

$$N(2060) \ 5/2^-$$

$$I(J^P) = \frac{1}{2}(\frac{5}{2}^-) \text{ Status: } ***$$

was $N(2200)$
Before our 2012 *Review*, this state appeared in our Listings as the $N(2200)$.

$N(2060)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
2020 to 2130 ($\approx$ 2070) OUR ESTIMATE			
2030 $\pm$ 15	SOKHOYAN	15A	DPWA Multichannel
2119 $\pm$ 11 $\pm$ 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
2100 $\pm$ 60	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2010	HUNT	19	DPWA Multichannel
2040 $\pm$ 15	ANISOVICH	12A	DPWA Multichannel
2144 $\pm$ 31	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

¹Fit to the amplitudes of HOEHLER 79.

–2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
350 to 430 ($\approx$ 400) OUR ESTIMATE			
400 $\pm$ 35	SOKHOYAN	15A	DPWA Multichannel
370 $\pm$ 20 $\pm$ 5	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
360 $\pm$ 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
395	HUNT	19	DPWA Multichannel
390 $\pm$ 25	ANISOVICH	12A	DPWA Multichannel
438 $\pm$ 13	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

¹Fit to the amplitudes of HOEHLER 79.

$N(2060)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
15 to 30 ($\approx$ 20) OUR ESTIMATE			
25 $\pm$ 8	SOKHOYAN	15A	DPWA Multichannel
19 $\pm$ 1 $\pm$ 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
20 $\pm$ 10	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
19 $\pm$ 5	ANISOVICH	12A	DPWA Multichannel
26	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

¹Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
–130 to –90 ($\approx$ –110) OUR ESTIMATE			
–130 $\pm$ 20	SOKHOYAN	15A	DPWA Multichannel
–94 $\pm$ 5 $\pm$ 1	¹ SVARC	14	L+P $\pi N \rightarrow \pi N$
–90 $\pm$ 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
–125 $\pm$ 20	ANISOVICH	12A	DPWA Multichannel
–71	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
¹ Fit to the amplitudes of HOEHLER 79.			

 $N(2060)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow N(2060) \rightarrow N\eta$

MODULUS	PHASE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
0.05 $\pm$ 0.03	40 $\pm$ 25	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2060) \rightarrow \Lambda K$

MODULUS	DOCUMENT ID	TECN	COMMENT
0.01 $\pm$ 0.005	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2060) \rightarrow \Sigma K$

MODULUS	PHASE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
0.04 $\pm$ 0.02	–70 $\pm$ 30	ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2060) \rightarrow \Delta(1232)\pi$, D -wave

MODULUS	PHASE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
0.06 $\pm$ 0.03	–90 $\pm$ 40	SOKHOYAN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2060) \rightarrow N\sigma$

MODULUS	PHASE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
0.12 $\pm$ 0.06	80 $\pm$ 40	SOKHOYAN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2060) \rightarrow N(1440)\pi$

MODULUS	PHASE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
0.17 $\pm$ 0.09	–60 $\pm$ 35	SOKHOYAN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2060) \rightarrow N(1520)\pi$, P -wave

MODULUS	PHASE ($^{\circ}$)	DOCUMENT ID	TECN	COMMENT
0.14 $\pm$ 0.06	–45 $\pm$ 15	SOKHOYAN	15A	DPWA Multichannel

 $N(2060)$ BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
2030 to 2200 ($\approx$ 2100) OUR ESTIMATE			
2111 $\pm$ 17	¹ HUNT	19	DPWA Multichannel
2045 $\pm$ 15	SOKHOYAN	15A	DPWA Multichannel
2180 $\pm$ 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
2228 $\pm$ 30	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$

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

2060±15	ANISOVICH	12A	DPWA	Multichannel
2116±21	¹ SHRESTHA	12A	DPWA	Multichannel
2217±27	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$

¹Statistical error only.

***N*(2060) BREIT-WIGNER WIDTH**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
300 to 450 ($\approx$ 400) OUR ESTIMATE			
499± 70	¹ HUNT	19	DPWA Multichannel
420± 30	SOKHOYAN	15A	DPWA Multichannel
400±100	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
310± 50	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$

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

375± 25	ANISOVICH	12A	DPWA	Multichannel
307±112	¹ SHRESTHA	12A	DPWA	Multichannel
481± 17	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$

¹Statistical error only.

***N*(2060) DECAY MODES**

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	7–12 %
Γ_2 $N\eta$	2–38 %
Γ_3 $N\omega$	1–7 %
Γ_4 ΛK	10–20 %
Γ_5 ΣK	1–5 %
Γ_6 $N\pi\pi$	12–52 %
Γ_7 $\Delta(1232)\pi$, <i>D</i> -wave	4–10 %
Γ_8 $N\rho$	5–33 %
Γ_9 $N\rho$, <i>S</i> =1/2, <i>P</i> -wave	<10 %
Γ_{10} $N\rho$, <i>S</i> =3/2, <i>D</i> -wave	5–23 %
Γ_{11} $N\sigma$	3–9 %
Γ_{12} $N(1440)\pi$	4–14 %
Γ_{13} $N(1520)\pi$, <i>P</i> -wave	9–21 %
Γ_{14} $N(1680)\pi$, <i>S</i> -wave	8–22 %
Γ_{15} $\Lambda K^*(892)$	0.3–1.3 %
Γ_{16} $p\gamma$	0.03–0.19 %
Γ_{17} $p\gamma$, helicity=1/2	0.02–0.08 %
Γ_{18} $p\gamma$, helicity=3/2	0.01–0.10 %
Γ_{19} $n\gamma$	0.003–0.07 %
Γ_{20} $n\gamma$, helicity=1/2	0.001–0.02 %
Γ_{21} $n\gamma$, helicity=3/2	0.002–0.05 %

$N(2060)$ BRANCHING RATIOS **$\Gamma(N\pi)/\Gamma_{\text{total}}$** **$\Gamma_1/\Gamma$**

VALUE (%)	DOCUMENT ID	TECN	COMMENT
7 to 12 (≈ 10) OUR ESTIMATE			
5.3 ± 1.4	¹ HUNT	19	DPWA Multichannel
11 ± 2	SOKHOYAN	15A	DPWA Multichannel
10 ± 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
7 ± 2	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
8 ± 2	ANISOVICH	12A	DPWA Multichannel
9 ± 2	¹ SHRESTHA	12A	DPWA Multichannel
13 ± 4	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

¹ Statistical error only. **$\Gamma(N\eta)/\Gamma_{\text{total}}$** **$\Gamma_2/\Gamma$**

VALUE (%)	DOCUMENT ID	TECN	COMMENT
2–38 % OUR ESTIMATE			
6 ± 2	MUELLER	20	DPWA Multichannel
30 ± 8	¹ HUNT	19	DPWA Multichannel
4 ± 2	ANISOVICH	12A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
< 1	¹ SHRESTHA	12A	DPWA Multichannel
0.2 ± 1.0	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

¹ Statistical error only. **$\Gamma(N\omega)/\Gamma_{\text{total}}$** **$\Gamma_3/\Gamma$**

VALUE (%)	DOCUMENT ID	TECN	COMMENT
4 ± 3	DENISENKO	16	DPWA Multichannel

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

VALUE (%)	DOCUMENT ID	TECN	COMMENT
10–20 % OUR ESTIMATE			
15 ± 5	¹ HUNT	19	DPWA Multichannel

¹ Statistical error only. **$\Gamma(\Sigma K)/\Gamma_{\text{total}}$** **$\Gamma_5/\Gamma$**

VALUE (%)	DOCUMENT ID	TECN	COMMENT
3 ± 2	ANISOVICH	12A	DPWA Multichannel

 $\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}}$ **Γ_7/Γ**

VALUE (%)	DOCUMENT ID	TECN	COMMENT
4–10 % OUR ESTIMATE			
15 ± 6	¹ HUNT	19	DPWA Multichannel
7 ± 3	SOKHOYAN	15A	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
40 ± 13	¹ SHRESTHA	12A	DPWA Multichannel

¹ Statistical error only.

