

$N(1535) 1/2^-$ $I(J^P) = \frac{1}{2}(\frac{1}{2}^-)$ Status: ****

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* **G33** 1 (2006).

 $N(1535)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1525 to 1545 (≈ 1535) OUR ESTIMATE			
1526 ± 2	SHKLYAR	13	DPWA Multichannel
1519 ± 5	ANISOVICH	12A	DPWA Multichannel
1547.0 ± 0.7	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1550 ± 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1526 ± 7	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1538 ± 1	SHRESTHA	12A	DPWA Multichannel
1535 ± 20	ANISOVICH	10	DPWA Multichannel
1553 ± 8	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
1548 ± 15	THOMA	08	DPWA Multichannel
1546.7 ± 2.2	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
1526 ± 2	PENNER	02C	DPWA Multichannel
1530 ± 10	BAI	01B	BES $J/\psi \rightarrow p\bar{p}\eta$
1522 ± 11	THOMPSON	01	CLAS $\gamma^* p \rightarrow p\eta$
1542 ± 3	VRANA	00	DPWA Multichannel
1532 ± 5	ARMSTRONG	99B	DPWA $\gamma^* p \rightarrow p\eta$
1549.0 ± 2.1	ABAEV	96	DPWA $\pi^- p \rightarrow \eta n$
1525 ± 10	ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
1535	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
1544 ± 13	KRUSCHE	95	DPWA $\gamma p \rightarrow p\eta$
1518	LI	93	IPWA $\gamma N \rightarrow \pi N$
1534 ± 7	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
1520	¹ LONGACRE	77	IPWA $\pi N \rightarrow N\pi\pi$
1510	² LONGACRE	75	IPWA $\pi N \rightarrow N\pi\pi$

 $N(1535)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
125 to 175 (≈ 150) OUR ESTIMATE			
131 ± 12	SHKLYAR	13	DPWA Multichannel
128 ± 14	ANISOVICH	12A	DPWA Multichannel
188.4 ± 3.8	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
148.2 ± 8.1	GREEN	97	DPWA $\pi N \rightarrow \pi N, \eta N$
240 ± 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
120 ± 20	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$

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

141 ± 4	SHRESTHA	12A	DPWA	Multichannel
170 ± 35	ANISOVICH	10	DPWA	Multichannel
182 ± 25	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
170 ± 20	THOMA	08	DPWA	Multichannel
178.0 ± 11.6	ARNDT	04	DPWA	$\pi N \rightarrow \pi N, \eta N$
129 ± 8	PENNER	02C	DPWA	Multichannel
95 ± 25	BAI	01B	BES	$J/\psi \rightarrow p\bar{p}\eta$
143 ± 18	THOMPSON	01	CLAS	$\gamma^* p \rightarrow p\eta$
112 ± 19	VRANA	00	DPWA	Multichannel
154 ± 20	ARMSTRONG	99B	DPWA	$\gamma^* p \rightarrow p\eta$
212 ± 20	³ KRUSCHE	97	DPWA	$\gamma N \rightarrow \eta N$
168.8 ± 11.6	ABAEV	96	DPWA	$\pi^- p \rightarrow \eta n$
103 ± 5	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
66	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
200 ± 40	KRUSCHE	95	DPWA	$\gamma p \rightarrow p\eta$
84	LI	93	IPWA	$\gamma N \rightarrow \pi N$
151 ± 27	MANLEY	92	IPWA	$\pi N \rightarrow \pi N \& N\pi\pi$
135	¹ LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$
100	² LONGACRE	75	IPWA	$\pi N \rightarrow N\pi\pi$

N(1535) POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1490 to 1530 (\approx 1510) OUR ESTIMATE			
1509 ± 4 ± 2	⁴ SVARC	14	MLS $\pi N \rightarrow \pi N$
1501 ± 4	ANISOVICH	12A	DPWA Multichannel
1502	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1487	⁵ HOEHLER	93	SPED $\pi N \rightarrow \pi N$
1510 ± 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

