON IMPACT TRANSITION EXISTS
C                                      TO THE METASTABLE LEVEL  GIVEN BY
C                                      'IMETR()'.
C                           .FALSE. => ELECTRON  IMPACT  TRANSITIONS  DO
C                                      NOT EXIST TO THE METASTABLE LEVEL
C                                      GIVEN BY 'IMETR()'.
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C
C          (R*8)  WN2RYD  = PARAMETER =
C                           WAVE NUMBER (CM-1) TO RYDBERG CONVERSION
C
C          (I*4)  L1      = PARAMETER = 1
C          (I*4)  L2      = PARAMETER = 2
C          (I*4)  L3      = PARAMETER = 3
C
C          (R*8)  R8DCON  = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (R*8)  R8TCON  = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (R*8)  BRYDO   = IONISATION POTENTIAL (RYDBERGS)
C          (R*8)  BWN     = ENERGY RELATIVE TO IONISATION POTENTIAL IN
C                           WAVE NUMBERS (CM-1).
C          (R*8)  BRYD    = ENERGY RELATIVE TO IONISATION POTENTIAL IN
C                           RYDBERGS.
C          (R*8)  ERVAL   = ENERGY RELATIVE TO LEVEL 1 (RYDBERGS)
C          (R*8)  TEV     = ELECTRON TEMPERATURE (eV)
C          (R*8)  TRED    = ELECTRON TEMPERATURE (reduced)
C          (R*8)  DRED    = ELECTRON DENSITY (reduced)
C
C          (I*4)  I       = GENERAL USE
C
C          (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXADAS     ADAS      GATHERS ADAS HEADER INFORMATION
C          R8DCON     ADAS      FUNCTION - DENSITY UNIT CONVERSION
C          R8TCON     ADAS      FUNCTION - TEMPERATURE UNIT CONVERSION
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  17/01/91 - PE BRIDEN: ADDED HEADER INFORMATION TO OUTPUT
C                                - RENAMED SUBROUTINE (ORIGINALLY B7WR7A)
C
C UPDATE:  28/01/91 - PE BRIDEN: REFORMATTED OUTPUT. INTRODUCED 'WN2RYD'
C                                'BRYD' & 'BRYDO'. RENAMED 'BW' -> 'BWN'
C
C UPDATE:  29/01/91 - PE BRIDEN: SET 'CADAS' TO BLANK AT START (VIA DATA
C                                STATEMENT) AND ADDED 'SAVE CADAS'.
C
C UPDATE:  28/01/94 - PE BRIDEN: ADAS91 - INCREASED CSTRGA C*12 -> C*18
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 30-03-95
C MODIFIED: LALIT JALOTA (TESSELLA SUPPORT SERVICES PLC)
C               - FIRST VERSION
C
C VERSION: 1.2                          DATE: 09-02-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - REPLACED OUTDATED HOLLERITH CODES WITH SPACES
C
C-----------------------------------------------------------------------
      INTEGER    L1           , L2            , L3
C-----------------------------------------------------------------------
      REAL*8     WN2RYD
C-----------------------------------------------------------------------
      PARAMETER( L1 = 1       , L2 = 2        , L3 = 3     )
C-----------------------------------------------------------------------
      PARAMETER( WN2RYD = 9.11269D-06 )
```

```
C-----------------------------------------------------------------------
      INTEGER    I
      INTEGER    IUNIT         , ICNTR          , ICNTH      ,
     &           IZ            , IZ0            , IZ1        ,
     &           IL            , NMET           ,
     &           MAXT          , MAXD
C-----------------------------------------------------------------------
      REAL*8     R8DCON        , R8TCON
      REAL*8     BWNO          , BWN            , BRYDO      , BRYD   ,
     &           ERVAL         , TEV            , TRED       , DRED
C-----------------------------------------------------------------------
CX UNIX/IDL PORT - MAKE FILE NAMES 80 CHARACTERS
      CHARACTER  TITLED*3      , DATE*8         ,
CX     &           DSNP44*44     , DSNC44*44      , CADAS*80
     &           DSNP44*80     , DSNC44*80      , CADAS*80
C-----------------------------------------------------------------------
      INTEGER    IA(IL)        , ISA(IL)        , ILA(IL)
      INTEGER    IMETR(NMET)
C-----------------------------------------------------------------------
      REAL*8     XJA(IL)       , WA(IL)         ,
     &           TEA(MAXT)     , DENSA(MAXD)
C-----------------------------------------------------------------------
      CHARACTER  CSTRGA(IL)*18 , STRGA(IL)*22
C-----------------------------------------------------------------------
      LOGICAL    LMETR(IL)
C-----------------------------------------------------------------------
      SAVE       CADAS
C-----------------------------------------------------------------------
      DATA       CADAS/' '/
C-----------------------------------------------------------------------
```

B7OUT1

```
      SUBROUTINE B7OUT1( IUNIT  , LEQUIL ,
     &                   NDLEV  , NDMET  , NDTEM  , NDDEN  ,
     &                            NMET   , MAXT   , MAXD   ,
     &                            IMETR  , TEA    , DENSA  ,
     &                            XMMULT ,
     &                   ICNTE  , ICNTR  , ICNTH  ,
     &                   IE1A   , IE2A   ,
     &                   STRGA  , RATHA  , RATIA  ,
     &                   NSTRN1 , ISTRN1 , LSTRN1 , ASTRN1 ,
     &                   EM1    ,
     &                   NSTRN2 , ISTRN2 , LSTRN2 , ASTRN2 ,
     &                   EM2    ,
     &                   RAT
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B7OUT1 ******************
C
C  PURPOSE: OUTPUT OF MAIN RESULTS (SPECTRUM LINE INTENSITIES & RATIOS)
C
C  CALLING PROGRAM: ADAS207
C
C  DATA:
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           TEMPERATURES        : KELVIN
C           DENSITIES           : CM-3
C           A-VALUES            : SEC-1
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT FOR RESULTS
C  INPUT : (L*4)  LEQUIL  = .TRUE.  =>     EQUILIBRIUM CONDITIONS
C                         = .FALSE. => NON-EQUILIBRIUM CONDITIONS
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLE LEVELS (1<=NMET<=NDMET)
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> NDTEM)
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> NDDEN )
C
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET' )
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C
C  INPUT : (R*8)  XMMULT()= METASTABLE LEVEL SCALING FACTORS
C
C  INPUT : (I*4)  ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C  INPUT : (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT : (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  INPUT : (I*4)  IE1A()   = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  INPUT : (I*4)  IE2A()   = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
```

```
C
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C  INPUT : (R*8)  RATHA() = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C  INPUT : (R*8)  RATIA() = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C
C  INPUT : (I*4)  NSTRN1  = NO. OF LINES CHOSEN FOR FIRST COMPOSITE
C                           ASSEMBLY
C  INPUT : (I*4)  ISTRN1()= SELECTED TRANSITION INDEXES FOR FIRST
C                           COMPOSITE LINE ASSEMBLY
C  INPUT : (L*4)  LSTRN1()= FIRST COMPOSITE LINE ASSEMBLY:
C                           .TRUE.  => COMPOSITE LINE IS METASTABLE
C                           .FALSE. => COMPOSITE LINE IS ORDINARY
C  INPUT : (R*8)  ASTRN1()= COMPOSITE LINE A-VALUE (SEC-1) FOR FIRST
C                           COMPOSITE LINE ASSEMBLY
C
C  INPUT : (R*8)  EM1(,)  = SPECTRUM-LINE INTENSITY FOR FIRST COMPOSITE
C                           ASSEMBLY AT GIVEN TEMPERATURE AND DENSITY.
C                           1st DIMENSION = ELECTRON TEMPERATURE INDEX
C                           2nd DIMENSION = ELECTRON DENSITY INDEX
C
C  INPUT : (I*4)  NSTRN2  = NO. OF LINES CHOSEN FOR SECOND COMPOSITE
C                           ASSEMBLY
C  INPUT : (I*4)  ISTRN2()= SELECTED TRANSITION INDEXES FOR SECOND
C                           COMPOSITE LINE ASSEMBLY
C  INPUT : (L*4)  LSTRN2()= SECOND COMPOSITE LINE ASSEMBLY:
C                           .TRUE.  => COMPOSITE LINE IS METASTABLE
C                           .FALSE. => COMPOSITE LINE IS ORDINARY
C  INPUT : (R*8)  ASTRN2()= COMPOSITE LINE A-VALUE (SEC-1) FOR SECOND
C                           COMPOSITE LINE ASSEMBLY
C
C  INPUT : (R*8)  EM2(,)  = SPECTRUM-LINE INTENSITY FOR SECOND COMPOSITE
C                           ASSEMBLY AT GIVEN TEMPERATURE AND DENSITY.
C                           1st DIMENSION = ELECTRON TEMPERATURE INDEX
C                           2nd DIMENSION = ELECTRON DENSITY INDEX
C
C  INPUT : (R*8)  RAT(,)  = SPECTRUM LINE INTENSITY RATIOS:
C                           1st DIMENSION = ELECTRON TEMPERATURE INDEX
C                           2nd DIMENSION = ELECTRON DENSITY INDEX
C                           ( = EM1(,) / EM2(,) )
C
C          (I*4)  PGLEN   = PARAMETER = NUMBER OF LINES PER OUTPUT PAGE
C
C          (C*3)  CMET    = PARAMETER = 'MET'  (METASTABLE LEVEL)
C          (C*3)  CORD    = PARAMETER = 'ORD'  (ORDINARY LEVEL)
C          (C*6)  C1ST    = PARAMETER = 'FIRST '
C          (C*6)  C2ND    = PARAMETER = 'SECOND'
C
C          (I*4)  NBLOCK  = NUMBER OF LINES IN CURRENT OUTPUT BLOCK.
C          (I*4)  NLINES  = LAST PAGE LINE WRITTEN.
C                           IF 'NLINES+NBLOCK' > 'PGLEN' START NEW PAGE.
C          (I*4)  ISTOP   = NUMBER OF OUTPUT DENSITY BLOCKS REQUIRED
C                           FOR SPECTRUM LINE INTENSITY RESULTS.
C                         = 1 => 'MAXD' < 11
C                         = 2 => 'MAXD' > 10
C          (I*4)  IB      = OUTPUT BLOCK INDEX NUMBER FOR ARRAY USE
C          (I*4)  IC      = COMPOSITE ASSEMBLY LINE NUMBER FOR ARRAY USE
C          (I*4)  IM      = METASTABLE LEVEL NUMBER FOR ARRAY USE
C          (I*4)  IN      = DENSITY INDEX NUMBER FOR ARRAY USE
C          (I*4)  IT      = TEMPERATURE INDEX NUMBER FOR ARRAY USE
C
C          (C*3)  C3LEV   = COMPOSITE ASSEMBLY LINE TYPE: 'ORD'INARY OR
C                                                         'MET'ASTABLE
C
C          (I*4)  INBGN(1)= STARTING DENSITY INDEX FOR OUTPUT BLOCK 1=1
C          (I*4)  INBGN(2)= STARTING DENSITY INDEX FOR OUTPUT BLOCK 2
C                           IF 'ISTOP=1' (I.E. 'MAXD' < 11) = NOT USED
C                           IF 'ISTOP=2' (I.E. 'MAXD' > 10) = 11
C          (I*4)  INEND(1)= FINAL DENSITY INDEX FOR OUTPUT BLOCK 1.
C                           IF 'ISTOP=1' = 'MAXD'
C                           IF 'ISTOP=2' = 10
C          (I*4)  INBGN(2)= FINAL DENSITY INDEX FOR OUTPUT BLOCK 2
C                           IF 'ISTOP=1' (I.E. 'MAXD' < 11) = NOT USED
C                           IF 'ISTOP=2' (I.E. 'MAXD' > 10) = 'MAXD'
C
C
C NOTE:
C          DENSITIES ARE OUTPUT IN BLOCKS OF TEN.
C
C          AN 'OUTPUT BLOCK' IS A SINGLE CONTAINED OUTPUT TABLE
C
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXSTNP     ADAS      STARTS NEW PAGE IF CURRENT PAGE FULL
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  17/01/91 - PE BRIDEN: RENAMED SUBROUTINE (ORIGINALLY B7WR7B)
C
C UNIX-IDL PORT:
C
```

```
C VERSION: 1.1                          DATE: 30-03-95
C MODIFIED: LALIT JALOTA (TESSELLA SUPPORT SERVICES PLC)
C               - FIRST VERSION
C
C VERSION: 1.2                          DATE: 09-02-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - REMOVED HOLLERITH CONSTANTS FROM OUTPUT
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   PGLEN
C-----------------------------------------------------------------------
      CHARACTER CMET*3    , CORD*3    , C1ST*6    , C2ND*6
C-----------------------------------------------------------------------
      PARAMETER ( PGLEN = 63 )
C-----------------------------------------------------------------------
      PARAMETER ( CMET = 'MET'        , CORD = 'ORD'        ,
     &            C1ST = 'FIRST '     , C2ND = 'SECOND'     )
C-----------------------------------------------------------------------
      INTEGER   IUNIT     ,
     &          NDLEV     , NDTEM     , NDDEN       , NDMET
      INTEGER   NMET      , MAXT      , MAXD        ,
     &          ICNTE     , ICNTR     , ICNTH       ,
     &          NSTRN1    , NSTRN2
      INTEGER   NBLOCK    , NLINES    , ISTOP       ,
     &          IB        , IC        , IM          , IN        , IT
C-----------------------------------------------------------------------
      LOGICAL   LEQUIL
C-----------------------------------------------------------------------
      CHARACTER C3LEV*3
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)     , IE1A(ICNTE)     , IE2A(ICNTE)
      INTEGER   ISTRN1(NSTRN1)   , ISTRN2(NSTRN2)
      INTEGER   INBGN(2)         , INEND(2)
C-----------------------------------------------------------------------
      REAL*8    XMMULT(NDMET)    ,
     &          TEA(NDTEM)       , DENSA(NDDEN)     ,
     &          RATHA(NDDEN)     , RATIA(NDDEN)
      REAL*8    ASTRN1(NSTRN1)   , ASTRN2(NSTRN2)
      REAL*8    EM1(NDTEM,NDDEN) , EM2(NDTEM,NDDEN) ,
     &          RAT(NDTEM,NDDEN)
C-----------------------------------------------------------------------
      LOGICAL   LSTRN1(NSTRN1)   , LSTRN2(NSTRN2)
C-----------------------------------------------------------------------
      CHARACTER STRGA(NDLEV)*22
C-----------------------------------------------------------------------
```

B7OUTG

```
      SUBROUTINE B7OUTG( IOPT   , LGHOST , DATE   ,
     &                   NDDEN  , NDTEM  , IGMAX  , ICMAX  ,
     &                   IZ     , TITLED , GTIT1  , DSNINC ,
     &                   ISEL   , CONTR  , IGSEL  ,
     &                   LGRD1  , LDEF1  , LOGINT ,
     &                   XMIN   , XMAX   , YMIN   , YMAX   ,
     &                   NMET   , MAXD   , MAXT   , NSTRN1 , NSTRN2 ,
     &                   XMMULT , DENSA  , TEA    , CSTRN1 , CSTRN2 ,
     &                   STRGM  ,
     &                   RAT
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B7OUTG *********************
C
C  PURPOSE:  PIPE COMMUNICATION WITH IDL.
C
C            OPTION 1 - SPECTRUM LINE RATIO ON TEMP/DEN PLANE CONTOURS
C            OPTION 2 - SPECTRUM LINE RATION VS. TEMPERATURE PLOT
C            OPTION 3 - SPECTRUM LINE RATION VS. DENSITY PLOT
C
C            ELECTRON TEMPERATURES ARE IN KELVIN
C            ELECTRON DENSITIES    ARE IN CM-3
C
C            PLOTS ARE LOG/LOG.
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C
C  INPUT : (I*4)  IOPT    = GRAPHICAL OUTPUT OPTION NUMBER:
C                           1 => CONTOUR PLOT
C                           2 => SPECTRUM-LINE RATIO VS. TEMP. PLOT
C                           2 => SPECTRUM-LINE RATIO VS. DENSITY PLOT
C  INPUT : (L*4)  LGHOST  = .TRUE.  => GHOST80 INITIALISED
C                           .FALSE. => GHOST80 NOT INITIALISED
C  INPUT : (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF INPUT DENSITIES ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF INPUT TEMPERATURES ALLOWED
C  INPUT : (I*4)  IGMAX   = MAXIMUM NUMBER OF TEMPERATURE OR DENSITY
C                           VALUES THAT CAN BE PLOTTED ON A SINGLE
```

```
C                                GRAPH. MUST BE <= 20.
C  INPUT : (I*4)  ICMAX   = MAXIMUM NUMBER OF USER ENTERED CONTOUR
C                            VALUES THAT CAN BE PLOTTED ON A SINGLE
C                            GRAPH. MUST BE 20.
C
C  INPUT : (I*4)  IZ      = RECOMBINED ION CHARGE
C  INPUT : (C*3)  TITLED  = ELEMENT SYMBOL.
C  INPUT : (C*40) GTIT1   = ISPF ENTERED TITLE FOR GRAPH
C  INPUT : (C*44) DSNINC  = ASSOCIATED COPASE DATA SET NAME (MVS DSN)
C
C  INPUT : (I*4)  ISEL    = OPTION 1 - NUMBER OF OWN CONTOUR VALUES
C                                      ENTERED (=0 IF DEAULT SELECTED)
C                            OPTION 2 - NO. OF DENSITIES SELECTED FOR
C                                      GRAPHING (FROM INPUT LIST).
C                            OPTION 3 - NO. OF TEMPERATURES SELECTED
C                                      FOR GRAPHING (FROM INPUT LIST).
C  INPUT : (R*8)  CONTR() = OPTION 1 - CONTOUR VALUES
C                            OPTION 2 - NOT USED
C                            OPTION 3 - NOT USED
C  INPUT : (I*4)  IGSEL() = OPTION 1 - NOT USED
C                            OPTION 2 - INDEXES OF DENSITIES SELECTED
C                                      FOR GRAPHING.
C                            OPTION 3 - INDEXES OF TEMPERATURES
C                                      SELECTED FOR GRAPHING.
C
C  INPUT : (L*4)  LGRD1   = .TRUE.  => PUT GRAPH IN GRID FILE
C                         = .FALSE. => DO NOT PUT GRAPH IN GRID FILE
C  INPUT : (L*4)  LDEF1   = .TRUE.  => USE GRAPH DEFAULT SCALING
C                         = .FALSE. => DO NOT USE DEFAULT SCALING
C  INPUT : (L*4)  LOGINT  = OPTION 1:
C                            .TRUE.  => LOGARITHMIC INTERPOLATION
C                            .FALSE. => LINEAR INTERPOLATION
C                            OPTION 2 - NOT USED
C                            OPTION 3 - NOT USED
C
C  INPUT : (R*8)  XMIN    = OPTION 1 - NOT USED
C                            OPTION 2 - LOWER LIMIT FOR X-AXIS OF GRAPH
C                            OPTION 3 - LOWER LIMIT FOR X-AXIS OF GRAPH
C  INPUT : (R*8)  XMAX    = OPTION 1 - NOT USED
C                            OPTION 2 - UPPER LIMIT FOR X-AXIS OF GRAPH
C                            OPTION 3 - UPPER LIMIT FOR X-AXIS OF GRAPH
C  INPUT : (R*8)  YMIN    = OPTION 1 - NOT USED
C                            OPTION 2 - LOWER LIMIT FOR Y-AXIS OF GRAPH
C                            OPTION 3 - LOWER LIMIT FOR Y-AXIS OF GRAPH
C  INPUT : (R*8)  YMAX    = OPTION 1 - NOT USED
C                            OPTION 2 - UPPER LIMIT FOR Y-AXIS OF GRAPH
C                            OPTION 3 - UPPER LIMIT FOR Y-AXIS OF GRAPH
C
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT ELECTRON DENSITIES
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT ELECTRON TEMPERATURES
C  INPUT : (I*4)  NSTRN1  = NO. OF LINES CHOSEN FOR FIRST COMPOSITE
C                            ASSEMBLY
C  INPUT : (I*4)  NSTRN2  = NO. OF LINES CHOSEN FOR SECOND COMPOSITE
C                            ASSEMBLY
C
C
C  INPUT : (R*8)  XMMULT()= METASTABLE LEVEL SCALING FACTORS
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES (UNITS: CM-3)
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (C*40) CSTRN1()= SELECTED TRANSITION TITLES FOR FIRST
C                            COMPOSITE LINE ASSEMBLY
C  INPUT : (C*40) CSTRN2()= SELECTED TRANSITION TITLES FOR SECOND
C                            COMPOSITE LINE ASSEMBLY
C
C  INPUT : (C*22) STRGM() = METASTABLE LEVEL DESIGNATIONS
C                            DIMENSION: METASTABLE LEVEL INDEX
C
C  INPUT : (R*8)  RAT(,)  = SPECTRUM LINE INTENSITY RATIOS:
C                            1st DIMENSION = ELECTRON TEMPERATURE INDEX
C                            2nd DIMENSION = ELECTRON DENSITY INDEX
C
C
C          (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C          (I*4)   I, J     = LOOP INCREMENT
C          (I*4)   LOGIC    = USED TO PIPE LOGICAL VALUES
C
C ROUTINES:
C          ROUTINE     SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C NOTES:
C
C       GRAPHICAL OPTION 1:
C
C       CONTOURS ARE BASED ON A LOG10(TEMP.) VS. LOG10(DENSITY) GRID
C
C       THEREFORE CONTOURS ARE PLOTTED USING LINEAR MAPPING AND LOG10
C       TEMPERATURE AND DENSITY VALUES. THEREFORE RE-MAP PLOTTING REGION
C       USING SAME VECTOR SPACE AND EQUIVALENT RANGES.
C
C       IF THIS IS NOT CARRIED OUT THE APPEARANCE OF THE PLOT IS OF
C       EXPONENTIAL CURVES CONNECTING POINTS.
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
```

```
C          JET EXT. 4569
C
C DATE:    17/10/90
C
C UPDATE:  14/01/91 - PE BRIDEN - ADAS91 - IF LAST OUTPUT POINT ON GRAPH
C                                          IS OFF SCREEN WRITE LINE  KEY
C                                          AT LAST PLOTTED POSITION.
C                                          BEFORE THE KEY WAS NOT OUTPUT
C                                          - (ADDED VARIABLE 'IPLOT') -
C
C UPDATE:  17/01/91 - PE BRIDEN - ADAS91 - ADDED HEADER INFO. TO OUTPUT
C
C UPDATE:  25/01/91 - PE BRIDEN - ADAS91 - INTRODUCE 'NCTEM' AND 'NCDEN'
C
C UPDATE:  29/01/91 - PE BRIDEN: SET 'CADAS' TO BLANK AT START (VIA DATA
C                                STATEMENT) AND ADDED 'SAVE CADAS'.
C
C UPDATE:  13/08/91 - PE BRIDEN - ADAS91 - CORRECTED ERROR:
C                                          'NCTEM' & 'NCDEN'  BOTH  SET
C                                           EQUAL TO 'NDIM1', THE ARRAY
C                                           BOUND FOR 'SURFAS'. (BEFORE
C                                           THE EQUALLED 'NDTEM & NDDEN'
C                                           BY MISTAKE   -  THIS HAD NO
C                                           EFFECT ON ADAS207 AS NDTEM=
C                                           NDDEN=NDIM1.)
C
C UPDATE:  25/11/91 - PE BRIDEN: MADE FILNAM/PICSAV ARGUMENT LIST
C                                COMPATIBLE WITH GHOST VERSION 8.
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C UPDATE:  27/03/95 - SP BELLAMY - UNIX PORT
C
C VERSION: 1.1                          DATE: ??
C
C VERSION: 1.2                          DATE: 06-08-96
C MODIFIED: TIM HAMMOND
C           - ADDED A WRITE TO I4UNIT WHICH ALTHOUGH IT SHOULD
C             HAVE NO EFFECT APPEARS TO BE NEEDED TO STOP THE CODE
C             PRODUCING A MASSIVE CORE DUMP ON THE HP.
C
C-----------------------------------------------------------------------
      INTEGER   IOPT     , NDDEN    , NDTEM    , IGMAX    , ICMAX    ,
     &          IZ       , ISEL     , NMET     , MAXD     , MAXT     ,
     &          NSTRN1   , NSTRN2
C-----------------------------------------------------------------------
      REAL*8    XMIN     , XMAX     ,
     &          YMIN     , YMAX
C-----------------------------------------------------------------------
      LOGICAL   LGHOST   , LGRD1    , LDEF1    , LOGINT
C-----------------------------------------------------------------------
      CHARACTER TITLED*3 , GTIT1*40 , DSNINC*80, DATE*8
C-----------------------------------------------------------------------
      INTEGER   IGSEL(IGMAX)
C-----------------------------------------------------------------------
      REAL*8    CONTR(ICMAX)        , XMMULT(NMET)         ,
     &          DENSA(NDDEN)        , TEA(NDTEM)           ,
     &          RAT(NDTEM,NDDEN)
C-----------------------------------------------------------------------
      CHARACTER STRGM(NMET)*22, CSTRN1(NSTRN1)*40, CSTRN2(NSTRN2)*40
C-----------------------------------------------------------------------
      INTEGER    LOGIC     , I4UNIT
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU     , ONE       , ZERO    , I, J
      PARAMETER( PIPEIN=5  , PIPEOU=6   , ONE=1     , ZERO=0 )
```

B7SLCA

```
      SUBROUTINE B7SLCA( NDLEV  , NDMET  , NMET   ,
     &                   NSTRN  ,
     &                   ISTRN  , KSTRN  , LSTRN  , ASTRN ,
     &                   SLCMET , SLCORD ,
     &                   STACK  ,
     &                   EM
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B7SLCA *********************
C
C  PURPOSE: TO CALCULATE SPECTRUM LINE INTENSITY FOR FIXED TEMPERATURE
C           AND DENSITY FOR A GIVEN COMPOSITE ASSEMBLY.
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES (1 <= NMET <= 'NDMET')
C
```

```
C  INPUT : (I*4)  NSTRN   = NO. OF LINES CHOSEN FOR COMPOSITE ASSEMBLY
C
C  INPUT : (I*4)  ISTRN() = SELECTED TRANSITION INDEXES FOR COMPOSITE
C                           LINE ASSEMBLY
C  INPUT : (I*4)  KSTRN() = ORDINARY/METASTABLE LEVEL INDEX OF UPPER
C                           LEVEL OF COMPOSITE LINE TRANSITION. (SEE
C                                                          'LSTRN()')
C  INPUT : (L*4)  LSTRN() = .TRUE.  => COMPOSITE LINE IS METASTABLE
C                           .FALSE. => COMPOSITE LINE IS ORDINARY
C  INPUT : (R*8)  ASTRN() = COMPOSITE LINE A-VALUE (SEC-1)
C
C  INPUT : (R*8) SLCMET() = METASTABLE LEVEL SPECTRUM-LINE COEFFICIENTS
C                           FOR FIXED TEMPERATURE AND DENSITY.
C                            1st DIMENSION: METASTABLE INDEX
C  INPUT : (R*8) SLCORD() = ORDINARY LEVEL SPECTRUM-LINE COEFFICIENTS
C                           FOR FIXED TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ORDINARY LEVEL INDDEX
C
C  INPUT : (R*8) STACK(,) = POPULATION DEPENDENCE
C                           FOR FIXED TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: METASTABLE INDEX
C
C  OUTPUT: (R*8)  EM      =  SPECTRUM-LINE INTENSITY FOR COMPOSITE
C                            ASSEMBLY AT GIVEN TEMPERATURE AND DENSITY.
C
C          (I*4)  IU      = COMPOSITE LINE UPPER-LEVEL INDEX
C          (I*4)  I       = COMPOSITE LINE ARRAY INDEX
C          (I*4)  IM      = METASTABLE LEVEL ARRAY INDEX
C
C          (R*8)  EMPART  =  PARTIAL SUM USED WHEN CALCULATING 'EM'
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 2520
C
C DATE:    09/10/90
C
C UPDATE:  25/06/91 - CORRECTED ERROR IN ALGREBRA WHICH  AFFECTS  NON-
C                     EQUILIBRIUM CONDITIONS - ADDED VARIABLE 'EMPART'.
C
C-----------------------------------------------------------------------
      INTEGER   NDMET        , NDLEV        , NMET     ,
     &          NSTRN
      INTEGER   I            , IM           , IU
C-----------------------------------------------------------------------
      REAL*8    EM           , EMPART
C-----------------------------------------------------------------------
      INTEGER   ISTRN(NSTRN)
      INTEGER   KSTRN(NSTRN)
C-----------------------------------------------------------------------
      REAL*8    ASTRN(NSTRN)
      REAL*8    SLCMET(NDMET)               , SLCORD(NDLEV)
      REAL*8    STACK (NDLEV,NDMET)
C-----------------------------------------------------------------------
      LOGICAL   LSTRN(NSTRN)
C-----------------------------------------------------------------------
```

B7SLCF

```
      SUBROUTINE B7SLCF( NDMET  , NDLEV  , NDTEM  , NDDEN ,
     &                   NMET   , NORD   , MAXT   , MAXD  ,
     &                   XMMULT , RATIA  , RATHA  , DENSA ,
     &                            ICNTR  , ICNTH  ,
     &                   STCKM  , STVR   , STVH   ,
     &                   STVRM  , STVHM  ,
     &                   SLCMET , SLCORD
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B7SLCF ******************
C
C  PURPOSE: TO SET UP COEFFICIENTS FOR CALCULATING SPECTRUM-LINE
C           INTENSITIES. (THESE ARE FUNCTIONS OF LEVEL, TEMP. & DENSITY)
C
C
C  CALLING PROGRAM: ADAS207
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4) NDMET    = MAXIMUM NUMBER OF METASTABLES ALLOWED
C  INPUT : (I*4) NDLEV    = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4) NDTEM    = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4) NDDEN    = MAXIMUM NUMBER OF DENSITIES ALLOWED
C
C  INPUT : (I*4) NMET     = NUMBER OF METASTABLES LEVELS: 1<=NMET<=NDMET
C  INPUT : (I*4) NORD     = NUMBER OF ORDINARY LEVELS
C  INPUT : (I*4) MAXT     = NUMBER OF INPUT TEMPERATURES ( 1 -> 'NDTEM')
C  INPUT : (I*4) MAXD     = NUMBER OF INPUT DENSITIES ( 1 -> 'NDDEN')
C
```

```
C  INPUT : (R*8) XMMULT() = METASTABLE LEVELS: SCALING FACTORS
C  INPUT : (R*8) RATHA()  = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C  INPUT : (R*8) RATIA()  = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C  INPUT : (R*8) DENSA()  = ELECTRON DENSITIES (UNITS: CM-3)
C
C  INPUT : (I*4) ICNTR    = NUMBER OF FREE ELECTRON RECOMBINATIONS
C  INPUT : (I*4) ICNTH    = NUMBER OF NEUTRAL HYDROGEN CHARGE EXCHANGES
C
C  INPUT : (R*8) STCKM(,,)= METASTABLE POPULATIONS STACK
C                           1st DIMENSION: METASTABLE INDEX
C                           2nd DIMENSION: TEMPERATURE INDEX
C                           3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVR(,,) = FREE ELECTRON RECOMBINATION COEFFICIENTS
C                           1st DIMENSION: ORDINARY LEVEL INDEX
C                           2nd DIMENSION: TEMPERATURE INDEX
C                           3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVH(,,) =  CHARGE EXCHANGE COEFFICIENTS
C                           1st DIMENSION: ORDINARY LEVEL INDEX
C                           2nd DIMENSION: TEMPERATURE INDEX
C                           3rd DIMENSION: DENSITY INDEX
C
C  INPUT : (R*8) STVRM(,,)= METASTABLE FREE ELECTRON RECOMBINATION
C                          COEFFICIENTS.
C                           1st DIMENSION: METASTABLE INDEX
C                           2nd DIMENSION: TEMPERATURE INDEX
C                           3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVHM(,,)= METASTABLE CHARGE EXCHANGE COEFFICIENTS
C                           1st DIMENSION: METASTABLE INDEX
C                           2nd DIMENSION: TEMPERATURE INDEX
C                           3rd DIMENSION: DENSITY INDEX
C
C  OUTPUT: (R*8) SLCMET(,,)= METASTABLE LEVEL SPECTRUM-LINE COEFFICIENTS
C                           1st DIMENSION: METASTABLE INDEX
C                           2nd DIMENSION: TEMPERATURE INDEX
C                           3rd DIMENSION: DENSITY INDEX
C  OUTPUT: (R*8) SLCORD(,,)= ORDINARY LEVEL SPECTRUM-LINE COEFFICIENTS
C                           1st DIMENSION: ORDINARY LEVEL INDDEX
C                           2nd DIMENSION: TEMPERATURE INDEX
C                           3rd DIMENSION: DENSITY INDEX
C
C          (I*4) IM       = METASTABLE LEVEL ARRAY INDEX
C          (I*4) IO       = ORDINARY LEVEL   ARRAY INDEX
C          (I*4) IT       = TEMPERATURE      ARRAY INDEX
C          (I*4) IN       = DENSITY          ARRAY INDEX
C
C          (R*8) DRIVAL   = DENSITY * 'RATIA()' (FOR GIVEN DENSITY)
C          (R*8) DRHVAL   = DENSITY * 'RATIA()' * 'RATHA()'
C                                               (FOR GIVEN DENSITY)
C
C          (L*4) LCNTR    = .TRUE.  => 'ICNTR' > 0
C                           .FALSE. => 'ICNTR' = 0
C          (L*4) LCNTH    = .TRUE.  => 'ICNTH' > 0
C                           .FALSE. => 'ICNTH' = 0
C
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 2520
C
C DATE:    09/10/90
C
C UPDATE:  25/06/91 - CORRECTED ERROR IN ALGEBRA WHICH  AFFECTS  NON-
C                     EQUILIBRIUM CONDITIONS.
C
C-----------------------------------------------------------------------
      INTEGER NDMET  , NDLEV  , NDTEM  , NDDEN
      INTEGER NMET   , NORD   , MAXT   , MAXD
      INTEGER IM     , IO     , IT     , IN
      INTEGER ICNTR  , ICNTH
C-----------------------------------------------------------------------
      REAL*8  DRIVAL , DRHVAL
C-----------------------------------------------------------------------
      LOGICAL LCNTR  , LCNTH
C-----------------------------------------------------------------------
      REAL*8  XMMULT(NDMET)
      REAL*8  RATIA (NDDEN)             , RATHA (NDDEN)            ,
     &        DENSA (NDDEN)
      REAL*8  SLCMET(NDMET,NDTEM,NDDEN) , SLCORD(NDLEV,NDTEM,NDDEN)
      REAL*8  STCKM (NDMET,NDTEM,NDDEN)
      REAL*8  STVHM (NDMET,NDTEM,NDDEN) , STVRM (NDMET,NDDEN,NDDEN)
      REAL*8  STVH  (NDLEV,NDTEM,NDDEN) , STVR  (NDLEV,NDTEM,NDDEN)
```

B7SPF0

```
      SUBROUTINE B7SPF0( REP , DSNPAS )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B7SPF0 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
```

```
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  OUTPUT: (C*3)   REP     = 'YES' => TERMINATE PROGRAM EXECUTION.
C                          = 'NO ' => CONTINUE PROGRAM EXECUTION.
C
C  OUTPUT: (C*44)  DSNPAS  = INPUT CONTOUR PASSING FILE DSN (SEQUENTIAL)
C                            (IN FORM SUITABLE FOR DYNAMIC ALLOCATION)
C
C
C          (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C
C AUTHOR:  S.P.BELLAMY (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    08/03/95 - UNIX PORT
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      CHARACTER    REP*3        , DSNPAS*80
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU
      PARAMETER( PIPEIN=5  , PIPEOU=6)
C-----------------------------------------------------------------------
```

B7SPF1

```
      SUBROUTINE B7SPF1( MAXD   , MAXT    , RMIN    , RMAX   ,
     &                   ICMAX  , IGMAX   ,
     &                   LGEND  ,
     &                   IOPT   , ISEL    ,
     &                   LGRD1  , LDEF1   , LOGINT  , LCFLOG ,
     &                   GTIT1  ,
     &                   CONTR  , IGSEL   ,
     &                   XL1    , XU1     , YL1     , YU1 ,
CX UNIX/IDL PORT - ADD NEW ARGUMENTS FOR TEXT OUTPUT
     &                   LPAPER , LNEWPA  , DSNPAP
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B7SPF1 *********************
C
C  PURPOSE: GRAPHICAL ANALYSIS OF DATA: ISPF PANEL INPUT SUBROUTINE
C
C  CALLING PROGRAM: ADAS207
C
C  SUBROUTINE:
C
C  INPUT : (I*4)   MAXD     = NUMBER OF DENSITY VALUES ENTERED
C  INPUT : (I*4)   MAXT     = NUMBER OF TEMPERATURE VALUES ENTERED
C  INPUT : (R*8)   RMIN     = MINIMUM SPECTRUM LINE RATIO
C  INPUT : (R*8)   RMAX     = MAXIMUM SPECTRUM LINE RATIO
C
C  INPUT : (I*4)   IGMAX    = MAXIMUM NUMBER OF TEMPERATURE OR DENSITY
C                             VALUES THAT CAN BE PLOTTED ON A SINGLE
C                             GRAPH. MUST BE <= 20.
C  INPUT : (I*4)   ICMAX    = MAXIMUM NUMBER OF USER ENTERED CONTOUR
C                             VALUES THAT CAN BE PLOTTED ON A SINGLE
C                             GRAPH. MUST BE 20.
C
C  I/O   : (L*4)   LGEND    = .TRUE.  => END GRAPHICAL ANALYSIS OF
C                                        CURRENT DATA
C                            = .FALSE. => CONTINUE GRAPHICAL ANALYSIS OF
C                                        CURRENT DATA
C
C  OUTPUT: (I*4)   IOPT     = GRAPHICAL OPTION NUMBER:
C                             1 => CONTOUR PLOT
C                                  (PANEL: P20716A)
C                             2 => SPECTRUM-LINE RATIO VS TEMP. PLOT
C                                  (PANEL: P20716B)
C                             3 => SPECTRUM-LINE RATIO VS DENSITY PLOT
C                                  (PANEL: P20716C)
C
C  OUTPUT: (I*4)   ISEL     = OPTION 1 - NUMBER OF OWN CONTOUR VALUES
C                                        ENTERED (0 IF DEFAULT SELECTED)
C                             OPTION 2 - NO. OF DENSITIES SELECTED FOR
C                                        GRAPHING (FROM INPUT LIST).
C                             OPTION 3 - NO. OF TEMPERATURES SELECTED
C                                        FOR GRAPHING (FROM INPUT LIST).
C
C  OUTPUT: (L*4)   LGRD1    = .TRUE.  => PUT GRAPH IN GRID FILE
C                            = .FALSE. => DO NOT PUT GRAPH IN GRID FILE
C  OUTPUT: (L*4)   LDEF1    = .TRUE.  => USE GRAPH DEFAULT SCALING
C                            = .FALSE. => DO NOT USE DEFAULT SCALING
```

```
C  OUTPUT: (L*4)   LOGINT   = OPTION 1:
C                              .TRUE.  => LOGARITHMIC INTERPOLATION
C                              .FALSE. => LINEAR INTERPOLATION
C                              OPTION 2 - NOT USED
C                              OPTION 3 - NOT USED
C  OUTPUT: (L*4)   LCFLOG   = OPTION 1 (DEFAULT CONTOUR VALUES):
C                              .TRUE.  => LOGARITHMIC CONTOUR SPACING
C                              .FALSE. => LINEAR CONTOUR SPACING
C                              OPTION 2 - NOT USED
C                              OPTION 3 - NOT USED
C
C  OUTPUT: (C*40)  GTIT1    = ISPF ENTERED TITLE FOR GRAPH
C
C  OUTPUT: (R*8)   CONTR()  = OPTION 1 - USER ENTERED CONTOUR VALUES
C                              OPTION 2 - NOT USED
C                              OPTION 3 - NOT USED
C  OUTPUT: (I*4)   IGSEL()  = OPTION 1 - NOT USED
C                              OPTION 2 - INDEXES OF DENSITIES SELECTED
C                                         FOR GRAPHING.
C                              OPTION 3 - INDEXES OF TEMPERATURES
C                                         SELECTED FOR GRAPHING.
C
C  OUTPUT: (R*8)   XL1      = OPTION 1 - NOT USED
C                              OPTION 2 - LOWER LIMIT FOR X-AXIS OF GRAPH
C                              OPTION 3 - LOWER LIMIT FOR X-AXIS OF GRAPH
C  OUTPUT: (R*8)   XU1      = OPTION 1 - NOT USED
C                              OPTION 2 - UPPER LIMIT FOR X-AXIS OF GRAPH
C                              OPTION 3 - UPPER LIMIT FOR X-AXIS OF GRAPH
C  OUTPUT: (R*8)   YL1      = OPTION 1 - NOT USED
C                              OPTION 2 - LOWER LIMIT FOR Y-AXIS OF GRAPH
C                              OPTION 3 - LOWER LIMIT FOR Y-AXIS OF GRAPH
C  OUTPUT: (R*8)   YU1      = OPTION 1 - NOT USED
C                              OPTION 2 - UPPER LIMIT FOR Y-AXIS OF GRAPH
C                              OPTION 3 - UPPER LIMIT FOR Y-AXIS OF GRAPH
C
CX OUTPUT: (L*4)  LPAPER  = .TRUE.  => OUTPUT DATA TO TEXT OUTPUT FILE.
CX                          .FALSE. => NO OUTPUT OF CURRENT DATA TO
CX                                     CONTOUR TEXT OUTPUT FILE.
CX OUTPUT: (L*4)  LNEWPA    .TRUE.  => NEW TEXT OUTPUT FILE OR
CX                                     REPLACEMENT OF EXISTING FILE
CX                                     REQUIRED.
CX                          .FALSE. => ALLOW APPEND ON EXISTING OPEN
CX                                     TEXT FILE.
CX OUTPUT: (C*80) DSNPAP  = INPUT TEXT OUTPUT DATA SET NAME
CX
CX         (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
CX         (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
CX         (I*4)   I        = LOOP INCREMENT
CX         (I*4)   LOGIC    = USED TO PIPE LOGICAL VALUES
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    17/10/90
C
C UPDATE:  26/11/90 - ADAS91 - PE BRIDEN - AMENDED   'XXDISP'   ARGUMENT
C                                          LIST. IT NOW INCLUDES DISPLAY
C                                          RETURN CODES.
C                                          IF 'RETURN' OR 'END' ENTERED
C                                          ON A PANEL, EXCEPT VIA PFKEY,
C                                          PROGRAM TERMINATES.
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C UPDATE:  20/03/95 - SP BELLAMY - UNIX/IDL PORT
C
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE:??
C
C VERSION: 1.2                          DATE: 06-08-96
C MODIFIED: TIM HAMMOND
C           - ADDED A WRITE TO I4UNIT WHICH ALTHOUGH IT SHOULD
C             HAVE NO EFFECT APPEARS TO BE NEEDED TO STOP THE CODE
C             PRODUCING A MASSIVE CORE DUMP ON THE HP.
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   MAXD       , MAXT       ,
     &          ICMAX      , IGMAX      ,
     &          IOPT       , ISEL
C-----------------------------------------------------------------------
      REAL*8    RMIN       , RMAX       ,
     &          XL1        , XU1        , YL1       , YU1
C-----------------------------------------------------------------------
      CHARACTER  GTIT1*40
C-----------------------------------------------------------------------
```

```
      LOGICAL    LGEND
      LOGICAL    LGRD1     , LDEF1      , LOGINT    , LCFLOG
C-----------------------------------------------------------------------
      INTEGER    IGSEL(IGMAX)
C-----------------------------------------------------------------------
      REAL*8     CONTR(ICMAX)
C-----------------------------------------------------------------------
      LOGICAL    LPAPER    , LNEWPA
      CHARACTER  DSNPAP*80
C-----------------------------------------------------------------------
      INTEGER    LOGIC     , I4UNIT
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU     , ONE       , ZERO    , I
      PARAMETER( PIPEIN=5  , PIPEOU=6   , ONE=1     , ZERO=0 )
C***********************************************************************
```

BXCHKM

```
      SUBROUTINE BXCHKM( NMET   , IMETR , ICNTE , IE1A , LMETR )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXCHKM *********************
C
C  PURPOSE: TO CHECK IF TRANSITIONS EXIST TO THE METASTABLE LEVELS.
C
C  CALLING PROGRAM: ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT : (I*4)   NMET    = NUMBER OF METASTABLES ( 1 <= NMET <= 5 )
C  INPUT : (I*4)   IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C  INPUT : (I*4)   ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C  INPUT : (I*4)   IE1A()  = ELECTRON IMPACT TRANSITION: LOWER ENERGY
C                            LEVEL INDEX.
C
C  OUTPUT: (L*4)   LMETR() = .TRUE.  =>ELECTRON IMPACT TRANSITION EXISTS
C                                      TO THE METASTABLE LEVEL  GIVEN BY
C                                       'IMETR()'.
C                            .FALSE. =>ELECTRON  IMPACT  TRANSITIONS  DO
C                                      NOT EXIST TO THE METASTABLE LEVEL
C                                      GIVEN BY 'IMETR()'.
C
C          (I*4)   I       = GENERAL USE
C          (I*4)   J       = GENERAL USE
C
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NMET        , ICNTE
      INTEGER   I           , J
      INTEGER   IMETR(NMET) , IE1A(ICNTE)
C-----------------------------------------------------------------------
      LOGICAL   LMETR(NMET)
C-----------------------------------------------------------------------
```

BXIORD

```
      SUBROUTINE BXIORD( IL   ,
     &                   NMET , IMETR ,
     &                   NORD , IORDR
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXIORD *********************
C
C  PURPOSE: TO SET UP THE INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C           LEVEL LIST 'IORDR()'.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS (MET. & ORD.)
C
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLE STATES
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLES IN COMPLETE LEVEL LIST
C
C  OUTPUT: (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS.
```

```
C  OUTPUT: (I*4)  IORDR() = INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                          LEVEL LIST.
C
C          (I*4)  I4UNIT  = FUNCTION (SEE ROUTINE SECTION BELOW)
C          (I*4)  IS      = ENERGY LEVEL ARRAY INDEX
C          (I*4)  IM      = METASTABLE LEVEL NUMBER COUNTER
C          (I*4)  IO      = ORDINARY EXCITED LEVEL NUMBER COUNTER
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXTERM     ADAS      TERMINATES PROGRAM WITH MESSAGE
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C
C
C NOTE:    'NMET' + 'NORD' = 'IL'
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  23/04/93 - PE BRIDEN - ADAS91: ADDED I4UNIT FUNCTION TO WRITE
C                                         STATEMENTS FOR SCREEN MESSAGES
C
C UPDATE:  24/05/93 - PE BRIDEN - ADAS91: CHANGED I4UNIT(0)-> I4UNIT(-1)
C
C VERSION: 1.5                                      DATE: 26-06-97
C MODIFIED: H.P. SUMMERS, RICHARD MARTIN
C                - CHANGED LINE IM=IM+1 TO IM=MIN(IM+1,NMET-1)
C                  THIS ENSURES UPPER ARRAY BOUND OF IMETR IS NOT
C                  EXCEEDED.
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER  I4UNIT
      INTEGER  IL           , NMET           , NORD
      INTEGER  IS           , IM             , IO
C-----------------------------------------------------------------------
      INTEGER                 IMETR(NMET)    , IORDR(IL)
C-----------------------------------------------------------------------
```

BXMCCA

```
      SUBROUTINE BXMCCA( NDLEV  , IL     ,
     &                            LPSEL  , LISEL ,
     &                   DENE   , DENP   ,
     &                   CRA    ,
     &                   CRCE   , CRCP   , CIE   ,
     &                   CC
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXMCCA *********************
C
C  PURPOSE: TO  CONSTRUCT WHOLE RATE MATRIX 'CC' FOR TRANSITIONS BETWEEN
C           ALL ENERGY LEVELS AT A FIXED TEMPERATURE  AND  GIVEN DENSITY
C           'DENE/DENP'.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  IL      = NUMBER OF ENERGY LEVELS
C
C  INPUT :  (L*4)  LPSEL   = .TRUE.  => INCLUDE PROTON COLLISIONS
C                            .FALSE. => DO NOT INCLUDE PROTON COLLISIONS
C  INPUT :  (L*4)  LISEL   = .TRUE.  => INCLUDE IONISATION RATES
C                            .FALSE. => DO NOT INCLUDE IONISATION RATES
C
C  INPUT :  (R*8)  DENE    = ELECTRON DENSITY (UNITS: CM-3)
C  INPUT :  (R*8)  DENP    = PROTON DENSITY (UNITS: CM-3)
C
C  INPUT :  (R*8)  CRA(,)  = A-VALUE (sec-1)  MATRIX  COVERING   ALL
C                            TRANSITIONS.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C                           (NOTE: DIAGONAL   ELEMENTS  REPRESENT   THE
C                                  NEGATIVE  SUM  OF  THEIR  RESPECTIVE
C                                  COLUMNS.)
C
C  INPUT :  (R*8)  CRCE(,) = ELECTRON IMPACT TRANSITIONS:
C                            EXCIT'N/DE-EXCIT'N RATE COEFFT MATRIX
C                            COVERING ALL TRANSITIONS (cm**3/s).
C                            VALUES FOR GIVEN TEMPERATURE.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C                           (NOTE: DIAGONAL   ELEMENTS  REPRESENT   THE
```

```
C                                NEGATIVE  SUM  OF  THEIR  RESPECTIVE
C                                COLUMNS.)
C  INPUT :  (R*8)  CRCP(,) = PROTON IMPACT TRANSITIONS:
C                             EXCIT'N/DE-EXCIT'N RATE COEFFT MATRIX
C                             COVERING ALL TRANSITIONS (cm**3/s).
C                             VALUES FOR GIVEN TEMPERATURE.
C                             1st DIMENSION: ENERGY LEVEL INDEX
C                             2nd DIMENSION: ENERGY LEVEL INDEX
C                            (NOTE: DIAGONAL   ELEMENTS  REPRESENT   THE
C                                NEGATIVE  SUM  OF  THEIR  RESPECTIVE
C                                COLUMNS.)
C  INPUT :  (R*8)  CIE()   = IONISATION RATE COEFFICIENT VECTOR FOR
C                             FIXED TEMPERATURE.
C                             DIMENSION: ENERGY LEVEL INDEX
C
C  OUTPUT:  (R*8)  CC(,)   = RATE MATRIX COVERING ALL TRANSITIONS
C                             (UNITS: SEC-1)
C                             VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                             1st DIMENSION: ENERGY LEVEL INDEX
C                             2nd DIMENSION: ENERGY LEVEL INDEX
C
C           (I*4)  IS1     = ENERGY LEVEL ARRAY INDEX
C           (I*4)  IS2     = ENERGY LEVEL ARRAY INDEX
C
C
C ROUTINES: NONE
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDLEV              , IL
      INTEGER    IS1                , IS2
C-----------------------------------------------------------------------
      REAL*8     DENE               , DENP
C-----------------------------------------------------------------------
      LOGICAL    LPSEL              , LISEL
C-----------------------------------------------------------------------
      REAL*8     CRA(NDLEV,NDLEV)   ,
     &           CRCE(NDLEV,NDLEV)  , CRCP(NDLEV,NDLEV)  ,
     &           CIE(NDLEV)
      REAL*8     CC(NDLEV,NDLEV)
C-----------------------------------------------------------------------
```

BXMCMA

