$N(1675)\ D_{15}$

$I(J^P) = \frac{1}{2}(\frac{5}{2}^-)$ 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).

N(1675) BREIT-WIGNER MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1670 to 1685 (≈ 1675) OUR ESTIMATE				
1676± 2	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
1675±10	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1679± 8	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1685± 4	VRANA	00	DPWA	Multichannel
1673± 5	ARNDT	96	IPWA	$\gamma N \to \pi N$
1673	ARNDT	95	DPWA	$\pi N \to N\pi$
1683±19	BATINIC	95	DPWA	$\pi N \to N\pi$, $N\eta$
1666	LI	93	IPWA	$\gamma N \to \pi N$
1685	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
1670	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$
1680	BARBOUR	78	DPWA	$\gamma N \to \pi N$
1650	[1] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
1660	[2] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

N(1675) BREIT-WIGNER WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
140 to 180 (≈ 150) OUR ESTIMATE				
159± 7	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
160±20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
120±15	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
131±10	VRANA	00	DPWA	Multichannel
154± 7	ARNDT	96	IPWA	$\gamma N \to \pi N$
154	ARNDT	95	DPWA	$\pi N \to N\pi$
142±23	BATINIC	95	DPWA	$\pi N \to N\pi$, $N\eta$
136	LI	93	IPWA	$\gamma N \to \pi N$
191	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
40	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$
88	BAKER	79	DPWA	$\pi^- p \to n\eta$
192	BARBOUR	78	DPWA	$\gamma N \to \pi N$
130	[1] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
150	[2] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$

N(1675) POLE POSITION

REAL PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1655 to 1665 (≈ 1660) OUR ESTIMATE				
1663	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
1656	[3] HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
1660±10	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1674	VRANA	00	DPWA	Multichannel
1655	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
1663 or 1668	[4] LONGACRE	78	IPWA	$\pi N \rightarrow N\pi\pi$
1649 or 1650	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

−2×IMAGINARY PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
125 to 155 (≈ 140) OUR ESTIMATE				
152	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
126	[3] HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
140±10	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
120	VRANA	00	DPWA	Multichannel
124	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
146 or 171	[4] LONGACRE	78	IPWA	$\pi N \rightarrow N\pi\pi$
127 or 127	[1] LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

N(1675) ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
29	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
23	HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
31±5	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
28	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90

PHASE θ

VALUE (°)	*DOCUMENT ID*		*TECN*	*COMMENT*
− 6	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
−22	HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
−30±10	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−17	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90

N(1675) DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	40–50 %
Γ_2	$N\eta$	(0.0 ± 1.0) %
Γ_3	ΛK	<1 %
Γ_4	ΣK	
Γ_5	$N\pi\pi$	50–60 %
Γ_6	$\Delta\pi$	50–60 %
Γ_7	$\Delta(1232)\pi$, D-wave	
Γ_8	$\Delta(1232)\pi$, G-wave	
Γ_9	$N\rho$	$<$ 1–3 %
Γ_{10}	$N\rho$, $S=1/2$, D-wave	
Γ_{11}	$N\rho$, $S=3/2$, D-wave	
Γ_{12}	$N\rho$, $S=3/2$, G-wave	
Γ_{13}	$N(\pi\pi)^{I=0}_{S\text{-wave}}$	
Γ_{14}	$p\gamma$	0.004–0.023 %
Γ_{15}	$p\gamma$, helicity=1/2	0.0–0.015 %
Γ_{16}	$p\gamma$, helicity=3/2	0.0–0.011 %
Γ_{17}	$n\gamma$	0.02–0.12 %
Γ_{18}	$n\gamma$, helicity=1/2	0.006–0.046 %
Γ_{19}	$n\gamma$, helicity=3/2	0.01–0.08 %

N(1675) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.4 to 0.5 OUR ESTIMATE				
0.47 ± 0.02	MANLEY	92	IPWA	$\pi N\to\pi N$ & $N\pi\pi$
0.38 ± 0.05	CUTKOSKY	80	IPWA	$\pi N\to\pi N$
0.38 ± 0.03	HOEHLER	79	IPWA	$\pi N\to\pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.35 ± 0.01	VRANA	00	DPWA	Multichannel
0.38	ARNDT	95	DPWA	$\pi N\to N\pi$
0.31 ± 0.06	BATINIC	95	DPWA	$\pi N\to N\pi$, $N\eta$

$\Gamma(N\eta)/\Gamma_{total}$ Γ_2/Γ

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. • • •				
0.001 ± 0.001	BATINIC	95	DPWA	$\pi N\to N\pi$, $N\eta$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1675) \to N\eta$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.07	BAKER	79	DPWA	$\pi^- p \to n\eta$
$+0.009$	FELTESSE	75	DPWA	Soln A; see BAKER 79

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1675) \to \Lambda K$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
±0.04 to ±0.08 OUR ESTIMATE				
-0.01	BELL	83	DPWA	$\pi^- p \to \Lambda K^0$
$+0.036$	[5] SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.034 ± 0.006	DEVENISH	74B		Fixed-t dispersion rel.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1675) \to \Sigma K$ — $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.003	[6] 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 $N\pi \to N(1675) \to \Delta(1232)\pi$, D-wave — $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.46$ to $+0.50$ OUR ESTIMATE				
$+0.496\pm0.003$	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
$+0.46$	[1,7] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
$+0.50$	[2] LONGACRE	75	IPWA	$\pi N \to N\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$+0.5$	[8] NOVOSELLER	78	IPWA	$\pi N \to N\pi\pi$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.63 ± 0.02	VRANA	00	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1675) \to N\rho$, S=1/2, D-wave — $(\Gamma_1\Gamma_{10})^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.04\pm0.02$	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$

$\Gamma(N\rho, S=1/2, D\text{-wave})/\Gamma_{total}$ — Γ_{10}/Γ

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

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1675) \to N\rho$, S=3/2, D-wave — $(\Gamma_1\Gamma_{11})^{1/2}/\Gamma$

VALUE		DOCUMENT ID		TECN	COMMENT
−0.12 to −0.06 OUR ESTIMATE					
−0.03±0.02		MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
−0.15	[1,7]	LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

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

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

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(1675) \to N(\pi\pi)^{I=0}_{S\text{-wave}}$ — $(\Gamma_1\Gamma_{13})^{1/2}/\Gamma$

VALUE		DOCUMENT ID		TECN	COMMENT
+0.03	[1,7]	LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

N(1675) PHOTON DECAY AMPLITUDES

$N(1675) \to p\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
+0.019±0.008 OUR ESTIMATE				
0.015±0.010	ARNDT	96	IPWA	$\gamma N \to \pi N$
0.021±0.011	CRAWFORD	83	IPWA	$\gamma N \to \pi N$
0.034±0.005	AWAJI	81	DPWA	$\gamma N \to \pi N$
0.006±0.005	ARAI	80	DPWA	$\gamma N \to \pi N$ (fit 1)
0.006±0.004	ARAI	80	DPWA	$\gamma N \to \pi N$ (fit 2)
0.023±0.015	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.012±0.002	LI	93	IPWA	$\gamma N \to \pi N$
+0.022±0.010	BARBOUR	78	DPWA	$\gamma N \to \pi N$
+0.034±0.004	FELLER	76	DPWA	$\gamma N \to \pi N$

$N(1675) \to p\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
+0.015±0.009 OUR ESTIMATE				
0.010±0.007	ARNDT	96	IPWA	$\gamma N \to \pi N$
0.015±0.009	CRAWFORD	83	IPWA	$\gamma N \to \pi N$
0.024±0.008	AWAJI	81	DPWA	$\gamma N \to \pi N$
0.030±0.004	ARAI	80	DPWA	$\gamma N \to \pi N$ (fit 1)
0.029±0.004	ARAI	80	DPWA	$\gamma N \to \pi N$ (fit 2)
0.003±0.012	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.021±0.002	LI	93	IPWA	$\gamma N \to \pi N$
+0.015±0.006	BARBOUR	78	DPWA	$\gamma N \to \pi N$
+0.019±0.009	FELLER	76	DPWA	$\gamma N \to \pi N$

