NODE=B015

$N(1720)\ P_{13}$

$I(J^P) = \frac{1}{2}(\frac{3}{2}^+)$ Status: ∗∗∗∗

NODE=B015

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(1720) BREIT-WIGNER MASS

NODE=B015205

NODE=B015M

→ NOT CHECKED ←

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1700 to 1750 (≈ 1720) OUR ESTIMATE				
1763.8 ± 4.6	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
1717 ± 31	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
1700 ± 50	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1710 ± 20	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1790 ±100	THOMA	08	DPWA	Multichannel
1749.6 ± 4.5	ARNDT	04	DPWA	$\pi N \rightarrow \pi N, \eta N$
1705 ± 10	PENNER	02C	DPWA	Multichannel
1716 ±112	VRANA	00	DPWA	Multichannel
1713 ± 10	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
1820	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
1711 ± 26	BATINIC	95	DPWA	$\pi N \rightarrow N\pi, N\eta$
1720	LI	93	IPWA	$\gamma N \rightarrow \pi N$
1690	SAXON	80	DPWA	$\pi^- p \rightarrow \Lambda K^0$
1750	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$
1720	[2] LONGACRE	75	IPWA	$\pi N \rightarrow N\pi\pi$

N(1720) BREIT-WIGNER WIDTH

NODE=B015210

NODE=B015W

→ NOT CHECKED ←

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
150 to 300 (≈ 200) OUR ESTIMATE				
210 ± 22	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
380 ± 180	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$
125 ± 70	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
190 ± 30	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
690 ± 100	THOMA	08	DPWA	Multichannel
256 ± 22	ARNDT	04	DPWA	$\pi N \rightarrow \pi N, \eta N$
237 ± 73	PENNER	02C	DPWA	Multichannel
121 ± 39	VRANA	00	DPWA	Multichannel
153 ± 15	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
354	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
235 ± 51	BATINIC	95	DPWA	$\pi N \rightarrow N\pi, N\eta$
200	LI	93	IPWA	$\gamma N \rightarrow \pi N$
120	SAXON	80	DPWA	$\pi^- p \rightarrow \Lambda K^0$
130	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$
150	[2] LONGACRE	75	IPWA	$\pi N \rightarrow N\pi\pi$

N(1720) POLE POSITION

NODE=B015215

REAL PART

NODE=B015RE

NODE=B015RE

→ NOT CHECKED ←

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1660 to 1690 (≈ 1675) OUR ESTIMATE				
1666	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
1686	[3] HOEHLER	93	SPED	$\pi N \rightarrow \pi N$
1680 ± 30	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1630 ± 90	THOMA	08	DPWA	Multichannel
1655	ARNDT	04	DPWA	$\pi N \rightarrow \pi N, \eta N$
1692	VRANA	00	DPWA	Multichannel
1717	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
1675	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
1716 or 1716	[4] LONGACRE	78	IPWA	$\pi N \rightarrow N\pi\pi$
1745 or 1748	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

NODE=B015IM
NODE=B015IM

−2×IMAGINARY PART

→ NOT CHECKED ←

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
115 to 275 OUR ESTIMATE				
355	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
187	[3] HOEHLER	93	SPED	$\pi N \to \pi N$
120±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
460±80	THOMA	08	DPWA	Multichannel
278	ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
94	VRANA	00	DPWA	Multichannel
388	ARNDT	95	DPWA	$\pi N \to N\pi$
114	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
124 or 126	[4] LONGACRE	78	IPWA	$\pi N \to N\pi\pi$
135 or 123	[1] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$N(1720)$ ELASTIC POLE RESIDUE

NODE=B015220

MODULUS $|r|$

NODE=B015RER
NODE=B015RER

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
25	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
15	HOEHLER	93	SPED	$\pi N \to \pi N$
8±2	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
20	ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
39	ARNDT	95	DPWA	$\pi N \to N\pi$
11	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90

PHASE θ

NODE=B015IMR
NODE=B015IMR

VALUE (°)	DOCUMENT ID		TECN	COMMENT
− 94	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
−160±30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
− 88	ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
− 70	ARNDT	95	DPWA	$\pi N \to N\pi$
−130	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90

$N(1720)$ DECAY MODES

NODE=B015225;NODE=B015

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

NODE=B015

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$N\pi$	10–20 %	DESIG=1;OUR EST
Γ_2	$N\eta$	(4.0±1.0) %	DESIG=2
Γ_3	ΛK	1–15 %	DESIG=3;OUR EST
Γ_4	ΣK		DESIG=4
Γ_5	$N\pi\pi$	>70 %	DESIG=5;OUR EST
Γ_6	$\Delta\pi$		DESIG=181
Γ_7	$\Delta(1232)\pi$, P-wave		DESIG=6
Γ_8	$N\rho$	70–85 %	DESIG=182;OUR EST
Γ_9	$N\rho$, S=1/2, P-wave		DESIG=7
Γ_{10}	$N\rho$, S=3/2, P-wave		DESIG=8
Γ_{11}	$N(\pi\pi)^{I=0}_{S\text{-wave}}$		DESIG=9
Γ_{12}	$p\gamma$	0.003–0.10 %	DESIG=184;OUR EST
Γ_{13}	$p\gamma$, helicity=1/2	0.003–0.08 %	DESIG=10;OUR EST
Γ_{14}	$p\gamma$, helicity=3/2	0.001–0.03 %	DESIG=11;OUR EST
Γ_{15}	$n\gamma$	0.002–0.39 %	DESIG=185;OUR EST
Γ_{16}	$n\gamma$, helicity=1/2	0.0–0.002 %	DESIG=12;OUR EST
Γ_{17}	$n\gamma$, helicity=3/2	0.001–0.39 %	DESIG=13;OUR EST

$N(1720)$ BRANCHING RATIOS

NODE=B015230

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

NODE=B015R1
NODE=B015R1
→ NOT CHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
0.10 to 0.20 OUR ESTIMATE				
0.094±0.005	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
0.13 ±0.05	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
0.10 ±0.04	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
0.14 ±0.03	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.09 ±0.06	THOMA	08	DPWA	Multichannel
0.190±0.004	ARNDT	04	DPWA	$\pi N \to \pi N, \eta N$
0.17 ±0.02	PENNER	02C	DPWA	Multichannel
0.05 ±0.05	VRANA	00	DPWA	Multichannel
0.16	ARNDT	95	DPWA	$\pi N \to N\pi$
0.18 ±0.04	BATINIC	95	DPWA	$\pi N \to N\pi, N\eta$

$\Gamma(N\eta)/\Gamma_{total}$ — Γ_2/Γ

NODE=B015R11
NODE=B015R11

VALUE	DOCUMENT ID		TECN	COMMENT
0.04 ±0.01	VRANA	00	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.10 ±0.07	THOMA	08	DPWA	Multichannel
0.002±0.002	PENNER	02C	DPWA	Multichannel
0.002±0.01	BATINIC	95	DPWA	$\pi N \to N\pi, N\eta$

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

NODE=B015R13
NODE=B015R13

VALUE	DOCUMENT ID		TECN	COMMENT
0.044±0.004 OUR AVERAGE				
0.043±0.004	SHKLYAR	05	DPWA	Multichannel
0.09 ±0.03	PENNER	02C	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.12 ±0.09	THOMA	08	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1720) \to \Lambda K$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

NODE=B015R3
NODE=B015R3
→ NOT CHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
−0.14 to −0.06 OUR ESTIMATE				
−0.09	BELL	83	DPWA	$\pi^- p \to \Lambda K^0$
−0.11	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$

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=B015310

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1720) \to \Delta(1232)\pi$, P-wave — $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

NODE=B015R5
NODE=B015R5
→ NOT CHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
±0.27 to ±0.37 OUR ESTIMATE				
−0.17	[1] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1720) \to N\rho$, S=1/2, P-wave — $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

NODE=B015R6
NODE=B015R6

VALUE	DOCUMENT ID		TECN	COMMENT
+0.34±0.05	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
−0.26	[1] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
+0.40	[2] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

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

NODE=B015R12
NODE=B015R12

VALUE	DOCUMENT ID		TECN	COMMENT
0.91±0.01	VRANA	00	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1720) \to N\rho$, S=3/2, P-wave — $(\Gamma_1\Gamma_{10})^{1/2}/\Gamma$

NODE=B015R7
NODE=B015R7

VALUE	DOCUMENT ID		TECN	COMMENT
+0.15	[1] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1720) \to N(\pi\pi)^{I=0}_{S\text{-wave}}$ — $(\Gamma_1\Gamma_{11})^{1/2}/\Gamma$

NODE=B015R8
NODE=B015R8

VALUE	DOCUMENT ID		TECN	COMMENT
−0.19	[1] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$N(1720)$ PHOTON DECAY AMPLITUDES

NODE=B015235

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

NODE=B015235

$N(1720) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B015A1
NODE=B015A1

→ NOT CHECKED ←

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
+0.018±0.030 OUR ESTIMATE				
0.097±0.003	DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
−0.015±0.015	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
0.044±0.066	CRAWFORD	83	IPWA	$\gamma N \rightarrow \pi N$
−0.004±0.007	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.073	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
−0.053	PENNER	02D	DPWA	Multichannel
0.012±0.003	LI	93	IPWA	$\gamma N \rightarrow \pi N$

$N(1720) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

NODE=B015A2
NODE=B015A2

→ NOT CHECKED ←

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.019±0.020 OUR ESTIMATE				
0.007±0.010	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
−0.024±0.006	CRAWFORD	83	IPWA	$\gamma N \rightarrow \pi N$
−0.040±0.016	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.011	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
0.027	PENNER	02D	DPWA	Multichannel
−0.022±0.003	LI	93	IPWA	$\gamma N \rightarrow \pi N$

$N(1720) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

NODE=B015A3
NODE=B015A3

→ NOT CHECKED ←

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
+0.001±0.015 OUR ESTIMATE				
−0.039±0.003	DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
0.007±0.015	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
0.002±0.005	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.003	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
−0.004	PENNER	02D	DPWA	Multichannel
0.050±0.004	LI	93	IPWA	$\gamma N \rightarrow \pi N$

$N(1720) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

NODE=B015A4
NODE=B015A4

→ NOT CHECKED ←

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.029±0.061 OUR ESTIMATE				
−0.005±0.025	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
−0.015±0.019	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.031	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
0.003	PENNER	02D	DPWA	Multichannel
−0.017±0.004	LI	93	IPWA	$\gamma N \rightarrow \pi N$

$N(1720)$ $\gamma p \rightarrow \Lambda K^+$ AMPLITUDES

NODE=B015240

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $p\gamma \rightarrow N(1720) \rightarrow \Lambda K^+$ (E_{1+} amplitude)

NODE=B015LK1
NODE=B015LK1

VALUE (units 10^{-3})	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
10.2 ±0.2	WORKMAN	90	DPWA
9.52	TANABE	89	DPWA

$p\gamma \rightarrow N(1720) \rightarrow \Lambda K^+$ phase angle θ (E_{1+} amplitude)

NODE=B015LP1
NODE=B015LP1

VALUE (degrees)	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−124 ±2	WORKMAN	90	DPWA
−103.4	TANABE	89	DPWA

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $p\gamma \to N(1720) \to \Lambda K^+$ (M_{1+} amplitude)

NODE=B015LK2
NODE=B015LK2

VALUE (units 10^{-3})	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-4.5 ± 0.2	WORKMAN	90	DPWA
3.18	TANABE	89	DPWA

N(1720) FOOTNOTES

NODE=B015

[1] LONGACRE 77 pole positions are from a search for poles in the unitarized T-matrix; the first (second) value uses, in addition to $\pi N \to N\pi\pi$ 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=B015;LINKAGE=L7

[2] From method II of LONGACRE 75: eyeball fits with Breit-Wigner circles to the T-matrix amplitudes. NODE=B015;LINKAGE=L5

[3] 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

[4] LONGACRE 78 values are from a search for poles in the unitarized T-matrix. The first (second) value uses, in addition to $\pi N \to N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis. NODE=B015;LINKAGE=L8

N(1720) REFERENCES

NODE=B015

For early references, see Physics Letters **111B** 1 (1982). NODE=B015

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
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	(PITT+)	REFID=47593
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
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
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
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