$\Gamma(N\rho, S=1/2, P\text{-wave})/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
<10 % OUR ESTIMATE			
<10	¹ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
21 ± 15	¹ SHRESTHA	12A	DPWA Multichannel
¹ Statistical error only.			

 $\Gamma(N\rho, S=3/2, D\text{-wave})/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
5–23 % OUR ESTIMATE			
14 ± 9	¹ HUNT	19	DPWA Multichannel
¹ Statistical error only.			

 $\Gamma(N\sigma)/\Gamma_{\text{total}}$ Γ_{11}/Γ

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

 $\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
9 ± 5	SOKHOYAN	15A	DPWA Multichannel

 $\Gamma(N(1520)\pi, P\text{-wave})/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
15 ± 6	SOKHOYAN	15A	DPWA Multichannel

 $\Gamma(N(1680)\pi, S\text{-wave})/\Gamma_{\text{total}}$ Γ_{14}/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
15 ± 7	SOKHOYAN	15A	DPWA Multichannel

 $\Gamma(\Lambda K^*(892))/\Gamma_{\text{total}}$ Γ_{15}/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
0.3–1.3 % OUR ESTIMATE			
0.8 ± 0.5	ANISOVICH	17B	DPWA Multichannel

 $N(2060)$ PHOTON DECAY AMPLITUDES AT THE POLE **$N(2060) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.064 ± 0.010	12 ± 8	SOKHOYAN	15A	DPWA Multichannel

 $N(2060) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.060 ± 0.020	13 ± 10	SOKHOYAN	15A	DPWA Multichannel

 $N(2060) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.052 ± 0.025	−5 ± 20	ANISOVICH	17E	DPWA Multichannel

$N(2060) \rightarrow n\gamma$, 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>
0.012 ± 0.007	-40 ± 35	ANISOVICH	17E	DPWA Multichannel

 $N(2060)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES **$N(2060) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$**

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.019 ± 0.005	¹ HUNT 19	DPWA	Multichannel
0.062 ± 0.010	SOKHOYAN 15A	DPWA	Multichannel

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

0.018 ± 0.004 ¹ SHRESTHA 12A DPWA Multichannel

¹Statistical error only.

 $N(2060) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.039 ± 0.005	¹ HUNT 19	DPWA	Multichannel
0.062 ± 0.020	SOKHOYAN 15A	DPWA	Multichannel

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

0.010 ± 0.004 ¹ SHRESTHA 12A DPWA Multichannel

¹Statistical error only.

 $N(2060) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.069 ± 0.017	¹ HUNT 19	DPWA	Multichannel
0.052 ± 0.024	ANISOVICH 17E	DPWA	Multichannel

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

0.025 ± 0.011 ANISOVICH 13B DPWA Multichannel

-0.012 ± 0.017 ¹ SHRESTHA 12A DPWA Multichannel

¹Statistical error only.

 $N(2060) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

<u>VALUE ($\text{GeV}^{-1/2}$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.023 ± 0.020	¹ HUNT 19	DPWA	Multichannel
0.012 ± 0.007	ANISOVICH 17E	DPWA	Multichannel

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

-0.037 ± 0.017 ANISOVICH 13B DPWA Multichannel

-0.023 ± 0.023 ¹ SHRESTHA 12A DPWA Multichannel

¹Statistical error only.

N(2060) REFERENCES

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>	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan <i>et al.</i>	(CBELSA/TAPS 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)
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)
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP
