

$N(2190) 7/2^-$

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

Most of the results published before 1975 were last included in our 1982 edition, Physics Letters **111B** 1 (1982). Some further obsolete results published before 1984 were last included in our 2006 edition, Journal of Physics, G **33** 1 (2006).

$N(2190)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2100 to 2200 (≈ 2190) OUR ESTIMATE			
2180 ± 20	ANISOVICH	12A	DPWA Multichannel
2152.4 ± 1.4	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 $\pi N \rightarrow \pi N$
2140 ± 40	HENDRY	78	MPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
2150 ± 26	SHRESTHA	12A	DPWA Multichannel
2125 ± 61	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
2192.1 ± 8.7	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
2168 ± 18	VRANA	00	DPWA Multichannel
2131	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
2127 ± 9	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
2180	SAXON	80	DPWA $\pi^- p \rightarrow \Lambda K^0$

$N(2190)$ BREIT-WIGNER WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
300 to 700 (≈ 500) OUR ESTIMATE			
335 ± 40	ANISOVICH	12A	DPWA Multichannel
484 ± 13	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 $\pi N \rightarrow \pi N$
270 ± 50	HENDRY	78	MPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
500 ± 74	SHRESTHA	12A	DPWA Multichannel
381 ± 160	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
726 ± 62	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
453 ± 101	VRANA	00	DPWA Multichannel
476	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
550 ± 50	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
80	SAXON	80	DPWA $\pi^- p \rightarrow \Lambda K^0$

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

REAL PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2050 to 2100 (\approx 2075) OUR ESTIMATE			
2150 \pm 25	ANISOVICH	12A	DPWA Multichannel
2070	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
2042	¹ HOEHLER	93	SPED $\pi N \rightarrow \pi N$
2100 \pm 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
2062	SHRESTHA	12A	DPWA Multichannel
2063 \pm 32	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
2076	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
2107	VRANA	00	DPWA Multichannel
2030	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
2060	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

– 2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
400 to 520 (\approx 450) OUR ESTIMATE			
330 \pm 30	ANISOVICH	12A	DPWA Multichannel
520	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
482	¹ HOEHLER	93	SPED $\pi N \rightarrow \pi N$
400 \pm 160	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
428	SHRESTHA	12A	DPWA Multichannel
330 \pm 101	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
502	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
380	VRANA	00	DPWA Multichannel
460	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
464	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

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

MODULUS $|r|$

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
30 \pm 5	ANISOVICH	12A	DPWA Multichannel
72	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
45	HOEHLER	93	SPED $\pi N \rightarrow \pi N$
25 \pm 10	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
34	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
68	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
46	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
54	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

PHASE θ

VALUE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
30 ± 10	ANISOVICH	12A	DPWA Multichannel
-32	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
-30 ± 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
-19	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
-32	ARNDT	04	DPWA $\pi N \rightarrow \pi N, \eta N$
-23	ARNDT	95	DPWA $\pi N \rightarrow N\pi$
-44	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90

N(2190) INELASTIC POLE RESIDUE

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

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

MODULUS (%)	PHASE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
3 ± 1	20 ± 15	ANISOVICH	12A	DPWA Multichannel

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 $N\eta$	(0.0 ± 1.0) %
Γ_3 $N\omega$	seen
Γ_4 ΛK	seen
Γ_5 ΣK	
Γ_6 $N\pi\pi$	seen
Γ_7 $N\rho$	seen
Γ_8 $p\gamma$	0.02–0.06 %
Γ_9 $p\gamma$, helicity=1/2	0.02–0.04 %
Γ_{10} $p\gamma$, helicity=3/2	0.002–0.02 %

N(2190) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$	DOCUMENT ID	TECN	COMMENT	Γ_1/Γ
10 to 20 OUR ESTIMATE				
16 ± 2	ANISOVICH	12A	DPWA Multichannel	
23.8 ± 0.1	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 $\pi N \rightarrow \pi N$	
16 ± 4	HENDRY	78	MPWA $\pi N \rightarrow \pi N$	

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

20 ± 1	SHRESTHA	12A	DPWA	Multichannel
18 ± 12	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$
23.0 ± 0.2	ARNDT	04	DPWA	$\pi N \rightarrow \pi N, \eta N$
20 ± 4	VRANA	00	DPWA	Multichannel
23	ARNDT	95	DPWA	$\pi N \rightarrow N\pi$
22 ± 1	MANLEY	92	IPWA	$\pi N \rightarrow \pi N \& N\pi\pi$

$\Gamma(N\eta)/\Gamma_{\text{total}}$ Γ_2/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0 ± 1	VRANA	00	DPWA Multichannel

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

2 ± 1	SHRESTHA	12A	DPWA	Multichannel
0.1 ± 0.3	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
seen	WILLIAMS	09	IPWA $\gamma p \rightarrow p\omega$

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.5 ± 0.3	ANISOVICH	12A	DPWA Multichannel

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

<1	SHRESTHA	12A	DPWA	Multichannel
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$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(2190) \rightarrow \Lambda K$ $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.02	BELL	83	DPWA $\pi^- p \rightarrow \Lambda K^0$
-0.02	SAXON	80	DPWA $\pi^- p \rightarrow \Lambda K^0$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(2190) \rightarrow N\rho, S=3/2, D\text{-wave}$ $(\Gamma_1\Gamma_0)^{1/2}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.13 ± 0.05	SHRESTHA	12A	DPWA Multichannel
-0.25 ± 0.03	MANLEY	92	IPWA $\pi N \rightarrow \pi N \& N\pi\pi$

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

$\Gamma(N\rho, S=3/2, D\text{-wave})/\Gamma_{\text{total}}$ Γ_0/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
29 ± 28	VRANA	00	DPWA Multichannel

N(2190) PHOTON DECAY AMPLITUDES

Papers on γN amplitudes predating 1981 may be found in our 2006 edition, Journal of Physics, G **33** 1 (2006).

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

<u>VALUE (GeV^{-1/2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.065 ± 0.008	ANISOVICH	12A	DPWA Multichannel

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

VALUE (GeV ^{-1/2})	DOCUMENT ID	TECN	COMMENT
0.035 ± 0.017	ANISOVICH 12A	DPWA	Multichannel

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

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

$N(2190) \quad \gamma p \rightarrow \Lambda K^+$ AMPLITUDES

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $p\gamma \rightarrow N(2190) \rightarrow \Lambda K^+$ (E_{4-} amplitude)

VALUE (units 10 ⁻³)	DOCUMENT ID	TECN	
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2.5 ± 1.0	WORKMAN 90	DPWA	
2.04	TANABE 89	DPWA	

$p\gamma \rightarrow N(2190) \rightarrow \Lambda K^+$ phase angle θ (E_{4-} amplitude)

VALUE (degrees)	DOCUMENT ID	TECN	
• • • We do not use the following data for averages, fits, limits, etc. • • •			
- 4 ± 9	WORKMAN 90	DPWA	
-27.5	TANABE 89	DPWA	

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $p\gamma \rightarrow N(2190) \rightarrow \Lambda K^+$ (M_{4-} amplitude)

VALUE (units 10 ⁻³)	DOCUMENT ID	TECN	
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-7.0 ± 0.7	WORKMAN 90	DPWA	
-5.78	TANABE 89	DPWA	

$N(2190)$ FOOTNOTES

¹ See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of N and Δ resonances as determined from Argand diagrams of πN elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams.

$N(2190)$ REFERENCES

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

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>	(CEBAF CLAS Collab.)
ARNDT 06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
PDG 06	JPG 33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)
ARNDT 04	PR C69 035213	R.A. Arndt <i>et al.</i>	(GWU, TRIU)
VRANA 00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	(PITT+)
ARNDT 95	PR C52 2120	R.A. Arndt <i>et al.</i>	(VPI, BRCO)
HOEHLER 93	πN Newsletter 9 1	G. Hohler	(KARL)

MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KSA) IJP
Also		PR D30 904	D.M. Manley <i>et al.</i>	(VPI)
ARNDT	91	PR D43 2131	R.A. Arndt <i>et al.</i>	(VPI, TELE) IJP
WORKMAN	90	PR C42 781	R.L. Workman	(VPI)
TANABE	89	PR C39 741	H. Tanabe, M. Kohno, C. Bennhold	(MANZ)
Also		NC 102A 193	M. Kohno, H. Tanabe, C. Bennhold	(MANZ)
BELL	83	NP B222 389	K.W. Bell <i>et al.</i>	(RL) IJP
PDG	82	PL 111B 1	M. Roos <i>et al.</i>	(HELS, CIT, CERN)
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
SAXON	80	NP B162 522	D.H. Saxon <i>et al.</i>	(RHEL, BRIS) IJP
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP
HENDRY	78	PRL 41 222	A.W. Hendry	(IND, LBL) IJP
Also		ANP 136 1	A.W. Hendry	(IND)
