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

$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$ 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*
1800 to 1950 OUR ESTIMATE				
1870± 20	SOKHOYAN	15A	DPWA	Multichannel
2094± 7±11	[1] SVARC	14	L+P	$\pi N \to \pi N$
1880±100	[2] 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*
150 to 250 OUR ESTIMATE				
200± 15	SOKHOYAN	15A	DPWA	Multichannel
296± 15±4	[1] SVARC	14	L+P	$\pi N \to \pi N$
160± 80	[2] 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*
2 to 10 OUR ESTIMATE				
3 ±1.5	SOKHOYAN	15A	DPWA	Multichannel
13 ±1 ±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
10 ±5	[2] 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
160±50	SOKHOYAN	15A	DPWA	Multichannel
− 2± 4±9	[1] SVARC	14	L+P	$\pi N \to \pi N$
100±80	[2] CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
− 76	SHKLYAR	13	DPWA	Multichannel
− 65	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$

N(1875) INELASTIC POLE RESIDUE

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

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

MODULUS	DOCUMENT ID		TECN	COMMENT
0.015±0.005	ANISOVICH	12A	DPWA	Multichannel

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

MODULUS	DOCUMENT ID		TECN	COMMENT
0.04±0.02	ANISOVICH	12A	DPWA	Multichannel

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

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 $N\pi \to N(1875) \to \Delta(1232)\pi$, S-wave

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

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

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

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

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
1820 to 1920 (≈ 1875) OUR ESTIMATE				
1875± 20	SOKHOYAN	15A	DPWA	Multichannel
1934± 10	SHKLYAR	13	DPWA	Multichannel
1880±100	[2] CUTKOSKY	80	IPWA	$\pi N \to \pi N$

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

1880± 20	ANISOVICH	12A	DPWA	Multichannel
1951± 27	SHRESTHA	12A	DPWA	Multichannel
2048± 65	BATINIC	10	DPWA	$\pi N \rightarrow N\pi$, $N\eta$
1946± 1	PENNER	02C	DPWA	Multichannel
1895	MART	00	DPWA	$\gamma p \rightarrow \Lambda K^+$
2003± 18	VRANA	00	DPWA	Multichannel

N(1875) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
250± 70 OUR ESTIMATE				
200± 25	SOKHOYAN	15A	DPWA	Multichannel
857±100	SHKLYAR	13	DPWA	Multichannel
180± 60	[2] CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
200± 25	ANISOVICH	12A	DPWA	Multichannel
500± 45	SHRESTHA	12A	DPWA	Multichannel
529±128	BATINIC	10	DPWA	$\pi N \rightarrow N\pi$, $N\eta$
859± 7	PENNER	02C	DPWA	Multichannel
372	MART	00	DPWA	$\gamma p \rightarrow \Lambda K^+$
1070±858	VRANA	00	DPWA	Multichannel

N(1875) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	2–14 %
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}	$N\sigma$	30–60 %
Γ_{12}	$N(1440)\pi$	2–8 %
Γ_{13}	$N(1520)\pi$	<2 %
Γ_{14}	$p\gamma$	0.001–0.025 %
Γ_{15}	$p\gamma$, helicity=1/2	0.001–0.021 %
Γ_{16}	$p\gamma$, helicity=3/2	<0.003 %
Γ_{17}	$n\gamma$	<0.040 %
Γ_{18}	$n\gamma$, helicity=1/2	<0.007 %
Γ_{19}	$n\gamma$, helicity=3/2	<0.033 %

N(1875) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
7±6 OUR ESTIMATE				
4±2	SOKHOYAN	15A	DPWA	Multichannel
11±1	SHKLYAR	13	DPWA	Multichannel
10±4	[2] CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3±2	ANISOVICH	12A	DPWA	Multichannel
7±2	SHRESTHA	12A	DPWA	Multichannel
17±7	BATINIC	10	DPWA	$\pi N \rightarrow N\pi$, $N\eta$
12±2	PENNER	02C	DPWA	Multichannel
13±3	VRANA	00	DPWA	Multichannel

$\Gamma(N\eta)/\Gamma_{total}$ Γ_2/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
0±1	SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8±3	BATINIC	10	DPWA	$\pi N \rightarrow N\pi$, $N\eta$
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	SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
21±7	PENNER	02C	DPWA	Multichannel

$\Gamma(\Lambda K)/\Gamma_{total}$ 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*-wave$)/\Gamma_{total}$ Γ_8/Γ

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

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

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

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

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

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

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

$\Gamma(N(1520)\pi)/\Gamma_{total}$ — Γ_{13}/Γ

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

N(1875) PHOTON DECAY AMPLITUDES AT THE POLE

$N(1875) \rightarrow p\gamma$, 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

$N(1875) \rightarrow p\gamma$, 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

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

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

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

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

$N(1875) \rightarrow n\gamma$, 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	SHRESTHA	12A	DPWA	Multichannel
0.023	PENNER	02D	DPWA	Multichannel

$N(1875) \rightarrow n\gamma$, 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	SHRESTHA	12A	DPWA	Multichannel
-0.009	PENNER	02D	DPWA	Multichannel

N(1875) FOOTNOTES

[1] Fit to the amplitudes of HOEHLER 79.

[2] CUTKOSKY 80 finds a lower mass D_{13} resonance, as well as one in this region. Both are listed here.

N(1875) REFERENCES

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

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.*	
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
HOEHLER	79	PDAT 12-1	G. Hohler *et al.*	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP