

$N(2220) 9/2^+$ $I(J^P) = \frac{1}{2}(\frac{9}{2}^+)$ Status: ****

Most of the results published before 1975 were last included in our 1982 edition, *Physics Letters* **111B** 1 (1982). Some further obsolete results published before 1980 were last included in our 2006 edition, *Journal of Physics* (generic for all A,B,E,G) **G33** 1 (2006).

 $N(2220)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2200 to 2300 (≈ 2250) OUR ESTIMATE			
2316.3 \pm 2.9	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
2230 \pm 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
2205 \pm 10	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
2300 \pm 100	HENDRY	78	MPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
2270 \pm 11	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
2258	ARNDT	95	DPWA $\pi N \rightarrow N\pi$

 $N(2220)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
350 to 500 (≈ 400) OUR ESTIMATE			
633 \pm 17	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
500 \pm 150	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
365 \pm 30	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
450 \pm 150	HENDRY	78	MPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
366 \pm 42	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
334	ARNDT	95	DPWA $\pi N \rightarrow N\pi$

 $N(2220)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2130 to 2200 (≈ 2170) OUR ESTIMATE			
2150 \pm 35	ANISOVICH	12A	DPWA Multichannel
2199	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
2135	¹ HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
2160 \pm 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
2209	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
2203	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
2253	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

– 2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
400 to 560 (≈ 480) OUR ESTIMATE			
440 ± 40	ANISOVICH	12A	DPWA Multichannel
372	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
400	² 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. ● ● ●			
564	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
536	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
640	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

N(2220) ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
60 ± 12	ANISOVICH	12A	DPWA Multichannel
33	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
40	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
45 ± 20	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
96	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
68	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
85	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

PHASE θ

VALUE (°)	DOCUMENT ID	TECN	COMMENT
– 58 ± 12	ANISOVICH	12A	DPWA Multichannel
– 33	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
– 50	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$
– 45 ± 25	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
– 71	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
– 43	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
– 62	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

N(2220) DECAY MODES

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

Mode	Fraction (Γ_j/Γ)
Γ_1 $N\pi$	15–25 %
Γ_2 $N\eta$	
Γ_3 ΛK	

$N(2220)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$					Γ_1/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
15 to 25 OUR ESTIMATE					
24 \pm 5	ANISOVICH	12A	DPWA	Multichannel	
24.6 \pm 0.1	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$	
15 \pm 3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
18.0 \pm 1.5	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	
12 \pm 4	HENDRY	78	MPWA	$\pi N \rightarrow \pi N$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
20.0 \pm 0.6	ARNDT	04	DPWA	$\pi N \rightarrow \pi N, \eta N$	
26	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$	

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(2220) \rightarrow \Lambda K$					$(\Gamma_1\Gamma_3)^{1/2}/\Gamma$
VALUE	DOCUMENT ID	TECN	COMMENT		
not required	BELL	83	DPWA	$\pi^- p \rightarrow \Lambda K^0$	
not seen	SAXON	80	DPWA	$\pi^- p \rightarrow \Lambda K^0$	

 $N(2220)$ PHOTON DECAY AMPLITUDES

Papers on γN amplitudes predating 1981 may be found in our 2006 edition, *Journal of Physics* (generic for all A,B,E,G) **G33** 1 (2006).

 $N(2220) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
<0.01	³ ANISOVICH	12A	DPWA Multichannel

 $N(2220) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
<0.01	³ ANISOVICH	12A	DPWA Multichannel

 $N(2220)$ 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.

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 This ANISOVICH 12A value is the complex helicity amplitude at the pole position.

N(2220) REFERENCES

For early references, see *Physics Letters* **111B** 1 (1982).

ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
PDG	06	JP G33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)
ARNDT	04	PR C69 035213	R.A. Arndt <i>et al.</i>	(GWU, TRIU)
ARNDT	95	PR C52 2120	R.A. Arndt <i>et al.</i>	(VPI, BRCO)
HOEHLER	93	π N Newsletter 9 1	G. Hohler	(KARL)
ARNDT	91	PR D43 2131	R.A. Arndt <i>et al.</i>	(VPI, TELE) IJP
BELL	83	NP B222 389	K.W. Bell <i>et al.</i>	(RL) IJP
PDG	82	PL 111B 1	M. Roos <i>et al.</i>	(HELSE, CIT, CERN)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
SAXON	80	NP B162 522	D.H. Saxon <i>et al.</i>	(RHEL, BRIS) IJP
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP
HENDRY	78	PRL 41 222	A.W. Hendry	(IND, LBL) IJP
Also		ANP 136 1	A.W. Hendry	(IND)
