

$N(2250) 9/2^-$ $I(J^P) = \frac{1}{2}(\frac{9}{2}^-)$ Status: ****

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

 $N(2250)$ POLE POSITION**REAL PART**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
2100 to 2200 (≈ 2150) OUR ESTIMATE			
2220 \pm 40	SARANTSEV 25	DPWA	Multichannel
2095 \pm 10	ROENCHEN 22	DPWA	Multichannel
2195 \pm 45	AFZAL 20	DPWA	Multichannel
2157 \pm 3 \pm 14	¹ SVARC 14	L+P	$\pi N \rightarrow \pi N$
2150 \pm 50	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
2127	HUNT 19	DPWA	Multichannel
2062	ROENCHEN 15A	DPWA	Multichannel
2195 \pm 45	ANISOVICH 12A	DPWA	Multichannel
2217	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$
2187	HOEHLER 93	SPED	$\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.

–2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
350 to 500 (≈ 420) OUR ESTIMATE			
470 \pm 40	SARANTSEV 25	DPWA	Multichannel
422 \pm 13	ROENCHEN 22	DPWA	Multichannel
470 \pm 50	AFZAL 20	DPWA	Multichannel
412 \pm 7 \pm 44	¹ SVARC 14	L+P	$\pi N \rightarrow \pi N$
360 \pm 100	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
262	HUNT 19	DPWA	Multichannel
403	ROENCHEN 15A	DPWA	Multichannel
470 \pm 50	ANISOVICH 12A	DPWA	Multichannel
431	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$
388	HOEHLER 93	SPED	$\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.

 $N(2250)$ ELASTIC POLE RESIDUE**MODULUS $|r|$**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
15 to 30 (≈ 25) OUR ESTIMATE			
14 \pm 1	ROENCHEN 22	DPWA	Multichannel
24 \pm 1 \pm 5	¹ SVARC 14	L+P	$\pi N \rightarrow \pi N$
26 \pm 5	ANISOVICH 12A	DPWA	Multichannel
20 \pm 6	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$

• • • We do not use the following data for averages, fits, limits, etc. • • •

8.2	ROENCHEN	15A	DPWA	Multichannel
21	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
21	HOEHLER	93	SPED	$\pi N \rightarrow \pi N$

¹Fit to the amplitudes of HOEHLER 79.

PHASE θ

<u>VALUE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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–60 to –20 (\approx –40) OUR ESTIMATE

–67 \pm 9	ROENCHEN	22	DPWA	Multichannel
–62 \pm 1 \pm 11	¹ SVARC	14	L+P	$\pi N \rightarrow \pi N$
–38 \pm 25	ANISOVICH	12A	DPWA	Multichannel
–50 \pm 20	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$

• • • We do not use the following data for averages, fits, limits, etc. • • •

–64	ROENCHEN	15A	DPWA	Multichannel
–20	ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$

¹Fit to the amplitudes of HOEHLER 79.

***N*(2250) INELASTIC POLE RESIDUE**

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

Normalized residue in $N\pi \rightarrow N(2250) \rightarrow N\eta$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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0.018 \pm 0.001	–89 \pm 5	ROENCHEN	22	DPWA Multichannel
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.017	–89	ROENCHEN	15A	DPWA Multichannel
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Normalized residue in $N\pi \rightarrow N(2250) \rightarrow \Lambda K$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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0.003 \pm 0.001	80 \pm 5	ROENCHEN	22	DPWA Multichannel
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.006	–101	ROENCHEN	15A	DPWA Multichannel
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Normalized residue in $N\pi \rightarrow N(2250) \rightarrow \Sigma K$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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0.004 \pm 0.002	–111 \pm 5	ROENCHEN	22	DPWA Multichannel
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.002	70	ROENCHEN	15A	DPWA Multichannel
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***N*(2250) BREIT-WIGNER MASS**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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2250 to 2320 (\approx 2280) OUR ESTIMATE

2310 \pm 40	SARANTSEV	25	DPWA	Multichannel
2200 \pm 10	¹ HUNT	19	DPWA	Multichannel
2302 \pm 6	¹ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$
2250 \pm 80	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
2268 \pm 15	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$

• • • We do not use the following data for averages, fits, limits, etc. • • •

2280 \pm 40	ANISOVICH	12A	DPWA	Multichannel
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¹Statistical error only. **$N(2250)$ BREIT-WIGNER WIDTH**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
300 to 600 (\approx 500) OUR ESTIMATE			
520 \pm 50	SARANTSEV	25	DPWA Multichannel
343 \pm 51	¹ HUNT	19	DPWA Multichannel
628 \pm 28	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
480 \pm 120	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
300 \pm 40	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
520 \pm 50	ANISOVICH	12A	DPWA Multichannel

¹Statistical error only. **$N(2250)$ DECAY MODES**

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	5–15 %
Γ_2 $N\eta$	<5 %
Γ_3 ΛK	1–3 %
Γ_4 $N\pi\pi$	
Γ_5 $\Delta\pi$	(10 \pm 7) %
Γ_6 $\Delta\pi, G$ -wave	(10 \pm 7) %
Γ_7 $N\rho$	(11 \pm 7) %
Γ_8 $N\rho, S=1/2$	(5 \pm 5) %
Γ_9 $N\rho, S=3/2, G$ -wave	(6 \pm 4) %

 $N(2250)$ BRANCHING RATIOS

<u>$\Gamma(N\pi)/\Gamma_{\text{total}}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	Γ_1/Γ
5–15 % OUR ESTIMATE				
8.5 \pm 0.4	¹ HUNT	19	DPWA Multichannel	
12 \pm 4	ANISOVICH	12A	DPWA Multichannel	
8.9 \pm 0.1	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$	
10 \pm 2	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$	
10 \pm 2	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$	

¹Statistical error only.

<u>$\Gamma(N\eta)/\Gamma_{\text{total}}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	Γ_2/Γ
<5 % OUR ESTIMATE				
<5	¹ HUNT	19	DPWA Multichannel	

¹Statistical error only.

$\Gamma(\Lambda K)/\Gamma_{\text{total}}$				Γ_3/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
1-3 % OUR ESTIMATE				
2.0±0.6	¹ HUNT	19	DPWA	Multichannel
¹ Statistical error only.				
$\Gamma(\Delta\pi)/\Gamma_{\text{total}}$				Γ_5/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
10±7	SARANTSEV	25	DPWA	Multichannel
$\Gamma(\Delta\pi, G\text{-wave})/\Gamma_{\text{total}}$				Γ_6/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
10±7	SARANTSEV	25	DPWA	Multichannel
$\Gamma(N\rho)/\Gamma_{\text{total}}$				Γ_7/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
11±7	SARANTSEV	25	DPWA	Multichannel
$\Gamma(N\rho, S=1/2)/\Gamma_{\text{total}}$				Γ_8/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
5±5	SARANTSEV	25	DPWA	Multichannel
$\Gamma(N\rho, S=3/2, G\text{-wave})/\Gamma_{\text{total}}$				Γ_9/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
6±4	SARANTSEV	25	DPWA	Multichannel

$N(2250)$ PHOTON DECAY AMPLITUDES AT THE POLE

$N(2250) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

<u>MODULUS ($\text{GeV}^{-1/2}$)</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.020±0.010	-10 ± 30	SARANTSEV	25	DPWA Multichannel
-0.108±0.007	112 ± 4	ROENCHEN	22	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.026	-26	ROENCHEN	15A	DPWA Multichannel

$N(2250) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

<u>MODULUS ($\text{GeV}^{-1/2}$)</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.025±0.009	-10 ± 20	SARANTSEV	25	DPWA Multichannel
0.050±0.011	69 ± 8	ROENCHEN	22	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.119	-42	ROENCHEN	15A	DPWA Multichannel

$N(2250)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

$N(2250) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.015 ±0.008	SARANTSEV	25	DPWA Multichannel
0.0006±0.0037	¹ HUNT	19	DPWA Multichannel

¹Statistical error only.

$N(2250) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

<u>VALUE (GeV^{-1/2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.025±0.008	SARANTSEV 25	DPWA	Multichannel
0.013±0.004	¹ HUNT 19	DPWA	Multichannel

¹Statistical error only. **$N(2250)$ REFERENCES**

SARANTSEV 25	PR C112 015202	A.V. Sarantsev <i>et al.</i>	(Bonn-Gatchina Collab.)
ROENCHEN 22	EPJ A58 229	D. Roenchen <i>et al.</i>	(JULI, GWU, BONN+)
AFZAL 20	PRL 125 152002	F. Afzal <i>et al.</i>	(CBELSA/TAPS Collab.)
HUNT 19	PR C99 055205	B.C. Hunt, D.M. Manley	
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	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