# $\Delta(1900)\ S_{31}$

$I(J^P) = \frac{3}{2}(\frac{1}{2}^-)$ Status: ∗∗

OMITTED FROM SUMMARY TABLE

Some obsolete results published before 1980 were last included in our 2006 edition, Journal of Physics, G **33** 1 (2006).

The latest GWU analysis (ARNDT 06) finds no evidence for this resonance.

## Δ(1900) BREIT-WIGNER MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1850 to 1950 (≈ 1900) OUR ESTIMATE** | | | | |
| 1920 ±24 | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N \pi\pi$ |
| 1890 ±50 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 1908 ±30 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1802 ±87 | VRANA | 00 | DPWA | Multichannel |
| 1918.5±23.0 | CHEW | 80 | BPWA | $\pi^+ p \to \pi^+ p$ |
| 1803 | CRAWFORD | 80 | DPWA | $\gamma N \to \pi N$ |

## Δ(1900) BREIT-WIGNER WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **140 to 240 (≈ 200) OUR ESTIMATE** | | | | |
| 263 ±39 | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N \pi\pi$ |
| 170 ±50 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 140 ±40 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 48 ±45 | VRANA | 00 | DPWA | Multichannel |
| 93.5±54.0 | CHEW | 80 | BPWA | $\pi^+ p \to \pi^+ p$ |
| 137 | CRAWFORD | 80 | DPWA | $\gamma N \to \pi N$ |

## Δ(1900) POLE POSITION

### REAL PART

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 1780 | [1] HOEHLER | 93 | SPED | $\pi N \to \pi N$ |
| 1870±40 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1795 | VRANA | 00 | DPWA | Multichannel |
| not seen | ARNDT | 91 | DPWA | $\pi N \to \pi N$ Soln SM90 |
| 2029 or 2025 | [2] LONGACRE | 78 | IPWA | $\pi N \to N \pi\pi$ |

### −2×IMAGINARY PART

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 180±50 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 58 | VRANA | 00 | DPWA | Multichannel |
| not seen | ARNDT | 91 | DPWA | $\pi N \to \pi N$ Soln SM90 |
| 164 or 163 | [2] LONGACRE | 78 | IPWA | $\pi N \to N\pi\pi$ |

## Δ(1900) ELASTIC POLE RESIDUE

### MODULUS |r|

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 10±3 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |

### PHASE θ

| *VALUE* (°) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| +20±40 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |

## Δ(1900) DECAY MODES

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

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\pi$ | 10–30 % |
| $\Gamma_2$ | $\Sigma K$ | |
| $\Gamma_3$ | $N\pi\pi$ | |
| $\Gamma_4$ | $\Delta\pi$ | |
| $\Gamma_5$ | $\Delta(1232)\pi$, *D*-wave | |
| $\Gamma_6$ | $N\rho$ | |
| $\Gamma_7$ | $N\rho$, $S$=1/2, *S*-wave | |
| $\Gamma_8$ | $N\rho$, $S$=3/2, *D*-wave | |
| $\Gamma_9$ | $N(1440)\pi$, *S*-wave | |
| $\Gamma_{10}$ | $N\gamma$, helicity=1/2 | |

## Δ(1900) BRANCHING RATIOS

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

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **0.1 to 0.3 OUR ESTIMATE** | | | | |
| 0.41±0.04 | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |
| 0.10±0.03 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 0.08±0.04 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.33±0.10 | VRANA | 00 | DPWA | Multichannel |
| 0.28 | CHEW | 80 | BPWA | $\pi^+ p \to \pi^+ p$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1900) \to \Sigma K$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| <0.03 | CANDLIN | 84 | DPWA | $\pi^+ p \to \Sigma^+ K^+$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1900) \to \Delta(1232)\pi$, *D*-wave — $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $+0.25\pm0.07$ | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |

### $\Gamma(\Delta(1232)\pi$, *D*-wave$)/\Gamma_{total}$ — $\Gamma_5/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $0.28\pm0.01$ | VRANA | 00 | DPWA | Multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1900) \to N\rho$, $S$=1/2, *S*-wave — $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $-0.14\pm0.11$ | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |

### $\Gamma(N\rho$, $S$=1/2, *S*-wave$)/\Gamma_{total}$ — $\Gamma_7/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $0.30\pm0.02$ | VRANA | 00 | DPWA | Multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1900) \to N\rho$, $S$=3/2, *D*-wave — $(\Gamma_1\Gamma_8)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $-0.37\pm0.07$ | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |

### $\Gamma(N\rho$, $S$=3/2, *D*-wave$)/\Gamma_{total}$ — $\Gamma_8/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $0.05\pm0.01$ | VRANA | 00 | DPWA | Multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to \Delta(1900) \to N(1440)\pi$, *S*-wave — $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $-0.16\pm0.11$ | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |

### $\Gamma(N(1440)\pi$, *S*-wave$)/\Gamma_{total}$ — $\Gamma_9/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $0.04\pm0.01$ | VRANA | 00 | DPWA | Multichannel |

## $\Delta(1900)$ PHOTON DECAY AMPLITUDES

### $\Delta(1900) \to N\gamma$, helicity-1/2 amplitude $A_{1/2}$

| *VALUE* ($GeV^{-1/2}$) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $-0.004\pm0.016$ | CRAWFORD | 83 | IPWA | $\gamma N \to \pi N$ |
| $0.029\pm0.008$ | AWAJI | 81 | DPWA | $\gamma N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-0.006$ to $-0.025$ | CRAWFORD | 80 | DPWA | $\gamma N \to \pi N$ |

## $\Delta$(1900) FOOTNOTES

[1] See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of $N$ and $\Delta$ resonances as determined from Argand diagrams of $\pi N$ elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams.

[2] LONGACRE 78 values are from a search for poles in the unitarized T-matrix. The first (second) value uses, in addition to $\pi N \rightarrow N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis.

## $\Delta$(1900) REFERENCES

For early references, see Physics Letters **111B** 1 (1982).


| | | | | |
|---|---|---|---|---|
| ARNDT | 06 | PR C74 045205 | R.A. Arndt *et al.* | (GWU) |
| PDG | 06 | JPG 33 1 | W.-M. Yao *et al.* | (PDG Collab.) |
| VRANA | 00 | PRPL 328 181 | T.P. Vrana, S.A. Dytman,, T.-S.H. Lee | (PITT+) |
| HOEHLER | 93 | $\pi N$ Newsletter 9 1 | G. Hohler | (KARL) |
| MANLEY | 92 | PR D45 4002 | D.M. Manley, E.M. Saleski | (KENT) IJP |
| Also | | PR D30 904 | D.M. Manley *et al.* | (VPI) |
| ARNDT | 91 | PR D43 2131 | R.A. Arndt *et al.* | (VPI, TELE) IJP |
| CANDLIN | 84 | NP B238 477 | D.J. Candlin *et al.* | (EDIN, RAL, LOWC) |
| CRAWFORD | 83 | NP B211 1 | R.L. Crawford, W.T. Morton | (GLAS) |
| AWAJI | 81 | Bonn Conf. 352 | N. Awaji, R. Kajikawa | (NAGO) |
| Also | | NP B197 365 | K. Fujii *et al.* | (NAGO) |
| CHEW | 80 | Toronto Conf. 123 | D.M. Chew | (LBL) IJP |
| CRAWFORD | 80 | Toronto Conf. 107 | R.L. Crawford | (GLAS) |
| CUTKOSKY | 80 | Toronto Conf. 19 | R.E. Cutkosky *et al.* | (CMU, LBL) IJP |
| Also | | PR D20 2839 | R.E. Cutkosky *et al.* | (CMU, LBL) IJP |
| HOEHLER | 79 | PDAT 12-1 | G. Hohler *et al.* | (KARLT) IJP |
| Also | | Toronto Conf. 3 | R. Koch | (KARLT) IJP |
| LONGACRE | 78 | PR D17 1795 | R.S. Longacre *et al.* | (LBL, SLAC) |