

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

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

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	$\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
–180 to 90 (\approx – 90) OUR ESTIMATE			
93 ± 7	ROENCHEN	22	DPWA Multichannel
-155 ± 30	SOKHOYAN	15A	DPWA Multichannel
$-83 \pm 4 \pm 1$	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	$\pi N \rightarrow \pi N, \eta N$

¹ Fit 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 ($^\circ$)	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 ($^\circ$)	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 ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.11 ± 0.04	-150 ± 50	GUTZ	14	DPWA Multichannel

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

MODULUS	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.06 ± 0.03	170 ± 45	SOKHOYAN	15A	DPWA Multichannel

$\Delta(1910)$ BREIT-WIGNER MASS

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

 $\Delta(1910)$ BREIT-WIGNER WIDTH

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

$\Gamma(\Delta(1232)\pi)/\Gamma_{\text{total}}$					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	

$\Delta(1910)$ PHOTON DECAY AMPLITUDES AT THE POLE **$\Delta(1910) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$**

<u>MODULUS ($\text{GeV}^{-1/2}$)</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-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 $A_{1/2}$**

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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

¹Statistical 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