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

1490	SHKLYAR	13	DPWA	Multichannel
1515	SHRESTHA	12A	DPWA	Multichannel
1510 ± 25	ANISOVICH	10	DPWA	Multichannel
1521 ± 14	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
1508 ⁺¹⁰ ₋₃₀	THOMA	08	DPWA	Multichannel
1526	ARNDT	04	DPWA	$\pi N \rightarrow \pi N, \eta N$
1525	VRANA	00	DPWA	Multichannel
1510 ± 10	⁶ ARNDT	98	DPWA	$\pi N \rightarrow \pi N, \eta N$
1501	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
1499	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
1496 or 1499	⁷ LONGACRE	78	IPWA	$\pi N \rightarrow N\pi\pi$
1525 or 1527	¹ LONGACRE	77	IPWA	$\pi N \rightarrow N\pi\pi$

–2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
90 to 250 (≈ 170) OUR ESTIMATE			
118± 9±2	⁴ SVARC	14	MLS $\pi N \rightarrow \pi N$
134±11	ANISOVICH	12A	DPWA Multichannel
95	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
260±80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
100	SHKLYAR	13	DPWA Multichannel
123	SHRESTHA	12A	DPWA Multichannel
140±30	ANISOVICH	10	DPWA Multichannel
190±28	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
165±15	THOMA	08	DPWA Multichannel
130	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
102	VRANA	00	DPWA Multichannel
170±30	⁶ ARNDT	98	DPWA $\pi N \rightarrow \pi N, \eta N$
124	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
110	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90
103 or 105	⁷ LONGACRE	78	IPWA $\pi N \rightarrow N\pi\pi$
135 or 123	¹ LONGACRE	77	IPWA $\pi N \rightarrow N\pi\pi$

 $N(1535)$ ELASTIC POLE RESIDUE**MODULUS $|r|$**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
50±20 OUR ESTIMATE			
22± 2±0.4	⁴ SVARC	14	MLS $\pi N \rightarrow \pi N$
31± 4	ANISOVICH	12A	DPWA Multichannel
16	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
120±40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
15	SHKLYAR	13	DPWA Multichannel
68	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
33	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
31	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
23	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

PHASE θ

<u>VALUE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
–15±15 OUR ESTIMATE			
– 5± 5±3	⁴ SVARC	14	MLS $\pi N \rightarrow \pi N$
–29± 5	ANISOVICH	12A	DPWA Multichannel
–16	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
+15±45	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
–51	SHKLYAR	13	DPWA Multichannel
12	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
14	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
–12	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
–13	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

N(1535) INELASTIC POLE RESIDUE

The “normalized residue” is the residue divided by $\Gamma_{pole}/2$.

Normalized residue in $N\pi \rightarrow N(1535) \rightarrow N\eta$

<u>MODULUS (%)</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
43±3	-76 ± 5	ANISOVICH	12A DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1535) \rightarrow \Delta\pi, D\text{-wave}$

<u>MODULUS (%)</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
12±3	145 ± 17	ANISOVICH	12A DPWA	Multichannel

N(1535) DECAY MODES

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	35–55 %
Γ_2 $N\eta$	(42 ± 10) %
Γ_3 $N\pi\pi$	1–10 %
Γ_4 $\Delta\pi$	<1 %
Γ_5 $\Delta(1232)\pi, D\text{-wave}$	0–4 %
Γ_6 $N\rho$	<4 %
Γ_7 $N\rho, S=1/2, S\text{-wave}$	(2.0 ± 1.0) %
Γ_8 $N\rho, S=3/2, D\text{-wave}$	(0.0 ± 1.0) %
Γ_9 $N(\pi\pi)_{S\text{-wave}}^{I=0}$	(2 ± 1) %
Γ_{10} $N(1440)\pi$	(8 ± 3) %
Γ_{11} $p\gamma$	0.15–0.30 %
Γ_{12} $p\gamma, \text{helicity}=1/2$	0.15–0.30 %
Γ_{13} $n\gamma$	0.01–0.25 %
Γ_{14} $n\gamma, \text{helicity}=1/2$	0.01–0.25 %

N(1535) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$	Γ_1/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
35 to 55 OUR ESTIMATE	
35 ± 3	SHKLYAR 13 DPWA Multichannel
54 ± 5	ANISOVICH 12A DPWA Multichannel
35.5 ± 0.2	ARNDT 06 DPWA $\pi N \rightarrow \pi N, \eta N$
39.4 ± 0.9	GREEN 97 DPWA $\pi N \rightarrow \pi N, \eta N$
50 ± 10	CUTKOSKY 80 IPWA $\pi N \rightarrow \pi N$
38 ± 4	HOEHLER 79 IPWA $\pi N \rightarrow \pi N$

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

37 ± 1	SHRESTHA	12A	DPWA	Multichannel
35 ± 15	ANISOVICH	10	DPWA	Multichannel
46 ± 7	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
37 ± 9	THOMA	08	DPWA	Multichannel
36.0 ± 0.9	ARNDT	04	DPWA	$\pi N \rightarrow \pi N, \eta N$
36 ± 1	PENNER	02C	DPWA	Multichannel
35 ± 8	VRANA	00	DPWA	Multichannel
33.0 ± 1.1	ABAEV	96	DPWA	$\pi^- p \rightarrow \eta n$
31	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
51 ± 5	MANLEY	92	IPWA	$\pi N \rightarrow \pi N \& N\pi\pi$

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

<u>VALUE (%)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
42 ± 10				OUR ESTIMATE
58 ± 4		SHKLYAR	13	DPWA Multichannel
33 ± 5		ANISOVICH	12A	DPWA Multichannel
53 ± 1		PENNER	02C	DPWA Multichannel
51 ± 5		VRANA	00	DPWA Multichannel

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

41 ± 2	SHRESTHA	12A	DPWA	Multichannel
50 ± 7	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
40 ± 10	THOMA	08	DPWA	Multichannel
>45	95	⁸ ARMSTRONG	99B	DPWA $p(e, e'p)\eta$
56.8 ± 1.1		GREEN	97	DPWA $\pi N \rightarrow \pi N, \eta N$
59.1 ± 1.7		ABAEV	96	DPWA $\pi^- p \rightarrow \eta n$

$\Gamma(N\eta)/\Gamma(N\pi)$ Γ_2/Γ_1

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.95 ± 0.03	AZNAURYAN	09	CLAS π, η electroproduction

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(1535) \rightarrow N\eta$ $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
+0.44 to +0.50			OUR ESTIMATE
+0.47 ± 0.02	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$

Note: Signs of couplings from $\pi N \rightarrow N\pi\pi$ 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 $\Delta(1232)\pi$.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(1535) \rightarrow \Delta(1232)\pi, D\text{-wave}$ $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.04 to +0.06			OUR ESTIMATE
0.00	¹ LONGACRE	77	IPWA $\pi N \rightarrow N\pi\pi$
+0.06	² LONGACRE	75	IPWA $\pi N \rightarrow N\pi\pi$
+0.00 ± 0.04	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
0 to 4 OUR ESTIMATE			
2.5 ± 1.5	ANISOVICH	12A	DPWA Multichannel
1 ± 1	VRANA	00	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1.8 ± 0.8	SHRESTHA	12A	DPWA Multichannel
23 ± 8	THOMA	08	DPWA Multichannel

$(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(1535) \rightarrow N\rho, S=1/2, S\text{-wave}$ $(\Gamma_1 \Gamma_7)^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
-0.14 to -0.06 OUR ESTIMATE			
-0.10	¹ LONGACRE	77	IPWA $\pi N \rightarrow N\pi\pi$
-0.09	² LONGACRE	75	IPWA $\pi N \rightarrow N\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.10 ± 0.03	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$

$\Gamma(N\rho, S=1/2, S\text{-wave})/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
2 ± 1	VRANA	00	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
10 ± 1	SHRESTHA	12A	DPWA Multichannel

$\Gamma(N\rho, S=3/2, D\text{-wave})/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
0 ± 1	VRANA	00	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
8 ± 1	SHRESTHA	12A	DPWA Multichannel

$(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(1535) \rightarrow N(\pi\pi)_{S\text{-wave}}^{I=0}$ $(\Gamma_1 \Gamma_9)^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
+0.03 to +0.13 OUR ESTIMATE			
+0.08	¹ LONGACRE	77	IPWA $\pi N \rightarrow N\pi\pi$
+0.09	² LONGACRE	75	IPWA $\pi N \rightarrow N\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$+0.07 \pm 0.04$	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$

$\Gamma(N(\pi\pi)_{S\text{-wave}}^{I=0})/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
2 ± 1	VRANA	00	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1.5 ± 0.5	SHRESTHA	12A	DPWA Multichannel

$(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(1535) \rightarrow N(1440)\pi$ $(\Gamma_1 \Gamma_{10})^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$+0.10 \pm 0.05$	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$

$\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$				Γ_{10}/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
8±3 OUR ESTIMATE				
8±2	⁹ STAROSTIN	03		$\pi^- p \rightarrow n 3\pi^0$
10±9	VRANA	00	DPWA	Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 1	SHRESTHA	12A	DPWA	Multichannel

$N(1535)$ PHOTON DECAY AMPLITUDES

Papers on γN amplitudes predating 1981 may be found in our 2006 edition, *Journal of Physics* **G33** 1 (2006).

