

$\Delta(1900) 1/2^-$ $I(J^P) = \frac{3}{2}(\frac{1}{2}^-)$ 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 (≈ 1865) OUR ESTIMATE			
1815 \pm 20	SARANTSEV	25	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	SOKHOYAN	15A	DPWA Multichannel
1845 \pm 20	GUTZ	14	DPWA Multichannel
1795	VRANA	00	DPWA Multichannel
1780	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

-2xIMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
180 to 300 (≈ 240) OUR ESTIMATE			
340 \pm 35	SARANTSEV	25	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	SOKHOYAN	15A	DPWA Multichannel
295 \pm 35	GUTZ	14	DPWA Multichannel
58	VRANA	00	DPWA Multichannel

¹Fit to the amplitudes of HOEHLER 79.

 $\Delta(1900)$ ELASTIC POLE RESIDUE**MODULUS $|r|$**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
8 to 14 (≈ 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

¹Fit 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			
1825 ± 20	SARANTSEV 25	DPWA	Multichannel
1989 ± 22	¹ HUNT 19	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	SOKHOYAN 15A	DPWA	Multichannel
1840 ± 20	GUTZ 14	DPWA	Multichannel
1868 ± 12	¹ SHRESTHA 12A	DPWA	Multichannel
1802 ± 87	VRANA 00	DPWA	Multichannel

¹Statistical error only.

$\Delta(1900)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
180 to 320 (≈ 250) OUR ESTIMATE			
360 \pm 35	SARANTSEV	25	DPWA Multichannel
457 \pm 60	¹ HUNT	19	DPWA Multichannel
170 \pm 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
140 \pm 40	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
295 \pm 30	SOKHOYAN	15A	DPWA Multichannel
295 \pm 30	GUTZ	14	DPWA Multichannel
234 \pm 27	¹ SHRESTHA	12A	DPWA Multichannel
48 \pm 45	VRANA	00	DPWA Multichannel

¹Statistical 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 $\Delta(1232)\pi$	30–70%
Γ_5 $N\rho$	22–60 %
Γ_6 $N\rho, S=1/2$	11–35%
Γ_7 $N\rho, S=3/2$	11–25%
Γ_8 $N(1440)\pi$	3–32%
Γ_9 $N(1520)\pi$	2–10%
Γ_{10} $\Delta(1232)\eta$	< 2%
Γ_{11} $N\gamma, \text{helicity}=1/2$	0.06–0.43 %

$\Delta(1900)$ BRANCHING RATIOS

<u>$\Gamma(N\pi)/\Gamma_{\text{total}}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	Γ_1/Γ
4–12% OUR ESTIMATE				
4 \pm 4	SEIFEN	25	DPWA Multichannel	
3.7 \pm 0.8	¹ HUNT	19	DPWA Multichannel	
10 \pm 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$	
8 \pm 4	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
7 \pm 2	SOKHOYAN	15A	DPWA Multichannel	
7 \pm 2	GUTZ	14	DPWA Multichannel	
8 \pm 1	¹ SHRESTHA	12A	DPWA Multichannel	
33 \pm 10	VRANA	00	DPWA Multichannel	

¹Statistical error only.

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
30-70% OUR ESTIMATE			
64 ± 15	SARANTSEV	25	DPWA Multichannel
60 ± 25	SEIFEN	25	DPWA Multichannel
42 ± 8	¹ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
50 ± 20	SOKHOYAN	15A	DPWA Multichannel
56 ± 6	¹ SHRESTHA	12A	DPWA Multichannel
28 ± 1	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Gamma(N\rho)/\Gamma_{\text{total}}$ Γ_5/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
38 ± 13			
	SARANTSEV	25	DPWA Multichannel

$\Gamma(N\rho, S=1/2)/\Gamma_{\text{total}}$ Γ_6/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
11-35% OUR ESTIMATE			
18 ± 8	SARANTSEV	25	DPWA Multichannel
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.

$\Gamma(N\rho, S=3/2)/\Gamma_{\text{total}}$ Γ_7/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
11-25% OUR ESTIMATE			
20 ± 10	SARANTSEV	25	DPWA Multichannel
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.

$\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$ Γ_8/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
3-32% OUR ESTIMATE			
15 ± 12	SEIFEN	25	DPWA Multichannel
12 ± 9	¹ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
20 ± 12	SOKHOYAN	15A	DPWA Multichannel
< 1	¹ SHRESTHA	12A	DPWA Multichannel
4 ± 1	VRANA	00	DPWA Multichannel

¹Statistical error only.

$\Gamma(N(1520)\pi)/\Gamma_{\text{total}}$				Γ_9/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
2-10% OUR ESTIMATE				
10 ± 7	SEIFEN	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
6 ± 4	SOKHOYAN	15A	DPWA	Multichannel
$\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}}$				Γ_{10}/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
< 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 $A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.075 ± 0.015	-65 ± 25	SARANTSEV	25	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
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 $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.075 ± 0.015	SARANTSEV	25	DPWA Multichannel
0.212 ± 0.029	¹ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.065 ± 0.015	SOKHOYAN	15A	DPWA Multichannel
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).

SARANTSEV	25	PR C112 015202	A.V. Sarantsev <i>et al.</i>	(Bonn-Gatchina Collab.)
SEIFEN	25	EPJ A61 173	T. Seifen <i>et al.</i>	(CBELSA/TAPS Collab.)
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