

$\Delta(1920) P_{33}$

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

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

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1900 to 1970 (≈ 1920) OUR ESTIMATE			
2014 ± 16	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$
1920 ± 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1868 ± 10	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1840 ± 40	CANDLIN	84	DPWA $\pi^+ p \rightarrow \Sigma^+ K^+$
1955.0 ± 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

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

 $\Delta(1920)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1850 to 1950 (≈ 1900) OUR ESTIMATE			
1900	² HOEHLER	93	SPED $\pi N \rightarrow \pi N$
1900 ± 80	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

-2xIMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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. ● ● ●			
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

$\Delta(1920)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

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

PHASE θ

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-150 ± 30	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

$\Delta(1920)$ 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	

$\Delta(1920)$ BRANCHING RATIOS

<u>$\Gamma(N\pi)/\Gamma_{\text{total}}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>Γ_1/Γ</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. ● ● ●				
0.24	¹ CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$	
0.18	¹ CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$	

<u>$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1920) \rightarrow \Sigma K$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>$(\Gamma_1\Gamma_2)^{1/2}/\Gamma$</u>
-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 $\pi N \rightarrow \Sigma K$	

<u>$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1920) \rightarrow \Delta(1232)\pi$, <i>P</i>-wave</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>$(\Gamma_1\Gamma_4)^{1/2}/\Gamma$</u>
-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).

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>	(HELSE, 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)