$N(1700)\ D_{13}$

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

Most of the results published before 1975 are now obsolete and have been omitted. They may be found in our 1982 edition, Physics Letters **111B** (1982).

The various partial-wave analyses do not agree very well.

N(1700) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1650 to 1750 (≈ 1700) OUR ESTIMATE				
1737±44	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N \pi \pi$
1675±25	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1731±15	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1736±33	VRANA	00	DPWA	Multichannel
1791±46	BATINIC	95	DPWA	$\pi N \to N \pi$, $N \eta$
1709	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
1650	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$
1690 to 1710	BAKER	78	DPWA	$\pi^- p \to \Lambda K^0$
1719	BARBOUR	78	DPWA	$\gamma N \to \pi N$
1670±10	[1] BAKER	77	IPWA	$\pi^- p \to \Lambda K^0$
1690	[1] BAKER	77	DPWA	$\pi^- p \to \Lambda K^0$
1660	[2] LONGACRE	77	IPWA	$\pi N \to N \pi \pi$
1710	[3] LONGACRE	75	IPWA	$\pi N \to N \pi \pi$

N(1700) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
50 to 150 (≈ 100) OUR ESTIMATE				
250±220	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N \pi \pi$
90± 40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
110± 30	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
175±133	VRANA	00	DPWA	Multichannel
215± 60	BATINIC	95	DPWA	$\pi N \to N \pi$, $N \eta$
166	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
70	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$
70 to 100	BAKER	78	DPWA	$\pi^- p \to \Lambda K^0$
126	BARBOUR	78	DPWA	$\gamma N \to \pi N$
90± 25	[1] BAKER	77	IPWA	$\pi^- p \to \Lambda K^0$
100	[1] BAKER	77	DPWA	$\pi^- p \to \Lambda K^0$
600	[2] LONGACRE	77	IPWA	$\pi N \to N \pi \pi$
300	[3] LONGACRE	75	IPWA	$\pi N \to N \pi \pi$

$N(1700)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1630 to 1730 (≈ 1680) OUR ESTIMATE				
1700	[4] HOEHLER	93	SPED	$\pi N \to \pi N$
1660±30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1704	VRANA	00	DPWA	Multichannel
not seen	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
1710 or 1678	[5] LONGACRE	78	IPWA	$\pi N \to N \pi\pi$
1616 or 1613	[2] LONGACRE	77	IPWA	$\pi N \to N \pi\pi$

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
50 to 150 (≈ 100) OUR ESTIMATE				
120	[4] HOEHLER	93	SPED	$\pi N \to \pi N$
90±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
156	VRANA	00	DPWA	Multichannel
not seen	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
607 or 567	[5] LONGACRE	78	IPWA	$\pi N \to N \pi\pi$
577 or 575	[2] LONGACRE	77	IPWA	$\pi N \to N \pi\pi$

$N(1700)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
5	HOEHLER	93	SPED	$\pi N \to \pi N$
6±3	CUTKOSKY	80	IPWA	$\pi N \to \pi N$

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
0±50	CUTKOSKY	80	IPWA	$\pi N \to \pi N$

$N(1700)$ DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	5–15 %
Γ_2	$N\eta$	(0.0±1.0) %
Γ_3	ΛK	<3 %
Γ_4	ΣK	
Γ_5	$N\pi\pi$	85–95 %
Γ_6	$\Delta\pi$	
Γ_7	$\Delta(1232)\pi$, S-wave	
Γ_8	$\Delta(1232)\pi$, D-wave	
Γ_9	$N\rho$	<35 %

Γ_{10}	$N\rho$, S=1/2, D-wave	
Γ_{11}	$N\rho$, S=3/2, S-wave	
Γ_{12}	$N\rho$, S=3/2, D-wave	
Γ_{13}	$N(\pi\pi)^{I=0}_{S\text{-wave}}$	
Γ_{14}	$p\gamma$	0.01–0.05 %
Γ_{15}	$p\gamma$, helicity=1/2	0.0–0.024 %
Γ_{16}	$p\gamma$, helicity=3/2	0.002–0.026 %
Γ_{17}	$n\gamma$	0.01–0.13 %
Γ_{18}	$n\gamma$, helicity=1/2	0.0–0.09 %
Γ_{19}	$n\gamma$, helicity=3/2	0.01–0.05 %

$N(1700)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ $\quad\Gamma_1/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.05 to 0.15 OUR ESTIMATE				
0.01±0.02	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
0.11±0.05	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
0.08±0.03	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.04±0.02	VRANA	00	DPWA	Multichannel
0.04±0.05	BATINIC	95	DPWA	$\pi N \to N\pi$, $N\eta$

$\Gamma(N\eta)/\Gamma_{total}$ $\quad\Gamma_2/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.00±0.01	VRANA	00	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.10±0.06	BATINIC	95	DPWA	$\pi N \to N\pi$, $N\eta$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1700) \to \Lambda K$ $\quad(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
−0.06 to +0.04 OUR ESTIMATE				
−0.012	BELL	83	DPWA	$\pi^- p \to \Lambda K^0$
−0.012	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.04	[6] BAKER	78	DPWA	See SAXON 80
−0.03 ±0.004	[1] BAKER	77	IPWA	$\pi^- p \to \Lambda K^0$
−0.03	[1] BAKER	77	DPWA	$\pi^- p \to \Lambda K^0$
+0.026±0.019	DEVENISH	74B		Fixed-t dispersion rel.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1700) \to \Sigma K$ $\quad(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	LIVANOS	80	DPWA	$\pi p \to \Sigma K$
<0.017	[7] DEANS	75	DPWA	$\pi N \to \Sigma K$

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 $\Delta(1232)\pi$.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1700) \to \Delta(1232)\pi$, S-wave — $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.00 to ±0.08 OUR ESTIMATE				
+0.02±0.03	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
0.00	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
−0.16	[3] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.11±0.01	VRANA	00	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1700) \to \Delta(1232)\pi$, D-wave — $(\Gamma_1\Gamma_8)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
±0.04 to ±0.20 OUR ESTIMATE				
+0.10±0.09	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
−0.12	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
+0.14	[3] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

$\Gamma(\Delta(1232)\pi$, D-wave$)/\Gamma_{total}$ — Γ_8/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.79±0.56	VRANA	00	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1700) \to N\rho$, S=3/2, S-wave — $(\Gamma_1\Gamma_{11})^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
±0.01 to ±0.13 OUR ESTIMATE				
−0.04±0.06	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
−0.07	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
+0.07	[3] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

$\Gamma(N\rho$, S=3/2, S-wave$)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.07±0.01	VRANA	00	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1700) \to N(\pi\pi)^{I=0}_{S\text{-wave}}$ — $(\Gamma_1\Gamma_{13})^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
±0.02 to ±0.28 OUR ESTIMATE				
+0.02±0.02	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
0.00	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
+0.2	[3] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

$\Gamma(N(\pi\pi)^{I=0}_{S\text{-wave}})/\Gamma_{total}$ — Γ_{13}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.00±0.01	VRANA	00	DPWA	Multichannel

$N(1700)$ PHOTON DECAY AMPLITUDES

$N(1700) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.018±0.013 OUR ESTIMATE				
−0.016±0.014	CRAWFORD	83	IPWA	$\gamma N \rightarrow \pi N$
−0.002±0.013	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
−0.028±0.007	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
−0.029±0.006	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
−0.024±0.019	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.033±0.021	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$
−0.014±0.025	FELLER	76	DPWA	$\gamma N \rightarrow \pi N$

$N(1700) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.002±0.024 OUR ESTIMATE				
−0.009±0.012	CRAWFORD	83	IPWA	$\gamma N \rightarrow \pi N$
0.029±0.014	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
−0.002±0.005	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
0.014±0.005	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
−0.017±0.014	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.014±0.025	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$
0.0 ±0.014	FELLER	76	DPWA	$\gamma N \rightarrow \pi N$

$N(1700) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.000±0.050 OUR ESTIMATE				
0.006±0.024	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
−0.002±0.013	FUJII	81	DPWA	$\gamma N \rightarrow \pi N$
−0.052±0.030	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
−0.055±0.030	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
0.052±0.035	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
+0.050±0.042	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$

$N(1700) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.003±0.044 OUR ESTIMATE				
−0.033±0.017	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
0.018±0.018	FUJII	81	DPWA	$\gamma N \rightarrow \pi N$
−0.037±0.036	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
−0.035±0.024	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
0.041±0.030	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
+0.035±0.030	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$

$N(1700)$ $\gamma p \to \Lambda K^+$ AMPLITUDES

$(\Gamma_i \Gamma_f)^{½} / \Gamma_{total}$ in $p\gamma \to N(1700) \to \Lambda K^+$ (E_{2-} amplitude)

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

$(\Gamma_i \Gamma_f)^{½} / \Gamma_{total}$ in $p\gamma \to N(1700) \to \Lambda K^+$ (M_{2-} amplitude)

VALUE (units 10^{-3})	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−7.09	TANABE	89	DPWA

$p\gamma \to N(1700) \to \Lambda K^+$ phase angle θ (E_{2-} amplitude)

VALUE (degrees)	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−35.9	TANABE	89	DPWA

$N(1700)$ FOOTNOTES

[1] The two BAKER 77 entries are from an IPWA using the Barrelet-zero method and from a conventional energy-dependent analysis.

[2] 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.

[3] From method II of LONGACRE 75: eyeball fits with Breit-Wigner circles to the T-matrix amplitudes.

[4] 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.

[5] 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.

[6] The overall phase of BAKER 78 couplings has been changed to agree with previous conventions.

[7] The range given is from the four best solutions.

$N(1700)$ REFERENCES

For early references, see Physics Letters **111B** 70 (1982).

VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	(PITT+)
BATINIC	95	PR C51 2310	M. Batinic *et al.*	(BOSK, UCLA)
Also		PR C57 1004 (erratum)	M. Batinic *et al.*	
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KENT) IJP
Also		PR D30 904	D.M. Manley *et al.*	(VPI)
ARNDT	91	PR D43 2131	R.A. Arndt *et al.*	(VPI, TELE) IJP
TANABE	89	PR C39 741	H. Tanabe, M. Kohno, C. Bennhold	(MANZ)
Also		NC 102A 193	M. Kohno, H. Tanabe, C. Bennhold	(MANZ)
BELL	83	NP B222 389	K.W. Bell *et al.*	(RL) IJP
CRAWFORD	83	NP B211 1	R.L. Crawford, W.T. Morton	(GLAS)
PDG	82	PL 111B	M. Roos *et al.*	(HELS, CIT, CERN)
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)
Also		NP B197 365	K. Fujii *et al.*	(NAGO)

FUJII	81	NP B187 53	K. Fujii *et al.*	(NAGO, OSAK)
ARAI	80	Toronto Conf. 93	I. Arai	(INUS)
Also		NP B194 251	I. Arai, H. Fujii	(INUS)
CRAWFORD	80	Toronto Conf. 107	R.L. Crawford	(GLAS)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
LIVANOS	80	Toronto Conf. 35	P. Livanos *et al.*	(SACL) IJP
SAXON	80	NP B162 522	D.H. Saxon *et al.*	(RHEL, BRIS) IJP
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP
BAKER	78	NP B141 29	R.D. Baker *et al.*	(RL, CAVE) IJP
BARBOUR	78	NP B141 253	I.M. Barbour, R.L. Crawford, N.H. Parsons	(GLAS)
LONGACRE	78	PR D17 1795	R.S. Longacre *et al.*	(LBL, SLAC)
BAKER	77	NP B126 365	R.D. Baker *et al.*	(RHEL) IJP
LONGACRE	77	NP B122 493	R.S. Longacre, J. Dolbeau	(SACL) IJP
Also		NP B108 365	J. Dolbeau *et al.*	(SACL) IJP
FELLER	76	NP B104 219	P. Feller *et al.*	(NAGO, OSAK) IJP
DEANS	75	NP B96 90	S.R. Deans *et al.*	(SFLA, ALAH) IJP
LONGACRE	75	PL 55B 415	R.S. Longacre *et al.*	(LBL, SLAC) IJP
DEVENISH	74B	NP B81 330	R.C.E. Devenish, C.D. Froggatt, B.R. Martin	(DESY+)