

$\Delta(1900) S_{31}$

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

OMITTED FROM SUMMARY TABLE

$\Delta(1900)$ BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1850 to 1950 (≈ 1900) OUR ESTIMATE			
1920 ± 24	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$
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. ● ● ●			
1918.5 ± 23.0	CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$
1803	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$

$\Delta(1900)$ BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
140 to 240 (≈ 200) OUR ESTIMATE			
263 ± 39	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$
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. ● ● ●			
93.5 ± 54.0	CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$
137	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$

$\Delta(1900)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1780	¹ HOEHLER	93	SPED $\pi N \rightarrow \pi N$
1870 ± 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90
2029 or 2025	² LONGACRE	78	IPWA $\pi N \rightarrow N\pi\pi$

-2xIMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
180 ± 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90
164 or 163	² LONGACRE	78	IPWA $\pi N \rightarrow N\pi\pi$

$\Delta(1900)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
10 ± 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

PHASE θ

VALUE (°)	DOCUMENT ID	TECN	COMMENT
+20±40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

$\Delta(1900)$ DECAY MODES

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

Mode	Fraction (Γ_j/Γ)
Γ_1 $N\pi$	10–30 %
Γ_2 ΣK	
Γ_3 $N\pi\pi$	
Γ_4 $\Delta\pi$	
Γ_5 $\Delta(1232)\pi$, <i>D</i> -wave	
Γ_6 $N\rho$	
Γ_7 $N\rho$, <i>S</i> =1/2, <i>S</i> -wave	
Γ_8 $N\rho$, <i>S</i> =3/2, <i>D</i> -wave	
Γ_9 $N(1440)\pi$, <i>S</i> -wave	
Γ_{10} $N\gamma$, helicity=1/2	

$\Delta(1900)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$	DOCUMENT ID	TECN	COMMENT	Γ_1/Γ
0.1 to 0.3 OUR ESTIMATE				
0.41±0.04	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$	
0.10±0.03	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$	
0.08±0.04	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.28	CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$	

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow \Sigma K$	DOCUMENT ID	TECN	COMMENT	$(\Gamma_1\Gamma_2)^{1/2}/\Gamma$
<0.03	CANDLIN	84	DPWA $\pi^+ p \rightarrow \Sigma^+ K^+$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.076	³ DEANS	75	DPWA $\pi N \rightarrow \Sigma K$	
0.11	LANGBEIN	73	IPWA $\pi N \rightarrow \Sigma K$ (sol. 1)	
0.12	LANGBEIN	73	IPWA $\pi N \rightarrow \Sigma K$ (sol. 2)	

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow \Delta(1232)\pi$, <i>D</i> -wave	DOCUMENT ID	TECN	COMMENT	$(\Gamma_1\Gamma_5)^{1/2}/\Gamma$
+0.25±0.07	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$	

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N\rho$, <i>S</i> =1/2, <i>S</i> -wave	DOCUMENT ID	TECN	COMMENT	$(\Gamma_1\Gamma_7)^{1/2}/\Gamma$
−0.14±0.11	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$	

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N\rho, S=3/2, D\text{-wave}$	$(\Gamma_1 \Gamma_8)^{1/2} / \Gamma$
VALUE	DOCUMENT ID TECN COMMENT
-0.37 ± 0.07	MANLEY 92 IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N(1440)\pi, S\text{-wave}$	$(\Gamma_1 \Gamma_9)^{1/2} / \Gamma$
VALUE	DOCUMENT ID TECN COMMENT
-0.16 ± 0.11	MANLEY 92 IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$

$\Delta(1900)$ PHOTON DECAY AMPLITUDES

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

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.004 ± 0.016	CRAWFORD	83	IPWA $\gamma N \rightarrow \pi N$
0.029 ± 0.008	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.006 to -0.025	CRAWFORD	80	DPWA $\gamma N \rightarrow \pi N$

$\Delta(1900)$ FOOTNOTES

¹ See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of N and Δ resonances as determined from Argand diagrams of πN elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams.

² LONGACRE 78 values are from a search for poles in the unitarized T-matrix. The first (second) value uses, in addition to $\pi N \rightarrow N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis.

³ The value given is from solution 1; the resonance is not present in solutions 2, 3, or 4.

$\Delta(1900)$ REFERENCES

For early references, see Physics Letters **111B** 70 (1982).

HOEHLER	93	πN Newsletter 9 1		(KARL)
MANLEY	92	PR D45 4002	+Saleski	(KENT) IJP
Also	84	PR D30 904	Manley, Arndt, Goradia, Teplitz	(VPI)
ARNDT	91	PR D43 2131	+Li, Roper, Workman, Ford	(VPI, TELE) IJP
CANDLIN	84	NP B238 477	+Lowe, Peach, Scotland+	(EDIN, RAL, LOWC)
CRAWFORD	83	NP B211 1	+Morton	(GLAS)
AWAJI	81	Bonn Conf. 352	+Kajikawa	(NAGO)
Also	82	NP B197 365	Fujii, Hayashii, Iwata, Kajikawa+	(NAGO)
CHEW	80	Toronto Conf. 123		(LBL) IJP
CRAWFORD	80	Toronto Conf. 107		(GLAS)
CUTKOSKY	80	Toronto Conf. 19	+Forsyth, Babcock, Kelly, Hendrick	(CMU, LBL) IJP
Also	79	PR D20 2839	Cutkosky, Forsyth, Hendrick, Kelly	(CMU, LBL) IJP
HOEHLER	79	PDAT 12-1	+Kaiser, Koch, Pietarinen	(KARLT) IJP
Also	80	Toronto Conf. 3	Koch	(KARLT) IJP
LONGACRE	78	PR D17 1795	+Lasinski, Rosenfeld, Smadja+	(LBL, SLAC)
DEANS	75	NP B96 90	+Mitchell, Montgomery+	(SFLA, ALAH) IJP
LANGBEIN	73	NP B53 251	+Wagner	(MUNI) IJP