

$N(2000) 5/2^+$ $I(J^P) = \frac{1}{2}(5/2^+)$ Status: **

OMITTED FROM SUMMARY TABLE

Before the 2012 *Review*, all the evidence for a $J^P = 5/2^+$ state with a mass above 1800 MeV was filed under a two-star $N(2000)$. There is now some evidence from ANISOVICH 12A for two $5/2^+$ states in this region, so we have split the older data (according to mass) between two two-star $5/2^+$ states, an $N(1860)$ and an $N(2000)$.

 $N(2000)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2030 ± 40	SOKHOYAN	15A	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1900	SHKLYAR	13	DPWA Multichannel
2030 ± 110	ANISOVICH	12A	DPWA Multichannel

–2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
380 ± 60	SOKHOYAN	15A	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
123	SHKLYAR	13	DPWA Multichannel
480 ± 100	ANISOVICH	12A	DPWA Multichannel

 $N(2000)$ ELASTIC POLE RESIDUE**MODULUS $|r|$**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
18 ± 8	SOKHOYAN	15A	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
11	SHKLYAR	13	DPWA Multichannel
35^{+80}_{-15}	ANISOVICH	12A	DPWA Multichannel

PHASE θ

<u>VALUE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-150 ± 40	SOKHOYAN	15A	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
– 6	SHKLYAR	13	DPWA Multichannel
-100 ± 40	ANISOVICH	12A	DPWA Multichannel

 $N(2000)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow N(2000) \rightarrow \Delta(1232)\pi$, P-wave

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.16 ± 0.06	100 ± 50	SOKHOYAN	15A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow N(2000) \rightarrow \Delta(1232)\pi$, F -wave

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.20 \pm 0.10	-20 \pm 45	SOKHOYAN	15A DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(2000) \rightarrow N\sigma$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.12 \pm 0.06	80 \pm 40	SOKHOYAN	15A DPWA	Multichannel

Normalized residue in $N\pi \rightarrow N(2000) \rightarrow N(1520)\pi$, D -wave

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.17 \pm 0.09	-60 \pm 35	SOKHOYAN	15A DPWA	Multichannel

 $N(2000)$ BREIT-WIGNER MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2060 \pm 30	SOKHOYAN	15A DPWA	Multichannel
1946 \pm 4	¹ SHKLYAR	13 DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2090 \pm 120	ANISOVICH	12A DPWA	Multichannel

¹Statistical error only. **$N(2000)$ BREIT-WIGNER WIDTH**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
390 \pm 55	SOKHOYAN	15A DPWA	Multichannel
198 \pm 2	² SHKLYAR	13 DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
460 \pm 100	ANISOVICH	12A DPWA	Multichannel

²Statistical error only. **$N(2000)$ DECAY MODES**

Mode	Fraction (Γ_j/Γ)
Γ_1 $N\pi$	6–10 %
Γ_2 $N\eta$	<4 %
Γ_3 $N\omega$	<2 %
Γ_4 $N\pi\pi$	35–90 %
Γ_5 $\Delta(1232)\pi$	30–80 %
Γ_6 $\Delta(1232)\pi$, P -wave	12–32 %
Γ_7 $\Delta(1232)\pi$, F -wave	19–49 %
Γ_8 $N\sigma$	5–15 %
Γ_9 $N(1520)\pi$, D -wave	11–31 %
Γ_{10} $N(1680)\pi$, P -wave	17–25 %
Γ_{11} $\Lambda K^*(892)$	1–3 %
Γ_{12} $p\gamma$	0.01–0.08 %

Γ_{13}	$p\gamma$, helicity=1/2	0.003–0.031 %
Γ_{14}	$p\gamma$, helicity=3/2	0.008–0.048 %
Γ_{15}	$n\gamma$	0.002–0.07 %
Γ_{16}	$n\gamma$, helicity=1/2	<0.017 %
Γ_{17}	$n\gamma$, helicity=3/2	0.001–0.056 %

$N(2000)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$				Γ_1/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

6 to 10 (≈ 8) OUR ESTIMATE

8 ± 4	SOKHOYAN	15A	DPWA	Multichannel
10 ± 1	³ SHKLYAR	13	DPWA	Multichannel

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

9 ± 4	ANISOVICH	12A	DPWA	Multichannel
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³Statistical error only.

$\Gamma(N\eta)/\Gamma_{\text{total}}$				Γ_2/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

2 ± 2	MUELLER	20	DPWA	Multichannel
2 ± 2	⁴ SHKLYAR	13	DPWA	Multichannel

⁴Statistical error only.

$\Gamma(N\omega)/\Gamma_{\text{total}}$				Γ_3/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

18 ± 8	DENISENKO	16	DPWA	Multichannel
1 ± 1	⁵ SHKLYAR	13	DPWA	Multichannel

⁵Statistical error only.

$\Gamma(\Delta(1232)\pi, P\text{-wave})/\Gamma_{\text{total}}$				Γ_6/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

22 ± 10	SOKHOYAN	15A	DPWA	Multichannel
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$\Gamma(\Delta(1232)\pi, F\text{-wave})/\Gamma_{\text{total}}$				Γ_7/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

34 ± 15	SOKHOYAN	15A	DPWA	Multichannel
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$\Gamma(N\sigma)/\Gamma_{\text{total}}$				Γ_8/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

10 ± 5	SOKHOYAN	15A	DPWA	Multichannel
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$\Gamma(N(1520)\pi, D\text{-wave})/\Gamma_{\text{total}}$				Γ_9/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

21 ± 10	SOKHOYAN	15A	DPWA	Multichannel
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$\Gamma(N(1680)\pi, P\text{-wave})/\Gamma_{\text{total}}$				Γ_{10}/Γ
<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

16 ± 9	SOKHOYAN	15A	DPWA	Multichannel
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$\Gamma(\Lambda K^*(892))/\Gamma_{\text{total}}$	Γ_{11}/Γ		
VALUE (%)	DOCUMENT ID	TECN	COMMENT
1-3 % OUR EVALUATION			
2.2 ± 1.0	ANISOVICH	17B	DPWA Multichannel

$N(2000)$ PHOTON DECAY AMPLITUDES AT THE POLE

$N(2000) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.033 ± 0.010	15 ± 25	SOKHOYAN	15A	DPWA Multichannel

$N(2000) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS ($\text{GeV}^{-1/2}$)	PHASE ($^\circ$)	DOCUMENT ID	TECN	COMMENT
0.045 ± 0.008	-140 ± 25	SOKHOYAN	15A	DPWA Multichannel

$N(2000)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

$N(2000) \rightarrow p\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.031 ± 0.010	SOKHOYAN	15A	DPWA Multichannel
0.011 ± 0.001	⁶ SHKLYAR	13	DPWA Multichannel

⁶ Statistical error only.

$N(2000) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.043 ± 0.008	SOKHOYAN	15A	DPWA Multichannel
0.025 ± 0.001	⁷ SHKLYAR	13	DPWA Multichannel

⁷ Statistical error only.

$N(2000) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.018 ± 0.012	ANISOVICH	13B	DPWA Multichannel

$N(2000) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.035 ± 0.020	ANISOVICH	13B	DPWA Multichannel

$N(2000)$ REFERENCES

MUELLER	20	PL B803 135323	J. Mueller <i>et al.</i>	(CBELSA/TAPS Collab.)
ANISOVICH	17B	PL B771 142	A.V. Anisovich <i>et al.</i>	
DENISENKO	16	PL B755 97	I. Denisenko <i>et al.</i>	
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan <i>et al.</i>	(CBELSA/TAPS Collab.)
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich <i>et al.</i>	
SHKLYAR	13	PR C87 015201	V. Shklyar, H. Lenske, U. Mosel	(GIES)
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)