

$\Delta(1700) \ 3/2^-$ $I(J^P) = \frac{3}{2}(\frac{3}{2}^-)$ 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			
1685 \pm 10	SOKHOYAN	15A	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. ● ● ●			
1677	ROENCHEN	15A	DPWA Multichannel
1685 \pm 10	GUTZ	14	DPWA Multichannel
1680 \pm 10	ANISOVICH	12A	DPWA Multichannel
1656	SHRESTHA	12A	DPWA Multichannel
1632	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1726	VRANA	00	DPWA Multichannel
1651	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.**-2 \times IMAGINARY PART**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
200 to 300 (≈ 250) OUR ESTIMATE			
300 \pm 15	SOKHOYAN	15A	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. ● ● ●			
305	ROENCHEN	15A	DPWA Multichannel
300 \pm 15	GUTZ	14	DPWA Multichannel
305 \pm 15	ANISOVICH	12A	DPWA Multichannel
226	SHRESTHA	12A	DPWA Multichannel
253	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
118	VRANA	00	DPWA Multichannel
159	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹ Fit 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			
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	$\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

PHASE θ

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
−40 to 0 (≈ −20) OUR ESTIMATE			
− 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

¹Fit 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 $N\pi \rightarrow \Delta(1700) \rightarrow \Delta\eta$

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

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

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

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.011	−147	ROENCHEN	15A	DPWA Multichannel

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

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

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

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.25±0.12	135 ± 45	SOKHOYAN	15A	DPWA Multichannel
0.39	151	ROENCHEN	15A	DPWA Multichannel

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

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>
0.12 \pm 0.06	-160 \pm 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 \pm 0.03	-10 \pm 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 (\approx 1710) OUR ESTIMATE			
1704 \pm 8	GOLOVATCH	19 DPWA	$\gamma p \rightarrow \pi^+ \pi^- p$
1715 \pm 20	SOKHOYAN	15A DPWA	Multichannel
1691 \pm 4	¹ SHRESTHA	12A DPWA	Multichannel
1695.0 \pm 1.3	¹ ARNDT	06 DPWA	$\pi N \rightarrow \pi N, \eta N$
1710 \pm 30	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
1680 \pm 70	HOEHLER	79 IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1715 \pm 20	GUTZ	14 DPWA	Multichannel
1715 $\begin{smallmatrix} +30 \\ -15 \end{smallmatrix}$	ANISOVICH	12A DPWA	Multichannel
1678 \pm 1	PENNER	02C DPWA	Multichannel
1732 \pm 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 (\approx 300) OUR ESTIMATE			
295 \pm 35	GOLOVATCH	19 DPWA	$\gamma p \rightarrow \pi^+ \pi^- p$
300 \pm 25	SOKHOYAN	15A DPWA	Multichannel
248 \pm 9	¹ SHRESTHA	12A DPWA	Multichannel
375.5 \pm 7.0	¹ ARNDT	06 DPWA	$\pi N \rightarrow \pi N, \eta N$
280 \pm 80	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
230 \pm 80	HOEHLER	79 IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
300 \pm 25	GUTZ	14 DPWA	Multichannel
310 $\begin{smallmatrix} +40 \\ -15 \end{smallmatrix}$	ANISOVICH	12A DPWA	Multichannel
606 \pm 15	PENNER	02C DPWA	Multichannel
119 \pm 70	VRANA	00 DPWA	Multichannel

¹Statistical error only.

$\Delta(1700)$ 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 $\Delta(1232)\pi$, <i>S</i> -wave	5–35 %
Γ_5 $\Delta(1232)\pi$, <i>D</i> -wave	4–16 %
Γ_6 $N\rho$	
Γ_7 $N\rho$, $S=3/2$, <i>S</i> -wave	seen
Γ_8 $N(1520)\pi$, <i>P</i> -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

$\Gamma(N\pi)/\Gamma_{\text{total}}$					Γ_1/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
10 to 20 OUR ESTIMATE					
22 \pm 4	SOKHOYAN	15A	DPWA	Multichannel	
14 \pm 1	¹ SHRESTHA	12A	DPWA	Multichannel	
15.6 \pm 0.1	¹ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$	
12 \pm 3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
20 \pm 3	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
22 \pm 4	GUTZ	14	DPWA	Multichannel	
22 \pm 4	ANISOVICH	12A	DPWA	Multichannel	
14 \pm 1	PENNER	02C	DPWA	Multichannel	
5 \pm 1	VRANA	00	DPWA	Multichannel	
¹ Statistical error only.					

$\Gamma(N\pi\pi)/\Gamma_{\text{total}}$					Γ_2/Γ
VALUE	DOCUMENT ID	TECN	COMMENT		
0.89\pm0.11	GOLOVATCH	19	DPWA	$\gamma p \rightarrow \pi^+\pi^-p$	

$\Gamma(\Delta(1232)\pi, S\text{-wave})/\Gamma_{\text{total}}$					Γ_4/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
20 \pm 15	SOKHOYAN	15A	DPWA	Multichannel	
54 \pm 3	¹ SHRESTHA	12A	DPWA	Multichannel	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
20 ⁺²⁵ ₋₁₃	ANISOVICH	12A	DPWA	Multichannel	
90 \pm 2	VRANA	00	DPWA	Multichannel	

¹Statistical error only.

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
10 ± 6	SOKHOYAN 15A	DPWA	Multichannel
1 ± 1	¹ SHRESTHA 12A	DPWA	Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
12 ⁺¹⁴ ₋₇	ANISOVICH 12A	DPWA	Multichannel
4 ± 1	VRANA 00	DPWA	Multichannel

¹Statistical error only.

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

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

¹Statistical error only.

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

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

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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_{10}/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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}

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
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 $A_{1/2}$

<u>MODULUS ($\text{GeV}^{-1/2}$)</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.175 ± 0.020	50 ± 10	SOKHOYAN 15A	DPWA	Multichannel
0.109 ± 0.010	-21 ⁺¹² ₋₆	ROENCHEN 14	DPWA	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.123	1.1	ROENCHEN 15A	DPWA	Multichannel

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

<u>MODULUS ($\text{GeV}^{-1/2}$)</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.180 ± 0.020	45 ± 10	SOKHOYAN	15A	DPWA Multichannel
$0.111^{+0.027}_{-0.006}$	12^{+9}_{-11}	ROENCHEN	14	DPWA
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.124	22	ROENCHEN	15A	DPWA Multichannel

 $\Delta(1700)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES **$\Delta(1700) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$**

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.100 to 0.160 (≈ 0.130) OUR ESTIMATE			
0.0872 ± 0.0189	GOLOVATCH 19	DPWA	$\gamma p \rightarrow \pi^+ \pi^- p$
0.165 ± 0.020	SOKHOYAN 15A	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	GUTZ 14	DPWA	Multichannel
0.160 ± 0.020	ANISOVICH 12A	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 $A_{3/2}$**

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.090 to 0.170 (≈ 0.130) OUR ESTIMATE			
0.0872 ± 0.0164	GOLOVATCH 19	DPWA	$\gamma p \rightarrow \pi^+ \pi^- p$
0.170 ± 0.025	SOKHOYAN 15A	DPWA	Multichannel
0.108 ± 0.005	¹ DUGGER 13	DPWA	$\gamma N \rightarrow \pi N$
0.092 ± 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 ± 0.025	GUTZ 14	DPWA	Multichannel
0.165 ± 0.025	ANISOVICH 12A	DPWA	Multichannel
0.097 ± 0.008	¹ 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

¹Statistical error only.

$\Delta(1700)$ REFERENCES

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

GOLOVATCH	19	PL B788 371	E. Golovatch <i>et al.</i>	(CLAS Collab.)
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.)
ROENCHEN	14	EPJ A50 101	D. Roenchen <i>et al.</i>	
Also		EPJ A51 63 (errat.)	D. Roenchen <i>et al.</i>	
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