```
      SUBROUTINE BXMCMA( NDLEV  ,
     &                   NORD   , IORDR  ,
     &                   CC     ,
     &                   CMAT
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXMCMA *********************
C
C  PURPOSE: TO  STACK  UP  NON-METASTABLE/ORDINARY  EXCITED  LEVEL  RATE
C           MATRIX 'CMAT' FROM WHOLE RATE MATRIX 'CC' FOR ALL TRANSIT'NS
C           BETWEEN ALL ENERGY LEVELS AT A FIXED TEMPERATURE AND DENSITY
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C
C  INPUT :  (I*4)  NORD    = NUMBER OF NON-METASTABLE/ORDINARY EXCITED
C                            ENERGY LEVELS.
C  INPUT :  (I*4)  IORDR() = INDEX OF NON-METASTABLE/ORDINARY EXCITED
C                            LEVELS IN COMPLETE LEVEL LIST.
C
C  INPUT :  (R*8)  CC(,)   = RATE MATRIX COVERING ALL TRANSITIONS
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C
C  OUTPUT:  (R*8)  CMAT(,) = RATE MATRIX COVERING ALL NON-METASTABLE/
C                            ORDINARY EXCITED LEVELS.
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                            2nd DIMENSION: ORDINARY EXCITED LEVEL INDEX
C
C           (I*4)  IS1     = ORDINARY EXCITED LEVEL ARRAY INDEX
C           (I*4)  IS2     = ORDINARY EXCITED LEVEL ARRAY INDEX
C
C
```

```
C ROUTINES: NONE
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDLEV              , NORD
      INTEGER    IS1                , IS2
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8     CC(NDLEV,NDLEV)    ,
     &           CMAT(NDLEV,NDLEV)
C-----------------------------------------------------------------------
```

BXMCRA

```
      SUBROUTINE BXMCRA( NDTRN  , NDLEV  ,
     &                   ICNT   , IL     ,
     &                   I1A    , I2A    ,
     &                   AVAL   ,
     &                   CRA
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXMCRA *********************
C
C  PURPOSE: TO CONSTRUCT A-VALUE MATRIX  'CRA'  FOR TRANSITIONS  BETWEEN
C           ALL ENERGY LEVELS.
C
C  CALLING PROGRAM:  ASAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTRN   = MAXIMUM NUMBER OF RECOMBINATIONS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C
C  INPUT :  (I*4)  ICNT    = NUMBER OF SELECTED TRANSITIONS
C  INPUT :  (I*4)  IL      = NUMBER OF ENERGY LEVELS
C                                    (SEE: 'ITRN()')
C
C  INPUT :  (I*4)  I1A()   = SELECTED TRANSITION TYPE:
C                            LOWER ENERGY LEVEL INDEX.
C                            DIMENSION: TRANSITION INDEX
C  INPUT :  (I*4)  I2A()   = SELECTED TRANSITION TYPE:
C                            UPPER ENERGY LEVEL INDEX.
C                            DIMENSION: TRANSITION INDEX
C
C  INPUT :  (R*8)  AVAL()  = A-VALUE (sec-1)
C                            DIMENSION: TRANSITION INDEX
C
C  OUTPUT:  (R*8)  CRA(,)  = A-VALUE  (sec-1)  MATRIX  COVERING  ALL
C                            TRANSITIONS.
C                            1st DIMENSION: LOWER ENERGY LEVEL INDEX
C                            2nd DIMENSION: UPPER ENERGY LEVEL INDEX
C                           (NOTE: DIAGONAL   ELEMENTS  REPRESENT   THE
C                                  NEGATIVE  SUM  OF  THEIR  RESPECTIVE
C                                  COLUMNS.)
C
C           (I*4)  IS1     = ENERGY LEVEL ARRAY INDEX
C           (I*4)  IS2     = ENERGY LEVEL ARRAY INDEX
C           (I*4)  IC      = TRANSITION ARRAY INDEX
C
C ROUTINES: NONE
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDTRN              , NDLEV      ,
     &           ICNT               , IL
      INTEGER    IS1                , IS2                , IC
C-----------------------------------------------------------------------
      INTEGER    I1A(NDTRN)         , I2A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8     AVAL(NDTRN)        ,
     &           CRA(NDLEV,NDLEV)
C-----------------------------------------------------------------------
```

BXMCRC

```
      SUBROUTINE BXMCRC( NDTEM  , NDTRN  , NDLEV  ,
     &                   IT     , ICNT   , IL     ,
     &                   I1A    , I2A    ,
     &                   RATE   , DRATE  ,
     &                   CRC
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXMCRC *********************
C
C  PURPOSE: TO  CONSTRUCT  EXCITATION/DE-EXCIATATION   RATE  COEFFICIENT
C           MATRIX  'CRC' FOR TRANSITIONS BETWEEN ALL ENERGY LEVELS AT A
C           GIVEN TEMPERATURE 'IT' AND FOR A GIVEN TRANSITION TYPE
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDTRN   = MAXIMUM NUMBER OF RECOMBINATIONS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C
C  INPUT :  (I*4)  IT      = INDEX OF TEMPERATURE VALUE BEING ASSESSED
C  INPUT :  (I*4)  ICNT    = NUMBER OF SELECTED TRANSITIONS
C  INPUT :  (I*4)  IL      = NUMBER OF ENERGY LEVELS
C                                    (SEE: 'ITRN()')
C
C  INPUT :  (I*4)  I1A()   = SELECTED TRANSITION TYPE:
C                            LOWER ENERGY LEVEL INDEX.
C                            DIMENSION: TRANSITION INDEX
C  INPUT :  (I*4)  I2A()   = SELECTED TRANSITION TYPE:
C                            UPPER ENERGY LEVEL INDEX.
C                            DIMENSION: TRANSITION INDEX
C
C  INPUT :  (R*8)  RATE(,) = EXCITATION RATE COEFFS (cm**3/s)
C                            1st DIMENSION: TEMPERATURE INDEX
C                            2nd DIMENSION: TRANSITION INDEX
C  INPUT :  (R*8)  DRATE(,)= DE-EXCIT'N RATE COEFFS (cm**3/s)
C                            1st DIMENSION: TEMPERATURE INDEX
C                            2nd DIMENSION: TRANSITION INDEX
C
C  OUTPUT:  (R*8)  CRC(,)  = EXCIT'N/DE-EXCIT'N RATE COEFFT MATRIX
C                            COVERING ALL TRANSITIONS (cm**3/s).
C                            VALUES FOR GIVEN TEMPERATURE & TRANSITION
C                            TYPE.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C                           (NOTE: DIAGONAL   ELEMENTS  REPRESENT   THE
C                                  NEGATIVE  SUM  OF  THEIR  RESPECTIVE
C                                  COLUMNS.)
C
C           (I*4)  IS1     = ENERGY LEVEL ARRAY INDEX
C           (I*4)  IS2     = ENERGY LEVEL ARRAY INDEX
C           (I*4)  IC      = TRANSITION ARRAY INDEX
C
C
C ROUTINES: NONE
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDTEM              , NDTRN              , NDLEV      ,
     &           IT                 , ICNT               , IL
      INTEGER    IS1                , IS2                , IC
C-----------------------------------------------------------------------
      INTEGER    I1A(NDTRN)         , I2A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8     RATE(NDTEM,NDTRN)  , DRATE(NDTEM,NDTRN) ,
     &           CRC(NDLEV,NDLEV)
C-----------------------------------------------------------------------
```

BXMPOP

```
      SUBROUTINE BXMPOP( NDMET ,
     &                   NMET  ,
     &                   CRED  ,
     &                   RHS   , CRMAT ,
     &                   STKM
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
```

```
C
C  ****************** FORTRAN77 SUBROUTINE: BXMPOP *********************
C
C  PURPOSE: TO CALCULATE AND STACK UP IN  'STKM'  THE  METASTABLE LEVEL
C           POPULATIONS FOR A GIVEN TEMPERATURE AND DENSITY.
C
C           ALSO OUTPUTS INVERTED METASTABLE RATE MATRIX.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (R*8)  CRED(,) = MATRIX  OF  TRANSITION   RATES   BETWEEN
C                            METASTABLE LEVELS.
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: METASTABLE LEVEL INDEX
C                            2nd DIMENSION: METASTABLE LEVEL INDEX
C
C  OUTPUT:  (R*8)  RHS()   = GENERAL MATRIX SOLUTION WORK SPACE:
C                            USED IN SOLUTION OF 'NMET-1' LINEAR EQNS.
C                                       A.X=B
C                            INPUT TO XXMINV: RIGHT HAND SIDE VECTOR 'B'
C                             (RHS(IM) = -(RATE FROM LEVEL 'IM+1' TO 1))
C                             (UNITS: SEC-1)
C                            OUTPUT FROM XXMINV: SOLUTION VECTOR 'X'
C                             (RHS(IM) = POPULATION OF LEVEL 'IM+1')
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            DIMENSION: METASTABLE LEVEL - 1
C  OUTPUT:  (R*8)  CRMAT(,)= INVERTED  METASTABLE  LEVEL   RATE   MATRIX
C                            COVERING ALL TRANSITIONS BETWEEN METASTABLE
C                            LEVELS EXCEPT THOSE INVOLVING LEVEL 1.
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            BEFORE INPUT  TO   XXMINV: NOT INVERTED
C                            AFTER  OUTPUT FROM XXMINV: AS-ABOVE
C                            1st DIMENSION: METASTABLE LEVEL INDEX - 1
C                            2nd DIMENSION: METASTABLE LEVEL INDEX - 1
C
C  OUTPUT:  (R*8)  STKM()  = METASTABLE LEVEL POPULATION MATRIX.
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            DIMENSION: METASTABLE LEVEL INDEX
C
C           (L*4)  LSOLVE  = PARAMETER = .TRUE.
C                                   => USE 'XXMINV' TO SOLVE A SET  OF
C                                      LINEAR EQUATIONS A.X = B, WHERE
C                                      A,X,B ARE MATRICES/VECTORS AND:
C                                       A='CRMAT(,)' INPUT  TO   XXMINV
C                                       B='RHS()'    INPUT  TO   XXMINV
C                                       X='RHS()'    OUTPUT FROM XXMINV
C
C           (I*4)  NMET1   = 'NMET - 1'
C           (I*4)  IM      = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IM1     = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IM2     = METASTABLE LEVEL ARRAY INDEX
C
C           (R*8)  DMINT   = +1 or -1 DEPENDING ON WHETHER THE NUMBER OF
C                            ROW   INTERCHANGES   WAS   EVEN   OR   ODD,
C                            RESPECTIVELY, WHEN INVERTING A MATRIX USING
C                            'XXMINV'.
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXMINV     ADAS      INVERTS MATRIX AND SOLVES EQUATIONS.
C
C NOTE:
C        THE SOLUTION OF METASTABLE POPULATIONS GIVEN BELOW IS BASED ON
C        METASTABLE LEVEL 1 HAVING A POPULATION OF UNITY (1.0).
C
C        IF:     m  =  number of metastable levels - 1
C
C            R(mxm) = Rate matrix (sec-1) covering transistions between
C                     all possible pairs of metastable levels (except 1)
C                     row   : final   level
C                     column: initial level
C                     (R(mxm)   = 'CRMAT(,)' on input  to   XXMINV)
C                     (R-1(mxm) = 'CRMAT(,)' on output from XXMINV)
C            V(m)   = Rate vector (sec-1) covering transistions between
C                     each metastable level (except 1) and met. level 1
C                     ( = 'RHS()' on input  to   XXMINV)
C            P(m)   = Metastable level populations - levels 2 -> 'NMET'
C                     ( = 'RHS()' on output from XXMINV)
C
C           Therefore:  R(mxm).P(m) = V(m)
C
C            =>         P(m) = R-1(mxm).V(m)
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
```

```
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      LOGICAL    LSOLVE
C-----------------------------------------------------------------------
      PARAMETER( LSOLVE = .TRUE.        )
C-----------------------------------------------------------------------
      INTEGER    NDMET                  , NMET
      INTEGER    NMET1                  , IM          ,
     &           IM1                    , IM2
C-----------------------------------------------------------------------
      REAL*8     DMINT
C-----------------------------------------------------------------------
      REAL*8     CRED(NDMET,NDMET)      ,
     &           RHS(NDMET)             ,
     &           CRMAT(NDMET,NDMET)     ,
     &           STKM(NDMET)
C-----------------------------------------------------------------------
```

BXOUT0

```
      SUBROUTINE BXOUT0( IUNIT  , DATE   , PRGTYP , DSNC80 , DSNP80 ,
     &                   TITLED , IZ     , IZ0    , IZ1    , BWNO   ,
     &                   ICNTE  , ICNTP  , ICNTR  , ICNTH  ,
     &                   IL     ,
     &                   IA     , CSTRGA , ISA    , ILA    , XJA  , WA ,
     &                   ER     ,
     &                   NV     , TSCEF
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXOUT0 *********************
C
C  PURPOSE: TO OUTPUT ION SPECIFICATIONS, INDEXED ENERGY LEVELS AND
C           WAVE NUMBERS RELATIVE  TO GROUND TO STREAM 'IUNIT'.
C
C  CALLING PROGRAM: ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  IUNIT  = OUTPUT STREAM NUMBER
C  INPUT :  (C*8)  DATE   = CURRENT DATE AS 'DD/MM/YY'
C  INPUT :  (C*1)  PRGTYP = PROGRAM TYPE
C  INPUT :  (C*80) DSNC80 = INPUT COPASE DATA SET NAME
C  INPUT :  (C*80) DSNP80 = INPUT PROTON DATA SET NAME
C
C  INPUT :  (C*3)  TITLED = ELEMENT SYMBOL.
C  INPUT :  (I*4)  IZ     =  RECOMBINED ION CHARGE
C  INPUT :  (I*4)  IZ0    =         NUCLEAR CHARGE
C  INPUT :  (I*4)  IZ1    = RECOMBINING ION CHARGE
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT :  (R*8)  BWNO   = IONISATION POTENTIAL (CM-1)
C
C  INPUT :  (I*4)  ICNTE  = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C  INPUT :  (I*4)  ICNTP  = NUMBER OF PROTON IMPACT TRANSITIONS INPUT
C  INPUT :  (I*4)  ICNTR  = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT :  (I*4)  ICNTH  = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  INPUT :  (I*4)  IL     = NUMBER OF ENERGY LEVELS
C
C  INPUT :  (I*4)  IA()   = ENERGY LEVEL INDEX NUMBER
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  INPUT :  (I*4)  ISA()  = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT :  (I*4)  ILA()  = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT :  (R*8)  XJA()  = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT :  (R*8)  WA()   = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C
C  INPUT : (R*8)  ER()    = ENERGY RELATIVE TO LEVEL 1 (RYDBERGS)
C                           FOR LEVEL 'IA()'
C
C  INPUT : (I*4)  NV      = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR A GIVEN TRANSITION.
C  INPUT : (R*8)  TSCEF(,) = INPUT DATA FILE: ELECTRON TEMPERATURES
C                            1ST DIMENSION: TEMPERATURE (NOTE: TE=TP=TH)
C                            2ND DIMENSION: 1 => KELVIN  (IFOUT=1)
C                                           2 => EV      (IFOUT=2)
C                                           3 => REDUCED (IFOUT=3)
C
C          (R*8)  WN2RYD  = PARAMETER =
C                           WAVE NUMBER (CM-1) TO RYDBERG CONVERSION
C
C          (R*8)  BRYDO   = IONISATION POTENTIAL (RYDBERGS)
C          (R*8)  BWN     = ENERGY RELATIVE TO IONISATION POTENTIAL IN
C                           WAVE NUMBERS (CM-1).
C          (R*8)  BRYD    = ENERGY RELATIVE TO IONISATION POTENTIAL IN
C                           RYDBERGS.
C
C          (I*4)  I       = GENERAL USE
C
C          (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
```

```
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          -------------------------------------------------------------
C          XXADAS     ADAS      GATHERS ADAS HEADER INFORMATION
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    09/10/90
C
C UPDATE:  17/01/91 - PE BRIDEN: ADDED HEADER INFORMATION TO OUTPUT
C                              - RENAMED SUBROUTINE (ORIGINALLY BXWR7A)
C
C UPDATE:  23/01/91 - PE BRIDEN: REFORMATTED OUTPUT. INTRODUCED 'WN2RYD'
C                                'BRYD' & 'BRYDO'. RENAMED 'BW' -> 'BWN'
C                               - ADDED ARGUMENTS 'TSCEF' AND 'NV'.
C                               - ADDED ARGUMENTS 'ICNTE, ICNTP , ICNTR
C                                 and ICNTH'.
C
C UPDATE:  29/01/91 - PE BRIDEN: SET 'CADAS' TO BLANK AT START (VIA DATA
C                                STATEMENT) AND ADDED 'SAVE CADAS'.
C
C UPDATE:  30/07/92 - PE BRIDEN: 'XJA' VALUES NOW  OUTPUT  USING  FORMAT
C                                F6.1 INSTEAD OF F4.1 - THEREFORE FORMAT
C                                STATEMENT NUMBERED 1005 HAS BEEN EDITED
C
C UPDATE:  20/05/93 - PE BRIDEN - ADAS91: TO REFLECT CHANGES IN BXDATA
C                                         THE FOLLOWING ARRAY DIMENSION/
C                                         SIZE CHANGES WERE MADE:
C                                       1) CHARACTER CSTRGA *12 -> *18
C                                          (CHANGED FORMAT STMT 1005)
C                                       2) TSCEF(8,3)   -> TSCEF(14,3)
C UNIX PORT:
C VERSION: 1.3                             DATE: 24/10/95
C MODIFIED:      TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C                - INCREASED FORMAT 1008 FROM I3 TO I4 TO ALLOW FOR MORE
C                  THAN 1000 TRANSITIONS.
C               - ADDED CHECK FOR A NULL FILENAME OF DSNP80
C               - TIDIED UP SOME OF THE FORMAT STATEMENTS
C
C-----------------------------------------------------------------------
      REAL*8     WN2RYD
C-----------------------------------------------------------------------
      PARAMETER( WN2RYD = 9.11269D-06 )
C-----------------------------------------------------------------------
      INTEGER    I
      INTEGER    IUNIT          ,
     &           IZ             , IZ0            , IZ1        ,
     &           ICNTE          , ICNTP          , ICNTR      , ICNTH  ,
     &           IL             , NV
C-----------------------------------------------------------------------
      REAL*8     BWNO           , BWN            , BRYDO      , BRYD
C-----------------------------------------------------------------------
      CHARACTER  TITLED*3       , DATE*8         , PRGTYP*1   ,
     &           DSNC80*80      , DSNP80*80      , CADAS*80
C-----------------------------------------------------------------------
      INTEGER    IA(IL)         , ISA(IL)        , ILA(IL)
C-----------------------------------------------------------------------
      REAL*8     XJA(IL)        , WA(IL)         , ER(IL)
      REAL*8     TSCEF(14,3)
C-----------------------------------------------------------------------
      CHARACTER  CSTRGA(IL)*18
C-----------------------------------------------------------------------
      SAVE       CADAS
C-----------------------------------------------------------------------
      DATA       CADAS/' '/
C-----------------------------------------------------------------------
```

BXOUTG

```
      SUBROUTINE BXOUTG( LGHOST , DATE  ,
     &                   NDLEV  , NDTEM , NDDEN , NDMET  ,
     &                   TITLED , TITLE , GTIT1 , DSNINC ,
     &                   IZ     , ITSEL , TEV   ,
     &                   LGRD1  , LDEF1 ,
     &                   XMIN   , XMAX  , YMIN  , YMAX   ,
     &                   IL     , NMET  , NORD  , MAXD   ,
     &                   LMETR  , IMETR , IORDR , DENSA  ,
     &                   STRGA  , STACK
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXOUTG *********************
C
C  PURPOSE:  PIPE COMMUNICATIONS WITH IDL
C
C  CALLING PROGRAM: ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT : (L*4)  LGHOST  = .TRUE.  => GHOST80 INITIALISED
```

```
C                                .FALSE. => GHOST80 NOT INITIALISED
C  INPUT : (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (C*3)  TITLED  = ELEMENT SYMBOL.
C  INPUT : (C*40) TITLE   = ISPF ENTERED GENERAL TITLE FOR PROGRAM RUN
C  INPUT : (C*40) GTIT1   = ISPF ENTERED TITLE FOR GRAPH
CX INPUT : (C*80) DSNINC  = INPUT COPASE DATA SET NAME (MVS DSN)
C
C  INPUT : (I*4)  IZ      = RECOMBINED ION CHARGE
C  INPUT : (I*4)  ITSEL   = INDEX OF TEMPERATURE SELECTED FROM GRAPH
C  INPUT : (R*8)  TEV     = SELECTED ELECTRON TEMPERATURE (EV) FOR GRAPH
C
C  INPUT : (L*4)  LGRD1   = .TRUE.  => PUT GRAPH IN GRID FILE
C                           = .FALSE. => DO NOT PUT GRAPH IN GRID FILE
C  INPUT : (L*4)  LDEF1   = .TRUE.  => USE GRAPH DEFAULT SCALING
C                           = .FALSE. => DO NOT USE DEFAULT SCALING
C
C  INPUT : (R*8)  XMIN    = LOWER LIMIT FOR X-AXIS OF GRAPH
C  INPUT : (R*8)  XMAX    = UPPER LIMIT FOR X-AXIS OF GRAPH
C  INPUT : (R*8)  YMIN    = LOWER LIMIT FOR Y-AXIS OF GRAPH
C  INPUT : (R*8)  YMAX    = UPPER LIMIT FOR Y-AXIS OF GRAPH
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS = 'NMET' + 'NORD'
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT ELECTRON DENSITIES
C
C  INPUT : (L*4)  LMETR() = .TRUE.  => ELECTRON IMPACT TRANSITION EXISTS
C                                      TO THE METASTABLE LEVEL  GIVEN BY
C                                      'IMETR()'.
C                           .FALSE. => ELECTRON  IMPACT  TRANSITIONS  DO
C                                      NOT EXIST TO THE METASTABLE LEVEL
C                                      GIVEN BY 'IMETR()'.
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET' )
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                           LEVEL LIST.
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES (UNITS: CM-3)
C
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C  INPUT : (R*4) STACK(,,,)= POPULATION DEPENDENCE
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: METASTABLE INDEX
C                             3rd DIMENSION: TEMPERATURE INDEX
C                             4th DIMENSION: DENSITY INDEX
C
C          (I*4)  NDIM1   = PARAMETER = MAXIMUM NUMBER OF DENSITY VALUES
C                           (MUST NOT BE LESS THAN 'NDDEN')
C          (I*4)  NDIM2   = PARAMETER = MAXIMUM NUMBER OF LEVELS (ORD.)
C                           (MUST NOT BE LESS THAN 'NDLEV')
C          (I*4)  NGPIC   = PARAMETER = MAXIMUM NUMBER OF LEVEL POPULAT-
C                           IONS TO BE DISPLAYED ON A SINGLE GRAPH.
C          (I*4)  NGLEV   = PARAMETER = MAXIMUM NUMBER OF ENERGY LEVELS
C                           WHICH CAN BE LISTED ON THE GRAPH.
C
C          (R*4)  CUTMIN  = PARAMETER = IN DEFAULT GRAPH SCALING IS THE
C                           MINIMUM Y-VALUE THAT IS ALLOWED.
C                           (NOTE: 'CUTMIN' MUST BE > THAN 'GHZERO')
C          (R*4)  GHZERO  = PARAMETER = VALUE BELOW WHICH GHOST80 TAKES
C                           NUMBERS AS BEING ZERO = 1.0E-36
C
C          (I*4)  ID      = DENSITY INDEX NUMBER FOR ARRAY USE
C          (I*4)  IM      = METASTABLE INDEX NUMBER FOR ARRAY USE
C          (I*4)  ILEV    = (ORDINARY) LEVEL INDEX NUMBER FOR ARRAY USE
C          (I*4)  IORD1   = INITIAL ORDINARY LEVEL FOR CURRENT GRAPH
C          (I*4)  IORD2   = FINAL ORDINARY LEVEL FOR CURRENT GRAPH
C          (I*4)  IPLOT   = CO-ORDINATE ID AT WHICH LEVEL INDEX VALUE
C                           FOR GRAPH LINE IS TO BE PLOTTED.
C          (I*4)  ILMAX   = MINIMUM OF: NO. OF ENERGY LEVELS OR 'NGLEV'
C
C          (R*4)  XHIGH   = UPPER X-AXIS LIMIT FOR USE WITH GHOST80
C          (R*4)  XLOW    = LOWER X-AXIS LIMIT FOR USE WITH GHOST80
C          (R*4)  YHIGH   = UPPER Y-AXIS LIMIT FOR USE WITH GHOST80
C          (R*4)  YLOW    = LOWER Y-AXIS LIMIT FOR USE WITH GHOST80
C          (R*4)  X()     = X-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                           ELECTRON DENSITIES
C          (R*4)  Y(,)    = Y-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                           LEVEL POPULATIONS.
C                           1st DIMENSION = ELECTRON DENSITY INDEX
C                           2nd DIMENSION = ORDINARY  LEVEL  INDEX
C
C          (C*1)  GRID    = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*1)  PIC     = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*3)  C3      = BLANK 3 BYTE STRING
C          (C*13) DNAME   = '       DATE: '
C          (C*13) FNAME   = 'INPUT FILE : '
C          (C*13) GNAME   = 'GRAPH TITLE: '
C          (C*23) XTIT    = X-AXIS UNITS/TITLE
C          (C*23) YTIT    = Y-AXIS UNITS/TITLE
C          (C*30) STRG1   = HEADING FOR LEVEL ASSIGNMENTS
C          (C*30) STRG2   = HEADING FOR LEVEL ASSIGNMENTS
C          (C*30) STRG3   = TEMPORARY STRING FOR LEVEL ASSIGNMENTS
C          (C*80) ISPEC   = GRAPH TITLE (INCORPORATES 'TITLED,IZ,TEV').
```

```
C          (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
C
C          (L*4)  LGTXT   = .TRUE.  => LAST SCREEN DUMP WAS TEXT.
C                           = .FALSE. => LAST SCREEN DUMP WAS GHOST80.
C          (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C          (I*4)   ONE      = PARAMETER = THE INTEGER VALUE 1
C          (I*4)   ZERO     = PARAMETER = THE INTEGER VALUE 0
C          (I*4)   I        = LOOP INCREMENT
C          (I*4)   J        = LOOP INCREMENT
C          (I*4)   K        = LOOP INCREMENT
C          (I*4)   L        = LOOP INCREMENT
C
C ROUTINES:
C          ROUTINE     SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
CX          XXADAS      ADAS      GATHERS ADAS HEADER INFORMATION
C          XXFLSH      ADAS      FLUSHES I/O STREAM
C
C
C AUTHOR:  ANDREW BOWEN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    01/04/93
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 11-05-93
C MODIFIED: ANDREW BOWEN
C               - PUT UNDER S.C.C.S. CONTROL
C
C VERSION: 1.2                          DATE: 21-05-93
C MODIFIED: ANDREW BOWEN
C               - DATASET NAME VARIABLE EXTENDED TO 80 CHARACTERS
C
C VERSION: 1.3                          DATE: 04-04-95
C MODIFIED: TIM HAMMOND
C               - CHANGED STACK FROM REAL*8 TO REAL*4 IN LINE WITH
C                 OTHER ROUTINES
C
C VERSION: 1.4                          DATE: 03-04-96
C MODIFIED: TIM HAMMOND/PAUL BRIDEN
C               - TIDIED UP HEADER COMMENTS
C               - CHANGED OUTPUT OF STACK FROM FOUR LEVEL IMPLIED DO
C                 TO SINGLE IMPLIED AND THREE LEVEL NESTED DO.
C
C VERSION: 1.5                          DATE: 15-04-96
C MODIFIED: TIM HAMMOND/PAUL BRIDEN
C               - INCREASED PARAMETER NDIM1 20 -> 24
C
C VERSION: 1.6                          DATE: 17-06-96
C MODIFIED: WILLIAM OSBORN
C               - ADDED PIPE FLUSHES AND MADE EXPLICIT THE LOOPS
C
C VERSION: 1.7                          DATE: 14-10-96
C MODIFIED: WILLIAM OSBORN
C               - ADDED WRITE TO I4UNIT FOR HP MACHINES
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDIM1    , NDIM2    , NGPIC    , NGLEV    , I4UNIT
C-----------------------------------------------------------------------
      REAL*4    CUTMIN   , GHZERO
C-----------------------------------------------------------------------
      PARAMETER ( NDIM1= 24  , NDIM2=200        , NGPIC=7 , NGLEV = 55 )
      PARAMETER ( CUTMIN = 1.0E-30 , GHZERO = 1.0E-36 )
C-----------------------------------------------------------------------
      INTEGER   NDLEV    , NDTEM    , NDDEN    , NDMET
      INTEGER   IL       , NMET     , NORD     , MAXD     ,
     &          IZ       , ITSEL
      INTEGER   ID       , IM       , ILEV     , IORD1    , IORD2    ,
     &          IPLOT    , ILMAX
C-----------------------------------------------------------------------
      REAL*4    XHIGH    , XLOW     ,
     &          YHIGH    , YLOW
C-----------------------------------------------------------------------
      REAL*8    TEV      ,
     &          XMIN     , XMAX     ,
     &          YMIN     , YMAX
C-----------------------------------------------------------------------
      LOGICAL   LGHOST   , LGRD1    , LDEF1    , LGTXT
C-----------------------------------------------------------------------
CX  DSNINC CHANGED TO 80 CHARS
CX
      CHARACTER TITLED*3 , TITLE*40 , GTIT1*40 , DSNINC*80
      CHARACTER GRID*1   , PIC*1    , C3*3     , DATE*8   ,
     &          DNAME*13 , FNAME*13 , GNAME*13 , XTIT*23  , YTIT*23  ,
     &          STRG1*30 , STRG2*30 , STRG3*30 , ISPEC*80 , CADAS*80
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)        , IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*4    X(NDIM1)            , Y(NDIM1,NDIM2)
C-----------------------------------------------------------------------
      CHARACTER STRGA(NDLEV)*22
C-----------------------------------------------------------------------
      REAL*8    DENSA(NDDEN)
      REAL*4    STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
```

```
      LOGICAL   LMETR(NDMET)
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU , ONE      , ZERO
      PARAMETER( PIPEIN=5  , PIPEOU=6 , ONE=1    , ZERO=0 )
      INTEGER    I       , J        , K        , L
C-----------------------------------------------------------------------
      SAVE      CADAS
C-----------------------------------------------------------------------
      DATA GRID  /' '/   ,
     &     PIC  /' '/    ,
     &     C3   /'   '/  ,
     &     CADAS/' '/
      DATA DNAME/'       DATE: '/,
     &     FNAME/'INPUT FILE : '/,
     &     GNAME/'GRAPH TITLE: '/
      DATA XTIT/'ELECTRON DENSITY (CM-3)'/
      DATA YTIT/'N(I)/(NE*N(**))  (CM+3)'/
      DATA STRG1/'----- LEVEL  ASSIGNMENTS -----'/,
     &     STRG2/'INDEX       DESIGNATION       '/
      DATA ISPEC(1:40)/'POPULATION DEPENDENCE ON METASTABLES:   '/
C-----------------------------------------------------------------------
```

BXPOPM

```
      SUBROUTINE BXPOPM( NDTEM  , NDDEN , NDMET , NDLEV ,
     &                   MAXT   , MAXD  , NMET  ,
     &                            DENSA , IMETR ,
     &                            LRSEL , LHSEL ,
     &                            RATIA , RATHA ,
     &                   STCKM  , STVRM , STVHM ,
     &                   POPAR
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXPOPM *********************
C
C  PURPOSE: TO CONSTRUCT METASTABLE LEVEL POPULATIONS.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C
C  INPUT :  (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 ->'NDTEM')
C  INPUT :  (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 ->'NDDEN')
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLES LEVELS ( 1 ->'NDMET')
C
C  INPUT :  (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C
C  INPUT :  (L*4)  LRSEL   = .TRUE.  => FREE ELECTRON RECOMBINATION
C                                       REQUESTED.
C                            .FALSE. => FREE ELECTRON RECOMBINATION
C                                       NOT REQUESTED.
C  INPUT :  (L*4)  LHSEL   = .TRUE.  => CHARGE TRANSFER FROM NEUTRAL
C                                       HYDROGREN REQUESTED.
C                            .FALSE. => CHARGE TRANSFER FROM NEUTRAL
C                                       HYDROGREN NOT REQUESTED.
C
C  INPUT :  (R*8)  RATIA() = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C  INPUT :  (R*8)  RATHA() = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C
C  INPUT :  (R*8)  STCKM(,,)= METASTABLE POPULATIONS STACK:
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT :  (R*8)  STVRM(,,)= METASTABLE LEVEL:
C                             FREE-ELECTRON RECOMBINATION COEFFICIENTS
C                             (UNITS* CM**3/SEC-1)
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT :  (R*8)  STVHM(,,)= METASTABLE LEVEL:
C                             CHARGE-EXCHANGE RECOMBINATION COEFFICIENTS
C                             (UNITS* CM**3/SEC-1)
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C
C  OUTPUT:  (R*8)  POPAR(,,)= LEVEL POPULATIONS
C                              1st DIMENSION: LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              (ON OUTPUT CONTAINS POPULATIONS FOR
C                               METASTABLE LEVELS ONLY.)
C
C           (R*8) DCOEF     = DENSITY MULTIPLIED BY RELEVANT RATIOS  FOR
C                             CALCULATING RECOMBINATION CONTRIBUTIONS.
```

```
C
C           (I*4) IT        = TEMPERATURE ARRAY INDEX
C           (I*4) IN        = DENSITY ARRAY INDEX
C           (I*4) IM        = METASTABLE LEVEL ARRAY INDEX
C
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDTEM        , NDDEN        , NDMET   , NDLEV   ,
     &          MAXT         , MAXD         , NMET
      INTEGER   IT           , IN           , IM
C-----------------------------------------------------------------------
      REAL*8    DCOEF
C-----------------------------------------------------------------------
      LOGICAL   LRSEL        , LHSEL
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)
C-----------------------------------------------------------------------
      REAL*8    DENSA(NDDEN)                ,
     &          RATIA(NDDEN)                , RATHA(NDDEN)
      REAL*8    STCKM(NDMET,NDTEM,NDDEN)    ,
     &          STVRM(NDMET,NDTEM,NDDEN)    , STVHM(NDMET,NDTEM,NDDEN)
      REAL*8    POPAR(NDLEV,NDTEM,NDDEN)
C-----------------------------------------------------------------------
```

BXPOPO

```
      SUBROUTINE BXPOPO( NDTEM  , NDDEN , NDMET , NDLEV ,
     &                   MAXT   , MAXD  , NMET  , NORD  ,
     &                            DENSA , IMETR , IORDR ,
     &                            LRSEL , LHSEL ,
     &                            RATIA , RATHA ,
     &                   STACK  , STVR  , STVH  ,
     &                   POPAR
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXPOPO *********************
C
C  PURPOSE: TO CONSTRUCT ORDINARY/NON-METASTABLE LEVEL POPULATIONS.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C
C  INPUT :  (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 ->'NDTEM')
C  INPUT :  (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 ->'NDDEN')
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLES LEVELS ( 1 ->'NDMET')
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ( 1 ->'NDLEV')
C
C  INPUT :  (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                           LEVEL LIST.
C                           (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (L*4)  LRSEL   = .TRUE.  => FREE ELECTRON RECOMBINATION
C                                       REQUESTED.
C                            = .FALSE. => FREE ELECTRON RECOMBINATION
C                                       NOT REQUESTED.
C  INPUT :  (L*4)  LHSEL   = .TRUE.  => CHARGE TRANSFER FROM NEUTRAL
C                                       HYDROGREN REQUESTED.
C                            = .FALSE. => CHARGE TRANSFER FROM NEUTRAL
C                                       HYDROGREN NOT REQUESTED.
C
C  INPUT :  (R*8)  RATIA() = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C  INPUT :  (R*8)  RATHA() = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C
C  INPUT : (R*4) STACK(,,,)= ORDINARY EXCITED LEVEL POPULAT'N DEPENDENCE
C                           ON METASTABLE LEVEL.
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: METASTABLE INDEX
C                            3rd DIMENSION: TEMPERATURE INDEX
C                            4th DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVR(,,)  = ORDINARY EXCITED LEVEL:
C                            FREE-ELECTRON RECOMBINATION COEFFICIENTS
C                            (UNITS* CM**3/SEC-1)
C                            1st DIMENSION: ORDINARY LEVEL INDEX
```

```
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVH(,,)  = ORDINARY EXCITED LEVEL:
C                              CHARGE-EXCHANGE RECOMBINATION COEFFICIENTS
C                              (UNITS* CM**3/SEC-1)
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C
C  I/O   :  (R*8)  POPAR(,,)= LEVEL POPULATIONS
C                               1st DIMENSION: LEVEL INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C                                ON INPUT : CONTAINS POPULATIONS FOR
C                                           METASTABLE LEVELS ONLY.
C                                ON OUTPUT: CONTAINS POPULATIONS FOR
C                                           ALL LEVELS.
C
C           (R*8) DCOEF     = DENSITY MULTIPLIED BY RELEVANT RATIOS  FOR
C                             CALCULATING RECOMBINATION CONTRIBUTIONS.
C
C           (I*4) IT        = TEMPERATURE ARRAY INDEX
C           (I*4) IN        = DENSITY ARRAY INDEX
C           (I*4) IO        = ORDINARY LEVEL ARRAY INDEX
C           (I*4) IM        = METASTABLE LEVEL ARRAY INDEX
C
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  20/05/93- P BRIDEN: STACK ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDTEM        , NDDEN        , NDMET   , NDLEV   ,
     &          MAXT         , MAXD         , NMET    , NORD
      INTEGER   IT           , IN           , IM      , IO
C-----------------------------------------------------------------------
      REAL*8    DCOEF
C-----------------------------------------------------------------------
      LOGICAL   LRSEL        , LHSEL
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)               , IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8    DENSA(NDDEN)               ,
     &          RATIA(NDDEN)               , RATHA(NDDEN)
      REAL*8    STVR(NDLEV,NDTEM,NDDEN)    , STVH(NDLEV,NDTEM,NDDEN)
      REAL*8    POPAR(NDLEV,NDTEM,NDDEN)
      REAL*4    STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
```

BXRATE

```
      SUBROUTINE BXRATE( NDTEM  , NDTRN  , GSCALE ,
     &                   NTIN   , TIN    , GAMIN  ,
     &                   NTOUT  , TOUT   ,
     &                   ICNT   , ITRN   ,
     &                   RATE   , DRATE  ,
     &                   LTRNG
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXRATE *********************
C
C  PURPOSE: TO CALCULATE THE EXCITATION AND DE-EXCITATION RATE COEFFICI-
C           ENTS FOR A SET OF INPUT TEMPERATURES 'TOUT' & TRANSITIONS OF
C           A SPECIFIED TYPE (ELECTRON OR PROTON IMPACT).
C
C           TRANSITION TYPE SELECTED VIA 'ICNT & ITRN'.
C
C           INPUT RATE COEFFICIENTS 'RATE' & 'DRATE'  ASSUME  THAT  THE
C           GAMMA VALUE IS UNITY, AND ARE GIVEN FOR THE TEMPERATURES IN
C           'TOUT'. THE GAMMA VALUES 'GAMIN' ARE FOR  THE  TEMPERARTURE
C           ARRAY 'TIN'.  SPLINES ARE USED  TO  EXTRAPOLATE/INTERPOLATE
C           THE GAMMA VALUES INTO THE 'TOUT' ARRAY  AND  THESE USED  TO
C           CALCULATE THE CORRECT RATE COEFFICIENTS.
C
C           SPLINE IS CARRIED OUT USING LOG(GAMMA VALUES)
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDTRN   = MAXIMUM NUMBER OF TRANSITIONS ALLOWED
C  INPUT :  (I*4)  GSCALE  = SCALING FACTOR FOR OUTPUT GAMMA VALUES
C
```

```
C  INPUT :  (I*4)  NTIN    = NUMBER OF TEMPERATURES REPRESENTED IN THE
C                            INPUT DATA SET.
C  INPUT :  (R*8)  TIN()   = TEMPERATURES REPRESENTED IN INPUT DATA SET
C  INPUT :  (R*8)  GAMIN(,)= GAMMA VALUES REPRESENTED IN INPUT DATA SET
C                            1st DIMENSION: TEMPERATURE INDEX ('TIN')
C                            2nd DIMENSION: TRANSITION INDEX
C                                           (SEE: 'ITRN()')
C
C  INPUT :  (I*4)  NTOUT   = NUMBER OF ISPF SELECTED TEMPERATURES FOR
C                            OUTPUT.
C  INPUT :  (R*8)  TOUT()  = ISPF SELECTED TEMPERATURES FOR OUTPUT.
C
C  INPUT :  (I*4)  ICNT    = NUMBER OF SELECTED TRANSITIONS
C  INPUT :  (I*4)  ITRN()  = INDEX VALUES IN MAIN TRANSITION ARRAY WHICH
C                            REPRESENT TRANSITIONS OF THE SELECTED TYPE.
C                            USED TO SELECT APPROPRIATE GAMMA VALUES FOR
C                            TRANSITION TYPE.
C
C  I/O   :  (R*8)  RATE(,) = EXCITATION RATE COEFFS (cm**3/s)
C                            INPUT : UNIT GAMMA VALUES
C                            OUTPUT: TRUE VALUES
C                            1st DIMENSION: TEMPERATURE INDEX ('TOUT')
C                            2nd DIMENSION: TRANSITION INDEX
C  I/O   :  (R*8)  DRATE(,)= DE-EXCIT'N RATE COEFFS (cm**3/s)
C                            INPUT : UNIT GAMMA VALUES
C                            OUTPUT: TRUE VALUES
C                            1st DIMENSION: TEMPERATURE INDEX ('TOUT')
C                            2nd DIMENSION: TRANSITION INDEX
C
C  OUTPUT:  (L*4)  LTRNG() = .TRUE. => TEMPERATURE VALUES WITHIN RANGE
C                                      READ FROM INPUT COPASE DATA SET.
C                          = .FALSE.=>TEMPERATURE VALUE NOT WITHIN RANGE
C                                     READ FROM INPUT COPASE DATA SET.
C                            1st DIMENSION: TEMPERATURE INDEX.
C
C
C           (I*4)  NTDSN   = PARAMETER = MAXIMUM NUMBER OF TEMPERATURES
C                                        ALLOWED IN INPUT DATA SET = 8
C           (I*4)  NLTEM   = PARAMETER = MUST BE >= 'NDTEM'
C
C           (I*4)  GZERO   = PARAMETER = IF 'GAMIN(1,) < GZERO' THEN ALL
C                                        THE 'RATE' AND  'DRATE'  VALUES
C                                        FOR THE  GIVEN  TRANSITION  ARE
C                                        SAID TO BE ZERO.
C
C           (I*4)  IOPT    = SPLINE END CONDITIONS/EXTRAPOLATION CONTROL
C                            SWITCH - SEE 'XXSPLE'
C                            I.E. DEFINES THE BOUNDARY DERIVATIVES.
C                            (VALID VALUES = 0, 1, 2, 3, 4)
C           (I*4)  ITRAN   = APPROPRIATE TRANSITION INDEX FOR 'GAMIN(,)'
C           (I*4)  IC      = TRANSITION ARRAY INDEX
C           (I*4)  IT      = TEMPERATURE ARRAY INDEX
C
C           (R*8)  GAMMA   = SPLINED GAMMA VALUE FOR GIVEN TEMPERATURE
C                            (FROM 'TOUT()') AND TRANSITION.
C           (R*8)  DYIN()  = INTERPOLATED DERIVATIVES
C                            DIMENSION: TEMPERATURE INDEX ('TIN()')
C
C           (L*4)  LSETX   = .TRUE.  => X-AXES ('TIN()' VALUES) NEED TO
C                                       SET IN 'XXSPLE'.
C                            .FALSE. => X-AXES ('TIN()' VALUES) HAVE
C                                       BEEN SET IN 'XXSPLE'.
C                            (NOTE: 'LSETX' IS RESET BY 'XXSPLE')
C
C           (R*8)  LGIN()  = LOG ( 'GAMIN(,)' ) FOR GIVEN TRANSITION
C                            DIMENSION: TEMPERATURE INDEX ('TIN()')
C           (R*8)  LGOUT() = LOG ( SPLINED GAMMA VALUES )
C                            DIMENSION: TEMPERATURE INDEX ('TOUT()' )
C
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C           XXSPLE     ADAS      SPLINE SUBROUTINE (WITH EXTRAP. INFO)
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  31/01/91 - PE BRIDEN - ADAS91 - INTRODUCED 'LTRNG'
C                                        - REPLACED XXSPLN WITH XXSPLE
C
C UPDATE:  26/03/91 - PE BRIDEN - ADAS91 - IF 'GAMIN(1,)' <='GZERO' THEN
C                                          SET 'RATE' AND 'DRATE' TO 0.0
C                                          FOR ALL TEMPERATURE VALUES.
C                                           * INCLUDED  FOR  LATER  USE.
C                                             AT PRESENT 'BXDATA'  MAKES
C                                             SURE 'GAMIN' HAS A MINIMUM
C                                             VALUE OF 1.00D-30. *
C
C UPDATE:  11/12/91 - PE BRIDEN - ADAS91 -NLTEM INCREASED FROM 20 to 101
C
C UPDATE:  20/05/93 - PE BRIDEN - ADAS91 -NTDSN INCREASED FROM 8 to 14
C                                         (REFLECTS CHANGES TO BXDATA)
C
```

```
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NTDSN              , NLTEM
C-----------------------------------------------------------------------
      REAL*8     GZERO
C-----------------------------------------------------------------------
      PARAMETER( NTDSN = 14         , NLTEM = 101        )
C-----------------------------------------------------------------------
      PARAMETER( GZERO = 1.01D-70   )
C-----------------------------------------------------------------------
      INTEGER    NDTRN              , NDTEM              ,
     &           NTIN               , NTOUT              ,
     &           ICNT
      INTEGER    IOPT               , ITRAN              ,
     &           IC                 , IT
C-----------------------------------------------------------------------
      REAL*8     GSCALE             , GAMMA
C-----------------------------------------------------------------------
      LOGICAL    LSETX
C-----------------------------------------------------------------------
      INTEGER    ITRN(NDTRN)
C-----------------------------------------------------------------------
      REAL*8     TIN(NTDSN)         , GAMIN(NTDSN,NDTRN) ,
     &           TOUT(NDTEM)        ,
     &           RATE(NDTEM,NDTRN)  , DRATE(NDTEM,NDTRN)
      REAL*8     DYIN(NTDSN)        ,
     &           LGIN(NTDSN)        , LGOUT(NLTEM)
C-----------------------------------------------------------------------
      LOGICAL    LTRNG(NDTEM)
C-----------------------------------------------------------------------
      INTRINSIC  DLOG
C-----------------------------------------------------------------------
```

BXRCOM

```
      SUBROUTINE BXRCOM( NDTEM  , NDTRN  , NDLEV  ,
     &                   NTIN   , TIN    , RCIN   ,
     &                   NTOUT  , TOUT   ,
     &                   ICNT   , ITRN   , ICLEV  ,
     &                   RCOUT  , LTRNG
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXRCOM *********************
C
C  PURPOSE: TO ESTABLISH RECOMBINATION RATE COEFFICIENTS  FOR  A SET  OF
C           TEMPERATURES GIVEN BY THE ARRAY 'TOUT()' USING CUBIC SPLINES
C           ON  A SET OF RATE  COEFFICIENTS  COVERING  THE  TEMPERATURES
C           GIVEN BY THE ARRAY 'TIN()'.
C
C           RECOMBINATION TYPE IS SELECTED VIA 'ICNT' & 'ITRN'
C
C           RATE COEFFICIENTS ARE GIVEN FOR A NUMBER OF CAPTURING LEVELS
C           AND THE ARRAY 'RCOUT(,)' REPRESENTS  COEFFTS.  FOR COMBINAT-
C           IONS OF TEMPERATURE AND CAPTURING LEVEL INDEX.
C
C           SPLINE IS CARRIED OUT USING LOG(RATE COEFFICIENT VALUES)
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDTRN   = MAXIMUM NUMBER OF RECOMBINATIONS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C
C  INPUT :  (I*4)  NTIN    = NUMBER OF TEMPERATURES REPRESENTED IN THE
C                            INPUT DATA SET.
C  INPUT :  (R*8)  TIN()   = TEMPERATURES REPRESENTED IN INPUT DATA SET
C  INPUT :  (R*8)  RCIN(,) = RATE COEFF. REPRESENTED IN INPUT DATA SET
C                            1st DIMENSION: TEMPERATURE INDEX ('TIN')
C                            2nd DIMENSION: RECOMBINATION INDEX
C                                           (SEE: 'ITRN()')
C
C  INPUT :  (I*4)  NTOUT   = NUMBER OF ISPF SELECTED TEMPERATURES FOR
C                            OUTPUT.
C  INPUT :  (R*8)  TOUT()  = ISPF SELECTED TEMPERATURES FOR OUTPUT.
C
C  INPUT :  (I*4)  ICNT    = NUMBER OF SELECTED RECOMBINATIONS
C  INPUT :  (I*4)  ITRN()  = INDEX VALUES IN MAIN TRANSITION ARRAY WHICH
C                            REPRESENT RECOMBINASTION  OF THE  SELECTED
C                            TYPE
C                            USED TO SELECT APPROPRIATE RATE COEFFTS FOR
C                            RECOMBINATION TYPE.
C  INPUT :  (I*4)  ICLEV() = CAPTURING LEVELS INDICES.
C                            DIMENSION: 'TRANSITION'/RECOMBINATION INDEX
C
C  OUTPUT:  (R*8)  RCOUT(,)= SPLINED RECOMBINATION RATE COEFFT. VALUES.
C                            1st DIMENSION: TEMPERATURE INDEX ('TOUT')
C                            2nd DIMENSION: CAPTURING LEVEL INDEX.
C
C  OUTPUT:  (L*4)  LTRNG() = .TRUE. => TEMPERATURE VALUES WITHIN RANGE
```

```
C                                READ FROM INPUT COPASE DATA SET.
C                           = .FALSE.=>TEMPERATURE VALUE NOT WITHIN RANGE
C                                    READ FROM INPUT COPASE DATA SET.
C                             1st DIMENSION: TEMPERATURE INDEX.
C
C
C           (I*4)  NTDSN   = PARAMETER = MAXIMUM NUMBER OF TEMPERATURES
C                                        ALLOWED IN INPUT DATA SET = 8
C           (I*4)  NLTEM   = PARAMETER = MUST BE >= 'NDTEM'
C
C           (I*4)  IOPT    = SPLINE END CONDITIONS/EXTRAPOLATION CONTROL
C                            SWITCH - SEE 'XXSPLE'
C                            I.E. DEFINES THE BOUNDARY DERIVATIVES.
C                            (VALID VALUES = 0, 1, 2, 3, 4)
C           (I*4)  IRECMB  = APPROPRIATE RECOMBINATN INDEX FOR 'RCIN(,)'
C           (I*4)  ICAP    = CAPTURING LEVEL INDEX BEING ASSESSED.
C           (I*4)  IC      = RECOMBINATION ARRAY INDEX
C           (I*4)  IT      = TEMPERATURE ARRAY INDEX
C
C           (R*8)  DYIN()  = INTERPOLATED DERIVATIVES
C                            DIMENSION: TEMPERATURE INDEX ('TIN()')
C
C           (L*4)  LSETX   = .TRUE.  => X-AXES ('TIN()' VALUES) NEED TO
C                                       SET IN 'XXSPLE'.
C                            .FALSE. => X-AXES ('TIN()' VALUES) HAVE
C                                       BEEN SET IN 'XXSPLE'.
C                            (NOTE: 'LSETX' IS RESET BY 'XXSPLE')
C
C           (R*8)  LRCIN() = LOG ( 'RCIN(,)' ) FOR GIVEN CAPTURING LEVEL
C                            DIMENSION: TEMPERATURE INDEX ('TIN()')
C           (R*8)  LRCOUT()= LOG ( SPLINED RECOMBINATION RATE COEFTS )
C                            DIMENSION: TEMPERATURE INDEX ('TOUT()' )
C
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C           XXSPLE     ADAS      SPLINE SUBROUTINE (WITH EXTRAP. INFO)
C
C
C AUTHOR:   PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C           K1/0/81
C           JET EXT. 4569
C
C DATE:     09/10/90
C
C UPDATE:   31/01/91 - PE BRIDEN - ADAS91 - INTRODUCED 'LTRNG'
C                                         - REPLACED XXSPLN WITH XXSPLE
C
C UPDATE:   11/12/91 - PE BRIDEN - ADAS91 -NLTEM INCREASED FROM 20 to 101
C
C UPDATE:   10/06/92 - PE BRIDEN - ADAS91 -CORRECT ERROR - CHANGED
C                                          'ICAP=ICLEV(IC)' TO
C                                          'ICAP=ICLEV(IRECMB)'
C
C UPDATE:   20/05/93 - PE BRIDEN - ADAS91 -NTDSN INCREASED FROM 8 to 14
C                                          (REFLECTS CHANGES TO BXDATA)
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NTDSN              , NLTEM
C-----------------------------------------------------------------------
      PARAMETER( NTDSN = 14         , NLTEM = 101        )
C-----------------------------------------------------------------------
      INTEGER    NDTRN              , NDTEM              , NDLEV      ,
     &           NTIN               , NTOUT              ,
     &           ICNT
      INTEGER    IOPT               , IRECMB             , ICAP       ,
     &           IC                 , IT
C-----------------------------------------------------------------------
      LOGICAL    LSETX
C-----------------------------------------------------------------------
      INTEGER    ICLEV(NDTRN)       , ITRN(NDTRN)
C-----------------------------------------------------------------------
      REAL*8     TIN(NTDSN)         , RCIN(NTDSN,NDTRN)  ,
     &           TOUT(NDTEM)        ,
     &           RCOUT(NDTEM,NDLEV)
      REAL*8     DYIN(NTDSN)        ,
     &           LRCIN(NTDSN)       , LRCOUT(NLTEM)
C-----------------------------------------------------------------------
      LOGICAL    LTRNG(NDTEM)
C-----------------------------------------------------------------------
      INTRINSIC  DLOG
C-----------------------------------------------------------------------
```

BXSTKA

