$\Delta(1905)\ 5/2^+$

$I(J^P) = \frac{3}{2}(\frac{5}{2}^+)$ Status: ∗∗∗∗

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics C **38** 070001 (2014).

$\Delta(1905)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1805 to 1835 (≈ 1820) OUR ESTIMATE				
1800± 6	SOKHOYAN	15A	DPWA	Multichannel
1752± 3±2	[1] SVARC	14	L+P	$\pi N \to \pi N$
1819	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
1829	HOEHLER	93	SPED	$\pi N \to \pi N$
1830±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1800± 6	GUTZ	14	DPWA	Multichannel
1805±10	ANISOVICH	12A	DPWA	Multichannel
1769	SHRESTHA	12A	DPWA	Multichannel
1793	VRANA	00	DPWA	Multichannel

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
265 to 300 (≈ 280) OUR ESTIMATE				
290±15	SOKHOYAN	15A	DPWA	Multichannel
346± 6±2	[1] SVARC	14	L+P	$\pi N \to \pi N$
247	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
303	HOEHLER	93	SPED	$\pi N \to \pi N$
280±60	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
290±15	GUTZ	14	DPWA	Multichannel
300±15	ANISOVICH	12A	DPWA	Multichannel
239	SHRESTHA	12A	DPWA	Multichannel
302	VRANA	00	DPWA	Multichannel

$\Delta(1905)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
15 to 25 (≈ 20) OUR ESTIMATE				
19±2	SOKHOYAN	15A	DPWA	Multichannel
24±1±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
15	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
25	HOEHLER	93	SPED	$\pi N \to \pi N$
25±8	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
19±2	GUTZ	14	DPWA	Multichannel
20±2	ANISOVICH	12A	DPWA	Multichannel

PHASE θ

VALUE (°)		DOCUMENT ID		TECN	COMMENT
−120 to −30 (≈ −50) OUR ESTIMATE					
− 45± 4		SOKHOYAN	15A	DPWA	Multichannel
−114± 1±2	[1]	SVARC	14	L+P	$\pi N \rightarrow \pi N$
− 30		ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
− 50±20		CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
− 45± 4		GUTZ	14	DPWA	Multichannel
− 44± 5		ANISOVICH	12A	DPWA	Multichannel

Δ(1905) INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow \Delta(1905) \rightarrow \Delta\pi$, P-wave

MODULUS (%)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
19±7	10 ± 30	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
25±6	0 ± 15	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1905) \rightarrow N(1535)\pi$

MODULUS (%)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
2.5±1.0	130 ± 35	GUTZ	14	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1905) \rightarrow \Delta(1232)\eta$

MODULUS (%)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
7±2	40 ± 20	GUTZ	14	DPWA	Multichannel

Δ(1905) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1855 to 1910 (≈ 1880) OUR ESTIMATE				
1856 ± 6	SOKHOYAN	15A	DPWA	Multichannel
1857.8± 1.6	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
1910 ±30	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1905 ±20	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1856 ± 6	GUTZ	14	DPWA	Multichannel
1861 ± 6	ANISOVICH	12A	DPWA	Multichannel
1818 ± 8	SHRESTHA	12A	DPWA	Multichannel
1873 ±77	VRANA	00	DPWA	Multichannel

Δ(1905) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
270 to 400 (≈ 330) OUR ESTIMATE				
325 ± 15	SOKHOYAN	15A	DPWA	Multichannel
320.6± 8.6	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
400 ±100	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
260 ± 20	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$

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

325 ± 15	GUTZ	14	DPWA	Multichannel
335 ± 18	ANISOVICH	12A	DPWA	Multichannel
278 ± 18	SHRESTHA	12A	DPWA	Multichannel
461 ±111	VRANA	00	DPWA	Multichannel

