

$N(1860) 5/2^+$ $I(J^P) = \frac{1}{2}(5/2^+)$ 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 $N(2000)$.

 $N(1860)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$1834 \pm 19 \pm 6$	¹ SVARC 14	L+P	$\pi N \rightarrow \pi N$
1830^{+120}_{-60}	ANISOVICH 12A	DPWA	Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1871	HUNT 19	DPWA	Multichannel
1807	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$

¹ Fit to the amplitudes of HOEHLER 79.**−2×IMAGINARY PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$122 \pm 34 \pm 7$	² SVARC 14	L+P	$\pi N \rightarrow \pi N$
250^{+150}_{-50}	ANISOVICH 12A	DPWA	Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
337	HUNT 19	DPWA	Multichannel
109	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$

² Fit to the amplitudes of HOEHLER 79. **$N(1860)$ ELASTIC POLE RESIDUE****MODULUS $|r|$**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$4 \pm 1 \pm 1$	³ SVARC 14	L+P	$\pi N \rightarrow \pi N$
50 ± 20	ANISOVICH 12A	DPWA	Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
60	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$

³ Fit to the amplitudes of HOEHLER 79.**PHASE θ**

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$-39 \pm 18 \pm 9$	⁴ SVARC 14	L+P	$\pi N \rightarrow \pi N$
-80 ± 40	ANISOVICH 12A	DPWA	Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
-67	ARNDT 06	DPWA	$\pi N \rightarrow \pi N, \eta N$

⁴ Fit to the amplitudes of HOEHLER 79.

N(1860) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1928 ± 21	⁵ HUNT	19	DPWA Multichannel
1860 $\begin{smallmatrix} +120 \\ -60 \end{smallmatrix}$	ANISOVICH	12A	DPWA Multichannel
1882 ± 10	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1900 ± 7	⁵ SHRESTHA	12A	DPWA Multichannel
1817.7	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$

⁵ Statistical error only.

N(1860) BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
376 ± 58	⁶ HUNT	19	DPWA Multichannel
270 $\begin{smallmatrix} +140 \\ -50 \end{smallmatrix}$	ANISOVICH	12A	DPWA Multichannel
95 ± 20	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
219 ± 23	⁶ SHRESTHA	12A	DPWA Multichannel
117.6	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$

⁶ Statistical error only.

N(1860) DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\pi$	4–20 %
Γ_2 $N\eta$	0–6 %
Γ_3 ΛK	<0.01 %
Γ_4 $N\pi\pi$	>61 %
Γ_5 $\Delta\pi$	20–54 %
Γ_6 $\Delta\pi, P\text{-wave}$	4–16 %
Γ_7 $\Delta\pi, F\text{-wave}$	16–38 %
Γ_8 $N\rho$	<8.6 %
Γ_9 $N\rho, S=3/2, P\text{-wave}$	<8.5 %
Γ_{10} $N\rho, S=3/2, F\text{-wave}$	<0.1 %
Γ_{11} $N\sigma$	41–61 %
Γ_{12} $p\gamma$	
Γ_{13} $p\gamma, \text{helicity}=1/2$	seen
Γ_{14} $p\gamma, \text{helicity}=3/2$	seen
Γ_{15} $n\gamma$	0.0017–0.062 %
Γ_{16} $n\gamma, \text{helicity}=1/2$	0.0003–0.019 %
Γ_{17} $n\gamma, \text{helicity}=3/2$	0.0014–0.043 %

N(1860) BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{\text{total}}$ Γ_1/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
4–20 % OUR ESTIMATE			
8.0±0.1	⁷ HUNT	19	DPWA Multichannel
20 ±6	ANISOVICH	12A	DPWA Multichannel
4 ±2	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
17 ±1	⁷ SHRESTHA	12A	DPWA Multichannel
12.7	ARNDT	06	DPWA $\pi N \rightarrow \pi N, \eta N$
⁷ Statistical error only.			

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0–6 % OUR ESTIMATE			
0.11±0.09	⁸ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
4 ±2	⁸ SHRESTHA	12A	DPWA Multichannel
⁸ Statistical error only.			

$\Gamma(\Lambda K)/\Gamma_{\text{total}}$ Γ_3/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<0.01 % OUR ESTIMATE			
<0.01	⁹ HUNT	19	DPWA Multichannel
⁹ Statistical error only.			

$\Gamma(\Delta\pi, P\text{-wave})/\Gamma_{\text{total}}$ Γ_6/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
4–16 % OUR ESTIMATE			
10±6	¹⁰ HUNT	19	DPWA Multichannel
¹⁰ Statistical error only.			

$\Gamma(\Delta\pi, F\text{-wave})/\Gamma_{\text{total}}$ Γ_7/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
16–38 % OUR ESTIMATE			
27±11	¹¹ HUNT	19	DPWA Multichannel
¹¹ Statistical error only.			

$\Gamma(N\rho, S=3/2, P\text{-wave})/\Gamma_{\text{total}}$ Γ_9/Γ

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<8.5 % OUR ESTIMATE			
<8.5	¹² HUNT	19	DPWA Multichannel
¹² Statistical error only.			

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<0.1 % OUR ESTIMATE			
<0.1	¹³ HUNT	19	DPWA Multichannel
¹³ Statistical error only.			

$\Gamma(N\sigma)/\Gamma_{\text{total}}$				Γ_{11}/Γ
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
41–61 % OUR ESTIMATE				
51 ± 10	¹⁴ HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
41 ± 6	¹⁴ SHRESTHA	12A	DPWA	Multichannel
¹⁴ Statistical error only.				

$N(1860)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES

$N(1860) \rightarrow \rho\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
-0.022 ± 0.020	¹⁵ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.017 ± 0.003	¹⁵ SHRESTHA	12A	DPWA Multichannel
¹⁵ Statistical error only.			

$N(1860) \rightarrow \rho\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE	DOCUMENT ID	TECN	COMMENT
-0.032 ± 0.034	¹⁶ HUNT	19	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.029 ± 0.004	¹⁶ SHRESTHA	12A	DPWA Multichannel
¹⁶ Statistical error only.			

$N(1860) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.021 ± 0.029	¹⁷ HUNT	19	DPWA Multichannel
0.021 ± 0.013	ANISOVICH	13B	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.010 ± 0.005	¹⁷ SHRESTHA	12A	DPWA Multichannel
¹⁷ Statistical error only.			

$N(1860) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.070 ± 0.035	¹⁸ HUNT	19	DPWA Multichannel
0.034 ± 0.017	ANISOVICH	13B	DPWA Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.009 ± 0.005	¹⁸ SHRESTHA	12A	DPWA Multichannel
¹⁸ Statistical error only.			

$N(1860)$ REFERENCES

HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
SVARC	14	PR C89 045205	A. Svarc <i>et al.</i>	(RBI Zagreb, UNI Tuzla)
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich <i>et al.</i>	
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT)