$N(1875)\ 3/2^-$

$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$ 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(1875) POLE POSITION

REAL PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1850 to 1950 (≈ 1900) OUR ESTIMATE				
1870± 20	SOKHOYAN	15A	DPWA	Multichannel
1880±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1810	SHKLYAR	13	DPWA	Multichannel
1860± 25	ANISOVICH	12A	DPWA	Multichannel
1975	SHRESTHA	12A	DPWA	Multichannel
1957± 49	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
1824	VRANA	00	DPWA	Multichannel

−2×IMAGINARY PART

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
100 to 220 (≈ 160) OUR ESTIMATE				
200± 15	SOKHOYAN	15A	DPWA	Multichannel
160± 80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
98	SHKLYAR	13	DPWA	Multichannel
200± 20	ANISOVICH	12A	DPWA	Multichannel
495	SHRESTHA	12A	DPWA	Multichannel
467±106	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
614	VRANA	00	DPWA	Multichannel

N(1875) ELASTIC POLE RESIDUE

MODULUS $|r|$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
3 to 12 (≈ 10) OUR ESTIMATE				
3 ±1.5	SOKHOYAN	15A	DPWA	Multichannel
10 ±5	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3	SHKLYAR	13	DPWA	Multichannel
2.5±1.0	ANISOVICH	12A	DPWA	Multichannel
53	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$

PHASE θ

VALUE (°)	DOCUMENT ID		TECN	COMMENT
50 to 200 (≈ 100) OUR ESTIMATE				
160 ± 50	SOKHOYAN	15A	DPWA	Multichannel
100 ± 80	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
− 76	SHKLYAR	13	DPWA	Multichannel
− 65	BATINIC	10	DPWA	$\pi N \rightarrow N\pi$, $N\eta$

$N(1875)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow N(1875) \rightarrow \Lambda K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.015 ± 0.005		ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1875) \rightarrow \Sigma K$

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

Normalized residue in $N\pi \rightarrow N(1875) \rightarrow N\sigma$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.09 ± 0.03	−175 ± 45	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.08 ± 0.03	−170 ± 65	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1875) \rightarrow \Delta(1232)\pi$, S-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.05 ± 0.03	undefined	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1875) \rightarrow \Delta(1232)\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.04 ± 0.02	undefined	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(1875) \rightarrow N(1440)\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.03 ± 0.02	undefined	SOKHOYAN	15A	DPWA	Multichannel

$N(1875)$ BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1850 to 1920 (≈ 1875) OUR ESTIMATE				
1875 ± 20	SOKHOYAN	15A	DPWA	Multichannel
1934 ± 10	[1] SHKLYAR	13	DPWA	Multichannel
1951 ± 27	[1] SHRESTHA	12A	DPWA	Multichannel
1880 ± 100	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$

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

1880± 20	ANISOVICH	12A	DPWA	Multichannel
2048± 65	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
1946± 1	PENNER	02C	DPWA	Multichannel
1895	MART	00	DPWA	$\gamma p \to \Lambda K^+$
2003± 18	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

N(1875) BREIT-WIGNER WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
120 to 250 (≈ 200) OUR ESTIMATE				
200± 25	SOKHOYAN	15A	DPWA	Multichannel
857±100	[1] SHKLYAR	13	DPWA	Multichannel
500± 45	[1] SHRESTHA	12A	DPWA	Multichannel
180± 60	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)

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

200± 25	ANISOVICH	12A	DPWA	Multichannel
529±128	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
859± 7	PENNER	02C	DPWA	Multichannel
372	MART	00	DPWA	$\gamma p \to \Lambda K^+$
1070±858	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

N(1875) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	3–11 %
Γ_2	$N\eta$	<1 %
Γ_3	$N\omega$	15–25 %
Γ_4	ΛK	seen
Γ_5	ΣK	seen
Γ_6	$N\pi\pi$	
Γ_7	$\Delta(1232)\pi$	10–35 %
Γ_8	$\Delta(1232)\pi$, S-wave	7–21 %
Γ_9	$\Delta(1232)\pi$, D-wave	2–12 %
Γ_{10}	$N\rho$, S=3/2, S-wave	seen
Γ_{11}	$\Lambda K^*(892)$	
Γ_{12}	$N\sigma$	30–60 %
Γ_{13}	$N(1440)\pi$	2–8 %
Γ_{14}	$N(1520)\pi$	<2 %
Γ_{15}	$p\gamma$	0.001–0.025 %
Γ_{16}	$p\gamma$, helicity=1/2	0.001–0.021 %
Γ_{17}	$p\gamma$, helicity=3/2	<0.003 %

Γ_{18}	$n\gamma$	<0.040 %
Γ_{19}	$n\gamma$, helicity=1/2	<0.007 %
Γ_{20}	$n\gamma$, helicity=3/2	<0.033 %

N(1875) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
3 to 11 (≈ 7) OUR ESTIMATE				
4±2	SOKHOYAN	15A	DPWA	Multichannel
11±1	[1] SHKLYAR	13	DPWA	Multichannel
7±2	[1] SHRESTHA	12A	DPWA	Multichannel
10±4	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3±2	ANISOVICH	12A	DPWA	Multichannel
17±7	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$
12±2	PENNER	02C	DPWA	Multichannel
13±3	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

$\Gamma(N\eta)/\Gamma_{total}$ Γ_2/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<1	SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8±3	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$
7±2	PENNER	02C	DPWA	Multichannel
0±2	VRANA	00	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
13±7	DENISENKO	16	DPWA	Multichannel
20±5	[1] SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
21±7	PENNER	02C	DPWA	Multichannel

[1] Statistical error only

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.2±0.2	PENNER	02C	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
0.7±0.4	PENNER	02C	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
14± 7	SOKHOYAN	15A	DPWA	Multichannel
87± 3	[1] SHRESTHA	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
40±10	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
7± 5	SOKHOYAN	15A	DPWA	Multichannel
< 6	SHRESTHA	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
17±10	VRANA	00	DPWA	Multichannel

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<5	SHRESTHA	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
6±6	VRANA	00	DPWA	Multichannel

$\Gamma(\Lambda K^*(892))/\Gamma_{total}$ Γ_{11}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
<0.002	ANISOVICH	17B	DPWA	Multichannel

$\Gamma(N\sigma)/\Gamma_{total}$ Γ_{12}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
45±15	SOKHOYAN	15A	DPWA	Multichannel
< 4	SHRESTHA	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
24±24	VRANA	00	DPWA	Multichannel

$\Gamma(N(1440)\pi)/\Gamma_{total}$ Γ_{13}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5±3	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1520)\pi)/\Gamma_{total}$ Γ_{14}/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<2	SOKHOYAN	15A	DPWA	Multichannel

$N(1875)$ PHOTON DECAY AMPLITUDES AT THE POLE

$N(1875) \to p\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.017±0.009	−110 ± 40	SOKHOYAN	15A	DPWA	Multichannel

$N(1875) \to p\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($GeV^{-1/2}$)	*PHASE* (°)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.008 ± 0.004	180 ± 40	SOKHOYAN	15A	DPWA	Multichannel

$N(1875)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

$N(1875) \to p\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.010 to 0.025 (≈ 0.015) OUR ESTIMATE				
0.011 ± 0.001	[1] SHKLYAR	13	DPWA	Multichannel
0.018 ± 0.010	ANISOVICH	12A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.007 ± 0.008	[1] SHRESTHA	12A	DPWA	Multichannel
0.012	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

$N(1875) \to p\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
-0.010 to 0.025 (≈ -0.005) OUR ESTIMATE				
-0.007 ± 0.004	SOKHOYAN	15A	DPWA	Multichannel
0.026 ± 0.001	[1] SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.009 ± 0.005	ANISOVICH	12A	DPWA	Multichannel
0.043 ± 0.022	[1] SHRESTHA	12A	DPWA	Multichannel
-0.010	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

$N(1875) \to n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.010 ± 0.006	ANISOVICH	13B	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.055 ± 0.021	[1] SHRESTHA	12A	DPWA	Multichannel
0.023	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

$N(1875) \to n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($GeV^{-1/2}$)	*DOCUMENT ID*		*TECN*	*COMMENT*
-0.020 ± 0.015	ANISOVICH	13B	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.085 ± 0.031	[1] SHRESTHA	12A	DPWA	Multichannel
-0.009	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

N(1875) REFERENCES

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

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.)
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich *et al.*	
SHKLYAR	13	PR C87 015201	V. Shklyar, H. Lenske, U. Mosel	(GIES)
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)
PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)
PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)
MART	00	PR C61 012201	T. Mart, C. Bennhold	
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL) IJP