Δ(1700) 3/2⁻

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

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014).

Δ(1700) POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1620 to 1680 (≈ 1650) OUR ESTIMATE				
1685±10	SOKHOYAN	15A	DPWA	Multichannel
1643± 6±3	[1] SVARC	14	L+P	$\pi N \to \pi N$
1632	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
1651	HOEHLER	93	SPED	$\pi N \to \pi N$
1675±25	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1685±10	GUTZ	14	DPWA	Multichannel
1680±10	ANISOVICH	12A	DPWA	Multichannel
1656	SHRESTHA	12A	DPWA	Multichannel
1726	VRANA	00	DPWA	Multichannel

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
160 to 300 (≈ 230) OUR ESTIMATE				
300±15	SOKHOYAN	15A	DPWA	Multichannel
217±10±8	[1] SVARC	14	L+P	$\pi N \to \pi N$
253	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
159	HOEHLER	93	SPED	$\pi N \to \pi N$
220±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
300±15	GUTZ	14	DPWA	Multichannel
305±15	ANISOVICH	12A	DPWA	Multichannel
226	SHRESTHA	12A	DPWA	Multichannel
118	VRANA	00	DPWA	Multichannel

Δ(1700) ELASTIC POLE RESIDUE

MODULUS |r|

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
10 to 40 (≈ 25) OUR ESTIMATE				
40±6	SOKHOYAN	15A	DPWA	Multichannel
13±1±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
18	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
10	HOEHLER	93	SPED	$\pi N \to \pi N$
13±3	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
40±6	GUTZ	14	DPWA	Multichannel
42±7	ANISOVICH	12A	DPWA	Multichannel

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−40 to 0 (≈ −20) OUR ESTIMATE				
− 1±10	SOKHOYAN	15A	DPWA	Multichannel
−30± 4±3	[1] SVARC	14	L+P	$\pi N \to \pi N$
−40	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
−20±25	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
− 1±10	GUTZ	14	DPWA	Multichannel
− 3±15	ANISOVICH	12A	DPWA	Multichannel

Δ(1700) INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \to \Delta(1700) \to \Delta\eta$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.12±0.02	−60 ± 12	GUTZ	14	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.12±0.03	−60 ± 15	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1700) \to N(1535)\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.035±0.015	−75 ± 30	GUTZ	14	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1700) \to \Delta(1232)\pi$, S-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.25±0.12	135 ± 45	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1700) \to \Delta(1232)\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.12±0.06	−160 ± 30	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1700) \to N(1520)\pi$, P-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.10±0.03	−10 ± 20	SOKHOYAN	15A	DPWA	Multichannel

Δ(1700) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1670 to 1750 (≈ 1700) OUR ESTIMATE				
1715 ±20	SOKHOYAN	15A	DPWA	Multichannel
1695.0± 1.3	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
1710 ±30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1680 ±70	HOEHLER	79	IPWA	$\pi N \to \pi N$

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

1715 ± 20	GUTZ 14	DPWA	Multichannel
1715 $^{+30}_{-15}$	ANISOVICH 12A	DPWA	Multichannel
1691 $\pm$ 4	SHRESTHA 12A	DPWA	Multichannel
1678 $\pm$ 1	PENNER 02C	DPWA	Multichannel
1732 ± 23	VRANA 00	DPWA	Multichannel

Δ(1700) BREIT-WIGNER WIDTH

VALUE (MeV)	*DOCUMENT ID*	*TECN*	*COMMENT*
200 to 400 (≈ 300) OUR ESTIMATE			
300 ± 25	SOKHOYAN 15A	DPWA	Multichannel
375.5 $\pm$ 7.0	ARNDT 06	DPWA	$\pi N \to \pi N, \eta N$
280 ± 80	CUTKOSKY 80	IPWA	$\pi N \to \pi N$
230 ± 80	HOEHLER 79	IPWA	$\pi N \to \pi N$

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

300 ± 25	GUTZ 14	DPWA	Multichannel
310 $^{+40}_{-15}$	ANISOVICH 12A	DPWA	Multichannel
248 $\pm$ 9	SHRESTHA 12A	DPWA	Multichannel
606 ± 15	PENNER 02C	DPWA	Multichannel
119 ± 70	VRANA 00	DPWA	Multichannel

Δ(1700) DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	10–20 %
Γ_2	$N\pi\pi$	10–55 %
Γ_3	$\Delta(1232)\pi$	10–50 %
Γ_4	$\Delta(1232)\pi$, S-wave	5–35 %
Γ_5	$\Delta(1232)\pi$, D-wave	4–16 %
Γ_6	$N\rho$	
Γ_7	$N\rho$, S=3/2, S-wave	seen
Γ_8	$N(1520)\pi$, P-wave	1–5 %
Γ_9	$N(1535)\pi$	0.5–1.5 %
Γ_{10}	$\Delta(1232)\eta$	3–7 %
Γ_{11}	$N\gamma$	0.22–0.60 %
Γ_{12}	$N\gamma$, helicity=1/2	0.12–0.30 %
Γ_{13}	$N\gamma$, helicity=3/2	0.10–0.30 %

