$\Delta(1620)\ 1/2^-$

$I(J^P) = \frac{3}{2}(\frac{1}{2}^-)$ Status: ∗∗∗∗

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

Δ(1620) POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1590 to 1610 (≈ 1600) OUR ESTIMATE				
1597± 5	SOKHOYAN	15A	DPWA	Multichannel
1603± 7±2	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
1600±15	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1577	HUNT	19	DPWA	Multichannel
1600	ROENCHEN	15A	DPWA	Multichannel
1597± 4	ANISOVICH	12A	DPWA	Multichannel
1595	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
1607	VRANA	00	DPWA	Multichannel
1608	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
100 to 140 (≈ 120) OUR ESTIMATE				
134± 8	SOKHOYAN	15A	DPWA	Multichannel
114±12±4	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
120±20	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
101	HUNT	19	DPWA	Multichannel
65	ROENCHEN	15A	DPWA	Multichannel
130± 9	ANISOVICH	12A	DPWA	Multichannel
135	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
148	VRANA	00	DPWA	Multichannel
116	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

Δ(1620) ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
15 to 20 (≈ 17) OUR ESTIMATE				
20±3	SOKHOYAN	15A	DPWA	Multichannel
17±2±1	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
15±2	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$

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

16	ROENCHEN	15A	DPWA	Multichannel
18±2	ANISOVICH	12A	DPWA	Multichannel
15	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
19	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−120 to −80 (≈ − 100) OUR ESTIMATE				
− 90±15	SOKHOYAN	15A	DPWA	Multichannel
−106±10±4	[1] SVARC	14	L+P	$\pi N \rightarrow \pi N$
−110±20	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−104	ROENCHEN	15A	DPWA	Multichannel
−100± 5	ANISOVICH	12A	DPWA	Multichannel
− 92	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
− 95	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

Δ(1620) INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow \Delta(1620) \rightarrow \Delta\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.42±0.06	−90 ± 20	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.57	105	ROENCHEN	15A	DPWA	Multichannel
0.38±0.09	−85 ± 30	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1620) \rightarrow \Sigma K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.22	−105	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1620) \rightarrow N(1440)\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.10±0.06	−65 ± 30	SOKHOYAN	15A	DPWA	Multichannel

Δ(1620) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1590 to 1630 (≈ 1610) OUR ESTIMATE				
1635 ± 8	GOLOVATCH	19	DPWA	$\gamma p \rightarrow \pi^+ \pi^- p$
1589 ± 3	[1] HUNT	19	DPWA	Multichannel
1595 ± 8	SOKHOYAN	15A	DPWA	Multichannel
1615.2± 0.4	[1] ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
1620 ±20	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1610 ± 7	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$

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

1600 ± 8	ANISOVICH	12A	DPWA	Multichannel
1600 ± 1	[1] SHRESTHA	12A	DPWA	Multichannel
1612 ± 2	PENNER	02C	DPWA	Multichannel
1617 ±15	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

Δ(1620) BREIT-WIGNER WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
110 to 150 (≈ 130) OUR ESTIMATE				
144 ±16	GOLOVATCH	19	DPWA	$\gamma p \to \pi^+ \pi^- p$
107 ± 7	[1] HUNT	19	DPWA	Multichannel
135 ± 9	SOKHOYAN	15A	DPWA	Multichannel
146.9± 1.9	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
140 ±20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
139 ±18	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
130 ±11	ANISOVICH	12A	DPWA	Multichannel
112 ± 2	[1] SHRESTHA	12A	DPWA	Multichannel
202 ± 7	PENNER	02C	DPWA	Multichannel
143 ±42	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

Δ(1620) DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	25–35 %
Γ_2	$N\pi\pi$	>67 %
Γ_3	$\Delta(1232)\pi$, *D*-wave	44–72 %
Γ_4	$N\rho$	23–32%
Γ_5	$N\rho$, S=1/2, *S*-wave	23–32%
Γ_6	$N\rho$, S=3/2, *D*-wave	<0.04%
Γ_7	$N(1440)\pi$	<9 %
Γ_8	$N\gamma$, helicity=1/2	0.03–0.10 %

Δ(1620) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
25 to 35 (≈ 30) OUR ESTIMATE				
24 ±2	[1] HUNT	19	DPWA	Multichannel
28 ±3	SOKHOYAN	15A	DPWA	Multichannel
31.5±0.1	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
25 ±3	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
35 ±6	HOEHLER	79	IPWA	$\pi N \to \pi N$

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

28 ±3		ANISOVICH	12A	DPWA Multichannel
33 ±2	[1]	SHRESTHA	12A	DPWA Multichannel
34 ±1		PENNER	02C	DPWA Multichannel
45 ±5		VRANA	00	DPWA Multichannel

[1] Statistical error only.

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.90±0.10	GOLOVATCH	19	DPWA	$\gamma p \to \pi^+\pi^- p$

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{total}$ Γ_3/Γ

VALUE (%)		DOCUMENT ID		TECN	COMMENT
48± 4	[1]	HUNT	19	DPWA	Multichannel
62±10		SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
60±17		ANISOVICH	12A	DPWA	Multichannel
32± 2	[1]	SHRESTHA	12A	DPWA	Multichannel
39± 2		VRANA	00	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N\rho, S=1/2, S\text{-wave})/\Gamma_{total}$ Γ_5/Γ

VALUE (%)		DOCUMENT ID		TECN	COMMENT
27±4	[1]	HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
26±2	[1]	SHRESTHA	12A	DPWA	Multichannel
14±3		VRANA	00	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N\rho, S=3/2, D\text{-wave})/\Gamma_{total}$ Γ_6/Γ

VALUE (%)		DOCUMENT ID		TECN	COMMENT
<0.04	[1]	HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2 ±1		VRANA	00	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N(1440)\pi)/\Gamma_{total}$ Γ_7/Γ

VALUE (%)		DOCUMENT ID		TECN	COMMENT
<0.02	[1]	HUNT	19	DPWA	Multichannel
6 ±3		SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
9 ±1	[1]	SHRESTHA	12A	DPWA	Multichannel
0 ±1		VRANA	00	DPWA	Multichannel

[1] Statistical error only.

Δ(1620) PHOTON DECAY AMPLITUDES AT THE POLE

Δ(1620) → $N\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS (GeV$^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.054±0.007	−6 ± 7	SOKHOYAN	15A	DPWA	Multichannel
$-0.028^{+0.006}_{-0.002}$	-166^{+1}_{-4}	ROENCHEN	14	DPWA	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.014	26	ROENCHEN	15A	DPWA	Multichannel

Δ(1620) BREIT-WIGNER PHOTON DECAY AMPLITUDES

Δ(1620) → $N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.030 to 0.060 (≈ 0.050) OUR ESTIMATE				
0.029 ±0.0062	GOLOVATCH	19	DPWA	$\gamma p \rightarrow \pi^+ \pi^- p$
0.0124±0.0007	[1] HUNT	19	DPWA	Multichannel
0.055 ±0.007	SOKHOYAN	15A	DPWA	Multichannel
0.029 ±0.003	[1] WORKMAN	12A	DPWA	$\gamma N \rightarrow N\pi$
0.050 ±0.002	[1] DUGGER	07	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.052 ±0.005	ANISOVICH	12A	DPWA	Multichannel
−0.003 ±0.003	[1] SHRESTHA	12A	DPWA	Multichannel
0.066	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$
−0.050	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

Δ(1620) REFERENCES

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

GOLOVATCH	19	PL B788 371	E. Golovatch *et al.*	(CLAS Collab.)
HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
ROENCHEN	15A	EPJ A51 70	D. Roenchen *et al.*	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan *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.*	(RBI Zagreb, UNI Tuzla)
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)
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