$\Delta(1920)$ 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 ± 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. • • •				
2057 ± 1	PENNER	02C	DPWA	Multichannel
1889 ±100	VRANA	00	DPWA	Multichannel
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

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
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. • • •				
525 ± 32	PENNER	02C	DPWA	Multichannel
123 ± 53	VRANA	00	DPWA	Multichannel
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

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
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. • • •				
1880	VRANA	00	DPWA	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	DPWA	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	(2.10±0.30) %
Γ_3	$N\pi\pi$	
Γ_4	$\Delta(1232)\pi$, P-wave	
Γ_5	$N(1440)\pi$, P-wave	
Γ_6	$N\gamma$, helicity=1/2	
Γ_7	$N\gamma$, helicity=3/2	

Δ(1920) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
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. • • •				
0.15±0.01	PENNER	02C	DPWA	Multichannel
0.05±0.04	VRANA	00	DPWA	Multichannel
0.24	[1] CHEW	80	BPWA	$\pi^+ p \rightarrow \pi^+ p$
0.18	[1] CHEW	80	BPWA	$\pi^+ p \rightarrow \pi^+ p$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ 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	$\pi N \rightarrow \Sigma K$

$\Gamma(\Sigma K)/\Gamma_{total}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.021 ±0.003	PENNER	02C	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ 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 ± 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	$\pi N \rightarrow N\pi\pi$

$\Gamma(\Delta(1232)\pi$, *P*-wave$)/\Gamma_{total}$ — Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.41 ± 0.03	VRANA	00	DPWA	Multichannel

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

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.06\pm0.07$	MANLEY	92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$

$\Gamma(N(1440)\pi$, *P*-wave$)/\Gamma_{total}$ — Γ_5/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.53 ± 0.08	VRANA	00	DPWA	Multichannel

$\Delta(1920)$ PHOTON DECAY AMPLITUDES

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

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.040 ± 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 ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.023 ± 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

Δ(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°.

Δ(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	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 *et al.*	(VPI)	
ARNDT	91	PR D43 2131	R.A. Arndt *et al.*	(VPI, TELE)	IJP
CANDLIN	84	NP B238 477	D.J. Candlin *et al.*	(EDIN, RAL, LOWC)	
HOEHLER	83	Landolt-Boernstein 1/9B2	G. Hohler	(KARLT)	
PDG	82	PL 111B	M. Roos *et al.*	(HELS, CIT, CERN)	
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)	
Also	82	NP B197 365	K. Fujii *et al.*	(NAGO)	
CHEW	80	Toronto Conf. 123	D.M. Chew	(LBL)	IJP
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL)	IJP
Also	79	PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL)	IJP
LIVANOS	80	Toronto Conf. 35	P. Livanos *et al.*	(SACL)	IJP
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(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 *et al.*	(SFLA, ALAH)	IJP
HERNDON	75	PR D11 3183	D. Herndon *et al.*	(LBL, SLAC)	