# $N(2190)$ $G_{17}$

$I(J^P) = \frac{1}{2}(\frac{7}{2}^-)$ Status: ****

Most of the results published before 1975 are now obsolete and have been omitted. They may be found in our 1982 edition, Physics Letters **111B** (1982).

## $N(2190)$ BREIT-WIGNER MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **2100 to 2200 (≈ 2190) OUR ESTIMATE** | | | | |
| 2127 ± 9 | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |
| 2200 ± 70 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 2140 ± 12 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| 2140 ± 40 | HENDRY | 78 | MPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2131 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |
| 2198 ± 68 | BATINIC | 95 | DPWA | $\pi N \to N\pi$, $N\eta$ |
| 2098 | CRAWFORD | 80 | DPWA | $\gamma N \to \pi N$ |
| 2180 | SAXON | 80 | DPWA | $\pi^- p \to \Lambda K^0$ |
| 2140 | BAKER | 79 | DPWA | $\pi^- p \to n\eta$ |
| 2117 | BARBOUR | 78 | DPWA | $\gamma N \to \pi N$ |

## $N(2190)$ BREIT-WIGNER WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **350 to 550 (≈ 450) OUR ESTIMATE** | | | | |
| 550 ± 50 | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |
| 500 ± 150 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 390 ± 30 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| 270 ± 50 | HENDRY | 78 | MPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 476 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |
| 805 ± 140 | BATINIC | 95 | DPWA | $\pi N \to N\pi$, $N\eta$ |
| 238 | CRAWFORD | 80 | DPWA | $\gamma N \to \pi N$ |
| 80 | SAXON | 80 | DPWA | $\pi^- p \to \Lambda K^0$ |
| 319 | BAKER | 79 | DPWA | $\pi^- p \to n\eta$ |
| 220 | BARBOUR | 78 | DPWA | $\gamma N \to \pi N$ |

## $N(2190)$ POLE POSITION

### REAL PART

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1950 to 2150 (≈ 2050) OUR ESTIMATE** | | | | |
| 2030 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |
| 2042 | [1] HOEHLER | 93 | SPED | $\pi N \to \pi N$ |
| 2100 ± 50 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2060 | ARNDT | 91 | DPWA | $\pi N \to \pi N$ Soln SM90 |

### $-2\times$IMAGINARY PART

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **350 to 550 ($\approx$ 450) OUR ESTIMATE** | | | | |
| 460 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |
| 482 | [1] HOEHLER | 93 | SPED | $\pi N \to \pi N$ |
| 400 $\pm$ 160 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 464 | ARNDT | 91 | DPWA | $\pi N \to \pi N$ Soln SM90 |

## *N*(2190) ELASTIC POLE RESIDUE

### MODULUS $|r|$

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 46 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |
| 45 | HOEHLER | 93 | SPED | $\pi N \to \pi N$ |
| 25 $\pm$ 10 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 54 | ARNDT | 91 | DPWA | $\pi N \to \pi N$ Soln SM90 |

### PHASE $\theta$

| *VALUE* (°) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| $-23$ | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |
| $-30 \pm 50$ | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-44$ | ARNDT | 91 | DPWA | $\pi N \to \pi N$ Soln SM90 |

## *N*(2190) DECAY MODES

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

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\pi$ | 10–20 % |
| $\Gamma_2$ | $N\eta$ | |
| $\Gamma_3$ | $\Lambda K$ | |
| $\Gamma_4$ | $\Sigma K$ | |
| $\Gamma_5$ | $N\pi\pi$ | |
| $\Gamma_6$ | $N\rho$ | |
| $\Gamma_7$ | $N\rho$, $S$=3/2, $D$-wave | |
| $\Gamma_8$ | $p\gamma$, helicity=1/2 | |
| $\Gamma_9$ | $p\gamma$, helicity=3/2 | |
| $\Gamma_{10}$ | $n\gamma$, helicity=1/2 | |
| $\Gamma_{11}$ | $n\gamma$, helicity=3/2 | |

## $N(2190)$ BRANCHING RATIOS

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.1 to 0.2 OUR ESTIMATE** | | | | |
| 0.22±0.01 | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |
| 0.12±0.06 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 0.14±0.02 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| 0.16±0.04 | HENDRY | 78 | MPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.23 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |
| 0.19±0.05 | BATINIC | 95 | DPWA | $\pi N \to N\pi$, $N\eta$ |

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.001±0.003 | BATINIC | 95 | DPWA | $\pi N \to N\pi$, $N\eta$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(2190) \to N\eta$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| +0.052 | BAKER | 79 | DPWA | $\pi^- p \to n\eta$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(2190) \to \Lambda K$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.02 | BELL | 83 | DPWA | $\pi^- p \to \Lambda K^0$ |
| −0.02 | SAXON | 80 | DPWA | $\pi^- p \to \Lambda K^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(2190) \to \Sigma K$ — $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.014 to 0.019 | [2] DEANS | 75 | DPWA | $\pi N \to \Sigma K$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \to N(2190) \to N\rho$, $S$=3/2, $D$-wave — $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.25±0.03 | MANLEY | 92 | IPWA | $\pi N \to \pi N$ & $N\pi\pi$ |

## $N(2190)$ PHOTON DECAY AMPLITUDES

### $N(2190) \to p\gamma$, helicity-1/2 amplitude $A_{1/2}$

| VALUE (GeV$^{-1/2}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.055 | CRAWFORD | 80 | DPWA | $\gamma N \to \pi N$ |
| −0.030 | BARBOUR | 78 | DPWA | $\gamma N \to \pi N$ |

### $N(2190) \rightarrow p\gamma$, helicity-3/2 amplitude $A_{3/2}$

| VALUE ($GeV^{-1/2}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.081 | CRAWFORD | 80 | DPWA | $\gamma N \rightarrow \pi N$ |
| +0.180 | BARBOUR | 78 | DPWA | $\gamma N \rightarrow \pi N$ |

### $N(2190) \rightarrow n\gamma$, helicity-1/2 amplitude $A_{1/2}$

| VALUE ($GeV^{-1/2}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.042 | CRAWFORD | 80 | DPWA | $\gamma N \rightarrow \pi N$ |
| −0.085 | BARBOUR | 78 | DPWA | $\gamma N \rightarrow \pi N$ |

### $N(2190) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

| VALUE ($GeV^{-1/2}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.126 | CRAWFORD | 80 | DPWA | $\gamma N \rightarrow \pi N$ |
| +0.007 | BARBOUR | 78 | DPWA | $\gamma N \rightarrow \pi N$ |

## $N(2190)$ $\gamma p \rightarrow \Lambda K^+$ AMPLITUDES

### $(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{total}$ in $p\gamma \rightarrow N(2190) \rightarrow \Lambda K^+$ ($E_{4-}$ amplitude)

| VALUE (units $10^{-3}$) | DOCUMENT ID | | TECN |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 2.5 ±1.0 | WORKMAN | 90 | DPWA |
| 2.04 | TANABE | 89 | DPWA |

### $p\gamma \rightarrow N(2190) \rightarrow \Lambda K^+$ phase angle $\theta$ ($E_{4-}$ amplitude)

| VALUE (degrees) | DOCUMENT ID | | TECN |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| − 4 ±9 | WORKMAN | 90 | DPWA |
| −27.5 | TANABE | 89 | DPWA |

### $(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{total}$ in $p\gamma \rightarrow N(2190) \rightarrow \Lambda K^+$ ($M_{4-}$ amplitude)

| VALUE (units $10^{-3}$) | DOCUMENT ID | | TECN |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| −7.0 ±0.7 | WORKMAN | 90 | DPWA |
| −5.78 | TANABE | 89 | DPWA |

## $N(2190)$ 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] The range given for DEANS 75 is from the four best solutions. Disagrees with $\pi^+ p \rightarrow \Sigma^+ K^+$ data of WINNIK 77 around 1920 MeV.

## *N*(2190) REFERENCES

For early references, see Physics Letters **111B** 70 (1982).


| | | | | | |
|---|---|---|---|---|---|
| ARNDT | 95 | PR C52 2120 | R.A. Arndt *et al.* | (VPI, BRCO) | |
| BATINIC | 95 | PR C51 2310 | M. Batinic *et al.* | (BOSK, UCLA) | |
| Also | 98 | PR C57 1004 (erratum) | M. Batinic *et al.* | | |
| HOEHLER | 93 | $\pi N$ Newsletter 9 1 | G. Hohler | (KARL) | |
| MANLEY | 92 | PR D45 4002 | D.M. Manley, E.M. Saleski | (KENT) | IJP |
| Also | 84 | PR D30 904 | D.M. Manley *et al.* | (VPI) | |
| ARNDT | 91 | PR D43 2131 | R.A. Arndt *et al.* | (VPI, TELE) | IJP |
| WORKMAN | 90 | PR C42 781 | R.L. Workman | (VPI) | |
| TANABE | 89 | PR C39 741 | H. Tanabe, M. Kohno, C. Bennhold | (MANZ) | |
| Also | 89 | NC 102A 193 | M. Kohno, H. Tanabe, C. Bennhold | (MANZ) | |
| BELL | 83 | NP B222 389 | K.W. Bell *et al.* | (RL) | IJP |
| PDG | 82 | PL 111B | M. Roos *et al.* | (HELS, CIT, CERN) | |
| CRAWFORD | 80 | Toronto Conf. 107 | R.L. Crawford | (GLAS) | |
| CUTKOSKY | 80 | Toronto Conf. 19 | R.E. Cutkosky *et al.* | (CMU, LBL) | IJP |
| Also | 79 | PR D20 2839 | R.E. Cutkosky *et al.* | (CMU, LBL) | IJP |
| SAXON | 80 | NP B162 522 | D.H. Saxon *et al.* | (RHEL, BRIS) | IJP |
| BAKER | 79 | NP B156 93 | R.D. Baker *et al.* | (RHEL) | IJP |
| HOEHLER | 79 | PDAT 12-1 | G. Hohler *et al.* | (KARLT) | IJP |
| Also | 80 | Toronto Conf. 3 | R. Koch | (KARLT) | IJP |
| BARBOUR | 78 | NP B141 253 | I.M. Barbour, R.L. Crawford, N.H. Parsons | (GLAS) | |
| HENDRY | 78 | PRL 41 222 | A.W. Hendry | (IND, LBL) | IJP |
| Also | 81 | ANP 136 1 | A.W. Hendry | (IND) | |
| WINNIK | 77 | NP B128 66 | M. Winnik *et al.* | (HAIF) | I |
| DEANS | 75 | NP B96 90 | S.R. Deans *et al.* | (SFLA, ALAH) | IJP |