NODE=B066

$N(1650)\ S_{11}$

$I(J^P) = \frac{1}{2}(\frac{1}{2}^-)$ Status: ∗∗∗∗

NODE=B066

Most of the results published before 1975 were last included in our 1982 edition, Physics Letters **111B** 1 (1982). Some further obsolete results published before 1984 were last included in our 2006 edition, Journal of Physics, G **33** 1 (2006).

N(1650) BREIT-WIGNER MASS

NODE=B066205

NODE=B066M

→ NOT CHECKED ←

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1645 to 1670 (≈ 1655) OUR ESTIMATE				
1634.7±1.1	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
1659 ±9	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N \pi\pi$
1650 ±30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1670 ±8	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1655 ±15	THOMA	08	DPWA	Multichannel
1651.2±4.7	ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
1665 ±2	PENNER	02C	DPWA	Multichannel
1647 ±20	BAI	01B	BES	$J/\psi \to p\overline{p}\eta$
1689 ±12	VRANA	00	DPWA	Multichannel
1677 ±8	ARNDT	96	IPWA	$\gamma N \to \pi N$
1667	ARNDT	95	DPWA	$\pi N \to N\pi$
1712	[1] ARNDT	95	DPWA	$\pi N \to N\pi$
1669 ±17	BATINIC	95	DPWA	$\pi N \to N\pi, N\eta$
1713 ±27	[2] BATINIC	95	DPWA	$\pi N \to N\pi, N\eta$
1674	LI	93	IPWA	$\gamma N \to \pi N$
1672	MUSETTE	80	IPWA	$\pi^- p \to \Lambda K^0$
1680	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$
1700	[3] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
1660	[4] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

OCCUR=2

OCCUR=2

N(1650) BREIT-WIGNER WIDTH

NODE=B066210

NODE=B066W

→ NOT CHECKED ←

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
145 to 185 (≈ 165) OUR ESTIMATE				
115.4±2.8	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
167.9±9.4	GREEN	97	DPWA	$\pi N \to \pi N, \eta N$
173 ±12	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N \pi\pi$
150 ±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
180 ±20	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
180 ±20	THOMA	08	DPWA	Multichannel
130.6±7.0	ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
138 ±7	PENNER	02C	DPWA	Multichannel
145 $^{+80}_{-45}$	BAI	01B	BES	$J/\psi \to p\overline{p}\eta$
202 ±40	VRANA	00	DPWA	Multichannel
160 ±12	ARNDT	96	IPWA	$\gamma N \to \pi N$
90	ARNDT	95	DPWA	$\pi N \to N\pi$
184	[1] ARNDT	95	DPWA	$\pi N \to N\pi$
215 ±32	BATINIC	95	DPWA	$\pi N \to N\pi, N\eta$
279 ±54	[2] BATINIC	95	DPWA	$\pi N \to N\pi, N\eta$
225	LI	93	IPWA	$\gamma N \to \pi N$
179	MUSETTE	80	IPWA	$\pi^- p \to \Lambda K^0$
120	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$
170	[3] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
130	[4] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

OCCUR=2

OCCUR=2

N(1650) POLE POSITION

NODE=B066215

REAL PART

NODE=B066RE

NODE=B066RE

→ NOT CHECKED ←

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1640 to 1670 (≈ 1655) OUR ESTIMATE				
1648	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
1670	[5] HOEHLER	93	ARGD	$\pi N \to \pi N$
1640±20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$

• • • We do not use the following data for averages, fits, limits, etc. • • •

1645±15		THOMA	08	DPWA	Multichannel
1653		ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
1663		VRANA	00	DPWA	Multichannel
1660±10	[6]	ARNDT	98	DPWA	$\pi N \to \pi N, \eta N$
1673		ARNDT	95	DPWA	$\pi N \to N\pi$
1689	[1]	ARNDT	95	DPWA	$\pi N \to N\pi$
1657		ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
1648 or 1651	[7]	LONGACRE	78	IPWA	$\pi N \to N\pi\pi$
1699 or 1698	[3]	LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

