# $N(1895)\ 1/2^-$

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

Before our 2012 *Review*, this state appeared in our Listings as the $N(2090)$. Any structure in the $S_{11}$ wave above 1800 MeV is listed here. A few early results that are now obsolete have been omitted.

## *N*(1895) POLE POSITION

### REAL PART

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **1890 to 1930 (≈ 1910) OUR ESTIMATE** | | | | |
| 1895±15 | ANISOVICH | 17A | DPWA | Multichannel |
| 1906±17 | [1] ANISOVICH | 17A | L+P | $\gamma p,\ \pi^- p \rightarrow\ K\Lambda$ |
| 1917±19±1 | [2] SVARC | 14 | L+P | $\pi N \rightarrow\ \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1907±10 | ANISOVICH | 17C | DPWA | Multichannel |
| 1907±10 | SOKHOYAN | 15A | DPWA | Multichannel |
| 1900±15 | ANISOVICH | 12A | DPWA | Multichannel |
| 1858 | SHRESTHA | 12A | DPWA | Multichannel |
| 1797±26 | BATINIC | 10 | DPWA | $\pi N \rightarrow\ N\pi,\ N\eta$ |
| 1795 | VRANA | 00 | DPWA | Multichannel |
| 2150±70 | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow\ \pi N$ |

[1] Statistical error only.
[2] Fit to the amplitudes of HOEHLER 79.

### −2×IMAGINARY PART

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **80 to 140 (≈ 110) OUR ESTIMATE** | | | | |
| 132± 30 | ANISOVICH | 17A | DPWA | Multichannel |
| 100± 10 | [1] ANISOVICH | 17A | L+P | $\gamma p,\ \pi^- p \rightarrow\ K\Lambda$ |
| 101± 36±1 | [1,2] SVARC | 14 | L+P | $\pi N \rightarrow\ \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $100^{+\ 40}_{-\ 10}$ | ANISOVICH | 17C | DPWA | Multichannel |
| $100^{+\ 40}_{-\ 15}$ | SOKHOYAN | 15A | DPWA | Multichannel |
| $90^{+\ 30}_{-\ 15}$ | ANISOVICH | 12A | DPWA | Multichannel |
| 479 | SHRESTHA | 12A | DPWA | Multichannel |
| 420± 45 | BATINIC | 10 | DPWA | $\pi N \rightarrow\ N\pi,\ N\eta$ |
| 220 | VRANA | 00 | DPWA | Multichannel |
| 350±100 | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow\ \pi N$ |

[1] Statistical error only.
[2] Fit to the amplitudes of HOEHLER 79.

## *N*(1895) ELASTIC POLE RESIDUE

### MODULUS $|r|$

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **1 to 5 (≈ 3) OUR ESTIMATE** | | | | |
| 3 ± 2 | SOKHOYAN | 15A | DPWA | Multichannel |
| 3.1± 1.4 | [1] SVARC | 14 | L+P | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1 ± 1 | ANISOVICH | 12A | DPWA | Multichannel |
| 60 | BATINIC | 10 | DPWA | $\pi N \to N\pi, N\eta$ |
| 40 ±20 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |

[1] Fit to the amplitudes of HOEHLER 79.

### PHASE $\theta$

| *VALUE* (°) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 125±45 | SOKHOYAN | 15A | DPWA | Multichannel |
| −107±23±2 | [1] SVARC | 14 | L+P | $\pi N \to \pi N$ |
| 0±90 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −164 | BATINIC | 10 | DPWA | $\pi N \to N\pi, N\eta$ |

[1] Fit to the amplitudes of HOEHLER 79.

## *N*(1895) INELASTIC POLE RESIDUE

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

### Normalized residue in $N\pi \to N(1895) \to \Lambda K$

| *MODULUS* | *PHASE* (°) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| 0.09±0.03 | 8 ± 30 | ANISOVICH | 17A | DPWA | Multichannel |
| 0.06±0.02 | 87 ± 27 | [1] ANISOVICH | 17A | L+P | $\gamma p, \pi^- p \to K\Lambda$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.05±0.02 | −90 ± 30 | ANISOVICH | 12A | DPWA | Multichannel |

[1] Statistical error only.