$N(1535) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE (GeV ^{-1/2})	DOCUMENT ID	TECN	COMMENT
+0.115±0.015 OUR ESTIMATE			
0.105±0.010	ANISOVICH	12A	DPWA Multichannel
0.128±0.004	WORKMAN	12A	DPWA $\gamma N \rightarrow N\pi$
0.091±0.002	DUGGER	07	DPWA $\gamma N \rightarrow \pi N$
0.120±0.011±0.015	³ KRUSCHE	97	DPWA $\gamma N \rightarrow \eta N$
0.097±0.006	BENMERROU..95	DPWA	$\gamma N \rightarrow N\eta$
0.095±0.011	¹⁰ BENMERROU..91		$\gamma p \rightarrow p\eta$
0.053±0.015	CRAWFORD	83	IPWA $\gamma N \rightarrow \pi N$
0.077±0.021	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.091±0.004	SHKLYAR	13	DPWA Multichannel
0.059±0.003	SHRESTHA	12A	DPWA Multichannel
0.090±0.015	ANISOVICH	10	DPWA Multichannel
0.090±0.025	¹¹ ANISOVICH	09A	DPWA $\gamma d \rightarrow \eta N(N)$
0.066	DRECHSEL	07	DPWA $\gamma N \rightarrow \pi N$
0.090	PENNER	02D	DPWA Multichannel
0.060±0.015	ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
0.110 to 0.140	KRUSCHE	95	DPWA $\gamma p \rightarrow p\eta$
0.125±0.025	KRUSCHE	95C	IPWA $\gamma d \rightarrow \eta N(N)$
0.061±0.003	LI	93	IPWA $\gamma N \rightarrow \pi N$
0.055	WADA	84	DPWA Compton scattering

$N(1535) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE (GeV ^{-1/2})	DOCUMENT ID	TECN	COMMENT
-0.075±0.020 OUR ESTIMATE			
-0.093±0.011	ANISOVICH	13B	DPWA Multichannel
-0.058±0.006	CHEN	12A	DPWA $\gamma N \rightarrow \pi N$
-0.080±0.020	¹² ANISOVICH	09A	DPWA $\gamma d \rightarrow \eta N(N)$
0.035±0.014	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
-0.062±0.003	FUJII	81	DPWA $\gamma N \rightarrow \pi N$

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

-0.049 ± 0.003	SHRESTHA	12A	DPWA	Multichannel
-0.051	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
-0.024	PENNER	02D	DPWA	Multichannel
-0.020 ± 0.035	ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
-0.100 ± 0.030	KRUSCHE	95C	IPWA	$\gamma d \rightarrow \eta N(N)$
-0.046 ± 0.005	LI	93	IPWA	$\gamma N \rightarrow \pi N$

$N(1535) \rightarrow N\gamma$, ratio $A_{1/2}^n/A_{1/2}^p$

VALUE (GeV^{-1/2}) DOCUMENT ID TECN

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

-0.84 ± 0.15	MUKHOPAD...	95B	IPWA
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N(1535) 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 KRUSCHE 97 fits with the mass fixed at 1544 MeV.
- ⁴ Fit to the amplitudes of HOEHLER 79.
- 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.
- ⁶ ARNDT 98 also lists pole residues, which display more model dependence than do the associated pole positions.
- 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.
- ⁸ The best value ARMSTRONG 99B obtains is $\simeq 0.55$; this assumes S_{11} dominance in the reaction $p(e, e'p) \eta$ at $Q^2 = 4$ (GeV/c)².
- ⁹ This STAROSTIN 03 value is an estimate made using simplest assumptions.
- ¹⁰ BENMERROUCHE 91 uses an effective Lagrangian approach to analyze η photoproduction data.
- ¹¹ This ANISOVICH 09A amplitude is evaluated at the pole position; the phase is $(20 \pm 15)^\circ$.
- ¹² This ANISOVICH 09A amplitude is evaluated at the pole position; the phase is $(20 \pm 20)^\circ$.

