

$$\Delta(1900) \ 1/2^-$$

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

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

$\Delta(1900)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1830 to 1900 (\approx 1865) OUR ESTIMATE			
1845 \pm 20	SOKHOYAN	15A	DPWA Multichannel
1865 \pm 35 \pm 19	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
1870 \pm 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1957	HUNT	19	DPWA Multichannel
1845 \pm 20	GUTZ	14	DPWA Multichannel
1845 \pm 25	ANISOVICH	12A	DPWA Multichannel
1795	VRANA	00	DPWA Multichannel
1780	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.

-2xIMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
180 to 300 (\approx 240) OUR ESTIMATE			
295 \pm 35	SOKHOYAN	15A	DPWA Multichannel
187 \pm 50 \pm 19	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
180 \pm 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
447	HUNT	19	DPWA Multichannel
295 \pm 35	GUTZ	14	DPWA Multichannel
300 \pm 45	ANISOVICH	12A	DPWA Multichannel
58	VRANA	00	DPWA Multichannel

¹ Fit to the amplitudes of HOEHLER 79.

$\Delta(1900)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
8 to 14 (\approx 11) OUR ESTIMATE			
11 \pm 2	SOKHOYAN	15A	DPWA Multichannel
11 \pm 4 \pm 2	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
10 \pm 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
11 \pm 2	GUTZ	14	DPWA Multichannel
10 \pm 3	ANISOVICH	12A	DPWA Multichannel

¹ Fit to the amplitudes of HOEHLER 79.

PHASE θ

<u>VALUE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-115 ± 20	SOKHOYAN	15A	DPWA Multichannel
$20 \pm 27 \pm 19$	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
$+ 20 \pm 40$	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
-115 ± 20	GUTZ	14	DPWA Multichannel
-125 ± 20	ANISOVICH	12A	DPWA Multichannel
¹ Fit to the amplitudes of HOEHLER 79.			

$\Delta(1900)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow \Delta(1900) \rightarrow \Sigma K$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.07 ± 0.02	-50 ± 30	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1900) \rightarrow \Delta\pi, D\text{-wave}$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.18 ± 0.10	105 ± 25	SOKHOYAN	15A	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$0.12^{+0.08}_{-0.05}$	110 ± 20	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1900) \rightarrow \Delta(1232)\eta$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.013 ± 0.006	undefined	GUTZ	14	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1900) \rightarrow N(1440)\pi$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.11 ± 0.06	115 ± 30	SOKHOYAN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1900) \rightarrow N(1520)\pi$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.06 ± 0.03	undefined	SOKHOYAN	15A	DPWA Multichannel

$\Delta(1900)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1840 to 1920 (\approx 1860) OUR ESTIMATE			
1989 ± 22	¹ HUNT	19	DPWA Multichannel
1840 ± 20	SOKHOYAN	15A	DPWA Multichannel
1890 ± 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1908 ± 30	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1840 ± 20	GUTZ	14	DPWA Multichannel
1840 ± 30	ANISOVICH	12A	DPWA Multichannel
1868 ± 12	¹ SHRESTHA	12A	DPWA Multichannel
1802 ± 87	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Delta(1900)$ BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
180 to 320 (≈ 250) OUR ESTIMATE			
457 ± 60	¹ HUNT	19	DPWA Multichannel
295 ± 30	SOKHOYAN	15A	DPWA Multichannel
170 ± 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
140 ± 40	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
295 ± 30	GUTZ	14	DPWA Multichannel
300 ± 45	ANISOVICH	12A	DPWA Multichannel
234 ± 27	¹ SHRESTHA	12A	DPWA Multichannel
48 ± 45	VRANA	00	DPWA Multichannel
¹ Statistical error only.			

$\Delta(1900)$ DECAY MODES

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	4–12%
Γ_2 ΣK	seen
Γ_3 $N\pi\pi$	> 52%
Γ_4 $\Delta(1232)\pi$, <i>D</i> -wave	30–70%
Γ_5 $N\rho$	22–60 %
Γ_6 $N\rho$, <i>S</i> =1/2, <i>S</i> -wave	11–35%
Γ_7 $N\rho$, <i>S</i> =3/2, <i>D</i> -wave	11–25%
Γ_8 $N(1440)\pi$	3–32%
Γ_9 $N(1520)\pi$	2–10%
Γ_{10} $\Delta(1232)\eta$	< 2%
Γ_{11} $N\gamma$, helicity=1/2	0.06–0.43 %

$\Delta(1900)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$	DOCUMENT ID	TECN	COMMENT	Γ_1/Γ
4–12% OUR ESTIMATE				
3.7 ± 0.8	¹ HUNT	19	DPWA Multichannel	
7 ± 2	SOKHOYAN	15A	DPWA Multichannel	
10 ± 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$	
8 ± 4	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
7 ± 2	GUTZ	14	DPWA Multichannel	
7 ± 3	ANISOVICH	12A	DPWA Multichannel	
8 ± 1	¹ SHRESTHA	12A	DPWA Multichannel	
33 ± 10	VRANA	00	DPWA Multichannel	
¹ Statistical error only.				

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
30–70% OUR ESTIMATE			
42 ± 8	¹ HUNT	19	DPWA Multichannel
50 ± 20	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
15 ⁺⁵⁰ ₋₁₀	ANISOVICH	12A	DPWA Multichannel
56 ± 6	¹ SHRESTHA	12A	DPWA Multichannel
28 ± 1	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Gamma(N\rho, S=1/2, S\text{-wave})/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma$

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
11–35% OUR ESTIMATE			
23 ± 12	¹ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
12 ± 4	¹ SHRESTHA	12A	DPWA Multichannel
30 ± 2	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Gamma(N\rho, S=3/2, D\text{-wave})/\Gamma_{\text{total}} \quad \Gamma_7/\Gamma$

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
11–25% OUR ESTIMATE			
18 ± 7	¹ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
23 ± 5	¹ SHRESTHA	12A	DPWA Multichannel
5 ± 1	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Gamma(N(1440)\pi)/\Gamma_{\text{total}} \quad \Gamma_8/\Gamma$

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
3–32% OUR ESTIMATE			
12 ± 9	¹ HUNT	19	DPWA Multichannel
20 ± 12	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
< 1	¹ SHRESTHA	12A	DPWA Multichannel
4 ± 1	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Gamma(N(1520)\pi)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma$

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2–10% OUR ESTIMATE			
6 ± 4	SOKHOYAN	15A	DPWA Multichannel

$\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}} \quad \Gamma_{10}/\Gamma$

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
< 2% OUR ESTIMATE			
1 ± 1	GUTZ	14	DPWA Multichannel

$\Delta(1900)$ PHOTON DECAY AMPLITUDES AT THE POLE

$\Delta(1900) \rightarrow N\gamma$, 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>
0.064 ± 0.015	60 ± 20	SOKHOYAN	15A	DPWA Multichannel

$\Delta(1900)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

$\Delta(1900) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.212 ± 0.029	¹ HUNT	19	DPWA Multichannel
0.065 ± 0.015	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.057 ± 0.014	GUTZ	14	DPWA Multichannel
-0.082 ± 0.009	¹ SHRESTHA	12A	DPWA Multichannel

¹Statistical error only.

$\Delta(1900)$ REFERENCES

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

HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
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)
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