OCCUR=2

−2×IMAGINARY PART

NODE=B066IM
NODE=B066IM

VALUE (MeV)		*DOCUMENT ID*		*TECN*	*COMMENT*
150 to 180 (≈ 165) OUR ESTIMATE					
80		ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
163	[5]	HOEHLER	93	ARGD	$\pi N \to \pi N$
150±30		CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
187±20		THOMA	08	DPWA	Multichannel
182		ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
240		VRANA	00	DPWA	Multichannel
140±20	[6]	ARNDT	98	DPWA	$\pi N \to \pi N, \eta N$
82		ARNDT	95	DPWA	$\pi N \to N\pi$
192	[1]	ARNDT	95	DPWA	$\pi N \to N\pi$
160		ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
117 or 119	[7]	LONGACRE	78	IPWA	$\pi N \to N\pi\pi$
174 or 173	[3]	LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

→ NOT CHECKED ←

OCCUR=2

N(1650) ELASTIC POLE RESIDUE

NODE=B066220

MODULUS |*r*|

NODE=B066RER
NODE=B066RER

VALUE (MeV)		*DOCUMENT ID*		*TECN*	*COMMENT*
14		ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
39		HOEHLER	93	ARGD	$\pi N \to \pi N$
60±10		CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
69		ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
22		ARNDT	95	DPWA	$\pi N \to N\pi$
72	[1]	ARNDT	95	DPWA	$\pi N \to N\pi$
54		ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90

OCCUR=2

PHASE θ

NODE=B066IMR
NODE=B066IMR

VALUE (°)		*DOCUMENT ID*		*TECN*	*COMMENT*
−69		ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
−37		HOEHLER	93	ARGD	$\pi N \to \pi N$
−75±25		CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−55		ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
29		ARNDT	95	DPWA	$\pi N \to N\pi$
−85	[1]	ARNDT	95	DPWA	$\pi N \to N\pi$
−38		ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90

OCCUR=2

N(1650) DECAY MODES

NODE=B066225;NODE=B066

The following branching fractions are our estimates, not fits or averages.

NODE=B066

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$N\pi$	0.60 to 0.95	DESIG=1
Γ_2	$N\eta$	3–10 %	DESIG=2;OUR EST
Γ_3	ΛK	3–11 %	DESIG=3;OUR EST
Γ_4	ΣK		DESIG=4
Γ_5	$N\pi\pi$	10–20 %	DESIG=5;OUR EST
Γ_6	$\Delta\pi$	1–7 %	DESIG=181;OUR EST
Γ_7	$\Delta(1232)\pi$, D-wave		DESIG=6
Γ_8	$N\rho$	4–12 %	DESIG=182;OUR EST

Γ_9	$N\rho$, S=1/2, S-wave		DESIG=7
Γ_{10}	$N\rho$, S=3/2, D-wave		DESIG=8
Γ_{11}	$N(\pi\pi)^{I=0}_{S\text{-wave}}$	<4 %	DESIG=9;OUR EST
Γ_{12}	$N(1440)\pi$	<5 %	DESIG=10;OUR EST
Γ_{13}	$p\gamma$	0.04–0.18 %	DESIG=184;OUR EST
Γ_{14}	$p\gamma$, helicity=1/2	0.04–0.18 %	DESIG=11;OUR EST
Γ_{15}	$n\gamma$	0.003–0.17 %	DESIG=185;OUR EST
Γ_{16}	$n\gamma$, helicity=1/2	0.003–0.17 %	DESIG=12;OUR EST

N(1650) BRANCHING RATIOS

NODE=B066230

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

NODE=B066R1
NODE=B066R1
→ NOT CHECKED ←

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*	
0.60 to 0.95 OUR ESTIMATE					
1.0	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN	
0.735±0.011	GREEN	97	DPWA	$\pi N \to \pi N$, ηN	
0.89 ±0.07	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$	
0.65 ±0.10	CUTKOSKY	80	IPWA	$\pi N \to \pi N$	
0.61 ±0.04	HOEHLER	79	IPWA	$\pi N \to \pi N$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.70 ±0.15	THOMA	08	DPWA	Multichannel	
1.000	ARNDT	04	DPWA	$\pi N \to \pi N$, ηN	
0.65 ±0.04	PENNER	02C	DPWA	Multichannel	
0.74 ±0.02	VRANA	00	DPWA	Multichannel	
0.99	ARNDT	95	DPWA	$\pi N \to N\pi$	
0.27	[1] ARNDT	95	DPWA	$\pi N \to N\pi$	OCCUR=2
0.94 ±0.07	BATINIC	95	DPWA	$\pi N \to N\pi$, $N\eta$	
0.49 ±0.21	[2] BATINIC	95	DPWA	$\pi N \to N\pi$, $N\eta$	OCCUR=2