$N(1675) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\mathrm{GeV}^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.043±0.012 OUR ESTIMATE				
−0.049±0.010	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
−0.057±0.024	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
−0.033±0.004	FUJII	81	DPWA	$\gamma N \rightarrow \pi N$
−0.039±0.017	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
−0.025±0.027	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
−0.059±0.015	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
−0.021±0.011	TAKEDA	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.060±0.003	LI	93	IPWA	$\gamma N \rightarrow \pi N$
−0.066±0.020	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$

$N(1675) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($\mathrm{GeV}^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.058±0.013 OUR ESTIMATE				
−0.051±0.010	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
−0.077±0.018	AWAJI	81	DPWA	$\gamma N \rightarrow \pi N$
−0.069±0.004	FUJII	81	DPWA	$\gamma N \rightarrow \pi N$
−0.066±0.026	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 1)
−0.071±0.022	ARAI	80	DPWA	$\gamma N \rightarrow \pi N$ (fit 2)
−0.059±0.020	CRAWFORD	80	DPWA	$\gamma N \rightarrow \pi N$
−0.030±0.012	TAKEDA	80	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.074±0.003	LI	93	IPWA	$\gamma N \rightarrow \pi N$
−0.073±0.014	BARBOUR	78	DPWA	$\gamma N \rightarrow \pi N$

N(1675) FOOTNOTES

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

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

[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.

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

[5] SAXON 80 finds the coupling phase is near 90°.

[6] The range given is from the four best solutions. DEANS 75 disagrees with $\pi^+ p \rightarrow \Sigma^+ K^+$ data of WINNIK 77 around 1920 MeV.

[7] LONGACRE 77 considers this coupling to be well determined.

[8] A Breit-Wigner fit to the HERNDON 75 IPWA.

N(1675) 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+)
ARNDT	96	PR C53 430	R.A. Arndt, I.I. Strakovsky, R.L. Workman	(VPI)
ARNDT	95	PR C52 2120	R.A. Arndt *et al.*	(VPI, BRCO)
BATINIC	95	PR C51 2310	M. Batinic *et al.*	(BOSK, UCLA)
Also	98	PR C57 1004 (erratum)	M. Batinic *et al.*	
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)
LI	93	PR C47 2759	Z.J. Li *et al.*	(VPI)
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KENT) IJP
Also	84	PR D30 904	D.M. Manley *et al.*	(VPI)
ARNDT	91	PR D43 2131	R.A. Arndt *et al.*	(VPI, TELE) IJP
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	82	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	82	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	79	PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
SAXON	80	NP B162 522	D.H. Saxon *et al.*	(RHEL, BRIS) IJP
TAKEDA	80	NP B168 17	H. Takeda *et al.*	(TOKY, INUS)
BAKER	79	NP B156 93	R.D. Baker *et al.*	(RHEL) IJP
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT) IJP
Also	80	Toronto Conf. 3	R. Koch	(KARLT) 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)
NOVOSELLER	78	NP B137 509	D.E. Novoseller	(CIT) IJP
Also	78B	NP B137 445	D.E. Novoseller	(CIT) IJP
LONGACRE	77	NP B122 493	R.S. Longacre, J. Dolbeau	(SACL) IJP
Also	76	NP B108 365	J. Dolbeau *et al.*	(SACL) IJP
WINNIK	77	NP B128 66	M. Winnik *et al.*	(HAIF) I
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
FELTESSE	75	NP B93 242	J. Feltesse *et al.*	(SACL) IJP
HERNDON	75	PR D11 3183	D. Herndon *et al.*	(LBL, SLAC)
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+)