$\Delta(1910)$ P_{31}

$I(J^P) = \frac{3}{2}(\frac{1}{2}^+)$ 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).

$\Delta(1910)$ MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1870 to 1920 (≈ 1910) OUR ESTIMATE				
1882 ±10	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
1910 ±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
1888 ±20	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1960.1 ± 21.0	[1] CHEW	80	BPWA	$\pi^+ p \to \pi^+ p$
$2121.4^{+13.0}_{-14.3}$	[1] CHEW	80	BPWA	$\pi^+ p \to \pi^+ p$
1921	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
1899	BARBOUR	78	DPWA	$\gamma N \to \pi N$
1790	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$\Delta(1910)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
190 to 270 (≈ 250) OUR ESTIMATE				
239 ±25	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
225 ±50	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
280 ±50	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
152.9 ± 60.0	[1] CHEW	80	BPWA	$\pi^+ p \to \pi^+ p$
172.2 ± 37.0	[1] CHEW	80	BPWA	$\pi^+ p \to \pi^+ p$
351	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
230	BARBOUR	78	DPWA	$\gamma N \to \pi N$
170	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$\Delta(1910)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1874	[3] HOEHLER	93	SPED	$\pi N \to \pi N$
1950	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
1880 ± 30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1792 or 1801	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
283	[3] HOEHLER	93	SPED	$\pi N \to \pi N$
398	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
200 ± 40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
172 or 165	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$\Delta(1910)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
38	HOEHLER	93	SPED	$\pi N \to \pi N$
37	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
20 ± 4	CUTKOSKY	80	IPWA	$\pi N \to \pi N$

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−91	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90
−90 ± 30	CUTKOSKY	80	IPWA	$\pi N \to \pi N$

$\Delta(1910)$ DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	15–30 %
Γ_2	ΣK	
Γ_3	$N\pi\pi$	
Γ_4	$\Delta\pi$	
Γ_5	$\Delta(1232)\pi$, P-wave	
Γ_6	$N\rho$	
Γ_7	$N\rho$, S=3/2, P-wave	
Γ_8	$N(1440)\pi$	
Γ_9	$N(1440)\pi$, P-wave	
Γ_{10}	$N\gamma$, helicity=1/2	

$\Delta(1910)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.15 to 0.3 OUR ESTIMATE				
0.23 ± 0.08	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$
0.19 ± 0.03	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
0.24 ± 0.06	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.17	[1] CHEW	80	BPWA	$\pi^+ p \to \pi^+ p$
0.40	[1] CHEW	80	BPWA	$\pi^+ p \to \pi^+ p$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1910) \to \Sigma K$ $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
< 0.03	CANDLIN	84	DPWA	$\pi^+ p \to \Sigma^+ K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.019	LIVANOS	80	DPWA	$\pi p \to \Sigma K$
0.082 to 0.184	[4] DEANS	75	DPWA	$\pi N \to \Sigma K$

Note: Signs of couplings from $\pi N \to N\pi\pi$ analyses were changed in the 1986 edition to agree with the baryon-first convention; the overall phase ambiguity is resolved by choosing a negative sign for the $\Delta(1620)$ S_{31} coupling to $\Delta(1232)\pi$.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1910) \to \Delta(1232)\pi$, P-wave $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+ 0.06	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1910) \to N\rho$, S=3/2, P-wave $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+ 0.29	[2] LONGACRE	77	IPWA	$\pi N \to N\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
+ 0.17	[5] NOVOSELLER	78	IPWA	$\pi N \to N\pi\pi$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1910) \to N(1440)\pi$, P-wave $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
−0.39 ± 0.04	MANLEY	92	IPWA	$\pi N \to \pi N$ & $N\pi\pi$

$\Delta(1910)$ PHOTON DECAY AMPLITUDES

$\Delta(1910) \to N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
+0.013 ± 0.022 OUR ESTIMATE				
0.032 ± 0.003	LI	93	IPWA	$\gamma N \to \pi N$
0.014 ± 0.030	CRAWFORD	83	IPWA	$\gamma N \to \pi N$
0.025 ± 0.011	AWAJI	81	DPWA	$\gamma N \to \pi N$
−0.012 ± 0.005	ARAI	80	DPWA	$\gamma N \to \pi N$ (fit 1)
−0.031 ± 0.004	ARAI	80	DPWA	$\gamma N \to \pi N$ (fit 2)
−0.005 ± 0.030	CRAWFORD	80	DPWA	$\gamma N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.035 ± 0.021	BARBOUR	78	DPWA	$\gamma N \to \pi N$

$\Delta(1910)$ FOOTNOTES

[1] CHEW 80 reports four resonances in the P_{31} wave — see also the $\Delta(1750)$. Problems with this analysis are discussed in section 2.1.11 of HOEHLER 83.

[2] LONGACRE 77 pole positions are from a search for poles in the unitarized T-matrix; the first (second) value uses, in addition to $\pi N \to N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis. The other LONGACRE 77 values are from eyeball fits with Breit-Wigner circles to the T-matrix amplitudes.

[3] See HOEHLER 93 and HOEHLER 94 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.

[4] The range given for DEANS 75 is from the four best solutions.

[5] Evidence for this coupling is weak; see NOVOSELLER 78. This coupling assumes the mass is near 1820 MeV.

$\Delta(1910)$ REFERENCES

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

HOEHLER	94	πN Newsletter 10 (to be pub.)	(KARL)
HOEHLER	93	πN Newsletter 9 1	(KARL)
LI	93	PR C47 2759 +Arndt, Roper, Workman	(VPI)
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)
HOEHLER	83	Landolt-Boernstein 1/9B2	(KARLT)
PDG	82	PL 111B Roos, Porter, Aguilar-Benitez+	(HELS, CIT, CERN)
AWAJI	81	Bonn Conf. 352 +Kajikawa	(NAGO)
Also	82	NP B197 365 Fujii, Hayashii, Iwata, Kajikawa+	(NAGO)