

$\Delta(1950) 7/2^+$ $I(J^P) = \frac{3}{2}(\frac{7}{2}^+)$ Status: ****

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

 $\Delta(1950)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1870 to 1890 (\approx 1880) OUR ESTIMATE			
1888 \pm 4	SOKHOYAN	15A	DPWA Multichannel
1877 \pm 2 \pm 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
1876	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1878	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
1890 \pm 15	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1888 \pm 4	GUTZ	14	DPWA Multichannel
1890 \pm 4	ANISOVICH	12A	DPWA Multichannel
1871	SHRESTHA	12A	DPWA Multichannel
1910	VRANA	00	DPWA Multichannel

-2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
220 to 260 (\approx 240) OUR ESTIMATE			
245 \pm 8	SOKHOYAN	15A	DPWA Multichannel
223 \pm 4 \pm 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
227	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
230	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
260 \pm 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
245 \pm 8	GUTZ	14	DPWA Multichannel
243 \pm 8	ANISOVICH	12A	DPWA Multichannel
220	SHRESTHA	12A	DPWA Multichannel
230	VRANA	00	DPWA Multichannel

 $\Delta(1950)$ ELASTIC POLE RESIDUE**MODULUS $|r|$**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
44 to 60 (\approx 52) OUR ESTIMATE			
58 \pm 2	SOKHOYAN	15A	DPWA Multichannel
44 \pm 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
53	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
47	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
50 \pm 7	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
58 \pm 2	GUTZ	14	DPWA Multichannel
58 \pm 2	ANISOVICH	12A	DPWA Multichannel

PHASE θ

<u>VALUE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
–24 to –40 (\approx –32) OUR ESTIMATE			
–24 \pm 3	SOKHOYAN	15A	DPWA Multichannel
–39 \pm 1 \pm 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
–31	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
–32	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
–33 \pm 8	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
–24 \pm 3	GUTZ	14	DPWA Multichannel
–24 \pm 3	ANISOVICH	12A	DPWA Multichannel

 $\Delta(1950)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow \Delta(1950) \rightarrow \Sigma K$

<u>MODULUS (%)</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
5 \pm 1	–65 \pm 25	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1950) \rightarrow \Delta\pi, F$ -wave

<u>MODULUS (%)</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
12 \pm 4	undefined	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
12 \pm 4	12 \pm 10	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1950) \rightarrow \Delta(1232)\eta$

<u>MODULUS (%)</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
3.5 \pm 0.5	90 \pm 25	GUTZ	14	DPWA Multichannel

 $\Delta(1950)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1915 to 1950 (\approx 1930) OUR ESTIMATE			
1917 \pm 4	SOKHOYAN	15A	DPWA Multichannel
1921.3 \pm 0.2	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1950 \pm 15	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1913 \pm 8	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1917 \pm 4	GUTZ	14	DPWA Multichannel
1915 \pm 6	ANISOVICH	12A	DPWA Multichannel
1918 \pm 1	SHRESTHA	12A	DPWA Multichannel
1936 \pm 5	VRANA	00	DPWA Multichannel

 $\Delta(1950)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
235 to 335 (\approx 285) OUR ESTIMATE			
251 \pm 8	SOKHOYAN	15A	DPWA Multichannel
271.1 \pm 1.1	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
340 \pm 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
224 \pm 10	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$

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

251 ± 8	GUTZ	14	DPWA	Multichannel
246 ± 10	ANISOVICH	12A	DPWA	Multichannel
259 ± 4	SHRESTHA	12A	DPWA	Multichannel
245 ± 12	VRANA	00	DPWA	Multichannel

Δ(1950) DECAY MODES

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

Mode	Fraction (Γ_j/Γ)
Γ_1 $N\pi$	35–45 %
Γ_2 ΣK	0.3–0.5 %
Γ_3 $N\pi\pi$	
Γ_4 $\Delta(1232)\pi$, <i>F</i> -wave	1–9 %
Γ_5 $N(1680)\pi$, <i>P</i> -wave	3–9 %
Γ_6 $\Delta(1232)\eta$	< 1 %

Δ(1950) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE (%) DOCUMENT ID TECN COMMENT

35 to 45 OUR ESTIMATE

46 ± 2	SOKHOYAN	15A	DPWA	Multichannel
47.1 ± 0.1	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
39 ± 4	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
38 ± 2	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$

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

46 ± 2	GUTZ	14	DPWA	Multichannel
45 ± 2	ANISOVICH	12A	DPWA	Multichannel
45.6 ± 0.4	SHRESTHA	12A	DPWA	Multichannel
44 ± 1	VRANA	00	DPWA	Multichannel

$\Gamma(\Sigma K)/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE (%) DOCUMENT ID TECN COMMENT

0.4 ± 0.1	ANISOVICH	12A	DPWA	Multichannel
-----------	-----------	-----	------	--------------

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

VALUE (%) DOCUMENT ID TECN COMMENT

5 ± 4	SOKHOYAN	15A	DPWA	Multichannel
-------	----------	-----	------	--------------

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

2.8 ± 1.4	ANISOVICH	12A	DPWA	Multichannel
8 ± 1	SHRESTHA	12A	DPWA	Multichannel
36 ± 1	VRANA	00	DPWA	Multichannel

$\Gamma(N(1680)\pi, P\text{-wave})/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (%) DOCUMENT ID TECN COMMENT

6 ± 3	SOKHOYAN	15A	DPWA	Multichannel
-------	----------	-----	------	--------------

$\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}}$				Γ_6/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
<1	GUTZ	14	DPWA	Multichannel

$\Delta(1950)$ PHOTON DECAY AMPLITUDES AT THE POLE

$\Delta(1950) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
-0.067 ± 0.004	-10 ± 5	SOKHOYAN	15A	DPWA Multichannel

$\Delta(1950) \rightarrow N\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
-0.095 ± 0.004	-10 ± 5	SOKHOYAN	15A	DPWA Multichannel

$\Delta(1950)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

$\Delta(1950) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.067 ± 0.005	SOKHOYAN	15A	DPWA Multichannel
-0.083 ± 0.004	WORKMAN	12A	DPWA $\gamma N \rightarrow N\pi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
-0.067 ± 0.005	GUTZ	14	DPWA Multichannel
-0.071 ± 0.004	ANISOVICH	12A	DPWA Multichannel
-0.065 ± 0.001	SHRESTHA	12A	DPWA Multichannel
-0.094	DRECHSEL	07	DPWA $\gamma N \rightarrow \pi N$

$\Delta(1950) \rightarrow N\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.094 ± 0.004	SOKHOYAN	15A	DPWA Multichannel
-0.096 ± 0.004	WORKMAN	12A	DPWA $\gamma N \rightarrow N\pi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
-0.094 ± 0.004	GUTZ	14	DPWA Multichannel
-0.094 ± 0.005	ANISOVICH	12A	DPWA Multichannel
-0.083 ± 0.001	SHRESTHA	12A	DPWA Multichannel
-0.121	DRECHSEL	07	DPWA $\gamma N \rightarrow \pi N$

$\Delta(1950)$ FOOTNOTES

¹ Fit to the amplitudes of HOEHLER 79.

$\Delta(1950)$ REFERENCES

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	CPC 38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>	
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)
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator	(MAINZ, JINR)
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)
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
