

$\Delta(1920) P_{33}$

$I(J^P) = \frac{3}{2}(\frac{3}{2}^+)$  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
<b>1900 to 1970 (<math>\approx 1920</math>) OUR ESTIMATE</b>			
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. • • •			
2057 $\pm$ 1	PENNER	02C	DPWA Multichannel
1889 $\pm$ 100	VRANA	00	DPWA Multichannel
1840 $\pm$ 40	CANDLIN	84	DPWA $\pi^+ p \rightarrow \Sigma^+ K^+$
1955.0 $\pm$ 13.0	<sup>1</sup> CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$
2065.0 $^{+13.6}_{-12.9}$	<sup>1</sup> CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$

### $\Delta(1920)$ BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>150 to 300 (<math>\approx 200</math>) OUR ESTIMATE</b>			
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. • • •			
525 $\pm$ 32	PENNER	02C	DPWA Multichannel
123 $\pm$ 53	VRANA	00	DPWA Multichannel
200 $\pm$ 40	CANDLIN	84	DPWA $\pi^+ p \rightarrow \Sigma^+ K^+$
88.3 $\pm$ 35.0	<sup>1</sup> CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$
62.0 $\pm$ 44.0	<sup>1</sup> CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$

### $\Delta(1920)$ POLE POSITION

#### REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>1850 to 1950 (<math>\approx 1900</math>) OUR ESTIMATE</b>			
1900	<sup>2</sup> 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	DPWA Multichannel
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

## – 2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>200 to 400 (≈ 300) OUR ESTIMATE</b>			
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	DPWA Multichannel
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

## Δ(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 $\pi N \rightarrow \pi N$

## Δ(1920) DECAY MODES

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

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\pi$	5–20 %
$\Gamma_2$ $\Sigma K$	(2.10±0.30) %
$\Gamma_3$ $N\pi\pi$	
$\Gamma_4$ $\Delta(1232)\pi$ , <i>P</i> -wave	
$\Gamma_5$ $N(1440)\pi$ , <i>P</i> -wave	
$\Gamma_6$ $N\gamma$ , helicity=1/2	
$\Gamma_7$ $N\gamma$ , helicity=3/2	

## Δ(1920) BRANCHING RATIOS

<u>Γ(Nπ)/Γ<sub>total</sub></u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>Γ<sub>1</sub>/Γ</u>
<b>0.05 to 0.2 OUR ESTIMATE</b>				
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. ● ● ●				
0.15±0.01	PENNER	02C	DPWA Multichannel	
0.05±0.04	VRANA	00	DPWA Multichannel	
0.24	<sup>1</sup> CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$	
0.18	<sup>1</sup> 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
$-0.052 \pm 0.015$	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 $0.120$	<sup>3</sup> DEANS	75	DPWA $\pi N \rightarrow \Sigma K$

$\Gamma(\Sigma K) / \Gamma_{\text{total}}$   $\Gamma_2 / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.021 \pm 0.003</math></b>	PENNER	02C	DPWA Multichannel

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$  in  $N\pi \rightarrow \Delta(1920) \rightarrow \Delta(1232)\pi$ , *P-wave*  $(\Gamma_1 \Gamma_4)^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.13 \pm 0.04$	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$
$0.3$	<sup>4</sup> NOVOSELLER	78	IPWA $\pi N \rightarrow N\pi\pi$
$0.27$	<sup>5</sup> NOVOSELLER	78	IPWA $\pi N \rightarrow N\pi\pi$

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

VALUE	DOCUMENT ID	TECN	COMMENT
$0.41 \pm 0.03$	VRANA	00	DPWA Multichannel

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$  in  $N\pi \rightarrow \Delta(1920) \rightarrow N(1440)\pi$ , *P-wave*  $(\Gamma_1 \Gamma_5)^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$+0.06 \pm 0.07$	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$

$\Gamma(N(1440)\pi$ , *P-wave*) /  $\Gamma_{\text{total}}$   $\Gamma_5 / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$0.53 \pm 0.08$	VRANA	00	DPWA Multichannel

**$\Delta(1920)$  PHOTON DECAY AMPLITUDES**

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

VALUE ( $\text{GeV}^{-1/2}$ )	DOCUMENT ID	TECN	COMMENT
$0.040 \pm 0.014$	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$-0.007$	PENNER	02D	DPWA Multichannel

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

VALUE ( $\text{GeV}^{-1/2}$ )	DOCUMENT ID	TECN	COMMENT
$0.023 \pm 0.017$	AWAJI	81	DPWA $\gamma N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$-0.001$	PENNER	02D	DPWA Multichannel

## $\Delta(1920)$ FOOTNOTES

- <sup>1</sup> 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.
- <sup>2</sup> See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of  $N$  and  $\Delta$  resonances as determined from Argand diagrams of  $\pi N$  elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams.
- <sup>3</sup> The range given for DEANS 75 is from the four best solutions.
- <sup>4</sup> A Breit-Wigner fit to the HERNDON 75 IPWA; the phase is near  $-90^\circ$ .
- <sup>5</sup> A Breit-Wigner fit to the NOVOSELLER 78B IPWA; the phase is near  $-90^\circ$ .

## $\Delta(1920)$ REFERENCES

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

PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)
PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	(PITT+)
HOEHLER	93	$\pi N$ 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)