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

$I(J^P) = \frac{1}{2}(\frac{9}{2}^+)$ 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 (≈ 2150) OUR ESTIMATE				
2165±30	SARANTSEV	25	DPWA	Multichannel
2131± 6	ROENCHEN	22	DPWA	Multichannel
2127± 3±24	[1] SVARC	14	L+P	$\pi N \to \pi N$
2160±80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2171	ROENCHEN	15A	DPWA	Multichannel
2150±35	ANISOVICH	12A	DPWA	Multichannel
2199	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
2135	HOEHLER	93	ARGD	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

−2×IMAGINARY PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
360 to 480 (≈ 400) OUR ESTIMATE				
440± 40	SARANTSEV	25	DPWA	Multichannel
388± 6	ROENCHEN	22	DPWA	Multichannel
380± 7±22	[1] SVARC	14	L+P	$\pi N \to \pi N$
480±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
593	ROENCHEN	15A	DPWA	Multichannel
440± 40	ANISOVICH	12A	DPWA	Multichannel
372	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
400	HOEHLER	93	ARGD	$\pi N \to \pi N$

[1] Fit 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				
48± 5	ROENCHEN	22	DPWA	Multichannel
38± 1±5	[1] SVARC	14	L+P	$\pi N \to \pi N$
60±12	ANISOVICH	12A	DPWA	Multichannel
45±20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
62	ROENCHEN	15A	DPWA	Multichannel
33	ARNDT	06	DPWA	$\pi N \to \pi N, \eta N$
40	HOEHLER	93	ARGD	$\pi N \to \pi N$

[1] Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)	*DOCUMENT ID*		*TECN*	*COMMENT*
−60 to −10 (≈ −40) OUR ESTIMATE				
−13± 2	ROENCHEN	22	DPWA	Multichannel
−52± 1±14	[1] SVARC	14	L+P	$\pi N \to \pi N$
−58±12	ANISOVICH	12A	DPWA	Multichannel
−45±25	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−59	ROENCHEN	15A	DPWA	Multichannel
−33	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
−50	HOEHLER	93	ARGD	$\pi N \to \pi N$

[1] 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 $N\pi \to N(2220) \to N\eta$

MODULUS	*PHASE* (°)	*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 $N\pi \to N(2220) \to \Lambda K$

MODULUS	*PHASE* (°)	*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 $N\pi \to N(2220) \to \Sigma K$

MODULUS	*PHASE* (°)	*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*
2200 to 2300 (≈ 2250) OUR ESTIMATE				
2230 ±30	SARANTSEV	25	DPWA	Multichannel
2316.3± 2.9	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
2230 ±80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
2205 ±10	HOEHLER	79	IPWA	$\pi N \to \pi N$

[1] Statistical error only.

N(2220) BREIT-WIGNER WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
350 to 500 (≈ 400) OUR ESTIMATE				
500± 40	SARANTSEV	25	DPWA	Multichannel
633± 17	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
500±150	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
365± 30	HOEHLER	79	IPWA	$\pi N \to \pi N$

[1] Statistical 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 %
Γ_2	$N\pi\pi$	
Γ_3	$\Delta\pi$	(15±10) %
Γ_4	$\Delta\pi$, *F*-wave	(15±10) %
Γ_5	$N\rho$	(10±10) %
Γ_6	$N\rho$, S=3/2 , *F*-wave	(10±10) %
Γ_7	$N\sigma$	(5± 5) %

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±0.1	[1] ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
15 ±3	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
18.0±1.5	HOEHLER	79	IPWA	$\pi N \to \pi N$

[1] Statistical error only.

$\Gamma(\Delta\pi)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
15±10	SARANTSEV	25	DPWA	Multichannel

$\Gamma(\Delta\pi, F\text{-wave})/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
15±10	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\rho)/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
10±10	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\rho, S{=}3/2, F\text{-wave})/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
10±10	SARANTSEV	25	DPWA	Multichannel

$\Gamma(N\sigma)/\Gamma_{total}$ **Γ_7/Γ**

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
5±5	SARANTSEV	25	DPWA	Multichannel

N(2220) PHOTON DECAY AMPLITUDES AT THE POLE

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

MODULUS ($GeV^{-1/2}$)	*PHASE* (°)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.015±0.010	90 ± 30	SARANTSEV	25	DPWA	Multichannel
0.357±0.020	−91 ± 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) → $p\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($GeV^{-1/2}$)	*PHASE* (°)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.018±0.010	−20 ± 30	SARANTSEV	25	DPWA	Multichannel
−0.273±0.025	−102 ± 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) BREIT-WIGNER PHOTON DECAY AMPLITUDES

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

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.017±0.010	[1] SARANTSEV	25	DPWA	Multichannel

[1] Sign is undetermined

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

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.020±0.010	SARANTSEV	25	DPWA	Multichannel

N(2220) REFERENCES

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

SARANTSEV	25	PR C112 015202	A.V. Sarantsev *et al.*	(Bonn-Gatchina Collab.)
ROENCHEN	22	EPJ A58 229	D. Roenchen *et al.*	(JULI, GWU, BONN+)
ROENCHEN	15A	EPJ A51 70	D. Roenchen *et al.*	
PDG	14	CP C38 070001	K. Olive *et al.*	(PDG Collab.)
SVARC	14	PR C89 045205	A. Svarc *et al.*	(RBI Zagreb, UNI Tuzla)
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)
ARNDT	06	PR C74 045205	R.A. Arndt *et al.*	(GWU)
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP