

$\Sigma(2030) F_{17}$  $I(J^P) = 1(\frac{7}{2}^+)$  Status: \*\*\*\*

Discovered by COOL 66 and by WOHL 66. For most results published before 1974 (they are now obsolete), see our 1982 edition Physics Letters **111B** (1982).

This entry only includes results from partial-wave analyses. Parameters of peaks seen in cross sections and invariant-mass distributions around 2030 MeV may be found in our 1984 edition, Reviews of Modern Physics **56** No. 2 Pt. II (1984).

 **$\Sigma(2030)$  MASS**

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u>  | <u>TECN</u> | <u>COMMENT</u>                               |
|---|---------------------|-------------|--|
| <b>2025 to 2040 (<math>\approx</math> 2030) OUR ESTIMATE</b>                  |                     |             |  |
| 2036 $\pm$ 5  | GOPAL               | 80          | DPWA $\bar{K}N \rightarrow \bar{K}N$         |
| 2038 $\pm$ 10   | CORDEN              | 77B         | $K^- N \rightarrow N\bar{K}^*$               |
| 2040 $\pm$ 5  | GOPAL               | 77          | DPWA $\bar{K}N$ multichannel                 |
| 2030 $\pm$ 3  | <sup>1</sup> CORDEN | 76          | DPWA $K^- n \rightarrow \Lambda\pi^-$        |
| 2035 $\pm$ 15   | BAILLON             | 75          | IPWA $\bar{K}N \rightarrow \Lambda\pi$       |
| 2038 $\pm$ 10   | HEMINGWAY           | 75          | DPWA $K^- p \rightarrow \bar{K}N$            |
| 2042 $\pm$ 11   | VANHORN             | 75          | DPWA $K^- p \rightarrow \Lambda\pi^0$        |
| 2020 $\pm$ 6  | KANE                | 74          | DPWA $K^- p \rightarrow \Sigma\pi$           |
| 2035 $\pm$ 10   | LITCHFIELD          | 74B         | DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$  |
| 2020 $\pm$ 30   | LITCHFIELD          | 74C         | DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$ |
| 2025 $\pm$ 10   | LITCHFIELD          | 74D         | DPWA $K^- p \rightarrow \Lambda(1820)\pi^0$  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                     |             |  |
| 2027 to 2057  | GOYAL               | 77          | DPWA $K^- N \rightarrow \Sigma\pi$           |
| 2030  | DEBELLEFON          | 76          | IPWA $K^- p \rightarrow \Lambda\pi^0$        |

 **$\Sigma(2030)$  WIDTH**

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u>  | <u>TECN</u> | <u>COMMENT</u>                               |
|---|---------------------|-------------|--|
| <b>150 to 200 (<math>\approx</math> 180) OUR ESTIMATE</b> |                     |             |  |
| 172 $\pm$ 10  | GOPAL               | 80          | DPWA $\bar{K}N \rightarrow \bar{K}N$         |
| 137 $\pm$ 40  | CORDEN              | 77B         | $K^- N \rightarrow N\bar{K}^*$               |
| 190 $\pm$ 10  | GOPAL               | 77          | DPWA $\bar{K}N$ multichannel                 |
| 201 $\pm$ 9   | <sup>1</sup> CORDEN | 76          | DPWA $K^- n \rightarrow \Lambda\pi^-$        |
| 180 $\pm$ 20  | BAILLON             | 75          | IPWA $\bar{K}N \rightarrow \Lambda\pi$       |
| 172 $\pm$ 15  | HEMINGWAY           | 75          | DPWA $K^- p \rightarrow \bar{K}N$            |
| 178 $\pm$ 13  | VANHORN             | 75          | DPWA $K^- p \rightarrow \Lambda\pi^0$        |
| 111 $\pm$ 5   | KANE                | 74          | DPWA $K^- p \rightarrow \Sigma\pi$           |
| 160 $\pm$ 20  | LITCHFIELD          | 74B         | DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$  |
| 200 $\pm$ 30  | LITCHFIELD          | 74C         | DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$ |

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

|            |            |     |      |  |
|------------|------------|-----|------|--|
| 260        | DECLAIS    | 77  | DPWA | $\bar{K}N \rightarrow \bar{K}N$        |
| 126 to 195 | GOYAL      | 77  | DPWA | $K^- N \rightarrow \Sigma \pi$         |
| 160        | DEBELLEFON | 76  | IPWA | $K^- p \rightarrow \Lambda \pi^0$      |
| 70 to 125  | LITCHFIELD | 74D | DPWA | $K^- p \rightarrow \Lambda(1820)\pi^0$ |

### $\Sigma(2030)$ DECAY MODES

| Mode  | Fraction ( $\Gamma_i/\Gamma$ ) |
|---|--------------------------------|
| $\Gamma_1$ $N\bar{K}$   | 17–23 %                        |
| $\Gamma_2$ $\Lambda\pi$   | 17–23 %                        |
| $\Gamma_3$ $\Sigma\pi$  | 5–10 %                         |
| $\Gamma_4$ $\Xi K$  | <2 %                           |
| $\Gamma_5$ $\Sigma(1385)\pi$                                    | 5–15 %                         |
| $\Gamma_6$ $\Sigma(1385)\pi$ , <i>F</i> -wave                   |                                |
| $\Gamma_7$ $\Lambda(1520)\pi$                                   | 10–20 %                        |
| $\Gamma_8$ $\Lambda(1520)\pi$ , <i>D</i> -wave                  |                                |
| $\Gamma_9$ $\Lambda(1520)\pi$ , <i>G</i> -wave                  |                                |
| $\Gamma_{10}$ $\Delta(1232)\bar{K}$                             | 10–20 %                        |
| $\Gamma_{11}$ $\Delta(1232)\bar{K}$ , <i>F</i> -wave            |                                |
| $\Gamma_{12}$ $\Delta(1232)\bar{K}$ , <i>H</i> -wave            |                                |
| $\Gamma_{13}$ $N\bar{K}^*(892)$                                 | <5 %                           |
| $\Gamma_{14}$ $N\bar{K}^*(892)$ , <i>S</i> =1/2, <i>F</i> -wave |                                |
| $\Gamma_{15}$ $N\bar{K}^*(892)$ , <i>S</i> =3/2, <i>F</i> -wave |                                |
| $\Gamma_{16}$ $\Lambda(1820)\pi$ , <i>P</i> -wave               |                                |

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

### $\Sigma(2030)$ BRANCHING RATIOS

See “Sign conventions for resonance couplings” in the Note on  $\Lambda$  and  $\Sigma$  Resonances.

| $\Gamma(N\bar{K})/\Gamma_{\text{total}}$                                      |             |      |                                      | $\Gamma_1/\Gamma$ |
|---|-------------|------|--------------------------------------|-------------------|
| VALUE   | DOCUMENT ID | TECN | COMMENT                              |                   |
| <b>0.17 to 0.23 OUR ESTIMATE</b>  |             |      |                                      |                   |
| 0.19±0.03   | GOPAL       | 80   | DPWA $\bar{K}N \rightarrow \bar{K}N$ |                   |
| 0.18±0.03   | HEMINGWAY   | 75   | DPWA $K^- p \rightarrow \bar{K}N$    |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                      |                   |
| 0.15  | DECLAIS     | 77   | DPWA $\bar{K}N \rightarrow \bar{K}N$ |                   |
| 0.24±0.02   | GOPAL       | 77   | DPWA See GOPAL 80                    |                   |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Lambda\pi$ |                     |      |         | $(\Gamma_1 \Gamma_2)^{1/2} / \Gamma$ |
|---|---------------------|------|---------|--------------------------------------|
| VALUE   | DOCUMENT ID         | TECN | COMMENT |                                      |
| +0.18 ± 0.02  | GOPAL               | 77   | DPWA    | $\bar{K}N$ multichannel              |
| +0.20 ± 0.01  | <sup>1</sup> CORDEN | 76   | DPWA    | $K^- n \rightarrow \Lambda\pi^-$     |
| +0.18 ± 0.02  | BAILLON             | 75   | IPWA    | $\bar{K}N \rightarrow \Lambda\pi$    |
| +0.20 ± 0.01  | VANHORN             | 75   | DPWA    | $K^- p \rightarrow \Lambda\pi^0$     |
| +0.195 ± 0.053  | DEVENISH            | 74B  |         | Fixed- $t$ dispersion rel.           |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                     |                     |      |         |                                      |
| 0.20  | DEBELLEFON          | 76   | IPWA    | $K^- p \rightarrow \Lambda\pi^0$     |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Sigma\pi$ |                     |      |         | $(\Gamma_1 \Gamma_3)^{1/2} / \Gamma$ |
|--|---------------------|------|---------|--------------------------------------|
| VALUE  | DOCUMENT ID         | TECN | COMMENT |                                      |
| -0.09 ± 0.01   | <sup>2</sup> CORDEN | 77C  |         | $K^- n \rightarrow \Sigma\pi$        |
| -0.06 ± 0.01   | <sup>2</sup> CORDEN | 77C  |         | $K^- n \rightarrow \Sigma\pi$        |
| -0.15 ± 0.03   | GOPAL               | 77   | DPWA    | $\bar{K}N$ multichannel              |
| -0.10 ± 0.01   | KANE                | 74   | DPWA    | $K^- p \rightarrow \Sigma\pi$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                    |                     |      |         |                                      |
| -0.085 ± 0.02  | <sup>3</sup> GOYAL  | 77   | DPWA    | $K^- N \rightarrow \Sigma\pi$        |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Xi K$ |             |      |         | $(\Gamma_1 \Gamma_4)^{1/2} / \Gamma$ |
|--|-------------|------|---------|--------------------------------------|
| VALUE  | DOCUMENT ID | TECN | COMMENT |                                      |
| 0.023  | MULLER      | 69B  | DPWA    | $K^- p \rightarrow \Xi K$            |
| <0.05  | BURGUN      | 68   | DPWA    | $K^- p \rightarrow \Xi K$            |
| <0.05  | TRIPP       | 67   | RVUE    | $K^- p \rightarrow \Xi K$            |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Lambda(1820)\pi$ , $P$ -wave |             |      |         | $(\Gamma_1 \Gamma_{16})^{1/2} / \Gamma$ |
|---|-------------|------|---------|---|
| VALUE   | DOCUMENT ID | TECN | COMMENT |   |
| 0.14 ± 0.02   | CORDEN      | 75B  | DBC     | $K^- n \rightarrow N\bar{K}\pi^-$       |
| 0.18 ± 0.04   | LITCHFIELD  | 74D  | DPWA    | $K^- p \rightarrow \Lambda(1820)\pi^0$  |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Lambda(1520)\pi$ , $D$ -wave |                      |      |         | $(\Gamma_1 \Gamma_8)^{1/2} / \Gamma$   |
|---|----------------------|------|---------|--|
| VALUE   | DOCUMENT ID          | TECN | COMMENT |  |
| +0.114 ± 0.010  | <sup>4</sup> CAMERON | 77   | DPWA    | $K^- p \rightarrow \Lambda(1520)\pi^0$ |
| 0.14 ± 0.03   | LITCHFIELD           | 74B  | DPWA    | $K^- p \rightarrow \Lambda(1520)\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •   |                      |      |         |  |
| 0.10 ± 0.03   | <sup>5</sup> CORDEN  | 75B  | DBC     | $K^- n \rightarrow N\bar{K}\pi^-$      |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Lambda(1520)\pi$ , $G$ -wave |                      |      |         | $(\Gamma_1 \Gamma_9)^{1/2} / \Gamma$   |
|---|----------------------|------|---------|--|
| VALUE   | DOCUMENT ID          | TECN | COMMENT |  |
| +0.146 ± 0.010  | <sup>4</sup> CAMERON | 77   | DPWA    | $K^- p \rightarrow \Lambda(1520)\pi^0$ |
| 0.02 ± 0.02   | LITCHFIELD           | 74B  | DPWA    | $K^- p \rightarrow \Lambda(1520)\pi^0$ |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Delta(1232)\bar{K}$ , $F$ -wave |                     |      |         | $(\Gamma_1 \Gamma_{11})^{1/2} / \Gamma$ |
|--|---------------------|------|---------|---|
| VALUE  | DOCUMENT ID         | TECN | COMMENT |   |
| 0.16 ± 0.03  | LITCHFIELD          | 74C  | DPWA    | $K^- p \rightarrow \Delta(1232)\bar{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •  |                     |      |         |   |
| 0.17 ± 0.03  | <sup>5</sup> CORDEN | 75B  | DBC     | $K^- n \rightarrow N\bar{K}\pi^-$       |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Delta(1232)\bar{K}$ , <i>H-wave</i> | $(\Gamma_1 \Gamma_{12})^{1/2} / \Gamma$                     |
|--|---|
| VALUE  | DOCUMENT ID TECN COMMENT                                    |
| $0.00 \pm 0.02$  | LITCHFIELD 74C DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$ |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Sigma(1385)\pi$ | $(\Gamma_1 \Gamma_5)^{1/2} / \Gamma$                             |
|--|--|
| VALUE  | DOCUMENT ID TECN COMMENT   |
| $+0.153 \pm 0.026$   | <sup>4</sup> CAMERON 78 DPWA $K^- p \rightarrow \Sigma(1385)\pi$ |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow N\bar{K}^*(892)$ , <i>S=1/2, F-wave</i> | $(\Gamma_1 \Gamma_{14})^{1/2} / \Gamma$                      |
|---|--|
| VALUE   | DOCUMENT ID TECN COMMENT                                     |
| $+0.06 \pm 0.03$  | <sup>4</sup> CAMERON 78B DPWA $K^- p \rightarrow N\bar{K}^*$ |
| $-0.02 \pm 0.01$  | CORDEN 77B $K^- d \rightarrow NN\bar{K}^*$                   |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(2030) \rightarrow N\bar{K}^*(892)$ , <i>S=3/2, F-wave</i> | $(\Gamma_1 \Gamma_{15})^{1/2} / \Gamma$                      |
|---|--|
| VALUE   | DOCUMENT ID TECN COMMENT                                     |
| $+0.04 \pm 0.03$  | <sup>6</sup> CAMERON 78B DPWA $K^- p \rightarrow N\bar{K}^*$ |
| $-0.12 \pm 0.02$  | CORDEN 77B $K^- d \rightarrow NN\bar{K}^*$                   |

