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

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

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 ± 15	SOKHOYAN	15A	DPWA	Multichannel
$2119\pm11\pm1$	[1] SVARC	14	L+P	$\pi N \to \pi N$
2100 ± 60	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2010	HUNT	19	DPWA	Multichannel
2040 ± 15	ANISOVICH	12A	DPWA	Multichannel
2144 ± 31	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$

[1] Fit to the amplitudes of HOEHLER 79.

$-2\times$IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
350 to 430 ($\approx$ 400) OUR ESTIMATE				
400 ± 35	SOKHOYAN	15A	DPWA	Multichannel
$370\pm20\pm5$	[1] SVARC	14	L+P	$\pi N \to \pi N$
360 ± 80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
395	HUNT	19	DPWA	Multichannel
390 ± 25	ANISOVICH	12A	DPWA	Multichannel
438 ± 13	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$

[1] Fit 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 ± 8	SOKHOYAN	15A	DPWA	Multichannel
$19\pm1\pm1$	[1] SVARC	14	L+P	$\pi N \to \pi N$
20 ± 10	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
19 ± 5	ANISOVICH	12A	DPWA	Multichannel
26	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$

[1] Fit to the amplitudes of HOEHLER 79.

PHASE θ

VALUE (°)		DOCUMENT ID		TECN	COMMENT
−130 to −90 (≈ − 110) OUR ESTIMATE					
−130±20		SOKHOYAN	15A	DPWA	Multichannel
− 94± 5±1	[1]	SVARC	14	L+P	$\pi N \to \pi N$
− 90±50		CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−125±20		ANISOVICH	12A	DPWA	Multichannel
− 71		BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$

[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 $N\pi \to N(2060) \to N\eta$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.05±0.03	40 ± 25	ANISOVICH	12A	DPWA	Multichannel

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

MODULUS		DOCUMENT ID		TECN	COMMENT
0.01±0.005		ANISOVICH	12A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.04±0.02	−70 ± 30	ANISOVICH	12A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.06±0.03	−90 ± 40	SOKHOYAN	15A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.12±0.06	80 ± 40	SOKHOYAN	15A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.17±0.09	−60 ± 35	SOKHOYAN	15A	DPWA	Multichannel

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

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.14±0.06	−45 ± 15	SOKHOYAN	15A	DPWA	Multichannel

N(2060) BREIT-WIGNER MASS

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

• • • 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 $\pi N \to N\pi, N\eta$

[1] Statistical error only.

N(2060) BREIT-WIGNER WIDTH

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

• • • 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 $\pi N \to N\pi, N\eta$

[1] Statistical error only.

N(2060) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	7–12 %
Γ_2	$N\eta$	2–6 %
Γ_3	$N\omega$	1–7 %
Γ_4	ΛK	seen
Γ_5	ΣK	1–5 %
Γ_6	$N\pi\pi$	7–19 %
Γ_7	$\Delta(1232)\pi$	
Γ_8	$\Delta(1232)\pi$, *D*-wave	4–10 %
Γ_9	$N\rho$	
Γ_{10}	$N\rho$, S=1/2, *P*-wave	seen
Γ_{11}	$N\rho$, S=3/2 , *D*-wave	
Γ_{12}	$\Lambda K^*(892)$	0.3–1.3 %
Γ_{13}	$N\sigma$	3–9 %
Γ_{14}	$N(1440)\pi$	4–14 %
Γ_{15}	$N(1520)\pi$, *P*-wave	9–21 %
Γ_{16}	$N(1680)\pi$, *S*-wave	8–22 %
Γ_{17}	$p\gamma$	0.03–0.19 %
Γ_{18}	$p\gamma$, helicity=1/2	0.02–0.08 %
Γ_{19}	$p\gamma$, helicity=3/2	0.01–0.10 %
Γ_{20}	$n\gamma$	0.003–0.07 %
Γ_{21}	$n\gamma$, helicity=1/2	0.001–0.02 %
Γ_{22}	$n\gamma$, helicity=3/2	0.002–0.05 %

N(2060) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$ $\qquad\qquad$ Γ_1/Γ

VALUE (%)		DOCUMENT ID		TECN	COMMENT
7 to 12 ($\approx$ 10) OUR ESTIMATE					
5.3 ± 1.4	[1]	HUNT	19	DPWA	Multichannel
$11\ \pm2$		SOKHOYAN	15A	DPWA	Multichannel
$10\ \pm3$		CUTKOSKY	80	IPWA	$\pi N \to \pi N$
$7\ \pm2$		HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$8\ \pm2$		ANISOVICH	12A	DPWA	Multichannel
$9\ \pm2$	[1]	SHRESTHA	12A	DPWA	Multichannel
$13\ \pm4$		BATINIC	10	DPWA	$\pi N \to N\pi,\, N\eta$

[1] Statistical error only.

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

VALUE (%)		DOCUMENT ID		TECN	COMMENT
$30\ \pm8$	[1]	HUNT	19	DPWA	Multichannel
$4\ \pm2$		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	$\pi N \to N\pi,\, N\eta$

[1] Statistical error only.

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

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

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

VALUE (%)		DOCUMENT ID		TECN	COMMENT
15 ± 5	[1]	HUNT	19	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(\Sigma K)/\Gamma_{\text{total}}$ $\qquad\qquad$ Γ_5/Γ

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

$\Gamma(\Delta(1232)\pi,\, D\text{-wave})/\Gamma_{\text{total}}$ $\qquad\qquad$ Γ_8/Γ

VALUE (%)		DOCUMENT ID		TECN	COMMENT
$15\pm\ 6$	[1]	HUNT	19	DPWA	Multichannel
$7\pm\ 3$		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.

$\Gamma(N\rho, S=1/2, P\text{-wave})/\Gamma_{total}$ $\qquad$ Γ_{10}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<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.

$\Gamma(N\rho, S=3/2, D\text{-wave})/\Gamma_{total}$ $\qquad$ Γ_{11}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
14 ± 9	[1] HUNT	19	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(\Lambda K^*(892))/\Gamma_{total}$ $\qquad$ Γ_{12}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.008 ± 0.005	ANISOVICH	17B	DPWA	Multichannel

$\Gamma(N\sigma)/\Gamma_{total}$ $\qquad$ Γ_{13}/Γ

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

$\Gamma(N(1440)\pi)/\Gamma_{total}$ $\qquad$ Γ_{14}/Γ

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

$\Gamma(N(1520)\pi, P\text{-wave})/\Gamma_{total}$ $\qquad$ Γ_{15}/Γ

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

$\Gamma(N(1680)\pi, S\text{-wave})/\Gamma_{total}$ $\qquad$ Γ_{16}/Γ

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

$N(2060)$ PHOTON DECAY AMPLITUDES AT THE POLE

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

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

N(2060) BREIT-WIGNER PHOTON DECAY AMPLITUDES

N(2060) → *p*γ, helicity-1/2 amplitude A$_{1/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
-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

[1] Statistical error only.

N(2060) → *p*γ, helicity-3/2 amplitude A$_{3/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
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

[1] Statistical error only.

N(2060) → *n*γ, helicity-1/2 amplitude A$_{1/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.069 ± 0.017	[1] HUNT	19	DPWA	Multichannel
0.025 ± 0.011	ANISOVICH	13B	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.012 ± 0.017	[1] SHRESTHA	12A	DPWA	Multichannel

[1] Statistical error only.

N(2060) → *n*γ, helicity-3/2 amplitude A$_{3/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
-0.023 ± 0.020	[1] HUNT	19	DPWA	Multichannel
-0.037 ± 0.017	ANISOVICH	13B	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.023 ± 0.023	[1] SHRESTHA	12A	DPWA	Multichannel

[1] Statistical error only.

N(2060) REFERENCES

HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
ANISOVICH	17B	PL B771 142	A.V. Anisovich *et al.*	
DENISENKO	16	PL B755 97	I. Denisenko *et al.*	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan *et al.*	(CBELSA/TAPS Collab.)
SVARC	14	PR C89 045205	A. Svarc *et al.*	(RBI Zagreb, UNI Tuzla)
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich *et al.*	
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
BATINIC	10	PR C82 038203	M. Batinic *et al.*	(ZAGR)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL)
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP