$\Delta(1930)$ $5/2^-$

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

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

$\Delta(1930)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1840 to 1920 (≈ 1880) OUR ESTIMATE				
1848± 9±19	[1] SVARC	14	L+P	$\pi N \to \pi N$
1890±50	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1863	HUNT	19	DPWA	Multichannel
1836	ROENCHEN	15A	DPWA	Multichannel
2001	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
1883	VRANA	00	DPWA	Multichannel
1850	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
230 to 330 (≈ 280) OUR ESTIMATE				
321±17±7	[1] SVARC	14	L+P	$\pi N \to \pi N$
260±60	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
260	HUNT	19	DPWA	Multichannel
724	ROENCHEN	15A	DPWA	Multichannel
387	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
250	VRANA	00	DPWA	Multichannel
180	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

$\Delta(1930)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
8 to 20 (≈ 14) OUR ESTIMATE				
9±1±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
18±6	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
34	ROENCHEN	15A	DPWA	Multichannel
7	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
20	HOEHLER	93	SPED	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
− 40 to −10 (≈ − 30) OUR ESTIMATE				
− 37± 3±7	[1] SVARC	14	L+P	$\pi N \to \pi N$
− 20±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−155	ROENCHEN	15A	DPWA	Multichannel
− 12	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN

[1] Fit to the amplitudes of HOEHLER 79.

Δ(1930) INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \to \Delta(1930) \to \Sigma K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.043	−0.5	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1930) \to \Delta\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.15	30	ROENCHEN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to \Delta(1930) \to \Delta\pi$, G-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.009	121	ROENCHEN	15A	DPWA	Multichannel

Δ(1930) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1900 to 2000 (≈ 1950) OUR ESTIMATE				
1988± 32	[1] HUNT	19	DPWA	Multichannel
2233± 53	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
1940± 30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1901± 15	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1930± 12	[1] SHRESTHA	12A	DPWA	Multichannel
1932±100	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

Δ(1930) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
200 to 400 (≈ 300) OUR ESTIMATE				
500±160	[1] HUNT	19	DPWA	Multichannel
773±187	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN

320± 60	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
195± 60	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
235± 39	[1] SHRESTHA	12A	DPWA	Multichannel
316±237	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

Δ(1930) DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	5–15 %
Γ_2	$N\gamma$	0.0–0.01 %
Γ_3	$N\gamma$, helicity=1/2	0.0–0.005 %
Γ_4	$N\gamma$, helicity=3/2	0.0–0.004 %

Δ(1930) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5 to 15 (≈ 10) OUR ESTIMATE				
9.5±0.1	[1] HUNT	19	DPWA	Multichannel
8.1±1.2	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
14 ±4	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
4 ±3	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
7.9±0.4	[1] SHRESTHA	12A	DPWA	Multichannel
9 ±8	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

Δ(1930) PHOTON DECAY AMPLITUDES AT THE POLE

Δ(1930) → $N\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS (GeV$^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
$0.130^{+0.073}_{-0.096}$	-50^{+77}_{-26}	ROENCHEN	14	DPWA	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.270	33	ROENCHEN	15A	DPWA	Multichannel

Δ(1930) → $N\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS (GeV$^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
$-0.056^{+0.003}_{-0.151}$	168^{+72}_{-76}	ROENCHEN	14	DPWA	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.153	81	ROENCHEN	15A	DPWA	Multichannel

Δ(1930) BREIT-WIGNER PHOTON DECAY AMPLITUDES

Δ(1930) → $N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
-0.043 ± 0.008	[1] HUNT	19	DPWA	Multichannel
-0.007 ± 0.010	[1] ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.011 ± 0.003	[1] SHRESTHA	12A	DPWA	Multichannel

[1] Statistical error only.

Δ(1930) → $N\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
-0.020 ± 0.017	[1] HUNT	19	DPWA	Multichannel
0.005 ± 0.010	[1] ARNDT	96	IPWA	$\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.002 ± 0.002	[1] SHRESTHA	12A	DPWA	Multichannel

[1] Statistical error only.

Δ(1930) REFERENCES

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

HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
ROENCHEN	15A	EPJ A51 70	D. Roenchen *et al.*	
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)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
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)
ARNDT	96	PR C53 430	R.A. Arndt, I.I. Strakovsky, R.L. Workman	(VPI)
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