

$$N(2190) \ 7/2^-$$

$$I(J^P) = \frac{1}{2}(\frac{7}{2}^-) \text{ Status: } ****$$

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

***N*(2190) POLE POSITION**

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1950 to 2150 ($\approx$ 2050) OUR ESTIMATE			
1965 $\pm$ 6	ROENCHEN	22	DPWA Multichannel
2140 $\pm$ 20	AFZAL	20	DPWA Multichannel
2150 $\pm$ 25	SOKHOYAN	15A	DPWA Multichannel
2079 $\pm$ 4 $\pm$ 9	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
2100 $\pm$ 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2162	HUNT	19	DPWA Multichannel
2074	ROENCHEN	15A	DPWA Multichannel
2150 $\pm$ 25	ANISOVICH	12A	DPWA Multichannel
2063 $\pm$ 32	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
2070	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
2107	VRANA	00	DPWA Multichannel
2042	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
300 to 500 ($\approx$ 400) OUR ESTIMATE			
287 $\pm$ 33	ROENCHEN	22	DPWA Multichannel
420 ⁺¹²⁰ _{– 40}	AFZAL	20	DPWA Multichannel
325 $\pm$ 25	SOKHOYAN	15A	DPWA Multichannel
509 $\pm$ 7 $\pm$ 16	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
400 $\pm$ 160	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
407	HUNT	19	DPWA Multichannel
327	ROENCHEN	15A	DPWA Multichannel
330 $\pm$ 30	ANISOVICH	12A	DPWA Multichannel
330 $\pm$ 101	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
520	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
380	VRANA	00	DPWA Multichannel
482	HOEHLER	93	SPED $\pi N \rightarrow \pi N$

¹ Fit to the amplitudes of HOEHLER 79.

***N*(2190) ELASTIC POLE RESIDUE**

MODULUS $|r|$

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
20 to 60 (≈ 40) OUR ESTIMATE			
18 ± 4	ROENCHEN	22	DPWA Multichannel
30 ± 4	SOKHOYAN	15A	DPWA Multichannel
$54 \pm 1 \pm 3$	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
25 ± 10	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
35	ROENCHEN	15A	DPWA Multichannel
30 ± 5	ANISOVICH	12A	DPWA Multichannel
34	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
72	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
45	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>
−30 to 30 (≈ 0) OUR ESTIMATE			
-45 ± 14	ROENCHEN	22	DPWA Multichannel
28 ± 10	SOKHOYAN	15A	DPWA Multichannel
$-18 \pm 1 \pm 3$	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
-30 ± 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−40	ROENCHEN	15A	DPWA Multichannel
30 ± 10	ANISOVICH	12A	DPWA Multichannel
−19	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
−32	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$

¹Fit to the amplitudes of HOEHLER 79.

***N*(2190) INELASTIC POLE RESIDUE**

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

Normalized residue in $N\pi \rightarrow N(2190) \rightarrow \Lambda K$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.026 ± 0.007	-78 ± 15	ROENCHEN	22	DPWA Multichannel
0.03 ± 0.01	20 ± 15	ANISOVICH	12A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.005	−51	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2190) \rightarrow \Sigma K$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.005 ± 0.001	-92 ± 16	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.013	−69	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2190) \rightarrow N\eta$

<i>MODULUS</i>	<i>PHASE (°)</i>	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
0.021 ± 0.005	-65 ± 15	ROENCHEN	22	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.016	129	ROENCHEN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2190) \rightarrow \Delta(1232)\pi$, *D*-wave

<i>MODULUS</i>	<i>PHASE (°)</i>	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
0.27 ± 0.04	-165 ± 20	SOKHOYAN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2190) \rightarrow N\sigma$

<i>MODULUS</i>	<i>PHASE (°)</i>	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
0.13 ± 0.05	50 ± 15	SOKHOYAN	15A	DPWA Multichannel

$N(2190)$ BREIT-WIGNER MASS

<i>VALUE (MeV)</i>	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
2140 to 2220 (≈ 2180) OUR ESTIMATE			
2222 ± 15	¹ HUNT	19	DPWA Multichannel
2205 ± 18	SOKHOYAN	15A	DPWA Multichannel
2152.4 ± 1.4	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
2200 ± 70	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
2140 ± 12	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2180 ± 20	ANISOVICH	12A	DPWA Multichannel
2150 ± 26	¹ SHRESTHA	12A	DPWA Multichannel
2125 ± 61	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
2168 ± 18	VRANA	00	DPWA Multichannel

¹Statistical error only.

$N(2190)$ BREIT-WIGNER WIDTH

<i>VALUE (MeV)</i>	<i>DOCUMENT ID</i>	<i>TECN</i>	<i>COMMENT</i>
300 to 500 (≈ 400) OUR ESTIMATE			
442 ± 40	¹ HUNT	19	DPWA Multichannel
355 ± 30	SOKHOYAN	15A	DPWA Multichannel
484 ± 13	¹ ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
500 ± 150	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
390 ± 30	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
335 ± 40	ANISOVICH	12A	DPWA Multichannel
500 ± 74	¹ SHRESTHA	12A	DPWA Multichannel
381 ± 160	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
453 ± 101	VRANA	00	DPWA Multichannel

¹Statistical error only.

$N(2190)$ DECAY MODES

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

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	10–20 %
Γ_2 $N\eta$	1–5 %
Γ_3 $N\omega$	8–20 %
Γ_4 ΛK	0.2–0.8 %
Γ_5 $N\pi\pi$	22–51 %
Γ_6 $\Delta(1232)\pi$, D -wave	19–31 %
Γ_7 $N\rho$, $S=3/2$, D -wave	<11 %
Γ_8 $N\sigma$	3–9 %
Γ_9 $\Lambda K^*(892)$	0.2–0.8 %
Γ_{10} $p\gamma$	<0.08 %
Γ_{11} $p\gamma$, helicity=1/2	<0.06 %
Γ_{12} $p\gamma$, helicity=3/2	<0.02 %
Γ_{13} $n\gamma$	<0.04 %
Γ_{14} $n\gamma$, helicity=1/2	<0.01 %
Γ_{15} $n\gamma$, helicity=3/2	<0.03 %

$N(2190)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$					Γ_1/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
10–20 % OUR ESTIMATE					
22.9± 0.6	¹ HUNT	19	DPWA	Multichannel	
16 ± 2	SOKHOYAN	15A	DPWA	Multichannel	
23.8± 0.1	¹ ARNDT	06	DPWA	$\pi N \rightarrow \pi N, \eta N$	
12 ± 6	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$	
14 ± 2	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
16 ± 2	ANISOVICH	12A	DPWA	Multichannel	
20 ± 1	¹ SHRESTHA	12A	DPWA	Multichannel	
18 ±12	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$	
20 ± 4	VRANA	00	DPWA	Multichannel	

¹Statistical error only.

$\Gamma(N\eta)/\Gamma_{\text{total}}$					Γ_2/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT		
1–5 % OUR ESTIMATE					
4 ±2	MUELLER	20	DPWA	Multichannel	
2.7±2.2	¹ HUNT	19	DPWA	Multichannel	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2 ±1	¹ SHRESTHA	12A	DPWA	Multichannel	
0.1±0.3	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$	
0 ±1	VRANA	00	DPWA	Multichannel	

¹Statistical error only.

$\Gamma(N\omega)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
8–20 % OUR ESTIMATE			
14 ± 6	DENISENKO	16	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
seen	WILLIAMS	09	IPWA $\gamma p \rightarrow p\omega$

$\Gamma(\Lambda K)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
0.2–0.8 % OUR ESTIMATE			
0.6 ± 0.1	¹ HUNT	19	DPWA Multichannel
0.5 ± 0.3	ANISOVICH	12A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
<1	¹ SHRESTHA	12A	DPWA Multichannel
¹ Statistical error only.			

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
19–31 % OUR ESTIMATE			
25 ± 6	SOKHOYAN	15A	DPWA Multichannel

$\Gamma(N\rho, S=3/2, D\text{-wave})/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
<11 % OUR ESTIMATE			
<11	¹ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
29 ± 28	VRANA	00	DPWA Multichannel
¹ Statistical error only.			

$\Gamma(N\sigma)/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
3–9 % OUR ESTIMATE			
6 ± 3	SOKHOYAN	15A	DPWA Multichannel

$\Gamma(\Lambda K^*(892))/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
0.2–0.8 % OUR ESTIMATE			
0.5 ± 0.3	ANISOVICH	17B	DPWA Multichannel

$N(2190)$ PHOTON DECAY AMPLITUDES AT THE POLE

$N(2190) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
−0.015 ± 0.004	111 ± 9	ROENCHEN	22	DPWA Multichannel
0.068 ± 0.005	−170 ± 12	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.041	−21	ROENCHEN	15A	DPWA Multichannel

$N(2190) \rightarrow p\gamma$, 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>
0.062 ± 0.011	179 ± 13	ROENCHEN	22	DPWA Multichannel
0.025 ± 0.010	22 ± 10	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.085	−22	ROENCHEN	15A	DPWA Multichannel

 $N(2190) \rightarrow n\gamma$, 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>
0.030 ± 0.007	5 ± 15	ANISOVICH	17E	DPWA Multichannel

 $N(2190) \rightarrow n\gamma$, 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>
-0.023 ± 0.008	13 ± 20	ANISOVICH	17E	DPWA Multichannel

 $N(2190)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES **$N(2190) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.001 ± 0.002	¹ HUNT 19	DPWA	Multichannel
-0.071 ± 0.006	SOKHOYAN 15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.065 ± 0.008	ANISOVICH 12A	DPWA	Multichannel

¹ Statistical error only. **$N(2190) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$**

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.015 ± 0.003	¹ HUNT 19	DPWA	Multichannel
0.027 ± 0.010	SOKHOYAN 15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.035 ± 0.017	ANISOVICH 12A	DPWA	Multichannel

¹ Statistical error only. **$N(2190) \rightarrow p\gamma$, ratio of helicity amplitudes $A_{3/2}/A_{1/2}$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.17 ± 0.15	WILLIAMS 09	IPWA	$\gamma p \rightarrow p\omega$

 $N(2190) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.01 ± 0.02	¹ HUNT 19	DPWA	Multichannel
0.030 ± 0.007	ANISOVICH 17E	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.015 ± 0.013	ANISOVICH 13B	DPWA	Multichannel

¹ Statistical error only.

$N(2190) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE (GeV ^{-1/2})	DOCUMENT ID	TECN	COMMENT
−0.023±0.022	¹ HUNT	19	DPWA Multichannel
−0.023±0.008	ANISOVICH	17E	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−0.034±0.022	ANISOVICH	13B	DPWA Multichannel
¹ Statistical error only.			

$N(2190)$ REFERENCES

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

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.)
MUELLER	20	PL B803 135323	J. Mueller <i>et al.</i>	(CBELSA/TAPS Collab.)
HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
ANISOVICH	17B	PL B771 142	A.V. Anisovich <i>et al.</i>	
ANISOVICH	17E	PR C96 055202	A.V. Anisovich <i>et al.</i>	(BONN, PNPI, JLAB+)
DENISENKO	16	PL B755 97	I. Denisenko <i>et al.</i>	
ROENCHEN	15A	EPJ A51 70	D. Roenchen <i>et al.</i>	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan <i>et al.</i>	(CBELSA/TAPS Collab.)
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	13B	EPJ A49 67	A.V. Anisovich <i>et al.</i>	
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
BATINIC	10	PR C82 038203	M. Batinic <i>et al.</i>	(ZAGR)
WILLIAMS	09	PR C80 065209	M. Williams <i>et al.</i>	(JLab CLAS Collab.)
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)
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