

$$N(2220) \ 9/2^+$$

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

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014).

### N(2220) POLE POSITION

#### REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>2130 to 2200 (<math>\approx</math> 2150) OUR ESTIMATE</b>			
2131 $\pm$ 6	ROENCHEN	22	DPWA Multichannel
2127 $\pm$ 3 $\pm$ 24	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
2150 $\pm$ 35	ANISOVICH	12A	DPWA Multichannel
2160 $\pm$ 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
2171	ROENCHEN	15A	DPWA Multichannel
2199	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
2135	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$

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

#### -2xIMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>360 to 480 (<math>\approx</math> 400) OUR ESTIMATE</b>			
388 $\pm$ 6	ROENCHEN	22	DPWA Multichannel
380 $\pm$ 7 $\pm$ 22	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
440 $\pm$ 40	ANISOVICH	12A	DPWA Multichannel
480 $\pm$ 100	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
593	ROENCHEN	15A	DPWA Multichannel
372	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
400	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$

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

### N(2220) ELASTIC POLE RESIDUE

#### MODULUS |r|

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>35 to 60 (<math>\approx</math> 45) OUR ESTIMATE</b>			
48 $\pm$ 5	ROENCHEN	22	DPWA Multichannel
38 $\pm$ 1 $\pm$ 5	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
60 $\pm$ 12	ANISOVICH	12A	DPWA Multichannel
45 $\pm$ 20	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
62	ROENCHEN	15A	DPWA Multichannel
33	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
40	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$

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

## PHASE $\theta$

VALUE ( $^{\circ}$ )	DOCUMENT ID	TECN	COMMENT
<b>−60 to −10 (<math>\approx</math> −40) OUR ESTIMATE</b>			
−13 ± 2	ROENCHEN	22	DPWA Multichannel
−52 ± 1 ± 14	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
−58 ± 12	ANISOVICH	12A	DPWA Multichannel
−45 ± 25	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−59	ROENCHEN	15A	DPWA Multichannel
−33	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
−50	HOEHLER	93	ARGD $\pi N \rightarrow \pi N$

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

## $N(2220)$ INELASTIC POLE RESIDUE

The “normalized residue” is the residue divided by  $\Gamma_{pole}/2$ .

### Normalized residue in $N\pi \rightarrow N(2220) \rightarrow N\eta$

MODULUS	PHASE ( $^{\circ}$ )	DOCUMENT ID	TECN	COMMENT
0.042 ± 0.006	−48 ± 2	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.004	−101	ROENCHEN	15A	DPWA Multichannel

### Normalized residue in $N\pi \rightarrow N(2220) \rightarrow \Lambda K$

MODULUS	PHASE ( $^{\circ}$ )	DOCUMENT ID	TECN	COMMENT
0.020 ± 0.003	−60 ± 2	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.007	62	ROENCHEN	15A	DPWA Multichannel

### Normalized residue in $N\pi \rightarrow N(2220) \rightarrow \Sigma K$

MODULUS	PHASE ( $^{\circ}$ )	DOCUMENT ID	TECN	COMMENT
0.003 ± 0.008	−70 ± 2	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.009	−128	ROENCHEN	15A	DPWA Multichannel

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

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>2200 to 2300 (<math>\approx</math> 2250) OUR ESTIMATE</b>			
2316.3 ± 2.9	<sup>1</sup> ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
2230 ± 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
2205 ± 10	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$

<sup>1</sup>Statistical error only.

### **$N(2220)$ 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	<sup>1</sup> 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 $\pi N \rightarrow \pi N$

<sup>1</sup>Statistical error only.

### **$N(2220)$ DECAY MODES**

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

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1 \quad N\pi$	15–30 %

### **$N(2220)$ BRANCHING RATIOS**

<u><math>\Gamma(N\pi)/\Gamma_{\text{total}}</math></u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u><math>\Gamma_1/\Gamma</math></u>
<b>15 to 30 (<math>\approx</math> 25) OUR ESTIMATE</b>				
24 $\pm$ 5	ANISOVICH	12A	DPWA	Multichannel
24.6 $\pm$ 0.1	<sup>1</sup> 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	$\pi N \rightarrow \pi N$

<sup>1</sup>Statistical error only.

### **$N(2220)$ PHOTON DECAY AMPLITUDES AT THE POLE**

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

<u>MODULUS (<math>\text{GeV}^{-1/2}</math>)</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.357 $\pm$ 0.020	$-91 \pm 4$	ROENCHEN	22	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.135	114	ROENCHEN	15A	DPWA Multichannel

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

<u>MODULUS (<math>\text{GeV}^{-1/2}</math>)</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$-0.273 \pm 0.025$	$-102 \pm 3$	ROENCHEN	22	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.082	$-41$	ROENCHEN	15A	DPWA Multichannel

## ***N*(2220) REFERENCES**

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

ROENCHEN	22	EPJ A58 229	D. Roenchen <i>et al.</i>	(JULI, GWU, BONN+)
ROENCHEN	15A	EPJ A51 70	D. Roenchen <i>et al.</i>	
PDG	14	CP C38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>	(RBI Zagreb, UNI Tuzla)
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)
HOEHLER	93	$\pi N$ Newsletter 9 1	G. Hohler	(KARL)
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
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP

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