

$$N(2000) \ 5/2^+$$

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

OMITTED FROM SUMMARY TABLE  
was  $N(1900)$

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  $\theta$**

| <u>VALUE (°)</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**

| <i>MODULUS</i> | <i>PHASE (°)</i> | <i>DOCUMENT ID</i> | <i>TECN</i> | <i>COMMENT</i>    |
|----------------|------------------|--------------------|-------------|-------------------|
| 0.16±0.06      | 100 ± 50         | SOKHOYAN           | 15A         | DPWA Multichannel |

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

| <i>MODULUS</i> | <i>PHASE (°)</i> | <i>DOCUMENT ID</i> | <i>TECN</i> | <i>COMMENT</i>    |
|----------------|------------------|--------------------|-------------|-------------------|
| 0.20±0.10      | − 20 ± 45        | SOKHOYAN           | 15A         | DPWA Multichannel |

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

| <i>MODULUS</i> | <i>PHASE (°)</i> | <i>DOCUMENT ID</i> | <i>TECN</i> | <i>COMMENT</i>    |
|----------------|------------------|--------------------|-------------|-------------------|
| 0.12±0.06      | 80 ± 40          | SOKHOYAN           | 15A         | DPWA Multichannel |

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

| <i>MODULUS</i> | <i>PHASE (°)</i> | <i>DOCUMENT ID</i> | <i>TECN</i> | <i>COMMENT</i>    |
|----------------|------------------|--------------------|-------------|-------------------|
| 0.17±0.09      | − 60 ± 35        | SOKHOYAN           | 15A         | DPWA Multichannel |

***N*(2000) BREIT-WIGNER MASS**

| <i>VALUE (MeV)</i> | <i>DOCUMENT ID</i>   | <i>TECN</i> | <i>COMMENT</i>    |
|--------------------|----------------------|-------------|-------------------|
| 2060± 30           | SOKHOYAN             | 15A         | DPWA Multichannel |
| 1946± 4            | <sup>1</sup> SHKLYAR | 13          | DPWA Multichannel |

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

|          |           |     |                   |
|----------|-----------|-----|-------------------|
| 2090±120 | ANISOVICH | 12A | DPWA Multichannel |
|----------|-----------|-----|-------------------|

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

***N*(2000) BREIT-WIGNER WIDTH**

| <i>VALUE (MeV)</i> | <i>DOCUMENT ID</i>   | <i>TECN</i> | <i>COMMENT</i>    |
|--------------------|----------------------|-------------|-------------------|
| 390± 55            | SOKHOYAN             | 15A         | DPWA Multichannel |
| 198± 2             | <sup>2</sup> SHKLYAR | 13          | DPWA Multichannel |

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

|         |           |     |                   |
|---------|-----------|-----|-------------------|
| 460±100 | ANISOVICH | 12A | DPWA Multichannel |
|---------|-----------|-----|-------------------|

<sup>2</sup>Statistical error only.

***N*(2000) DECAY MODES**

|            | Mode                               | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------|------------------------------------|--------------------------------|
| $\Gamma_1$ | $N\pi$                             | 6–10 %                         |
| $\Gamma_2$ | $N\eta$                            | <4 %                           |
| $\Gamma_3$ | $N\omega$                          | <2 %                           |
| $\Gamma_4$ | $N\pi\pi$                          | 35–90 %                        |
| $\Gamma_5$ | $\Delta(1232)\pi$                  | 30–80 %                        |
| $\Gamma_6$ | $\Delta(1232)\pi$ , <i>P</i> -wave | 12–32 %                        |
| $\Gamma_7$ | $\Delta(1232)\pi$ , <i>F</i> -wave | 19–49 %                        |

|               |                          |               |
|---------------|--------------------------|---------------|
| $\Gamma_8$    | $N\sigma$                | 5–15 %        |
| $\Gamma_9$    | $N(1520)\pi$ , $D$ -wave | 11–31 %       |
| $\Gamma_{10}$ | $N(1680)\pi$ , $P$ -wave | 17–25 %       |
| $\Gamma_{11}$ | $\Lambda K^*(892)$       | 1–3 %         |
| $\Gamma_{12}$ | $p\gamma$                | 0.01–0.08 %   |
| $\Gamma_{13}$ | $p\gamma$ , helicity=1/2 | 0.003–0.031 % |
| $\Gamma_{14}$ | $p\gamma$ , helicity=3/2 | 0.008–0.048 % |
| $\Gamma_{15}$ | $n\gamma$                | 0.002–0.07 %  |
| $\Gamma_{16}$ | $n\gamma$ , helicity=1/2 | <0.017 %      |
| $\Gamma_{17}$ | $n\gamma$ , helicity=3/2 | 0.001–0.056 % |

## $N(2000)$ BRANCHING RATIOS

### $\Gamma(N\pi)/\Gamma_{\text{total}}$ $\Gamma_1/\Gamma$

| VALUE (%)                                                                     | DOCUMENT ID          | TECN | COMMENT           |
|-------------------------------------------------------------------------------|----------------------|------|-------------------|
| <b>6 to 10 (<math>\approx 8</math>) OUR ESTIMATE</b>                          |                      |      |                   |
| $8 \pm 4$                                                                     | SOKHOYAN             | 15A  | DPWA Multichannel |
| $10 \pm 1$                                                                    | <sup>3</sup> SHKLYAR | 13   | DPWA Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |      |                   |
| $9 \pm 4$                                                                     | ANISOVICH            | 12A  | DPWA Multichannel |
| <sup>3</sup> Statistical error only.                                          |                      |      |                   |

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

| VALUE (%)                            | DOCUMENT ID          | TECN | COMMENT           |
|--------------------------------------|----------------------|------|-------------------|
| $2 \pm 2$                            | MUELLER              | 20   | DPWA Multichannel |
| $2 \pm 2$                            | <sup>4</sup> SHKLYAR | 13   | DPWA Multichannel |
| <sup>4</sup> Statistical error only. |                      |      |                   |

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

| VALUE (%)                            | DOCUMENT ID          | TECN | COMMENT           |
|--------------------------------------|----------------------|------|-------------------|
| $18 \pm 8$                           | DENISENKO            | 16   | DPWA Multichannel |
| $1 \pm 1$                            | <sup>5</sup> SHKLYAR | 13   | DPWA Multichannel |
| <sup>5</sup> Statistical error only. |                      |      |                   |

### $\Gamma(\Delta(1232)\pi, P\text{-wave})/\Gamma_{\text{total}}$ $\Gamma_6/\Gamma$

| VALUE (%)   | DOCUMENT ID | TECN | COMMENT           |
|-------------|-------------|------|-------------------|
| $22 \pm 10$ | SOKHOYAN    | 15A  | DPWA Multichannel |

### $\Gamma(\Delta(1232)\pi, F\text{-wave})/\Gamma_{\text{total}}$ $\Gamma_7/\Gamma$

| VALUE (%)   | DOCUMENT ID | TECN | COMMENT           |
|-------------|-------------|------|-------------------|
| $34 \pm 15$ | SOKHOYAN    | 15A  | DPWA Multichannel |

### $\Gamma(N\sigma)/\Gamma_{\text{total}}$ $\Gamma_8/\Gamma$

| VALUE (%)  | DOCUMENT ID | TECN | COMMENT           |
|------------|-------------|------|-------------------|
| $10 \pm 5$ | SOKHOYAN    | 15A  | DPWA Multichannel |

### $\Gamma(N(1520)\pi, D\text{-wave})/\Gamma_{\text{total}}$ $\Gamma_9/\Gamma$

| VALUE (%)   | DOCUMENT ID | TECN | COMMENT           |
|-------------|-------------|------|-------------------|
| $21 \pm 10$ | SOKHOYAN    | 15A  | DPWA Multichannel |

$\Gamma(N(1680)\pi, P\text{-wave})/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (%)  | DOCUMENT ID | TECN | COMMENT           |
|------------|-------------|------|-------------------|
| $16 \pm 9$ | SOKHOYAN    | 15A  | DPWA Multichannel |

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

| VALUE (%)                   | DOCUMENT ID | TECN | COMMENT           |
|-----------------------------|-------------|------|-------------------|
| <b>1-3 % OUR EVALUATION</b> |             |      |                   |
| $2.2 \pm 1.0$               | 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           |
|---------------------------------|--------------------|-------------|------|-------------------|
| $0.033 \pm 0.010$               | $15 \pm 25$        | 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           |
|---------------------------------|--------------------|-------------|------|-------------------|
| $0.045 \pm 0.008$               | $-140 \pm 25$      | SOKHOYAN    | 15A  | DPWA Multichannel |

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

| MODULUS ( $\text{GeV}^{-1/2}$ ) | PHASE ( $^\circ$ ) | DOCUMENT ID | TECN | COMMENT           |
|---------------------------------|--------------------|-------------|------|-------------------|
| $0.019 \pm 0.010$               | $-80 \pm 40$       | ANISOVICH   | 17E  | DPWA Multichannel |

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

| MODULUS ( $\text{GeV}^{-1/2}$ ) | PHASE ( $^\circ$ ) | DOCUMENT ID | TECN | COMMENT           |
|---------------------------------|--------------------|-------------|------|-------------------|
| $0.011 \pm 0.005$               | $82 \pm 30$        | ANISOVICH   | 17E  | 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           |
|-------------------------------|----------------------|------|-------------------|
| $0.031 \pm 0.010$             | SOKHOYAN             | 15A  | DPWA Multichannel |
| $0.011 \pm 0.001$             | <sup>6</sup> SHKLYAR | 13   | DPWA Multichannel |

<sup>6</sup> Statistical error only. **$N(2000) \rightarrow p\gamma$ , helicity-3/2 amplitude  $A_{3/2}$** 

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

<sup>7</sup> Statistical error only. **$N(2000) \rightarrow n\gamma$ , helicity-1/2 amplitude  $A_{1/2}$** 

| VALUE ( $\text{GeV}^{-1/2}$ ) | DOCUMENT ID | TECN | COMMENT           |
|-------------------------------|-------------|------|-------------------|
| $-0.018 \pm 0.012$            | 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           |
|-------------------------------|-------------|------|-------------------|
| $-0.035 \pm 0.020$            | 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>    |                       |
| ANISOVICH | 17E | PR C96 055202  | A.V. Anisovich <i>et al.</i>    | (BONN, PNPI, JLAB+)   |
| 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)          |

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