

$$\Delta(1910) \ 1/2^+$$

$$I(J^P) = \frac{3}{2}(\frac{1}{2}^+) \text{ Status: } ****$$

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

$\Delta(1910)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1800 to 1900 ($\approx$ 1850) OUR ESTIMATE			
1802 $\pm$ 6	ROENCHEN	22	DPWA Multichannel
1840 $\pm$ 40	SOKHOYAN	15A	DPWA Multichannel
1896 $\pm$ 11	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
1880 $\pm$ 30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1801	HUNT	19	DPWA Multichannel
1799	ROENCHEN	15A	DPWA Multichannel
1840 $\pm$ 40	GUTZ	14	DPWA Multichannel
1850 $\pm$ 40	ANISOVICH	12A	DPWA Multichannel
1771	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1880	VRANA	00	DPWA Multichannel
1874	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

–2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
200 to 500 ($\approx$ 350) OUR ESTIMATE			
550 $\pm$ 11	ROENCHEN	22	DPWA Multichannel
370 $\pm$ 60	SOKHOYAN	15A	DPWA Multichannel
302 $\pm$ 22	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
200 $\pm$ 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
224	HUNT	19	DPWA Multichannel
648	ROENCHEN	15A	DPWA Multichannel
370 $\pm$ 60	GUTZ	14	DPWA Multichannel
350 $\pm$ 45	ANISOVICH	12A	DPWA Multichannel
479	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
496	VRANA	00	DPWA Multichannel
283	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

$\Delta(1910)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
20 to 30 ($\approx$ 25) OUR ESTIMATE			
35 $\pm$ 13	ROENCHEN	22	DPWA Multichannel
25 $\pm$ 6	SOKHOYAN	15A	DPWA Multichannel
29 $\pm$ 2	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
20 $\pm$ 4	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

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

90	ROENCHEN	15A	DPWA	Multichannel
25 ± 6	GUTZ	14	DPWA	Multichannel
24 ± 6	ANISOVICH	12A	DPWA	Multichannel
45	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
38	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)	DOCUMENT ID	TECN	COMMENT
−180 to 90 (≈ − 90) OUR ESTIMATE			
93 ± 7	ROENCHEN	22	DPWA Multichannel
−155 ± 30	SOKHOYAN	15A	DPWA Multichannel
− 83 ± 4 ± 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
− 90 ± 30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

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

− 83	ROENCHEN	15A	DPWA	Multichannel
−155 ± 30	GUTZ	14	DPWA	Multichannel
−145 ± 30	ANISOVICH	12A	DPWA	Multichannel
+172	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$

¹Fit to the amplitudes of HOEHLER 79.

$\Delta(1910)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow \Delta(1910) \rightarrow \Sigma K$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.002 ± 0.002	138 ± 10	ROENCHEN	22	DPWA Multichannel
0.07 ± 0.02	−110 ± 30	ANISOVICH	12A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.019	−123	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1910) \rightarrow \Delta\pi, P$ -wave

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.24 ± 0.09	−42 ± 7	ROENCHEN	22	DPWA Multichannel
0.24 ± 0.10	85 ± 35	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.58	131	ROENCHEN	15A	DPWA Multichannel
0.16 ± 0.09	95 ± 40	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1910) \rightarrow \Delta(1232)\eta$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.11 ± 0.04	−150 ± 50	GUTZ	14	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1910) \rightarrow N(1440)\pi$

<i>MODULUS</i>	<i>PHASE (°)</i>	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
0.06±0.03	170 ± 45	SOKHOYAN	15A DPWA	Multichannel

$\Delta(1910)$ BREIT-WIGNER MASS

<i>VALUE (MeV)</i>	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
1850 to 1950 (≈ 1900) OUR ESTIMATE			
1846 ± 18	¹ HUNT	19	DPWA Multichannel
1845 ± 40	SOKHOYAN	15A	DPWA Multichannel
2067.9± 1.7	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
1910 ± 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1888 ± 20	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1845 ± 40	GUTZ	14	DPWA Multichannel
1860 ± 40	ANISOVICH	12A	DPWA Multichannel
1934 ± 5	¹ SHRESTHA	12A	DPWA Multichannel
1995 ± 12	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Delta(1910)$ BREIT-WIGNER WIDTH

<i>VALUE (MeV)</i>	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
200 to 400 (≈ 300) OUR ESTIMATE			
260± 57	¹ HUNT	19	DPWA Multichannel
360± 60	SOKHOYAN	15A	DPWA Multichannel
543± 10	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
225± 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
280± 50	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
360± 60	GUTZ	14	DPWA Multichannel
350± 55	ANISOVICH	12A	DPWA Multichannel
211± 11	¹ SHRESTHA	12A	DPWA Multichannel
713± 465	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Delta(1910)$ DECAY MODES

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	10–30%
Γ_2 ΣK	4–14%
Γ_3 $\Delta(1232)\pi$	34–66%
Γ_4 $N(1440)\pi$	3–45%
Γ_5 $\Delta(1232)\eta$	5–13%
Γ_6 $N\gamma$, helicity=1/2	0.0–0.02 %

$\Delta(1910)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$					Γ_1/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		

10–30% OUR ESTIMATE

13 $\pm$ 3	¹ HUNT	19	DPWA	Multichannel	
12 $\pm$ 3	SOKHOYAN	15A	DPWA	Multichannel	
23.9 $\pm$ 0.1	¹ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$	
19 $\pm$ 3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
24 $\pm$ 6	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
12 $\pm$ 3	GUTZ	14	DPWA	Multichannel	
12 $\pm$ 3	ANISOVICH	12A	DPWA	Multichannel	
17 $\pm$ 1	¹ SHRESTHA	12A	DPWA	Multichannel	
29 $\pm$ 21	VRANA	00	DPWA	Multichannel	

¹Statistical error only.

$\Gamma(\Sigma K)/\Gamma_{\text{total}}$					Γ_2/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		

4–14% OUR ESTIMATE

9 $\pm$ 5	ANISOVICH	12A	DPWA	Multichannel	
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$\Gamma(\Delta(1232)\pi)/\Gamma_{\text{total}}$					Γ_3/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		

34–66% OUR ESTIMATE

50 $\pm$ 16	SOKHOYAN	15A	DPWA	Multichannel	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
60 $\pm$ 28	ANISOVICH	12A	DPWA	Multichannel	

$\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$					Γ_4/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		

3–45% OUR ESTIMATE

33 $\pm$ 12	¹ HUNT	19	DPWA	Multichannel	
6 $\pm$ 3	SOKHOYAN	15A	DPWA	Multichannel	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
47 $\pm$ 6	¹ SHRESTHA	12A	DPWA	Multichannel	
56 $\pm$ 7	VRANA	00	DPWA	Multichannel	

¹Statistical error only.

$\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}}$					Γ_5/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		

5–13% OUR ESTIMATE

9 $\pm$ 4	GUTZ	14	DPWA	Multichannel	
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$\Delta(1910)$ PHOTON DECAY AMPLITUDES AT THE POLE

$\Delta(1910) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

<i>MODULUS</i> ($\text{GeV}^{-1/2}$)	<i>PHASE</i> ($^\circ$)	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
-0.446 ± 0.036	-70 ± 11	ROENCHEN	22	DPWA Multichannel
0.027 ± 0.009	-30 ± 60	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.321	39	ROENCHEN	15A	DPWA Multichannel

$\Delta(1910)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

$\Delta(1910) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

<i>VALUE</i> ($\text{GeV}^{-1/2}$)	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
0.010 to 0.030 (≈ 0.020) OUR ESTIMATE			
0.203 ± 0.056	¹ HUNT	19	DPWA Multichannel
0.026 ± 0.008	SOKHOYAN	15A	DPWA Multichannel
-0.002 ± 0.008	¹ ARNDT	96	IPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.026 ± 0.008	GUTZ	14	DPWA Multichannel
0.022 ± 0.009	ANISOVICH	12A	DPWA Multichannel
0.030 ± 0.002	¹ SHRESTHA	12A	DPWA Multichannel
¹ Statistical error only.			

$\Delta(1910)$ 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>	
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	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)
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)
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