

$N(2220) 9/2^+$ $I(J^P) = \frac{1}{2}(\frac{9}{2}^+)$ 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
2130 to 2200 (≈ 2170) OUR ESTIMATE			
$2127 \pm 3 \pm 24$	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
2150 ± 35	ANISOVICH	12A	DPWA Multichannel
2160 ± 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 $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.**-2xIMAGINARY PART**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
360 to 480 (≈ 400) OUR ESTIMATE			
$380 \pm 7 \pm 22$	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
440 ± 40	ANISOVICH	12A	DPWA Multichannel
480 ± 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 $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79. **$N(2220)$ ELASTIC POLE RESIDUE****MODULUS $|r|$**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
35 to 60 (≈ 45) OUR ESTIMATE			
$38 \pm 1 \pm 5$	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
60 ± 12	ANISOVICH	12A	DPWA Multichannel
45 ± 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 $\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

PHASE θ

<u>VALUE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
–60 to –30 (\approx –50) OUR ESTIMATE			
$-52 \pm 1 \pm 14$	¹ 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 $\pi N \rightarrow \pi N$

¹Fit 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 $N\pi \rightarrow N(2220) \rightarrow N\eta$**

<u>MODULUS</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.004	–101	ROENCHEN	15A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.007	62	ROENCHEN	15A	DPWA Multichannel

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

<u>MODULUS</u>	<u>PHASE ($^{\circ}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.009	–128	ROENCHEN	15A	DPWA Multichannel

 $N(2220)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2200 to 2300 (\approx 2250) OUR ESTIMATE			
2316.3 ± 2.9	¹ 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 $\pi N \rightarrow \pi N$

¹Statistical error only. **$N(2220)$ BREIT-WIGNER WIDTH**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
350 to 500 (\approx 400) OUR ESTIMATE			
633 ± 17	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
500 ± 150	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
365 ± 30	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$

¹Statistical error only.

$N(2220)$ DECAY MODES

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	15–30 %

 $N(2220)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$					Γ_1/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
15 to 30 (≈ 25) OUR ESTIMATE					
24 ± 5	ANISOVICH	12A	DPWA	Multichannel	
24.6 \pm 0.1	¹ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$	
15 ± 3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
18.0 \pm 1.5	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	
¹ Statistical error only.					

 $N(2220)$ PHOTON DECAY AMPLITUDES AT THE POLE **$N(2220) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
$-0.233^{+0.084}_{-0.044}$	-47^{+10}_{-6}	ROENCHEN	14	DPWA
• • • 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 $A_{3/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
$0.162^{+0.041}_{-0.038}$	-27^{+26}_{-13}	ROENCHEN	14	DPWA
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.082	-41	ROENCHEN	15A	DPWA Multichannel

 $N(2220)$ REFERENCESFor early references, see Physics Letters **111B** 1 (1982).

ROENCHEN	15A	EPJ A51 70	D. Roenchen <i>et al.</i>	
PDG	14	CP C38 070001	K. Olive <i>et al.</i>	(PDG Collab.)
ROENCHEN	14	EPJ A50 101	D. Roenchen <i>et al.</i>	
Also		EPJ A51 63 (errat.)	D. Roenchen <i>et al.</i>	
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	πN 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