$\Delta(1700)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
10 to 20 OUR ESTIMATE				
22 ±4	SOKHOYAN	15A	DPWA	Multichannel
15.6±0.1	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
12 ±3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
20 ±3	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
22 ±4	GUTZ	14	DPWA	Multichannel
22 ±4	ANISOVICH	12A	DPWA	Multichannel
14 ±1	SHRESTHA	12A	DPWA	Multichannel
14 ±1	PENNER	02C	DPWA	Multichannel
5 ±1	VRANA	00	DPWA	Multichannel

$\Gamma(\Delta(1232)\pi, S\text{-wave})/\Gamma_{total}$ Γ_4/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
20±15	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
20^{+25}_{-13}	ANISOVICH	12A	DPWA	Multichannel
54± 3	SHRESTHA	12A	DPWA	Multichannel
90± 2	VRANA	00	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
10± 6	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
12^{+14}_{-7}	ANISOVICH	12A	DPWA	Multichannel
1± 1	SHRESTHA	12A	DPWA	Multichannel
4± 1	VRANA	00	DPWA	Multichannel

$\Gamma(N\rho, S{=}3/2, S\text{-wave})/\Gamma_{total}$ Γ_7/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
30±3	SHRESTHA	12A	DPWA	Multichannel
1±1	VRANA	00	DPWA	Multichannel

$\Gamma(N(1520)\pi, P\text{-wave})/\Gamma_{total}$ Γ_8/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
3±2	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1535)\pi)/\Gamma_{total}$ Γ_9/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
1.0±0.5	GUTZ	14	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4 ±2	HORN	08A	DPWA	Multichannel

$\Gamma(\Delta(1232)\eta)/\Gamma_{total}$ — Γ_{10}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5±2	GUTZ	14	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
5±2	ANISOVICH	12A	DPWA	Multichannel

$\Gamma(N(1535)\pi)/\Gamma(\Delta(1232)\eta)$ — Γ_9/Γ_{10}

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.67	KASHEVAROV	09	CBAL	$\gamma p \rightarrow p\pi^0\eta$

Δ(1700) PHOTON DECAY AMPLITUDES AT THE POLE

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

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.175±0.020	50 ± 10	SOKHOYAN	15A	DPWA	Multichannel
0.109±0.010	-21^{+12}_{-6}	ROENCHEN	14	DPWA	

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

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.180±0.020	45 ± 10	SOKHOYAN	15A	DPWA	Multichannel
$0.111^{+0.027}_{-0.006}$	12^{+9}_{-11}	ROENCHEN	14	DPWA	

Δ(1700) BREIT-WIGNER PHOTON DECAY AMPLITUDES

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

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.140±0.030 OUR ESTIMATE				
0.165±0.020	SOKHOYAN	15A	DPWA	Multichannel
0.132±0.005	DUGGER	13	DPWA	$\gamma N \rightarrow \pi N$
0.105±0.005	WORKMAN	12A	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.165±0.020	GUTZ	14	DPWA	Multichannel
0.160±0.020	ANISOVICH	12A	DPWA	Multichannel
0.058±0.010	SHRESTHA	12A	DPWA	Multichannel
0.226	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
0.125±0.003	DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
0.096	PENNER	02D	DPWA	Multichannel

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

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.140±0.030 OUR ESTIMATE				
0.170±0.025	SOKHOYAN	15A	DPWA	Multichannel
0.108±0.005	DUGGER	13	DPWA	$\gamma N \rightarrow \pi N$
0.092±0.004	WORKMAN	12A	DPWA	$\gamma N \rightarrow \pi N$

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

0.170±0.025	GUTZ	14	DPWA	Multichannel
0.165±0.025	ANISOVICH	12A	DPWA	Multichannel
0.097±0.008	SHRESTHA	12A	DPWA	Multichannel
0.210	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
0.105±0.003	DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
0.154	PENNER	02D	DPWA	Multichannel

Δ(1700) FOOTNOTES

[1] Fit to the amplitudes of HOEHLER 79.

Δ(1700) REFERENCES

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

SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan *et al.*	(CBELSA/TAPS Collab.)
GUTZ	14	EPJ A50 74	E. Gutz *et al.*	(CBELSA/TAPS Collab.)
PDG	14	CP C38 070001	K. Olive *et al.*	(PDG Collab.)
ROENCHEN	14	EPJ A50 101	D. Roenchen *et al.*	
Also		EPJ A51 63 (errat.)	D. Roenchen *et al.*	
SVARC	14	PR C89 045205	A. Svarc *et al.*	
DUGGER	13	PR C88 065203	M. Dugger *et al.*	(JLab CLAS Collab.)
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
WORKMAN	12A	PR C86 015202	R. Workman *et al.*	(GWU)
KASHEVAROV	09	EPJ A42 141	V.L. Kashevarov *et al.*	(MAMI Crystal Ball/TAPS)
HORN	08A	EPJ A38 173	I. Horn *et al.*	(CB-ELSA Collab.)
Also		PRL 101 202002	I. Horn *et al.*	(CB-ELSA Collab.)
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator	(MAINZ, JINR)
DUGGER	07	PR C76 025211	M. Dugger *et al.*	(JLab CLAS Collab.)
ARNDT	06	PR C74 045205	R.A. Arndt *et al.*	(GWU)
PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)
PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)
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
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP