

$\Delta(1700) \ 3/2^-$ $I(J^P) = \frac{3}{2}(\frac{3}{2}^-)$ Status: ****Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014). **$\Delta(1700)$ POLE POSITION****REAL PART**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1640 to 1690 (≈ 1665) OUR ESTIMATE			
1655 \pm 15	SARANTSEV 25	DPWA	Multichannel
1637 \pm 32	ROENCHEN 22	DPWA	Multichannel
1643 \pm 6 \pm 3	¹ SVARC 14	L+P	$\pi N \rightarrow \pi N$
1675 \pm 25	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1693	HUNT 19	DPWA	Multichannel
1677	ROENCHEN 15A	DPWA	Multichannel
1685 \pm 10	SOKHOYAN 15A	DPWA	Multichannel
1685 \pm 10	GUTZ 14	DPWA	Multichannel
1632	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$
1726	VRANA 00	DPWA	Multichannel
1651	HOEHLER 93	SPED	$\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.**-2xIMAGINARY PART**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
200 to 300 (≈ 250) OUR ESTIMATE			
300 \pm 15	SARANTSEV 25	DPWA	Multichannel
295 \pm 29	ROENCHEN 22	DPWA	Multichannel
217 \pm 10 \pm 8	¹ SVARC 14	L+P	$\pi N \rightarrow \pi N$
220 \pm 40	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
213	HUNT 19	DPWA	Multichannel
305	ROENCHEN 15A	DPWA	Multichannel
300 \pm 15	SOKHOYAN 15A	DPWA	Multichannel
300 \pm 15	GUTZ 14	DPWA	Multichannel
253	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$
118	VRANA 00	DPWA	Multichannel
159	HOEHLER 93	SPED	$\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79. **$\Delta(1700)$ ELASTIC POLE RESIDUE****MODULUS $|r|$**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
10 to 40 (≈ 25) OUR ESTIMATE			
15 \pm 12	ROENCHEN 22	DPWA	Multichannel
40 \pm 6	SOKHOYAN 15A	DPWA	Multichannel
13 \pm 1 \pm 1	¹ SVARC 14	L+P	$\pi N \rightarrow \pi N$
13 \pm 3	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$

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

24	ROENCHEN	15A	DPWA	Multichannel
40 ± 6	GUTZ	14	DPWA	Multichannel
42 ± 7	ANISOVICH	12A	DPWA	Multichannel
18	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
10	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)	DOCUMENT ID	TECN	COMMENT
−40 to 0 (≈ −20) OUR ESTIMATE			
−13 ± 74	ROENCHEN	22	DPWA Multichannel
−1 ± 10	SOKHOYAN	15A	DPWA Multichannel
−30 ± 4 ± 3	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
−40	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
−20 ± 25	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

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

−7.3	ROENCHEN	15A	DPWA	Multichannel
−1 ± 10	GUTZ	14	DPWA	Multichannel
−3 ± 15	ANISOVICH	12A	DPWA	Multichannel

¹ Fit to the amplitudes of HOEHLER 79.

$\Delta(1700)$ INELASTIC POLE RESIDUE

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

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

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.12 ± 0.02	−60 ± 12	GUTZ	14	DPWA Multichannel
• • •	• • •	• • •	• • •	• • •
0.12 ± 0.03	−60 ± 15	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1700) \rightarrow \Sigma K$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.007 ± 0.008	−176 ± 160	ROENCHEN	22	DPWA Multichannel
• • •	• • •	• • •	• • •	• • •
0.011	−147	ROENCHEN	15A	DPWA Multichannel

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

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

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

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.20 ± 0.15	146 ± 133	ROENCHEN	22	DPWA Multichannel
0.25 ± 0.12	135 ± 45	SOKHOYAN	15A	DPWA Multichannel
• • •	• • •	• • •	• • •	• • •
0.39	151	ROENCHEN	15A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.038 ± 0.039	127 ± 127	ROENCHEN	22	DPWA Multichannel
0.12 ± 0.06	-160 ± 30	SOKHOYAN	15A	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.054	166	ROENCHEN	15A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.10 ± 0.03	-10 ± 20	SOKHOYAN	15A	DPWA Multichannel

 $\Delta(1700)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1690 to 1730 (≈ 1710) OUR ESTIMATE			
1690 ± 15	SARANTSEV	25	DPWA Multichannel
1704 ± 8	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
1720 ± 5	¹ HUNT	19	DPWA Multichannel
1695.0 ± 1.3	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1710 ± 30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1680 ± 70	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1715 ± 20	SOKHOYAN	15A	DPWA Multichannel
1715 ± 20	GUTZ	14	DPWA Multichannel
1691 ± 4	¹ SHRESTHA	12A	DPWA Multichannel
1678 ± 1	PENNER	02C	DPWA Multichannel
1732 ± 23	VRANA	00	DPWA Multichannel

¹Statistical error only. **$\Delta(1700)$ BREIT-WIGNER WIDTH**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
220 to 380 (≈ 300) OUR ESTIMATE			
310 ± 15	SARANTSEV	25	DPWA Multichannel
295 ± 35	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+ \pi^- p$
226 ± 14	¹ HUNT	19	DPWA Multichannel
375.5 ± 7.0	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
280 ± 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
230 ± 80	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
300 ± 25	SOKHOYAN	15A	DPWA Multichannel
300 ± 25	GUTZ	14	DPWA Multichannel
248 ± 9	¹ SHRESTHA	12A	DPWA Multichannel
606 ± 15	PENNER	02C	DPWA Multichannel
119 ± 70	VRANA	00	DPWA Multichannel

¹Statistical error only.

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 $N\pi\pi$	>31 %
Γ_3 $\Delta(1232)\pi$	9–70 %
Γ_4 $\Delta(1232)\pi$, <i>S</i> -wave	5–54 %
Γ_5 $\Delta(1232)\pi$, <i>D</i> -wave	4–16 %
Γ_6 $N\rho$	(15 ± 4) %
Γ_7 $N\rho$, <i>S</i> =3/2, <i>S</i> -wave	22–32%
Γ_8 $N(1440)\pi$	(3.0±2.0) %
Γ_9 $N(1520)\pi$, <i>P</i> -wave	1–5 %
Γ_{10} $N(1535)\pi$	0.5–1.5 %
Γ_{11} $\Delta(1232)\eta$	3–7 %
Γ_{12} $N\gamma$	0.22–0.60 %
Γ_{13} $N\gamma$, helicity=1/2	0.12–0.30 %
Γ_{14} $N\gamma$, helicity=3/2	0.10–0.30 %

Δ(1700) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$	Γ_1/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
10 to 20 OUR ESTIMATE	
22 ± 6	SEIFEN 25 DPWA Multichannel
15 ± 2	¹ HUNT 19 DPWA Multichannel
15.6±0.1	¹ ARNDT 06 DPWA $\pi N \rightarrow \pi N, \eta N$
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	SOKHOYAN 15A DPWA Multichannel
22 ± 4	GUTZ 14 DPWA Multichannel
14 ± 1	¹ SHRESTHA 12A DPWA Multichannel
14 ± 1	PENNER 02C DPWA Multichannel
5 ± 1	VRANA 00 DPWA Multichannel

¹Statistical error only.

$\Gamma(N\pi\pi)/\Gamma_{\text{total}}$	Γ_2/Γ
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
0.89±0.11	GOLOVATCH 19 DPWA $\gamma p \rightarrow \pi^+ \pi^- p$

$\Gamma(\Delta(1232)\pi)/\Gamma_{\text{total}}$	Γ_3/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
35±13	SARANTSEV 25 DPWA Multichannel

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

VALUE (%)	DOCUMENT ID	TECN	COMMENT
23±13	SARANTSEV	25	DPWA Multichannel
16±15	SEIFEN	25	DPWA Multichannel
49±5	¹ HUNT	19	DPWA Multichannel
●●● We do not use the following data for averages, fits, limits, etc. ●●●			
20±15	SOKHOYAN	15A	DPWA Multichannel
54±3	¹ SHRESTHA	12A	DPWA Multichannel
90±2	VRANA	00	DPWA Multichannel

¹Statistical error only. $\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
12 ±8	SARANTSEV	25	DPWA Multichannel
8 ±6	SEIFEN	25	DPWA Multichannel
7.6±0.3	¹ HUNT	19	DPWA Multichannel
●●● We do not use the following data for averages, fits, limits, etc. ●●●			
10 ±6	SOKHOYAN	15A	DPWA Multichannel
1 ±1	¹ SHRESTHA	12A	DPWA Multichannel
4 ±1	VRANA	00	DPWA Multichannel

¹Statistical error only. $\Gamma(N\rho)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
15±4	SARANTSEV	25	DPWA Multichannel

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

VALUE (%)	DOCUMENT ID	TECN	COMMENT
15±4	SARANTSEV	25	DPWA Multichannel
27±5	¹ HUNT	19	DPWA Multichannel
●●● We do not use the following data for averages, fits, limits, etc. ●●●			
30±3	¹ SHRESTHA	12A	DPWA Multichannel
1±1	VRANA	00	DPWA Multichannel

¹Statistical error only. $\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
3±2	SEIFEN	25	DPWA Multichannel

 $\Gamma(N(1520)\pi, P\text{-wave})/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
<1	SEIFEN	25	DPWA Multichannel
●●● We do not use the following data for averages, fits, limits, etc. ●●●			
3±2	SOKHOYAN	15A	DPWA Multichannel

 $\Gamma(N(1535)\pi)/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
<1	SEIFEN	25	DPWA Multichannel
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

$\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}}$ Γ_{11}/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_{10}/Γ_{11}

VALUE	DOCUMENT ID	TECN	COMMENT
0.67	KASHEVAROV 09	CBAL	$\gamma p \rightarrow p\pi^0\eta$

$\Delta(1700)$ PHOTON DECAY AMPLITUDES AT THE POLE

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

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.150±0.020	30 ± 15	SARANTSEV	25	DPWA Multichannel
0.163±0.060	-4.4 ± 39	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.123	1.1	ROENCHEN	15A	DPWA Multichannel
0.175±0.020	50 ± 10	SOKHOYAN	15A	DPWA Multichannel

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

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.155±0.020	40 ± 15	SARANTSEV	25	DPWA Multichannel
0.221±0.093	-12 ± 40	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.124	22	ROENCHEN	15A	DPWA Multichannel
0.180±0.020	45 ± 10	SOKHOYAN	15A	DPWA Multichannel

$\Delta(1700)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

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

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.100 to 0.160 (≈ 0.130) OUR ESTIMATE			
0.153 ±0.018	SARANTSEV	25	DPWA Multichannel
0.0872±0.0189	GOLOVATCH	19	DPWA $\gamma p \rightarrow \pi^+\pi^-p$
0.156 ±0.017	¹ HUNT	19	DPWA Multichannel
0.132 ±0.005	¹ DUGGER	13	DPWA $\gamma N \rightarrow \pi N$
0.105 ±0.005	¹ WORKMAN	12A	DPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.165 ±0.020	SOKHOYAN	15A	DPWA Multichannel
0.165 ±0.020	GUTZ	14	DPWA Multichannel
0.058 ±0.010	¹ 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

¹Statistical error only.

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

VALUE (GeV ^{-1/2})	DOCUMENT ID	TECN	COMMENT
0.090 to 0.170 (≈ 0.130) OUR ESTIMATE			
0.158 \pm 0.017	SARANTSEV 25	DPWA	Multichannel
0.0872 \pm 0.0164	GOLOVATCH 19	DPWA	$\gamma p \rightarrow \pi^+ \pi^- p$
0.0125 \pm 0.0016	¹ HUNT 19	DPWA	Multichannel
0.108 \pm 0.005	¹ DUGGER 13	DPWA	$\gamma N \rightarrow \pi N$
0.092 \pm 0.004	¹ WORKMAN 12A	DPWA	$\gamma N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.170 \pm 0.025	SOKHOYAN 15A	DPWA	Multichannel
0.170 \pm 0.025	GUTZ 14	DPWA	Multichannel
0.097 \pm 0.008	¹ SHRESTHA 12A	DPWA	Multichannel
0.210	DRECHSEL 07	DPWA	$\gamma N \rightarrow \pi N$
0.105 \pm 0.003	DUGGER 07	DPWA	$\gamma N \rightarrow \pi N$
0.154	PENNER 02D	DPWA	Multichannel

¹Statistical error only. $\Delta(1700)$ REFERENCESFor early references, see Physics Letters **111B** 1 (1982).

SARANTSEV 25	PR C112 015202	A.V. Sarantsev <i>et al.</i>	(Bonn-Gatchina Collab.)
SEIFEN 25	EPJ A61 173	T. Seifen <i>et al.</i>	(CBELSA/TAPS Collab.)
ROENCHEN 22	EPJ A58 229	D. Roenchen <i>et al.</i>	(JULI, GWU, BONN+)
GOLOVATCH 19	PL B788 371	E. Golovatch <i>et al.</i>	(CLAS Collab.)
HUNT 19	PR C99 055205	B.C. Hunt, D.M. Manley	
ROENCHEN 15A	EPJ A51 70	D. Roenchen <i>et al.</i>	
SOKHOYAN 15A	EPJ A51 95	V. Sokhoyan <i>et al.</i>	(CBELSA/TAPS Collab.)
GUTZ 14	EPJ A50 74	E. Gutz <i>et al.</i>	(CBELSA/TAPS Collab.)
PDG 14	CP C38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
SVARC 14	PR C89 045205	A. Svarc <i>et al.</i>	(RBI Zagreb, UNI Tuzla)
DUGGER 13	PR C88 065203	M. Dugger <i>et al.</i>	(JLab CLAS Collab.)
ANISOVICH 12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
SHRESTHA 12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
WORKMAN 12A	PR C86 015202	R. Workman <i>et al.</i>	(GWU)
KASHEVAROV 09	EPJ A42 141	V.L. Kashevarov <i>et al.</i>	(MAMI Crystal Ball/TAPS)
HORN 08A	EPJ A38 173	I. Horn <i>et al.</i>	(CB-ELSA Collab.)
Also	PRL 101 202002	I. Horn <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>	(JLab CLAS Collab.)
ARNDT 06	PR C74 045205	R.A. Arndt <i>et al.</i>	(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 <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