# $N(2220)$ $H_{19}$

$I(J^P) = \frac{1}{2}(\frac{9}{2}^+)$ Status: ****

Most of the results published before 1975 were last included in our 1982 edition, Physics Letters **111B** 1 (1982). Some further obsolete results published before 1980 were last included in our 2006 edition, Journal of Physics, G **33** 1 (2006).

## *N*(2220) BREIT-WIGNER MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **2200 to 2300 (≈ 2250) OUR ESTIMATE** | | | | |
| 2316.3± 2.9 | ARNDT | 06 | DPWA | $\pi N \to \pi N, \eta N$ |
| 2230 ± 80 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 2205 ± 10 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| 2300 ±100 | HENDRY | 78 | MPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2270 ± 11 | ARNDT | 04 | DPWA | $\pi N \to \pi N, \eta N$ |
| 2258 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |

## *N*(2220) BREIT-WIGNER WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **350 to 500 (≈ 400) OUR ESTIMATE** | | | | |
| 633± 17 | ARNDT | 06 | DPWA | $\pi N \to \pi N, \eta N$ |
| 500±150 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| 365± 30 | HOEHLER | 79 | IPWA | $\pi N \to \pi N$ |
| 450±150 | HENDRY | 78 | MPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 366± 42 | ARNDT | 04 | DPWA | $\pi N \to \pi N, \eta N$ |
| 334 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |

## *N*(2220) POLE POSITION

### REAL PART

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **2130 to 2200 (≈ 2170) OUR ESTIMATE** | | | | |
| 2199 | ARNDT | 06 | DPWA | $\pi N \to \pi N, \eta N$ |
| 2135 | [1] HOEHLER | 93 | ARGD | $\pi N \to \pi N$ |
| 2160±80 | CUTKOSKY | 80 | IPWA | $\pi N \to \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2209 | ARNDT | 04 | DPWA | $\pi N \to \pi N, \eta N$ |
| 2203 | ARNDT | 95 | DPWA | $\pi N \to N\pi$ |
| 2253 | ARNDT | 91 | DPWA | $\pi N \to \pi N$ Soln SM90 |

### −2×IMAGINARY PART

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **400 to 560 (≈ 480) OUR ESTIMATE** | | | | |
| 372 | ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| 400 | [2] HOEHLER | 93 | ARGD | $\pi N \rightarrow \pi N$ |
| 480 ± 100 | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 564 | ARNDT | 04 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| 536 | ARNDT | 95 | DPWA | $\pi N \rightarrow N\pi$ |
| 640 | ARNDT | 91 | DPWA | $\pi N \rightarrow \pi N$ Soln SM90 |

## *N*(2220) ELASTIC POLE RESIDUE

### MODULUS $|r|$

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 33 | ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| 40 | HOEHLER | 93 | ARGD | $\pi N \rightarrow \pi N$ |
| 45 ± 20 | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 96 | ARNDT | 04 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| 68 | ARNDT | 95 | DPWA | $\pi N \rightarrow N\pi$ |
| 85 | ARNDT | 91 | DPWA | $\pi N \rightarrow \pi N$ Soln SM90 |

### PHASE $\theta$

| *VALUE* (°) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| −33 | ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| −50 | HOEHLER | 93 | ARGD | $\pi N \rightarrow \pi N$ |
| −45 ± 25 | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −71 | ARNDT | 04 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| −43 | ARNDT | 95 | DPWA | $\pi N \rightarrow N\pi$ |
| −62 | ARNDT | 91 | DPWA | $\pi N \rightarrow \pi N$ Soln SM90 |

## *N*(2220) DECAY MODES

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

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\pi$ | 10–20 % |
| $\Gamma_2$ | $N\eta$ | |
| $\Gamma_3$ | $\Lambda K$ | |

## *N*(2220) BRANCHING RATIOS

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.1 to 0.2 OUR ESTIMATE** | | | | |
| $0.246 \pm 0.001$ | ARNDT | 06 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| $0.15 \pm 0.03$ | CUTKOSKY | 80 | IPWA | $\pi N \rightarrow \pi N$ |
| $0.18 \pm 0.015$ | HOEHLER | 79 | IPWA | $\pi N \rightarrow \pi N$ |
| $0.12 \pm 0.04$ | HENDRY | 78 | MPWA | $\pi N \rightarrow \pi N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $0.200 \pm 0.006$ | ARNDT | 04 | DPWA | $\pi N \rightarrow \pi N, \eta N$ |
| 0.26 | ARNDT | 95 | DPWA | $\pi N \rightarrow N\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\pi \rightarrow N(2220) \rightarrow \Lambda K$ $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| not required | BELL | 83 | DPWA | $\pi^- p \rightarrow \Lambda K^0$ |
| not seen | SAXON | 80 | DPWA | $\pi^- p \rightarrow \Lambda K^0$ |

## *N*(2220) 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] 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.

## *N*(2220) 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.) |
| ARNDT | 04 | PR C69 035213 | R.A. Arndt *et al.* | (GWU, TRIU) |
| ARNDT | 95 | PR C52 2120 | R.A. Arndt *et al.* | (VPI, BRCO) |
| HOEHLER | 93 | $\pi N$ Newsletter 9 1 | G. Hohler | (KARL) |
| ARNDT | 91 | PR D43 2131 | R.A. Arndt *et al.* | (VPI, TELE) IJP |
| BELL | 83 | NP B222 389 | K.W. Bell *et al.* | (RL) IJP |
| PDG | 82 | PL 111B 1 | M. Roos *et al.* | (HELS, CIT, CERN) |
| 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 |
| SAXON | 80 | NP B162 522 | D.H. Saxon *et al.* | (RHEL, BRIS) IJP |
| HOEHLER | 79 | PDAT 12-1 | G. Hohler *et al.* | (KARLT) IJP |
| Also | | Toronto Conf. 3 | R. Koch | (KARLT) IJP |
| HENDRY | 78 | PRL 41 222 | A.W. Hendry | (IND, LBL) IJP |
| Also | | ANP 136 1 | A.W. Hendry | (IND) |