

$N(2060) 5/2^-$  $I(J^P) = \frac{1}{2}(\frac{5}{2}^-)$  Status: \*\*\*

Before our 2012 *Review*, this state appeared in our Listings as the  $N(2200)$ .

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### $N(2060)$ POLE POSITION

**REAL PART**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>2020 to 2130 (<math>\approx</math> 2070) OUR ESTIMATE</b>			
2030 $\pm$ 15	SOKHOYAN	15A	DPWA Multichannel
2119 $\pm$ 11 $\pm$ 1	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
2100 $\pm$ 60	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
2010	HUNT	19	DPWA Multichannel
2040 $\pm$ 15	ANISOVICH	12A	DPWA Multichannel
2144 $\pm$ 31	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

<sup>1</sup>Fit to the amplitudes of HOEHLER 79.

**–2×IMAGINARY PART**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>350 to 430 (<math>\approx</math> 400) OUR ESTIMATE</b>			
400 $\pm$ 35	SOKHOYAN	15A	DPWA Multichannel
370 $\pm$ 20 $\pm$ 5	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
360 $\pm$ 80	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
395	HUNT	19	DPWA Multichannel
390 $\pm$ 25	ANISOVICH	12A	DPWA Multichannel
438 $\pm$ 13	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

<sup>1</sup>Fit to the amplitudes of HOEHLER 79.

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### $N(2060)$ ELASTIC POLE RESIDUE

**MODULUS  $|r|$** 

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>15 to 30 (<math>\approx</math> 20) OUR ESTIMATE</b>			
25 $\pm$ 8	SOKHOYAN	15A	DPWA Multichannel
19 $\pm$ 1 $\pm$ 1	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
20 $\pm$ 10	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
19 $\pm$ 5	ANISOVICH	12A	DPWA Multichannel
26	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$

<sup>1</sup>Fit to the amplitudes of HOEHLER 79.

**PHASE  $\theta$** 

VALUE ( $^\circ$ )	DOCUMENT ID	TECN	COMMENT
<b>–130 to –90 (<math>\approx</math> –110) OUR ESTIMATE</b>			
–130 $\pm$ 20	SOKHOYAN	15A	DPWA Multichannel
–94 $\pm$ 5 $\pm$ 1	<sup>1</sup> SVARC	14	L+P $\pi N \rightarrow \pi N$
–90 $\pm$ 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

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

–  $125 \pm 20$  ANISOVICH 12A DPWA Multichannel  
 – 71 BATINIC 10 DPWA  $\pi N \rightarrow N\pi, N\eta$

<sup>1</sup> Fit to the amplitudes of HOEHLER 79.

## **$N(2060)$ INELASTIC POLE RESIDUE**

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

### **Normalized residue in $N\pi \rightarrow N(2060) \rightarrow N\eta$**

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.05 ± 0.03	40 ± 25	ANISOVICH	12A DPWA	Multichannel

### **Normalized residue in $N\pi \rightarrow N(2060) \rightarrow \Lambda K$**

<u>MODULUS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.01 ± 0.005	ANISOVICH	12A DPWA	Multichannel

### **Normalized residue in $N\pi \rightarrow N(2060) \rightarrow \Sigma K$**

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.04 ± 0.02	– 70 ± 30	ANISOVICH	12A DPWA	Multichannel

### **Normalized residue in $N\pi \rightarrow N(2060) \rightarrow \Delta(1232)\pi, D\text{-wave}$**

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.06 ± 0.03	– 90 ± 40	SOKHOYAN	15A DPWA	Multichannel

### **Normalized residue in $N\pi \rightarrow N(2060) \rightarrow N\sigma$**

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

### **Normalized residue in $N\pi \rightarrow N(2060) \rightarrow N(1440)\pi$**

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

### **Normalized residue in $N\pi \rightarrow N(2060) \rightarrow N(1520)\pi, P\text{-wave}$**

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.14 ± 0.06	– 45 ± 15	SOKHOYAN	15A DPWA	Multichannel

## **$N(2060)$ BREIT-WIGNER MASS**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>2030 to 2200 (<math>\approx</math> 2100) OUR ESTIMATE</b>			
2111 ± 17	<sup>1</sup> HUNT	19 DPWA	Multichannel
2045 ± 15	SOKHOYAN	15A DPWA	Multichannel
2180 ± 80	CUTKOSKY	80 IPWA	$\pi N \rightarrow \pi N$
2228 ± 30	HOEHLER	79 IPWA	$\pi N \rightarrow \pi N$

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

2060 ± 15	ANISOVICH	12A DPWA	Multichannel
2116 ± 21	<sup>1</sup> SHRESTHA	12A DPWA	Multichannel
2217 ± 27	BATINIC	10 DPWA	$\pi N \rightarrow N\pi, N\eta$

<sup>1</sup> Statistical error only.

**$N(2060)$  BREIT-WIGNER WIDTH**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>300 to 450 (<math>\approx 400</math>) OUR ESTIMATE</b>			
$499 \pm 70$	<sup>1</sup> HUNT	19	DPWA Multichannel
$420 \pm 30$	SOKHOYAN	15A	DPWA Multichannel
$400 \pm 100$	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
$310 \pm 50$	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$375 \pm 25$	ANISOVICH	12A	DPWA Multichannel
$307 \pm 112$	<sup>1</sup> SHRESTHA	12A	DPWA Multichannel
$481 \pm 17$	BATINIC	10	DPWA $\pi N \rightarrow N\pi, N\eta$
<sup>1</sup> Statistical error only.			

 **$N(2060)$  DECAY MODES**

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\pi$	7–12 %
$\Gamma_2$ $N\eta$	2–38 %
$\Gamma_3$ $N\omega$	1–7 %
$\Gamma_4$ $\Lambda K$	10–20 %
$\Gamma_5$ $\Sigma K$	1–5 %
$\Gamma_6$ $N\pi\pi$	12–52 %
$\Gamma_7$ $\Delta(1232)\pi$ , $D$ -wave	4–10 %
$\Gamma_8$ $N\rho$	5–33 %
$\Gamma_9$ $N\rho$ , $S=1/2$ , $P$ -wave	<10 %
$\Gamma_{10}$ $N\rho$ , $S=3/2$ , $D$ -wave	5–23 %
$\Gamma_{11}$ $N\sigma$	3–9 %
$\Gamma_{12}$ $N(1440)\pi$	4–14 %
$\Gamma_{13}$ $N(1520)\pi$ , $P$ -wave	9–21 %
$\Gamma_{14}$ $N(1680)\pi$ , $S$ -wave	8–22 %
$\Gamma_{15}$ $\Lambda K^*(892)$	0.3–1.3 %
$\Gamma_{16}$ $p\gamma$	0.03–0.19 %
$\Gamma_{17}$ $p\gamma$ , helicity=1/2	0.02–0.08 %
$\Gamma_{18}$ $p\gamma$ , helicity=3/2	0.01–0.10 %
$\Gamma_{19}$ $n\gamma$	0.003–0.07 %
$\Gamma_{20}$ $n\gamma$ , helicity=1/2	0.001–0.02 %
$\Gamma_{21}$ $n\gamma$ , helicity=3/2	0.002–0.05 %

 **$N(2060)$  BRANCHING RATIOS**

$\Gamma(N\pi)/\Gamma_{\text{total}}$				$\Gamma_1/\Gamma$
VALUE (%)	DOCUMENT ID	TECN	COMMENT	
<b>7 to 12 (<math>\approx 10</math>) OUR ESTIMATE</b>				
$5.3 \pm 1.4$	<sup>1</sup> HUNT	19	DPWA Multichannel	
$11 \pm 2$	SOKHOYAN	15A	DPWA Multichannel	

10 ± 3	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
7 ± 2	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8 ± 2	ANISOVICH	12A	DPWA	Multichannel
9 ± 2	<sup>1</sup> SHRESTHA	12A	DPWA	Multichannel
13 ± 4	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$

<sup>1</sup>Statistical error only.

**$\Gamma(N\eta)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$**

VALUE (%) DOCUMENT ID TECN COMMENT

**2–38 % OUR ESTIMATE**

6 ± 2	MUELLER	20	DPWA	Multichannel
30 ± 8	<sup>1</sup> HUNT	19	DPWA	Multichannel
4 ± 2	ANISOVICH	12A	DPWA	Multichannel

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

< 1	<sup>1</sup> SHRESTHA	12A	DPWA	Multichannel
0.2 ± 1.0	BATINIC	10	DPWA	$\pi N \rightarrow N\pi, N\eta$

<sup>1</sup>Statistical error only.

**$\Gamma(N\omega)/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma$**

VALUE (%) DOCUMENT ID TECN COMMENT

4 ± 3	DENISENKO	16	DPWA	Multichannel
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**$\Gamma(\Lambda K)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma$**

VALUE (%) DOCUMENT ID TECN COMMENT

**10–20 % OUR ESTIMATE**

15 ± 5	<sup>1</sup> HUNT	19	DPWA	Multichannel
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<sup>1</sup>Statistical error only.

**$\Gamma(\Sigma K)/\Gamma_{\text{total}}$   $\Gamma_5/\Gamma$**

VALUE (%) DOCUMENT ID TECN COMMENT

3 ± 2	ANISOVICH	12A	DPWA	Multichannel
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**$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}}$   $\Gamma_7/\Gamma$**

VALUE (%) DOCUMENT ID TECN COMMENT

**4–10 % OUR ESTIMATE**

15 ± 6	<sup>1</sup> HUNT	19	DPWA	Multichannel
7 ± 3	SOKHOYAN	15A	DPWA	Multichannel

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

40 ± 13	<sup>1</sup> SHRESTHA	12A	DPWA	Multichannel
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<sup>1</sup>Statistical error only.

**$\Gamma(N\rho, S=1/2, P\text{-wave})/\Gamma_{\text{total}}$   $\Gamma_9/\Gamma$**

VALUE (%) DOCUMENT ID TECN COMMENT

**<10 % OUR ESTIMATE**

<10	<sup>1</sup> HUNT	19	DPWA	Multichannel
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• • • We do not use the following data for averages, fits, limits, etc. • • •

21 ± 15	<sup>1</sup> SHRESTHA	12A	DPWA	Multichannel
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<sup>1</sup>Statistical error only.

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

VALUE (%)	DOCUMENT ID	TECN	COMMENT
<b>5–23 % OUR ESTIMATE</b>			
14 ± 9	<sup>1</sup> HUNT	19	DPWA Multichannel

<sup>1</sup>Statistical error only. $\Gamma(N\sigma)/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$ 

VALUE (%)	DOCUMENT ID	TECN	COMMENT
6 ± 3	SOKHOYAN	15A	DPWA Multichannel

 $\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$   $\Gamma_{12}/\Gamma$ 

VALUE (%)	DOCUMENT ID	TECN	COMMENT
9 ± 5	SOKHOYAN	15A	DPWA Multichannel

 $\Gamma(N(1520)\pi, P\text{-wave})/\Gamma_{\text{total}}$   $\Gamma_{13}/\Gamma$ 

VALUE (%)	DOCUMENT ID	TECN	COMMENT
15 ± 6	SOKHOYAN	15A	DPWA Multichannel

 $\Gamma(N(1680)\pi, S\text{-wave})/\Gamma_{\text{total}}$   $\Gamma_{14}/\Gamma$ 

VALUE (%)	DOCUMENT ID	TECN	COMMENT
15 ± 7	SOKHOYAN	15A	DPWA Multichannel

 $\Gamma(\Lambda K^*(892))/\Gamma_{\text{total}}$   $\Gamma_{15}/\Gamma$ 

VALUE (%)	DOCUMENT ID	TECN	COMMENT
<b>0.3–1.3 % OUR ESTIMATE</b>			
0.8 ± 0.5	ANISOVICH	17B	DPWA Multichannel

 **$N(2060)$  PHOTON DECAY AMPLITUDES AT THE POLE** **$N(2060) \rightarrow p\gamma$ , helicity-1/2 amplitude  $A_{1/2}$** 

MODULUS ( $\text{GeV}^{-1/2}$ )	PHASE ( $^\circ$ )	DOCUMENT ID	TECN	COMMENT
0.064 ± 0.010	12 ± 8	SOKHOYAN	15A	DPWA Multichannel

 **$N(2060) \rightarrow p\gamma$ , helicity-3/2 amplitude  $A_{3/2}$** 

MODULUS ( $\text{GeV}^{-1/2}$ )	PHASE ( $^\circ$ )	DOCUMENT ID	TECN	COMMENT
0.060 ± 0.020	13 ± 10	SOKHOYAN	15A	DPWA Multichannel

 **$N(2060)$  BREIT-WIGNER PHOTON DECAY AMPLITUDES** **$N(2060) \rightarrow p\gamma$ , helicity-1/2 amplitude  $A_{1/2}$** 

VALUE ( $\text{GeV}^{-1/2}$ )	DOCUMENT ID	TECN	COMMENT
−0.019 ± 0.005	<sup>1</sup> HUNT	19	DPWA Multichannel
0.062 ± 0.010	SOKHOYAN	15A	DPWA Multichannel

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

0.018 ± 0.004	<sup>1</sup> SHRESTHA	12A	DPWA Multichannel
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<sup>1</sup>Statistical error only.

**$N(2060) \rightarrow p\gamma$ , helicity-3/2 amplitude  $A_{3/2}$** 

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.039±0.005	<sup>1</sup> HUNT	19	DPWA Multichannel
0.062±0.020	SOKHOYAN	15A	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.010±0.004	<sup>1</sup> SHRESTHA	12A	DPWA Multichannel

<sup>1</sup>Statistical error only. **$N(2060) \rightarrow n\gamma$ , helicity-1/2 amplitude  $A_{1/2}$** 

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.069±0.017	<sup>1</sup> HUNT	19	DPWA Multichannel
0.025±0.011	ANISOVICH	13B	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
-0.012±0.017	<sup>1</sup> SHRESTHA	12A	DPWA Multichannel

<sup>1</sup>Statistical error only. **$N(2060) \rightarrow n\gamma$ , helicity-3/2 amplitude  $A_{3/2}$** 

<u>VALUE (GeV<sup>-1/2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.023±0.020	<sup>1</sup> HUNT	19	DPWA Multichannel
-0.037±0.017	ANISOVICH	13B	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
-0.023±0.023	<sup>1</sup> SHRESTHA	12A	DPWA Multichannel

<sup>1</sup>Statistical error only. **$N(2060)$  REFERENCES**

MUELLER	20	PL B803 135323	J. Mueller <i>et al.</i>	(CBELSA/TAPS Collab.)
HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley	
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.)
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)
BATINIC	10	PR C82 038203	M. Batinic <i>et al.</i>	(ZAGR)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky <i>et al.</i>	(CMU, LBL)
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP