

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

$I(J^P) = \frac{3}{2}(\frac{5}{2}^-)$ 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
1820 to 1880 ($\approx$ 1850) OUR ESTIMATE			
1821 $\pm$ 2	ROENCHEN	22	DPWA Multichannel
1848 $\pm$ 9 $\pm$ 19	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
1890 $\pm$ 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • 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 $\pi N \rightarrow \pi N, \eta N$
1883	VRANA	00	DPWA Multichannel
1850	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

–2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
300 to 450 ($\approx$ 320) OUR ESTIMATE			
447 $\pm$ 7	ROENCHEN	22	DPWA Multichannel
321 $\pm$ 17 $\pm$ 7	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
260 $\pm$ 60	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • 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 $\pi N \rightarrow \pi N, \eta N$
250	VRANA	00	DPWA Multichannel
180	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

$\Delta(1930)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
8 to 20 ($\approx$ 14) OUR ESTIMATE			
15 $\pm$ 2	ROENCHEN	22	DPWA Multichannel
9 $\pm$ 1 $\pm$ 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
18 $\pm$ 6	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
34	ROENCHEN	15A	DPWA Multichannel
7	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
20	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)	DOCUMENT ID	TECN	COMMENT
−100 to −10 (≈ −50) OUR ESTIMATE			
−108±5	ROENCHEN	22	DPWA Multichannel
−37±3±7	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
−20±40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−155	ROENCHEN	15A	DPWA Multichannel
−12	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
¹ Fit to the amplitudes of HOEHLER 79.			

$\Delta(1930)$ INELASTIC POLE RESIDUE

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

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

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.010±0.001	49 ± 5	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.043	−0.5	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1930) \rightarrow \Delta\pi, D\text{-wave}$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.12±0.02	64 ± 4	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.15	30	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1930) \rightarrow \Delta\pi, G\text{-wave}$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.008±0.001	148 ± 2	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.009	121	ROENCHEN	15A	DPWA Multichannel

$\Delta(1930)$ 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 $\pi N \rightarrow \pi N, \eta N$
1940±30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1901±15	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • 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

¹Statistical error only.

$\Delta(1930)$ 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 $\pi N \rightarrow \pi N, \eta N$
320 ± 60	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
195 ± 60	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • 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

¹Statistical error only.

$\Delta(1930)$ DECAY MODES

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

Mode	Fraction (Γ_i/Γ)
$\Gamma_1 \quad N\pi$	5–15 %
$\Gamma_2 \quad N\gamma$	0.0–0.01 %
$\Gamma_3 \quad N\gamma, \text{ helicity}=1/2$	0.0–0.005 %
$\Gamma_4 \quad N\gamma, \text{ helicity}=3/2$	0.0–0.004 %

$\Delta(1930)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$					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 $\pi N \rightarrow \pi N, \eta N$		
14 ± 4	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$		
4 ± 3	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$		
• • • 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		

¹Statistical error only.

$\Delta(1930)$ PHOTON DECAY AMPLITUDES AT THE POLE

$\Delta(1930) \rightarrow N\gamma, \text{ helicity-1/2 amplitude } A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.104 ± 0.009	129 ± 8	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.270	33	ROENCHEN	15A	DPWA Multichannel

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

<i>MODULUS</i> (GeV ^{-1/2})	<i>PHASE</i> (°)	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
0.322±0.022	142 ± 4	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.153	81	ROENCHEN	15A	DPWA Multichannel

$\Delta(1930)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

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

<i>VALUE</i> (GeV ^{-1/2})	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
−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.			

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

<i>VALUE</i> (GeV ^{-1/2})	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
−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.			

$\Delta(1930)$ REFERENCES

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

ROENCHEN	22	EPJ A58 229	D. Roenchen <i>et al.</i>	(JULI, GWU, BONN+)
HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
ROENCHEN	15A	EPJ A51 70	D. Roenchen <i>et al.</i>	
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)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(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 <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