N(1535) REFERENCES

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

SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich <i>et al.</i>
SHKLYAR	13	PR C87 015201	V. Shklyar, H. Lenske, U. Mosel (GIES)
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i> (BONN, PNPI)
CHEN	12A	PR C86 015206	W. Chen <i>et al.</i> (DUKE, GWU, MSST, ITEP+)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley (KSU)
WORKMAN	12A	PR C86 015202	R. Workman <i>et al.</i> (GWU)
ANISOVICH	10	EPJ A44 203	A.V. Anisovich <i>et al.</i> (BONN, PNPI)
BATINIC	10	PR C82 038203	M. Batinic <i>et al.</i> (ZAGR)
ANISOVICH	09A	EPJ A41 13	A.V. Anisovich <i>et al.</i> (BONN, PNPI, BASL)
AZNAURYAN	09	PR C80 055203	I.G. Aznauryan <i>et al.</i> (JLAB CLAS Collab.)
THOMA	08	PL B659 87	U. Thoma <i>et al.</i> (CB-ELSA Collab.)
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator (MAINZ, JINR)

DUGGER	07	PR C76 025211	M. Dugger <i>et al.</i>	(Jefferson Lab CLAS Collab.)
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
PDG	06	JP G33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)
ARNDT	04	PR C69 035213	R.A. Arndt <i>et al.</i>	(GWU, TRIU)
STAROSTIN	03	PR C67 068201	A. Starostin <i>et al.</i>	(BNL Crystal Ball Collab.)
PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)
PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)
BAI	01B	PL B510 75	J.Z. Bai <i>et al.</i>	(BES Collab.)
THOMPSON	01	PRL 86 1702	R. Thompson <i>et al.</i>	(Jefferson Lab CLAS Collab.)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	(PITT+)
ARMSTRONG	99B	PR D60 052004	C.S. Armstrong <i>et al.</i>	
ARNDT	98	PR C58 3636	R.A. Arndt <i>et al.</i>	
GREEN	97	PR C55 R2167	A.M. Green, S. Wycech	(HELs, WINR)
KRUSCHE	97	PL B397 171	B. Krusche <i>et al.</i>	(GIES, RPI, SASK)
ABAEV	96	PR C53 385	V.V. Abaev, B.M.K. Nefkens	(UCLA)
ARNDT	96	PR C53 430	R.A. Arndt, I.I. Strakovsky, R.L. Workman	(VPI)
ARNDT	95	PR C52 2120	R.A. Arndt <i>et al.</i>	(VPI, BRCO)
BENMERROU...	95	PR D51 3237	M. Benmerrouche, N.C. Mukhopadhyay, J.F. Zhang	
KRUSCHE	95	PRL 74 3736	B. Krusche <i>et al.</i>	(GIES, MANZ, GLAS+)
KRUSCHE	95C	PL B358 40	B. Krusche <i>et al.</i>	(GIES, MANZ, GLAS+)
MUKHOPAD...	95B	PL B364 1	N.C. Mukhopadhyay, J.F. Zhang, M. Benmerrouche	
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)
LI	93	PR C47 2759	Z.J. Li <i>et al.</i>	(VPI)
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KSA) IJP
Also		PR D30 904	D.M. Manley <i>et al.</i>	(VPI)
ARNDT	91	PR D43 2131	R.A. Arndt <i>et al.</i>	(VPI, TELE) IJP
BENMERROU...	91	PRL 67 1070	M. Benmerrouche, N.C. Mukhopadhyay	(RPI)
WADA	84	NP B247 313	Y. Wada <i>et al.</i>	(INUS)
CRAWFORD	83	NP B211 1	R.L. Crawford, W.T. Morton	(GLAS)
PDG	82	PL 111B 1	M. Roos <i>et al.</i>	(HELs, CIT, CERN)
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)
Also		NP B197 365	K. Fujii <i>et al.</i>	(NAGO)
FUJII	81	NP B187 53	K. Fujii <i>et al.</i>	(NAGO, OSAK)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP
LONGACRE	78	PR D17 1795	R.S. Longacre <i>et al.</i>	(LBL, SLAC)
LONGACRE	77	NP B122 493	R.S. Longacre, J. Dolbeau	(SACL) IJP
Also		NP B108 365	J. Dolbeau <i>et al.</i>	(SACL) IJP
LONGACRE	75	PL 55B 415	R.S. Longacre <i>et al.</i>	(LBL, SLAC) IJP