```
      SUBROUTINE BXSTKA( NDLEV  , NDMET  ,
     &                   NORD   , NMET   ,
     &                   IORDR  , IMETR  ,
     &                   CMAT   , CC     ,
     &                   STCK
     &                 )
```

```
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXSTKA *********************
C
C  PURPOSE: TO STACK UP IN  'STCK'  THE NON-METASTABLE/ORDINARY EXCITED
C           LEVEL POPULATION DEPENDENCE ON METASTABLE LEVEL FOR A GIVEN
C           TEMPERATURE AND DENSITY.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                            LEVEL LIST.
C                            (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (R*8)  CMAT(,) = INVERTED   RATE   MATRIX   COVERING   ALL
C                            NON-METASTABLE/ORDINARY EXCITED LEVELS.
C                            (UNITS: SEC)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                            2nd DIMENSION: ORDINARY EXCITED LEVEL INDEX
C
C  INPUT :  (R*8)  CC(,)   = RATE MATRIX COVERING ALL TRANSITIONS
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C
C  OUTPUT:  (R*4)  STCK(,) = POPULATION MATRIX COVERING ALL NON-METAST-
C                            ABLE/ORDINARY EXCITED LEVELS AS FUNCTION
C                            OF METASTABLE INDEX.
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                            2nd DIMENSION: METASTABLE LEVEL INDEX
C
C           (I*4)  IS1     = ORDINARY EXCITED LEVEL INDEX
C           (I*4)  IS2     = ORDINARY EXCITED LEVEL INDEX
C           (I*4)  IM      = METASTABLE LEVEL ARRAY INDEX
C
C           (R*8)  POP     = VARIABLE USED TO SUM POPULATION VALUES
C
C
C ROUTINES: NONE
C
C NOTE:
C        IF:     n  =  number of ordinary/non-metastable levels
C                m  =  number of metastable levels
C           Ro(nxn) = Rate matrix (sec-1) covering transistions between
C                     all possible pairs of ordinary levels.
C                     row   : final   level
C                     column: initial level
C                     (Inverse Ro-1(nxn) = 'CMAT(,)' )
C           Rm(nxm) = Rate matrix (sec-1) covering transistions between
C                     all combinations of ordinary and metastable level
C                     ( = 'CC(,)' - ordinary level part )
C           P(nxm)  = Population matrix giving the population dependence
C                     of each ordinary level on metastable level.
C                     ( = 'STCK(,)' )
C
C           Therefore:  Ro(nxn).P(nxm) = Rm(nxm)
C
C            =>          P(nxm)  = Ro-1(nxn).Rm(nxm)
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  20/05/93 - P BRIDEN: STCK ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDLEV              , NDMET             ,
     &           NORD               , NMET
      INTEGER    IS1                , IS2               , IM
C-----------------------------------------------------------------------
      REAL*8     POP
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)       , IMETR(NDMET)
C-----------------------------------------------------------------------
      REAL*8     CMAT(NDLEV,NDLEV)  , CC(NDLEV,NDLEV)
      REAL*4     STCK(NDLEV,NDMET)
C-----------------------------------------------------------------------
```

BXSTKB

```
      SUBROUTINE BXSTKB( NDTEM  , NDLEV  ,
     &                   IT     , NORD   ,
     &                            IORDR  ,
     &                   CMAT   , VEC    ,
     &                   STV
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXSTKA *********************
C
C  PURPOSE: TO STACK UP IN  'STV'  THE  RECOMBINATION CONTRIBUTION  FOR
C           EACH  NON-METASTABLE/ORDINARY  EXCITED  LEVEL  FOR  A GIVEN
C           TEMPERATURE AND DENSITY.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C
C  INPUT :  (I*4)  IT      = INDEX DENOTING THE TEMPERATURE
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                           LEVEL LIST.
C                           (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (R*8)  CMAT(,) = INVERTED   RATE   MATRIX   COVERING   ALL
C                           NON-METASTABLE/ORDINARY EXCITED LEVELS
C                           TRANSITIONS.
C                           (UNITS: SEC)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                           2nd DIMENSION: ORDINARY EXCITED LEVEL INDEX
C
C  INPUT :  (R*8)  VEC(,)  = RECOMBINATION RATE COEFFT. VALUES.
C                           (UNITS: CM**3/SEC-1)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           1st DIMENSION: TEMPERATURE INDEX ('IT')
C                           2nd DIMENSION: CAPTURING LEVEL INDEX
C
C  OUTPUT:  (R*8)  STV()   = RECOMBINATION  CONTRIBUTION  FOR  EACH
C                           NON-METASTABLE/ORDINARY EXCITED LEVELS.
C                           (UNITS: CM**3)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           DIMENSION: ORDINARY EXCITED LEVEL INDEX
C
C           (I*4)  IS1     = ORDINARY EXCITED LEVEL INDEX
C           (I*4)  IS2     = ORDINARY EXCITED LEVEL INDEX
C
C           (R*8)  COEF    = VARIABLE USED TO SUM COEFFICIENT VALUES
C
C
C ROUTINES: NONE
C
C NOTE:
C        IF:     n  =  number of ordinary/non-metastable levels
C            R(nxn) = Rate matrix (SEC-1) covering transistions between
C                     all possible pairs of ordinary levels.
C                     row   : final   level
C                     column: initial level
C                     (Inverse R-1(nxn) = 'CMAT(,)' )
C            V(n)   = Recombination rate vector (CM**3 SEC-1) covering
C                     all ordinary levels.
C                     ( = 'VEC()' - ordinary level part ).
C            S(n)   = Recombination contribution vector (CM**3) covering
C                     all ordinary levels ( = 'STV()' ).
C
C           Therefore:  R(nxn).S(n) = V(n)
C
C            =>         S(n)  = R-1(nxn).V(n)
C
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDTEM              , NDLEV              ,
     &           IT                 , NORD
      INTEGER    IS1                , IS2
C-----------------------------------------------------------------------
      REAL*8     COEF
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8     CMAT(NDLEV,NDLEV)  , VEC(NDTEM,NDLEV)   ,
```

```
     &          STV(NDLEV)
C-----------------------------------------------------------------------
```

BXSTKC

```
      SUBROUTINE BXSTKC( NDLEV  , NDMET  ,
     &                   NORD   , NMET   ,
     &                   IORDR  , IMETR  ,
     &                   CC     , STCK   ,
     &                   CRED
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXSTKC *********************
C
C  PURPOSE: TO STACK UP IN  'CRED'  THE TRANSITION RATE BETWEEN METASTA-
C           BLE LEVELS FOR A GIVEN TEMPERATURE STABLE LEVEL FOR A GIVEN
C           TEMPERATURE AND DENSITY.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                            LEVEL LIST.
C                            (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (R*8)  CC(,)   = RATE MATRIX COVERING ALL TRANSITIONS
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C  INPUT :  (R*4)  STCK(,) = POPULATION MATRIX COVERING ALL NON-METAST-
C                            ABLE/ORDINARY EXCITED LEVELS AS FUNCTION
C                            OF METASTABLE INDEX.
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                            2nd DIMENSION: METASTABLE LEVEL INDEX
C
C  OUTPUT:  (R*8)  CRED(,) = MATRIX  OF  TRANSITION   RATES   BETWEEN
C                            METASTABLE LEVELS.
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: METASTABLE LEVEL INDEX
C                            2nd DIMENSION: METASTABLE LEVEL INDEX
C
C           (I*4)  IM1     = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IM2     = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IS      = ORDINARY EXCITED LEVEL INDEX
C
C
C ROUTINES: NONE
C
C NOTE:
C           CRED(IM1,IM2) = ( the transition rate from IM2 to IM1 )
C                                          +
C                           SUM( (the transistion rate from ordinary
C                                 level IS to IM1)  x (the population
C                                 in metastable level IM2 that excite
C                                 to oridinary level IS) )
C
C                           ABOVE SUM IS OVER ALL ORDINARY LEVELS.
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C UPDATE:  20/05/93 - P BRIDEN: STCK ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDLEV              , NDMET             ,
     &           NORD               , NMET
      INTEGER    IM1                , IM2               , IS
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)       , IMETR(NDMET)
C-----------------------------------------------------------------------
      REAL*8     CC(NDLEV,NDLEV)    , CRED(NDMET,NDMET)
      REAL*4     STCK(NDLEV,NDMET)
C-----------------------------------------------------------------------
```

BXSTKD

```
      SUBROUTINE BXSTKD( NDTEM  , NDLEV  , NDMET  ,
     &                   IT     , NORD   , NMET   ,
     &                            IORDR  , IMETR  ,
     &                   CC     , STV    , VEC    ,
     &                   VRED
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXSTKD *********************
C
C  PURPOSE: TO STACK UP IN  'VRED'  THE RECOMBINATION RATE CONTRIBUTIONS
C           FOR  EACH  METASTABLE  LEVEL  FOR  A  GIVEN TEMPERATURE  AND
C           DENSITY.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  IT      = INDEX DENOTING THE TEMPERATURE
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                            LEVEL LIST.
C                            (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (R*8)  CC(,)   = RATE MATRIX COVERING ALL TRANSITIONS
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C  INPUT :  (R*8)  STV()   = RECOMBINATION  CONTRIBUTION  FOR  EACH
C                            NON-METASTABLE/ORDINARY EXCITED LEVELS.
C                            (UNITS: CM**3)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            DIMENSION: ORDINARY EXCITED LEVEL INDEX
C  INPUT :  (R*8)  VEC(,)  = RECOMBINATION RATE COEFFT. VALUES.
C                            (UNITS: CM**3/SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: TEMPERATURE INDEX ('IT')
C                            2nd DIMENSION: CAPTURING LEVEL INDEX
C
C  OUTPUT:  (R*8)  VRED()  = VECTOR  OF RECOMBINATION RATE CONTRIBUTIONS
C                            FOR EACH METASTABLE LEVEL.
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            DIMENSION: METASTABLE LEVEL INDEX
C
C           (I*4)  IM      = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IS      = ORDINARY EXCITED LEVEL INDEX
C
C
C ROUTINES: NONE
C
C NOTE:
C           VRED(IM)      =    ( the recombination rate for IM )
C                                                 +
C                              SUM( (the transistion rate from ordinary
C                                    level IS to IM)  x  (the recombin-
C                                    ation  contribution  for  ordinary
C                                    level IS) )
C
C                              ABOVE SUM IS OVER ALL ORDINARY LEVELS.
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDTEM              , NDLEV              , NDMET      ,
     &           IT                 , NORD               , NMET
      INTEGER    IM                 , IS
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)       , IMETR(NDMET)
C-----------------------------------------------------------------------
      REAL*8     CC(NDLEV,NDLEV)    , STV(NDLEV)         ,
     &           VEC(NDTEM,NDLEV)   , VRED(NDMET)
C-----------------------------------------------------------------------
```

BXSTVM

```
      SUBROUTINE BXSTVM( NDMET  ,
     &                   NMET   ,
     &                   CRMAT  ,
     &                   VRED   ,
     &                   STVM
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BXSTVM *********************
C
C  PURPOSE: TO  CALCULATE  AND STACK UP IN  'STVM'  THE METASTABLE LEVEL
C           RECOMBINATION  COEFFICIENTS  FOR  A  GIVEN  TEMPERATURE  AND
C           DENSITY.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (R*8)  CRMAT(,)= INVERTED  METASTABLE  LEVEL   RATE   MATRIX
C                            COVERING ALL TRANSITIONS BETWEEN METASTABLE
C                            LEVELS EXCEPT THOSE INVOLVING LEVEL 1.
C                            (UNITS: SEC)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: METASTABLE LEVEL INDEX - 1
C                            2nd DIMENSION: METASTABLE LEVEL INDEX - 1
C
C  INPUT :  (R*8)  VRED()  = VECTOR  OF RECOMBINATION RATE CONTRIBUTIONS
C                            FOR EACH METASTABLE LEVEL.
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            DIMENSION: METASTABLE LEVEL INDEX
C
C  OUTPUT:  (R*8)  STVM()  = RECOMBINATION  CONTRIBUTION  FOR  EACH
C                            METASTABLE LEVEL. (UNITS: CM**3)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            (LEVEL 1 IS TAKEN AS ZERO)
C                            DIMENSION: METASTABLE LEVEL INDEX
C
C           (I*4)  IM1     = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IM2     = METASTABLE LEVEL ARRAY INDEX
C
C
C ROUTINES: NONE
C
C NOTE:
C           STVM(IM1)       SUM( (the transistion rate from IM2 to IM1)
C                                x (the recombination rate contribution
C                                   for metastable level IM2) )
C
C                           (IM1 & IM2 = METASTABLE LEVEL INDEX)
C
C                           ABOVE SUM IS OVER ALL METASTABLE LEVELS
C                           EXCEPT LEVEL ONE.
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/81
C          JET EXT. 4569
C
C DATE:    09/10/90
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDMET               , NMET
      INTEGER    IM1                 , IM2
C-----------------------------------------------------------------------
      REAL*8     CRMAT(NDMET,NDMET)  , VRED(NDMET)       ,
     &           STVM(NDMET)
C-----------------------------------------------------------------------
```

BXWR11

```
      SUBROUTINE BXWR11( IUNIT  , DSNINC , TITLED ,
     &                   NDLEV  , NDTEM  , NDDEN  , NDMET ,
     &                   IZ     , IZ0    , IZ1    , BWNO  ,
     &                   IL     , NMET   , NORD   ,
     &                   MAXT   , MAXD   , ICNTR  , ICNTH ,
     &                   IA     , ISA    , ILA    , XJA   ,
     &                   CSTRGA ,
     &                   IMETR  , IORDR  , TEA    , DENSA ,
```

```
     &                  STCKM  , STVR   , STVH   ,
     &                  STVRM  , STVHM  , STACK  '
     &                )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: BXWR11 ******************
C
C  PURPOSE:  TO OUTPUT DATA TO CONTOUR PASSING FILE.
C            POPULATION  DATA  FOR DIAGNOSTIC USE.
C
C  CALLING PROGRAM: ADAS205/ADAS206
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT NUMBER FOR RESULTS
CX INPUT : (C*44) DSNINC  = INPUT COPASE DATA SET NAME (IN QUOTES).
CA INPUT : (C*80) DSNINC  = INPUT COPASE DATA SET NAME (IN QUOTES).
C  INPUT : (C*3)  TITLED  = ELEMENT SYMBOL.
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (I*4)  IZ      =  RECOMBINED ION CHARGE READ
C  INPUT : (I*4)  IZ0     =         NUCLEAR CHARGE READ
C  INPUT : (I*4)  IZ1     = RECOMBINING ION CHARGE READ
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT : (R*8)  BWNO    = IONISATION POTENTIAL (CM-1)
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES LEVELS: 1<=NMET<=NDMET
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> 'NDTEM')
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> 'NDDEN')
C  INPUT : (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT : (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  INPUT : (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  INPUT : (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT : (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT : (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST.
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C
C  INPUT : (R*8) STCKM(,,) = METASTABLE POPULATIONS STACK
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVR(,,)  = FREE ELECTRON RECOMBINATION COEFFICIENTS
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVH(,,)  =  CHARGE EXCHANGE COEFFICIENTS
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVRM(,,) = METASTABLE FREE ELECTRON RECOMBINATION
C                           COEFFICIENTS.
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVHM(,,) = METASTABLE CHARGE EXCHANGE COEFFICIENTS
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*4) STACK(,,,)= POPULATION DEPENDENCE
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: METASTABLE INDEX
C                            3rd DIMENSION: TEMPERATURE INDEX
C                            4th DIMENSION: DENSITY INDEX
C
C          (I*4) I         = GENERAL USE
C          (I*4) J         = GENERAL USE
C          (I*4) K         = GENERAL USE
C          (I*4) L         = GENERAL USE
C
C NOTE:
C          THIS OUTPUT DATA IS FOR SUBSEQUENT INPUT INTO THE DIAGNOSTIC
C          AND CONTOUR GRAPHING PROGRAM 'CONTOUR'.
C
C
C ROUTINES: NONE
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
```

```
C
C DATE:    09/10/90
C
C
C UPDATE:  20/05/93 - PE BRIDEN - ADAS91: TO REFLECT CHANGES IN BXDATA
C                                         THE FOLLOWING ARRAY DIMENSION/
C                                         SIZE CHANGES WERE MADE:
C                                       1) CHARACTER CSTRGA *12 -> *18
C                                          (FORMAT STMT 1003 CHANGED)
C
C UPDATE:  20/05/93- P BRIDEN: STACK ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C-----------------------------------------------------------------------
      INTEGER   NDLEV     , NDTEM      , NDDEN   , NDMET
      INTEGER   IUNIT     ,
     &          IZ        , IZ0        , IZ1     ,
     &          IL        , NMET       , NORD    ,
     &          MAXT      , MAXD       , ICNTR   , ICNTH
      INTEGER   I         , J          , K       , L
C-----------------------------------------------------------------------
      REAL*8    BWNO
C-----------------------------------------------------------------------
CX    CHARACTER TITLED*3         , DSNINC*44
      CHARACTER TITLED*3         , DSNINC*80
      CHARACTER CSTRGA(NDLEV)*18
C-----------------------------------------------------------------------
      INTEGER   IA(NDLEV)        , ISA(NDLEV)       , ILA(NDLEV)
      INTEGER   IMETR(NDMET)     , IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8   XJA(NDLEV)        , TEA(NDTEM)       , DENSA(NDDEN)
      REAL*8   STCKM(NDMET,NDTEM,NDDEN)
      REAL*8   STVR(NDLEV,NDTEM,NDDEN)        , STVH(NDLEV,NDTEM,NDDEN)
      REAL*8   STVRM(NDMET,NDTEM,NDDEN)       , STVHM(NDMET,NDTEM,NDDEN)
      REAL*4   STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
```

CHINDX

```
       SUBROUTINE CHINDX(  CNJL  ,  INDJL  ,  NJLEVX  ,  NJLEN  ,
     &                     CNBL  ,  INDBL  ,  BNDLS   ,  NGAP   ,
     &                     INDBLO
     &                  )
       IMPLICIT NONE
C-----------------------------------------------------------------------
C  FORTRAN 77 SUBROUTINE CHINDX
C
C  PURPOSE: TO RE-INDEX & ALTER TERMS FOR A BUNDLED SET OF LEVELS
C
C  AUTHOR: DAVID H.BROOKS
C
C  DATE: 28.04.95
C
C  MODIFIED: 23.01.96 DAVID H.BROOKS
C            SLIGHT ALTERATION TO METHOD TO TRAP SOME WIDER CASES.
C
C  MODIFIED: 18.11.98 DAVID H.BROOKS
C            FURTHER ALTERATION TO TRAP SOME WIDER CASES.
C-----------------------------------------------------------------------
       INTEGER INDJL, INDBL, BNDLS, NJLEVX
       INTEGER NGAP , MK   ,INDBLO, NJLEN
       INTEGER I    , J    ,  IMK
C-----------------------------------------------------------------------
       CHARACTER CNJL(NJLEVX)*18, CNBL(NJLEVX)*18
C-----------------------------------------------------------------------
       DIMENSION INDJL(NJLEVX), INDBL(NJLEVX)
       DIMENSION BNDLS(NJLEVX), NGAP(NJLEVX)
       DIMENSION INDBLO(NJLEVX)
C-----------------------------------------------------------------------
```

DIELCL

```
       SUBROUTINE DIELCL(Z,EIJ,F,T,COR,JCOR,N,DEF,AD,L,CPT)
       IMPLICIT REAL*8 (A-H,O-Z)
C-----------------------------------------------------------------------
C
C  ************** FORTRAN77 SUBROUTINE: DIELCL  ************************
C
C  VERSION:  1.0
C
C  PURPOSE:  THIS SUBROUTINE IS NOT YET PROPERLY DOCUMENTED
C
C-----------------------------------------------------------------------
C
C UNIX-IDL CONVERSION:
C
C VERSION: 1.1                          DATE: 22-08-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST CONVERTED. NO CHANGES.
C
```

```
C VERSION: 1.2                          DATE: 09-09-96
C MODIFIED: WILLIAM OSBORN
C               - COMMENTED-OUT LINE 'CPT=CPTS(L+1)' WHICH WAS GIVING
C                 A COMPILER WARNING AND IS NOT YET NEEDED.
C-----------------------------------------------------------------------

       DIMENSION THETA(1000),COR(20),CPTS(1000)
```

FINTB

```
       FUNCTION FINTB(X)
C-----------------------------------------------------------------------
C
C  ************** FORTRAN77 SUBROUTINE: FINTB   ************************
C
C  VERSION:  1.0
C
C  PURPOSE:  DEFINE INTERPOLATION INDEPENDENT VARAIABLE
C
C  THIS SUBROUTINE IS NOT YET PROPERLY DOCUMENTED
C
C-----------------------------------------------------------------------
C
C UNIX-IDL CONVERSION:
C
C VERSION: 1.1                          DATE: 22-08-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST CONVERTED. NO CHANGES.
C
C-----------------------------------------------------------------------
       IMPLICIT REAL*8 (A-H,O-Z)
```

NGFFMH

```
       FUNCTION NGFFMH(GAM2)
       IMPLICIT REAL*8(A-H,O-Z)
C-----------------------------------------------------------------------
C
C  ************** FORTRAN77 SUBROUTINE: NGFFMH  ************************
C
C  VERSION:  1.0
C
C  PURPOSE:
C
C  EVALUATES ELECTRON TEMPERATURE AND FREQUENCY AVERAGED HYDROGENIC
C  FREE FREE GAUNT FACTOR.
C  OBTAINED FROM INTERPOLATION OF KARZAS & LATTER (1959) FIG.6
C  FOR -3<LOG10(Z0*Z0*IH/KTE)<1. OUTSIDE THIS RANGE A VERY APPROXIMATE
C  EXTRAPOLATION IS PERFORMED WITH GFFMH=1 IN THE INFINITE LIMITS.
C
C  INPUT:
C       GAM2=Z0*Z0*IH/KTE
C  OUTPUT:
C       NGFFMH=MAXWELL AND FREQUENCY AVERAGED FREE-FREE GAUNT FACTOR.
C  ********* H.P.SUMMERS, JET         12 JAN 1987    ******************
C-----------------------------------------------------------------------
C
C UNIX-IDL CONVERSION:
C
C VERSION: 1.1                          DATE: 22-08-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST CONVERTED. NO CHANGES.
C
C-----------------------------------------------------------------------
       DIMENSION GAM2LA(17),GA(17)
       DATA GAM2LA/-3.0D0,-2.75D0,-2.50D0,-2.25D0,-2.00D0,-1.75D0,
     &-1.50D0,-1.25D0,-1.00D0,-0.75D0,-0.50D0,-0.25D0,0.00D0,0.25D0,
     &0.50D0,0.75D0,1.00D0/
       DATA GA/1.139D0,1.151D0,1.167D0,1.189D0,1.215D0,1.248D0,1.283D0,
     &1.326D0,1.370D0,1.411D0,1.431D0,1.436D0,1.433D0,1.415D0,1.379D0,
     &1.338D0,1.296D0/
```

PHOTOLT

```
       SUBROUTINE PHOTOLT(PION,PREC,PSTIM,Z,TE,TP,EN,N,NCUT,
     & KPION,KPREC,KPSTIM)
       IMPLICIT REAL*8 (A-H,O-Z)
C-----------------------------------------------------------------------
C
C  ************** FORTRAN77 SUBROUTINE: PHOTOLT ************************
C
C  VERSION:  1.0
C
C  PURPOSE:
C
```

```
C  VARIANT OF PHOTO:  MULTIPLIES PREC BY EXP(XNT) IF N<NCUT
C
C  NOT YET FULLY ANNOTATED
C
C  ******** H.P.SUMMERS, JET                  23 JAN 1990     **********
C----------------------------------------------------------------------
C
C UNIX-IDL CONVERSION:
C
C VERSION: 1.1                          DATE: 22-08-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST CONVERTED. NO CHANGES.
C
C----------------------------------------------------------------------
C----------------------------------------------------------------------
       DIMENSION A(10),B(10),U(10),V(10),R(10),S(10),D(10),WA(10),WB(10)
```

R2PHOTO

```
       SUBROUTINE R2PHOTO(ATE,EN,RREC,QRREC)
       IMPLICIT REAL*8(A-H,O-Z)
C----------------------------------------------------------------------
C  *********  FORTRAN 77 SUBROUTINE ******************
C
C            NAME:  R2PHOTO
C
C         VERSION:  2.0
C
C  PREVIOUS NAMES:  JETSHP.NMAINCH(RPHOTO)  (H.P. SUMMERS)
C
C          AUTHOR:  H.P. SUMMERS/ W.J. DICKSON
C
C            DATE:  19/10/93
C
C    PURPOSE:
C    --------
C    UPDATED VERSION OF RPHOTO TO ALLOW
C
C      (I)  RETURN OF ENERGY AVERAGED ELECTRON COOLING COEFFICIENT
C
C
C    INPUT:
C    ------
C    ATE         R*8      EQUAL TO  (157890.0 /TE) *Z*Z
C    EN          R*8      N SHELL
C
C
C    OUTPUT:
C    -------
C    RREC        R*8      ENERGY AVERAGED BOUND-FREE GAUNT FACTOR
C                          (= INT FROM 0 TO INFINITY OF GII*EXP(-X) DX)
C    QRREC       R*8      ENERGY AVERAGED BOUND-FREE GAUNT FACTOR FOR
C                         CALCULATION OF ELECTRON COOLING FUNCTION.
C                          ( = RREC REDUCED BY FACTOR OF E/HV,
C                                WHERE E  = ELECTRON ENERGY
C                                      HV = PHOTON ENERGY )
C
C   NOTES:
C   ------
C    TE IS IN KELVIN UNITS
C    X = E/KT
C
C----------------------------------------------------------------------
C
C UNIX-IDL CONVERSION:
C
C VERSION: 1.1                          DATE: 22-08-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST CONVERTED. NO CHANGES.
C
C----------------------------------------------------------------------
C----------------------------------------------------------------------
C
       DIMENSION XA(6),WA(6)
C
       DATA NX/6/
       DATA XA/0.2228466042D0,1.1889321017D0,2.9927363261D0,
     &         5.7751435691D0,9.8374674184D0,15.9828739806D0/
       DATA WA/4.58964673950D-1,4.17000830772D-1,1.13373382074D-1,
     &         1.03991974531D-2,2.61017202815D-4,8.98547906430D-7/
C
C----------------------------------------------------------------------
```

ADWLPOL

```
       SUBROUTINE ADWLPOL(Z0,NLQS,NSHELL,NA,LA,EA,QDA,ALFAA,JSN,JEALFA,
     &ACC,XMAX,H,LAM,IREPT,IEXT,ANS,OPEN17)
       IMPLICIT REAL*8(A-H,O-Z)
C----------------------------------------------------------------------
```

```
C  VERSION OF DWLPOL FOR USE BY ADASRRC.  IT AVOIDS ALFA SEARCH FOR FREE
C  WAVE FUNCTIONS BY USING SAME SCREENING PARAMETERS AS BOUND STATE
C  ************** H.P. SUMMERS, JET   30 JUNE 1992 **********************
C
C  EVALUATES LAM-POLE RADIAL MATRIX ELEMENTS USING DISTORTED WAVES
C  BOUND-BOUND, BOUND-FREE AND FREE-FREE CASES ARE HANDLED.  THE
C  DISTORTED WAVES ARE IN A JUCYS OR SLATER TYPE POTENTIAL.
C  ************** H.P. SUMMERS, JET  24 APRIL 1985 **********************
C  INPUT
C      Z0=NUCLEAR CHARGE (+VE)
C      NLQS(I)=N,L,IQ FOR EACH SCREENING SHELL I=1 TO NSHELL
C      NSHELL=NUMBER OF SCREENING SHELLS
C      NA(1),NA(2)=INITIAL AND FINAL STATE PRINCIPAL QUANTUM NUMBERS.
C                  SET TO ZERO FOR FREE STATES
C      LA(1),LA(2)=INITIAL AND FINAL STATE ORBITAL QUANTUM NUMBERS.
C      EA(1),EA(2)=ENERGIES(RYD) OF INITIAL AND FINAL STATES
C                  SET <0 FOR BOUND STATES, SET >0 FOR FREE STATES.
C      QDA(1),QDA(2)=QUANTUM DEFECTS FOR INITIAL AND FINAL STATES.
C                   EXTRAPOLATED QUANTUM DEFECT USED FOR FREE STATE
C      ALFAA(1,I),ALFAA(2,I)=SCREENING PARAMETERS FOR INITIAL AND FINAL
C                         STATES FOR EACH SHELL I=1 TO NSHELL.
C      JSN=-1 JUCYS POTENTIAL
C         =0  SLATER POTENTIAL
C      JEALFA=0 SEARCH FOR ENERGIES GIVEN POTENTIAL (NO EFFECT FOR
C                  FREE STATES)
C            =1 SEARCH FOR ALFAA PARAMETERS FOR POTENTIAL GIVEN ENERGIES
C                  AND QUANTUM DEFECTS.
C      ACC=SEARCH ACCURACY SETTING
C      XMAX=RANGE FOR NUMERICAL WAVE FUNCTION GENERATION AND STORAGE
C      H=STEP INTERVAL FOR NUMERICAL WAVE FUNCTION STORAGE
C      LAM=MULTIPOLE (FOR RADIAL INTEGRAL <X**LAM>)
C      IREPT=0 FULL WAVE FUNCTION DETERMINATION
C           =1 REPETITION WITH SAME WAVE FUNCTIONS AS IN PREVIOUS CASE
C           =2 USE SAME BOUND WAVE FUNCTIONS AS IN PREVIOUS CASE,
C              USE FREE WAVE FUNCTIONS IN SAME POTENTIAL AS IN PREVIOUS
C              BUT WITH POSSIBLY DIFFERENT ENERGIES.
C      IEXT=0 NORMAL OPERATION WITH INTERNALLY GENERATED WAVE FUNCTIONS
C          =1 USE EXTERNAL WAVE FUNCTIONS SUPPLIED IN FUNCTION
C             GEXT(X,N,L) WITH N AND L SPECIFYING ORBITAL.
C      OPEN17 = FLAG WHETHER UNIT 17 IS OPENED OR NOT
C  OUTPUT
C      ANS=RADIAL INTEGRAL (AT. UNITS)
C
C
C  UPDATE:  HP SUMMERS  16/06/95  ALTER DEFINIAITON OF NLQS AS
C                                 1000*N+100*L+IQ TO AVOID PROBLEM WHEN\
C                                 NUMBER OF EQUIVALENT ELECTRONS IS 10.
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    4TH JULY 1996
C
C VERSION: 1.1                          DATE: 04-07-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST VERSION.
C
C VERSION: 1.2                          DATE: 19-08-96
C MODIFIED: WILLIAM OSBORN
C               - COMMENTED-OUT DIAGNOSTIC OUTPUT.
C               - ADDED OPEN17 PARAMETER.
C
C VERSION: 1.3                          DATE: 23-08-96
C MODIFIED: WILLIAM OSBORN
C               - CORRECTED OUTPUT TO STREAM 17
C
C-----------------------------------------------------------------------
      DIMENSION NLQS(10),NUMEL(10),NC(10),ALFA(10)
      DIMENSION ALFAA(2,10),NA(2),LA(2),EA(2),QDA(2)
      DIMENSION X0A(2),X1A(2),X2A(2)
      DIMENSION GI(1000),GJ(1000),ZL(1000),ZS(100)
      DIMENSION AMPI(20),AMPJ(20),AMP1(20),AMP2(20)
      LOGICAL OPEN17
```

ADWRD2

```
      FUNCTION ADWRD2(N,L,L1)
      IMPLICIT REAL*8(A-H,O-Z)
C -----------------------------------------------------------------------
C
C  VERSION OF DWRD2 FOR USE BY ADASRRC WHICH MAKES USE OF ADWLPOL
C  *********  H.P. SUMMERS, JET    30 JUNE 1992 **********************
C
C  CALCULATES SQUARE OF BOUND FREE DIPOLE INTEGRAL IN DISTORTED WAVE
C  APPROXIMATION.  THIS FUNCTION ACTS AS AN INTERFACE BETWEEN GIIDW AND
C  DWLPOL.  ATOMIC STRUCTURE AND POTENTIAL DATA IS BROUGHT IN VIA
C  LABELLED COMMON BLOCK  /DWPARS/
C  *********  H.P. SUMMERS, JET 19 AUGUST 1985  **********************
C  INPUT
C      N=PRINCIPAL QUANTUM NUMBER OF BOUND ELECTRON
C      L=ORBITAL QUANTUM NUMBER OF BOUND ELECTRON
C      L1=ORBITAL QUANTUM NUMBER OF FREE ELECTRON
C  OUTPUT
C      ADWRD2=SQUARED RADIAL DIPOLE INTEGRAL
```

```
C ----------------------------------------------------------------------
C----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    4TH JULY 1996
C
C VERSION: 1.1                          DATE: 04-07-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST VERSION.
C----------------------------------------------------------------------
       DIMENSION NLQS(10),NA(2),LA(2),EA(2),QDA(2),ALFAA(2,10)
       COMMON /DWPARS/Z0,EA,QDA,ALFAA,ACC,XMAX,H,NLQS,NSHELL,NA,LA,JSN,
     &JEALFA,IONCE
```

AGIIDW

```
       FUNCTION AGIIDW(VVE,V,N,L,L1,LP,ISP,LT,LT1,IS,IRESOL)
       IMPLICIT REAL*8(A-H,O-Z)
C ----------------------------------------------------------------------
C
C  VERSION OF GIIDW FOR USE BY APHOTDW CALLED BY ADASRRC
C  ******************** H.P.SUMMERS, JET   30 JUNE 1992 ***************
C
C  CALCULATES BOUND-FREE G-FACTORS USING DISTORTED WAVES, BURGESS-SEATON
C  PEACH OR HYDROGENIC APPROXIMATIONS
C  ******************** H.P.SUMMERS, JET   19 AUG. 1984 ***************
C  MAY SELECT DISTORTED WAVE MATRIX ELEMENTS, FROM PEACH TABLES, FROM
C  ORIGINAL BURGESS-SEATON APPROXIMATION OR HYDROGENIC MATRIX ELEMENTS
C  USING SELECTOR IBSOPT IN THE /BSPARS/ COMMON BLOCK.
C  FOR COMPLETENESS, THE UNRESOLVED, BUNDLED N, GBF (BURGESS AND SUMMERS
C  ,1976) CAN ALSO BE OBTAINED.
C  THE DRIVING PROGRAM MUST SET COMMON BLOCKS /PCHGTB/ AND /PCHXTB/ FOR
C  USE BY FUNCTIONS PCHG AND PCHX AND SET IFIRST=IGONE=1 AT START UP.
C  /PCHGTB/ DATA IS REQUIRED FROM FILE PCHGTAB.DATA ON STREAM 13
C  /PCHXTB/ DATA IS REQUIRED FROM FILE PCHXTAB.DATA ON STREAM 14
C  INPUT
C      VVE=V**2*E WHERE E=(FREE ELECTRON ENERGY)/Z**2 (RYD)
C      V=EFFECTIVE PRINCIPAL QUANTUM NUMBER OF BOUND ELECTRON
C      N=PRINCIPAL QUANTUM NUMBER OF BOUND ELECTRON
C      L=ORBITAL QUANTUM NUMBER OF BOUND ELECTRON
C      L1=ORBITAL QUANTUM NUMBER OF FREE ELECTRON
C      ISP=2*SP+1 WHERE SP IS TOTAL SPIN OF PARENT STATE
C      LP=TOTAL ORBITAL ANGULAR MOMENTUM QUANTUM NUMBER OF PARENT STATE
C      LT=TOTAL ORBITAL ANGULAR MOMENTUM QUANTUM NUMBER OF BOUND SYSTEM
C      LT1=TOTAL ORBITAL ANGULAR MOMENTUM QUANTUM NUMBER OF FREE SYSTEM
C      IS=2*S+1 WHERE S IS TOTAL SPIN OF SYSTEM
C      IRESOL=1 GIVES GII((LP,SP)N L LT S,(LP,SP)E L1 LT1 S)
C             =2 GIVES GII((LP,SP)N L LT S,(LP,SP)E L1 S) =ABOVE LT1 SUM
C             =3 GIVES GII((LP,SP)N L S,(LP,SP)E L1 S)   = ABOVE LT SUM
C             =4 GIVES GII((LP,SP)N L,(LP,SP)E L1)      = ABOVE S SUM
C             =5 GIVES GII(N,E) = GBF  (BURGESS AND SUMMERS)
C  OUTPUT
C      AGIIDW  THE BOUND-FREE GAUNT FACTOR
C----------------------------------------------------------------------
C  UPDATE:  01/10/96  HP SUMMERS - BYPASS PEACH DATA INPUT IF IBSOPT=3
C----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    4TH JULY 1996
C
C VERSION: 1.1                          DATE: 04-07-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST VERSION.
C VERSION: 1.2                          DATE: 14-10-96
C MODIFIED: WILLIAM OSBORN
C               - ADDED CHANGES DATED 01/10/96 ABOVE.
C
C----------------------------------------------------------------------
C ----------------------------------------------------------------------
       DIMENSION A(6),B(6),C(6),ALF(6),BET(6)
       DIMENSION G(72),GAM(72)
       DIMENSION G01(8),GAM01(8),X01(8),V01(8)
       DIMENSION RG10(11),G10(11),GAM10(11),X10(11),V10(11)
       DIMENSION RG12(11),G12(11),GAM12(11),X12(11),B12(11),V12(11)
       DIMENSION NLQS(10),NAA(2),LAA(2),EAA(2),QDAA(2),ALFAA(2,10)
       COMMON /DWPARS/Z0,EAA,QDAA,ALFAA,ACC,XMAX,H,NLQS,NSHELL,NAA,LAA,
     &JSN,JEALFA,IONCE
       COMMON /BSPARS/Z,U1,U2,U3,ZETA,IBSOPT,IWARN
C      Z=BOUND STATE ION CHARGE+1
C      U1,U2,U3=QUANTUM DEFECT EXPANSION PARAMETERS FOR FREE STATE
C      ZETA=ZETA PARAMETER FOR BOUND STATE
C      IBSOPT=1 TO USE FITTED PEACH PHASE IN MATRIX ELEMENT
C             =2 TO USE BURGESS-SEATON PHASE IN MATRIX ELEMENT
C             =3 TO USE HYDROGENIC MATRIX ELEMENT
C             =4 TO USE DISTORTED WAVE MATRIX ELEMENT
C      IWARN=0 NO SENSITIVITY (OR HYDROGENIC OPTION SELECTED)
C           =I1+2*I2+4*I3+8*I4   WHERE
C                I1=1 IMPLIES PEACH PHASE SENSITIVITY
C                I2=1 IMPLIES B&S PHASE SENSITIVITY
C                I3=1 IMPLIES IBSOPT CHOICE SENSITIVE
```

```
C                I4=1 IMPLIES B&S AND PEACH STRADDLE PI/2
      DATA A/-0.147D0,-0.216D0,-0.120D0,-0.247D0,-0.117D0,-0.362D0/
      DATA B/0.2515D0,-0.171D0,0.600D0,-0.272D0,1.170D0,0.599D0/
      DATA C/-0.078D0,0.0D0,0.0D0,0.0D0,0.0D0,-2.432D0/
      DATA ALF/0.310D0,0.0D0,0.362D0,-0.010D0,0.321D0,-0.390D0/
      DATA BET/0.0D0,0.0D0,0.0535D0,-0.019D0,0.106D0,0.050D0/
      DATA G/2.723D0,0.0D0,0.0D0,0.0D0,0.0D0,0.0D0,
     &2.095D0,1.028D0,2.840D0,0.0D0,0.0D0,0.0D0,
     &1.856D0,1.117D0,2.264D0,0.669D0,3.000D0,0.000D0,
     &1.718D0,1.152D0,2.010D0,0.818D0,2.413D0,0.468D0,
     &1.623D0,1.168D0,1.856D0,0.899D0,2.139D0,0.599D0,
     &1.553D0,1.175D0,1.749D0,0.952D0,1.971D0,0.704D0,
     &1.498D0,1.177D0,1.666D0,0.988D0,1.854D0,0.793D0,
     &1.452D0,1.176D0,1.601D0,1.014D0,1.765D0,0.868D0,
     &1.414D0,1.173D0,1.546D0,1.033D0,1.694D0,0.933D0,
     &1.381D0,1.170D0,1.501D0,1.047D0,1.635D0,0.911D0,
     &1.352D0,1.165D0,1.461D0,1.058D0,1.585D0,1.041D0,
     &1.327D0,1.161D0,1.427D0,1.065D0,1.543D0,1.085D0/
      DATA GAM/1.754D0,0.0D0,0.0D0,0.0D0,0.0D0,0.0D0,0.0D0,
     &1.605D0,1.667D0,1.574D0,0.0D0,0.0D0,0.0D0,
     &1.591D0,1.667D0,1.582D0,1.819D0,1.447D0,0.000D0,
     &1.590D0,1.667D0,1.579D0,1.771D0,1.535D0,1.850D0,
     &1.591D0,1.667D0,1.582D0,1.741D0,1.544D0,1.908D0,
     &1.594D0,1.667D0,1.587D0,1.722D0,1.549D0,1.918D0,
     &1.596D0,1.667D0,1.593D0,1.707D0,1.556D0,1.920D0,
     &1.599D0,1.667D0,1.598D0,1.697D0,1.564D0,1.921D0,
     &1.601D0,1.667D0,1.603D0,1.688D0,1.573D0,1.922D0,
     &1.603D0,1.667D0,1.608D0,1.682D0,1.581D0,1.924D0,
     &1.605D0,1.667D0,1.614D0,1.676D0,1.589D0,1.926D0,
     &1.607D0,1.667D0,1.618D0,1.672D0,1.596D0,1.928D0/
      DATA V01/0.6D0,0.8D0,1.0D0,1.2D0,1.4D0,1.6D0,1.8D0,2.0D0/
      DATA G01/3.259D0,2.976D0,2.739D0,2.527D0,2.360D0,2.244D0,
     &2.162D0,2.095D0/
      DATA GAM01/1.85D0,1.77D0,1.701D0,1.655D0,1.632D0,1.620D0,
     &1.612D0,1.604D0/
      DATA X01/0.143D0,0.085D0,0.043D0,0.011D0,-0.008D0,-0.020D0,
     &-0.031D0,-0.041D0/
      DATA V10/1.0D0,1.2D0,1.4D0,1.6D0,1.8D0,2.0D0,2.2D0,2.4D0,
     &2.6D0,2.8D0,3.0D0/
      DATA RG10/1.88D0,1.50D0,1.31D0,1.18D0,0.0D0,0.0D0,0.0D0,0.0D0,
     &0.0D0,0.0D0,0.0D0/
      DATA G10/0.0D0,0.670D0,0.826D0,0.911D0,0.962D0,0.999D0,
     &1.029D0,1.058D0,1.080D0,1.100D0,1.117D0/
      DATA GAM10/1.333D0,1.515D0,1.585D0,1.630D0,1.655D0,1.667D0,
     &1.667D0,1.667D0,1.667D0,1.667D0,1.667D0/
      DATA X10/-0.330D0,-0.321D0,-0.313D0,-0.306D0,-0.300D0,-0.295D0,
     &-0.290D0,-0.286D0,-0.281D0,-0.277D0,-0.273D0/
      DATA V12/1.0D0,1.2D0,1.4D0,1.6D0,1.8D0,2.0D0,2.2D0,2.4D0,
     &2.6D0,2.8D0,3.0D0/
      DATA RG12/5.69D0,5.57D0,5.02D0,4.25D0,0.0D0,0.0D0,0.0D0,
     &0.0D0,0.0D0,0.0D0,0.0D0/
      DATA G12/0.0D0,2.489D0,3.174D0,3.291D0,3.075D0,2.757D0,2.512D0,
     &2.415D0,2.386D0,2.340D0,2.251D0/
      DATA GAM12/2.340D0,1.911D0,1.703D0,1.625D0,1.624D0,1.658D0,
     &1.675D0,1.635D0,1.593D0,1.576D0,1.597D0/
      DATA X12/0.650D0,0.511D0,0.389D0,0.287D0,0.210D0,0.164D0,
     &0.1425D0,0.131D0,0.115D0,0.0945D0,0.073D0/
      DATA B12/0.079D0,0.069D0,0.054D0,0.038D0,0.029D0,0.035D0,
     &0.053D0,0.068D0,0.068D0,0.060D0,0.050D0/
```

APHOTDW

```
      SUBROUTINE APHOTDW(B,B1,V,N,L,L1,LP,ISP,LT,LT1,IS,PREC,PION,     0000000
     &PSTIM,IRESOL)
      IMPLICIT REAL*8(A-H,O-Z)
C ---------------------------------------------------------------------
C
C  VERSION OF PHOTDW FOR USE BY ADASRRC WHICH USES AGIIDW
C  ****************** H.P.SUMMERS, JET   30 JUNE 1992 ***************
C
C  CALCULATE PHOTO INTEGRALS USING GIIDW BOUND-FREE GAUNT-FACTORS
C  SAME AS RECOM.FORT(PHOTO5) BUT CALLS GIIDW
C  ****************** H.P.SUMMERS, JET   19 AUG. 1984****************
C  INPUT
C      B=1.5789D5*Z**2/(V**2*TE)
C      B1=1.5789D5*Z**2/(V**2*TR)
C               WHERE
C               TE=ELECTRON TEMPERATURE (K)
C               TR=RADIATION TEMPERATURE (K)
C               Z=BOUND STATE ION CHARGE +1
C               (THUS Z**2/V***2 IS THE IONISATION POTENTIAL  (RYD))
C      V=EFFECTIVE PRINCIPAL QUANTUM NUMBER OF BOUND ELECTRON
C      N=PRINCIPAL QUANTUM NUMBER OF BOUND ELECTRON
C      L=ORBITAL QUANTUM NUMBER OF BOUND ELECTRON
C      L1=ORBITAL QUANTUM NUMBER OF FREE ELECTRON
C      ISP=2*SP+1 WHERE SP IS TOTAL SPIN OF PARENT STATE
C      LP=TOTAL ORBITAL ANGULAR MOMENTUM QUANTUM NUMBER OF PARENT STATE
C      LT=TOTAL ORBITAL ANGULAR MOMENTUM QUANTUM NUMBER OF BOUND SYSTEM
C      LT1=TOTAL ORBITAL ANGULAR MOMENTUM QUANTUM NUMBER OF FREE SYSTEM
C      IS=2*S+1 WHERE S IS TOTAL SPIN OF SYSTEM
C  OUTPUT
C      PREC=RADIATIVE RECOMBINATION INTEGRAL
C      PION=PHOTOIONISATION INTEGRAL
C      PSTIM=STIMULATED RECOMBINATION INTEGRAL
```

```
C          WHERE
C      IRESOL=1 FOR  ((LP,SP)N L LT S,(LP,SP)L1 LT1 S)
C             =2 FOR  ((LP,SP)N L LT S,(LP,SP)L1 S) =ABOVE LT1 SUM
C             =3 FOR  ((LP,SP)N L S,(LP,SP)L1 S)  = ABOVE LT SUM
C             =4 FOR  ((LP,SP)N L,(LP,SP)L1)  = ABOVE S SUM
C             =5 FOR  NO L RESOLUTION USING GBF
C
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    4TH JULY 1996
C
C VERSION: 1.1                          DATE: 04-07-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST VERSION.
C
C ---------------------------------------------------------------------0000000
C
       DIMENSION X1(8),X2(8),W1(8),W2(8)                                0000000
C
C-----------------------------------------------------------------
C     DATA FOR FOUR POINT QUADRATURE
C-----------------------------------------------------------------
C      DATA X1/-0.8611363156D0, -0.3399810436D0, 0.3399810436D0,        0000000
C     &          0.8611363156D0,  4*0.0D0 /                            0000000
C      DATA X2/ 0.3225476896D0,  1.7457611012D0, 4.5366202969D0,        0000000
C     &          9.3950709123D0,  4*0.0D0 /                            0000000
C      DATA W1/ 0.3478548451D0,  0.6521451548D0, 0.6521451548D0,        0000000
C     &0.3478548451D0,4*0.0D0/                                          0000000
C      DATA W2/ 6.03154104340D-1, 3.5741869244D-1, 3.8887908515D-2,     0000000
C     &          5.3929470556D-4 , 4*0.0D0 /                           0000000
C
C-----------------------------------------------------------------
C     DATA FOR EIGHT POINT QUADRATURE
C-----------------------------------------------------------------
       DATA X1/-0.9602898564D0, -0.7966664774D0, -0.5255324099D0,       0000000
     &         -0.1834346424D0,  0.1834346424D0,  0.5255324099D0,       0000000
     &          0.7966664774D0,  0.9602898564D0   /                     0000000

       DATA X2/ 0.170279632305,  0.9037017768D0,  2.2510866299D0,       0000000
     &          4.2667001703D0,  7.0459054024D0, 1.07585160102D1,       0000000
     &         1.57406786413D1, 2.28631317369D1  /                     0000000

       DATA W1/ 0.1012285362D0,  0.2223810344D0, 0.3137066458D0,        0000000
     &          0.3626837833D0,  0.3626837833D0, 0.3137066458D0,        0000000
     &          0.2223810344D0,  0.1012285362D0   /                     0000000

       DATA W2/ 3.69188589342D-1, 4.18786780814D-1, 1.75794986637D-1,   0000000
     &          3.33434922612D-2, 2.79453623523D-3, 9.07650877336D-5,   0000000
     &          8.48574671627D-7, 1.04800117487D-9  /                   0000000

C-----------------------------------------------------------------
```

ARGAM*8

```
       REAL FUNCTION ARGAM*8(L,A)                                       0000000
C CALCULATES ARGGAMMA(L+1+I*A)                                          0000000
C WHERE L IS AN INTEGER NOT LESS THAN ZERO                              0000000
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    4TH JULY 1996
C
C VERSION: 1.1                          DATE: 04-07-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST VERSION.
C-----------------------------------------------------------------------
       IMPLICIT REAL*8(A-H,O-Z)                                         0000000
```

ASS

