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

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

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 (≈ 2070) OUR ESTIMATE				
2030±15	SOKHOYAN	15A	DPWA	Multichannel
2119±11±1	[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×IMAGINARY PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
350 to 430 (≈ 400) OUR ESTIMATE				
400±35	SOKHOYAN	15A	DPWA	Multichannel
370±20±5	[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 (≈ 20) OUR ESTIMATE				
25± 8	SOKHOYAN	15A	DPWA	Multichannel
19± 1±1	[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

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

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	$\pi N \to \pi N$
7 ±2	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • 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	$\pi N \to N\pi, N\eta$

[1] Statistical error only.

$\Gamma(N\eta)/\Gamma_{total}$ Γ_2/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
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	$\pi N \to N\pi, N\eta$

[1] Statistical error only.

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

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

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

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

[1] Statistical error only.

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

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

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
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.

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

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

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

[1] Statistical error only.

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

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

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

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

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

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

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

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

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

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

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

$N(2060) \to p\gamma$, 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

$N(2060) \to p\gamma$, 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) → *pγ*, 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) → *pγ*, 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) → *nγ*, 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) → *nγ*, 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

MUELLER	20	PL B803 135323	J. Mueller *et al.*	(CBELSA/TAPS Collab.)
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