

**$N(2220) 9/2^+$**  $I(J^P) = \frac{1}{2}(\frac{9}{2}^+)$  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* **G33** 1 (2006).

 **$N(2220)$  BREIT-WIGNER MASS**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>2200 to 2300 (<math>\approx</math> 2250) OUR ESTIMATE</b>			
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>
<b>350 to 500 (<math>\approx</math> 400) OUR ESTIMATE</b>			
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>
<b>2130 to 2200 (<math>\approx</math> 2170) OUR ESTIMATE</b>			
2127 $\pm$ 3 $\pm$ 24	<sup>1</sup> SVARC	14	MLS $\pi N \rightarrow \pi N$
2150 $\pm$ 35	ANISOVICH	12A	DPWA Multichannel
2199	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
2135	<sup>2</sup> 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
<b>400 to 560 (≈ 480) OUR ESTIMATE</b>			
380 ± 7 ± 22	<sup>1</sup> SVARC 14	MLS	$\pi N \rightarrow \pi N$
440 ± 40	ANISOVICH 12A	DPWA	Multichannel
372	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$
400	<sup>3</sup> 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
38 ± 1 ± 5	<sup>1</sup> SVARC 14	MLS	$\pi N \rightarrow \pi N$
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 $\theta$

VALUE (°)	DOCUMENT ID	TECN	COMMENT
–52 ± 1 ± 14	<sup>1</sup> SVARC 14	MLS	$\pi N \rightarrow \pi N$
–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 ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\pi$	15–25 %
$\Gamma_2$ $N\eta$	
$\Gamma_3$ $\Lambda K$	

## $N(2220)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$				$\Gamma_1/\Gamma$
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>15 to 25 OUR ESTIMATE</b>				
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 $N\pi \rightarrow N(2220) \rightarrow \Lambda K$				$(\Gamma_1\Gamma_3)^{1/2}/\Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
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  $\gamma N$  amplitudes predating 1981 may be found in our 2006 edition, *Journal of Physics G33* 1 (2006).

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

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<0.01	<sup>4</sup> ANISOVICH	12A	DPWA	Multichannel

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

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<0.01	<sup>4</sup> ANISOVICH	12A	DPWA	Multichannel

## $N(2220)$ FOOTNOTES

- <sup>1</sup> Fit to the amplitudes of HOEHLER 79.
- <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> 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>4</sup> 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).

SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>	
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	$\pi N$ 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>	(HELS, 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)

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