$\Gamma(N\eta)/\Gamma_{total}$ Γ_2/Γ

NODE=B066R13
NODE=B066R13

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*	
0.023±0.022 OUR AVERAGE Error includes scale factor of 4.3.					
0.010±0.006	PENNER	02C	DPWA	Multichannel	
0.06 ±0.01	VRANA	00	DPWA	Multichannel	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.15 ±0.06	THOMA	08	DPWA	Multichannel	
0.06 ±0.05	BATINIC	95	DPWA	$\pi N \to N\pi$, $N\eta$	
0.02 ±0.03	[2] BATINIC	95	DPWA	$\pi N \to N\pi$, $N\eta$	OCCUR=2

$\Gamma(\Lambda K)/\Gamma_{total}$ Γ_3/Γ

NODE=B066R19
NODE=B066R19

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.029±0.004 OUR AVERAGE Error includes scale factor of 1.2.				
0.04 ±0.01	SHKLYAR	05	DPWA	Multichannel
0.027±0.004	PENNER	02C	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1650) \to \Lambda K$ $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

NODE=B066R3
NODE=B066R3
→ NOT CHECKED ←

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
−0.27 to −0.17 OUR ESTIMATE				
−0.22	BELL	83	DPWA	$\pi^- p \to \Lambda K^0$
−0.22	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1650) \to \Sigma K$ $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

NODE=B066R4
NODE=B066R4

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.254	LIVANOS	80	DPWA	$\pi p \to \Sigma K$

Note: Signs of couplings from $\pi N \to N\pi\pi$ analyses were changed in the 1986 edition to agree with the baryon-first convention; the overall phase ambiguity is resolved by choosing a negative sign for the $\Delta(1620)$ S_{31} coupling to $\Delta(1232)\pi$.

NODE=B066310

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1650) \to \Delta(1232)\pi$, D-wave $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

NODE=B066R5
NODE=B066R5
→ NOT CHECKED ←

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
+0.15 to 0.23 OUR ESTIMATE				
+0.12±0.04	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
+0.29	[3,8] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
+0.15	[4] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
+0.26±0.14	THOMA	08	DPWA	Multichannel

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{total}$ — Γ_7/Γ

NODE=B066R16
NODE=B066R16

VALUE	DOCUMENT ID		TECN	COMMENT
0.02 ± 0.01	VRANA	00	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.10 ± 0.05	THOMA	08	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1650) \to N\rho$, S=1/2, S-wave — $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

NODE=B066R6
NODE=B066R6
→ NOT CHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
±0.03 to ±0.19 OUR ESTIMATE				
-0.01 ± 0.09	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
$+0.17$	[3,8] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
-0.16	[4] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

$\Gamma(N\rho, S{=}1/2, S\text{-wave})/\Gamma_{total}$ — Γ_9/Γ

NODE=B066R14
NODE=B066R14

VALUE	DOCUMENT ID		TECN	COMMENT
0.01 ± 0.01	VRANA	00	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1650) \to N\rho$, S=3/2, D-wave — $(\Gamma_1\Gamma_{10})^{1/2}/\Gamma$

NODE=B066R7
NODE=B066R7
→ NOT CHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
+0.17 to +0.29 OUR ESTIMATE				
$+0.16\pm0.06$	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
$+0.29$	[3,8] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$\Gamma(N\rho, S{=}3/2, D\text{-wave})/\Gamma_{total}$ — Γ_{10}/Γ

NODE=B066R15
NODE=B066R15

VALUE	DOCUMENT ID		TECN	COMMENT
0.13 ± 0.03	VRANA	00	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1650) \to N(\pi\pi)^{I=0}_{S\text{-wave}}$ — $(\Gamma_1\Gamma_{11})^{1/2}/\Gamma$

NODE=B066R8
NODE=B066R8
→ NOT CHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
+0.04 to +0.18 OUR ESTIMATE				
$+0.12\pm0.08$	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
0.00	[3,8] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
$+0.25$	[4] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

$\Gamma(N(\pi\pi)^{I=0}_{S\text{-wave}})/\Gamma_{total}$ — Γ_{11}/Γ

NODE=B066R17
NODE=B066R17

VALUE	DOCUMENT ID		TECN	COMMENT
0.01 ± 0.01	VRANA	00	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1650) \to N(1440)\pi$ — $(\Gamma_1\Gamma_{12})^{1/2}/\Gamma$

NODE=B066R9
NODE=B066R9

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.11\pm0.06$	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$

$\Gamma(N(1440)\pi)/\Gamma_{total}$ — Γ_{12}/Γ

NODE=B066R18
NODE=B066R18

VALUE	DOCUMENT ID		TECN	COMMENT
0.03 ± 0.01	VRANA	00	DPWA	Multichannel

$N(1650)$ PHOTON DECAY AMPLITUDES

NODE=B066235

Papers on γN amplitudes predating 1981 may be found in our 2006 edition, Journal of Physics, G **33** 1 (2006).

NODE=B066235

$N(1650) \to p\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B066A1
NODE=B066A1
→ NOT CHECKED ←

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
$+0.053\pm0.016$ OUR ESTIMATE				
0.022 ± 0.007	DUGGER	07	DPWA	$\gamma N \to \pi N$
0.069 ± 0.005	ARNDT	96	IPWA	$\gamma N \to \pi N$
0.033 ± 0.015	CRAWFORD	83	IPWA	$\gamma N \to \pi N$
0.050 ± 0.010	AWAJI	81	DPWA	$\gamma N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.033	DRECHSEL	07	DPWA	$\gamma N \to \pi N$
0.049	PENNER	02D	DPWA	Multichannel
0.068 ± 0.003	LI	93	IPWA	$\gamma N \to \pi N$
0.091	WADA	84	DPWA	Compton scattering

$N(1650) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B066A2
NODE=B066A2

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.015±0.021 OUR ESTIMATE				
−0.015±0.005	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
−0.008±0.004	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
0.004±0.004	FUJII	81	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.009	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
−0.011	PENNER	02D	DPWA	Multichannel
−0.002±0.002	LI	93	IPWA	$\gamma N \rightarrow \pi N$

→ NOT CHECKED ←

$N(1650)$ $\gamma p \rightarrow \Lambda K^+$ AMPLITUDES

NODE=B066240

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $p\gamma \rightarrow N(1650) \rightarrow \Lambda K^+$ (E_{0+} amplitude)

NODE=B066LK1
NODE=B066LK1

VALUE (units 10^{-3})	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
7.8 ±0.3	WORKMAN	90	DPWA
8.13	TANABE	89	DPWA

$p\gamma \rightarrow N(1650) \rightarrow \Lambda K^+$ phase angle θ (E_{0+} amplitude)

NODE=B066LP1
NODE=B066LP1

VALUE (degrees)	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−107 ±3	WORKMAN	90	DPWA
−107.8	TANABE	89	DPWA

$N(1650)$ FOOTNOTES

NODE=B066

[1] ARNDT 95 finds two distinct states. NODE=B066;LINKAGE=C

[2] BATINIC 95 finds two distinct states. This second resonance was associated with the $N(2090)$ S_{11}. NODE=B066;LINKAGE=A

[3] LONGACRE 77 pole positions are from a search for poles in the unitarized T-matrix; the first (second) value uses, in addition to $\pi N \rightarrow N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis. The other LONGACRE 77 values are from eyeball fits with Breit-Wigner circles to the T-matrix amplitudes. NODE=B066;LINKAGE=L7

[4] From method II of LONGACRE 75: eyeball fits with Breit-Wigner circles to the T-matrix amplitudes. NODE=B066;LINKAGE=L5

[5] See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of N and Δ resonances as determined from Argand diagrams of πN elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams. NODE=B010;LINKAGE=H9

[6] ARNDT 98 also lists pole residues, which display more model dependence than do the associated pole positions. NODE=B066;LINKAGE=AA

[7] LONGACRE 78 values are from a search for poles in the unitarized T-matrix. The first (second) value uses, in addition to $\pi N \rightarrow N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis. NODE=B066;LINKAGE=L8

[8] LONGACRE 77 considers this coupling to be well determined. NODE=B066;LINKAGE=X

$N(1650)$ REFERENCES

NODE=B066

For early references, see Physics Letters **111B** 1 (1982).

NODE=B066

THOMA	08	PL B659 87	U. Thoma *et al.*	(CB-ELSA Collab.)	REFID=52087
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator	(MAINZ, JINR)	REFID=52105
DUGGER	07	PR C76 025211	M. Dugger *et al.*	(Jefferson Lab CLAS Collab.)	REFID=52039
ARNDT	06	PR C74 045205	R.A. Arndt *et al.*	(GWU)	REFID=51535
PDG	06	JPG 33 1	W.-M. Yao *et al.*	(PDG Collab.)	REFID=51004
SHKLYAR	05	PR C72 015210	V. Shklyar, H. Lenske, U. Mosel	(GIES)	REFID=50977
ARNDT	04	PR C69 035213	R.A. Arndt *et al.*	(GWU, TRIU)	REFID=49947
PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)	REFID=49129
PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)	REFID=49130
BAI	01B	PL B510 75	J.Z. Bai *et al.*	(BES Collab.)	REFID=48266
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	(PITT+)	REFID=47593
ARNDT	98	PR C58 3636	R.A. Arndt *et al.*		REFID=46532
GREEN	97	PR C55 R2167	A.M. Green, S. Wycech	(HELS, WINR)	REFID=45462
ARNDT	96	PR C53 430	R.A. Arndt, I.I. Strakovsky, R.L. Workman	(VPI)	REFID=44675
ARNDT	95	PR C52 2120	R.A. Arndt *et al.*	(VPI, BRCO)	REFID=44535
BATINIC	95	PR C51 2310	M. Batinic *et al.*	(BOSK, UCLA)	REFID=44253
Also		PR C57 1004 (erratum)	M. Batinic *et al.*		REFID=46020
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)	REFID=43821
LI	93	PR C47 2759	Z.J. Li *et al.*	(VPI)	REFID=43327
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KENT) IJP	REFID=41535
Also		PR D30 904	D.M. Manley *et al.*	(VPI)	REFID=30071

ARNDT	91	PR D43 2131	R.A. Arndt *et al.*	(VPI, TELE) IJP	REFID=41467
WORKMAN	90	PR C42 781	R.L. Workman	(VPI)	REFID=43685
TANABE	89	PR C39 741	H. Tanabe, M. Kohno, C. Bennhold	(MANZ)	REFID=40997
Also		NC 102A 193	M. Kohno, H. Tanabe, C. Bennhold	(MANZ)	REFID=40998
WADA	84	NP B247 313	Y. Wada *et al.*	(INUS)	REFID=30072
BELL	83	NP B222 389	K.W. Bell *et al.*	(RL) IJP	REFID=30409
CRAWFORD	83	NP B211 1	R.L. Crawford, W.T. Morton	(GLAS)	REFID=30070
PDG	82	PL 111B 1	M. Roos *et al.*	(HELS, CIT, CERN)	REFID=41167
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)	REFID=30067
Also		NP B197 365	K. Fujii *et al.*	(NAGO)	REFID=30068
FUJII	81	NP B187 53	K. Fujii *et al.*	(NAGO, OSAK)	REFID=30069
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP	REFID=30064
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL) IJP	REFID=40096
LIVANOS	80	Toronto Conf. 35	P. Livanos *et al.*	(SACL) IJP	REFID=30402
MUSETTE	80	NC 57A 37	M. Musette	(BRUX) IJP	REFID=30403
SAXON	80	NP B162 522	D.H. Saxon *et al.*	(RHEL, BRIS) IJP	REFID=30404
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT) IJP	REFID=30058
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP	REFID=30859
LONGACRE	78	PR D17 1795	R.S. Longacre *et al.*	(LBL, SLAC)	REFID=30054
LONGACRE	77	NP B122 493	R.S. Longacre, J. Dolbeau	(SACL) IJP	REFID=30051
Also		NP B108 365	J. Dolbeau *et al.*	(SACL) IJP	REFID=30052
LONGACRE	75	PL 55B 415	R.S. Longacre *et al.*	(LBL, SLAC) IJP	REFID=30047