### $\Sigma(2030)$ FOOTNOTES

- <sup>1</sup> Preferred solution 3; see CORDEN 76 for other possibilities.
- <sup>2</sup> The two entries for CORDEN 77C are from two different acceptable solutions.
- <sup>3</sup> This coupling is extracted from unnormalized data.
- <sup>4</sup> The published sign has been changed to be in accord with the baryon-first convention.
- <sup>5</sup> An upper limit.
- <sup>6</sup> The upper limit on the  $G_3$  wave is 0.03.

### $\Sigma(2030)$ REFERENCES

|            |     |                     |   |                         |
|------------|-----|---------------------|---|-------------------------|
| PDG        | 84  | RMP 56 No. 2 Pt. II | C.G. Wohl <i>et al.</i>                     | (LBL, CIT, CERN)        |
| PDG        | 82  | PL 111B             | M. Roos <i>et al.</i>                       | (HELS, CIT, CERN)       |
| GOPAL      | 80  | Toronto Conf. 159   | G.P. Gopal                                  | (RHEL) IJP              |
| CAMERON    | 78  | NP B143 189         | W. Cameron <i>et al.</i>                    | (RHEL, LOIC) IJP        |
| CAMERON    | 78B | NP B146 327         | W. Cameron <i>et al.</i>                    | (RHEL, LOIC) IJP        |
| CAMERON    | 77  | NP B131 399         | W. Cameron <i>et al.</i>                    | (RHEL, LOIC) IJP        |
| CORDEN     | 77B | NP B121 365         | M.J. Corden <i>et al.</i>                   | (BIRM) IJP              |
| CORDEN     | 77C | NP B125 61          | M.J. Corden <i>et al.</i>                   | (BIRM) IJP              |
| DECLAIS    | 77  | CERN 77-16          | Y. Declais <i>et al.</i>                    | (CAEN, CERN) IJP        |
| GOPAL      | 77  | NP B119 362         | G.P. Gopal <i>et al.</i>                    | (LOIC, RHEL) IJP        |
| GOYAL      | 77  | PR D16 2746         | D.P. Goyal, A.V. Sodhi                      | (DELH) IJP              |
| CORDEN     | 76  | NP B104 382         | M.J. Corden <i>et al.</i>                   | (BIRM) IJP              |
| DEBELLEFON | 76  | NP B109 129         | A. de Bellefon, A. Berthon                  | (CDEF) IJP              |
| BAILLON    | 75  | NP B94 39           | P.H. Baillon, P.J. Litchfield               | (CERN, RHEL) IJP        |
| CORDEN     | 75B | NP B92 365          | M.J. Corden <i>et al.</i>                   | (BIRM) IJP              |
| HEMINGWAY  | 75  | NP B91 12           | R.J. Hemingway <i>et al.</i>                | (CERN, HEIDH, MPIM) IJP |
| VANHORN    | 75  | NP B87 145          | A.J. van Horn                               | (LBL) IJP               |
| Also       | 75B | NP B87 157          | A.J. van Horn                               | (LBL) IJP               |
| DEVENISH   | 74B | NP B81 330          | R.C.E. Devenish, C.D. Froggatt, B.R. Martin | (DESY+)                 |
| KANE       | 74  | LBL-2452            | D.F. Kane                                   | (LBL) IJP               |

|            |     |                   |   |                    |
|------------|-----|-------------------|---|--------------------|
| LITCHFIELD | 74B | NP B74 19         | P.J. Litchfield <i>et al.</i>           | (CERN, HEIDH) IJP  |
| LITCHFIELD | 74C | NP B74 39         | P.J. Litchfield <i>et al.</i>           | (CERN, HEIDH) IJP  |
| LITCHFIELD | 74D | NP B74 12         | P.J. Litchfield <i>et al.</i>           | (CERN, HEIDH) IJP  |
| MULLER     | 69B | Thesis UCRL 19372 | R.A. Muller                             | (LRL)              |
| BURGUN     | 68  | NP B8 447         | G. Burgun <i>et al.</i>                 | (SACL, CDEF, RHEL) |
| TRIPP      | 67  | NP B3 10          | R.D. Tripp <i>et al.</i>                | (LRL, SLAC, CERN+) |
| COOL       | 66  | PRL 16 1228       | R.L. Cool <i>et al.</i>                 | (BNL)              |
| WOHL       | 66  | PRL 17 107        | C.G. Wohl, F.T. Solmitz, M.L. Stevenson | (LRL) IJP          |

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