$\Delta(1905)$ DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	9–15 %
Γ_2	$N\pi\pi$	
Γ_3	$\Delta(1232)\pi$	
Γ_4	$\Delta(1232)\pi$, P-wave	23–43 %
Γ_5	$\Delta(1232)\pi$, F-wave	seen
Γ_6	$N\rho$	
Γ_7	$N\rho$, S=3/2, P-wave	seen
Γ_8	$N(1535)\pi$	$<$ 1 %
Γ_9	$N(1680)\pi$, P-wave	5–15 %
Γ_{10}	$\Delta(1232)\eta$	2–6 %
Γ_{11}	$N\gamma$	0.012–0.036 %
Γ_{12}	$N\gamma$, helicity=1/2	0.002–0.006 %
Γ_{13}	$N\gamma$, helicity=3/2	0.01–0.03 %

$\Delta(1905)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
9 to 15 OUR ESTIMATE				
13 ±2	SOKHOYAN	15A	DPWA	Multichannel
12.2±0.1	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
8 ±3	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
15 ±2	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
13 ±2	GUTZ	14	DPWA	Multichannel
13 ±2	ANISOVICH	12A	DPWA	Multichannel
6 ±1	SHRESTHA	12A	DPWA	Multichannel
9 ±1	VRANA	00	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
33±10	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
45±14	ANISOVICH	12A	DPWA	Multichannel
28± 7	SHRESTHA	12A	DPWA	Multichannel
23± 1	VRANA	00	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
64±8	SHRESTHA	12A	DPWA	Multichannel
44±1	VRANA	00	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 6	SHRESTHA	12A	DPWA	Multichannel
24±1	VRANA	00	DPWA	Multichannel

$\Gamma(N(1535)\pi)/\Gamma_{total}$ — Γ_8/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<1	GUTZ	14	DPWA	Multichannel

$\Gamma(N(1680)\pi, P\text{-wave})/\Gamma_{total}$ — Γ_9/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
10±5	SOKHOYAN	15A	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4±2	GUTZ	14	DPWA	Multichannel

Δ(1905) PHOTON DECAY AMPLITUDES AT THE POLE

$\Delta(1905) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.025±0.005	−28 ± 12	SOKHOYAN	15A	DPWA	Multichannel

$\Delta(1905) \rightarrow N\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
−0.050±0.004	5 ± 10	SOKHOYAN	15A	DPWA	Multichannel

Δ(1905) BREIT-WIGNER PHOTON DECAY AMPLITUDES

$\Delta(1905) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
+0.022±0.005 OUR ESTIMATE				
0.025±0.005	SOKHOYAN	15A	DPWA	Multichannel
0.020±0.002	DUGGER	13	DPWA	$\gamma N \rightarrow \pi N$
0.019±0.002	WORKMAN	12A	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.025±0.005	GUTZ	14	DPWA	Multichannel
0.025±0.004	ANISOVICH	12A	DPWA	Multichannel
0.066±0.018	SHRESTHA	12A	DPWA	Multichannel
0.018	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$

$\Delta(1905) \rightarrow N\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE (GeV$^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
−0.045±0.010 OUR ESTIMATE				
−0.050±0.005	SOKHOYAN	15A	DPWA	Multichannel
−0.049±0.005	DUGGER	13	DPWA	$\gamma N \rightarrow \pi N$
−0.038±0.004	WORKMAN	12A	DPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.050±0.005	GUTZ	14	DPWA	Multichannel
−0.049±0.004	ANISOVICH	12A	DPWA	Multichannel
−0.223±0.029	SHRESTHA	12A	DPWA	Multichannel
−0.028	DRECHSEL	07	DPWA	$\gamma N \rightarrow \pi N$

$\Delta(1905)$ FOOTNOTES

[1] Fit to the amplitudes of HOEHLER 79.

$\Delta(1905)$ 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	CPC 38 070001	K. Olive *et al.*	(PDG Collab.)
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)
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator	(MAINZ, JINR)
ARNDT	06	PR C74 045205	R.A. Arndt *et al.*	(GWU)
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