

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

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

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).

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

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                   |
|---|--------------------|-------------|----------------------------------|
| <b>2180 to 2310 (<math>\approx 2220</math>) OUR ESTIMATE</b>                  |                    |             |                                  |
| 2230 $\pm$ 80   | CUTKOSKY           | 80          | IPWA $\pi N \rightarrow \pi N$   |
| 2205 $\pm$ 10   | HOEHLER            | 79          | IPWA $\pi N \rightarrow \pi N$   |
| 2300 $\pm$ 100  | HENDRY             | 78          | MPWA $\pi N \rightarrow \pi N$   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                    |             |                                  |
| 2258  | ARNDT              | 95          | DPWA $\pi N \rightarrow N\pi$    |
| 2050  | BAKER              | 79          | DPWA $\pi^- p \rightarrow n\eta$ |

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

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                 |
|---|--------------------|-------------|--------------------------------|
| <b>320 to 550 (<math>\approx 400</math>) OUR ESTIMATE</b>                     |                    |             |                                |
| 500 $\pm$ 150   | CUTKOSKY           | 80          | IPWA $\pi N \rightarrow \pi N$ |
| 365 $\pm$ 30  | HOEHLER            | 79          | IPWA $\pi N \rightarrow \pi N$ |
| 450 $\pm$ 150   | HENDRY             | 78          | MPWA $\pi N \rightarrow \pi N$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                    |             |                                |
| 334   | ARNDT              | 95          | DPWA $\pi N \rightarrow N\pi$  |

 **$N(2220)$  POLE POSITION****REAL PART**

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u>   | <u>TECN</u> | <u>COMMENT</u>                           |
|---|----------------------|-------------|--|
| <b>2100 to 2240 (<math>\approx 2170</math>) OUR ESTIMATE</b>                  |                      |             |  |
| 2203  | ARNDT                | 95          | DPWA $\pi N \rightarrow N\pi$            |
| 2135  | <sup>1</sup> HOEHLER | 93          | ARGD $\pi N \rightarrow \pi N$           |
| 2160 $\pm$ 80   | CUTKOSKY             | 80          | IPWA $\pi N \rightarrow \pi N$           |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                      |             |  |
| 2253  | ARNDT                | 91          | DPWA $\pi N \rightarrow \pi N$ Soln SM90 |

**-2xIMAGINARY PART**

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u>   | <u>TECN</u> | <u>COMMENT</u>                           |
|---|----------------------|-------------|--|
| <b>370 to 570 (<math>\approx 470</math>) OUR ESTIMATE</b>                     |                      |             |  |
| 536   | ARNDT                | 95          | DPWA $\pi N \rightarrow N\pi$            |
| 400   | <sup>1</sup> HOEHLER | 93          | ARGD $\pi N \rightarrow \pi N$           |
| 480 $\pm$ 100   | CUTKOSKY             | 80          | IPWA $\pi N \rightarrow \pi N$           |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                      |             |  |
| 640   | ARNDT                | 91          | DPWA $\pi N \rightarrow \pi N$ Soln SM90 |

**$N(2220)$  ELASTIC POLE RESIDUE****MODULUS  $|r|$** 

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                           |
|---|--------------------|-------------|--|
| 68  | ARNDT              | 95          | DPWA $\pi N \rightarrow N\pi$            |
| 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. ● ● ● |                    |             |  |
| 85  | ARNDT              | 91          | DPWA $\pi N \rightarrow \pi N$ Soln SM90 |

**PHASE  $\theta$** 

| <u>VALUE (°)</u>  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                           |
|---|--------------------|-------------|--|
| −43   | ARNDT              | 95          | DPWA $\pi N \rightarrow N\pi$            |
| −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. ● ● ● |                    |             |  |
| −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**

| $\Gamma(N\pi)/\Gamma_{\text{total}}$  | $\Gamma_1/\Gamma$  |             |                                |
|---|--------------------|-------------|--------------------------------|
| <u>VALUE</u>  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                 |
| <b>0.1 to 0.2 OUR ESTIMATE</b>  |                    |             |                                |
| 0.15 ± 0.03   | CUTKOSKY           | 80          | IPWA $\pi N \rightarrow \pi N$ |
| 0.18 ± 0.015  | HOEHLER            | 79          | IPWA $\pi N \rightarrow \pi N$ |
| 0.12 ± 0.04   | HENDRY             | 78          | MPWA $\pi N \rightarrow \pi N$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                    |             |                                |
| 0.26  | ARNDT              | 95          | DPWA $\pi N \rightarrow N\pi$  |

| $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(2220) \rightarrow N\eta$ | $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$ |             |                                  |
|--|-----------------------------------|-------------|----------------------------------|
| <u>VALUE</u>   | <u>DOCUMENT ID</u>                | <u>TECN</u> | <u>COMMENT</u>                   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                    |                                   |             |                                  |
| 0.034  | BAKER                             | 79          | DPWA $\pi^- p \rightarrow n\eta$ |

| $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow N(2220) \rightarrow \Lambda K$ | $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$ |             |  |
|--|-----------------------------------|-------------|--|
| <u>VALUE</u>   | <u>DOCUMENT ID</u>                | <u>TECN</u> | <u>COMMENT</u>                         |
| 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

<sup>1</sup> 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** 70 (1982).

|          |    |                        |  |                   |
|----------|----|------------------------|--|-------------------|
| ARNDT    | 95 | PR C52 2120            | +Strakovsky, Workman, Pavan              | (VPI, BRCO)       |
| HOEHLER  | 93 | $\pi N$ Newsletter 9 1 |  | (KARL)            |
| ARNDT    | 91 | PR D43 2131            | +Li, Roper, Workman, Ford                | (VPI, TELE) IJP   |
| BELL     | 83 | NP B222 389            | +Blissett, Broome, Daley, Hart, Lintern+ | (RL) IJP          |
| PDG      | 82 | PL 111B                | Roos, Porter, Aguilar-Benitez+           | (HELS, CIT, CERN) |
| CUTKOSKY | 80 | Toronto Conf. 19       | +Forsyth, Babcock, Kelly, Hendrick       | (CMU, LBL) IJP    |
| Also     | 79 | PR D20 2839            | Cutkosky, Forsyth, Hendrick, Kelly       | (CMU, LBL) IJP    |
| SAXON    | 80 | NP B162 522            | +Baker, Bell, Blissett, Bloodworth+      | (RHEL, BRIS) IJP  |
| BAKER    | 79 | NP B156 93             | +Brown, Clark, Davies, Depagter, Evans+  | (RHEL) IJP        |
| HOEHLER  | 79 | PDAT 12-1              | +Kaiser, Koch, Pietarinen                | (KARLT) IJP       |
| Also     | 80 | Toronto Conf. 3        | Koch                                     | (KARLT) IJP       |
| HENDRY   | 78 | PRL 41 222             |  | (IND, LBL) IJP    |
| Also     | 81 | ANP 136 1              | Hendry                                   | (IND)             |