$N(2120)$ $3/2^-$

$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$ Status: ∗∗∗

Before the 2012 *Review*, all the evidence for a $J^P = 3/2^-$ state with a mass above 1800 MeV was filed under a two-star $N(2080)$. There is now evidence from ANISOVICH 12A for two $3/2^-$ states in this region, so we have split the older data (according to mass) between a three-star $N(1875)$ and a two-star $N(2120)$.

$N(2120)$ POLE POSITION

REAL PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
2050 to 2150 (≈ 2100) OUR ESTIMATE				
2115±40	SOKHOYAN	15A	DPWA	Multichannel
2094± 7±11	SVARC	14	L+P	$\pi N \to \pi N$
2050±70	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (higher m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2357	HUNT	19	DPWA	Multichannel
2115±40	GUTZ	14	DPWA	Multichannel
2110±50	ANISOVICH	12A	DPWA	Multichannel

−2×IMAGINARY PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
200 to 360 (≈ 280) OUR ESTIMATE				
345±35	SOKHOYAN	15A	DPWA	Multichannel
296±15±4	SVARC	14	L+P	$\pi N \to \pi N$
200±80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (higher m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
503	HUNT	19	DPWA	Multichannel
345±35	GUTZ	14	DPWA	Multichannel
340±45	ANISOVICH	12A	DPWA	Multichannel

$N(2120)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
10 to 30 (≈ 20) OUR ESTIMATE				
11± 6	SOKHOYAN	15A	DPWA	Multichannel
13± 1±1	SVARC	14	L+P	$\pi N \to \pi N$
30±20	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (higher m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
11± 6	GUTZ	14	DPWA	Multichannel
13± 3	ANISOVICH	12A	DPWA	Multichannel

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
−40 to 20 (≈ −10) OUR ESTIMATE				
−30 ± 20	SOKHOYAN	15A	DPWA	Multichannel
− 2 ± 4 ± 9	SVARC	14	L+P	$\pi N \to \pi N$
0 ± 100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (higher m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−30 ± 20	GUTZ	14	DPWA	Multichannel
−20 ± 10	ANISOVICH	12A	DPWA	Multichannel

$N(2120)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \to N(2120) \to \Lambda K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.03 ± 0.01	100 ± 30	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \to N(2120) \to \Sigma K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.02 ± 0.015	−50 ± 40	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \to N(2120) \to N(1535)\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.15 ± 0.08	−90 ± 40	GUTZ	14	DPWA	Multichannel

Normalized residue in $N\pi \to N(2120) \to \Delta(1232)\pi$, S-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.25 ± 0.10	undefined	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to N(2120) \to \Delta(1232)\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.15 ± 0.06	−35 ± 30	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to N(2120) \to N\sigma$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.09 ± 0.05	−80 ± 50	SOKHOYAN	15A	DPWA	Multichannel

$N(2120)$ BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
2060 to 2160 (≈ 2120) OUR ESTIMATE				
2353 ± 29	[1] HUNT	19	DPWA	Multichannel
2120 ± 45	SOKHOYAN	15A	DPWA	Multichannel
2060 ± 80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
2081 ± 20	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2120 ± 35	GUTZ	14	DPWA	Multichannel
2150 ± 60	ANISOVICH	12A	DPWA	Multichannel

[1] Statistical error only.

$N(2120)$ BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
260 to 360 (≈ 300) OUR ESTIMATE				
503±62	[1] HUNT	19	DPWA	Multichannel
340±35	SOKHOYAN	15A	DPWA	Multichannel
300±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (higher m)
265±40	HOEHLER	79	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
340±35	GUTZ	14	DPWA	Multichannel
330±45	ANISOVICH	12A	DPWA	Multichannel

[1] Statistical error only.

$N(2120)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	5–15 %
Γ_2	$N\eta$	1–5 %
Γ_3	$N\eta'$	2–6 %
Γ_4	$N\omega$	4–20 %
Γ_5	ΛK	6–11 %
Γ_6	$N\pi\pi$	>27 %
Γ_7	$\Delta(1232)\pi$	>23 %
Γ_8	$\Delta(1232)\pi$, S-wave	15–70 %
Γ_9	$\Delta(1232)\pi$, D-wave	8–45 %
Γ_{10}	$N\rho$, S=3/2 , S-wave	< 3 %
Γ_{11}	$N\sigma$	4–15 %
Γ_{12}	$N(1535)\pi$	7–23 %
Γ_{13}	$\Lambda K^*(892)$	< 0.2 %
Γ_{14}	$p\gamma$	0.16–2.1 %
Γ_{15}	$p\gamma$, helicity=1/2	0.07–0.80 %
Γ_{16}	$p\gamma$, helicity=3/2	0.09–1.3 %
Γ_{17}	$n\gamma$	0.04–0.72 %
Γ_{18}	$n\gamma$, helicity=1/2	0.04–0.60 %
Γ_{19}	$n\gamma$, helicity=3/2	0.001–0.12 %

$N(2120)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5–15 % OUR ESTIMATE				
19±2	[1] HUNT	19	DPWA	Multichannel
5±3	SOKHOYAN	15A	DPWA	Multichannel
14±7	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (higher m)
6±2	HOEHLER	79	IPWA	$\pi N \to \pi N$

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

5±3		GUTZ 14	DPWA	Multichannel
6±2		ANISOVICH 12A	DPWA	Multichannel

[1] Statistical error only.

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

VALUE (%)		DOCUMENT ID	TECN	COMMENT
1–5 % OUR ESTIMATE				
<1		MUELLER 20	DPWA	Multichannel
3.1±2.4	[1]	HUNT 19	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N\eta')/\Gamma_{total}$ — Γ_3/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
2–6 % OUR ESTIMATE			
4±2	ANISOVICH 17C	DPWA	Multichannel

$\Gamma(N\omega)/\Gamma_{total}$ — Γ_4/Γ

VALUE (%)	DOCUMENT ID	TECN	COMMENT
4–20 % OUR ESTIMATE			
12±8	DENISENKO 16	DPWA	Multichannel

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

VALUE (%)		DOCUMENT ID	TECN	COMMENT
6–11 % OUR ESTIMATE				
8.5±2.5	[1]	HUNT 19	DPWA	Multichannel

[1] Statistical error only.

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

VALUE (%)		DOCUMENT ID	TECN	COMMENT
15–70 % OUR ESTIMATE				
25±11	[1]	HUNT 19	DPWA	Multichannel
50±20		SOKHOYAN 15A	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{total}$ — Γ_9/Γ

VALUE (%)		DOCUMENT ID	TECN	COMMENT
8–45 % OUR ESTIMATE				
34±11	[1]	HUNT 19	DPWA	Multichannel
20±12		SOKHOYAN 15A	DPWA	Multichannel

[1] Statistical error only.

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

VALUE (%)		DOCUMENT ID	TECN	COMMENT
< 3 % OUR ESTIMATE				
<3	[1]	HUNT 19	DPWA	Multichannel

[1] Statistical error only.

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4–15 % OUR ESTIMATE				
9±5	[1] HUNT	19	DPWA	Multichannel
11±4	SOKHOYAN	15A	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N(1535)\pi)/\Gamma_{total}$ — Γ_{12}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
7–23 % OUR ESTIMATE				
15±8	GUTZ	14	DPWA	Multichannel

$\Gamma(\Lambda K^*(892))/\Gamma_{total}$ — Γ_{13}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
< 0.2 % OUR ESTIMATE				
<0.2	ANISOVICH	17B	DPWA	Multichannel

N(2120) PHOTON DECAY AMPLITUDES AT THE POLE

$N(2120) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.130±0.045	−40 ± 25	SOKHOYAN	15A	DPWA	Multichannel

$N(2120) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.160±0.060	−30 ± 15	SOKHOYAN	15A	DPWA	Multichannel

$N(2120) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.080±0.030	15 ± 25	ANISOVICH	17E	DPWA	Multichannel

$N(2120) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
−0.033±0.020	−60 ± 35	ANISOVICH	17E	DPWA	Multichannel

N(2120) BREIT-WIGNER PHOTON DECAY AMPLITUDES

$N(2120) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.047±0.009	[1] HUNT	19	DPWA	Multichannel
0.130±0.050	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.130±0.050	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

$N(2120) \to p\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.001 ± 0.007	[1] HUNT	19	DPWA	Multichannel
0.160 ± 0.065	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.160 ± 0.065	GUTZ	14	DPWA	Multichannel

[1] Statistical error only.

$N(2120) \to n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
-0.020 ± 0.013	[1] HUNT	19	DPWA	Multichannel
0.081 ± 0.030	ANISOVICH	17E	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.110 ± 0.045	ANISOVICH	13B	DPWA	Multichannel

[1] Statistical error only.

$N(2120) \to n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
-0.00 ± 0.02	[1] HUNT	19	DPWA	Multichannel
-0.032 ± 0.020	ANISOVICH	17E	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.040 ± 0.030	ANISOVICH	13B	DPWA	Multichannel

[1] Statistical error only.

N(2120) 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.	
ANISOVICH	17C	PL B772 247	A.V. Anisovich et al.	
ANISOVICH	17E	PR C96 055202	A.V. Anisovich et al.	(BONN, PNPI, JLAB+)
DENISENKO	16	PL B755 97	I. Denisenko et al.	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan et al.	(CBELSA/TAPS Collab.)
GUTZ	14	EPJ A50 74	E. Gutz 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)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky et al.	(CMU, LBL)
HOEHLER	79	PDAT 12-1	G. Hohler et al.	(KARLT)