

$\Delta(1920) \ P_{33}$

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

Most of the results published before 1975 are now obsolete and have been omitted. They may be found in our 1982 edition, Physics Letters **111B** (1982).

$\Delta(1920)$ BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1900 to 1970 (≈ 1920) OUR ESTIMATE			
2014 $\pm$ 16	MANLEY	92 IPWA	$\pi N \rightarrow \pi N \ \& \ N \pi \pi$
1920 $\pm$ 80	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
1868 $\pm$ 10	HOEHLER	79 IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1889 $\pm$ 100	VRANA	00	Multichannel
1840 $\pm$ 40	CANDLIN	84 DPWA	$\pi^+ p \rightarrow \Sigma^+ K^+$
1955.0 $\pm$ 13.0	¹ CHEW	80 BPWA	$\pi^+ p \rightarrow \pi^+ p$
2065.0 $^{+13.6}_{-12.9}$	¹ CHEW	80 BPWA	$\pi^+ p \rightarrow \pi^+ p$

$\Delta(1920)$ BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
150 to 300 (≈ 200) OUR ESTIMATE			
152 $\pm$ 55	MANLEY	92 IPWA	$\pi N \rightarrow \pi N \ \& \ N \pi \pi$
300 $\pm$ 100	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
220 $\pm$ 80	HOEHLER	79 IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
123 $\pm$ 53	VRANA	00	Multichannel
200 $\pm$ 40	CANDLIN	84 DPWA	$\pi^+ p \rightarrow \Sigma^+ K^+$
88.3 $\pm$ 35.0	¹ CHEW	80 BPWA	$\pi^+ p \rightarrow \pi^+ p$
62.0 $\pm$ 44.0	¹ CHEW	80 BPWA	$\pi^+ p \rightarrow \pi^+ p$

$\Delta(1920)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1850 to 1950 (≈ 1900) OUR ESTIMATE			
1900	² HOEHLER	93 SPED	$\pi N \rightarrow \pi N$
1900 $\pm$ 80	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1880	VRANA	00	Multichannel
not seen	ARNDT	91 DPWA	$\pi N \rightarrow \pi N$ Soln SM90

– 2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
200 to 400 (≈ 300) OUR ESTIMATE			
300±100	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
120	VRANA	00	Multichannel
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

Δ(1920) ELASTIC POLE RESIDUE

MODULUS |r|

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
24±4	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

PHASE θ

VALUE (°)	DOCUMENT ID	TECN	COMMENT
– 150±30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

Δ(1920) DECAY MODES

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	5–20 %
Γ_2 ΣK	
Γ_3 $N\pi\pi$	
Γ_4 $\Delta(1232)\pi$, <i>P</i> -wave	
Γ_5 $N(1440)\pi$, <i>P</i> -wave	
Γ_6 $N\gamma$, helicity=1/2	
Γ_7 $N\gamma$, helicity=3/2	

Δ(1920) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$					Γ_1/Γ
<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>		
0.05 to 0.2 OUR ESTIMATE					
0.02±0.02	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$	
0.20±0.05	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
0.14±0.04	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
0.05±0.04	VRANA	00	Multichannel		
0.24	¹ CHEW	80	BPWA	$\pi^+ p \rightarrow \pi^+ p$	
0.18	¹ CHEW	80	BPWA	$\pi^+ p \rightarrow \pi^+ p$	

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1920) \rightarrow \Sigma K$				$(\Gamma_1 \Gamma_2)^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
-0.052 ± 0.015	CANDLIN	84	DPWA $\pi^+ p \rightarrow \Sigma^+ K^+$	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.049	LIVANOS	80	DPWA $\pi p \rightarrow \Sigma K$	
0.048 to 0.120	³ DEANS	75	DPWA $\pi N \rightarrow \Sigma K$	

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1920) \rightarrow \Delta(1232)\pi$, <i>P</i> -wave				$(\Gamma_1 \Gamma_4)^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
-0.13 ± 0.04	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$	
0.3	⁴ NOVOSELLER 78	IPWA	$\pi N \rightarrow N\pi\pi$	
0.27	⁵ NOVOSELLER 78	IPWA	$\pi N \rightarrow N\pi\pi$	

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1920) \rightarrow N(1440)\pi$, <i>P</i> -wave				$(\Gamma_1 \Gamma_5)^{1/2} / \Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT	
$+0.06 \pm 0.07$	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$	

$\Delta(1920)$ PHOTON DECAY AMPLITUDES

$\Delta(1920) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.040 ± 0.014	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$

$\Delta(1920) \rightarrow N\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.023 ± 0.017	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$

$\Delta(1920)$ FOOTNOTES

¹ CHEW 80 reports two P_{33} resonances in this mass region. Problems with this analysis are discussed in section 2.1.11 of HOEHLER 83.

² 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.

³ The range given for DEANS 75 is from the four best solutions.

⁴ A Breit-Wigner fit to the HERNDON 75 IPWA; the phase is near -90° .

⁵ A Breit-Wigner fit to the NOVOSELLER 78B IPWA; the phase is near -90° .

$\Delta(1920)$ REFERENCES

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

VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KENT) IJP
Also	84	PR D30 904	D.M. Manley <i>et al.</i>	(VPI)
ARNDT	91	PR D43 2131	R.A. Arndt <i>et al.</i>	(VPI, TELE) IJP
CANDLIN	84	NP B238 477	D.J. Candlin <i>et al.</i>	(EDIN, RAL, LOWC)
HOEHLER	83	Landolt-Boernstein 1/9B2	G. Hohler	(KARLT)
PDG	82	PL 111B	M. Roos <i>et al.</i>	(HELS, CIT, CERN)
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)
Also	82	NP B197 365	K. Fujii <i>et al.</i>	(NAGO)

CHEW	80	Toronto Conf. 123	D.M. Chew	(LBL) IJP
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
Also	79	PR D20 2839	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
LIVANOS	80	Toronto Conf. 35	P. Livanos <i>et al.</i>	(SACL) IJP
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also	80	Toronto Conf. 3	R. Koch	(KARLT) IJP
NOVOSELLER	78	NP B137 509	D.E. Novoseller	(CIT)
NOVOSELLER	78B	NP B137 445	D.E. Novoseller	(CIT)
DEANS	75	NP B96 90	S.R. Deans <i>et al.</i>	(SFLA, ALAH) IJP
HERNDON	75	PR D11 3183	D. Herndon <i>et al.</i>	(LBL, SLAC)
