

$$\Delta(1910) \ 1/2^+$$

$$I(J^P) = \frac{3}{2}(\frac{1}{2}^+) \text{ Status: } ****$$

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014).

$\Delta(1910)$ POLE POSITION

REAL PART

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|---|--------------------|------|--|
| 1830 to 1890 (\approx 1860) OUR ESTIMATE | | | |
| 1840 \pm 40 | SOKHOYAN | 15A | DPWA Multichannel |
| 1896 \pm 11 | ¹ SVARC | 14 | L+P $\pi N \rightarrow \pi N$ |
| 1880 \pm 30 | CUTKOSKY | 80 | IPWA $\pi N \rightarrow \pi N$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| 1801 | HUNT | 19 | DPWA Multichannel |
| 1799 | ROENCHEN | 15A | DPWA Multichannel |
| 1840 \pm 40 | GUTZ | 14 | DPWA Multichannel |
| 1850 \pm 40 | ANISOVICH | 12A | DPWA Multichannel |
| 1771 | ARNDT | 06 | DPWA $\pi N \rightarrow \pi N, \eta N$ |
| 1880 | VRANA | 00 | DPWA Multichannel |
| 1874 | HOEHLER | 93 | SPED $\pi N \rightarrow \pi N$ |

¹Fit to the amplitudes of HOEHLER 79.

–2×IMAGINARY PART

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|---|--------------------|------|--|
| 200 to 400 (\approx 300) OUR ESTIMATE | | | |
| 370 \pm 60 | SOKHOYAN | 15A | DPWA Multichannel |
| 302 \pm 22 | ¹ SVARC | 14 | L+P $\pi N \rightarrow \pi N$ |
| 200 \pm 40 | CUTKOSKY | 80 | IPWA $\pi N \rightarrow \pi N$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| 224 | HUNT | 19 | DPWA Multichannel |
| 648 | ROENCHEN | 15A | DPWA Multichannel |
| 370 \pm 60 | GUTZ | 14 | DPWA Multichannel |
| 350 \pm 45 | ANISOVICH | 12A | DPWA Multichannel |
| 479 | ARNDT | 06 | DPWA $\pi N \rightarrow \pi N, \eta N$ |
| 496 | VRANA | 00 | DPWA Multichannel |
| 283 | HOEHLER | 93 | SPED $\pi N \rightarrow \pi N$ |

¹Fit to the amplitudes of HOEHLER 79.

$\Delta(1910)$ ELASTIC POLE RESIDUE

MODULUS $|r|$

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|--|--------------------|------|--------------------------------|
| 20 to 30 (\approx 25) OUR ESTIMATE | | | |
| 25 \pm 6 | SOKHOYAN | 15A | DPWA Multichannel |
| 29 \pm 2 | ¹ SVARC | 14 | L+P $\pi N \rightarrow \pi N$ |
| 20 \pm 4 | CUTKOSKY | 80 | IPWA $\pi N \rightarrow \pi N$ |

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

| | | | | |
|--------|-----------|-----|------|-----------------------------------|
| 90 | ROENCHEN | 15A | DPWA | Multichannel |
| 25 ± 6 | GUTZ | 14 | DPWA | Multichannel |
| 24 ± 6 | ANISOVICH | 12A | DPWA | Multichannel |
| 45 | ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| 38 | HOEHLER | 93 | SPED | $\pi N \rightarrow \pi N$ |

¹ Fit to the amplitudes of HOEHLER 79.

PHASE θ

| <u>VALUE (°)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--|--------------------|-------------|--------------------------------|
| −180 to −80 (≈ −130) OUR ESTIMATE | | | |
| −155 ± 30 | SOKHOYAN | 15A | DPWA Multichannel |
| −83 ± 4 ± 1 | ¹ SVARC | 14 | L+P $\pi N \rightarrow \pi N$ |
| −90 ± 30 | CUTKOSKY | 80 | IPWA $\pi N \rightarrow \pi N$ |

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

| | | | | |
|-----------|-----------|-----|------|-----------------------------------|
| −83 | ROENCHEN | 15A | DPWA | Multichannel |
| −155 ± 30 | GUTZ | 14 | DPWA | Multichannel |
| −145 ± 30 | ANISOVICH | 12A | DPWA | Multichannel |
| +172 | ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |

¹ Fit to the amplitudes of HOEHLER 79.

$\Delta(1910)$ INELASTIC POLE RESIDUE

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

Normalized residue in $N\pi \rightarrow \Delta(1910) \rightarrow \Sigma K$

| <u>MODULUS</u> | <u>PHASE (°)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------|------------------|--------------------|-------------|-------------------|
| 0.07 ± 0.02 | −110 ± 30 | ANISOVICH | 12A | DPWA Multichannel |
| 0.019 | −123 | ROENCHEN | 15A | DPWA Multichannel |

Normalized residue in $N\pi \rightarrow \Delta(1910) \rightarrow \Delta\pi, P$ -wave

| <u>MODULUS</u> | <u>PHASE (°)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------|------------------|--------------------|-------------|-------------------|
| 0.24 ± 0.10 | 85 ± 35 | SOKHOYAN | 15A | DPWA Multichannel |
| 0.58 | 131 | ROENCHEN | 15A | DPWA Multichannel |
| 0.16 ± 0.09 | 95 ± 40 | ANISOVICH | 12A | DPWA Multichannel |

Normalized residue in $N\pi \rightarrow \Delta(1910) \rightarrow \Delta(1232)\eta$

| <u>MODULUS</u> | <u>PHASE (°)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------|------------------|--------------------|-------------|-------------------|
| 0.11 ± 0.04 | −150 ± 50 | GUTZ | 14 | DPWA Multichannel |

Normalized residue in $N\pi \rightarrow \Delta(1910) \rightarrow N(1440)\pi$

| <u>MODULUS</u> | <u>PHASE (°)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------|------------------|--------------------|-------------|-------------------|
| 0.06 ± 0.03 | 170 ± 45 | SOKHOYAN | 15A | DPWA Multichannel |

$\Delta(1910)$ BREIT-WIGNER MASS

| <u>VALUE (MeV)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-----------------------|-------------|--|
| 1850 to 1950 (\approx 1900) OUR ESTIMATE | | | |
| 1846 \pm 18 | ¹ HUNT | 19 | DPWA Multichannel |
| 1845 \pm 40 | SOKHOYAN | 15A | DPWA Multichannel |
| 2067.9 \pm 1.7 | ¹ ARNDT | 06 | DPWA $\pi N \rightarrow \pi N, \eta N$ |
| 1910 \pm 40 | CUTKOSKY | 80 | IPWA $\pi N \rightarrow \pi N$ |
| 1888 \pm 20 | HOEHLER | 79 | IPWA $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 1845 \pm 40 | GUTZ | 14 | DPWA Multichannel |
| 1860 \pm 40 | ANISOVICH | 12A | DPWA Multichannel |
| 1934 \pm 5 | ¹ SHRESTHA | 12A | DPWA Multichannel |
| 1995 \pm 12 | VRANA | 00 | DPWA Multichannel |
| ¹ Statistical error only. | | | |

 $\Delta(1910)$ BREIT-WIGNER WIDTH

| <u>VALUE (MeV)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-----------------------|-------------|--|
| 200 to 400 (\approx 300) OUR ESTIMATE | | | |
| 260 \pm 57 | ¹ HUNT | 19 | DPWA Multichannel |
| 360 \pm 60 | SOKHOYAN | 15A | DPWA Multichannel |
| 543 \pm 10 | ¹ ARNDT | 06 | DPWA $\pi N \rightarrow \pi N, \eta N$ |
| 225 \pm 50 | CUTKOSKY | 80 | IPWA $\pi N \rightarrow \pi N$ |
| 280 \pm 50 | HOEHLER | 79 | IPWA $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 360 \pm 60 | GUTZ | 14 | DPWA Multichannel |
| 350 \pm 55 | ANISOVICH | 12A | DPWA Multichannel |
| 211 \pm 11 | ¹ SHRESTHA | 12A | DPWA Multichannel |
| 713 \pm 465 | VRANA | 00 | DPWA Multichannel |
| ¹ Statistical error only. | | | |

 $\Delta(1910)$ DECAY MODES

The following branching fractions are our estimates, not fits or averages.

| Mode | Fraction (Γ_i/Γ) |
|-------------------------------------|--------------------------------|
| Γ_1 $N\pi$ | 15–30 % |
| Γ_2 ΣK | 4–14 % |
| Γ_3 $N\pi\pi$ | |
| Γ_4 $\Delta(1232)\pi$ | 34–66 % |
| Γ_5 $N(1440)\pi$ | 3–9 % |
| Γ_6 $\Delta(1232)\eta$ | 5–13 % |
| Γ_7 $N\gamma$, helicity=1/2 | 0.0–0.02 % |

$\Delta(1910)$ BRANCHING RATIOS

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

15 to 30 (≈ 20) OUR ESTIMATE

| | | | | |
|----------------|--------------------|-----|------|-----------------------------------|
| 13 \pm 3 | ¹ HUNT | 19 | DPWA | Multichannel |
| 12 \pm 3 | SOKHOYAN | 15A | DPWA | Multichannel |
| 23.9 \pm 0.1 | ¹ ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| 19 \pm 3 | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |
| 24 \pm 6 | HOEHLER | 79 | IPWA | $\pi N \rightarrow \pi N$ |

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

| | | | | |
|-------------|-----------------------|-----|------|--------------|
| 12 \pm 3 | GUTZ | 14 | DPWA | Multichannel |
| 12 \pm 3 | ANISOVICH | 12A | DPWA | Multichannel |
| 17 \pm 1 | ¹ SHRESTHA | 12A | DPWA | Multichannel |
| 29 \pm 21 | VRANA | 00 | DPWA | Multichannel |

¹Statistical error only.

$\Gamma(\Sigma K)/\Gamma_{\text{total}}$ **Γ_2/Γ**
VALUE (%) DOCUMENT ID TECN COMMENT

| | | | | |
|-----------|-----------|-----|------|--------------|
| 9 \pm 5 | ANISOVICH | 12A | DPWA | Multichannel |
|-----------|-----------|-----|------|--------------|

$\Gamma(\Delta(1232)\pi)/\Gamma_{\text{total}}$ **Γ_4/Γ**
VALUE (%) DOCUMENT ID TECN COMMENT

| | | | | |
|-------------|----------|-----|------|--------------|
| 50 \pm 16 | SOKHOYAN | 15A | DPWA | Multichannel |
|-------------|----------|-----|------|--------------|

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

| | | | | |
|-------------|-----------|-----|------|--------------|
| 60 \pm 28 | ANISOVICH | 12A | DPWA | Multichannel |
|-------------|-----------|-----|------|--------------|

$\Gamma(N(1440)\pi)/\Gamma_{\text{total}}$ **Γ_5/Γ**
VALUE (%) DOCUMENT ID TECN COMMENT

| | | | | |
|-------------|-------------------|-----|------|--------------|
| 33 \pm 12 | ¹ HUNT | 19 | DPWA | Multichannel |
| 6 \pm 3 | SOKHOYAN | 15A | DPWA | Multichannel |

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

| | | | | |
|------------|-----------------------|-----|------|--------------|
| 47 \pm 6 | ¹ SHRESTHA | 12A | DPWA | Multichannel |
| 56 \pm 7 | VRANA | 00 | DPWA | Multichannel |

¹Statistical error only.

$\Gamma(\Delta(1232)\eta)/\Gamma_{\text{total}}$ **Γ_6/Γ**
VALUE (%) DOCUMENT ID TECN COMMENT

| | | | | |
|-----------|------|----|------|--------------|
| 9 \pm 4 | GUTZ | 14 | DPWA | Multichannel |
|-----------|------|----|------|--------------|

$\Delta(1910)$ PHOTON DECAY AMPLITUDES AT THE POLE **$\Delta(1910) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$**

| <u>MODULUS ($\text{GeV}^{-1/2}$)</u> | <u>PHASE ($^\circ$)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------------------------------|--------------------|-------------|-------------------|
| 0.027 ± 0.009 | -30 ± 60 | SOKHOYAN | 15A | DPWA Multichannel |
| $-0.246^{+0.024}_{-0.047}$ | 159^{+9}_{-4} | ROENCHEN | 14 | DPWA |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.321 | 39 | ROENCHEN | 15A | DPWA Multichannel |

 $\Delta(1910)$ BREIT-WIGNER PHOTON DECAY AMPLITUDES **$\Delta(1910) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$**

| <u>VALUE ($\text{GeV}^{-1/2}$)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-----------------------|-------------|-----------------------------------|
| 0.010 to 0.030 (≈ 0.020) OUR ESTIMATE | | | |
| 0.203 ± 0.056 | ¹ HUNT | 19 | DPWA Multichannel |
| 0.026 ± 0.008 | SOKHOYAN | 15A | DPWA Multichannel |
| -0.002 ± 0.008 | ¹ ARNDT | 96 | IPWA $\gamma N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 0.026 ± 0.008 | GUTZ | 14 | DPWA Multichannel |
| 0.022 ± 0.009 | ANISOVICH | 12A | DPWA Multichannel |
| 0.030 ± 0.002 | ¹ SHRESTHA | 12A | DPWA Multichannel |
| ¹ Statistical error only. | | | |

 $\Delta(1910)$ REFERENCESFor early references, see Physics Letters **111B** 1 (1982).

| | | | | |
|-----------|-----|------------------------|---|-------------------------|
| HUNT | 19 | PR C99 055205 | B.C. Hunt, D.M. Manley | |
| ROENCHEN | 15A | EPJ A51 70 | D. Roenchen <i>et al.</i> | |
| SOKHOYAN | 15A | EPJ A51 95 | V. Sokhoyan <i>et al.</i> | (CBELSA/TAPS Collab.) |
| GUTZ | 14 | EPJ A50 74 | E. Gutz <i>et al.</i> | (CBELSA/TAPS Collab.) |
| PDG | 14 | CP C38 070001 | K. Olive <i>et al.</i> | (PDG Collab.) |
| ROENCHEN | 14 | EPJ A50 101 | D. Roenchen <i>et al.</i> | |
| Also | | EPJ A51 63 (errat.) | D. Roenchen <i>et al.</i> | |
| SVARC | 14 | PR C89 045205 | A. Svarc <i>et al.</i> | (RBI Zagreb, UNI Tuzla) |
| 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) |
| VRANA | 00 | PRPL 328 181 | T.P. Vrana, S.A. Dytman, T.-S.H. Lee | (PITT, ANL) |
| ARNDT | 96 | PR C53 430 | R.A. Arndt, I.I. Strakovsky, R.L. Workman | (VPI) |
| HOEHLER | 93 | πN Newsletter 9 1 | G. Hohler | (KARL) |
| 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) IJP |
| HOEHLER | 79 | PDAT 12-1 | G. Hohler <i>et al.</i> | (KARLT) IJP |
| Also | | Toronto Conf. 3 | R. Koch | (KARLT) IJP |