Citation: C. Caso *et al.* (Particle Data Group), European Phys Jour **C3**, 1 (1998) and 1999 partial update for edition 2000 (URL: http://pdg.lbl.gov)

$N(2220)\ H_{19}$

$I(J^P) = \frac{1}{2}(\frac{9}{2}^+)$ 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).

$N(2220)$ BREIT-WIGNER MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
2180 to 2310 (≈ 2220) OUR ESTIMATE				
2230±80	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
2205±10	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
2300±100	HENDRY	78	MPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2258	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
2050	BAKER	79	DPWA	$\pi^- p \rightarrow n\eta$

$N(2220)$ BREIT-WIGNER WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
320 to 550 (≈ 400) OUR ESTIMATE				
500±150	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
365±30	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
450±150	HENDRY	78	MPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
334	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$

$N(2220)$ POLE POSITION

REAL PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
2100 to 2240 (≈ 2170) OUR ESTIMATE				
2203	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
2135	[1] HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
2160±80	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2253	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90

−2×IMAGINARY PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
370 to 570 (≈ 470) OUR ESTIMATE				
536	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
400	[1] HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
480±100	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
640	ARNDT	91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90

$N(2220)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
68	ARNDT	95	DPWA	$\pi N \to N\pi$
40	HOEHLER	93	ARGD	$\pi N \to \pi N$
45±20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
85	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90

PHASE θ

VALUE (°)	*DOCUMENT ID*		*TECN*	*COMMENT*
−43	ARNDT	95	DPWA	$\pi N \to N\pi$
−50	HOEHLER	93	ARGD	$\pi N \to \pi N$
−45±25	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−62	ARNDT	91	DPWA	$\pi N \to \pi N$ Soln SM90

$N(2220)$ DECAY MODES

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	10–20 %
Γ_2	$N\eta$	
Γ_3	ΛK	

$N(2220)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.1 to 0.2 OUR ESTIMATE				
0.15±0.03	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
0.18±0.015	HOEHLER	79	IPWA	$\pi N \to \pi N$
0.12±0.04	HENDRY	78	MPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.26	ARNDT	95	DPWA	$\pi N \to N\pi$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(2220) \to N\eta$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.034	BAKER	79	DPWA	$\pi^- p \to n\eta$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(2220) \to \Lambda K$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
not required	BELL	83	DPWA	$\pi^- p \to \Lambda K^0$
not seen	SAXON	80	DPWA	$\pi^- p \to \Lambda K^0$

N(2220) FOOTNOTES

[1] 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.

N(2220) REFERENCES

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

ARNDT	95	PR C52 2120	+Strakovsky, Workman, Pavan	(VPI, BRCO)
HOEHLER	93	πN Newsletter 9 1		(KARL)
ARNDT	91	PR D43 2131	+Li, Roper, Workman, Ford	(VPI, TELE) IJP
BELL	83	NP B222 389	+Blissett, Broome, Daley, Hart, Lintern+	(RL) IJP
PDG	82	PL 111B	Roos, Porter, Aguilar-Benitez+	(HELS, CIT, CERN)
CUTKOSKY	80	Toronto Conf. 19	+Forsyth, Babcock, Kelly, Hendrick	(CMU, LBL) IJP
Also	79	PR D20 2839	Cutkosky, Forsyth, Hendrick, Kelly	(CMU, LBL) IJP
SAXON	80	NP B162 522	+Baker, Bell, Blissett, Bloodworth+	(RHEL, BRIS) IJP
BAKER	79	NP B156 93	+Brown, Clark, Davies, Depagter, Evans+	(RHEL) IJP
HOEHLER	79	PDAT 12-1	+Kaiser, Koch, Pietarinen	(KARLT) IJP
Also	80	Toronto Conf. 3	Koch	(KARLT) IJP
HENDRY	78	PRL 41 222		(IND, LBL) IJP
Also	81	ANP 136 1	Hendry	(IND)