### Normalized residue in $N\pi \to N(1895) \to \Sigma K$

| *MODULUS* | *PHASE* (°) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| 0.06±0.02 | 40 ± 30 | ANISOVICH | 12A | DPWA | Multichannel |

### Normalized residue in $N\pi \to N(1895) \to \Delta(1232)\pi$

| *MODULUS* | *PHASE* (°) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| 0.05±0.025 | −100 ± 45 | SOKHOYAN | 15A | DPWA | Multichannel |

### Normalized residue in $N\pi \rightarrow N(1895) \rightarrow N(1440)\pi$

| *MODULUS* | *PHASE (°)* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| $0.05 \pm 0.025$ | $-100 \pm 45$ | SOKHOYAN | 15A | DPWA | Multichannel |

## $N(1895)$ BREIT-WIGNER MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **1870 to 1920 (≈ 1895) OUR ESTIMATE** | | | | |
| $1890^{+9}_{-23}$ | KASHEVAROV | 17 | DPWA | $\gamma p \rightarrow \eta p, \eta' p$ |
| $1905 \pm 12$ | SOKHOYAN | 15A | DPWA | Multichannel |
| $1910 \pm 15$ | [1] SHRESTHA | 12A | DPWA | Multichannel |
| $1880 \pm 20$ | HOEHLER | 79 | IPWA | $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $1895 \pm 15$ | ANISOVICH | 12A | DPWA | Multichannel |
| $1812 \pm 25$ | BATINIC | 10 | DPWA | $\pi N \rightarrow N\pi, N\eta$ |
| $1822 \pm 43$ | VRANA | 00 | DPWA | Multichannel |
| $2180 \pm 80$ | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |

[1] Statistical error only.

## $N(1895)$ BREIT-WIGNER WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **80 to 200 (≈ 120) OUR ESTIMATE** | | | | |
| $150 \pm 57$ | KASHEVAROV | 17 | DPWA | $\gamma p \rightarrow \eta p, \eta' p$ |
| $100^{+30}_{-10}$ | SOKHOYAN | 15A | DPWA | Multichannel |
| $502 \pm 47$ | [1] SHRESTHA | 12A | DPWA | Multichannel |
| $95 \pm 30$ | HOEHLER | 79 | IPWA | $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $90^{+30}_{-15}$ | ANISOVICH | 12A | DPWA | Multichannel |
| $405 \pm 40$ | BATINIC | 10 | DPWA | $\pi N \rightarrow N\pi, N\eta$ |
| $248 \pm 185$ | VRANA | 00 | DPWA | Multichannel |
| $350 \pm 100$ | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |

[1] Statistical error only.

## $N(1895)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\pi$ | 2–18 % |
| $\Gamma_2$ | $N\eta$ | 15–40 % |
| $\Gamma_3$ | $N\eta'$ | 10–40 % |
| $\Gamma_4$ | $N\omega$ | 16–40 % |
| $\Gamma_5$ | $\Lambda K$ | 13–23 % |
| $\Gamma_6$ | $\Sigma K$ | 6–20 % |
| $\Gamma_7$ | $N\pi\pi$ | |
| $\Gamma_8$ | $\Delta(1232)\pi$ | |

| | | |
|---|---|---|
| $\Gamma_9$ | $\Delta(1232)\pi$, $D$-wave | 3–11 % |
| $\Gamma_{10}$ | $N\rho$ | |
| $\Gamma_{11}$ | $N\rho$, $S$=1/2, $S$-wave | seen |
| $\Gamma_{12}$ | $N\rho$, $S$=3/2, $D$-wave | 3–12 % |
| $\Gamma_{13}$ | $\Lambda K^*(892)$ | 4–9 % |
| $\Gamma_{14}$ | $N\sigma$ | seen |
| $\Gamma_{15}$ | $N(1440)\pi$ | 1–4 % |
| $\Gamma_{16}$ | $p\gamma$, helicity=1/2 | 0.01–0.06 % |
| $\Gamma_{17}$ | $n\gamma$, helicity=1/2 | 0.003–0.05 % |

## $N(1895)$ BRANCHING RATIOS

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

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **2 to 18 (≈ 10) OUR ESTIMATE** | | | | |
| 2.5±1.5 | SOKHOYAN | 15A | DPWA | Multichannel |
| 17 ±2 | [1] SHRESTHA | 12A | DPWA | Multichannel |
| 9 ±5 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2 ±1 | ANISOVICH | 12A | DPWA | Multichannel |
| 32 ±6 | BATINIC | 10 | DPWA | $\pi N \to N\pi, N\eta$ |
| 17 ±3 | VRANA | 00 | DPWA | Multichannel |
| 18 ±8 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |

[1] Statistical error only.

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

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **15 to 40 (≈ 25) OUR ESTIMATE** | | | | |
| 10± 5 | ANISOVICH | 17C | DPWA | Multichannel |
| 20± 6 | [1] KASHEVAROV | 17 | DPWA | $\gamma p \to \eta p, \eta' p$ |
| 40± 4 | [2] SHRESTHA | 12A | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 21± 6 | ANISOVICH | 12A | DPWA | Multichannel |
| 22±10 | BATINIC | 10 | DPWA | $\pi N \to N\pi, N\eta$ |
| 41± 4 | VRANA | 00 | DPWA | Multichannel |

[1] Assuming $A_{1/2} = -0.030$ GeV$^{-1/2}$.

[2] Statistical error only.

### $\Gamma(N\eta')/\Gamma_{total}$ $\Gamma_3/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.10 to 0.40 (≈ 0.20) OUR ESTIMATE** | | | | |
| 0.13±0.05 | ANISOVICH | 17C | DPWA | Multichannel |
| 0.38±0.20 | [1] KASHEVAROV | 17 | DPWA | $\gamma p \to \eta p, \eta' p$ |

[1] Assuming $A_{1/2} = -0.030$ GeV$^{-1/2}$.

### $\Gamma(N\omega)/\Gamma_{total}$ $\Gamma_4/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $28\pm12$ | DENISENKO | 16 | DPWA | Multichannel |

### $\Gamma(\Lambda K)/\Gamma_{total}$ $\Gamma_5/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 18 $\pm5$ | ANISOVICH | 12A | DPWA | Multichannel |
| $1.8\pm0.8$ | [1] SHRESTHA | 12A | DPWA | Multichannel |

[1] Statistical error only.

### $\Gamma(\Sigma K)/\Gamma_{total}$ $\Gamma_6/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $13\pm7$ | ANISOVICH | 12A | DPWA | Multichannel |

### $\Gamma(\Delta(1232)\pi$, $D$-wave$)/\Gamma_{total}$ $\Gamma_9/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $7\pm4$ | SOKHOYAN | 15A | DPWA | Multichannel |
| $7\pm3$ | [1] SHRESTHA | 12A | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $1\pm1$ | VRANA | 00 | DPWA | Multichannel |

[1] Statistical error only.

### $\Gamma(N\rho$, $S$=1/2, $S$-wave$)/\Gamma_{total}$ $\Gamma_{11}/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $< 2$ | [1] SHRESTHA | 12A | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $36\pm1$ | VRANA | 00 | DPWA | Multichannel |

[1] Statistical error only.

### $\Gamma(N\rho$, $S$=3/2, $D$-wave$)/\Gamma_{total}$ $\Gamma_{12}/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $9\pm3$ | [1] SHRESTHA | 12A | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $1\pm1$ | VRANA | 00 | DPWA | Multichannel |

[1] Statistical error only.

### $\Gamma(\Lambda K^*(892))/\Gamma_{total}$ $\Gamma_{13}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $0.063\pm0.025$ | ANISOVICH | 17B | DPWA | Multichannel |

### $\Gamma(N\sigma)/\Gamma_{total}$ $\Gamma_{14}/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $<2$ | [1] SHRESTHA | 12A | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $2\pm1$ | VRANA | 00 | DPWA | Multichannel |

[1] Statistical error only.

### $\Gamma(N(1440)\pi)/\Gamma_{total}$ $\Gamma_{15}/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 2.5±1.5 | SOKHOYAN | 15A | DPWA | Multichannel |
| 24 ±4 | [1] SHRESTHA | 12A | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2 ±1 | VRANA | 00 | DPWA | Multichannel |

[1] Statistical error only.

## N(1895) PHOTON DECAY AMPLITUDES AT THE POLE

### N(1895) → pγ, helicity-1/2 amplitude $A_{1/2}$

| MODULUS ($GeV^{-1/2}$) | PHASE (°) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| −0.015±0.006 | −35 ± 35 | ANISOVICH | 17C | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.015±0.006 | 145 ± 35 | SOKHOYAN | 15A | DPWA | Multichannel |

## N(1895) BREIT-WIGNER PHOTON DECAY AMPLITUDES

### N(1895) → pγ, helicity-1/2 amplitude $A_{1/2}$

| VALUE ($GeV^{-1/2}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.016±0.006 | SOKHOYAN | 15A | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.012±0.006 | [1] SHRESTHA | 12A | DPWA | Multichannel |

[1] Statistical error only.

### N(1895) → nγ, helicity-1/2 amplitude $A_{1/2}$

| VALUE ($GeV^{-1/2}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.013±0.006 | ANISOVICH | 13B | DPWA | Multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.003±0.007 | [1] SHRESTHA | 12A | DPWA | Multichannel |

[1] Statistical error only.

## N(1895) REFERENCES


| | | | | |
|---|---|---|---|---|
| ANISOVICH | 17A | PRL 119 062004 | A.V. Anisovich *et al.* | |
| ANISOVICH | 17B | PL B771 142 | A.V. Anisovich *et al.* | |
| ANISOVICH | 17C | PL B772 247 | A.V. Anisovich *et al.* | |
| KASHEVAROV | 17 | PRL 118 212001 | V.L. Kashevarov *et al.* | (A2/MAMI Collab.) |
| 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.* | (RBI Zagreb, UNI Tuzla) |
| ANISOVICH | 13B | EPJ A49 67 | A.V. Anisovich *et al.* | |
| 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) |
| 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) |
| HOEHLER | 79 | PDAT 12-1 | G. Hohler *et al.* | (KARLT) IJP |
| Also | | Toronto Conf. 3 | R. Koch | (KARLT) IJP |