```
       SUBROUTINE ASS(A10,A1,A20,A2,PHI1,PHI2,X,N,E1,E2,NMAX,REM)       0000000
       IMPLICIT REAL*8(A-H,O-Z)                                         0000000
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    4TH JULY 1996
C
C VERSION: 1.1                          DATE: 04-07-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST VERSION.
C-----------------------------------------------------------------------
       DIMENSION A1(20),A2(20),B(20),C(20),D(20),E(20),F(20),G(20),H(20)0000000
```

```
     1,P(20),Q(20)                                                     0000000
```

ASS2

```
       SUBROUTINE ASS2(X1,H,X,F0,F1,G0,G1,EI,EJ,TKIJ,LI,LJ,Z,NI,REM)    0000000
       IMPLICIT REAL*8(A-H,O-Z)                                         0000000
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR:  WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    4TH JULY 1996
C
C VERSION: 1.1                          DATE: 04-07-96
C MODIFIED: WILLIAM OSBORN
C               - FIRST VERSION.
C-----------------------------------------------------------------------
```

B8GETP

```
      SUBROUTINE B8GETP(
     &                    IZ0    , IZ1    , DSNEXP, DSNSPF  ,
     &                    NDLEV  , NDMETI , NDTEMI , NDDENI ,
     &                    MAXD   , MAXT   , DENSA  , TEA    ,
     &                    LPDATA , LIOSEL , LRSEL  , LHSEL  ,
     &                    IL     , ITIN   , IDIN   ,
     &                    PCC    , PCIE   , PCIEPR , PV3PR  ,
     &                    PVCRPR , PVECR  , IUNT27 , OPEN27 ,
     &                    PR
     &                  )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8GETP *********************
C
C  PURPOSE:  TO FETCH DATA FROM EXPANSION FILE AND CONDENSED BUNDLE-N
C            MATRIX FILE AND COMBINE WITH COLLISIONAL-RADIATIVE
C            DATA FOR IN THE LOW LEVEL POPULATION SOLUTION.
C
C  CALLING PROGRAM: ADAS208
C
C  DATA:
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IZ0     = NUCLEAR CHARGE
C  INPUT : (I*4)  IZ1     = ION CHARGE+1 (=CHARGE OF PARENT)
C  INPUT : (C*80) DSNEXP  = FULL NAME OF EXPANSION FILE INCLUDING '/UID'
C  INPUT : (C*80) DSNSPF  = FULL NAME OF SPEC. ION FILE READ IN MAIN
C                           PROGRAM INCLUDING '/UID'
C  INPUT : (I*4)  NDLEV   = MAX. NUMBER OF ENERGY LEVELS ALLOWED
C                           IN MAIN PROGRAM
C  INPUT : (I*4)  NDMETI  = MAX. NUMBER OF METASTABLE LEVELS ALLOWED
C                           IN MAIN PROGRAM
C  INPUT : (I*4)  NDTEMI  = MAX. NUMBER OF TEMPERATURES ALLOWED
C                           IN MAIN PROGRAM
C  INPUT : (I*4)  NDDENI  = MAX. NUMBER OF DENSITIES ALLOWED
C                           IN MAIN PROGRAM
C  INPUT : (I*4)  MAXD    = NUMBER OF DENSITIES IN MAIN PROGRAM
C  INPUT : (I*4)  MAXT    = NUMBER OF TEMPERATURES IN MAIN PROGRAM
C  INPUT : (R*8)  DENSA() = SET OF DENSITIES (CM-3) IN MAIN PROGRAM
C  INPUT : (R*8)  TEA()   = SET OF TEMPERATURES (K) IN MAIN PROGRAM
C  INPUT : (L*4)  LPDATA  = .TRUE. - EXPANSION DATA EXISTS AND IS SET
C                           .FALSE.- NO EXPANSION DATA OR NOT SET
C  INPUT : (L*4)  LIOSEL  = .TRUE. - INCLUDE DIRECT IONISATION ON OUTPUT
C                           .FALSE.- DO NOT INCLUDE
C  INPUT : (L*4)  LHSEL   = .TRUE. - INCLUDE ELECTRON RECOM  ON OUTPUT
C                           .FALSE.- DO NOT INCLUDE
C  INPUT : (L*4)  LRSEL   = .TRUE. - INCLUDE CHARGE EXCHANGE ON OUTPUT
C                           .FALSE.- DO NOT INCLUDE
C  INPUT : (I*4)  IL      = INPUT COPASE FILE - NUMBER OF ENERGY LEVELS
C  INPUT : (I*4)  ITIN    = INDEX OF REQUIRED TEMPERATURE IN TEA() SET
C  INPUT : (I*4)  IDIN    = INDEX OF REQUIRED DENSITY IN DENSA() SET
C
C  INPUT : (I*4)  IUNT27  = UNIT FOR PAPER.TEXT OUTPUT
C  INPUT : (L*4)  OPEN27   = .TRUE. - PAPER.TEXT HAS BEEN OPENED
C                               .FALSE.- PAPER.TEXT HAS NOT BEEN OPENED
C
C  OUTPUT: (R*8)  PCC(,)  = PROJETED COLL. RAD. LOW LEVEL MATRIX
C                           1ST DIM: ENERGY LEVEL INDEX
C                           2ND DIM: ENERGY LEVEL INDEX
C  OUTPUT: (R*8)  PCIE()  = PROJECTED COLL. RAD. ION. COEFFT. VECTOR
C                           1ST DIM: ENERGY LEVEL INDEX
C  OUTPUT: (R*8)  PCIEPR(,)=PROJECTED PARENT RESOLVED COLL. RAD. ION
C                           MATRIX
C                           1ST DIM: ENERGY LEVEL INDEX
C                           2ND DIM: PARENT INDEX
C  OUTPUT: (R*8)  PV3PR(,)= DIRECT PARENT RESOLVED THREE
C                           BODY RECOMB. COEFFT MATRIX
```

```
C                                1ST DIM: ENERGY LEVEL INDEX
C                                2ND DIM: PARENT INDEX
C                                UNITS : CM3S-1
C  OUTPUT: (R*8)  PVECR(,)= PROJECTED PARENT RESOLVED COLL. RAD.
C                           RECOMB. COEFFT MATRIX ( RR + DR + 3B )
C                              1ST DIM: ENERGY LEVEL INDEX
C                              2ND DIM: PARENT INDEX
C                              UNITS : CM3S-1
C  OUTPUT: (R*8)  PR( ,,) = RECOM/BREMS. COEFFT (ERG S-1)
C                              1ST DIM: PARENT INDEX
C                              2ND DIM: TEMPERATURE INDEX
C                              3RD DIM: DENSITY INDEX
C
C
C          (C*80) DSNCPM  = FULL NAME OF COND.MAT. FILE INCLUDING '/UID'
C                           EXPANDED IF NECESSARY FROM SYMBOLIC FILENAME
C                           IN NAMELIST IN EXPANSION FILE
C          (C*80) DSNREF  = FULL NAME OF SPEC. ION FILE INCLUDING '/UID'
C                           EXPANDED IF NECESSARY FROM SYMBOLIC FILENAME
C                           IN NAMELIST IN EXPANSION FILE
C          (C*80) DSHORT  = TEMPORARY STRING
C          (C*11) PTSYMA()= PARENT SYMMETRY (2SP+1 LP) AS CHARACTERS
C                             1ST DIMENSION: PARENT INDEX
C          (I*4)  NPTSPA()= PARENT SPIN (2SP+1)
C                             1ST DIMENSION: PARENT INDEX
C          (I*4)  NSPSYS()= NO. OF SPIN SYSTEMS ASSOCIATED WITH PARENT
C                             1ST DIMENSION: PARENT INDEX
C          (I*4)  NCUTP() = N-SHELL CUT-OFF ASSOCIATED WITH AUGER
C                           PROCESSES FOR THE PARENT
C                             1ST DIMENSION: PARENT INDEX
C          (R*8)  DEPA()  = BINDING ENERGY (RYD) OF LOWEST AUGER
C                           N-SHELL FOR THE PARENT
C                             1ST DIMENSION: PARENT INDEX
C          (I*4)  NSHEL   = NUMBER OF N-SHELLS INVOLVED IN EXPANSION
C          (I*4)  NSHELA()= N-SHELLS INVOLVED IN THE EXPANSION
C                             1ST DIMENSION: SHELL INDEX (<= NSHEL)
C          (I*4)  NSPIN   = NUMBER OF SPIN SYSTEMS FOR CURRENT PARENT
C          (I*4)  NSPNA(,)= SPIN OF SYSTEM (2S+1)
C                             1ST DIMENSION: SPIN SYSTEM INDEX
C                             2ND DIMENSION: PARENT INDEX
C          (I*4)  NLWSTA(,)= LOWEST N-SHELL INCLUDED FOR THE SPIN SYSTEM
C                             1ST DIMENSION: SPIN SYSTEM INDEX
C                             2ND DIMENSION: PARENT INDEX
C          (R*8)  PLWSTA(,)= PHASE SPACE OCCUPANCY FACTOR FOR LOWEST
C                            N-SHELL FOR SPIN SYSTEM
C                             1ST DIMENSION: SPIN SYSTEM INDEX
C                             2ND DIMENSION: PARENT INDEX
C          (R*8)  FLWSTA(,)= FRACTIONAL PARENTAGE (EQUIV. ELECTRONS) FOR
C                            FOR IONISATION FROM LOWEST LEVEL OF
C                            SPIN SYSTEM
C                             1ST DIMENSION: SPIN SYSTEM INDEX
C                             2ND DIMENSION: PARENT INDEX
C          (R*8)  FRACPRT  = TEMP. STORE OF FRACTIONAL PARENTAGE
C          (I*4)  INDA()  = LEVEL INDEX WITH RESPECT TO SPEC. ION FILE
C                             1ST DIMENSION: COUNTER OVER EXP. RECORDS
C          (C*11) LVSYMA()= LEVEL SYMMETRY AND ADDITIONAL INFO.ON CONFIG
C                             1ST DIMENSION: COUNTER OVER EXP. RECORDS
C          (I*4)  LSZDA() = SZD FILE SELECTOR FOR RECORD (IF REQUIRED)
C                             1ST DIMENSION: COUNTER OVER EXP. RECORDS
C          (I*4)  LSPA()  = SPIN SYSTEM (2S+1) FOR RECORD
C                             1ST DIMENSION: COUNTER OVER EXP. RECORDS
C          (I*4)  LSHA()  = ACTIVE N SHELL FOR RECORD
C                             1ST DIMENSION: COUNTER OVER EXP. RECORDS
C          (I*4)  LPTA()  = PARENT INDEX  FOR RECORD
C                             1ST DIMENSION: COUNTER OVER EXP. RECORDS
C          (R*8)  WGHTA(,)= WEIGHTING FOR EXPANSION FOR RECORD
C                             1ST DIMENSION: COUNTER OVER EXP RECORDS
C                             2ND DIMENSION: NSHELL INDEX
C          (I*4)  NMET    = NUMBER OF '*' LEVELS COUNTED
C                           (NB. USE ONLY ONCE FOR A GIVEN LEVEL
C                                EVEN THOUGH ANOTHER RECORD FOR THE
C                                LEVEL MAY EXIST)
C          (I*4)  IMETR() = LEVEL INDEX OF METASTABLES '*'ED
C                             1ST DIMENSION: METASTABLE COUNTER(<=NMET)
C          (C*250)LSTRNG  = COND. BUNDLE-N. MATRIX (CBNM) FILE RECORD
C          (C*2)  SEQM    = SEQUENCE IDENTIFIER GIVEN ON CBNM FILE
C          (I*4)  NUCGM   = NUCLEAR CHARGE GIVEN ON CBNM FILE
C          (I*4)  NPRTM   = NO. OF PARENTS GIVEN ON CBNM FILE
C          (I*4)  MAXDM   = NO. OF DENSITIES GIVEN ON CBNM FILE
C          (I*4)  MAXTM   = NO. OF TEMPERATURES GIVEN ON CBNM FILE
C          (I*4)  IPRT    = PARENT INDEX
C          (I*4)  IPRTM   = PARENT INDEX IN CBNM FILE
C          (C*4)  TRMPM   = PARENT TERM SPECIFICATION AS (2SP+1LP)
C          (I*4)  SPNPM   = PARENT SPIN (2SP+1)
C          (I*4)  ISYSM   = SPIN SYSTEM INDEX IN CBNM FILE
C          (I*4)  SSYSM(,)= SPIN SYSTEM IN CBNM FILE
C                             1ST DIM.: PARENT INDEX       (<=NDMET)
C                             2ND DIM.: SPIN SYSTEM INDEX  (<=2)
C          (I*4)  NSYSM() = NO OF SPIN SYSTEM IN CBNM FILE FOR PARENT
C                             1ST DIM.: PARENT INDEX       (<=NDMET)
C          (I*4)  NSHLM(,)= NO. OF N-SHELLS IN CBNM FILE
C                             1ST. DIM.: PARENT INDEX      (<=NDMET)
C                             2ND. DIM.: SPIN SYSTEM INDEX (<=2)
C          (R*8)  DENSM() = ELECTRON DENSITIES (CM-3) ON CBNM FILE
C                             1ST DIMENSION: DENSITY INDEX (<=NDMAX)
C          (R*8)  TEM()   = ELECTRON TEMPS.  (K) ON CBNM FILE
C                             1ST DIMENSION: TEMP. INDEX (<=NTMAX)
C          (R*8)  PCRMAT(,,,,,)=PROJECTED COLLISIONAL-RADIATIVE MATRIX
```

```
C                                IN P-REPRESENTATION WITHOUT ELIMINATIONS
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: DENSITY INDEX
C                                3RD DIM.: ROW INDEX
C                                4TH DIM.: COLUMN INDEX
C                                5TH DIM.: PARENT INDEX
C                                6TH DIM.: SPIN SYSTEM INDEX
C          (R*8)  PIOMAT(,,,,,)=PROJECTED COLLISIONAL-RADIATIVE IONIS.
C                                MATRIX TO RESOLVED + METASTABLES
C                                IN P-REPRESENTATION WITHOUT ELIMINATIONS
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: DENSITY INDEX
C                                3RD DIM.: ROW INDEX
C                                4TH DIM.: COLUMN INDEX (+ METASTABLES)
C                                5TH DIM.: PARENT INDEX
C                                6TH DIM.: SPIN SYSTEM INDEX
C          (R*8)  PQPIND(,,,,,)=PROJECTED INDIRECT PARENT CQ COEFFICIENT
C                                MATRIX FROM SPECIFIC PARENT, SPIN TO
C                                FINAL PARENT IN PN REPRESENTATION
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: DENSITY INDEX
C                                3TH DIM.: FINAL   PARENT INDEX
C                                4TH DIM.: INITIAL PARENT INDEX
C                                5TH DIM.: SPIN SYSTEM INDEX
C          (R*8)  PVCRPR(,,)   =PROJECTED INDIRECT PARENT CQ COEFFICIENT
C                                MATRIX FROM SPECIFIC PARENT TO
C                                FINAL PARENT IN PN REPRESENTATION
C                                SUMMED OVER SPIN SYSTEMS
C                                1ST DIM.: FINAL   PARENT INDEX
C                                2ND DIM.: INITIAL PARENT INDEX
C          (R*8)  PCRRHS(,,,,)= PROJECTED COLLISIONAL-RADIATIVE RECOM.
C                                RHS. FROM A SPECIFIED PARENT AND IN
C                                A SPECIFIED SPIN SYSTEM
C                                IN P-REPRESENTATION WITHOUT ELIMINATIONS
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: DENSITY INDEX
C                                3RD DIM.: ROW INDEX
C                                5TH DIM.: PARENT INDEX
C                                6TH DIM.: SPIN SYSTEM INDEX
C          (R*8)  PRB(,,,)    = RECOM/BREMS. COEFFT (
C                                1ST DIM: TEMPERATURE INDEX
C                                2ND DIM: DENSITY INDEX
C                                3RD DIM: PARENT INDEX
C                                4TH DIM: SPIN SYSTEM INDEX
C          (R*8)  DCRMAT(,,,) = DIRECT COLLISIONAL-RADIATIVE MATRIX
C                                IN P-REPRESENTATION FOR LOW N-SHELLS
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: DENSITY INDEX
C                                3RD DIM.: ROW INDEX
C                                4TH DIM.: COLUMN INDEX
C          (R*8)  DIOMAT(,,,) = DIRECT COLLISIONAL-RADIATIVE IONIS.
C                                MATRIX TO RESOLVED + METASTABLES
C                                IN P-REPRESENTATION FOR LOW N-SHELLS
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: DENSITY INDEX
C                                3RD DIM.: ROW INDEX
C                                4TH DIM.: COLUMN INDEX (+ METASTABLES)
C          (R*8)  DTREC(,)    =  DIRECT THREE-BODY RECOMBINATION COEFFTS.
C                                FROM A SPECIFIED PARENT AND IN A
C                                SPECIFIED SPIN SYSTEM
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: ROW INDEX
C          (R*8)  DDREC(,)    =  DIRECT DIELECTR.  RECOMBINATION COEFFTS.
C                                FROM A SPECIFIED PARENT AND IN A
C                                SPECIFIED SPIN SYSTEM
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: ROW INDEX
C          (R*8)  DRREC(,)    =  DIRECT RADIATIVE  RECOMBINATION COEFFTS.
C                                FROM A SPECIFIED PARENT AND IN A
C                                SPECIFIED SPIN SYSTEM
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: ROW INDEX
C          (R*8)  DXREC(,)    =  DIRECT CH. EXCH.  RECOMBINATION COEFFTS.
C                                FROM A SPECIFIED PARENT AND IN A
C                                SPECIFIED SPIN SYSTEM DUE TO H(1S)
C                                1ST DIM.: TEMPERATURE INDEX
C                                2ND DIM.: ROW INDEX
C          (I*4)  NM()        =  LOW N-SHELLS FOR PARENT SPIN SYSTEM
C                                COMBINATION
C                                1ST. DIM.: N-SHELL INDEX
C          (I*4)  NSUP(,)     =  HIGHEST N-SHELL REQUIRED FOR EXPANSION
C                                FOR THE PARENT AND SPIN SYSTEM
C                                1ST. DIM.: PARENT INDEX
C                                2ND. DIM.: SPIN SYSTEM INDEX
C          (I*4)  ISPIN       =  GENERAL INDEX
C          (I*4)  IPT         =  GENERAL INDEX
C          (I*4)  JPT         =  GENERAL INDEX
C          (I*4)  I           =  GENERAL INDEX
C          (I*4)  J           =  GENERAL INDEX
C          (I*4)  II          =  GENERAL INDEX
C          (I*4)  JJ          =  GENERAL INDEX
C          (I*4)  IR          =  GENERAL INDEX
C          (I*4)  IC          =  GENERAL INDEX
C          (I*4)  IS          =  GENERAL INDEX
C          (I*4)  KI          =  GENERAL INDEX
C          (I*4)  KJ          =  GENERAL INDEX
C          (I*4)  IN          =  DENSITY INDEX
C          (I*4)  IT          =  TEMPERATURE INDEX
```

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C          (I*4)  NUP        =  UPPER N-SHELL FOR CURRENT EXPANSION
C          (I*4)  IMAX       =  NO. OF SHELLS REQUIRED IN EXPANSION
C          (L*4)  LSOLVE     = .TRUE. -INVERSION WITH SOLN. OF EQUATIONS
C                            = .FALSE. -INVERSION ONLY
C          (R*8)  AMAT(,)    = TEMPORARY ARRAY FOR INVERTING
C          (R*8)  BRHS()     = TEMPORARY R.H.S FOR EQUATION SOLUTION
C          (R*8)  DINTX      = + OR - DEPENDING ON INTERCHANGES IN
C                              INVERSION SUBROUTINE XXMINV
C          (R*8)  PCRTMP(,)  = TEMPORARY PROJECTED COLL. RAD. MATRIX
C                              TO BE CONDENSED TO PCRMAT
C          (R*8)  DCRTMP(,)  = TEMPORARY DIRECT COLL. RAD. MATRIX
C                              TO BE CONDENSED TO DCRMAT
C          (R*8)  PIOTMP(,)  = TEMPORARY PROJECTED IONIS. MATRIX
C                              TO BE CONDENSED TO PIOMAT
C          (R*8)  PRHTMP(,)  = TEMPORARY PROJECTED R.H.S. VECTOR
C                              TO BE CONDENSED TO PCRRHS
C          (R*8)  PQPTMP()   = TEMPORARY INDIRECT PARENT QC COEFFICIENT
C                              TO BE CONDENSED TO PQPIND
C                                 1ST INDEX  - FINAL PARENT
C          (R*8)  SUM        = GENERAL USE FOR SUMMING
C          (R*8)  Z0         = NUCLEAR CHARGE
C          (R*8)  Z1         = ION CHARGE+1 (=CHARGE OF PARENT)
C          (R*8)  SSYSWT     = FRACTIONAL WEIGHTING OF SPIN SYSTEM
C                              FOR PARTICULAR PARENT TO BE USED IF
C                              RECOMBINATION COEFFICIENTS ARE GIVEN IN
C                              THE MULTIPLIED UP FORM.
C          (L*4)  LTRNG()    = .TRUE. - OUTPUT VALUE WAS EXTRAPOLATED
C                                       FOR TEMPERATURE
C                              .FALSE. - OUTPUT VALUE NOT EXTRAPOLATED
C          (L*4)  LDRNG()    = .TRUE. - OUTPUT VALUE WAS EXTRAPOLATED
C                                       FOR DENSITY
C                              .FALSE. - OUTPUT VALUE NOT EXTRAPOLATED
C          (I*4)  IUP        = NUP-NM(1)+1
C          (R*8)  V          = TEMPORARY REAL NUMBER
C          (R*8)  ARRIN(,)   = TEMPORARY ARRAY FOR INPUT TO SPLINING
C          (R*8)  ARROUT(,)  = TEMPORARY ARRAY FOR IOUTPUT FROM SPLINING
C          (R*8)  TEMIN      = MINIMUM TEMPERATURE BELOW WHICH COEFFT.
C                              SHOULD BE SET TO ZERO
C          (R*8)  DEMIN      = MINIMUM DENSITY  BELOW WHICH COEFFT.
C                              SHOULD BE SET TO ZERO
C          (R*8)  DETMP      = TEMPORARY VALUE OF DEMIN
C          (R*8)  TETMP      = TEMPORARY VALUE OF TEMIN
C                              SHOULD BE SET TO ZERO
C          (I*4)  IUPA(,)    = DIMENSION OF FINAL CONDENSED N-SHELL
C                              MATRIX
C                              1ST DIM: PARENT INDEX
C                              2ND DIM: SPIN SYSTEM INDEX
C C        (I*4)  IPOINTA()  = POINTER TO INDEX OF N-SHELL IN NSHEL
C C                            LIST
C C                            1ST DIM: N=PRINCIPAL QUANTUM NUMBER
C
C          (I*4)  IEDMAT   = 0 PCRL ADDED ONTO PCRMAT                  00464000
C                            1 PCRL NOT ADDED ON                       00465000
C          (I*4)  IECION   = 0 PCION  ADDED ONTO TO PCRMAT             00470000
C                              PCIONRI ADDED ONTO PCIONRP              00471000
C                            1 PCION NOT ADDED ON                      00480000
C                              PCIONRI NOT ADDED ON                    00481000
C          (I*4)  IETREC   = 0 PTREC ADDED ONTO PCRRHS                 00490000
C                            1 PTREC NOT ADDED ON                      00500000
C          (I*4)  IEDREC   = 0 PDREC ADDED ONTO PCRRHS                 00501000
C                            1 PDREC NOT ADDED ON                      00502000
C          (I*4)  IERREC   = 0 PRREC ADDED ONTO PCRRHS                 00503000
C                            1 PRREC NOT ADDED ON                      00504000
C          (I*4)  IEXREC   = 0 PXREC ADDED ONTO PCRRHS                 00505000
C                            1 PXREC NOT ADDED ON                      00506000
C          (I*4)  IERSYS   = 0 RECOMBINATION RATES MULTIPLIED
C                                  BY SPIN SYSTEM WEIGHT
C                            1 RECOMBINATION RATES NOT MULTIPLIED
C                                  BY SSYSWT
C
C ROUTINES: NONE
C
C STREAM HANDLING :
C           7     OUTPUT (PAPER.TEXT)
C          14     EXPANSION FILE
C          15     CONDENSED MATRIX MASTER FILE
C
C AUTHOR:  HP SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    18/08/92
C
C-----------------------------------------------------------------------
C
C UPDATE:  WJ DICKSON
C          K1/1/26
C
C   DATE:  JANUARY 1993
C
C          NUMEROUS ADJUSTMENTS AND UPDATES
C
C-----------------------------------------------------------------------
C
C UPDATE:  WJ DICKSON
C          K1/1/26
C
C   DATE:  12TH AUGUST 1993
```

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C
C          INCLUSION OF VARIABLES IEFPRS AND IEFPRE AND CORRESPONDING
C          ADJUSTMENTS TO DIO , PCR AND PIO MATRICES. FRACTIONAL
C          PARENTAGE COEFFICIENTS AS GIVEN BY EXPANSION FILE
C          ( VARIABLE  FLWSTA )
C
C          (I*4)  IEFPRS   = 0 GROUND STATE IONISATION RATE COEFFICIENTS
C                              HAVE BEEN MULTIPLYIED BY FRACTIONAL
C                              PARENTAGE COEFFICIENT IN MAINBNS
C                            1 GROUND STATE IONISATION RATE COEFFICIENTS
C                              HAVE NOT BEEN MULTIPLYIED BY FRACTIONAL
C                              PARENTAGE COEFFICIENT IN MAINBNS
C
C          (I*4)  IEFPRE   = 0 ELEMENTS OF MAIN C-R MATRIX ARISING
C                              FROM GROUND STATE
C                              HAVE BEEN MULTIPLYIED BY FRACTIONAL
C                              PARENTAGE COEFFICIENT IN MAINBNS
C                            1 ELEMENTS OF MAIN C-R MATRIX ARISING
C                              FROM GROUND STATE
C                              HAVE NOT BEEN MULTIPLYIED BY FRACTIONAL
C                              PARENTAGE COEFFICIENT IN MAINBNS
C
C UNIX-IDL PORT:
C
C DATE: UNKNOWN
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C UPDATE:  29/03/96  HPS - INCREASE PARAMETER SETTINGS NDTEM: 20->35
C                                                      NDDEN: 20->24
C
C UPDATE:  18/04/96  HPS - ALTER FORMAT 2008 FOR READING TEMPS. AND
C                          DENS. FROM CBNM FILE FOR CONSISTENCY WITH
C                          NEW PRODUCTION VERSION OF ADAS204
C UPDATE:  18/04/96  HPS - ALTER B8SPLNX TO B8SPLN IN 2ND AND 3RD
C                          CALLS IN THE SUBROUTINE
C UPDATE:  03/05/96  DHB - ALTERED IBM SPECIFIC STATEMENTS. INCREASED
C                          SIZE OF DSNINC & DSNSPF TO 80.
C UPDATE:  09/03/98  HPS - ADDED PR TO PARAMETER LIST. PREPARED FROM PRB
C                          FROM PROJECTION MATRIX FILE BY INTERPOLATION.
C                          CORRECTED PB TO INCLUDE SUM OVER SPIN SYSTEMS
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C DATE:    10-05-96
C
C VERSION: 1.1                          DATE: 10-05-96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER SCCS
C
C VERSION: 1.2
C MODIFIED: WILLIAM OSBORN              DATE: 13-05-96
C            - ADDED IUNT27 AND OPEN27 TO ALLOW PAPER.TEXT OUTPUT
C
C VERSION: 1.3
C MODIFIED: WILLIAM OSBORN + HPS  DATE: 28-05-96
C            - ADDED CALL TO XXFLNM TO EXPAND FILENAMES
C
C VERSION: 1.4
C MODIFIED: TIM HAMMOND                 DATE: 02-08-96
C            - CHANGED NAME OF VARIABLE DINT TO DINTX AS DINT IS THE
C              NAME OF AN INTRINSIC FUNCTION ON HP WORKSTATIONS
C
C VERSION: 1.5
C MODIFIED: RICHARD MARTIN              DATE: 02-03-98
C            - CHANGED IUNT7 TO IUNT27 AND OPEN7 TO OPEN27.
C
C VERSION: 1.6
C MODIFIED: HUGH SUMMERS                DATE: 09-03-98
C                - ADDED PR TO PARAMETER LIST. PREPARED FROM PRB
C              FROM PROJECTION MATRIX FILE BY INTERPOLATION.
C              CORRECTED PB TO INCLUDE SUM OVER SPIN SYSTEMS
C
C-----------------------------------------------------------------------
      INTEGER  IUNT14     , IUNT15    , I4UNIT
      INTEGER  NDMET      , NDREC     , NDSHL
      INTEGER  NDDEN      , NDTEM
      INTEGER  NDMETI     , NDLEV
      INTEGER  NDDENI     , NDTEMI
C-----------------------------------------------------------------------
      PARAMETER( IUNT14 = 14 , IUNT15 = 15 )
      PARAMETER( NDTEM  = 35 , NDDEN = 24 , NDMET = 4)
      PARAMETER( NDREC  =100 , NDSHL =  5 )
C-----------------------------------------------------------------------
      INTEGER   NPARNT      , NSHEL       , NLEV       , IPARNT
      INTEGER   JPARNT
      INTEGER   K           , KREC        , NMET       , NSPIN
      INTEGER   NUCGM       , NPRTM       , MAXDM      , MAXTM
      INTEGER   I           , J           , IN         , IT
      INTEGER   IPRT        , IPRTM       , ISYSM
      INTEGER   II          , JJ          , IR         , IS
      INTEGER   KI          , KJ          , IC
      INTEGER   IMAX        , NUP         , IUP
      INTEGER   MAXD        , MAXT
      INTEGER   IZ0         , IZ1
      INTEGER   IL          , ITIN        , IDIN
      INTEGER   ISPIN       , IPT         , JPT
      INTEGER   IEDMAT      , IECION      , IETREC     , IEDREC
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```
      INTEGER   IERREC      , IEXREC      , IERSYS
      INTEGER   ITPRN       , INPRN
      INTEGER   IEFPRS      , IEFPRE
C-----------------------------------------------------------------------
      CHARACTER DSNEXP*80   , DSNSPF*80   , DSNREF*80
      CHARACTER DSNCPM*80   , DSHORT*80
      CHARACTER SEQ*2       , STRING*80   , STRNG1*80   , SUBSTRG*11
      CHARACTER SEQM*2      , LSTRNG*250  , TRMPM*4
C-----------------------------------------------------------------------
      REAL*8    SPNPM       , SUM         , DINTX      , V       , TEMIN
      REAL*8    DEMIN       , DETMP       , TETMP
      REAL*8    Z0          , Z1          , SSYSWT     , PRBSP
      REAL*8    FRACPRT
C-----------------------------------------------------------------------
      LOGICAL   LEXIST      , LSOLVE      , LPDATA
      LOGICAL   LIOSEL      , LHSEL       , LRSEL
C-----------------------------------------------------------------------
      INTEGER   NPTSPA(NDMET)  , NSPSYS(NDMET)  , NCUTP(NDMET)
      INTEGER   NSHELA(NDSHL)  , NSPNA(2,NDMET) , NLWSTA(2,NDMET)
      INTEGER   IMAXSTA(2,NDMET)
      INTEGER   INDA(NDREC)    , LSZDA(NDREC)
      INTEGER   LSPA(NDREC)    , LSHA(NDREC)    , LPTA(NDREC)
      INTEGER   IMETR(NDMET*2) , NSHLM(NDMET,2) , NM(NDSHL)
      INTEGER   NSYSM(NDMET)   , NSUP(NDMET,2)  , IUPA(NDMET,2)
      INTEGER   IPOINTA(10)
C-----------------------------------------------------------------------
      REAL*8    DENSA(NDDENI)        , TEA(NDTEMI)
      REAL*8    PCC(NDLEV,NDLEV)     , PCIE(NDLEV)
      REAL*8    PCIEPR(NDLEV,NDMETI) , PV3PR(NDLEV,NDMETI)
      REAL*8    PVECR(NDLEV,NDMETI)
      REAL*8    PVCRPR(NDMETI,NDMETI)
      REAL*8    PR(NDMETI,NDTEMI,NDDENI)    , PRB(NDTEM,NDDEN,NDMET,2)
C
      REAL*8    DEPA(NDMET)
      REAL*8    PLWSTA(2,NDMET), FLWSTA(2,NDMET)
      REAL*8    WGHTA(NDREC,NDSHL)
      REAL*8    DENSM(NDDEN)   , TEM(NDTEM)  , SSYSM(NDMET,2)
      REAL*8    PCRMAT(NDTEM,NDDEN,NDSHL,NDSHL,NDMET,2)
      REAL*8    DCRMAT(NDTEM,NDDEN,NDSHL,NDSHL)
      REAL*8    PCRRHS(NDTEM,NDDEN,NDSHL,NDMET,2)
      REAL*8    PTRRHS(NDTEM,NDDEN,NDSHL,NDMET,2)
      REAL*8    PIOMAT(NDTEM,NDDEN,NDSHL,NDMET,NDMET,2)
      REAL*8    PQPIND(NDTEM,NDDEN,NDMET,NDMET,2)
      REAL*8    DIOMAT(NDTEM,NDDEN,NDSHL,NDMET)
      REAL*8    DTREC(NDTEM,NDSHL)
      REAL*8    DDREC(NDTEM,NDSHL)
      REAL*8    DRREC(NDTEM,NDSHL)
      REAL*8    DXREC(NDTEM,NDSHL)
      REAL*8    PCRTMP(NDSHL,NDSHL)  , PIOTMP(NDSHL,NDMET)
      REAL*8    DCRTMP(NDSHL,NDSHL)
      REAL*8    PRHTMP(NDSHL) , PQPTMP(NDMET)
      REAL*8    AMAT(NDSHL,NDSHL)    , BRHS(NDSHL)
      REAL*8    ARRIN(NDTEM,NDDEN)   , ARROUT(NDTEM,NDDEN)
C-----------------------------------------------------------------------
      CHARACTER PTSYMA(NDMET)*11   , LVSYMA(NDREC)*26
      CHARACTER TRMPRT(NDMET)*4
C-----------------------------------------------------------------------
      LOGICAL   LTRNG(NDTEM)       , LDRNG(NDDEN)
C-----------------------------------------------------------------------
      NAMELIST  /SEQINF/SEQ,DSNREF,DSNCPM,NPARNT,NSHEL,NLEV
C-----------------------------------------------------------------------
      INTEGER   IUNT27
      LOGICAL   OPEN27
C
C-----------------------------------------------------------------------
```

B8LOSS

```
      SUBROUTINE B8LOSS( NDTRN  , NDLEV  , NDMET ,
     &                   ICNTE  , NMET   , IMETR , ISTRN  ,
     &                   XJA    , ER     , AVAL  ,
     &                   IE1A   , IE2A   ,
     &                   SLOSS  , SWVLN  , TLOSS
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8LOSS *********************
C
C  PURPOSE: TO CALCULATE THE DIRECT LINE POWER LOSS FOR EACH LEVEL AND
C           IDENTIFY THE STRONGEST SPECIFIC LINE POWER TRANSITIONS TO
C           EACH METASTABLE LEVEL - ELECTRONIC TRANSITION INDEX 'ISTRN'
C           (MODIFICATION OF B6LOSS)
C
C  CALLING PROGRAM:  ADAS208
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTRN   = MAXIMUM NUMBER OF TRANSITIONS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT :  (I*4)  ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLES
```

```
C  INPUT :  (I*4)  IMETR() = METASTABLE INDICES IN LEVEL LIST
C                            DIMENSION: METASTABLE COUNT INDEX
C  OUTPUT:  (I*4)  ISTRN() = SPECIFIC LINE POWER: SELECTED ELECTRON
C                            IMPACT TRANSITION INDEX. (FOR USE WITH
C                            'IE1A()' , 'IE2A()' AND 'AA()' ARRAYS)
C                            WHICH GIVES LARGEST POWER TO METASTABLE
C                            DIMENSION: METASTABLE COUNT INDEX
C
C
C  INPUT :  (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR GIVEN LEVEL.
C                            NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT :  (R*8)  ER()    = ENERGY RELATIVE TO LEVEL 1 (RYDBERGS)
C                            DIMENSION: ENERGY LEVEL.
C  INPUT :  (R*8)  AVAL()  = ELECTRON IMPACT TRANSITION: A-VALUE (SEC-1)
C                            DIMENSION: ENERGY LEVEL.
C
C  INPUT :  (I*4)  IE1A()  = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  INPUT :  (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C
C  OUTPUT:  (R*8)  SLOSS()  = DIRECT LINE POWER LOSS FOR SPECIFIC LINE
C                             POWER TRANSITION GIVEN BY 'ISTRN' FOR EACH
C                             METASTABLE (UNITS: ERGS SEC-1)
C                             DIMENSION: METASTABLE COUNT INDEX
C  OUTPUT:  (R*8)  SWVLN()  = WAVELENGTH (ANGSTROM) FOR SPECIFIC LINE
C                             POWER TRANSITION GIVEN BY 'ISTRN' FOR EACH
C                             METASTABLE (UNITS: ERGS SEC-1)
C                             DIMENSION: METASTABLE COUNT INDEX
C  OUTPUT:  (R*8)  TLOSS()  = DIRECT LINE POWER LOSS FOR EACH LEVEL.
C                             (UNITS: ERGS SEC-1)
C                             DIMENSION: LEVEL INDEX
C
C           (R*8)  R2LOSS  = PARAMETER = EQUATION CONSTANT = 2.17958D-11
C                            (CONVERTS RYDBERGS/SEC TO ERGS/SEC)
C           (R*8)  WCVRN   = PARAMETER = EQUATION CONSTANT = 911.268
C                            (CONVERTS RYD. TRANS ENERGY TO WAVELENGTH
C                             IN ANGSTROM)
C           (R*8)  SCURR   = CURRENT INDIVIDUAL LINE POWER
C
C           (I*4)  LLOWER  = SELECTED ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C           (I*4)  LUPPER  = SELECTED ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C           (I*4)  IC      = TRANSITION ARRAY INDEX
C           (I*4)  IM      = METASTABLE COUNT INDEX
C
C
C ROUTINES:  NONE
C
C NOTES:
C            EQUATIONS USED -
C
C            FOR EACH TRANSITION - DIRECT LINE POWER LOSS IS GIVEN BY:
C
C            LOSS  = 'R2LOSS' x AVALUE x (ENERGY DIFFERENCE)
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    09/10/90
C
C UPDATE:  29/07/92 - CORRECT ERROR - ZERO TLOSS OVER NDLEV INSTEAD OF
C                                     ICNTE.
C UPDATE:  23/05/96 - CONVERTED B6LOSS TO B8LOSS, CHANGED ISTRN TO
C                     OUTPUT INDEX OF STRONGEST RADIATING TRANSITION TO
C                     EACH METASTABLE.
C
C*======================================================================
C PUT UNDER S.C.C.S CONTROL:
C
C VERSION: 1.1                            DATE: 15/07/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER S.C.C.S
C
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      REAL*8     R2LOSS               , WCVRN
C-----------------------------------------------------------------------
      PARAMETER( R2LOSS = 2.17958D-11 , WCVRN = 911.268 )
C-----------------------------------------------------------------------
      INTEGER    NDTRN                , NDLEV       ,
     &           NDMET                , NMET        ,
     &           ICNTE
      INTEGER    LLOWER               , LUPPER      ,
     &           IC                   , IM
C-----------------------------------------------------------------------
      REAL*8     SCURR
C-----------------------------------------------------------------------
      INTEGER    IE1A(NDTRN)          , IE2A(NDTRN)
      INTEGER    IMETR(NDMET)         , ISTRN(NDMET)
C-----------------------------------------------------------------------
      REAL*8     XJA(NDLEV)           , ER(NDLEV)    ,
     &           AVAL(NDTRN)          , TLOSS(NDLEV)
```

```
      REAL*8     SLOSS(NDMET)         , SWVLN(NDMET)
C-----------------------------------------------------------------------
```

B8MCCA

```
      SUBROUTINE B8MCCA( NDLEV  , IL     ,
     &                   LPSEL  , LISEL  , LPDATA,
     &                   DENE   , DENP   ,
     &                   CRA    , PCC    ,
     &                   CRCE   , CRCP   , CIE   ,
     &                   CC
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8MCCA *********************
C
C  PURPOSE: TO  CONSTRUCT WHOLE RATE MATRIX 'CC' FOR TRANSITIONS BETWEEN
C           ALL ENERGY LEVELS AT A FIXED TEMPERATURE  AND  GIVEN DENSITY
C           'DENE/DENP'.
C
C          UPDATED VERSION OF BXMCCA, TO INCORPORATE INDIRECT COUPLINGS
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  IL      = NUMBER OF ENERGY LEVELS
C
C  INPUT :  (L*4)  LPSEL   = .TRUE.  => INCLUDE PROTON COLLISIONS
C                            .FALSE. => DO NOT INCLUDE PROTON COLLISIONS
C  INPUT :  (L*4)  LISEL   = .TRUE.  => INCLUDE IONISATION RATES
C                            .FALSE. => DO NOT INCLUDE IONISATION RATES
C  INPUT :  (L*4)  LPDATA  = .TRUE.  => INCLUDE INDIRECT COUPLINGS
C                            .FALSE. => DO NOT INCLUDE INDIRECT COUPLING
C
C  INPUT :  (R*8)  DENE    = ELECTRON DENSITY (UNITS: CM-3)
C  INPUT :  (R*8)  DENP    = PROTON DENSITY (UNITS: CM-3)
C
C  INPUT :  (R*8)  CRA(,)  = A-VALUE (sec-1)  MATRIX  COVERING   ALL
C                            TRANSITIONS.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C                           (NOTE: DIAGONAL   ELEMENTS  REPRESENT   THE
C                                  NEGATIVE  SUM  OF  THEIR  RESPECTIVE
C                                  COLUMNS.)
C
C  INPUT :  (R*8)  PCC(,)  = INDIRECT RATE MATRIX COVERING ALL
C                            TRANSITIONS (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C
C  INPUT :  (R*8)  CRCE(,) = ELECTRON IMPACT TRANSITIONS:
C                            EXCIT'N/DE-EXCIT'N RATE COEFFT MATRIX
C                            COVERING ALL TRANSITIONS (cm**3/s).
C                            VALUES FOR GIVEN TEMPERATURE.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C                           (NOTE: DIAGONAL   ELEMENTS  REPRESENT   THE
C                                  NEGATIVE  SUM  OF  THEIR  RESPECTIVE
C                                  COLUMNS.)
C  INPUT :  (R*8)  CRCP(,) = PROTON IMPACT TRANSITIONS:
C                            EXCIT'N/DE-EXCIT'N RATE COEFFT MATRIX
C                            COVERING ALL TRANSITIONS (cm**3/s).
C                            VALUES FOR GIVEN TEMPERATURE.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C                           (NOTE: DIAGONAL   ELEMENTS  REPRESENT   THE
C                                  NEGATIVE  SUM  OF  THEIR  RESPECTIVE
C                                  COLUMNS.)
C  INPUT :  (R*8)  CIE()   = IONISATION RATE COEFFICIENT VECTOR FOR
C                            FIXED TEMPERATURE.
C                            DIMENSION: ENERGY LEVEL INDEX
C
C  OUTPUT:  (R*8)  CC(,)   = RATE MATRIX COVERING ALL TRANSITIONS
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C
C          (I*4)  IS1     = ENERGY LEVEL ARRAY INDEX
C          (I*4)  IS2     = ENERGY LEVEL ARRAY INDEX
C
C
C ROUTINES: NONE
C
C
C AUTHOR:  WILLIAM J. DICKSON (MOSTLY COPIED FROM BXMCCA)
C          K1/1/36
C          JET EXT. 5057
C
C DATE:    06/01/92
```

```
C
C UNIX-IDL PORT:
C
C DATE: UNKNOWN
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDLEV              , IL
      INTEGER    IS1                , IS2
C-----------------------------------------------------------------------
      REAL*8     DENE               , DENP
C-----------------------------------------------------------------------
      LOGICAL    LPSEL              , LISEL             , LPDATA
C-----------------------------------------------------------------------
      REAL*8     CRA(NDLEV,NDLEV)   , pcc(NDLEV,NDLEV)   ,
     &           CRCE(NDLEV,NDLEV)  , CRCP(NDLEV,NDLEV)  ,
     &           CIE(NDLEV)
      REAL*8     CC(NDLEV,NDLEV)
C-----------------------------------------------------------------------
```

B8NORM

```
      SUBROUTINE B8NORM( NDLEV  , NDMET  ,
     &                   NORD   ,
     &                   STCK   ,
     &                   PLAX   , PLX    ,
     &                   PLASX  , PLSX
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B6STOT *********************
C
C  PURPOSE: TO NORMALISE TOTAL/SPECIFIC LINE POWERS FOR LEVEL 1
C           AND TOTAL EQUILIBRIUM LINE POWERS TO STAGE TOTAL POPULATION.
C
C  CALLING PROGRAM:  ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C
C  INPUT :  (R*4)  STCK(,) = POPULATION MATRIX COVERING ALL NON-METAST-
C                            ABLE/ORDINARY EXCITED LEVELS AS FUNCTION
C                            OF METASTABLE INDEX.
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                            2nd DIMENSION: METASTABLE LEVEL INDEX
C
C  I/O   :  (R*8)  PLAX    = INPUT:
C                            TOTAL EQUILIBRIUM LINE POWER COEFFICIENTS.
C                            AT FIXED TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS CM3 SEC-1)
C                            OUTPUT:
C                            NORMALISED TO TOTAL STAGE POPULATION
C  I/O   :  (R*8)  PLX     = INPUT:
C                            TOTAL LINE POWERS FOR LEVEL 1 AT FIXED
C                            TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS SEC-1).
C                            OUTPUT:
C                            NORMALISED TO TOTAL STAGE POPULATION
C
C  I/O   :  (R*8)  PLASX   = INPUT:
C                            SPECIFIC EQULIBRIUM LINE PWR COEFFICIENTS.
C                            AT FIXED TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS CM3 SEC-1)
C                            OUTPUT:
C                            NORMALISED TO TOTAL STAGE POPULATION
C  I/O   :  (R*8)  PLSX    = INPUT:
C                            SPECIFIC LINE PWR FOR LEVEL 1 AT FIXED
C                            TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS SEC-1).
C                            OUTPUT:
C                            NORMALISED TO TOTAL STAGE POPULATION
C
C           (I*4)  IS1     = ORDINARY EXCITED LEVEL INDEX
C
C           (R*8)  STOTX   = VARIABLE USED TO SUM STAGE TOTAL POPULATN.
C                            (INITIAL VALUE = 1 => GROUND)
C
C ROUTINES: NONE
```

```
C
C NOTE:
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    18/05/93
C
C UPDATE:  20/05/93 - P BRIDEN: STCK ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C UNIX-IDL PORT:
C
C DATE: UNKNOWN
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C-----------------------------------------------------------------------
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDLEV              , NDMET             ,
     &           NORD               , IS1
C-----------------------------------------------------------------------
      REAL*8     PLAX               , PLX               ,
     &           PLASX              , PLSX              ,
     &           STOTX
C-----------------------------------------------------------------------
      REAL*4     STCK(NDLEV,NDMET)
C-----------------------------------------------------------------------
```

B8OUT0

```
      SUBROUTINE B8OUT0( NDMET  , IUNIT  , DATE   , PRGTYP ,
     &                   DSNC80 , DSNE80 ,
     &                   TITLED , IZ     , IZ0    , IZ1    , BWNO   ,
     &                   NPL    , NPLR   , NPLI   , BWNOA  ,
     &                   ICNTE  , ICNTP  , ICNTR  , ICNTH  , ICNTI  ,
     &                   IL     ,
     &                   IA     , CSTRGA , ISA    , ILA    , XJA  , WA ,
     &                   ER     , CPLA   ,
     &                   NV     , TSCEF  , CTEMP
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B8OUT0 *********************
C
C  PURPOSE: TO OUTPUT ION SPECIFICATIONS, INDEXED ENERGY LEVELS AND
C           WAVE NUMBERS RELATIVE  TO GROUND TO STREAM 'IUNIT'.
C
C  CALLING PROGRAM: ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDMET  = MAXIMUM NO. OF METASTABLES ALLOWED
C  INPUT :  (I*4)  IUNIT  = OUTPUT STREAM NUMBER
C  INPUT :  (C*8)  DATE   = CURRENT DATE AS 'DD/MM/YY'
C  INPUT :  (C*1)  PRGTYP = PROGRAM TYPE
C  INPUT :  (C*80) DSNC80 = INPUT COPASE    DATA SET NAME
C  INPUT :  (C*80) DSNE80 = INPUT EXPANSION DATA SET NAME
C
C  INPUT :  (C*3)  TITLED = ELEMENT SYMBOL.
C  INPUT :  (I*4)  IZ     = RECOMBINED ION CHARGE
C  INPUT :  (I*4)  IZ0    =        NUCLEAR CHARGE
C  INPUT :  (I*4)  IZ1    = RECOMBINING ION CHARGE
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT :  (R*8)  BWNO   = IONISATION POTENTIAL(CM-1) FOR LOWEST PARENT
C  INPUT :  (I*4)  NPL    = NO. OF METASTABLES OF (Z+1) ION ACCESSED
C                           BY EXCITED STATE IONISATION IN COPASE
C                           FILE WITH IONISATION POTENTIALS GIVEN
C                           ON THE FIRST DATA LINE
C  INPUT :  (I*4)  NPLR   = NO. OF ACTIVE METASTABLES FOR (Z+1) ION
C  INPUT :  (I*4)  NPLI   = NO. OF ACTIVE METASTABLES FOR (Z-1) ION
C  INPUT :  (R*8)  BWNOA()= IONISATION POTENTIAL (CM-1) FOR PARENTS
C
C  INPUT :  (I*4)  ICNTE  = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C  INPUT :  (I*4)  ICNTP  = NUMBER OF PROTON IMPACT TRANSITIONS INPUT
C  INPUT :  (I*4)  ICNTR  = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT :  (I*4)  ICNTH  = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C  INPUT :  (I*4)  ICNTI  = NO. OF ELECTRON IMPACT IONISATIONS    INPUT
C
C  INPUT :  (I*4)  IL     = NUMBER OF ENERGY LEVELS
C
C  INPUT :  (I*4)  IA()   = ENERGY LEVEL INDEX NUMBER
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  INPUT :  (I*4)  ISA()  = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
```

```
C  INPUT :  (I*4)  ILA()  = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT :  (R*8)  XJA()  = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT :  (R*8)  WA()   = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C
C  INPUT : (R*8)  ER()    = ENERGY RELATIVE TO LEVEL 1 (RYDBERGS)
C                           FOR LEVEL 'IA()'
C  INPUT : (C*1)  CPLA()  = INDEX OF PARENTS FOR MEMBERS OF LEVEL LIST
C
C  INPUT : (I*4)  NV      = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR A GIVEN TRANSITION.
C  INPUT : (R*8)  TSCEF(,) = INPUT DATA FILE: ELECTRON TEMPERATURES
C                            1ST DIMENSION: TEMPERATURE (NOTE: TE=TP=TH)
C                            2ND DIMENSION: 1 => KELVIN  (IFOUT=1)
C                                           2 => EV      (IFOUT=2)
C                                           3 => REDUCED (IFOUT=3)
C
C          (R*8)  WN2RYD  = PARAMETER =
C                           WAVE NUMBER (CM-1) TO RYDBERG CONVERSION
C
C          (R*8)  BRYDO   = IONISATION POTENTIAL (RYDBERGS)
C          (R*8)  BWN     = ENERGY RELATIVE TO IONISATION POTENTIAL IN
C                           WAVE NUMBERS (CM-1).
C          (R*8)  BRYD    = ENERGY RELATIVE TO IONISATION POTENTIAL IN
C                           RYDBERGS.
C
C          (I*4)  I       = GENERAL USE
C          (I*4)  IP      = GENERAL USE
C
C          (C*1)  CHAR1   = GENERAL USE
C          (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ---------------------------------------------------------
C          XXADAS     ADAS      GATHERS ADAS HEADER INFORMATION
C
C AUTHOR:  HP SUMMERS (UPGRADE OF BXOUT0 BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:  12/07/93  HPS - MODIFIED TO ACCEPT CHANGES FROM B8DATA IN
C                          CSTRGA
C UNIX-IDL PORT:
C
C DATE: UNKNOWN
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C UPDATE:  18/03/96  DHB - INCREASED DATASET STRINGS TO 80 CHARACTERS.
C                          TIDIED FORMATS. OMITTED CHECK ON NULL PROTON
C                          DATASET (SEE BXOUT0). INCREASED I3 TO I4 IN
C                          FORMAT STATEMENT 1008 (IN LINE WITH BXOUT0).
C UPDATE:  02/05/96  DHB - PASSED CADAS THROUGH PARAMETER LIST IN THE
C                          FORM OF CTEMP TO ALLOW
C                          INCLUSION OF ISTOP IN ADAS208. REMOVED CALL
C                          TO XXADAS.
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C VERSION: 1.2                          DATE: 14/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - CHANGED PROGRAM NAME FROM 205 TO 208
C
C VERSION: 1.3                          DATE: 15/07/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - CHANGED PROGRAM NAME FROM 209 TO 208
C
C VERSION: 1.4                          DATE: 24/09/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - REMOVED SOME 1H HOLERITH CONSTANTS TO MAKE OUTPUT MORE
C             UNIFORM
C
C-----------------------------------------------------------------------
      REAL*8     WN2RYD
C-----------------------------------------------------------------------
      PARAMETER( WN2RYD = 9.11269D-06 )
C-----------------------------------------------------------------------
      INTEGER    NDMET         , I             , IP, I4UNIT
      INTEGER    IUNIT         ,
     &           IZ            , IZ0            , IZ1        ,
     &           NPL           , NPLR           , NPLI           ,
     &           ICNTE         , ICNTP          , ICNTR      , ICNTH  ,
     &           ICNTI         ,
     &           IL            , NV
C-----------------------------------------------------------------------
      REAL*8     BWNO          , BWN            , BRYDO      , BRYD
C-----------------------------------------------------------------------
      CHARACTER  TITLED*3      , DATE*8         , PRGTYP*1   ,
     &           DSNC80*80     , DSNE80*80      , CADAS*80   , CHAR1*1
      CHARACTER  CTEMP*80
```

```
C-----------------------------------------------------------------------
      INTEGER    IA(IL)        , ISA(IL)        , ILA(IL)
C-----------------------------------------------------------------------
      REAL*8     BWNOA(NDMET)
      REAL*8     XJA(IL)       , WA(IL)         , ER(IL)
      REAL*8     TSCEF(14,3)
C-----------------------------------------------------------------------
      CHARACTER  CSTRGA(IL)*18 , CPLA(IL)*1
C-----------------------------------------------------------------------
      SAVE       CADAS
C-----------------------------------------------------------------------
      DATA       CADAS/' '/
C-----------------------------------------------------------------------
```

B8OUT1

```
      SUBROUTINE B8OUT1( IUNIT ,
     &                   NDLEV , NDTEM  , NDDEN , NDMET ,
     &                   LNORM ,
     &                   IL    , NMET   , NORD  ,
     &                   NPL   , NPLR   , NPLI  , NPL3  ,
     &                   MAXT  , MAXD   , ZEFF  ,
     &                   ICNTP , ICNTR  , ICNTI , ICNTH ,
     &                   LPSEL , LZSEL  , LIOSEL, LHSEL , LRSEL ,
     &                   LISEL ,
     &                   LMETR , IMETR  , IORDR ,
     &                   STRGA ,
     &                   LTRNG , TEA    , TEVA  , TPVA  , THVA  ,
     &                   DENSA , DENSPA , RATHA , RATPIA, RATMIA,
     &                   POPAR ,
     &                   STCKM , STVR   , STVI  , STVH  ,
     &                   STVRM , STVIM  , STVHM , STACK
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B8OUT1 ******************
C
C  PURPOSE: OUTPUT OF MAIN RESULTS (METASTABLE POPULATIONS)
C
C  CALLING PROGRAM: ADAS20T
C
C  DATA:
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C           NEUTRAL BEAM ENERGY :
C           RATE COEFFICIENTS   : CM3 SEC-1
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT FOR RESULTS
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES ( 1 <= NMET <= 5 )
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C  INPUT : (I*4)  NPL     = NO. OF METASTABLES OF (Z+1) ION ACCESSED
C                           BY EXCITED STATE IONISATION IN COPASE
C                           FILE WITH IONISATION POTENTIALS GIVEN
C                           ON THE FIRST DATA LINE.
C  INPUT : (I*4)  NPLR    = NO. OF ACTIVE METASTABLES OF (Z+1) ION
C  INPUT : (I*4)  NPLI    = NO. OF ACTIVE METASTABLES OF (Z-1) ION
C  INPUT : (I*4)  NPL3    = NO. OF ACTIVE METASTABLES OF (Z-1) ION WITH
C                           THREE-BODY RECOMBINATION
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> 20)
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> 20)
C  INPUT : (R*8)  ZEFF    = PLASMA Z EFFECTIVE ( IF 'LZSEL' = .TRUE.)
C
C  INPUT : (I*4)  ICNTP   = NUMBER OF PROTON IMPACT TRANSITIONS INPUT
C  INPUT : (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT : (I*4)  ICNTI   = NUMBER OF LOWER STAGE IONISATIONS      INPUT
C  INPUT : (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  INPUT : (L*4)  LNORM   = .TRUE.  => IF NMET=1 NORMALISE TOTAL AND
C                                      SPECIFIC LINE POWER OUTPUT FILES
C                                      PLT & PLS TO STAGE TOT. POPULATN.
C                           .FALSE. => OTHERWISE NORMALISE TO IDENTIFIED
C                                      METASTABLE POPULATIONS.
C  INPUT : (L*4)  LPSEL   = .TRUE.  => INCLUDE PROTON COLLISIONS
C                           .FALSE. =>DO NOT INCLUDE PROTON COLLISIONS
C  INPUT : (L*4)  LZSEL   = .TRUE.  => SCALE PROTON COLLISIONS WITH
C                                      PLASMA Z EFFECTIVE'ZEFF'.
C                           .FALSE. => DO NOT SCALE PROTON COLLISIONS
C                                      WITH PLASMA Z EFFECTIVE 'ZEFF'.
```

```
C                          (ONLY USED IF 'LPSEL=.TRUE.')
C  INPUT : (L*4)  LIOSEL  = .TRUE.  => INCLUDE EXCITED STATE IONISATION
C                         = .FALSE. => DO NOT INCLUDE EXC. STATE IONIS.
C  INPUT : (L*4)  LHSEL   = .TRUE.  => INCLUDE CHARGE TRANSFER FROM
C                                      NEUTRAL HYDROGREN.
C                         = .FALSE. => DO NOT INCLUDE CHARGE TRANSFER
C                                      FROM NEUTRAL HYDROGREN.
C  INPUT : (L*4)  LRSEL   = .TRUE.  => INCLUDE FREE ELECTRON
C                                      RECOMBINATION.
C                         = .FALSE. => DO NOT INCLUDE FREE ELECTRON
C                                      RECOMBINATION.
C  INPUT : (L*4)  LISEL   = .TRUE.  => INCLUDE ELECTRON IMPACT
C                                      IONISATION CONTRIBUTIONS
C                         = .FALSE. => DO NOT INCLUDE FREE ELECTRON
C                                      RECOMBINATION.
C
C  INPUT : (L*4)  LMETR() = .TRUE.  => ELECTRON IMPACT TRANSITION EXISTS
C                                      TO THE METASTABLE LEVEL  GIVEN BY
C                                      'IMETR()'.
C                           .FALSE. => ELECTRON  IMPACT  TRANSITIONS  DO
C                                      NOT EXIST TO THE METASTABLE LEVEL
C                                      GIVEN BY 'IMETR()'.
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET')
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST.
C
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C
C  INPUT : (L*4)  LTRNG(,)= .TRUE.  => TEMPERATURE VALUE WITHIN RANGE
C                                      READ FROM INPUT COPASE DATA SET.
C                         = .FALSE. =>TEMPERATURE VALUE NOT WITHIN RANGE
C                                      READ FROM INPUT COPASE DATA SET.
C                           1st DIMENSION: TEMPERATURE INDEX.
C                           2nd DIMENSION: TEMPERATURE TYPE -
C                                          1) => ELECTRON
C                                          2) => PROTON
C                                          3) => NEUTRAL HYDROGEN
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (R*8)  TEVA()  = ELECTRON TEMPERATURES (UNITS: EV)
C  INPUT : (R*8)  TPVA()  = PROTON TEMPERATURES   (UNITS: EV)
C  INPUT : (R*8)  THVA()  = NEUTRAL HYDROGEN TEMPERATURES   (UNITS: EV)
C
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C  INPUT : (R*8)  DENSPA()= PROTON DENSITIES    (UNITS: CM-3)
C  INPUT : (R*8)  RATHA() = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C  INPUT : (R*8)  RATPIA(,) = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C                             1ST DIMENSION: DENSITY INDEX
C                             2ND DIMENSION: PARENT INDEX
C  INPUT : (R*8)  RATMIA(,) = RATIO ( N(Z-1)/N(Z)  STAGE ABUNDANCIES )
C                             1ST DIMENSION: DENSITY INDEX
C                             2ND DIMENSION: PARENT INDEX
C  INPUT : (R*8)  POPAR(,,) =  LEVEL POPULATIONS
C                              1st DIMENSION: LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C
C  INPUT : (R*8) STCKM(,,) = METASTABLE POPULATIONS STACK
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*4) STVR(,,,) = FREE ELECTRON RECOMBINATION COEFFICIENTS
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVI(,,,) = ELECTRON IMPACT IONISATION  COEFFICIENTS
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVH(,,,) =  CHARGE EXCHANGE COEFFICIENTS
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C
C  INPUT : (R*8) STVRM(,,,)= METASTABLE FREE ELECTRON RECOMBINATION
C                            COEFFICIENTS.
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*8) STVIM(,,,)= METASTABLE ELECTRON IMPACT IONISATION
C                            COEFFICIENTS.
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*8) STVHM(,,,)= METASTABLE CHARGE EXCHANGE COEFFICIENTS
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STACK(,,,)= POPULATION DEPENDENCE
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: METASTABLE INDEX
C                              3rd DIMENSION: TEMPERATURE INDEX
```

```
C                              4th DIMENSION: DENSITY INDEX
C
C          (I*4)  PGLEN   = PARAMETER = NUMBER OF LINES PER OUTPUT PAGE
C
C          (I*4)  NBLOCK  = NUMBER OF LINES IN CURRENT OUTPUT BLOCK.
C          (I*4)  NLINES  = LAST PAGE LINE WRITTEN.
C                           IF 'NLINES+NBLOCK' > 'PGLEN' START NEW PAGE.
C          (I*4)  MIND    = MINIMUM OF 10 AND 'MAXD'
C          (I*4)  I       = GENERAL USE
C          (I*4)  IP      = GENERAL USE
C          (I*4)  J       = GENERAL USE
C          (I*4)  IT      = TEMPERATURE INDEX NUMBER FOR ARRAY USE
C          (I*4)  IN      = DENSITY INDEX NUMBER FOR ARRAY USE
C          (I*4)  IUSEP   = NUMBER OF PROTON IMPACT TRANSITIONS USED
C          (I*4)  IUSER   = NO. OF STATE SELECTIVE RECOM. OF (Z+1) USED
C          (I*4)  IUSEI   = NO. OF STATE SELECTIVE IONIS. BY (Z-1) USED
C          (I*4)  IUSEH   = NO. OF STATE SELECTIVE CX BY (Z+1)     USED
C
C          (L*4)  LPRNG   = .TRUE.  => PROTON INPUT PARAMETERS USED
C                           .FALSE. => PROTON INPUT PARAMETERS NOT USED
C          (L*4)  LHRNG   = .TRUE.  => NEUTRAL H INPUT PARAMETERS USED
C                           .FALSE. => NEUTRAL H INPUT PARMS. NOT USED
C          (L*4)  LRRNG   = .TRUE.  => FREE ELEC. RECOMB. PARMS USED
C                           .FALSE. => FREE ELEC. RECOMB. PARMS NOT USED
C          (L*4)  LIRNG   = .TRUE.  => LOWER STAGE IONIS. PARMS USED
C                           .FALSE. => FREE ELEC. RECOMB. PARMS NOT USED
C
C          (C*32) C32     = GENERAL USE 32 BYTE CHARACTER STRING
C
C          (C*1)  CTRNG(7)= ' ' => OUTPUT VALUES FOR THIS TEMPERATURE
C                              INTERPOLATED.
C                           = '*' => OUTPUT VALUES FOR THIS TEMPERATURE
C                              EXTRAPOLATED.
C                           = '#' => NOT USED
C                             1st DIMENSION: TEMPERATURE TYPE -
C                                            1) => ELECTRON
C                                            2) => PROTON
C                                            3) => NEUTRAL HYDROGEN
C                                            DENSITY TYPE -
C                                            4) => PROTON
C                                            RATIO TYPE -
C                                            5) => 'RATHA'
C                                            6) => 'RATPIA'
C                                            7) => 'RATMIA'
C
C NOTE:
C          ONLY THE FIRST TEN DENSITIES ARE OUTPUT.
C
C          AN 'OUTPUT BLOCK' IS A SINGLE CONTAINED OUTPUT TABLE
C
C
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXSTNP     ADAS      STARTS NEW PAGE IF CURRENT PAGE FULL
C
C
C AUTHOR:  H P SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    15/01/92
C
C UPDATE:  12/06/92  HP SUMMERS - EXTENSION TO MULTIPLE PARENTS AND
C                                 INNER SHELL IONISATION CONTRIBUTIONS
C                                 MODIFICATIONS TO MAKE COMPATIBLE
C                                 WITH B8DATA
C
C UNIX-IDL PORT:
C
C DATE: UNKNOWN
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C VERSION: 1.2                          DATE: 13/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - REMOVED OUTDATED HOLERITH CONSTANTS: 1H1, 1H0
C
C VERSION: 1.3                          DATE: 05/07/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - REMOVED MORE OUTDATED HOLERITH CONSTANTS
C
C VERSION: 1.4                          DATE: 24/09/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - REMOVED SOME 1H HOLERITH CONSTANTS TO MAKE OUTPUT MORE
C             UNIFORM
C
C----------------------------------------------------------------------
C
C----------------------------------------------------------------------
```

```
      INTEGER   PGLEN
C-----------------------------------------------------------------------
      PARAMETER ( PGLEN = 63 )
C-----------------------------------------------------------------------
      INTEGER   IUNIT     ,
     &          NDLEV     , NDTEM     , NDDEN     , NDMET
      INTEGER   IL        ,
     &          NMET      , NORD      ,
     &          NPL       , NPLR      , NPLI      , NPL3      ,
     &          MAXT      , MAXD      ,
     &          ICNTP     , ICNTR     , ICNTI     , ICNTH
      INTEGER   NBLOCK    , NLINES    , MIND      ,
     &          I         , IP        , J         , IN        , IT    ,
     &          IUSEP     , IUSER     , IUSEI     , IUSEH
C-----------------------------------------------------------------------
      REAL*8    ZEFF
C-----------------------------------------------------------------------
      LOGICAL   LNORM
      LOGICAL   LPSEL     , LZSEL     , LIOSEL    , LHSEL   , LRSEL
      LOGICAL   LISEL     , LPRNG     , LHRNG     , LRRNG   , LIRNG
C-----------------------------------------------------------------------
      CHARACTER C32*32
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)    , IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8    TEVA(NDTEM)     , TPVA(NDTEM)      ,
     &          THVA(NDTEM)     , TEA(NDTEM)       ,
     &          DENSA(NDDEN)    , DENSPA(NDDEN)    ,
     &          RATHA(NDDEN)    , RATPIA(NDDEN,NDMET) ,
     &          RATMIA(NDDEN,NDMET)
      REAL*8    POPAR(NDLEV,NDTEM,NDDEN)
      REAL*8    STCKM(NDMET,NDTEM,NDDEN)
      REAL*8    STVRM(NDMET,NDTEM,NDDEN,NDMET) ,
     &          STVIM(NDMET,NDTEM,NDDEN,NDMET)
      REAL*8    STVHM(NDMET,NDTEM,NDDEN,NDMET)
C-----------------------------------------------------------------------
      REAL*4    STVR(NDLEV,NDTEM,NDDEN,NDMET) ,
     &          STVI(NDLEV,NDTEM,NDDEN,NDMET) ,
     &          STVH(NDLEV,NDTEM,NDDEN,NDMET)
      REAL*4    STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      LOGICAL   LMETR(NDMET)    , LTRNG(NDTEM,3)
C-----------------------------------------------------------------------
      CHARACTER CTRNG(7)*1      , STRGA(NDLEV)*22
C-----------------------------------------------------------------------
```

B8OUTG

```
      SUBROUTINE B8OUTG( LGHOST , DATE  ,
     &                   NDLEV  , NDTEM , NDDEN , NDMET  ,
     &                   TITLED , TITLE , GTIT1 , DSNINC ,
     &                   IZ     , ITSEL , TEV   ,
     &                   LGRD1  , LDEF1 ,
     &                   XMIN   , XMAX  , YMIN  , YMAX   ,
     &                   IL     , NMET  , NORD  , MAXD   ,
     &                   LMETR  , IMETR , IORDR , DENSA  ,
     &                   STRGA  , STACK
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8OUTG *********************
C
C  PURPOSE:  PIPE COMMUNICATIONS WITH IDL ROUTINE BXOUTG
C
C  CALLING PROGRAM: ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT : (L*4)  LGHOST  = .TRUE.  => GHOST80 INITIALISED
C                           .FALSE. => GHOST80 NOT INITIALISED
C  INPUT : (C*8)  DATE    = CURRENT DATE AS 'DD/MM/YY'
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (C*3)  TITLED  = ELEMENT SYMBOL.
C  INPUT : (C*40) TITLE   = ISPF ENTERED GENERAL TITLE FOR PROGRAM RUN
C  INPUT : (C*40) GTIT1   = ISPF ENTERED TITLE FOR GRAPH
CX INPUT : (C*80) DSNINC  = INPUT COPASE DATA SET NAME (MVS DSN)
C
C  INPUT : (I*4)  IZ      = RECOMBINED ION CHARGE
C  INPUT : (I*4)  ITSEL   = INDEX OF TEMPERATURE SELECTED FROM GRAPH
C  INPUT : (R*8)  TEV     = SELECTED ELECTRON TEMPERATURE (EV) FOR GRAPH
C
C  INPUT : (L*4)  LGRD1   = .TRUE.  => PUT GRAPH IN GRID FILE
C                           = .FALSE. => DO NOT PUT GRAPH IN GRID FILE
C  INPUT : (L*4)  LDEF1   = .TRUE.  => USE GRAPH DEFAULT SCALING
C                           = .FALSE. => DO NOT USE DEFAULT SCALING
C
C  INPUT : (R*8)  XMIN    = LOWER LIMIT FOR X-AXIS OF GRAPH
C  INPUT : (R*8)  XMAX    = UPPER LIMIT FOR X-AXIS OF GRAPH
```

```
C  INPUT : (R*8)  YMIN    = LOWER LIMIT FOR Y-AXIS OF GRAPH
C  INPUT : (R*8)  YMAX    = UPPER LIMIT FOR Y-AXIS OF GRAPH
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS = 'NMET' + 'NORD'
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT ELECTRON DENSITIES
C
C  INPUT : (L*4)  LMETR() = .TRUE.  => ELECTRON IMPACT TRANSITION EXISTS
C                                      TO THE METASTABLE LEVEL  GIVEN BY
C                                      'IMETR()'.
C                           .FALSE. => ELECTRON  IMPACT  TRANSITIONS  DO
C                                      NOT EXIST TO THE METASTABLE LEVEL
C                                      GIVEN BY 'IMETR()'.
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET' )
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                           LEVEL LIST.
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES (UNITS: CM-3)
C
C  INPUT : (C*22) STRGA() = LEVEL DESIGNATIONS
C  INPUT : (R*4) STACK(,,,)= POPULATION DEPENDENCE
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: METASTABLE INDEX
C                             3rd DIMENSION: TEMPERATURE INDEX
C                             4th DIMENSION: DENSITY INDEX
C
C          (I*4)  NDIM1   = PARAMETER = MAXIMUM NUMBER OF DENSITY VALUES
C                           (MUST NOT BE LESS THAN 'NDDEN')
C          (I*4)  NDIM2   = PARAMETER = MAXIMUM NUMBER OF LEVELS (ORD.)
C                           (MUST NOT BE LESS THAN 'NDLEV')
C          (I*4)  NGPIC   = PARAMETER = MAXIMUM NUMBER OF LEVEL POPULAT-
C                           IONS TO BE DISPLAYED ON A SINGLE GRAPH.
C          (I*4)  NGLEV   = PARAMETER = MAXIMUM NUMBER OF ENERGY LEVELS
C                           WHICH CAN BE LISTED ON THE GRAPH.
C
C          (R*4)  CUTMIN  = PARAMETER = IN DEFAULT GRAPH SCALING IS THE
C                           MINIMUM Y-VALUE THAT IS ALLOWED.
C                           (NOTE: 'CUTMIN' MUST BE > THAN 'GHZERO')
C          (R*4)  GHZERO  = PARAMETER = VALUE BELOW WHICH GHOST80 TAKES
C                           NUMBERS AS BEING ZERO = 1.0E-36
C
C          (I*4)  ID      = DENSITY INDEX NUMBER FOR ARRAY USE
C          (I*4)  IM      = METASTABLE INDEX NUMBER FOR ARRAY USE
C          (I*4)  ILEV    = (ORDINARY) LEVEL INDEX NUMBER FOR ARRAY USE
C          (I*4)  IORD1   = INITIAL ORDINARY LEVEL FOR CURRENT GRAPH
C          (I*4)  IORD2   = FINAL ORDINARY LEVEL FOR CURRENT GRAPH
C          (I*4)  IPLOT   = CO-ORDINATE ID AT WHICH LEVEL INDEX VALUE
C                           FOR GRAPH LINE IS TO BE PLOTTED.
C          (I*4)  ILMAX   = MINIMUM OF: NO. OF ENERGY LEVELS OR 'NGLEV'
C
C          (R*4)  XHIGH   = UPPER X-AXIS LIMIT FOR USE WITH GHOST80
C          (R*4)  XLOW    = LOWER X-AXIS LIMIT FOR USE WITH GHOST80
C          (R*4)  YHIGH   = UPPER Y-AXIS LIMIT FOR USE WITH GHOST80
C          (R*4)  YLOW    = LOWER Y-AXIS LIMIT FOR USE WITH GHOST80
C          (R*4)  X()     = X-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                           ELECTRON DENSITIES
C          (R*4)  Y(,)    = Y-AXIS CO-ORDINATES FOR USE WITH GHOST80
C                           LEVEL POPULATIONS.
C                           1st DIMENSION = ELECTRON DENSITY INDEX
C                           2nd DIMENSION = ORDINARY  LEVEL  INDEX
C
C          (C*1)  GRID    = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*1)  PIC     = DUMMY NAME VARIABLE FOR USE WITH GHOST80
C          (C*3)  C3      = BLANK 3 BYTE STRING
C          (C*13) DNAME   = '       DATE: '
C          (C*13) FNAME   = 'INPUT FILE : '
C          (C*13) GNAME   = 'GRAPH TITLE: '
C          (C*23) XTIT    = X-AXIS UNITS/TITLE
C          (C*23) YTIT    = Y-AXIS UNITS/TITLE
C          (C*30) STRG1   = HEADING FOR LEVEL ASSIGNMENTS
C          (C*30) STRG2   = HEADING FOR LEVEL ASSIGNMENTS
C          (C*30) STRG3   = TEMPORARY STRING FOR LEVEL ASSIGNMENTS
C          (C*80) ISPEC   = GRAPH TITLE (INCORPORATES 'TITLED,IZ,TEV').
C          (C*80) CADAS   = ADAS HEADER: INCLUDES RELEASE, PROGRAM, TIME
C
C          (L*4)  LGTXT   = .TRUE.  => LAST SCREEN DUMP WAS TEXT.
C                           .FALSE. => LAST SCREEN DUMP WAS GHOST80.
C          (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C          (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C          (I*4)   ONE      = PARAMETER = THE INTEGER VALUE 1
C          (I*4)   ZERO     = PARAMETER = THE INTEGER VALUE 0
C          (I*4)   I        = LOOP INCREMENT
C          (I*4)   J        = LOOP INCREMENT
C          (I*4)   K        = LOOP INCREMENT
C          (I*4)   L        = LOOP INCREMENT
C
C ROUTINES:
C          ROUTINE     SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXADAS      ADAS      GATHERS ADAS HEADER INFORMATION
C           XXFLSH      ADAS        FLUSHES PIPE
C
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE:    UNKNOWN
C
```

```
C VERSION: 1.0                              DATE: ????????
C MODIFIED: DAVID H BROOKS
C           - ADAPTED FROM BXOUTG.FOR
C
C VERSION: 1.1                              DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER S.C.C.S.
C
C VERSION: 1.2                              DATE: 20/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           ADDED CALLS TO XXFLSH AND MADE EXPLICIT THE PIPEOUT LOOPS
C
C VERSION: 1.3                            DATE: 05/08/96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C           ADDED BLANK WRITE TO I4UNIT(-1) BEFORE PIPE
C           COMMS WHICH SEEMS TO BE NEEDED FOR HP WORKSTATIONS!
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDIM1    , NDIM2    , NGPIC    , NGLEV
C-----------------------------------------------------------------------
      REAL*4    CUTMIN   , GHZERO
C-----------------------------------------------------------------------
      PARAMETER ( NDIM1= 20  , NDIM2=200        , NGPIC=7 , NGLEV = 55 )
      PARAMETER ( CUTMIN = 1.0E-30 , GHZERO = 1.0E-36 )
C-----------------------------------------------------------------------
      INTEGER   NDLEV    , NDTEM    , NDDEN    , NDMET
      INTEGER   IL       , NMET     , NORD     , MAXD     ,
     &          IZ       , ITSEL
      INTEGER   ID       , IM       , ILEV     , IORD1    , IORD2    ,
     &          IPLOT    , ILMAX
C-----------------------------------------------------------------------
      REAL*4    XHIGH    , XLOW     ,
     &          YHIGH    , YLOW
C-----------------------------------------------------------------------
      REAL*8    TEV      ,
     &          XMIN     , XMAX     ,
     &          YMIN     , YMAX
C-----------------------------------------------------------------------
      LOGICAL   LGHOST   , LGRD1    , LDEF1    , LGTXT
C-----------------------------------------------------------------------
CX  DSNINC CHANGED TO 80 CHARS
CX
      CHARACTER TITLED*3 , TITLE*40 , GTIT1*40 , DSNINC*80
      CHARACTER GRID*1   , PIC*1    , C3*3     , DATE*8   ,
     &          DNAME*13 , FNAME*13 , GNAME*13 , XTIT*23  , YTIT*23  ,
     &          STRG1*30 , STRG2*30 , STRG3*30 , ISPEC*80 , CADAS*80
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)        , IORDR(NDLEV)
      INTEGER   I4UNIT
C-----------------------------------------------------------------------
      REAL*4    X(NDIM1)            , Y(NDIM1,NDIM2)
C-----------------------------------------------------------------------
      CHARACTER STRGA(NDLEV)*22
C-----------------------------------------------------------------------
      REAL*8    DENSA(NDDEN)
      REAL*4    STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      LOGICAL   LMETR(NDMET)
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU , ONE      , ZERO
      PARAMETER( PIPEIN=5  , PIPEOU=6 , ONE=1    , ZERO=0 )
      INTEGER    I        , J        , K        , L
C-----------------------------------------------------------------------
      SAVE      CADAS
C-----------------------------------------------------------------------
      DATA GRID  /' '/   ,
     &     PIC  /' '/    ,
     &     C3   /'  '/  ,
     &     CADAS/' '/
      DATA DNAME/'       DATE: '/,
     &     FNAME/'INPUT FILE : '/,
     &     GNAME/'GRAPH TITLE: '/
      DATA XTIT/'ELECTRON DENSITY (CM-3)'/
      DATA YTIT/'N(I)/(NE*N(**))  (CM+3)'/
      DATA STRG1/'----- LEVEL  ASSIGNMENTS -----'/,
     &     STRG2/'INDEX       DESIGNATION       '/
      DATA ISPEC(1:40)/'POPULATION DEPENDENCE ON METASTABLES:   '/
C-----------------------------------------------------------------------
```

B8POPM

```
      SUBROUTINE B8POPM( NDTEM  , NDDEN , NDMET , NDLEV ,
     &                   NPL    , NPLR  , NPLI  ,
     &                   MAXT   , MAXD  , NMET  ,
     &                            DENSA , IMETR ,
     &                            LRSEL , LISEL , LHSEL ,
     &                            RATPIA, RATMIA, RATHA ,
     &                   STCKM  , STVRM , STVIM , STVHM ,
     &                   POPAR
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
```

```
C  ****************** FORTRAN77 SUBROUTINE: B8POPM *********************
C
C  PURPOSE: TO CONSTRUCT METASTABLE LEVEL POPULATIONS.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NPL     = NO. OF METASTABLES OF (Z+1) ION ACCESSED
C                               BY EXCITED STATE IONISATION IN COPASE
C                               FILE WITH IONISATION POTENTIALS GIVEN
C                               ON THE FIRST DATA LINE
C  INPUT :  (I*4)  NPLR    = NO. OF ACTIVE METASTABLES OF (Z+1) ION
C  INPUT :  (I*4)  NPLI    = NO. OF ACTIVE METASTABLES OF (Z-1) ION
C
C  INPUT :  (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 ->'NDTEM')
C  INPUT :  (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 ->'NDDEN')
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLES LEVELS ( 1 ->'NDMET')
C
C  INPUT :  (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C
C  INPUT :  (L*4)  LRSEL   = .TRUE.  => FREE ELECTRON RECOMBINATION
C                                        REQUESTED.
C                            .FALSE. => FREE ELECTRON RECOMBINATION
C                                        NOT REQUESTED.
C  INPUT :  (L*4)  LHSEL   = .TRUE.  => CHARGE TRANSFER FROM NEUTRAL
C                                        HYDROGREN REQUESTED.
C                            .FALSE. => CHARGE TRANSFER FROM NEUTRAL
C                                        HYDROGREN NOT REQUESTED.
C  INPUT :  (L*4)  LISEL   = .TRUE.  => IONISATION FROM LOWER IONIS.
C                                        STAGE REQUESTED.
C                            .FALSE. => IONISATION FROM LOWER IONIS.
C                                        STAGE NOT REQUESTED.
C
C  INPUT :  (R*8)  RATPIA(,)= RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C                               1ST DIMENSION: TEMP/DENS INDEX
C                               2ND DIMENSION: PARENT INDEX
C  INPUT :  (R*8)  RATMIA(,)= RATIO ( N(Z-1)/N(Z)  STAGE ABUNDANCIES )
C                               1ST DIMENSION: TEMP/DENS INDEX
C                               2ND DIMENSION: PARENT INDEX
C  INPUT :  (R*8)  RATHA() = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C
C  INPUT :  (R*8)  STCKM(,,)= METASTABLE POPULATIONS STACK:
C                               1st DIMENSION: METASTABLE INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C  INPUT :  (R*8)  STVRM(,,,)= METASTABLE LEVEL:
C                              FREE-ELECTRON RECOMBINATION COEFFICIENTS
C                              (UNITS* CM**3/SEC-1)
C                               1ST DIMENSION: METASTABLE INDEX
C                               2ND DIMENSION: TEMPERATURE INDEX
C                               3RD DIMENSION: DENSITY INDEX
C                               4TH DIMENSION: PARENT INDEX
C  INPUT :  (R*8)  STVIM(,,,)= METASTABLE LEVEL:
C                              ELECTRON IMPACT IONISATION  COEFFICIENTS
C                              (UNITS* CM**3/SEC-1)
C                               1ST DIMENSION: METASTABLE INDEX
C                               2ND DIMENSION: TEMPERATURE INDEX
C                               3RD DIMENSION: DENSITY INDEX
C                               4TH DIMENSION: PARENT INDEX
C  INPUT :  (R*8)  STVHM(,,,)= METASTABLE LEVEL:
C                              CHARGE-EXCHANGE RECOMBINATION COEFFICIENTS
C                              (UNITS* CM**3/SEC-1)
C                               1st DIMENSION: METASTABLE INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C                               4TH DIMENSION: PARENT INDEX
C
C  OUTPUT:  (R*8)  POPAR(,,)= LEVEL POPULATIONS
C                              1ST DIMENSION: LEVEL INDEX
C                              2ND DIMENSION: TEMPERATURE INDEX
C                              3RD DIMENSION: DENSITY INDEX
C                              (ON OUTPUT CONTAINS POPULATIONS FOR
C                               METASTABLE LEVELS ONLY.)
C
C           (R*8) DCOEF     = DENSITY MULTIPLIED BY RELEVANT RATIOS  FOR
C                             CALCULATING RECOMBINATION CONTRIBUTIONS.
C
C           (I*4) IT        = TEMPERATURE ARRAY INDEX
C           (I*4) IP        = PARENT INDEX
C           (I*4) IN        = DENSITY ARRAY INDEX
C           (I*4) IM        = METASTABLE LEVEL ARRAY INDEX
C
C
C ROUTINES: NONE
C
C AUTHOR:  HP SUMMERS (UPGRADE OF BXPOPM BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
```

```
C*****************************************************************
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C*****************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDTEM        , NDDEN        , NDMET   , NDLEV   ,
     &          MAXT         , MAXD         , NMET    ,
     &          NPL          , NPLR         , NPLI
      INTEGER   IT           , IN           , IM      , IP
C-----------------------------------------------------------------------
      REAL*8    DCOEF
C-----------------------------------------------------------------------
      LOGICAL   LRSEL        , LHSEL        , LISEL
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)
C-----------------------------------------------------------------------
      REAL*8    DENSA(NDDEN)                ,
     &          RATPIA(NDDEN,NDMET)         , RATMIA(NDDEN,NDMET) ,
     &          RATHA(NDDEN)
      REAL*8    STCKM(NDMET,NDTEM,NDDEN)    ,
     &          STVRM(NDMET,NDTEM,NDDEN,NDMET) ,
     &          STVIM(NDMET,NDTEM,NDDEN,NDMET),
     &          STVHM(NDMET,NDTEM,NDDEN,NDMET)
      REAL*8    POPAR(NDLEV,NDTEM,NDDEN)
C-----------------------------------------------------------------------
```

B8POPO

```
      SUBROUTINE B8POPO( NDTEM  , NDDEN , NDMET , NDLEV ,
     &                   NPL    , NPLR  , NPLI  ,
     &                   MAXT   , MAXD  , NMET  , NORD  ,
     &                            DENSA , IMETR , IORDR ,
     &                            LRSEL , LISEL , LHSEL ,
     &                            RATPIA, RATMIA, RATHA ,
     &                   STACK  , STVR  , STVI  , STVH  ,
     &                   POPAR
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B8POPO *********************
C
C  PURPOSE: TO CONSTRUCT ORDINARY/NON-METASTABLE LEVEL POPULATIONS.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NPL     = NO. OF METASTABLES OF (Z+1) ION ACCESSED
C                            BY EXCITED STATE IONISATION IN COPASE
C                            FILE WITH IONISATION POTENTIALS GIVEN
C                            ON THE FIRST DATA LINE
C  INPUT :  (I*4)  NPLR    = NO. OF ACTIVE METASTABLES OF (Z+1) ION
C  INPUT :  (I*4)  NPLI    = NO. OF ACTIVE METASTABLES OF (Z-1) ION
C
C  INPUT :  (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 ->'NDTEM')
C  INPUT :  (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 ->'NDDEN')
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLES LEVELS ( 1 ->'NDMET')
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ( 1 ->'NDLEV')
C
C  INPUT :  (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                            LEVEL LIST.
C                            (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (L*4)  LRSEL   = .TRUE.  => FREE ELECTRON RECOMBINATION
C                                       REQUESTED.
C                            = .FALSE. => FREE ELECTRON RECOMBINATION
C                                       NOT REQUESTED.
C  INPUT :  (L*4)  LISEL   = .TRUE.  => ELECTRON IMPACT IONISATION
C                                       REQUESTED.
C                            = .FALSE. => ELECTRON IMPACT IONISATION
C                                       NOT REQUESTED.
C  INPUT :  (L*4)  LHSEL   = .TRUE.  => CHARGE TRANSFER FROM NEUTRAL
C                                       HYDROGREN REQUESTED.
C                            = .FALSE. => CHARGE TRANSFER FROM NEUTRAL
```

```
C                                       HYDROGREN NOT REQUESTED.
C
C  INPUT :  (R*8)  RATPIA(,)= RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C                               1ST DIMENSION: TEMP/DENS INDEX
C                               2ND DIMENSION: PARENT INDEX
C  INPUT :  (R*8)  RATMIA(,)= RATIO ( N(Z-1)/N(Z)  STAGE ABUNDANCIES )
C                               1ST DIMENSION: TEMP/DENS INDEX
C                               2ND DIMENSION: PARENT INDEX
C  INPUT :  (R*8)  RATHA() = RATIO (NEUTRAL H DENSITY/ELECTRON DENSITY)
C
C  INPUT : (R*4) STACK(,,,)= ORDINARY EXCITED LEVEL POPULAT'N DEPENDENCE
C                            ON METASTABLE LEVEL.
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: METASTABLE INDEX
C                             3rd DIMENSION: TEMPERATURE INDEX
C                             4th DIMENSION: DENSITY INDEX
C  INPUT : (R*4) STVR(,,,) = ORDINARY EXCITED LEVEL:
C                             FREE-ELECTRON RECOMBINATION COEFFICIENTS
C                             (UNITS* CM**3/SEC-1)
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: TEMPERATURE INDEX
C                             3rd DIMENSION: DENSITY INDEX
C                             4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVI(,,,) = ORDINARY EXCITED LEVEL:
C                             ELECTRON IMPACT IONISATION  COEFFICIENTS
C                             (UNITS* CM**3/SEC-1)
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: TEMPERATURE INDEX
C                             3rd DIMENSION: DENSITY INDEX
C                             4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVH(,,,) = ORDINARY EXCITED LEVEL:
C                             CHARGE-EXCHANGE RECOMBINATION COEFFICIENTS
C                             (UNITS* CM**3/SEC-1)
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: TEMPERATURE INDEX
C                             3rd DIMENSION: DENSITY INDEX
C                             4TH DIMENSION: PARENT INDEX
C
C  I/O   :  (R*8)  POPAR(,,)= LEVEL POPULATIONS
C                              1st DIMENSION: LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                               ON INPUT : CONTAINS POPULATIONS FOR
C                                          METASTABLE LEVELS ONLY.
C                               ON OUTPUT: CONTAINS POPULATIONS FOR
C                                          ALL LEVELS.
C
C           (R*8) DCOEF     = DENSITY MULTIPLIED BY RELEVANT RATIOS  FOR
C                             CALCULATING RECOMBINATION CONTRIBUTIONS.
C
C           (I*4) IT        = TEMPERATURE ARRAY INDEX
C           (I*4) IP        = PARENT INDEX
C           (I*4) IN        = DENSITY ARRAY INDEX
C           (I*4) IO        = ORDINARY LEVEL ARRAY INDEX
C           (I*4) IM        = METASTABLE LEVEL ARRAY INDEX
C
C
C ROUTINES: NONE
C
C AUTHOR:  HP SUMMERS  (UPDATE OF BXPOPO BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:  12/07/93  HPS - CHANGE STSCK, STVR, STVI, STVH
C                          DIMENSIONS TO R*4
C**********************************************************************
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER   NDTEM        , NDDEN        , NDMET   , NDLEV   ,
     &          NPL          , NPLR         , NPLI    ,
     &          MAXT         , MAXD         , NMET    , NORD
      INTEGER   IT           , IN           , IM      , IO      , IP
C-----------------------------------------------------------------------
      REAL*8    DCOEF
C-----------------------------------------------------------------------
      LOGICAL   LRSEL        , LISEL        , LHSEL
C-----------------------------------------------------------------------
      INTEGER   IMETR(NDMET)                , IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8    DENSA(NDDEN)                ,
     &          RATPIA(NDDEN,NDMET)         , RATMIA(NDDEN,NDMET)    ,
     &          RATHA(NDDEN)
```

```
      REAL*8    POPAR(NDLEV,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      REAL*4    STVR(NDLEV,NDTEM,NDDEN,NDMET) ,
     &          STVI(NDLEV,NDTEM,NDDEN,NDMET) ,
     &          STVH(NDLEV,NDTEM,NDDEN,NDMET)
      REAL*4    STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
```

B8RCOM

```
      SUBROUTINE B8RCOM( NDTEM  , NDTRN  , NDLEV  , NDMET   ,
     &                   NTIN   , TIN    , RCIN   ,
     &                   NTOUT  , TOUT   ,
     &                   ICNT   , ITRN   , ICLEV  , IC2LEV  ,
     &                   RCOUT  , LTRNG
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8RCOM *********************
C
C  PURPOSE: TO ESTABLISH RECOMBINATION RATE COEFFICIENTS  FOR  A SET  OF
C           TEMPERATURES GIVEN BY THE ARRAY 'TOUT()' USING CUBIC SPLINES
C           ON  A SET OF RATE  COEFFICIENTS  COVERING  THE  TEMPERATURES
C           GIVEN BY THE ARRAY 'TIN()'.
C
C           RECOMBINATION TYPE IS SELECTED VIA 'ICNT' & 'ITRN'
C
C           RATE COEFFICIENTS ARE GIVEN FOR A NUMBER OF CAPTURING LEVELS
C           AND THE ARRAY 'RCOUT(,,)' REPRESENTS  COEFFTS.  FOR COMB-
C           INATIONS OF TEMPERATURE, CAPTURING LEVEL INDEX AND PARENT
C           INDEX.
C
C           SPLINE IS CARRIED OUT USING LOG(RATE COEFFICIENT VALUES)
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDTRN   = MAXIMUM NUMBER OF RECOMBINATIONS ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT :  (I*4)  NTIN    = NUMBER OF TEMPERATURES REPRESENTED IN THE
C                            INPUT DATA SET.
C  INPUT :  (R*8)  TIN()   = TEMPERATURES REPRESENTED IN INPUT DATA SET
C  INPUT :  (R*8)  RCIN(,) = RATE COEFF. REPRESENTED IN INPUT DATA SET
C                            1st DIMENSION: TEMPERATURE INDEX ('TIN')
C                            2nd DIMENSION: RECOMBINATION INDEX
C                                           (SEE: 'ITRN()')
C
C  INPUT :  (I*4)  NTOUT   = NUMBER OF ISPF SELECTED TEMPERATURES FOR
C                            OUTPUT.
C  INPUT :  (R*8)  TOUT()  = ISPF SELECTED TEMPERATURES FOR OUTPUT.
C
C  INPUT :  (I*4)  ICNT    = NUMBER OF SELECTED RECOMBINATIONS
C  INPUT :  (I*4)  ITRN()  = INDEX VALUES IN MAIN TRANSITION ARRAY WHICH
C                            REPRESENT RECOMBINATIONS  OF THE  SELECTED
C                            TYPE
C                            USED TO SELECT APPROPRIATE RATE COEFFTS FOR
C                            RECOMBINATION TYPE.
C  INPUT :  (I*4)  ICLEV() = CAPTURING LEVELS INDICES.
C                            DIMENSION: 'TRANSITION'/RECOMBINATION INDEX
C  INPUT :  (I*4)  IC2LEV()= PARENT INDEX.
C                            DIMENSION: 'TRANSITION'/RECOMB/IONIS  INDEX
C
C  OUTPUT:  (R*8)  RCOUT(,,)= SPLINED RECOMBINATION RATE COEFFT. VALUES.
C                            1st DIMENSION: TEMPERATURE INDEX ('TOUT')
C                            2nd DIMENSION: CAPTURING LEVEL INDEX.
C                            3RD DIMENSION: PARENT INDEX.
C
C  OUTPUT:  (L*4)  LTRNG() = .TRUE. => TEMPERATURE VALUES WITHIN RANGE
C                                      READ FROM INPUT COPASE DATA SET.
C                          = .FALSE.=>TEMPERATURE VALUE NOT WITHIN RANGE
C                                     READ FROM INPUT COPASE DATA SET.
C                            1st DIMENSION: TEMPERATURE INDEX.
C
C
C           (I*4)  NTDSN   = PARAMETER = MAXIMUM NUMBER OF TEMPERATURES
C                                        ALLOWED IN INPUT DATA SET = 14
C           (I*4)  NLTEM   = PARAMETER = MUST BE >= 'NDTEM'
C
C           (I*4)  IOPT    = SPLINE END CONDITIONS/EXTRAPOLATION CONTROL
C                            SWITCH - SEE 'XXSPLE'
C                            I.E. DEFINES THE BOUNDARY DERIVATIVES.
C                            (VALID VALUES = 0, 1, 2, 3, 4)
C           (I*4)  IRECMB  = APPROPRIATE RECOMBINATN INDEX FOR 'RCIN(,)'
C           (I*4)  ICAP    = CAPTURING LEVEL INDEX BEING ASSESSED.
C           (I*4)  IC      = RECOMBINATION ARRAY INDEX
C           (I*4)  IP      = PARENT INDEX
C           (I*4)  IT      = TEMPERATURE ARRAY INDEX
C
C           (R*8)  DYIN()  = INTERPOLATED DERIVATIVES
```

```
C                             DIMENSION: TEMPERATURE INDEX ('TIN()')
C
C           (L*4)  LSETX   = .TRUE.  => X-AXES ('TIN()' VALUES) NEED TO
C                                       SET IN 'XXSPLE'.
C                             .FALSE. => X-AXES ('TIN()' VALUES) HAVE
C                                       BEEN SET IN 'XXSPLE'.
C                             (NOTE: 'LSETX' IS RESET BY 'XXSPLE')
C
C           (R*8)  LRCIN() = LOG ( 'RCIN(,)' ) FOR GIVEN CAPTURING LEVEL
C                             DIMENSION: TEMPERATURE INDEX ('TIN()')
C           (R*8)  LRCOUT()= LOG ( SPLINED RECOMB.IONIS  RATE COEFTS )
C                             DIMENSION: TEMPERATURE INDEX ('TOUT()' )
C
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C           XXSPLE     ADAS      SPLINE SUBROUTINE (WITH EXTRAP. INFO)
C
C
C AUTHOR:  HP SUMMERS (UPGRADE OF BXRCOM BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:  12/07/93  HPS - MODIFICATIONS TO MAKE CONSISTENT WITH
C                          LATEST VERSION OF B8DATA
C
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C-----------------------------------------------------------------------
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                              DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NTDSN              , NLTEM
C-----------------------------------------------------------------------
      PARAMETER( NTDSN = 14         , NLTEM = 101        )
C-----------------------------------------------------------------------
      INTEGER    NDTRN              , NDTEM              , NDLEV      ,
     &           NDMET              ,
     &           NTIN               , NTOUT              ,
     &           ICNT
      INTEGER    IOPT               , IRECMB             , ICAP       ,
     &           IC                 , IT                 , IP
C-----------------------------------------------------------------------
      LOGICAL    LSETX
C-----------------------------------------------------------------------
      INTEGER    ICLEV(NDTRN)       , IC2LEV(NDTRN)      , ITRN(NDTRN)
C-----------------------------------------------------------------------
      REAL*8     TIN(NTDSN)         , RCIN(NTDSN,NDTRN)  ,
     &           TOUT(NDTEM)        ,
     &           RCOUT(NDTEM,NDLEV,NDMET)
      REAL*8     DYIN(NTDSN)        ,
     &           LRCIN(NTDSN)       , LRCOUT(NLTEM)
C-----------------------------------------------------------------------
      LOGICAL    LTRNG(NDTEM)
C-----------------------------------------------------------------------
      INTRINSIC  DLOG
C-----------------------------------------------------------------------
```

B8SPF0

```
      SUBROUTINE B8SPF0( REP    ,
     &                   DSNINP , DSNINX , DSNINC
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B8SPF0 *********************
C
C  PURPOSE: TO FETCH DATA SET NAME AND EXPANSION FILE NAME FROM IDL VIA
C           UNIX PIPE.
C           (INPUT DATA SET SPECIFICATIONS).
C           *** IDENTICAL TO B6SPF0 EXCEPT DTABLE='P20809' ***
C           ***                      AND    DPANEL='P20809' ***
C
C  CALLING PROGRAM: ADAS208
C
C  SUBROUTINE:
C
C  OUTPUT: (C*3)   REP     = 'YES' => TERMINATE PROGRAM EXECUTION.
C                          = 'NO ' => CONTINUE PROGRAM EXECUTION.
```

```
C
C  OUTPUT: (C*80)  DSNINP  = INPUT PROTON DATA SET NAME (SEQUENTIAL)
C                           (IN FORM SUITABLE FOR DYNAMIC ALLOCATION)
C  OUTPUT: (C*80)  DSNINX  = INPUT EXPANSION DATA SET NAME (SEQUENTIAL)
C                           (IN FORM SUITABLE FOR DYNAMIC ALLOCATION)
C  OUTPUT: (C*80)  DSNINC  = INPUT COPASE DATA SET NAME (FULL MVS DSN)
C                           (IN FORM SUITABLE FOR DYNAMIC ALLOCATION)
C
C
C AUTHOR:  D H BROOKS (UNIV>OF STRATHCLYDE)  03-MAY-1996
C          CUT OUT EVERYTHING FROM B8SPF0 FROM IBM AND REPLACED IT
C          WITH IDL-ADAS ALTERATIONS.
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                              DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
      CHARACTER    REP*3   , DSNINX*80 , DSNINC*80 , DSNINP*80
C-----------------------------------------------------------------------
      INTEGER      PIPEIN       , PIPEOU   ,  I4UNIT
C-----------------------------------------------------------------------
      PARAMETER( PIPEIN = 5 , PIPEOU = 6 )
C-----------------------------------------------------------------------
```

B8SPF1

```
      SUBROUTINE B8SPF1( NDTEM  , TINE   , MAXT   , IFOUT  ,
     &                   LPEND  , LGCR   , UID    ,
     &                   LNEWPA , LPAPER , LCONT  , LPASS  ,
     &                   DSNPAP , DSNOUT , DSNPAS , DSNGCR ,
     &                   LGPH   , ITSEL  , GTIT1  , CADAS
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8SPF1 *********************
C
C  PURPOSE: TO DISPLAY AND FETCH PANELS FOR PASSING FILE OUTPUT.
C           (OUTPUT DATA SET SPECIFICATIONS).
C
C  CALLING PROGRAM: ADAS208
C
C  SUBROUTINE:
C
C  INPUT:  (I*4)   NDTEM    = PARAMETER = MAX. NO. OF TEMPERATURES
C                                         ALLOWED
CX INPUT:  (R*8)   TINE()   = ELECTRON TEMPERATURES (UNITS: SEE 'IFOUT')
CX INPUT:  (I*4)   MAXT     = NUMBER OF INPUT TEMPERATURES
CX                            ( 1 -> 'NDTEM')
CX INPUT:  (I*4)   IFOUT    = 1 => INPUT TEMPERATURES IN KELVIN
CX                          = 2 => INPUT TEMPERATURES IN EV
CX                          = 3 => INPUT TEMPERATURES IN REDUCED FORM
C  OUTPUT: (L*4)   LPEND    = .TRUE.  => OUTPUT OPTIONS CANCELLED.
C                             .FALSE. => PROCESS OUTPUT OPTIONS.
C
CX OUTPUT: (L*4)   LNEWPA   = .TRUE.  => NEW TEXT OUTPUT FILE OR
CX                                       REPLACEMENT OF EXISTING FILE
CX                                       REQUIRED.
CX                            .FALSE. => ALLOW APPEND ON EXISTING OPEN
CX                                       TEXT FILE.
C
CX OUTPUT: (L*4)   LPAPER   = .TRUE.  => OUTPUT DATA TO TEXT OUTPUT
CX                                       FILE.
CX                            .FALSE. => NO OUTPUT OF CURRENT DATA TO
CX                                       TEXT OUTPUT FILE.
CX OUTPUT: (L*4)   LGPH     = .TRUE.  => SELECT GRAPHICAL OUTPUT
CX                          = .FALSE. => DO NOT SELECT GRAPHICAL OUTPUT
CX OUTPUT: (I*4)   ITSEL    = INDEX OF TEMPERATURE SELECTED FOR GRAPH
CX                          (FROM INPUT LIST).
CX OUTPUT: (C*40)  GTIT1    = ENTERED TITLE FOR GRAPH
C  OUTPUT: (L*4)   LCONT    = .TRUE.  => OUTPUT DATA TO PEC PASSING
C                                       FILE.
C                             .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                       PEC PASSING FILE.
C  OUTPUT: (L*4)   LPASS    = .TRUE.  => OUTPUT DATA TO SXB PASSING
C                                       FILE.
C                             .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                       SXB PASSING FILE.
C  OUTPUT: (L*4)   LGCR     = .TRUE.  => OUTPUT DATA TO GCR PASSING
C                                       FILE.
C                             .FALSE. => NO OUTPUT OF CURRENT DATA TO
C                                       GCR PASSING FILE.
C
C  OUTPUT: (C*80)  DSNOUT   = OUTPUT PEC DATA SET NAME (SEQUENTIAL)
C  OUTPUT: (C*80)  DSNPAS   = OUTPUT SXB DATA SET NAME (SEQUENTIAL)
C  OUTPUT: (C*26)  DSNGCR   = OUTPUT GCR DATA SET NAME (SEQUENTIAL)
C
C****** NEED TO CHECK WHICH OF THESE VARIABLES STILL REMAIN ****
C          (I*4)   L1       = PARAMETER = 1
C
C          (C*8)   F3       = PARAMETER = 'VDEFINE '
```

```
C          (C*8)   F5       = PARAMETER = 'CHAR    '
C
C          (I*4)  IPANRC   = RETURN CODE FROM ISPF PANEL DISPLAY
C          (I*4)  IDPAN    = INDEX FOR 'DPANEL' ISPF PANEL FOR DISPLAY
C          (I*4)  ILEN     = LENGTH, IN BYTES, OF ISPF DIALOG VARIABLES
C
C          (C*8)  DTABLE() = ISPF TABLE NAMES FOR 'DPANEL()'
C          (C*8)  DPANEL() = ISPF PANEL NAMES (FOR DISPLAY)
C          (C*8)  DPAN     = SPECIFIED ISPF PANEL NAME
C          (C*4)  KEY      = 'PF' KEY VALUE IF PRESSED E.G. = 'PF03'
C          (C*6)  USERID   = USER ID UNDER WHICH PROGRAM IS RUN
C          (C*8)  CURPOS   = CURSOR POSITION WHEN PANEL (RE)-DISPLAYED
C                            (PANEL VARIABLE NAME IN BRACKETS)
C          (C*8)  MSGTXT   = ERROR MESSAGE NAME (BLANK => NO ERROR)
C                            FOR NEXT DISPLAYED PANEL
C                            (MESSAGE NAME IN BRACKETS)
C          (C*8)  OUTDSN   = OUTPUT PEC PASSING FILE: LIBRARY NAME
C          (C*8)  PASDSN   = OUTPUT SXB PASSING FILE: LIBRARY NAME
C          (C*8)  GCRDSN   = OUTPUT GCR PASSING FILE: LIBRARY NAME
C
C          (L*4)  LREPLC   = .TRUE.  => IF PEC FILE EXISTS REPLACE
C                            .FALSE. => IF PEC FILE EXISTS DO NOT
C                                       REPLACE IT.
C          (L*4)  LREPLP   = .TRUE.  => IF SXB  FILE EXISTS REPLACE
C                            .FALSE. => IF SXB  FILE EXISTS DO NOT
C                                       REPLACE IT.
C          (L*4)  LREPLG   = .TRUE.  => IF GCR  FILE EXISTS REPLACE
C                            .FALSE. => IF GCR  FILE EXISTS DO NOT
C                                       REPLACE IT.
C          (L*4)  LEXIST   = .TRUE.  => DATASET EXISTS
C                            .FALSE. => DATASET DOES NOT EXIST
C          (C*80) CADAS    = ADAS HEADER: INCLUDES RELEASE,PROGRAM,TIME
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          XXFLSH     ADAS      FLUSH PIPE
C          XXADAS     ADAS      GET HEADER FROM IDL VIA PIPE
C
C***** END *****
C AUTHOR:  H P SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    15/01/92
C
C UPDATE:  10/07/92 HP SUMMERS  - INCLUDE GCR FILE
C
C**********************************************************************
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C UPDATE:  02/05/96 DH BROOKS   - LGCR FILE INCLUDED FOR 208.
C                                 READING OF HEADER BY XXADAS MOVED HERE
C                                 TO ALLOW INCLUSION OF ISTOP.
C**********************************************************************
C PUT UNDER S.C.C.S. CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER S.C.C.S.
C
C VERSION: 1.2                          DATE: 20/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - ADDED CALLS TO XXFLSH AND MADE LOOPS EXPLICIT
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C
      INTEGER    NDTEM     , MAXT      , IFOUT     ,
     &           ITSEL     , LOGIC     , I
      INTEGER    PIPEIN    , PIPEOU     , ONE  , IX
C-----------------------------------------------------------------------
      REAL*8     TINE(NDTEM)
C-----------------------------------------------------------------------
      CHARACTER  DSNPAP*80   , DSNOUT*80   , DSNPAS*80   , GTIT1*40
      CHARACTER  DSNGCR*80   , UID*10       , CADAS*80
C-----------------------------------------------------------------------
      LOGICAL    LPEND       , LPAPER      , LCONT       , LNEWPA  ,
     &           LPASS       , LGPH        , LGCR
C-----------------------------------------------------------------------
      PARAMETER( PIPEIN=5  , PIPEOU=6   , ONE=1 )
C-----------------------------------------------------------------------
```

B8SPLN

```
      SUBROUTINE B8SPLN( NTDIM , NDDIM ,
     &                   ITA    , IDA    , ITVAL   , IDVAL  ,
     &                   TETA   , TEDA   , TOUT    , DOUT   ,
     &                   CINA   ,          COUTA   ,
     &                                     LTRNG   , LDRNG
```

```
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8SPLN ******************  **
C
C  PURPOSE:
C          PERFORMS CUBIC SPLINE ON LOG(TEMPERATURE AND DENSITY)
C          VERSUS LOG(COLLISIONAL-RADIATIVE MATRIX COEFFICIENTS)
C          INPUT DATA
C
C          USING  TWO-WAY SPLINES IT CALCULATES  THE  INTERPOL. COEFFTS.
C          FOR  'ITVAL' ELECTRON TEMPERATURES  AND  'IDVAL' DENSITIES
C          FROM THE TWO-DIMENSIONAL TABLE OF TEMPERATURES/DENSITIES READ
C          IN FROM THE INPUT FILE. IF A  VALUE  CANNOT  BE  INTERPOLATED
C          USING SPLINES IT IS EXTRAPOLATED VIA 'XXSPLE'.
C
C  CALLING PROGRAM: ADAS208/B8GETP
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NTDIM   = MAX NUMBER OF ELECTRON TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDIM   = MAX NUMBER OF ELECTRON DENSITIES    ALLOWED
C
C  INPUT : (I*4)  ITA     = INPUT DATA  : NUMBER OF ELECTRON TEMPERA-
C                           TURES
C  INPUT : (I*4)  IDA     = INPUT DATA  : NUMBER OF ELECTRON DENSIT-
C                           IES
C  INPUT : (I*4)  ITVAL   = OUTPUT DATA : NUMBER OF TEMPERATURES
C  INPUT : (I*4)  IDVAL   = OUTPUT DATA : NUMBER OF DENSITIES
C
C  INPUT : (R*8)  TETA()  = INPUT DATA  : ELECTRON TEMPERATURES (K)
C  INPUT : (R*8)  TEDA()  = INPUT DATA  : ELECTRON DENSITIES (CM-3)
C  INPUT : (R*8)  TOUT()  = OUTPUT DATA : ELECTRON TEMPERATURES (K)
C  INPUT : (R*8)  DOUT()  = OUTPUT DATA : ELECTRON DENSITIES (CM-3)
C
C
C  INPUT : (R*8)  CINA(,)  =INPUT DATA FILE: FULL SET OF COLL. RAD.
C                           COEFFICIENTS FOR THE DATA-BLOCK BEING
C                           ANALYSED.
C                           1ST DIMENSION: ELECTRON TEMPERATURE INDEX
C                           2ND DIMENSION: ELECTRON DENSITY     INDEX
C  OUTPUT: (R*8)  COUTA(,)= SPLINE INTERPOLATED COLL. RAD. CEOFFICIENTS
C                           THE USER ENTERED TEMPERATURES AND DENSITIES
C                           1ST DIMENSION: ELECTRON TEMPERATURE INDEX
C                           2ND DIMENSION: ELECTRON DENSITY     INDEX
C
C  OUTPUT: (L*4)  LTRNG()=  .TRUE.  => OUTPUT 'COUTA()' VALUE WAS INTER-
C                                      POLATED  FOR  THE  USER  ENTERED
C                                      ELECTRON TEMPERATURE 'TOUT'()'.
C                           .FALSE. => OUTPUT 'COUTA()' VALUE WAS EXTRA-
C                                      POLATED  FOR  THE  USER  ENTERED
C                                      ELECTRON TEMPERATURE 'TOUT'()'.
C                           DIMENSION: TEMPERATURE/DENSITY PAIR INDEX
C
C  OUTPUT: (L*4)  LDRNG()=  .TRUE.  => OUTPUT 'COUTA()' VALUE WAS INTER-
C                                      POLATED  FOR  THE  USER  ENTERED
C                                      ELECTRON DENSITY 'DOUT()'.
C                           .FALSE. => OUTPUT 'COUTA()' VALUE WAS EXTRA-
C                                      POLATED  FOR  THE  USER  ENTERED
C                                      ELECTRON DENSITY 'DOUT()'.
C                           DIMENSION: TEMPERATURE/DENSITY PAIR INDEX
C
C          (I*4)  NIN     = PARAMETER = MAX. NO. OF INPUT  TEMP/DENSITY
C                                       VALUES. MUST BE >= 'ITA'&'IDA'
C          (I*4)  NOUT    = PARAMETER = MAX. NO. OF OUTPUT TEMP/DENSITY
C                                       PAIRS.  MUST BE >= 'ITVAL'
C          (I*4)  IED     = ARRAY SUBSCRIPT USED INPUT  FILE  ELECTRON
C                           DENSITIES.
C          (I*4)  IET     = ARRAY SUBSCRIPT USED INPUT  FILE  ELECTRON
C                           TEMPERATURES.
C          (I*4)  IT      = ARRAY  SUBSCRIPT  USED  FOR  USER  ENTERED
C                           TEMPERATURES.
C          (I*4)  IN      = ARRAY  SUBSCRIPT  USED  FOR  USER  ENTERED
C                           DENSITIES.
C          (I*4)  IOPT    = DEFINES THE BOUNDARY DERIVATIVES FOR THE
C                           SPLINE ROUTOUT'E 'XXSPLE', SEE 'XXSPLE'.
C                           (VALID VALUES = <0, 0, 1, 2, 3, 4)
C
C          (L*4)  LSETX   = .TRUE.  => SET UP SPLINE PARAMETERS RELATOUT'G
C                                      TO 'XIN' AXIS.
C                           .FALSE. => DO NOT SET UP SPLINE PARAMETERS
C                                      RELATOUT'G TO 'XIN' AXIS.
C                                      (I.E. THEY WERE SET IN A PREVIOUS
C                                            CALL )
C                           (VALUE SET TO .FALSE. BY 'XXSPLE')
C
C          (R*8)  R8FUN1  = FUNCTION - (SEE ROUTOUT'ES SECTION BELOW)
C
C          (R*8)  XIN()   = 1) LOG( DATA FILE ELECTRON DENSITIES    )
C                           2) LOG( DATA FILE ELECTRON TEMPERATURES )
C          (R*8)  YIN()   = LOG( INPUT COLL. RAD COEFFTS.)
C          (R*8)  XOUT()  = 1) LOG( SCALED USER ENTERED ELECTRON DENS. )
C                           2) LOG( SCALED USER ENTERED ELECTRON TEMPS.)
C          (R*8)  YOUT()  = LOG( OUTPUT GENERATED IONIZATIONS/PHOTON )
C          (R*8)  YPASS(,)= LOG( COL. RAD. COEFFTS.) INTERMEDIATE ARRAY
C                           WHICH   STORES   INTERPOLATED/EXTRAPOLATED
```

```
C                           VALUES  BETWEEN  THE  TWO  SPLINE SECTIONS.
C                           SECTIONS.
C          (R*8)  DF()    = SPLINE INTERPOLATED DERIVATIVES
C
C
C NOTE:
C
C ROUTOUT'ES:
C          ROUTOUT'E  SOURCE    BRIEF DESCRIPTION
C          ---------------------------------------------------------
C          XXSPLE     ADAS      SPLINE SUBROUTOUT'E (EXTENDED DIAGNOSTICS)
C          R8FUN1     ADAS      REAL*8 FUNCTION: ( X -> X )
C
C AUTHOR:  H.P. SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    15/07/92
C
C
C**********************************************************************
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C VERSION: 1.2                          DATE: 23/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - INCREASED NOUT TO 35
C
C VERSION: 1.3                          DATE: 30/09/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - INCREASED NIN TO 35
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NIN                  , NOUT
C-----------------------------------------------------------------------
      PARAMETER( NIN =35             , NOUT = 35        )
C-----------------------------------------------------------------------
      INTEGER    NTDIM                , NDDIM           ,
     &           ITA                  , IDA             , ITVAL
      INTEGER    IET                  , IED             , IT         ,
     &           IOPT                 , IN              , IDVAL
C-----------------------------------------------------------------------
      REAL*8     R8FUN1
C-----------------------------------------------------------------------
      LOGICAL    LSETX
C-----------------------------------------------------------------------
      REAL*8     TETA(ITA)            , TEDA(IDA)       ,
     &           TOUT(ITVAL)          , DOUT(IDVAL)     ,
     &           COUTA(NTDIM,NDDIM)   ,
     &           CINA(NTDIM,NDDIM)
      REAL*8     DF(NIN)              ,
     &           XIN(NIN)             , YIN(NIN)        ,
     &           XOUT(NOUT)           , YOUT(NOUT)      ,
     &                                  YPASS(NOUT,NIN)
C-----------------------------------------------------------------------
      LOGICAL    LTRNG(ITVAL)         , LDRNG(IDVAL)
C-----------------------------------------------------------------------
      EXTERNAL   R8FUN1
C-----------------------------------------------------------------------
```

B8STKB

```
      SUBROUTINE B8STKB( NDTEM  , NDLEV  , NDMET  ,
     &                   IT     , NORD   ,
     &                            IORDR  ,
     &                   CMAT   , VEC    ,
     &                   IP     ,
     &                   STV
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8STKB *********************
C
C  PURPOSE: TO STACK UP IN  'STV'  THE  RECOMBINATION CONTRIBUTION  FOR
C           EACH  NON-METASTABLE/ORDINARY  EXCITED  LEVEL  FOR  A GIVEN
C           TEMPERATURE AND DENSITY.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
```

```
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT :  (I*4)  IT      = INDEX DENOTING THE TEMPERATURE
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                           LEVEL LIST.
C                           (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (R*8)  CMAT(,) = INVERTED   RATE   MATRIX   COVERING   ALL
C                           NON-METASTABLE/ORDINARY EXCITED LEVELS
C                           TRANSITIONS.
C                           (UNITS: SEC)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                           2nd DIMENSION: ORDINARY EXCITED LEVEL INDEX
C  INPUT :  (I*4)  IP      = PARENT INDEX
C
C  INPUT :  (R*8)  VEC(,,) = RECOMBINATION RATE COEFFT. VALUES.
C                           (UNITS: CM**3/SEC-1)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           1st DIMENSION: TEMPERATURE INDEX ('IT')
C                           2nd DIMENSION: CAPTURING LEVEL INDEX
C                           3rd DIMENSION: PARENT INDEX
C
C  OUTPUT:  (R*4)  STV()   = RECOMBINATION  CONTRIBUTION  FOR  EACH
C                           NON-METASTABLE/ORDINARY EXCITED LEVELS.
C                           (UNITS: CM**3)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           DIMENSION: ORDINARY EXCITED LEVEL INDEX
C
C           (I*4)  IS1     = ORDINARY EXCITED LEVEL INDEX
C           (I*4)  IS2     = ORDINARY EXCITED LEVEL INDEX
C
C           (R*8)  COEF    = VARIABLE USED TO SUM COEFFICIENT VALUES
C
C
C ROUTINES: NONE
C
C NOTE:
C        IF:     n  =  number of ordinary/non-metastable levels
C            R(nxn) = Rate matrix (SEC-1) covering transistions between
C                     all possible pairs of ordinary levels.
C                     row   : final   level
C                     column: initial level
C                     (Inverse R-1(nxn) = 'CMAT(,)' )
C            V(n)   = Recombination rate vector (CM**3 SEC-1) covering
C                     all ordinary levels.
C                     ( = 'VEC()' - ordinary level part ).
C            S(n)   = Recombination contribution vector (CM**3) covering
C                     all ordinary levels ( = 'STV()' ).
C
C           Therefore:  R(nxn).S(n) = V(n)
C
C            =>         S(n)  = R-1(nxn).V(n)
C
C
C
C AUTHOR:  HP SUMMERS  (UPGRADE OF BXSTKB BT PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:  12/07/93  HPS - CHASNGE STV DIMENSION TO R*4
C**********************************************************************
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDTEM              , NDLEV             , NDMET   ,
     &           IT                 , IP                , NORD
      INTEGER    IS1                , IS2
C-----------------------------------------------------------------------
      REAL*8     COEF
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8     CMAT(NDLEV,NDLEV)  , VEC(NDTEM,NDLEV,NDMET)
C-----------------------------------------------------------------------
      REAL*4     STV(NDLEV)
C-----------------------------------------------------------------------
```

B8STKD

```
      SUBROUTINE B8STKD( NDTEM  , NDLEV  , NDMET  ,
     &                   IT     , NORD   , NMET   ,
     &                            IORDR  , IMETR  ,
     &                   CC     , STV    ,
     &                   VEC    , IP     ,
     &                   VRED
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B8STKD *********************
C
C  PURPOSE: TO STACK UP IN  'VRED'  THE RECOMBINATION RATE CONTRIBUTIONS
C           FOR  EACH  METASTABLE  LEVEL  FOR  A  GIVEN TEMPERATURE  AND
C           DENSITY.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  IT      = INDEX DENOTING THE TEMPERATURE
C  INPUT :  (I*4)  IP      = PARENT INDEX
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                            LEVEL LIST.
C                            (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (R*8)  CC(,)   = RATE MATRIX COVERING ALL TRANSITIONS
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ENERGY LEVEL INDEX
C                            2nd DIMENSION: ENERGY LEVEL INDEX
C  INPUT :  (R*4)  STV()   = RECOMBINATION  CONTRIBUTION  FOR  EACH
C                            NON-METASTABLE/ORDINARY EXCITED LEVELS.
C                            (UNITS: CM**3)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            DIMENSION: ORDINARY EXCITED LEVEL INDEX
C  INPUT :  (R*8)  VEC(,,) = RECOMBINATION RATE COEFFT. VALUES.
C                            (UNITS: CM**3/SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: TEMPERATURE INDEX ('IT')
C                            2nd DIMENSION: CAPTURING LEVEL INDEX
C                            3ND DIMENSION: PARENT INDEX
C
C  OUTPUT:  (R*8)  VRED(,) = VECTOR  OF RECOMBINATION RATE CONTRIBUTIONS
C                            FOR EACH METASTABLE LEVEL.
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1ST DIMENSION: METASTABLE LEVEL INDEX
C                            2ND DIMENSION: PARENT INDEX
C
C           (I*4)  IM      = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IS      = ORDINARY EXCITED LEVEL INDEX
C
C
C ROUTINES: NONE
C
C NOTE:
C           VRED(IM,IP)   =    ( THE RECOMBINATION RATE FOR IM )
C                                                 +
C                              SUM( (the transistion rate from ordinary
C                                    level IS to IM)  x  (the recombin-
C                                    ation  contribution  for  ordinary
C                                    level IS) )
C
C                              ABOVE SUM IS OVER ALL ORDINARY LEVELS.
C
C
C AUTHOR:  HP SUMMERS  (UPGRADE OF BXSTKD BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:  12/07/93  HPS - CHANGE STV DIMENSION TO R*4
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C-----------------------------------------------------------------------
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
```

```
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDTEM              , NDLEV              , NDMET      ,
     &           IT                 , NORD               , NMET
      INTEGER    IM                 , IS                 , IP
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)       , IMETR(NDMET)
C-----------------------------------------------------------------------
      REAL*8     CC(NDLEV,NDLEV)    ,
     &           VEC(NDTEM,NDLEV,NDMET)   , VRED(NDMET,NDMET)
C-----------------------------------------------------------------------
      REAL*4     STV(NDLEV)
C-----------------------------------------------------------------------
```

B8STKE

```
      SUBROUTINE B8STKE( NDTEM  , NDLEV  , NDMET  ,
     &                   IT     , NORD   ,
     &                            IORDR  ,
     &                   DENS   ,
     &                   CMAT   , VEC    , V3     ,
     &                   IP     ,
     &                   STV
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8STKE *********************
C
C  PURPOSE: TO STACK UP IN  'STV'  THE  RECOMBINATION CONTRIBUTION  FOR
C           EACH  NON-METASTABLE/ORDINARY  EXCITED  LEVEL  FOR  A GIVEN
C           TEMPERATURE AND DENSITY, BUT ADDING A THREE-BODY
C           RECOMBINATION PART FROM V3
C
C  CALLING PROGRAM:  ADAS208
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT :  (I*4)  IT      = INDEX DENOTING THE TEMPERATURE
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                           LEVEL LIST.
C                           (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (R*8)  DENS    = ELECTRON DENSITY (CM-3)
C  INPUT :  (R*8)  CMAT(,) = INVERTED   RATE   MATRIX   COVERING   ALL
C                           NON-METASTABLE/ORDINARY EXCITED LEVELS
C                           TRANSITIONS.
C                           (UNITS: SEC)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           1st DIMENSION: ORDINARY EXCITED LEVEL INDEX
C                           2nd DIMENSION: ORDINARY EXCITED LEVEL INDEX
C  INPUT :  (I*4)  IP      = PARENT INDEX
C
C  INPUT :  (R*8)  VEC(,,) = RECOMBINATION RATE COEFFT. VALUES.
C                           (UNITS: CM**3/SEC-1)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           1st DIMENSION: TEMPERATURE INDEX ('IT')
C                           2nd DIMENSION: CAPTURING LEVEL INDEX
C                           3rd DIMENSION: PARENT INDEX
C  INPUT :  (R*8)  V3(,)   = THREE-BODY RECOMB. RATE COEFFT. VALUES.
C                           (UNITS: CM**6/SEC-1)
C                           VALUES FOR A SPECIFIED TEMPERATURE.
C                           1ST DIMENSION: CAPTURING LEVEL INDEX
C                           2ND DIMENSION: PARENT INDEX
C
C  OUTPUT:  (R*4)  STV()   = RECOMBINATION  CONTRIBUTION  FOR  EACH
C                           NON-METASTABLE/ORDINARY EXCITED LEVELS.
C                           (UNITS: CM**3)
C                           VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                           DIMENSION: ORDINARY EXCITED LEVEL INDEX
C
C           (I*4)  IS1     = ORDINARY EXCITED LEVEL INDEX
C           (I*4)  IS2     = ORDINARY EXCITED LEVEL INDEX
C
C           (R*8)  COEF    = VARIABLE USED TO SUM COEFFICIENT VALUES
C
C
C ROUTINES: NONE
C
C NOTE:
C        IF:     n  =  number of ordinary/non-metastable levels
C            R(nxn) = Rate matrix (SEC-1) covering transistions between
C                     all possible pairs of ordinary levels.
C                     row   : final   level
```

```
C                     column: initial level
C                     (Inverse R-1(nxn) = 'CMAT(,)' )
C            V(n)   = Recombination rate vector (CM**3 SEC-1) covering
C                     all ordinary levels.
C                     ( = 'VEC()' - ordinary level part ).
C            S(n)   = Recombination contribution vector (CM**3) covering
C                     all ordinary levels ( = 'STV()' ).
C
C           Therefore:  R(nxn).S(n) = V(n)
C
C            =>         S(n)  = R-1(nxn).V(n)
C
C
C
C AUTHOR:  HP SUMMERS  (UPGRADE OF BXSTKB BT PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:  12/07/93  HPS - CHANGE STV DIMENSION TO R*4
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C-----------------------------------------------------------------------
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                              DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDTEM              , NDLEV              , NDMET   ,
     &           IT                 , IP                 , NORD
      INTEGER    IS1                , IS2
C-----------------------------------------------------------------------
      REAL*8     COEF               , DENS
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)
C-----------------------------------------------------------------------
      REAL*8     CMAT(NDLEV,NDLEV)  , VEC(NDTEM,NDLEV,NDMET) ,
     &           V3(NDLEV,NDMET)
      REAL*4     STV(NDLEV)
C-----------------------------------------------------------------------
```

B8STKF

```
      SUBROUTINE B8STKF( NDTEM  , NDLEV  , NDMET  ,
     &                   IT     , NORD   , NMET   ,
     &                            IORDR  , IMETR  ,
     &                   CC     , STV    ,
     &                   DENS   ,
     &                   VEC    , V3     , IP     ,
     &                   VRED
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ***************** FORTRAN77 SUBROUTINE: B8STKF *********************
C
C  PURPOSE: TO STACK UP IN  'VRED'  THE RECOMBINATION RATE CONTRIBUTIONS
C           FOR  EACH  METASTABLE  LEVEL  FOR  A  GIVEN TEMPERATURE  AND
C           DENSITY AND INCLUDE THREE-BODY RECOMBINATION PART
C
C  CALLING PROGRAM:  ADAS208
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT :  (I*4)  NDLEV   = MAXIMUM NUMBER OF ENERGY LEVELS ALLOWED
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  IT      = INDEX DENOTING THE TEMPERATURE
C  INPUT :  (I*4)  IP      = PARENT INDEX
C  INPUT :  (I*4)  NORD    = NUMBER OF ORDINARY EXCITED LEVELS
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                            (ARRAY SIZE = 'NDMET' )
C  INPUT :  (I*4)  IORDR() =INDEX OF ORDINARY EXCITED LEVELS IN COMPLETE
C                            LEVEL LIST.
C                            (ARRAY SIZE = 'NDLEV' )
C
C  INPUT :  (R*8)  DENS    = ELECTRON DENSITY (CM-3)
C  INPUT :  (R*8)  CC(,)   = RATE MATRIX COVERING ALL TRANSITIONS
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: ENERGY LEVEL INDEX
```

```
C                              2nd DIMENSION: ENERGY LEVEL INDEX
C  INPUT :  (R*4)  STV()    = RECOMBINATION  CONTRIBUTION  FOR  EACH
C                              NON-METASTABLE/ORDINARY EXCITED LEVELS.
C                              (UNITS: CM**3)
C                              VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                              DIMENSION: ORDINARY EXCITED LEVEL INDEX
C  INPUT :  (R*8)  VEC(,,) = RECOMBINATION RATE COEFFT. VALUES.
C                              (UNITS: CM**3/SEC-1)
C                              VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                              1st DIMENSION: TEMPERATURE INDEX ('IT')
C                              2nd DIMENSION: CAPTURING LEVEL INDEX
C                              3ND DIMENSION: PARENT INDEX
C  INPUT :  (R*8)  V3(,)    = THREE-BODY RECOMB. RATE COEFFT. VALUES.
C                              (UNITS: CM**6/SEC-1)
C                              VALUES FOR A SPECIFIC TEMPERATURE.
C                              1ST DIMENSION: CAPTURING LEVEL INDEX
C                              2ND DIMENSION: PARENT INDEX
C
C  OUTPUT:  (R*8)  VRED(,) = VECTOR  OF RECOMBINATION RATE CONTRIBUTIONS
C                              FOR EACH METASTABLE LEVEL.
C                              (UNITS: SEC-1)
C                              VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                              1ST DIMENSION: METASTABLE LEVEL INDEX
C                              2ND DIMENSION: PARENT INDEX
C
C           (I*4)  IM      = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IS      = ORDINARY EXCITED LEVEL INDEX
C
C
C ROUTINES: NONE
C
C NOTE:
C           VRED(IM,IP)   =    ( THE RECOMBINATION RATE FOR IM )
C                                                 +
C                              SUM( (the transistion rate from ordinary
C                                    level IS to IM)  x  (the recombin-
C                                    ation  contribution  for  ordinary
C                                    level IS) )
C
C                              ABOVE SUM IS OVER ALL ORDINARY LEVELS.
C
C
C AUTHOR:  HP SUMMERS  (UPGRADE OF BXSTKD BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:  12/07/93  HPS - CHANGE STV DIMENSION TO R*4
C*********************************************************************
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C*********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                            DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDTEM              , NDLEV              , NDMET      ,
     &           IT                 , NORD               , NMET
      INTEGER    IM                 , IS                 , IP
C-----------------------------------------------------------------------
      INTEGER    IORDR(NDLEV)       , IMETR(NDMET)
C-----------------------------------------------------------------------
      REAL*8     DENS
C-----------------------------------------------------------------------
      REAL*8     CC(NDLEV,NDLEV)    ,
     &           VEC(NDTEM,NDLEV,NDMET)   , VRED(NDMET,NDMET)  ,
     &           V3(NDLEV,NDMET)
C-----------------------------------------------------------------------
      REAL*4     STV(NDLEV)
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
```

B8STVM

```
      SUBROUTINE B8STVM( NDMET  ,
     &                   NMET   ,
     &                   CRMAT  ,
     &                   IP     ,
     &                   VRED   ,
     &                   STVM
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
```

```
C
C  ****************** FORTRAN77 SUBROUTINE: B8STVM *********************
C
C  PURPOSE: TO  CALCULATE  AND STACK UP IN  'STVM'  THE METASTABLE LEVEL
C           RECOMBINATION  COEFFICIENTS  FOR  A  GIVEN  TEMPERATURE  AND
C           DENSITY.
C
C  CALLING PROGRAM:  ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT :  (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLE LEVELS ALLOWED
C
C  INPUT :  (I*4)  NMET    = NUMBER OF METASTABLE LEVELS
C
C  INPUT :  (R*8)  CRMAT(,)= INVERTED  METASTABLE  LEVEL   RATE   MATRIX
C                            COVERING ALL TRANSITIONS BETWEEN METASTABLE
C                            LEVELS EXCEPT THOSE INVOLVING LEVEL 1.
C                            (UNITS: SEC)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            1st DIMENSION: METASTABLE LEVEL INDEX - 1
C                            2nd DIMENSION: METASTABLE LEVEL INDEX - 1
C           (I*4)  IP       = PARENT INDEX
C
C  INPUT :  (R*8)  VRED(,) = VECTOR  OF RECOMBINATION RATE CONTRIBUTIONS
C                            FOR EACH METASTABLE LEVEL.
C                            (UNITS: SEC-1)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            DIMENSION: METASTABLE LEVEL INDEX
C
C  OUTPUT:  (R*8)  STVM()  = RECOMBINATION  CONTRIBUTION  FOR  EACH
C                            METASTABLE LEVEL. (UNITS: CM**3)
C                            VALUES FOR GIVEN TEMPERATURE AND DENSITY.
C                            (LEVEL 1 IS TAKEN AS ZERO)
C                            DIMENSION: METASTABLE LEVEL INDEX
C
C           (I*4)  IM1      = METASTABLE LEVEL ARRAY INDEX
C           (I*4)  IM2      = METASTABLE LEVEL ARRAY INDEX
C
C
C ROUTINES: NONE
C
C NOTE:
C           STVM(IM1)       SUM( (the transistion rate from IM2 to IM1)
C                                x (the recombination rate contribution
C                                   for metastable level IM2) )
C
C                           (IM1 & IM2 = METASTABLE LEVEL INDEX)
C
C                           ABOVE SUM IS OVER ALL METASTABLE LEVELS
C                           EXCEPT LEVEL ONE.
C
C
C AUTHOR:  HP SUMMERS ( UPGRADE OF BXSTVM BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C-----------------------------------------------------------------------
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDMET               , NMET
      INTEGER    IM1                 , IM2               , IP
C-----------------------------------------------------------------------
      REAL*8     CRMAT(NDMET,NDMET)  , VRED(NDMET,NDMET)      ,
     &           STVM(NDMET)
C-----------------------------------------------------------------------
```

B8TOTH

```
      SUBROUTINE B8TOTH( NDLEV   , NDMET  , NDTEM , NDDEN ,
     &                   NORD    , NMET   , NPL   ,
     &                   IORDR   , IMETR  ,
     &                   IT      , MAXT   , IN    , MAXD  ,
     &                   RATPIA  ,
     &                   STVHM   , STVH   ,
     &                   PLA1    ,
     &                   PHA     , PH
     &                 )
```

```
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8TOTH *********************
C
C  PURPOSE: TO CALCULATE TOTAL CHARGE EXCHANGE DRIVEN LINE POWER.
C
C  NOTE: CODE EXECUTES FOR ONE TEMPERATURE AND DENSITY INDEX AT A TIME
C
C  CALLING PROGRAM:  ADAS208
C
C  SUBROUTINE:
C
C  INPUT : (I*4) NDLEV    = PARAMETER = MAX. NO. OF LEVELS ALLOWED
C  INPUT : (I*4) NDMET    = PARAMETER = MAX. NO. OF METASTABLES ALLOWED
C  INPUT : (I*4) NDTEM    = PARAMETER = MAX. NO. OF TEMPERATURES ALLOWED
C  INPUT : (I*4) NDDEN    = PARAMETER = MAX. NO. OF DENSITIES ALLOWED
C
C  INPUT : (I*4) NORD     = NUMBER OF ORD. LEVELS (1 <= NORD <= 'NDLEV')
C  INPUT : (I*4) NMET     = NUMBER OF METASTABLES (1 <= NMET <= 'NDMET')
C  INPUT : (I*4) NPL      = NUMBER OF PARENT METASTABLES (NPL<= 'NDMET')
C
C  INPUT : (I*4) IORDR()  = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST (ARRAY SIZE = 'NDLEV' )
C  INPUT : (I*4) IMETR()  = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET' )
C  INPUT : (I*4) IT       = CURRENT TEMPERATURE INDEX
C  INPUT : (I*4) MAXT     = NUMBER OF INPUT TEMPERATURES ( 1 -> 'NDTEM')
C  INPUT : (I*4) IN       = CURRENT DENSITY INDEX
C  INPUT : (I*4) MAXD     = NUMBER OF INPUT DENSITIES ( 1 -> 'NDDEN')
C  INPUT : (R*8) RATPIA(,)= RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C                            1ST DIMENSION: DENS INDEX
C                            2ND DIMENSION: PARENT INDEX
C
C  INPUT : (R*8) STVHM(,,,)= METASTABLE LEVEL:
C                           CHARGE-EXCHANGE RECOMBINATION POPUL. PART
C                           (UNITS* CM**3/SEC-1)
C                             1st DIMENSION: METASTABLE INDEX
C                             2nd DIMENSION: TEMPERATURE INDEX
C                             3rd DIMENSION: DENSITY INDEX
C                             4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVH(,,,)= ORDINARY EXCITED LEVEL:
C                             CHARGE-EXCHANGE RECOMBINATION POPUL. PART
C                             (UNITS* CM**3/SEC-1)
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: TEMPERATURE INDEX
C                             3rd DIMENSION: DENSITY INDEX
C                             4TH DIMENSION: PARENT INDEX
C  INPUT : (R*8)  PLA1()  = DIRECT LINE POWER LOSS FOR EACH LEVEL.
C                           (UNITS: ERGS SEC-1) (DIMENSION: LEVEL INDEX)
C
C  OUTPUT: (R*8)  PH(,,)  = TOTAL CX LINE POWER FOR PARENT. THIS IS
C                           THE SUM OF ALL EMISSIONS ORGINATING IN THE
C                           COLLISIONAL-RADIATIVE   SENSE   FROM   THE
C                           PARENT.
C                            => P(TOTAL)/N(IP)          (ERGS SEC-1)
C                             1ST DIMENSION: PARENT METASTABL INDEX
C                             2nd DIMENSION: TEMPERATURE INDEX
C                             3rd DIMENSION: DENSITY     INDEX
C  OUTPUT: (R*8)  PHA(,)  =  EQUILIBRIUM CX POWER COEFFT.
C                            => P(TOTAL)/(DENS*N(1))  (ERGS CM3 SEC-1)
C                             1st DIMENSION: TEMPERATURE INDEX
C                             2nd DIMENSION: DENSITY     INDEX
C
C          (I*4) IM       = METASTABLE LEVEL ARRAY INDEX
C          (I*4) IS       = ORDINARY LEVEL ARRAY INDEX
C          (I*4) IP       = PARENT METASTABLE INDEX
C
C
C
C ROUTINES: NONE
C
C
C AUTHOR:  H. P. SUMMERS, UNIVERSITY OF STRATHCLYDE
C          JA8.08
C          TEL. 0141-553-4196
C
C DATE:    24/05/96
C
C UPDATE:
C
C-----------------------------------------------------------------------
C PUT UNDER S.C.C.S CONTROL:
C
C VERSION: 1.1                          DATE: 15/07/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER S.C.C.S
C
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDMET         , NDLEV               ,
     &           NDTEM         , NDDEN               ,
     &           MAXT          , MAXD                ,
     &           NMET          , NORD                , NPL
      INTEGER    IM            , IS                  , IP             ,
     &           IT            , IN
```

```
C-----------------------------------------------------------------------
      INTEGER    IMETR(NMET)   , IORDR(NORD)
C-----------------------------------------------------------------------
      REAL*4     STVH(NDLEV,NDTEM,NDDEN,NDMET)
C-----------------------------------------------------------------------
      REAL*8     STVHM(NDMET,NDTEM,NDDEN,NDMET) ,
     &           PLA1(NDLEV)                    ,
     &           PHA(NDTEM,NDDEN)               ,
     &           PH(NDTEM,NDDEN,NDMET)
      REAL*8     RATPIA(NDDEN,NDMET)
C-----------------------------------------------------------------------
```

B8TOTL

```
      SUBROUTINE B8TOTL( NDLEV   , NDMET  ,
     &                   NORD    , NMET   ,
     &                   IORDR   , IMETR  , ISTRN ,
     &                   DENSX   ,
     &                   STCKMX  , STACKX ,
     &                   PLA1    , PLBAX  ,
     &                   PLAX    , PLX    ,
     &                   PSAX    , PSX
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8TOTL *********************
C
C  PURPOSE: TO  CALCULATE  TOTAL  LINE  POWERS FOR METASTABLES AND TOTAL
C           EQUILIBRIUM LINE POWERS. EXTENDED TO CALCULATE SPECIFIC LINE
C           POWERS FOR EACH METASTABLE AND EQUILIBRIUM SPECIFIC LINE
C           POWERS.  DEVELOPMENT OF B6TOTL.
C
C  NOTE:    A SPECIFIC LINE IS EVALUATED WHICH TERMINATES ON EACH
C           METASTABLE.  EACH IS RESOLVED INTO THE PART DRIVEN BY EACH
C           METASTABLE.  THE EQUILIBRIUM POWER IN EACH OF THESE LINES IS
C           ALSO EVALUATED USING THE EQUILIBRIUM METASTABLE FRACTIONS.
C
C  CALLING PROGRAM:  ADAS208
C
C  SUBROUTINE:
C
C  INPUT : (I*4) NDLEV    = PARAMETER = MAX. NO. OF LEVELS ALLOWED
C  INPUT : (I*4) NDMET    = PARAMETER = MAX. NO. OF METASTABLES ALLOWED
C
C  INPUT : (I*4) NORD     = NUMBER OF ORD. LEVELS (1 <= NORD <= 'NDLEV')
C  INPUT : (I*4) NMET     = NUMBER OF METASTABLES (1 <= NMET <= 'NDMET')
C
C  INPUT : (I*4) IORDR()  = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST (ARRAY SIZE = 'NDLEV' )
C  INPUT : (I*4) IMETR()  = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C                           (ARRAY SIZE = 'NDMET' )
C  INPUT : (I*4)  ISTRN() = SPECIFIC LINE POWER: SELECTED ELECTRON
C                           IMPACT TRANSITION INDEX. (FOR USE WITH
C                           'IE1A()' , 'IE2A()' AND 'AA()' ARRAYS)
C                           WHICH GIVES LARGEST POWER TO METASTABLE
C                            DIMENSION: METASTABLE LINE COUNT INDEX
C  INPUT : (R*8) DENSX    = ELECTRON DENSITY (UNITS: CM-3)
C
C  INPUT : (R*8) STCKMX() = METASTABLE POPULATIONS STACK
C                           AT FIXED TEMPERATURE AND DENSITY.
C                            DIMENSION: METASTABLE INDEX
C  INPUT : (R*4) STACKX(,)= ORDINARY EXCITED LEVEL POPULAT'N DEPENDENCE
C                           ON METASTABLE LEVEL. AT FIXED TEMPERATURE
C                           AND DENSITY.
C                             1st DIMENSION: ORDINARY LEVEL INDEX
C                             2nd DIMENSION: METASTABLE INDEX
C
C  INPUT : (R*8)  PLA1()  = DIRECT LINE POWER LOSS FOR EACH LEVEL.
C                           (UNITS: ERGS SEC-1) (DIMENSION: LEVEL INDEX)
C  INPUT : (R*8)  PLBAX() = HIGH N PROJECTED POWER BASED ON EXCITATIONS
C                           FROM A PARTICULAR METASTABLE TO LEVELS
C                           'IPROJ' UPWARDS. (UNITS: ERGS CM3 SEC-1)
C                           AT FIXED TEMPERATURE.
C                             DIMENSION: METASTABLE  INDEX
C
C  OUTPUT: (R*8)  PLAX    = TOTAL EQUILIBRIUM LINE POWER COEFFICIENTS.
C                           AT FIXED TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS CM3 SEC-1)
C  OUTPUT: (R*8)  PLX()   = TOTAL LINE POWERS FOR METASTABLES. THIS IS
C                           THE SUM OF ALL EMISSIONS ORGINATING IN THE
C                           COLLISIONAL-RADIATIVE   SENSE   FROM   THE
C                           METASTABLE. AT FIXED TEMPERATURE AND DENSITY
C                           (UNITS: ERGS SEC-1 )
C                             DIMENSION: METASTABLE  INDEX
C
C  OUTPUT: (R*8)  PSAX()  = TOTAL EQUILIBRIUM LINE POWER COEFFICIENTS.
C                           AT FIXED TEMPERATURE AND DENSITY.
C                            (UNITS: ERGS CM3 SEC-1)
C                             DIMENSION: METASTABLE  INDEX
C  OUTPUT: (R*8)  PSX(,)  = TOTAL LINE POWERS FOR METASTABLES. THIS IS
C                           THE SUM OF ALL EMISSIONS ORGINATING IN THE
C                           COLLISIONAL-RADIATIVE   SENSE   FROM   THE
C                           METASTABLE. AT FIXED TEMPERATURE AND DENSITY
```

```
C                           (UNITS: ERGS SEC-1 )
C                             1ST. DIMENSION: METASTABLE INDEX FOR LINE
C                             2ND. DIMENSION: METASTABLE INDEX OF DRIVER
C
C          (I*4) IM       = METASTABLE LEVEL ARRAY INDEX
C          (I*4) IS       = ORDINARY LEVEL ARRAY INDEX
C          (I*4) ISL      = SPECIFIC LINE POWER INDEX
C
C
C
C ROUTINES: NONE
C
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 5023
C
C DATE:    09/10/90
C
C UPDATE:  20/05/93-P BRIDEN: STACKX ARRAY CHANGED FROM REAL*8 -> REAL*4
C
C UPDATE:  24/05/96  HP SUMMERS - EXTENSION FOR SPECIFIC LINE POWER
C
C**********************************************************************
C PUT UNDER S.C.C.S CONTROL:
C
C VERSION: 1.1                             DATE: 16/07/95
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER S.C.C.S
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER    NDMET         , NDLEV              ,
     &           NMET          , NORD
      INTEGER    IM            , IS                 , ISL
C-----------------------------------------------------------------------
      REAL*8     DENSX         , PLAX
C-----------------------------------------------------------------------
      INTEGER    IMETR(NMET)   , IORDR(NORD)        , ISTRN(NDMET)
C-----------------------------------------------------------------------
      REAL*8     STCKMX(NDMET) ,
     &           PLA1(NDLEV)   , PLBAX(NDMET)       ,
     &           PLX(NDMET)
      REAL*8     PSAX(NDMET)   , PSX(NDMET,NDMET)
      REAL*4     STACKX(NDLEV,NDMET)
C-----------------------------------------------------------------------
```

B8TTYP

```
      SUBROUTINE B8TTYP( NDTRN  , NPLR   , NPLI   ,
     &                   ITRAN  , TCODE  , I1A    , I2A   , AVAL  ,
     &                   ICNTE  , ICNTP  , ICNTR  , ICNTH , ICNTI ,
     &                   IETRN  , IPTRN  , IRTRN  , IHTRN , IITRN ,
     &                                     IE1A   , IE2A  , AA    ,
     &                                     IP1A   , IP2A
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B8TTYP *********************
C
C  PURPOSE:  TO SORT TRANSITION ARRAYS INTO FOUR TRANSITION/RECOMB TYPES
C
C  CALLING PROGRAM: ADAS205/ADAS206
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS THAT CAN BE READ
C  INPUT : (I*4)  NPLR    = NO. OF ACTIVE METASTABLES OF (Z+1) ION
C  INPUT : (I*4)  NPLI    = NO. OF ACTIVE METASTABLES OF (Z-1) ION
C
C  INPUT : (I*4)  ITRAN   = INPUT DATA FILE: NUMBER OF TRANSITIONS
C  INPUT : (C*1)  TCODE() = TRANSITION: DATA TYPE POINTER:
C                           ' ' => Electron Impact   Transition
C                           'P' => Proton   Impact   Transition
C                           'H' => Charge   Exchange Recombination
C                           'R' => Free     Electron Recombination
C                           'I' => Electron Impact Ionisation
C  INPUT : (I*4)  I1A()   = TRANSITION:
C                            LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            NOT USED                 (CASE 'H' & 'R')
C  INPUT : (I*4)  I2A()   = TRANSITION:
C                            UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            CAPTURING    LEVEL INDEX (CASE 'H' & 'R')
C  INPUT : (R*8)  AVAL()  = TRANSITION:
C                            A-VALUE (SEC-1)          (CASE ' ')
C                            NEUTRAL BEAM ENERGY      (CASE 'H')
C                            NOT USED                 (CASE 'P' & 'R')
C
C  OUTPUT: (I*4)  ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C  OUTPUT: (I*4)  ICNTP   = NUMBER OF PROTON IMPACT TRANSITIONS INPUT
C  OUTPUT: (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  OUTPUT: (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
```

```
C
C  OUTPUT: (I*4)  IETRN() = ELECTRON IMPACT TRANSITION:
C                           INDEX VALUES IN MAIN TRANSITION ARRAYS WHICH
C                           REPRESENT ELECTRON IMPACT TRANSITIONS.
C  OUTPUT: (I*4)  IPTRN() = PROTON IMPACT TRANSITION:
C                           INDEX VALUES IN MAIN TRANSITION ARRAYS WHICH
C                           REPRESENT PROTON IMPACT TRANSITIONS.
C  OUTPUT: (I*4)  IRTRN() = FREE ELECTRON RECOMBINATION:
C                           INDEX VALUES IN MAIN TRANSITION ARRAYS WHICH
C                           REPRESENT FREE ELECTRON RECOMBINATIONS.
C  OUTPUT: (I*4)  IHTRN() = CHARGE EXCHANGE RECOMBINATION:
C                           INDEX VALUES IN MAIN TRANSITION ARRAYS WHICH
C                           REPRESENT CHARGE EXCHANGE RECOMBINATIONS.
C  OUTPUT: (I*4)  IITRN() = ELECTRON IMPACT IONISATION:
C                           INDEX VALUES IN MAIN TRANSITION ARRAYS WHICH
C                           REPRESENT IONISATIONS FROM LOWER STAGE ION.
C
C  OUTPUT: (I*4)  IE1A()  = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  OUTPUT: (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C  OUTPUT: (R*8)  AA()    = ELECTRON IMPACT TRANSITION: A-VALUE (SEC-1)
C
C
C  OUTPUT: (I*4)  IP1A()  = PROTON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  OUTPUT: (I*4)  IP2A()  = PROTON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C
C          (I*4)  I       = GENERAL USE.
C
C
C ROUTINES: NONE
C
C AUTHOR:  HP SUMMERS (REVISION OF BXTTYP BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE  :  11/06/92
C
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C-----------------------------------------------------------------------
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER SCCS
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
      INTEGER    NDTRN       , NPLR          , NPLI       , ITRAN     ,
     &           ICNTE       , ICNTP         , ICNTR      , ICNTH     ,
     &           ICNTI
      INTEGER    I
      INTEGER    I1A(NDTRN)  , I2A(NDTRN)
      INTEGER    IETRN(NDTRN), IPTRN(NDTRN)   ,
     &           IRTRN(NDTRN), IHTRN(NDTRN)   ,
     &           IITRN(NDTRN),
     &           IE1A(NDTRN) , IE2A(NDTRN)    ,
     &           IP1A(NDTRN) , IP2A(NDTRN)
C-----------------------------------------------------------------------
      REAL*8     AA(NDTRN)   , AVAL(NDTRN)
C-----------------------------------------------------------------------
      CHARACTER  TCODE(NDTRN)*1
C-----------------------------------------------------------------------
```

B8WR11

```
      SUBROUTINE B8WR11( IUNIT  , DSNINC , DSFULL , IBSELA,
     &                   TITLED , DATE  ,
     &                   NDLEV  , NDTEM  , NDDEN  , NDMET , NDTRN  ,
     &                   LNORM  ,
     &                   IZ     , IZ0    , IZ1    , BWNO  ,
     &                   IL     , NMET   , NORD   ,
     &                   MAXT   , MAXD   , ICNTR  , ICNTI , ICNTH ,
     &                   IA     , ISA    , ILA    , XJA   ,
     &                   CSTRGA , WA     ,
     &                   ICNTE  , IETRN  ,
     &                   IE1A   , IE2A   , AA     , SGRDA ,
     &                   IMETR  , IORDR  , TEVA   , DENSA ,
     &                   NPL    , NPLR   , NPLI   , NPL3  ,
     &                   LRSEL  , LISEL  , LHSEL  , LIOSEL,
     &                   WVLS   , WVLL   , AVLT   ,
     &                   STCKM  , STVR   , STVI   , STVH  ,
     &                   STVRM  , STVIM  , STVHM  ,
     &                   RATPIA , RATMIA , STACK
     &                 )
      IMPLICIT NONE
```

```
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B8WR11 ******************
C
C  PURPOSE:  TO OUTPUT DATA TO PEC PASSING FILE.
C            POPULATION  DATA  FOR DIAGNOSTIC USE.
C
C  CALLING PROGRAM: ADAS208
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT NUMBER FOR RESULTS
C  INPUT : (C*44) DSNINC  = INPUT COPASE DATA SET NAME (IN QUOTES).
C  INPUT : (C*3)  TITLED  = ELEMENT SYMBOL.
C  INPUT : (C*8)  DATE    = CURRENT DATE.
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (I*4)  IZ      =  RECOMBINED ION CHARGE READ
C  INPUT : (I*4)  IZ0     =         NUCLEAR CHARGE READ
C  INPUT : (I*4)  IZ1     = RECOMBINING ION CHARGE READ
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT : (R*8)  BWNO    = IONISATION POTENTIAL (CM-1)
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  INPUT : (L*4)  LNORM   =.TRUE.  => IF NMET=1 THEN VARIOUS
C                                     EMISSIVITY OUTPUT FILES
C                                     NORMALISED TO STAGE TOT.POPULATN.
C                                     (** NORM TYPE = T)
C                          =.FALSE. => OTHERWISE NORMALISE TO IDENTIFIED
C                                     METASTABLE POPULATIONS.
C                                      (** NORM TYPE = M)
C
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES LEVELS: 1<=NMET<=NDMET
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> 'NDTEM')
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> 'NDDEN')
C  INPUT : (I*4)  ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C  INPUT : (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT : (I*4)  ICNTI   = NUMBER OF LOWER STAGE IONISATIONS      INPUT
C  INPUT : (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  INPUT : (I*4)  IETRN() = ELECTRON IMPACT TRANSITION:
C                           INDEX VALUES IN MAIN TRANSITION ARRAYS WHICH
C  INPUT : (I*4)  IE1A()  = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  INPUT : (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C  INPUT : (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  INPUT : (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT : (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT : (I*4)  IBSELA(,)=IONISATION DATA BLOCK SELECTION INDICES
C                           1ST DIMENSION - (Z) ION METASTABLE COUNTER
C                           2ND DIMENSION - (Z+1) ION METASTABLE COUNTER
C  INPUT : (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT : (R*8)  WA()    = ENERGY RELATIVE TO LEVEL 1 (CM-1)
C                           DIMENSION: LEVEL INDEX
C  INPUT : (R*8)  AA()    = ELECTRON IMPACT TRANSITION: A-VALUE (SEC-1)
C
C  INPUT : (R*8)  SGRDA(,,)=GROUND & METASTABLE IONISATION RATE
C                           COEFFICIENTS  FROM SZD FILES (CM3 SEC-1)
C                           1ST DIMENSION: TEMPERATURE INDEX
C                           2ND DIMENSION: (Z) ION METASTABLE INDEX
C                           3RD DIMENSION: (Z+1) ION METASTABLE INDEX
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST.
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C
C  INPUT : (I*4)  NPL      = NO. OF METASTABLES OF(Z+1) ION ACCESSED
C                            BY EXCITED STATE IONISATION IN COPASE
C                            FILE WITH IONISATION POTENTIALS GIVEN
C                            ON THE FIRST DATA LINE
C  INPUT : (I*4)  NPLR     = NO. OF ACTIVE METASTABLES OF (Z+1) ION
C  INPUT : (I*4)  NPLI     = NO. OF ACTIVE METASTABLES OF (Z+1) ION
C  INPUT : (I*4)  NPL3     = NO. OF ACTIVE METASTABLES OF (Z+1) ION
C
C  INPUT   (L*4)  LRSEL   = .TRUE.  => INCLUDE FREE ELECTRON
C                                      RECOMBINATION.
C                           = .FALSE. => DO NOT INCLUDE FREE ELECTRON
C                                      RECOMBINATION.
C  INPUT   (L*4)  LISEL   = .TRUE.  => INCLUDE ELECTRON IMPACT
C                                      IONISATION.
C                           = .FALSE. => DO NOT INCLUDE FREE ELECTRON
C                                      RECOMBINATION.
C  INPUT   (L*4)  LHSEL   = .TRUE.  => INCLUDE CHARGE TRANSFER FROM
C                                      NEUTRAL HYDROGREN.
C                           = .FALSE. => DO NOT INCLUDE CHARGE TRANSFER
```

```
C                                       FROM NEUTRAL HYDROGREN.
C  INPUT   (L*4)  LIOSEL  = .TRUE.  => INCLUDE IONISATION RATES
C                        = .FALSE. => DO NOT INCLUDE IONISATION RATES
C                           FOR RECOM AND  3-BODY
C
C  INPUT: (R*8)   WVLS     = SHORT WAVELENGTH LIMIT FOR PEC & SXB (A)
C  INPUT: (R*8)   WVLL     = LONG WAVELENGTH LIMIT FOR PEC & SXB  (A)
C  INPUT: (R*8)   AVLT     = LOWER LIMIT OF A-VALUES FOR PEC & SXB
C
C  INPUT : (R*8) STCKM(,,) = METASTABLE POPULATIONS STACK
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*4) STVR(,,,) = FREE ELECTRON RECOMBINATION COEFFICIENTS
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C                            4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVI(,,,) = ELECTRON IMPACT IONISATION  COEFFICIENTS
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C                            4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVH(,,,) =  CHARGE EXCHANGE COEFFICIENTS
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8) STVRM(,,,)= METASTABLE FREE ELECTRON RECOMBINATION
C                           COEFFICIENTS.
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C                            4TH DIMENSION: PARENT INDEX
C  INPUT : (R*8) STVIM(,,,)= METASTABLE ELECTRON IMPACT IONISATION
C                           COEFFICIENTS.
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C                            4TH DIMENSION: PARENT INDEX
C  INPUT : (R*8) STVHM(,,,)= METASTABLE CHARGE EXCHANGE COEFFICIENTS
C                            1st DIMENSION: METASTABLE INDEX
C                            2nd DIMENSION: TEMPERATURE INDEX
C                            3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*8)  RATPIA(,)  = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C                            1ST DIMENSION: TEMP/DENS INDEX
C                            2ND DIMENSION: PARENT INDEX
C  INPUT : (R*8)  RATMIA(,)  = RATIO ( N(Z-1)/N(Z)  STAGE ABUNDANCIES )
C                            1ST DIMENSION: TEMP/DENS INDEX
C                            2ND DIMENSION: PARENT INDEX
C  INPUT : (R*4) STACK(,,,)= POPULATION DEPENDENCE
C                            1st DIMENSION: ORDINARY LEVEL INDEX
C                            2nd DIMENSION: METASTABLE INDEX
C                            3rd DIMENSION: TEMPERATURE INDEX
C                            4th DIMENSION: DENSITY INDEX
C
C          (I*4) NOTRN     = PARAMETER = MAXIMUM NUMBER OF TRANSITIONS
C          (I*4) NDPEC     = PARAMETER = MAXIMUM NUMBER OF PECS PER
C                                        METASTABLE FOR OUTPUT
C          (I*4) METCNT    = COUNTER OF PECS FOR EACH METASTABLE
C
C          (I*4) I4UNIT    = FUNCTION (SEE ROUTINE SELECTION BELOW)
C
C          (I*4) I         = GENERAL USE
C          (I*4) IP        = GENERAL USE
C          (I*4) J         = GENERAL USE
C          (I*4) K         = GENERAL USE
C          (I*4) L         = GENERAL USE
C
C          (R*8) DUM1      = GENERAL USE- DUMMY
C          (R*8) DUM2      = GENERAL USE- DUMMY
C          (R*8) DUM3      = GENERAL USE- DUMMY
C          (R*8) PEC()     = RENOMALISED PEC
C                            1ST DIMENSION: TEMPERATURE INDEX
C
C ROUTINES:
C          ----------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C          B8NORM     ADAS      PERFORM  STAGE POPULATION NORMALISATION
c
c
C AUTHOR:  H. P. SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    07/02/92
C
C UPDATE:  29/05/92  HP SUMMERS - INCREASE AA LIMIT FOR PEC PREPARATION
C                                 TO 10**5
C
C UPDATE:  26/06/92  HP SUMMERS - INCLUDE MULTIPLE PARENTS AND INNER
C                                 SHELL IONISATION CONTRIBUTIONS
C UPDATE:  12/07/93  HP SUMMERS - MODIFICATIONS TO MAKE COMPATIBLE
C                                 WITH LATEST B8DATA
C UPDATE:  29/08/96  HPS - ADDED WAVELENGTH & A-VALUE LIMITS FOR PEC &
C                          SXB FILES AND LIMITED NUMBER OF OUTPUT PECS
C                          PER METASTABLE TO NDPEC. SET NDPEC =50.
C**********************************************************************
C UNIX-IDL PORT:
```

```
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C UPDATE:  18/03/96  DH BROOKS  - CHANGED DSNINC TO 80 CHARACTERS &
C                                 FORMAT 1003 TO ACCOMODATE.
C*********************************************************************
C PUT UNDER S.C.C.S. CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - FIRST PUT UNDER S.C.C.S.
C
C VERSION: 1.2                          DATE: 13/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - INCREASED SIZE OF DSFULL TO 80
C
C VERSION: 1.3                          DATE: 30/09/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C            - ADDED HUGH'S CHANGES DATED 29/08/96 ABOVE
C
C VERSION: 1.4                          DATE: 18/10/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - ADDED CHECK FOR INDEX2.EQ.0 IN STRING PROCESSING
C
C-----------------------------------------------------------------------
      INTEGER   NOTRN    , NDPEC
C-----------------------------------------------------------------------
      PARAMETER ( NOTRN = 1000 , NDPEC = 50 )
C-----------------------------------------------------------------------
      INTEGER   I4UNIT
      INTEGER   NDLEV     , NDTEM      , NDDEN   , NDMET   , NDTRN
      INTEGER   IUNIT     , NPL        , NPLR    , NPLI    , NPL3   ,
     &          IZ        , IZ0        , IZ1     ,
     &          IL        , NMET       , NORD    ,
     &          MAXT      , MAXD       , ICNTE   , ICNTR   , ICNTI  ,
     &          ICNTH
      INTEGER   I         , J          , K       , L       , IM     ,
     &          ISEL      , IULEV      , KSTRN   , IO      , IP     ,
     &          ISEL1     , ISEL2      , ISEL3   , ISEL4   ,
     &          INDEX1    , INDEX2     , METCNT
C-----------------------------------------------------------------------
      REAL*8    BWNO      , DUM1       , DUM2    , DUM3
      REAL*8    SUM1
      REAL*8    WVLS      , WVLL       , AVLT    , WVL
C-----------------------------------------------------------------------
      CHARACTER TITLED*3         , DSNINC*80     , FILMEM*8  , TYPE(4)*9
      CHARACTER CSTRGA(NDLEV)*18 , DATE*8        , DSFULL*80
      CHARACTER TRANS*25         , TRANSA(NOTRN)*25
      CHARACTER METAS*12         , METASA(10)*12
C-----------------------------------------------------------------------
      LOGICAL   LNORM  , LSTRN
      LOGICAL   LRSEL  , LISEL  , LHSEL  , LIOSEL
C-----------------------------------------------------------------------
      INTEGER   IA(NDLEV)        , ISA(NDLEV)       , ILA(NDLEV)
      INTEGER   IMETR(NDMET)     , IORDR(NDLEV)
      INTEGER   IETRN(NDTRN)     , IE1A(NDTRN)      , IE2A(NDTRN)
      INTEGER   IMA(NOTRN)
      INTEGER   IBSELA(NDMET,NDMET)
C-----------------------------------------------------------------------
      REAL*8   PEC(50)           , SUM(50)
      REAL*8   XJA(NDLEV)        , TEVA(NDTEM)      , DENSA(NDDEN)
      REAL*8   WA(NDLEV)         , AA(NDTRN)        , WVLA(NOTRN)
      REAL*8   SGRDA(NDTEM,NDMET,NDMET)
      REAL*8   STCKM(NDMET,NDTEM,NDDEN)
      REAL*8   STVRM(NDMET,NDTEM,NDDEN,NDMET) ,
     &         STVIM(NDMET,NDTEM,NDDEN,NDMET)
      REAL*8   STVHM(NDMET,NDTEM,NDDEN,NDMET)
      REAL*8   RATPIA(NDDEN,NDMET)  , RATMIA(NDDEN,NDMET)
C-----------------------------------------------------------------------
      REAL*4   STVR(NDLEV,NDTEM,NDDEN,NDMET) ,
     &         STVI(NDLEV,NDTEM,NDDEN,NDMET) ,
     &         STVH(NDLEV,NDTEM,NDDEN,NDMET)
      REAL*4   STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      DATA    TYPE/'EXCIT    ','RECOM    ','CHEXC    ','IONIS    '/
C-----------------------------------------------------------------------
```

B8WR12

```
      SUBROUTINE B8WR12( IUNIT , DSNINC , DSFULL  , IBSELA,
     &                   TITLED , DATE  ,
     &                   NDLEV  , NDTEM  , NDDEN  , NDMET , NDTRN  ,
     &                   LNORM  ,
     &                   IZ     , IZ0    , IZ1    , BWNO  ,
     &                   IL     , NMET   , NORD   ,
     &                   MAXT   , MAXD   , ICNTR  , ICNTI , ICNTH ,
     &                   IA     , ISA    , ILA    , XJA   ,
     &                   CSTRGA , WA     ,
     &                   ICNTE  , IETRN  ,
     &                   IE1A   , IE2A   , AA     , SGRDA ,
     &                   IMETR  , IORDR  , TEVA   , DENSA ,
     &                   NPL    , NPLR   , NPLI   ,
```

```
     &                   WVLS   , WVLL   , AVLT   ,
     &                   STCKM  , STVR   , STVI   , STVH   ,
     &                   STVRM  , STVIM  , STVHM  , STACK  ,
     &                   LIOSEL , FVIONR
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************** FORTRAN77 SUBROUTINE: B8WR12 ***************** *
C
C  PURPOSE:  TO OUTPUT DATA TO SXB PASSING FILE.
C            POPULATION  DATA  FOR DIAGNOSTIC USE.
C
C  CALLING PROGRAM: ADAS20T
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT NUMBER FOR RESULTS
C  INPUT : (C*44) DSNINC  = INPUT COPASE DATA SET NAME (IN QUOTES).
C  INPUT : (C*3)  TITLED  = ELEMENT SYMBOL.
C  INPUT : (C*8)  DATE    = CURRENT DATE.
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (I*4)  IZ      =  RECOMBINED ION CHARGE READ
C  INPUT : (I*4)  IZ0     =         NUCLEAR CHARGE READ
C  INPUT : (I*4)  IZ1     = RECOMBINING ION CHARGE READ
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT : (R*8)  BWNO    = IONISATION POTENTIAL (CM-1)
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  INPUT : (L*4)  LNORM   =.TRUE.  => IF NMET=1 THEN VARIOUS
C                                     EMISSIVITY OUTPUT FILES
C                                     NORMALISED TO STAGE TOT.POPULATN.
C                                     (** NORM TYPE = T)
C                         =.FALSE. => OTHERWISE NORMALISE TO IDENTIFIED
C                                     METASTABLE POPULATIONS.
C                                      (** NORM TYPE = M)
C                          (NB. RENORMALISING NOT NEEDED FOR SXB RATIO)
C
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES LEVELS: 1<=NMET<=NDMET
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> 'NDTEM')
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> 'NDDEN')
C  INPUT : (I*4)  ICNTE   = NUMBER OF ELECTRON IMPACT TRANSITIONS INPUT
C  INPUT : (I*4)  ICNTR   = NUMBER OF FREE ELECTRON RECOMBINATIONS INPUT
C  INPUT : (I*4)  ICNTI   = NUMBER OF LOWER STAGE IONISATIONS INPUT
C  INPUT : (I*4)  ICNTH   = NO. OF CHARGE EXCHANGE RECOMBINATIONS INPUT
C
C  INPUT : (I*4)  IETRN() = ELECTRON IMPACT TRANSITION:
C                           INDEX VALUES IN MAIN TRANSITION ARRAYS WHICH
C  INPUT : (I*4)  IE1A()  = ELECTRON IMPACT TRANSITION:
C                            LOWER ENERGY LEVEL INDEX
C  INPUT : (I*4)  IE2A()  = ELECTRON IMPACT TRANSITION:
C                            UPPER ENERGY LEVEL INDEX
C  INPUT : (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  INPUT : (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT : (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT : (I*4)  IBSELA(,)=IONISATION DATA BLOCK SELECTOR INDICES
C                           1ST DIMENSION - (Z)   ION METASTABLE COUNT
C                           2ND DIMENSION - (Z+1) ION METASTABLE COUNT
C  INPUT : (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT : (R*8)  WA()    = ENERGY RELATIVE TO LEVEL 1 (CM-1)
C                           DIMENSION: LEVEL INDEX
C  INPUT : (R*8)  AA()    = ELECTRON IMPACT TRANSITION: A-VALUE (SEC-1)
C
C  INPUT : (R*8)  SGRDA(,,)=GROUND & METASTABLE IONISATION RATE
C                           COEFFICIENTS  FROM SZD FILES (CM3 SEC-1)
C                           1ST DIMENSION: TEMPERATURE INDEX
C                           2ND DIMENSION: (Z)   ION METASTABLE INDEX
C                           3RD DIMENSION: (Z+1) ION METASTABLE INDEX
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C
C  INPUT : (I*4)  IMETR() = INDEX OF METASTABLE IN COMPLETE LEVEL LIST
C  INPUT : (I*4)  IORDR() = INDEX OF ORDINARY LEVELS IN COMPLETE LEVEL
C                           LIST.
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C
C  INPUT : (I*4)  NPL      = NO. OF METASTABLES OF (Z+1) ION ACCESSED
C                            BY EXCITED STATE IONISATION IN COPASE
C                            FILE WITH IONISATION POTENTIALS GIVEN
C                            ON THE FIRST DATA LINE
C  INPUT : (I*4)  NPLR     = NO. OF ACTIVE METASTABLES OF (Z+1) ION
C  INPUT : (I*4)  NPLI     = NO. OF ACTIVE METASTABLES OF (Z-1) ION
C
C  INPUT : (R*8)  WVLS    = SHORT WAVELENGTH LIMIT FOR PEC & SXB (A)
C  INPUT : (R*8)  WVLL    = LONG WAVELENGTH LIMIT FOR PEC & SXB  (A)
C  INPUT : (R*8)  AVLT    = LOWER LIMIT OF A-VALUES FOR PEC & SXB
C
C  INPUT : (R*8) STCKM(,,) = METASTABLE POPULATIONS STACK
```

```
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*4) STVR(,,,) = FREE ELECTRON RECOMBINATION COEFFICIENTS
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVI(,,,) = ELECTRON IMPACT IONISATION  COEFFICIENTS
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*4) STVH(,,,) =  CHARGE EXCHANGE COEFFICIENTS
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*8) STVRM(,,,)= METASTABLE FREE ELECTRON RECOMBINATION
C                             COEFFICIENTS.
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*8) STVIM(,,,)= ELECTRON IMPACT IONISATION
C                             COEFFICIENTS.
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C                              4TH DIMENSION: PARENT INDEX
C  INPUT : (R*8) STVHM(,,,)= METASTABLE CHARGE EXCHANGE COEFFICIENTS
C                              1st DIMENSION: METASTABLE INDEX
C                              2nd DIMENSION: TEMPERATURE INDEX
C                              3rd DIMENSION: DENSITY INDEX
C  INPUT : (R*4) STACK(,,,)= POPULATION DEPENDENCE
C                              1st DIMENSION: ORDINARY LEVEL INDEX
C                              2nd DIMENSION: METASTABLE INDEX
C                              3rd DIMENSION: TEMPERATURE INDEX
C                              4th DIMENSION: DENSITY INDEX
C  INPUT : (L*4) LIOSEL    = .TRUE.  - GCR IONIS. COEFFTS CALCULATED
C                            .FALSE. - GCR IONIS. COEFFTS NOT CALCULATED
C                                      (USE ZERO DENSITY SZD RATES ONLY)
C  INPUT : (R*8) FVIONR(,,,)= GEN. COLL. RAD. IONIS. RATE COEFFTS.
C                              1ST DIMENSION: (Z) ION METASTABLE INDEX
C                              2ND DIMENSION: (Z+1) ION METASTABLE INDEX
C                              3rd DIMENSION: TEMPERATURE INDEX
C                              4th DIMENSION: DENSITY INDEX
C
C          (I*4) NOTRN     = PARAMETER = MAXIMUM NUMBER OF TRANSITIONS
C          (I*4) NDSXB     = PARAMETER = MAXIMUM NUMBER OF SXBS PER
C                                        METASTABLE FOR OUTPUT
C          (I*4) METCNT    = COUNTER OF PECS FOR EACH METASTABLE
C
C          (I*4) I         = GENERAL USE
C          (I*4) IP        = GENERAL USE
C          (I*4) J         = GENERAL USE
C          (I*4) K         = GENERAL USE
C          (I*4) L         = GENERAL USE
C
C          (R*8) SRATE     = IONISATION RATE FROM (Z) ION SUMMED OVER IP
C
C NOTE:
C          THIS OUTPUT DATA IS FOR SUBSEQUENT INPUT INTO THE DIAGNOSTIC
C          AND CONTOUR GRAPHING PROGRAM 'CONTOUR'.
C
C
C ROUTINES: NONE
C
C AUTHOR:  H. P. SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    07/02/92
C
C UPDATE:  07/02/92  HP SUMMERS - increase AA limit for preparation of
C                                 of output to 10**5
C
C UPDATE:  12/06/92  HP SUMMERS - EXTENSION TO MULTIPLE PARENTS AND
C                                 inner shell ionisation contributions
C
C UPDATE:  30/07/92  HP SUMMERS - INTRODUCE  AALMT PARAMETER
C
C UPDATE:  12/07/93  HP SUMMERS - MODIFICATION TO MAKE COMPATIBLE WITH
C                                 LATEST VERSION OF B8DATA
C UPDATE:  29/08/96  HPS - ADDED WAVELENGTH & A-VALUE LIMITS FOR PEC &
C                          SXB FILES AND LIMITED NUMBER OF OUTPUT SXBS
C                          PER METASTABLE TO NDSXB. SET NDSXB =50.
C-----------------------------------------------------------------------
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C UPDATE:  18/03/96  DH BROOKS  - CHANGED DSNINC TO 80 CHARACTERS AND
C                                 FORMAT 1003 TO ACCOMODATE.
C-----------------------------------------------------------------------
C PUT UNDER S.C.C.S. CONTROL:
```

```
C
C VERSION: 1.1                              DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER S.C.C.S.
C
C VERSION: 1.2                              DATE: 13/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - INCREASED SIZE OF DSFULL TO 80
C
C VERSION: 1.3                              DATE: 30/09/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - ADDED HUGH'S CHANGES DATED 29/08/96 ABOVE
C
C VERSION: 1.4                              DATE: 18/10/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - ADDED CHECK FOR INDEX2.EQ.0 IN STRING PROCESSING
C           - REVERSED WVLS AND WVLL IN PARAMETERS SINCE THEY WERE THE
C             WRONG WAY ROUND AND NO OUTPUT WAS HAPPENING
C-----------------------------------------------------------------------
      INTEGER   NOTRN     , NDSXB
C-----------------------------------------------------------------------
      PARAMETER ( NOTRN = 1000 , NDSXB = 50)
C-----------------------------------------------------------------------
      INTEGER   NDLEV     , NDTEM      , NDDEN   , NDMET   , NDTRN
      INTEGER   IUNIT     , NPL        , NPLR    , NPLI    ,
     &          IZ        , IZ0        , IZ1     ,
     &          IL        , NMET       , NORD    ,
     &          MAXT      , MAXD       , ICNTE   , ICNTR   , ICNTI  ,
     &          ICNTH
      INTEGER   I         , J          , K       , L       , IM     ,
     &          ISEL      , IULEV      , KSTRN   , IO      , IP     ,
     &          INDEX1    , INDEX2
      INTEGER   METCNT
C-----------------------------------------------------------------------
      REAL*8    BWNO      , SRATE
      REAL*8    WVLS      , WVLL       , AVLT    , WVL
C-----------------------------------------------------------------------
      CHARACTER TITLED*3         , DSNINC*80     , FILMEM*8  , TYPE*9
      CHARACTER CSTRGA(NDLEV)*18 , DATE*8        , DSFULL*80
      CHARACTER TRANS*25         , TRANSA(NOTRN)*25
      CHARACTER METAS*12         , METASA(NOTRN)*12
C-----------------------------------------------------------------------
      LOGICAL   LNORM  , LSTRN  , LIOSEL
C-----------------------------------------------------------------------
      INTEGER   IA(NDLEV)        , ISA(NDLEV)       , ILA(NDLEV)
      INTEGER   IMETR(NDMET)     , IORDR(NDLEV)
      INTEGER   IETRN(NDTRN)     , IE1A(NDTRN)      , IE2A(NDTRN)
      INTEGER   IMA(NOTRN)       , NMA(NOTRN)
      INTEGER   IBSELA(NDMET,NDMET)
C-----------------------------------------------------------------------
      REAL*8    XJA(NDLEV)       , TEVA(NDTEM)      , DENSA(NDDEN)
      REAL*8    WA(NDLEV)        , AA(NDTRN)        , WVLA(NOTRN)
      REAL*8    SGRDA(NDTEM,NDMET,NDMET), SXBA(30)
      REAL*8    STCKM(NDMET,NDTEM,NDDEN)
      REAL*8    STVRM(NDMET,NDTEM,NDDEN,NDMET) ,
     &          STVIM(NDMET,NDTEM,NDDEN,NDMET)
      REAL*8    STVHM(NDMET,NDTEM,NDDEN,NDMET)
      REAL*8    FVIONR(NDMET,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      REAL*4    STVR(NDLEV,NDTEM,NDDEN,NDMET) ,
     &          STVI(NDLEV,NDTEM,NDDEN,NDMET) ,
     &          STVH(NDLEV,NDTEM,NDDEN,NDMET)
      REAL*4    STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      DATA    TYPE/'EXCIT    '/
C-----------------------------------------------------------------------
```

B8WRMC

```
      SUBROUTINE B8WRMC( IUNIT  , IUNT14 , IUNT15 , IUNT16 , IUNT17 ,
     &                   IUNT18 , IUNT19 , IUNT20 , IUNT21 ,
     &                   IUNT22 , IUNT23 ,
     &                   DSNINC , DSFULL , DSNEXP ,
     &                   TITLED , DATE   , UID    ,
     &                   NDLEV  , NDTEM  , NDDEN  , NDMET  ,
     &                   LNORM  , IZ     , IZ0    , IZ1    ,
     &                   IBSELA , BWNOA  , PRTWTA ,
     &                   IL     , NMET   , NORD   , IMETR  ,
     &                   IA     , ISA    , ILA    , XJA    ,
     &                   CSTRGA , WA     ,
     &                   MAXT   , MAXD   , TEVA   , DENSA  ,
     &                   NPL    , NPLR   , NPL3   , NPLI   , CPRTA  ,
     &                   LRSEL  , LISEL  , LHSEL  , LIOSEL ,
     &                   LPSEL  , LZSEL  , LNSEL  , FVCRED ,
     &                   FVRRED , FVIRED , FVHRED , FVIONR ,
     &                   FVCRPR , PL     , PH     , PS     , SWVLN  ,
     &                   PR     ,
     &                   RATPIA , RATMIA , STACK  , STCKM
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ******************* FORTRAN77 SUBROUTINE: B8WRMC ***************** *
C
```

```
C  PURPOSE:  TO OUTPUT DATA TO GENERALISED COLLISIONAL RADIATIVE
C            COEFFICIENT PASSING FILE MASTER.PASS
C            FINAL STORAGE IS EXPECTED TO BE IN MASTER CONDENSED FILES
C
C
C  CALLING PROGRAM: ADAS208
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = OUTPUT UNIT NUMBER FOR GCR INFORMATION
C  INPUT : (I*4)  IUNT14  = OUTPUT UNIT NUMBER FOR ACD DATA
C  INPUT : (I*4)  IUNT15  = OUTPUT UNIT NUMBER FOR SCD DATA
C  INPUT : (I*4)  IUNT16  = OUTPUT UNIT NUMBER FOR CCD DATA
C  INPUT : (I*4)  IUNT17  = OUTPUT UNIT NUMBER FOR QCD DATA
C  INPUT : (I*4)  IUNT18  = OUTPUT UNIT NUMBER FOR XCD DATA
C  INPUT : (I*4)  IUNT19  = OUTPUT UNIT NUMBER FOR PRB DATA
C  INPUT : (I*4)  IUNT20  = OUTPUT UNIT NUMBER FOR PRC DATA
C  INPUT : (I*4)  IUNT21  = OUTPUT UNIT NUMBER FOR PLT DATA
C  INPUT : (I*4)  IUNT22  = OUTPUT UNIT NUMBER FOR PLS DATA
C  INPUT : (I*4)  IUNT23  = OUTPUT UNIT NUMBER FOR MET DATA
C  INPUT : (C*80) DSNINC  = INPUT COPASE DATA SET NAME (IN QUOTES).
C  INPUT : (C*80) DSFULL  = INPUT SZD  DATA SET NAME (IN QUOTES).
C  INPUT : (C*80) DSNEXP  = INPUT EXPANSION FILE
C  INPUT : (C*3)  TITLED  = ELEMENT SYMBOL.
C  INPUT : (C*8)  DATE    = CURRENT DATE.
C  INPUT : (C*10)  UID    = USER IDENTIFIER
C
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS ALLOWED
C  INPUT : (I*4)  NDTEM   = MAXIMUM NUMBER OF TEMPERATURES ALLOWED
C  INPUT : (I*4)  NDDEN   = MAXIMUM NUMBER OF DENSITIES ALLOWED
C  INPUT : (I*4)  NDMET   = MAXIMUM NUMBER OF METASTABLES ALLOWED
C
C  INPUT : (I*4)  IZ      =  RECOMBINED ION CHARGE READ
C  INPUT : (I*4)  IZ0     =         NUCLEAR CHARGE READ
C  INPUT : (I*4)  IZ1     = RECOMBINING ION CHARGE READ
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  INPUT : (I*4)  IBSELA(,)=IONISATION DATA BLOCK SELECTOR INDICES
C                           1ST DIMENSION - (Z)   ION METASTABLE COUNT
C                           2ND DIMENSION - (Z+1) ION METASTABLE COUNT
C  INPUT : (R*8)  BWNOA() = IONISATION POTENTIALS TO (Z+1) METAS.(CM-1)
C  INPUT : (R*8)  PRTWTA()= STATISTICAL WEIGHTS OF (Z+1) METASTABLES
C
C  INPUT : (I*4)  IL      = NUMBER OF ENERGY LEVELS
C  INPUT : (L*4)  LNORM   =.TRUE.  => IF NMET=1 THEN VARIOUS
C                                     IONISATION OUTPUT FILE
C                                     NORMALISED TO STAGE TOT.POPULATN.
C                                     (** NORM TYPE = T)
C                          =.FALSE. => OTHERWISE NORMALISE TO IDENTIFIED
C                                     METASTABLE POPULATIONS.
C                                      (** NORM TYPE = M)
C
C  INPUT : (I*4)  NMET    = NUMBER OF METASTABLES LEVELS: 1<=NMET<=NDMET
C  INPUT : (I*4)  NORD    = NUMBER OF ORDINARY LEVELS ('IL' - 'NMET')
C  INPUT : (I*4)  IMETR() = INDEX OF (Z) METAS. IN COMPLETE LEVEL LIST
C
C  INPUT : (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  INPUT : (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  INPUT : (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  INPUT : (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  INPUT : (R*8)  WA()    = ENERGY RELATIVE TO LEVEL 1 (CM-1)
C                           DIMENSION: LEVEL INDEX
C  INPUT : (R*8)  AA()    = ELECTRON IMPACT TRANSITION: A-VALUE (SEC-1)
C
C  INPUT : (R*8)  SGRDA(,,)=GROUND & METASTABLE IONISATION RATE
C                           COEFFICIENTS  FROM SZD FILES (CM3 SEC-1)
C                           1ST DIMENSION: TEMPERATURE INDEX
C                           2ND DIMENSION: (Z)   ION METASTABLE INDEX
C                           3RD DIMENSION: (Z+1) ION METASTABLE INDEX
C  INPUT : (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  INPUT : (I*4)  MAXT    = NUMBER OF INPUT TEMPERATURES ( 1 -> 'NDTEM')
C  INPUT : (I*4)  MAXD    = NUMBER OF INPUT DENSITIES ( 1 -> 'NDDEN')
C  INPUT : (R*8)  TEA()   = ELECTRON TEMPERATURES (UNITS: KELVIN)
C  INPUT : (R*8)  DENSA() = ELECTRON DENSITIES  (UNITS: CM-3)
C
C  INPUT : (I*4)  NPL      = NO. OF METASTABLES OF (Z+1) ION ACCESSED
C                            BY EXCITED STATE IONISATION IN COPASE
C                            FILE WITH IONISATION POTENTIALS GIVEN
C                            ON THE FIRST DATA LINE
C  INPUT : (I*4)  NPLR     = NO. OF ACTIVE METAS. FOR RECOM OF (Z+1) ION
C  INPUT : (I*4)  NPL3     = NO. OF ACTIVE METAS. FOR RE+3B OF (Z+1) ION
C  INPUT : (I*4)  NPLI     = NO. OF ACTIVE METASTABLES OF (Z-1) ION
C
C  INPUT : (L*4)  LRSEL    = .TRUE.  -  RECOMB  OF (Z+1) ION ACTIVE
C                            .FALSE. -  RECOMB. OF (Z+1) ION INACTIVE
C  INPUT : (L*4)  LISEL    = .TRUE.  -  IONIS.  OF (Z-1) ION ACTIVE
C                            .FALSE. -  IONIS.  OF (Z-1) ION INACTIVE
C  INPUT : (L*4)  LHSEL    = .TRUE.  -  CX REC. OF (Z+1) ION ACTIVE
C                            .FALSE. -  CX REC. OF (Z+1) ION INACTIVE
C  INPUT : (L*4)  LIOSEL   = .TRUE.  -  IONIS.  OF (Z) ION ACTIVE
C                            .FALSE. -  IONIS.  OF (Z) ION INACTIVE
C  INPUT : (L*4)  LPSEL    = .TRUE.  => INCLUDE PROTON COLLISIONS
C                          = .FALSE. =>DO NOT INCLUDE PROTON COLLISIONS
C  INPUT : (L*4)  LZSEL    = .TRUE.  => SCALE PROTON COLLISIONS WITH
C                                       PLASMA Z EFFECTIVE'ZEFF'.
C                          = .FALSE. => DO NOT SCALE PROTON COLLISIONS
```

```
C                                      WITH PLASMA Z EFFECTIVE 'ZEFF'.
C                              (ONLY USED IF 'LPSEL=.TRUE.')
C  INPUT : (L*4)  LNSEL    = .TRUE.  => INCLUDE PROJECTED BUNDLE-N DATA
C                                       FROM DATAFILE IF AVAILABLE
C                              = .FALSE. => DO NOT INCLUDE PROJECTED
C                                       BUNDLE-N DATA
C
C  INPUT : (R*8) FVCRED(,,,) = (Z)-(Z) CROSS GEN. COLL. RAD. COEFFTS.
C                               1ST DIMENSION: (Z) METASTABLE INDEX
C                               2ND DIMENSION: (Z) METASTABLE INDEX
C                               3RD DIMENSION: TEMPERATURE INDEX
C                               4TH DIMENSION: DENSITY INDEX
C  INPUT : (R*8) FVRRED(,,,) = (Z+1)-(Z) RECOM GEN. COLL. RAD. COEFFTS.
C                               1ST DIMENSION: (Z) METASTABLE INDEX
C                               2ND DIMENSION: (Z+1) METASTABLE INDEX
C                               3RD DIMENSION: TEMPERATURE INDEX
C                               4TH DIMENSION: DENSITY INDEX
C  INPUT : (R*8) FVIRED(,,,) = (Z-1)-(Z) IONIS GEN. COLL. RAD. COEFFTS.
C                               1ST DIMENSION: (Z) METASTABLE INDEX
C                               2ND DIMENSION: (Z-1) METASTABLE INDEX
C                               3RD DIMENSION: TEMPERATURE INDEX
C                               4TH DIMENSION: DENSITY INDEX
C  INPUT : (R*8) FVHRED(,,,) = (Z+1)-(Z) CX R. GEN. COLL. RAD. COEFFTS.
C                               1ST DIMENSION: (Z) METASTABLE INDEX
C                               2ND DIMENSION: (Z+1) METASTABLE INDEX
C                               3RD DIMENSION: TEMPERATURE INDEX
C                               4TH DIMENSION: DENSITY INDEX
C  INPUT : (R*8) FVIONR(,,,) = (Z)-(Z+1) IONIS GEN. COLL. RAD. COEFFTS.
C                               1ST DIMENSION: (Z) METASTABLE INDEX
C                               2ND DIMENSION: (Z+1) METASTABLE INDEX
C                               3RD DIMENSION: TEMPERATURE INDEX
C                               4TH DIMENSION: DENSITY INDEX
C  INPUT : (R*8) FVCRPR(,,,) = (Z+1)-(Z+1) CROSS COLL. RAD. COEFFTS.
C                               1ST DIMENSION: (Z+1) METASTABLE INDEX
C                                     FINAL STATE
C                               2ND DIMENSION: (Z+1) METASTABLE INDEX
C                                     INITIAL STATE
C                               3RD DIMENSION: TEMPERATURE INDEX
C                               4TH DIMENSION: DENSITY INDEX
C  INPUT : (R*8) PL(,,)     = TOTAL LINE POWER COEFFICIENTS
C                               1ST DIMENSION: (Z) METASTABLE INDEX
C                               2ND DIMENSION: TEMPERATURE INDEX
C                               3RD DIMENSION: DENSITY INDEX
C                                   UNITS: ERG SEC-1
C  INPUT : (R*8) PH(,,)     = CX RECOMBINATION POWER COEFFICIENTS
C                               1ST DIMENSION: TEMPERATURE INDEX
C                               2ND DIMENSION: DENSITY INDEX
C                               3RD DIMENSION: (Z+1) PARENT METAS. INDEX
C                                   UNITS: ERG SEC-1
C  INPUT : (R*8) PS(,,,)    = SPECIFIC LINE POWER COEFFICIENTS
C                               1ST DIMENSION: METASTABLE LINE INDEX
C                               2ND DIMENSION: (Z) METASTABLE INDEX
C                               3RD DIMENSION: TEMPERATURE INDEX
C                               4TH DIMENSION: DENSITY INDEX
C                                   UNITS: ERG SEC-1
C  INPUT : (R*8) SWVLN()    = WAVELENGTHS (ANGSTROM) OF SPECIFIC LINES
C                               1ST DIMENSION: METASTABLE LINE INDEX
C  INPUT : (R*8)  PR(,,)    = RECOM/BREMS. COEFFT (ERG S-1)
C                               1ST DIM: PARENT INDEX
C                               2ND DIM: TEMPERATURE INDEX
C                               3RD DIM: DENSITY INDEX
C  INPUT : (R*8)  RATPIA(,) = RATIO ( N(Z+1)/N(Z)  STAGE ABUNDANCIES )
C                               1ST DIMENSION: TEMP/DENS INDEX
C                               2ND DIMENSION: PARENT INDEX
C  INPUT : (R*8)  RATMIA(,) = RATIO ( N(Z-1)/N(Z)  STAGE ABUNDANCIES )
C                               1ST DIMENSION: TEMP/DENS INDEX
C                               2ND DIMENSION: PARENT INDEX
C
C  INPUT : (R*4)  STACK(,,,)= POPULATION DEPENDENCE
C                               1ST DIMENSION: ORDINARY LEVEL INDEX
C                               2ND DIMENSION: METASTABLE INDEX
C                               3RD DIMENSION: TEMPERATURE INDEX
C                               4TH DIMENSION: DENSITY INDEX
C         (R*8)  STCKM(,,) = METASTABLE POPULATIONS STACK
C                               1st DIMENSION: METASTABLE INDEX
C                               2nd DIMENSION: TEMPERATURE INDEX
C                               3rd DIMENSION: DENSITY INDEX
C
C         (R*8) DE         = ENERGY FOR TRANSITION ( CM-1)
C                             (IONIS. POT. FOR IONISATION COEFFTS.
C                              EXCIT. ENR. FOR EXCITATION COEFFTS.)
C
C         (I*4) I          = GENERAL USE
C         (I*4) IP         = GENERAL USE
C         (I*4) J          = GENERAL USE
C         (I*4) K          = GENERAL USE
C         (I*4) L          = GENERAL USE
C         (R*8) Z1         = RECOMBINING ION CHARGE
C         (R*8) DUM1       = GENERAL USE
C         (R*8) DUM2       = GENERAL USE
C         (R*8) DUM3       = GENERAL USE
C         (R*8) TR()       = REDUCED TEMPERATUTES ( TE(K) / Z1*Z1)
C         (R*8) DR()       = REDUCED DENSITIES    ( NE/ Z1**7)
C         (R*8) SUM()      = GENERAL USE IN RENORMALISATION
C         (R*8) FMULT()    = GENERAL USE IN RENORMALISATION
C
C
C
```

```
C ROUTINES: NONE
C
C AUTHOR:  H. P. SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    24/06/92
C
C UPDATE:  13/08/93  HP SUMMERS  - INCLUDE NORMALISING TO TOTALS WHEN
C                                  (LNORM. AND.(NMET.EQ.1)
C**********************************************************************
C UNIX-IDL PORT:
C
C AUTHOR: DAVID H BROOKS, UNIVERSITY OF STRATHCLYDE
C
C DATE: UNKNOWN
C
C UPDATE:  04/03/96  HP SUMMERS  - OUTPUT C-R DATA TO SEPARATE FILES
C                                  INCLUDE METASTABLE FRACTION FILE
C                                  USE IUNIT FOR INFORMATION.
C UPDATE:  03/05/96  DH BROOKS   - CHANGED DSNINC & DSNEXP TO 80
C                                  CHARACTERS. ALTERED FORMATS 1003
C                                  & 2042 TO ACCOMODATE.
C UPDATE:  13/05/96  HP SUMMERS  - CORRECT TITLE LINE ON QCD208.PASS
C                                  FILE TO GIVE CORRECT JGRD, IGRD
C                                  NAMES.
C UPDATE:  24/05/96  HP SUMMERS  - ADDED SPECIFIC LINE DATA, PS AND
C                                  SWVLN TO PARAMETER LIST
C UPDATE:  03/06/96  HP SUMMERS  - ADDED CX RECOMBINATION DATA, PH
C
C UPDATE:  23/07/96  HP SUMMERS  - TIDY UP NAMES IN OUTPUT FILES FOR
C                                  CONSISTENCY
C
C
C UPDATE:  09/03/98  HP SUMMERS  - ADDED PRB TO DATA PASSED FROM THE
C                                  PROJECTION MATRICES AND GIVEN AS
C                                  OUTPUT FROM ADAS208
C**********************************************************************
C PUT UNDER SCCS CONTROL:
C
C VERSION: 1.1                          DATE: 10/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - FIRST PUT UNDER SCCS
C
C VERSION: 1.2                          DATE: 13/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - INCREASED SIZE OF DSFULL TO 80
C
C VERSION: 1.3                          DATE: 14-05-96
C MODIFIED: WILLIAM OSBORN
C           REARRANGED ARGUMENTS TO STAY UNDER
C           LIMIT OF 20 CONTINUATION CHARACTERS AT ARCETRI AND GARCHING
C
C VERSION: 1.4                          DATE: 15-07-96
C MODIFIED: WILLIAM OSBORN
C           ADDED HUGH'S CORRECTIONS DATED 13/05/96, 24/05/96 AND
C           03/06/96 ABOVE
C
C VERSION: 1.5                          DATE: 30-09-96
C MODIFIED: WILLIAM OSBORN
C           ADDED HUGH'S CORRECTIONS DATED 23/07/96 ABOVE
C
C VERSION: 1.6                          DATE: 18/10/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C           - ADDED CHECK FOR INDEX2.EQ.0 IN STRING PROCESSING
C
C VERSION: 1.7                          DATE: 01/12/97
C MODIFIED: RICHARD MARTIN
C                - FIXED BUG IN WRITING OUT OF TEMPERATURES IN PLT208.PASS,
C                  PLS208.PASS & MET208.PASS
C
C VERSION: 1.8                          DATE: 09/03/98
C MODIFIED: HUGH SUMMERS
C                - ADDED PRB TO DATA PASSED FROM THE  PROJECTION MATRICES
C                  AND GIVEN AS OUTPUT FROM ADAS208.
C
C-----------------------------------------------------------------------
      INTEGER   NOTRN
C-----------------------------------------------------------------------
      PARAMETER ( NOTRN = 64 )
C-----------------------------------------------------------------------
      INTEGER   NDLEV     , NDTEM      , NDDEN   , NDMET
      INTEGER   IUNIT     ,
     &          IUNT14    , IUNT15     , IUNT16  , IUNT17  ,
     &          IUNT18    , IUNT19     , IUNT20  , IUNT21  ,
     &          IUNT22    , IUNT23     ,
     &          NPL       , NPLR       , NPL3    , NPLI    ,
     &          IZ        , IZ0        , IZ1     , NZ      ,
     &          IL        , NMET       , NORD    ,
     &          MAXT      , MAXD
      INTEGER   I         , J          , K       , L       , IM     ,
     &          ISEL      , IULEV      , KSTRN   , IO      , IP     ,
     &          INDEX1    , INDEX2     , II
C-----------------------------------------------------------------------
      CHARACTER TITLED*3         , DSNINC*80     , FILMEM*8  , TYPE*9
      CHARACTER CSTRGA(NDLEV)*18 , DATE*8        , DSFULL*80 , DSNEXP*80
      CHARACTER TRANS*61         , TRANSA(NOTRN)*61
      CHARACTER METAS*12         , METASA(10)*12
```

```
      CHARACTER CHINDI*5         , CHINDJ*5      , UID*10
C-----------------------------------------------------------------------
      LOGICAL   LNORM     , LSTRN
      LOGICAL   LRSEL     , LISEL      , LHSEL   , LIOSEL
      LOGICAL   LPSEL     , LZSEL      , LNSEL
C-----------------------------------------------------------------------
      INTEGER   IA(NDLEV)        , ISA(NDLEV)       , ILA(NDLEV)
      INTEGER   IMETR(NDMET)
      INTEGER   IBSELA(NDMET,NDMET)
C-----------------------------------------------------------------------
      REAL*8   DE     , Z1     , DUM1    , DUM2     , DUM3
C-----------------------------------------------------------------------
      REAL*8   TR(50) , DR(50) , SUM(50) , FMULT(50)
      REAL*8   XJA(NDLEV)        , TEVA(NDTEM)      , DENSA(NDDEN)
      REAL*8   WA(NDLEV)         , BWNOA(NDMET)     , PRTWTA(NDMET)
      REAL*8   FVCRED(NDMET,NDMET,NDTEM,NDDEN)
      REAL*8   FVRRED(NDMET,NDMET,NDTEM,NDDEN)
      REAL*8   FVIRED(NDMET,NDMET,NDTEM,NDDEN)
      REAL*8   FVHRED(NDMET,NDMET,NDTEM,NDDEN)
      REAL*8   FVIONR(NDMET,NDMET,NDTEM,NDDEN)
      REAL*8   FVCRPR(NDMET,NDMET,NDTEM,NDDEN)
      REAL*8   PL(NDMET,NDTEM,NDDEN) , PS(NDMET,NDMET,NDTEM,NDDEN)  ,
     &         PH(NDTEM,NDDEN,NDMET) , SWVLN(NDMET)
      REAL*8   PR(NDMET,NDTEM,NDDEN)
      REAL*8   RATPIA(NDDEN, NDMET)  , RATMIA(NDDEN,NDMET)
      REAL*8   STCKM(NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      REAL*4   STACK(NDLEV,NDMET,NDTEM,NDDEN)
C-----------------------------------------------------------------------
      CHARACTER CPRTA(NDMET)*9
C-----------------------------------------------------------------------
      DATA    TYPE/'EXCIT    '/
C-----------------------------------------------------------------------
```

B9DATA

```
        SUBROUTINE B9DATA( IUNIT  , NDLEV  , NDTRN , NDMET ,
     &                     TITLED , IZ     , IZ0   , IZ1   , BWNO  ,
     &                     NPL    , BWNOA  , LBSETA, PRTWTA, CPRTA ,
     &                     IL     ,
     &                     IA     , CSTRGA , ISA   , ILA   , XJA   , WA ,
     &                     CPLA   , NPLA   , IPLA  , ZPLA  ,
     &                     NV     , SCEF   ,
     &                     ITRAN  , MAXLEV ,
     &                     TCODE  , I1A    , I2A   , AVAL  , SCOM  , ITYP
     &                   )
        IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B9DATA *********************
C
C  PURPOSE:  TO FETCH DATA FROM INPUT COPASE DATA SET, INCLUDING
C            MULTIPLE PARENTS ON FREE-ELECTRON AND CHARGE EXCHANGE
C            ON RECOMBINATION, INCLUSION OF EXPLICIT CONTRIBUTIONS BY
C            IONISATION.  IMPROVEMENT OF AUTOMATIC IONISATION CALC.
C            BY INCLUDING ASSIGNMENT OF FINAL STATE PARENT.
C
C  CALLING PROGRAM: ADAS209
C
C  DATA:
C           THE 'REAL' DATA IN THE FILE IS REPRESENTED IN AN ABBREVIATED
C           FORM WHICH OMITS THE "D" OR "E" EXPONENT SPECIFIER.
C           e.g. 1.23D-06 or 1.23E-06 IS REPRESENTED AS 1.23-06
C                6.75D+07 or 6.75E+07 IS REPRESENTED AS 6.75+07
C
C           THEREFORE THE FORM OF EACH 'REAL' NUMBER IN THE DATA SET IS:
C                         N.NN+NN or N.NN-NN
C
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C           RATE COEFFT.        : CM3 SEC-1
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = UNIT TO WHICH INPUT FILE IS ALLOCATED
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS THAT CAN BE READ
C  INPUT : (I*4)  NDTRN   = MAX. NUMBER OF TRANSITIONS THAT CAN BE READ
C  INPUT : (I*4)  NDMET   = MAX. NUMBER OF METASTABLES ALLOWED
C
C  OUTPUT: (C*3)  TITLED  = ELEMENT SYMBOL.
C  OUTPUT: (I*4)  IZ      =  RECOMBINED ION CHARGE READ
C  OUTPUT: (I*4)  IZ0     =         NUCLEAR CHARGE READ
C  OUTPUT: (I*4)  IZ1     = RECOMBINING ION CHARGE READ
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  OUTPUT: (R*8)  BWNO    = IONISATION POTENTIAL (CM-1) OF LOWEST PARENT
C  OUTPUT: (I*4)  NPL     = NUMBER OF PARENTS ON FIRST LINE AND USED
C                           IN LEVEL ASSIGNMENTS
C  OUTPUT: (R*8)  BWNOA() = IONISATION POTENTIAL (CM-1) OF PARENTS
```

```
C  OUTPUT: (L*4)  LBSETA()= .TRUE.  - PARENT WEIGHT SET FOR BWNOA()
C                           .FALSE. - PARENT WEIGHT NOT SET FOR BWNOA()
C  OUTPUT: (R*8)  PRTWTA()= PARENT WEIGHT FOR BWNOA()
C  OUTPUT: (C*9)  CPRTA() = PARENT NAME IN BRACKETS
C
C  OUTPUT: (I*4)  IL      = INPUT DATA FILE: NUMBER OF ENERGY LEVELS
C
C  OUTPUT: (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  OUTPUT: (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  OUTPUT: (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  OUTPUT: (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  OUTPUT: (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  OUTPUT: (R*8)  WA()    = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C  OUTPUT: (C*1)  CPLA()  = CHAR. SPECIFYING 1ST PARENT FOR LEVEL 'IA()'
C                                INTEGER - PARENT IN BWNOA() LIST
C                                'BLANK' - PARENT BWNOA(1)
C                                  'X'   - DO NOT ASSIGN A PARENT
C  OUTPUT: (I*4)  NPLA()  = NO. OF PARENT/ZETA CONTRIBUTIONS TO IONIS.
C                           OF LEVEL
C  OUTPUT: (I*4)  IPLA(,) = PARENT INDEX FOR CONTRIBUTIONS TO IONIS.
C                           OF LEVEL
C                           1ST DIMENSION: PARENT INDEX
C                           2ND DIMENSION: LEVEL INDEX
C  OUTPUT: (I*4)  ZPLA(,) = EFF. ZETA PARAM. FOR CONTRIBUTIONS TO IONIS.
C                           OF LEVEL
C                           1ST DIMENSION: PARENT INDEX
C                           2ND DIMENSION: LEVEL INDEX
C
C  OUTPUT: (I*4)  NV      = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR A GIVEN TRANSITION.
C  OUTPUT: (R*8)  SCEF()  = INPUT DATA FILE: ELECTRON TEMPERATURES (K)
C                           (INITIALLY JUST THE MANTISSA. SEE 'ITPOW()')
C                           (NOTE: TE=TP=TH IS ASSUMED)
C
C  OUTPUT: (I*4)  ITRAN   = INPUT DATA FILE: NUMBER OF TRANSITIONS
C  OUTPUT: (I*4)  MAXLEV  = HIGHEST INDEX LEVEL IN READ TRANSITIONS
C
C  OUTPUT: (C*1)  TCODE() = TRANSITION: DATA TYPE POINTER:
C                           ' ' => Electron Impact   Transition
C                           'P' => Proton   Impact   Transition
C                           'H' => Charge   Exchange Recombination
C                           'R' => Free     Electron Recombination
C                           'I' => Coll. ionisation from lower stage ion
C  OUTPUT: (I*4)  I1A()   = TRANSITION:
C                            LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            SIGNED PARENT NDEX (CASE 'H','R' & 'I')
C  OUTPUT: (I*4)  I2A()   = TRANSITION:
C                            UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            CAPTURING LEVEL INDEX (CASE 'H','R' & 'I')
C  OUTPUT: (R*8)  AVAL()  = TRANSITION:
C                            A-VALUE (SEC-1)          (CASE ' ')
C                            NEUTRAL BEAM ENERGY      (CASE 'H')
C                            NOT USED             (CASE 'P','R' & 'I')
C  OUTPUT: (R*8)  SCOM(,) = TRANSITION:
C                            GAMMA VALUES             (CASE ' ' & 'P')
C                            RATE COEFFT.(CM3 SEC-1)(CASE 'H','R' & 'I')
C                           1ST DIMENSION - TEMPERATURE 'SCEF()'
C                           2ND DIMENSION - TRANSITION NUMBER
C
C           (I*4)  NVMAX   = PARAMETER = MAX. NUMBER OF TEMPERATURES
C                                        THAT CAN BE READ IN.
C           (I*4)  MTIED   = PARAMETER = MUST BE GREATER THAN OR EQUAL TO
C                                        THE MAX. NO. OF LEVELS.
C           (R*8)  DZERO   = PARAMETER = MINIMUM VALUE FOR 'AVAL()' AND
C                                        'SCOM()' ARRAYS = 1.0D-30
C
C           (I*4)  I4UNIT  = FUNCTION (SEE ROUTINE SELECTION BELOW)
C           (I*4)  IQS     = X-SECT DATA FORMAT SELECTOR
C                            NOTE: IQS=3 ONLY ALLOWED IN THIS PROGRAM
C           (I*4)  IFAIL   = FAILURE NUMBER FROM B9PARS AND B9PRS1
C           (I*4)  I       = GENERAL USE.
C           (I*4)  IABT    = RETURN CODE FROM 'R(FCTN' (0 => NO ERROR)
C                            OR FROM INTERROGATION OF 'C7'
C           (I*4)  J       = GENERAL USE.
C           (I*4)  J1      = INPUT DATA FILE - SELECTED TRANSITION:
C                             LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C           (I*4)  J2      = INPUT DATA FILE - SELECTED TRANSITION:
C                             UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                             CAPTURING    LEVEL INDEX (CASE 'H' & 'R')
C           (I*4)  LENCST  = BYTE LENGTH OF STRING CSTRGA()
C           (I*4)  ILINE   = ENERGY LEVEL INDEX FOR CURRENT LINE
C           (I*4)  IRECL   = RECORD LENGTH OF INPUT DATASET (<=128)
C           (I*4)  IAPOW   = EXPONENT OF 'AVALM'
C           (I*4)  IGPOW() = EXPONENT OF 'GAMMA()'
C           (I*4)  ITPOW() = TEMPERATURES - EXPONENT
C                            NOTE: MANTISSA INITIALLY KEPT IN 'SCEF()'
C
C           (R*4)  ZF      = SHOULD BE EQUIVALENT TO 'IZ1'
C
C           (R*8)  AVALM   = INPUT DATA FILE - SELECTED TRANSITION:
C                            MANTISSA OF:   ('IAPOW' => EXPONENT)
C                             A-VALUE (SEC-1)          (CASE ' ')
C                             NEUTRAL BEAM ENERGY      (CASE 'H')
C                             NOT USED             (CASE 'P','R' & 'I')
C           (R*8)  GAMMA() = INPUT DATA FILE - SELECTED TRANSITION:
```

```
C                           MANTISSA OF: ('IGPOW()' => EXPONENT)
C                            GAMMA VALUES            (CASE ' ' & 'P')
C                            RATE COEFFT.(CM3 SEC-1)(CASE 'H','R' & 'I')
C                           DIMENSION => TEMPERATURE 'SCEF()'
C
C          (C*7)  C7      = USED TO PARSE VALUE FOR XJA()
C          (C*7)  CDELIM  = DELIMITERS FOR INPUT OF DATA FROM HEADERS
C          (C*18) C18     = USED TO PARSE VALUE TO CSTRGA()
C          (C*18) C18T    = COPY OF C18 : UNSATISFACTORY METHOD OF
C                           AVOIDING COMPILER REFERENCE ERROR :
C                           DHB 07.04.95
C          (C*80) CLINE   = CURRENT ENERGY LEVEL INDEX PARAMETER LINE
C          (C*75) STRING  = TAIL STRING OF 1ST DATA LINE FOR PARSING
C          (C*56) STRG1   = TAIL STRING OF LEVEL SPEC LINES FOR PARSING
C          (C*128)BUFFER  = GENERAL STRING BUFFER STORAGE
C          (C*3)  CITPOW()= USED TO PARSE VALUES TO ITPOW()
C          (C*5)  CSCEF() = USED TO PARSE VALUES TO SCEF()
C
C          (L*4)  LDATA   = IDENTIFIES  WHETHER  THE END OF AN  INPUT
C                           SECTION IN THE DATA SET HAS BEEN LOCATED.
C                           (.TRUE. => END OF SECTION REACHED)
C          (L*4)  LTCHR   = .TRUE.  => CURRENT 'TCODE()' = 'H' OR 'R'
C                                                          OR 'I'
C                         = .FALSE. => CURRENT 'TCODE()'.NE.'H' OR 'R'
C                                                           OR 'I'
C          (L*4)  LTCPR   = .TRUE.  => CURRENT 'TCODE()' = 'P' OR 'R'
C                                                          OR 'I'
C                         = .FALSE. => CURRENT 'TCODE()'.NE. 'P' OR 'R'
C                                                            OR 'I'
C          (L*4)  LERROR  = .TRUE.  => UNTIED LEVEL FOUND
C                         = .FALSE. => ALL LEVELS TIED
C          (L*4)  LTIED() = .TRUE.  => SPECIFIED LEVEL TIED
C                         = .FALSE. => SPECIFIED LEVEL IS UNTIED
C                           DIMENSION => LEVEL INDEX
C OUTPUT:  (I*4)  ITYP    = RESOLUTION OF PARENT METASTABLES
C                           1 - LS RESOLVED
C                           2 - LSJ RESOLVED
C                           3 - UNIDENTIFIED
C
C
C NOTE:            LTCHR        LTCPR         TCODE()
C                 ----------------------------------
C                 .TRUE.       .TRUE.    =>     'R','I'
C                 .TRUE.       .FALSE.   =>     'H'
C                 .FALSE.      .TRUE.    =>     'P'
C                 .FALSE.      .FALSE.   =>     ' '
C
C        FOR A-VALUES & GAMMA-VALUES ENTRIES LESS THAN 'DZERO' ARE TAKEN
C        AS BEING EQUAL TO DZERO. THIS AFFECTS THE 'AVAL()' AND 'SCOM()'
C        ARRAYS.
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C          R8FCTN     ADAS      CONVERTS FROM CHARACTER TO REAL VARIABLE
C          I4FCTN     ADAS      CONVERTS FROM CHAR. TO INTEGER  VARIABLE
C          XXWORD     ADAS      PARSES A STRING INTO SEPARATE WORDS
C                               FOR ' ()<>{}' DELIMITERS
C
C AUTHOR:  HP SUMMERS   (REVISION OF BXDATA BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:   9/07/93  HPS - USE NEW VERSIONS OF PARSING ROUTINES
C                          B8PARS AND B8PRS1
C UPDATE:  12/07/93  HPS - REVISE TO CONSISTENCY WITH  BXDATA
C                          AT 25/07/93.
C UPDATE:  11/05/95  HPS - ADDED CPRTA TO PARAMETER LIST.ALTERED
C                          'READ()BUFFER' TO BE CONSISTENT WITH IDL-ADAS
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 27-06-95
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER SCCS CONTROL
C
C VERSION: 1.2                          DATE: 19-01-96
C MODIFIED: DAVID BROOKS (UNIVERSITY OF STRATHCLYDE)/TIM HAMMOND
C               - INCREASED LENGTH OF CPRTA FROM 4 TO 9 &
C                 STRING FROM 55 TO 75 IN LINE WITH
C                 MODIFICATIONS TO ACCOMODATE J-RESOLVED
C                 PARENT METASTABLES IN THE DATASETS.
C               - INCREASED LENGTH OF CLINE TO 92 & STRG1 TO
C                 56. ALTERED FORMAT NO. 1003 & READING OF
C                 CLINE FORMAT TO ACCOMMODATE CHANGES.
C
C VERSION: 1.3                          DATE: 26-01-96
C MODIFIED: DAVID BROOKS
C               - PASSED ITYP THROUGH TO MAIN PROGRAM
C
C
C VERSION: 1.4                            DATE: 18/04/96
C UPDATE:  WILLIAM OSBORN
C                - INCREASED MTIED TO SAME AS NDLEV
C
```

```
C UPDATE: DAVID BROOKS, ALLOWED LEVELS TO 250. 18/11/98
C-----------------------------------------------------------------------
      INTEGER   MTIED       , NVMAX
C-----------------------------------------------------------------------
      REAL*8    DZERO
C-----------------------------------------------------------------------
      PARAMETER( NVMAX = 14 , MTIED = 250 , DZERO = 1.0D-30 )
C-----------------------------------------------------------------------
      INTEGER   I4UNIT      , IFAIL          , ITYP
      INTEGER   IUNIT       , NDLEV          , NDTRN      , NDMET  ,
     &          IZ          , IZ0            , IZ1        ,
     &          IL          , NV             , ITRAN      ,
     &          MAXLEV      , NPL
      INTEGER   ILINE       , IRECL
      INTEGER   IQS         , I              , IABT       , J      ,
     &          J1          , J2             , LENCST     ,
     &          IAPOW       , IGPOW(NVMAX)   , ITPOW(NVMAX)
      INTEGER   IA(NDLEV)   , ISA(NDLEV)     , ILA(NDLEV) ,
     &          I1A(NDTRN)  , I2A(NDTRN)     ,
     &          IPLA(NDMET,NDLEV)            , NPLA(NDLEV)
C-----------------------------------------------------------------------
      REAL*4    ZF
C-----------------------------------------------------------------------
      REAL*8    R8FCTN
      REAL*8    BWNO        , BWNOA(NDMET)   , PRTWTA(NDMET)  , AVALM
      REAL*8    SCEF(NVMAX) , GAMMA(NVMAX)
      REAL*8    XJA(NDLEV)  , WA(NDLEV)      ,
     &          AVAL(NDTRN) , SCOM(NVMAX,NDTRN)  ,
     &          ZPLA(NDMET,NDLEV)
C-----------------------------------------------------------------------
      CHARACTER TITLED*3    , TCODE(NDTRN)*1 , CSTRGA(NDLEV)*(*)
      CHARACTER C7*7        , CDELIM*7       , C18*18
      CHARACTER CLINE*92    , STRING*75      , STRG1*56     , BUFFER*128
      CHARACTER CITPOW(NVMAX)*3              , CSCEF(NVMAX)*5
      CHARACTER CPLA(NDLEV)*1,CPRTA(NDMET)*9
C-----------------------------------------------------------------------
      LOGICAL   LDATA       , LTCHR          , LTCPR      , LERROR
C-----------------------------------------------------------------------
      LOGICAL   LTIED(MTIED), LBSETA(NDMET)
C-----------------------------------------------------------------------
      DATA      CDELIM/ ' ()<>{}'/
C-----------------------------------------------------------------------
```

B9PARS

```
       SUBROUTINE B9PARS(NDMET,STRING,NPT,BWNOA,LSETA,
     &                   PRTWTA,CPRTA,IFAIL,ITYPE)
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B9PARS *********************
C
C  PURPOSE:  TO ANALYSE THE TAIL CHARACTER STRING OF THE FIRST LINE OF
C            A SPECIFIC ION FILE INTO BINDING WAVE NUMBERS FOR DIFFERENT
C            PARENTS AND STATISTICAL WEIGHTS FOR THE PARENTS.
C            MODIFICATION OF B8PARS.
C
C  CALLING PROGRAM: ADAS209
C
C  NOTES: DETECT  -  BINDING WAVE NUMBER WHICH PRECEED TERM ASSIGNATION
C                 -   TERM CONTAINED IN '(..)'.
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NDMET    =  MAXIMUM NUMBER OF METASTABLES ALLOWED
C  INPUT : (C*(*))STRING   =  STRING TO BE PARSED
C
C  OUTPUT: (I*4)  NPT      =  NUMBER OF BINDING WAVE NUMBERS DETECTED
C  OUTPUT: (L*4)  LSETA()  =  .TRUE.  - PARENT TERM SET FOR THIS W.NO.
C                             .FALSE. - PARENT TERM NOT SET FOR W.NO.
C  OUTPUT: (L*4)  LFND     =  .TRUE.  - L QUANTUM NUMBER PRESENT IN
C                                       STRING
C                             .FALSE. - NO L QUANTUM NUMBER DETECTED
C  OUTPUT: (R*8)  BWNOA()  =  BINDING WAVE NUMBERS
C  OUTPUT: (R*8)  PRTWTA() =  PARENT STATISTICAL WEIGHTS
C  OUTPUT: (C*9)  CPRTA()  =  PARENT NAME IN BRACKETS
C  OUTPUT: (I*4)  IFAIL    =  0 - SUBROUTINE CONCLUDES CORRECTLY
C                             1 - FAULT DETECTED IN SUBROUTINE
C                             2 - SINGLE IONISATION POTENTIAL DETECTED
C
C          (I*4)  MAXWRD   =  MAXIMUM NUMBER OF WORDS SOUGHT INITIALLY
C                             INITIALLY, FINALLY NUMBER ACTUALLY FOUND
C          (I*4)  NFIRST   =  FIRST WORD TO BE EXTRACTED FROM STRING
C          (I*4)  IFIRST() =  INDEX OF FIRST CHAR. OF WORD () IN STRING
C          (I*4)  ILAST()  =  INDEX OF LAST  CHAR. OF WORD () IN STRING
C          (I*4)  IWORDS   =  NUMBER OF WORDS FOUND IN STRING
C          (I*4)  IABT     =  FAILURE NUMBER FROM R8FCTN
C          (I*4)  NCHAR    =  NUMBER OF CHARACTERS IN SUBSTRING
C          (I*4)  I        =  GENERAL USE
C          (I*4)  J        =  GENERAL USE
C          (I*4)  K        =  GENERAL USE
C          (I*4)  IC       =  GENERAL USE
C OUTPUT:  (I*4)  ITYPE    =  RESOLUTION OF PARENT METASTABLES
```

```
C                              1 - LS RESOLVED
C                              2 - LSJ RESOLVED
C                              3 - ARBITRARY RESOLUTION
C          (I*4)  ITP      =  FLAG FOR INCOMPATIBLE TYPES
C          (I*4)  ITYP     =  COPY OF CURRENT ITYPE
C          (I*4)  KMRK     =  POSITION MARKER IN THE STRING FOR PARENT
C                             L QUANTUM NUMBER
C          (R*8)  TWTA()   =  (2L+1) VALUE FOR PARENT L QUANTUM NUMBER
C          (C*1)  CTRMA()  =  PARENT L QUANTUM NUMBER LETTER SET
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C          R8FCTN     ADAS      CONVERTS FROM CHARACTER TO REAL VARIABLE
C          I4FCTN     ADAS      CONVERTS FROM CHAR. TO INTEGER  VARIABLE
C          XXWORD     ADAS      PARSES A STRING INTO SEPARATE WORDS
C                               FOR ' ()<>{}' DELIMITERS
C
C AUTHOR:  HP SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    22/06/92
C
C UPDATE:   8/07/93 - HPS  ALTERED TO USE XXWORD PARSING ROUTINE
C
C UPDATE:  11/05/95 - HPS  ADD CPRTA TO PARAMETER LIST
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 27-06-95
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER SCCS CONTROL
C
C VERSION: 1.2                          DATE: 13/11/95
C MODIFIED: DAVID BROOKS (UNIVERSITY OF STRATHCLYDE)
C               - EXTENDED ROUTINE TO HANDLE J/ARBITRARY
C                 RESOLVED PARENT METASTABLE INFORMATION
C                 IN THE FIRST DATA CARD STRING. INTRODUCED
C                 ITYPE TO FLAG RESOLUTION IF REQUIRED.
C
C VERSION: 1.3                          DATE: 26-01-96
C MODIFIED: DAVID BROOKS
C               - PASSED ITYPE FLAG OUT.
C
C-----------------------------------------------------------------------
       INTEGER*4 NDMET
C
       CHARACTER STRING*(*)   , SSTRNG*15  , CTRMA(9)*1
       CHARACTER CDELIM*7     , CPRTA(NDMET)*9
C
       INTEGER*4 NPT          , IABT       , IC        , I     , IFAIL
       INTEGER*4 NFIRST       , MAXWRD     , IWORDS    , ITYPE , ITP
       INTEGER*4 IFIRST(10)   , ILAST(10)  , KMRK      , J     , K
       INTEGER*4 I4FCTN       , I4UNIT     , ITYP
C
       LOGICAL   LSETA(NDMET) , LFND
C
       REAL*8    BWNOA(NDMET) , PRTWTA(NDMET)          , TWTA(9)
       REAL*8    R8FCTN
C-----------------------------------------------------------------------
       DATA  CTRMA/ 'S' , 'P' , 'D' , 'F' , 'G' , 'H' , 'I' , 'J' , 'K'/
       DATA  TWTA / 1.0 , 3.0 , 5.0 , 7.0 , 9.0 , 11.0, 13.0, 15.0,17.0/
       DATA CDELIM/' ()<>{}'/
C-----------------------------------------------------------------------
```

B9PRS1

```
       SUBROUTINE B9PRS1(NDMET,STRING,WNO,CPL,NPT,IPLA,ZPLA,IFAIL)
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B9PRS1 *********************
C
C  PURPOSE:  TO ANALYSE THE TAIL CHARACTER STRING OF A LEVEL DATA LINE
C            OF A SPECIFIC ION FILE INTO WAVE-NUMBER AND SETS OF
C            (PARENT IDENTIFIER, EFFECTIVE ZETA FOR THE PARENT) PAIRS.
C
C  CALLING PROGRAM: ADAS209
C
C  NOTES: DETECT  -  LEVEL WAVE NUMBER WHICH PRECEEDS FIRST '{'
C                 -  SETS OF   PARENT INDEX CONTAINED IN '{.}'
C                              FOLLOWED BY EFFECTIVE ZETA
C         NB. 'X' AS FIRST PARENT ASSIGNMENT MEANS EXCLUDE IONISATION
C             FROM THIS LEVEL.
C             NO PARENT ASSIGNMENT MEANS TAKE LOWEST PARENT WITH
C             ZETA =1.
C             LOWEST PARENT BUT NO ZETA MEANS TAKE ZETA =1.
C             IF THERE IS MORE THAN ONE PARENT THEN ZETA'S MUST BE IN.
C
C
C  SUBROUTINE:
```

```
C
C  INPUT : (I*4)  NDMET    =  MAXIMUM NUMBER OF PARENTS
C  INPUT : (C*(*))STRING   =  STRING TO BE PARSED
C
C  OUTPUT: (R*8)  WNO      =  EXCITATION WAVE NUMBER OF LEVEL RELATIVE
C                             TO LOWEST PARENT
C  OUTPUT: (C*1)  CPL      =  LEAD PARENT FOR IONISATION  OR 'X'
C  OUTPUT: (I*4)  NPT      =  NUMBER OF PARENTS DETECTED
C  OUTPUT: (I*4)  IPLA()   =  PARENT INDICES.
C  OUTPUT: (R*8)  ZPLA()   =  EFFECTIVE ZETA FOR PARENT IPLA()
C  OUTPUT: (I*4)  IFAIL    =  0 - SUBROUTINE CONCLUDES CORRECTLY
C                             1 - FAULT DETECTED IN SUBROUTINE
C                             2 - SINGLE IONISATION POTENTIAL DETECTED
C
C          (I*4)  MAXWRD   =  MAXIMUM NUMBER OF WORDS SOUGHT INITIALLY
C                             INITIALLY, FINALLY NUMBER ACTUALLY FOUND
C          (I*4)  NFIRST   =  FIRST WORD TO BE EXTRACTED FROM STRING
C          (I*4)  IFIRST() =  INDEX OF FIRST CHAR. OF WORD () IN STRING
C          (I*4)  ILAST()  =  INDEX OF LAST  CHAR. OF WORD () IN STRING
C          (I*4)  IWORDS   =  NUMBER OF WORDS FOUND IN STRING
C
C          (L*4)  LSET     =  .TRUE.  -  WAVE NUMBER PART SET
C                             .FALSE. -  WAVE NUMBER PART NOT SET
C          (L*4)  LWNO     =  .TRUE.  -  IN THE WAVE NUMBER PART
C                             .FALSE. -  NOT IN THE WAVE NUMBER PART
C          (L*4)  LPRNT    =  .TRUE.  -  IN A PARENT SPECIFIER
C                             .FALSE. -  NOT IN A PARENT SPECIFIER
C          (L*4)  LZETA    =  .TRUE.  -  IN A ZETA SPECIFIER
C                             .FALSE. -  NOT IN A ZETA SPECIFIER
C          (I*4)  IC       =  GENERAL USE
C          (I*4)  IABT     =  FAILURE NUMBER FROM R8FCTN
C          (I*4)  NCHAR    =  NUMBER OF CHARACTERS IN SUBSTRING
C          (C*15) SSTRNG   =  ISOLATED SUBSTRING
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C          R8FCTN     ADAS      CONVERTS FROM CHARACTER TO REAL VARIABLE
C          I4FCTN     ADAS      CONVERTS FROM CHAR. TO INTEGER  VARIABLE
C          XXWORD     ADAS      PARSES A STRING INTO SEPARATE WORDS
C                               FOR ' ()<>{}' DELIMITERS
C
C AUTHOR:  HP SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    22/06/92
C
C UPDATE:   8/07/93 - HPS  ALTERED TO USE XXWORD PARSING ROUTINE
C
C-----------------------------------------------------------------------
       CHARACTER STRING*(*)   , SSTRNG*15  , CPL*1
       CHARACTER CDELIM*7
C
       INTEGER*4 NDMET
       INTEGER*4 NPT          , IABT       , IC        , NCHAR     , I
       INTEGER*4 IFAIL
       INTEGER*4 IPLA(NDMET)
       INTEGER*4 NFIRST       , MAXWRD     , IWORDS
       INTEGER*4 IFIRST(10)   , ILAST(10)
       INTEGER*4 I4FCTN       , I4UNIT
C
       LOGICAL   LSET         , LWNO         , LPRNT        , LZETA
C
       REAL*8    WNO
       REAL*8    ZPLA(NDMET)
       REAL*8    R8FCTN
C-----------------------------------------------------------------------
       DATA CDELIM/' ()<>{}'/
C-----------------------------------------------------------------------
```

B9SPF0

```
      SUBROUTINE B9SPF0( REP  , DSFULL, LDSEL)

      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B1SPF0 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS209
C
C  SUBROUTINE:
C
C  OUTPUT: (C*3)   REP     = 'YES' => TERMINATE PROGRAM EXECUTION.
C                          = 'NO ' => CONTINUE PROGRAM EXECUTION.
C
C  OUTPUT: (C*80)  DSFULL  = INPUT DATA SET NAME , INCLUDING PATH
C
CA - UNIX PORT : LDSEL ONLY USED TO KEEP ARGUMENT LIST THE SAME.
CA               IT'S ORIGINAL FUNCTION IS CARRIED OUT IN IDL NOW
```

```
CX  OUTPUT: (L*4)   LDSEL   = .TRUE.  => COPASE DATA SET INFORMATION
CX                                     TO BE DISPLAYED BEFORE RUN.
CX                          = .FALSE. => COPASE DATA SET INFORMATION
CX                                     NOT TO BE DISPLAYED BEFORE RUN.
C
C           (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C           (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT TO PIPE
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C
C
C AUTHOR:  LALIT JALOTA (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    28/02/95
C
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      CHARACTER    REP*3        , DSFULL*80
C-----------------------------------------------------------------------
      LOGICAL      LDSEL
C-----------------------------------------------------------------------
      INTEGER    PIPEIN    , PIPEOU
      PARAMETER( PIPEIN=5  , PIPEOU=6)
C-----------------------------------------------------------------------
```

B9SPF1

```
      SUBROUTINE B9SPF1( L2FILE     , SAVFIL     ,
     &                   LPEND
     &                 )
      IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: B9SPF1 *********************
C
C  PURPOSE: PIPE COMMUNICATION WITH IDL
C
C  CALLING PROGRAM: ADAS209
C
C  SUBROUTINE:
C
C  OUTPUT:   (L*4)   L2FILE   = .TRUE.  => SAVE DATA TO FILE
C                               .FALSE. => DO NOT SAVE DATA TO FILE
C  OUTPUT:   (C*80)  SAVFIL   = FILENAME FOR SAVING DATA
C  OUTPUT:   (L*4)   LPEND    = .TRUE.  => PROCESS OUTPUT OPTIONS
C                               .FALSE. => CANCEL OUTPUT OPTIONS
C
C            (I*4)   PIPEIN   = PARAMETER = UNIT NUMBER FOR OUTPUT TO PIPE
C            (I*4)   PIPEOU   = PARAMETER = UNIT NUMBER FOR INPUT FROM PIPE
C            (I*4)   ONE      = PARAMETER = 1  : USED AS FLAG TO IDL
C            (I*4)   ZERO     = PARAMETER = 0  : USED AS FLAG TO IDL
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C            XXFLSH     IDL-ADAS  CALLS FLUSH TO CLEAR PIPES.
C
C AUTHOR:  Lalit Jalota (TESSELLA SUPPORT SERVICES PLC)
C
C DATE:    7/3/95
C
C
C MODIFIED: DAVID H.BROOKS (UNIV.OF STRATHCLYDE)
C           ALTERED B1SPF1.F TO B9SPF1.F FOR USE IN ADAS209.
C           REMOVED ALL GRAPHICS OUTPUT REFERENCES WHICH ARE NOT
C           REQUIRED FOR ADAS209
C           11/5/95
C-----------------------------------------------------------------------
      CHARACTER    SAVFIL*80
C-----------------------------------------------------------------------
      LOGICAL      LPEND       , L2FILE
      INTEGER      ILOGIC      ,
     &             PIPEIN      , PIPEOU      , ONE         , ZERO
C-----------------------------------------------------------------------
      PARAMETER( PIPEIN=5      , PIPEOU=6    , ONE=1       , ZERO=0)
C-----------------------------------------------------------------------
```

BADATA

```
       SUBROUTINE BADATA( IUNIT  , NDLEV  , NDTRN , NDMET ,
     &                    TITLED , IZ     , IZ0   , IZ1   , BWNO  ,
     &                    NPL    , BWNOA  , LBSETA, PRTWTA, CPRTA ,
     &                    IL     ,
     &                    IA     , CSTRGA , ISA   , ILA   , XJA   , WA ,
     &                    CPLA   , NPLA   , IPLA  , ZPLA  ,
```

```
     &                    NV     , SCEF   ,
     &                    ITRAN  , MAXLEV ,
     &                    TCODE  , I1A    , I2A   , AVAL  , SCOM
     &                  )
C
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: BADATA *********************
C
C  PURPOSE:  TO FETCH DATA FROM INPUT COPASE DATA SET, INCLUDING
C            MULTIPLE PARENTS ON FREE-ELECTRON AND CHARGE EXCHANGE
C            ON RECOMBINATION, INCLUSION OF EXPLICIT CONTRIBUTIONS BY
C            IONISATION.  IMPROVEMENT OF AUTOMATIC IONISATION CALC.
C            BY INCLUDING ASSIGNMENT OF FINAL STATE PARENT.
C
C  CALLING PROGRAM: ADAS210
C
C  DATA:
C           THE 'REAL' DATA IN THE FILE IS REPRESENTED IN AN ABBREVIATED
C           FORM WHICH OMITS THE "D" OR "E" EXPONENT SPECIFIER.
C           e.g. 1.23D-06 or 1.23E-06 IS REPRESENTED AS 1.23-06
C                6.75D+07 or 6.75E+07 IS REPRESENTED AS 6.75+07
C
C           THEREFORE THE FORM OF EACH 'REAL' NUMBER IN THE DATA SET IS:
C                        N.NN+NN or N.NN-NN
C
C           THE UNITS USED IN THE DATA FILE ARE TAKEN AS FOLLOWS:
C
C           IONISATION POTENTIAL: WAVE NUMBER (CM-1)
C           INDEX LEVEL ENERGIES: WAVE NUMBER (CM-1)
C           TEMPERATURES        : KELVIN
C           A-VALUES            : SEC-1
C           GAMMA-VALUES        :
C           RATE COEFFT.        : CM3 SEC-1
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  IUNIT   = UNIT TO WHICH INPUT FILE IS ALLOCATED
C  INPUT : (I*4)  NDLEV   = MAXIMUM NUMBER OF LEVELS THAT CAN BE READ
C  INPUT : (I*4)  NDTRN   = MAX. NUMBER OF TRANSITIONS THAT CAN BE READ
C  INPUT : (I*4)  NDMET   = MAX. NUMBER OF METASTABLES ALLOWED
C
C  OUTPUT: (C*3)  TITLED  = ELEMENT SYMBOL.
C  OUTPUT: (I*4)  IZ      =  RECOMBINED ION CHARGE READ
C  OUTPUT: (I*4)  IZ0     =         NUCLEAR CHARGE READ
C  OUTPUT: (I*4)  IZ1     = RECOMBINING ION CHARGE READ
C                           (NOTE: IZ1 SHOULD EQUAL IZ+1)
C  OUTPUT: (R*8)  BWNO    = IONISATION POTENTIAL (CM-1) OF LOWEST PARENT
C  OUTPUT: (I*4)  NPL     = NUMBER OF PARENTS ON FIRST LINE AND USED
C                           IN LEVEL ASSIGNMENTS
C  OUTPUT: (R*8)  BWNOA() = IONISATION POTENTIAL (CM-1) OF PARENTS
C  OUTPUT: (L*4)  LBSETA()= .TRUE.  - PARENT WEIGHT SET FOR BWNOA()
C                           .FALSE. - PARENT WEIGHT NOT SET FOR BWNOA()
C  OUTPUT: (R*8)  PRTWTA()= PARENT WEIGHT FOR BWNOA()
C  OUTPUT: (C*9)  CPRTA() = PARENT NAME IN BRACKETS
C
C  OUTPUT: (I*4)  IL      = INPUT DATA FILE: NUMBER OF ENERGY LEVELS
C
C  OUTPUT: (I*4)  IA()    = ENERGY LEVEL INDEX NUMBER
C  OUTPUT: (C*18) CSTRGA()= NOMENCLATURE/CONFIGURATION FOR LEVEL 'IA()'
C  OUTPUT: (I*4)  ISA()   = MULTIPLICITY FOR LEVEL 'IA()'
C                           NOTE: (ISA-1)/2 = QUANTUM NUMBER (S)
C  OUTPUT: (I*4)  ILA()   = QUANTUM NUMBER (L) FOR LEVEL 'IA()'
C  OUTPUT: (R*8)  XJA()   = QUANTUM NUMBER (J-VALUE) FOR LEVEL 'IA()'
C                           NOTE: (2*XJA)+1 = STATISTICAL WEIGHT
C  OUTPUT: (R*8)  WA()    = ENERGY RELATIVE TO LEVEL 1 (CM-1) FOR LEVEL
C                           'IA()'
C  OUTPUT: (C*1)  CPLA()  = CHAR. SPECIFYING 1ST PARENT FOR LEVEL 'IA()'
C                                INTEGER - PARENT IN BWNOA() LIST
C                                'BLANK' - PARENT BWNOA(1)
C                                  'X'   - DO NOT ASSIGN A PARENT
C  OUTPUT: (I*4)  NPLA()  = NO. OF PARENT/ZETA CONTRIBUTIONS TO IONIS.
C                           OF LEVEL
C  OUTPUT: (I*4)  IPLA(,) = PARENT INDEX FOR CONTRIBUTIONS TO IONIS.
C                           OF LEVEL
C                           1ST DIMENSION: PARENT INDEX
C                           2ND DIMENSION: LEVEL INDEX
C  OUTPUT: (I*4)  ZPLA(,) = EFF. ZETA PARAM. FOR CONTRIBUTIONS TO IONIS.
C                           OF LEVEL
C                           1ST DIMENSION: PARENT INDEX
C                           2ND DIMENSION: LEVEL INDEX
C
C  OUTPUT: (I*4)  NV      = INPUT DATA FILE: NUMBER OF GAMMA/TEMPERATURE
C                           PAIRS FOR A GIVEN TRANSITION.
C  OUTPUT: (R*8)  SCEF()  = INPUT DATA FILE: ELECTRON TEMPERATURES (K)
C                           (INITIALLY JUST THE MANTISSA. SEE 'ITPOW()')
C                           (NOTE: TE=TP=TH IS ASSUMED)
C
C  OUTPUT: (I*4)  ITRAN   = INPUT DATA FILE: NUMBER OF TRANSITIONS
C  OUTPUT: (I*4)  MAXLEV  = HIGHEST INDEX LEVEL IN READ TRANSITIONS
C
C  OUTPUT: (C*1)  TCODE() = TRANSITION: DATA TYPE POINTER:
C                           ' ' => Electron Impact   Transition
C                           'P' => Proton   Impact   Transition
C                           'H' => Charge   Exchange Recombination
C                           'R' => Free     Electron Recombination
```

```
C                                'I' => Coll. ionisation from lower stage ion
C  OUTPUT: (I*4)  I1A()   = TRANSITION:
C                            LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            SIGNED PARENT NDEX (CASE 'H','R' & 'I')
C  OUTPUT: (I*4)  I2A()   = TRANSITION:
C                            UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            CAPTURING LEVEL INDEX (CASE 'H','R' & 'I')
C  OUTPUT: (R*8)  AVAL()  = TRANSITION:
C                            A-VALUE (SEC-1)          (CASE ' ')
C                            NEUTRAL BEAM ENERGY      (CASE 'H')
C                            NOT USED             (CASE 'P','R' & 'I')
C  OUTPUT: (R*8)  SCOM(,) = TRANSITION:
C                            GAMMA VALUES             (CASE ' ' & 'P')
C                            RATE COEFFT.(CM3 SEC-1)(CASE 'H','R' & 'I')
C                           1ST DIMENSION - TEMPERATURE 'SCEF()'
C                           2ND DIMENSION - TRANSITION NUMBER
C
C          (I*4)  NVMAX   = PARAMETER = MAX. NUMBER OF TEMPERATURES
C                                       THAT CAN BE READ IN.
C          (I*4)  MTIED   = PARAMETER = MUST BE GREATER THAN OR EQUAL TO
C                                       THE MAX. NO. OF LEVELS.
C          (R*8)  DZERO   = PARAMETER = MINIMUM VALUE FOR 'AVAL()' AND
C                                       'SCOM()' ARRAYS = 1.0D-30
C
C          (I*4)  I4UNIT  = FUNCTION (SEE ROUTINE SELECTION BELOW)
C          (I*4)  IQS     = X-SECT DATA FORMAT SELECTOR
C                           NOTE: IQS=3 ONLY ALLOWED IN THIS PROGRAM
C          (I*4)  IFAIL   = FAILURE NUMBER FROM B9PARS AND B9PRS1
C          (I*4)  I       = GENERAL USE.
C          (I*4)  IABT    = RETURN CODE FROM 'R(FCTN' (0 => NO ERROR)
C                           OR FROM INTERROGATION OF 'C7'
C          (I*4)  J       = GENERAL USE.
C          (I*4)  J1      = INPUT DATA FILE - SELECTED TRANSITION:
C                            LOWER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C          (I*4)  J2      = INPUT DATA FILE - SELECTED TRANSITION:
C                            UPPER ENERGY LEVEL INDEX (CASE ' ' & 'P')
C                            CAPTURING    LEVEL INDEX (CASE 'H' & 'R')
C          (I*4)  LENCST  = BYTE LENGTH OF STRING CSTRGA()
C          (I*4)  ILINE   = ENERGY LEVEL INDEX FOR CURRENT LINE
C          (I*4)  IRECL   = RECORD LENGTH OF INPUT DATASET (<=128)
C          (I*4)  IAPOW   = EXPONENT OF 'AVALM'
C          (I*4)  IGPOW() = EXPONENT OF 'GAMMA()'
C          (I*4)  ITPOW() = TEMPERATURES - EXPONENT
C                           NOTE: MANTISSA INITIALLY KEPT IN 'SCEF()'
C
C          (R*4)  ZF      = SHOULD BE EQUIVALENT TO 'IZ1'
C
C          (R*8)  AVALM   = INPUT DATA FILE - SELECTED TRANSITION:
C                           MANTISSA OF:   ('IAPOW' => EXPONENT)
C                            A-VALUE (SEC-1)          (CASE ' ')
C                            NEUTRAL BEAM ENERGY      (CASE 'H')
C                            NOT USED             (CASE 'P','R' & 'I')
C          (R*8)  GAMMA() = INPUT DATA FILE - SELECTED TRANSITION:
C                           MANTISSA OF: ('IGPOW()' => EXPONENT)
C                            GAMMA VALUES             (CASE ' ' & 'P')
C                            RATE COEFFT.(CM3 SEC-1)(CASE 'H','R' & 'I')
C                           DIMENSION => TEMPERATURE 'SCEF()'
C
C          (C*7)  C7      = USED TO PARSE VALUE FOR XJA()
C          (C*7)  CDELIM  = DELIMITERS FOR INPUT OF DATA FROM HEADERS
C          (C*18) C18     = USED TO PARSE VALUE TO CSTRGA()
C          (C*18) C18T    = COPY OF C18 : UNSATISFACTORY METHOD OF
C                           AVOIDING COMPILER REFERENCE ERROR :
C                           DHB 07.04.95
C          (C*80) CLINE   = CURRENT ENERGY LEVEL INDEX PARAMETER LINE
C          (C*75) STRING  = TAIL STRING OF 1ST DATA LINE FOR PARSING
C          (C*44) STRG1   = TAIL STRING OF LEVEL SPEC LINES FOR PARSING
C          (C*128)BUFFER  = GENERAL STRING BUFFER STORAGE
C          (C*3)  CITPOW()= USED TO PARSE VALUES TO ITPOW()
C          (C*5)  CSCEF() = USED TO PARSE VALUES TO SCEF()
C
C          (L*4)  LDATA   = IDENTIFIES  WHETHER  THE END OF AN  INPUT
C                           SECTION IN THE DATA SET HAS BEEN LOCATED.
C                           (.TRUE. => END OF SECTION REACHED)
C          (L*4)  LTCHR   = .TRUE.  => CURRENT 'TCODE()' = 'H' OR 'R'
C                                                          OR 'I'
C                         = .FALSE. => CURRENT 'TCODE()'.NE.'H' OR 'R'
C                                                           OR 'I'
C          (L*4)  LTCPR   = .TRUE.  => CURRENT 'TCODE()' = 'P' OR 'R'
C                                                          OR 'I'
C                         = .FALSE. => CURRENT 'TCODE()'.NE. 'P' OR 'R'
C                                                            OR 'I'
C          (L*4)  LERROR  = .TRUE.  => UNTIED LEVEL FOUND
C                         = .FALSE. => ALL LEVELS TIED
C          (L*4)  LTIED() = .TRUE.  => SPECIFIED LEVEL TIED
C                         = .FALSE. => SPECIFIED LEVEL IS UNTIED
C                           DIMENSION => LEVEL INDEX
C
C
C NOTE:            LTCHR        LTCPR         TCODE()
C                 ------------------------------------
C                 .TRUE.       .TRUE.    =>     'R','I'
C                 .TRUE.       .FALSE.   =>     'H'
C                 .FALSE.      .TRUE.    =>     'P'
C                 .FALSE.      .FALSE.   =>     ' '
C
C        FOR A-VALUES & GAMMA-VALUES ENTRIES LESS THAN 'DZERO' ARE TAKEN
C        AS BEING EQUAL TO DZERO. THIS AFFECTS THE 'AVAL()' AND 'SCOM()'
```

```
C        ARRAYS.
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C          R8FCTN     ADAS      CONVERTS FROM CHARACTER TO REAL VARIABLE
C          I4FCTN     ADAS      CONVERTS FROM CHAR. TO INTEGER  VARIABLE
C          XXWORD     ADAS      PARSES A STRING INTO SEPARATE WORDS
C                               FOR ' ()<>{}' DELIMITERS
C
C AUTHOR:  HP SUMMERS   (REVISION OF BXDATA BY PE BRIDEN)
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    11/06/92
C
C UPDATE:   9/07/93  HPS - USE NEW VERSIONS OF PARSING ROUTINES
C                          B8PARS AND B8PRS1
C UPDATE:  12/07/93  HPS - REVISE TO CONSISTENCY WITH  BXDATA
C                          AT 25/07/93.
C UPDATE:  11/05/95  HPS - ADDED CPRTA TO PARAMETER LIST.ALTERED
C                          'READ()BUFFER' TO BE CONSISTENT WITH IDL-ADAS
C UPDATE:  13/11/95  DHB - INCREASED LENGTH OF CPRTA FROM 4 TO 9 &
C                          STRING FROM 55 TO 75 IN LINE WITH
C                          MODIFICATIONS TO ACCOMODATE J-RESOLVED
C                          PARENT METASTABLES IN THE DATASETS.
C UPDATE:  16/01/96  DHB - INCREASED LENGTH OF CLINE TO 92 & STRG1 TO
C                          56. ALTERED FORMAT NO. 1003 & READING OF
C                          CLINE FORMAT TO ACCOMODATE CHANGES.
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 19-1-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER SCCS CONTROL
C
C VERSION: 1.2                          DATE: 03-07-97
C MODIFIED: RICHARD MARTIN
C               - CHANGED I3 TO I4 IN FORMAT STATEMENT 1001
C
C VERSION: 1.3                          DATE: 20-11-98
C MODIFIED: DAVID H. BROOKS
C               - CHANGED MTIED TO 250.
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
      INTEGER   MTIED       , NVMAX
C-----------------------------------------------------------------------
      REAL*8    DZERO
C-----------------------------------------------------------------------
      PARAMETER( NVMAX = 14 , MTIED = 250 , DZERO = 1.0D-30 )
C-----------------------------------------------------------------------
      INTEGER   I4UNIT      , IFAIL
      INTEGER   IUNIT       , NDLEV          , NDTRN      , NDMET  ,
     &          IZ          , IZ0            , IZ1        ,
     &          IL          , NV             , ITRAN      ,
     &          MAXLEV      , NPL
      INTEGER   ILINE       , IRECL
      INTEGER   IQS         , I              , IABT       , J      ,
     &          J1          , J2             , LENCST     ,
     &          IAPOW       , IGPOW(NVMAX)   , ITPOW(NVMAX)
      INTEGER   IA(NDLEV)   , ISA(NDLEV)     , ILA(NDLEV) ,
     &          I1A(NDTRN)  , I2A(NDTRN)     ,
     &          IPLA(NDMET,NDLEV)            , NPLA(NDLEV)
C-----------------------------------------------------------------------
      REAL*4    ZF
C-----------------------------------------------------------------------
      REAL*8    R8FCTN
      REAL*8    BWNO        , BWNOA(NDMET)   , PRTWTA(NDMET)  , AVALM
      REAL*8    SCEF(NVMAX) , GAMMA(NVMAX)
      REAL*8    XJA(NDLEV)  , WA(NDLEV)      ,
     &          AVAL(NDTRN) , SCOM(NVMAX,NDTRN)  ,
     &          ZPLA(NDMET,NDLEV)
C-----------------------------------------------------------------------
      CHARACTER TITLED*3    , TCODE(NDTRN)*1 , CSTRGA(NDLEV)*(*)
      CHARACTER C7*7        , CDELIM*7       , C18*18
      CHARACTER CLINE*92    , STRING*75      , STRG1*56     , BUFFER*128
      CHARACTER CITPOW(NVMAX)*3              , CSCEF(NVMAX)*5
      CHARACTER CPLA(NDLEV)*1,CPRTA(NDMET)*9
C-----------------------------------------------------------------------
      LOGICAL   LDATA       , LTCHR          , LTCPR      , LERROR
C-----------------------------------------------------------------------
      LOGICAL   LTIED(MTIED), LBSETA(NDMET)
C-----------------------------------------------------------------------
      DATA      CDELIM/ ' ()<>{}'/
C-----------------------------------------------------------------------
```

BAPARS

```
       SUBROUTINE BAPARS(NDMET,STRING,NPT,BWNOA,LSETA,
     &                   PRTWTA,CPRTA,IFAIL)
C
       IMPLICIT NONE
C-----------------------------------------------------------------------
C
```

```
C  ****************** FORTRAN77 SUBROUTINE: BAPARS *********************
C
C  PURPOSE:  TO ANALYSE THE TAIL CHARACTER STRING OF THE FIRST LINE OF
C            A SPECIFIC ION FILE INTO BINDING WAVE NUMBERS FOR DIFFERENT
C            PARENTS AND STATISTICAL WEIGHTS FOR THE PARENTS.
C            MODIFICATION OF B8PARS.
C
C  CALLING PROGRAM: ADAS210
C
C  NOTES: DETECT  -  BINDING WAVE NUMBER WHICH PRECEED TERM ASSIGNATION
C                 -   TERM CONTAINED IN '(..)'.
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  NDMET    =  MAXIMUM NUMBER OF METASTABLES ALLOWED
C  INPUT : (C*(*))STRING   =  STRING TO BE PARSED
C
C  OUTPUT: (I*4)  NPT      =  NUMBER OF BINDING WAVE NUMBERS DETECTED
C  OUTPUT: (L*4)  LSETA()  =  .TRUE.  - PARENT TERM SET FOR THIS W.NO.
C                             .FALSE. - PARENT TERM NOT SET FOR W.NO.
C  OUTPUT: (L*4)  LFND     =  .TRUE.  - L QUANTUM NUMBER PRESENT IN
C                                       STRING
C                             .FALSE. - NO L QUANTUM NUMBER DETECTED
C  OUTPUT: (R*8)  BWNOA()  =  BINDING WAVE NUMBERS
C  OUTPUT: (R*8)  PRTWTA() =  PARENT STATISTICAL WEIGHTS
C  OUTPUT: (C*9)  CPRTA()  =  PARENT NAME IN BRACKETS
C  OUTPUT: (I*4)  IFAIL    =  0 - SUBROUTINE CONCLUDES CORRECTLY
C                             1 - FAULT DETECTED IN SUBROUTINE
C                             2 - SINGLE IONISATION POTENTIAL DETECTED
C
C          (I*4)  MAXWRD   =  MAXIMUM NUMBER OF WORDS SOUGHT INITIALLY
C                             INITIALLY, FINALLY NUMBER ACTUALLY FOUND
C          (I*4)  NFIRST   =  FIRST WORD TO BE EXTRACTED FROM STRING
C          (I*4)  IFIRST() =  INDEX OF FIRST CHAR. OF WORD () IN STRING
C          (I*4)  ILAST()  =  INDEX OF LAST  CHAR. OF WORD () IN STRING
C          (I*4)  IWORDS   =  NUMBER OF WORDS FOUND IN STRING
C          (I*4)  IABT     =  FAILURE NUMBER FROM R8FCTN
C          (I*4)  NCHAR    =  NUMBER OF CHARACTERS IN SUBSTRING
C          (I*4)  I        =  GENERAL USE
C          (I*4)  J        =  GENERAL USE
C          (I*4)  K        =  GENERAL USE
C          (I*4)  IC       =  GENERAL USE
C          (I*4)  ITYPE    =  RESOLUTION OF PARENT METASTABLES
C                             1 - LS RESOLVED
C                             2 - LSJ RESOLVED
C                             3 - ARBITRARY RESOLUTION
C          (I*4)  ITP      =  FLAG FOR INCOMPATIBLE TYPES
C          (I*4)  ITYP     =  COPY OF CURRENT ITYPE
C          (I*4)  KMRK     =  POSITION MARKER IN THE STRING FOR PARENT
C                             L QUANTUM NUMBER
C          (R*8)  TWTA()   =  (2L+1) VALUE FOR PARENT L QUANTUM NUMBER
C          (C*1)  CTRMA()  =  PARENT L QUANTUM NUMBER LETTER SET
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          I4UNIT     ADAS      FETCH UNIT NUMBER FOR OUTPUT OF MESSAGES
C          R8FCTN     ADAS      CONVERTS FROM CHARACTER TO REAL VARIABLE
C          I4FCTN     ADAS      CONVERTS FROM CHAR. TO INTEGER  VARIABLE
C          XXWORD     ADAS      PARSES A STRING INTO SEPARATE WORDS
C                               FOR ' ()<>{}' DELIMITERS
C
C AUTHOR:  HP SUMMERS
C          K1/1/57
C          JET EXT. 4941
C
C DATE:    22/06/92
C
C UPDATE:   8/07/93 - HPS  ALTERED TO USE XXWORD PARSING ROUTINE
C
C UPDATE:  11/05/95 - HPS  ADD CPRTA TO PARAMETER LIST
C
C UPDATE:  13/11/95 - DHB  EXTENDED ROUTINE TO HANDLE J/ARBITRARY
C                          RESOLVED PARENT METASTABLE INFORMATION
C                          IN THE FIRST DATA CARD STRING. INTRODUCED
C                          ITYPE TO FLAG RESOLUTION IF REQUIRED.
C
C UPDATE:  21/12/95 - DHB  INCREASED SIZE OF IFIRST & ILAST TO 12 IN
C                          LINE WITH INCREASE TO NDMET
C
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 22-1-96
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - PUT UNDER SCCS CONTROL
C
C VERSION: 1.2                          DATE: 28-1-96
C MODIFIED: HPS + WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C               - PUT IN DEFAULT FOR NO PARENTS IN FILE.
C
C-----------------------------------------------------------------------
       INTEGER*4 NDMET
C
       CHARACTER STRING*(*)   , SSTRNG*15  , CTRMA(9)*1
       CHARACTER CDELIM*7     , CPRTA(NDMET)*9
C
       INTEGER*4 NPT          , IABT       , IC        , I     , IFAIL
```

```
      INTEGER*4 NFIRST       , MAXWRD     , IWORDS    , ITYPE , ITP
      INTEGER*4 IFIRST(12)   , ILAST(12)  , KMRK      , J     , K
      INTEGER*4 I4FCTN       , I4UNIT     , ITYP
C
      LOGICAL   LSETA(NDMET) , LFND
C
      REAL*8    BWNOA(NDMET) , PRTWTA(NDMET)          , TWTA(9)
      REAL*8    R8FCTN
C-----------------------------------------------------------------------
      DATA  CTRMA/ 'S' , 'P' , 'D' , 'F' , 'G' , 'H' , 'I' , 'J' , 'K'/
      DATA  TWTA / 1.0 , 3.0 , 5.0 , 7.0 , 9.0 , 11.0, 13.0, 15.0,17.0/
      DATA CDELIM/' ()<>{}'/
C-----------------------------------------------------------------------
```