# $\Sigma(2030)$ $F_{17}$

$I(J^P) = 1(\frac{7}{2}^+)$ 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

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

## $\Sigma(2030)$ WIDTH

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

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

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

## $\Sigma(2030)$ DECAY MODES

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

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.17 to 0.23 OUR ESTIMATE** | | | | |
| 0.19±0.03 | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.18±0.03 | HEMINGWAY | 75 | DPWA | $K^- p \to \overline{K}N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.15 | DECLAIS | 77 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.24±0.02 | GOPAL | 77 | DPWA | See GOPAL 80 |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.18 ±0.02 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| +0.20 ±0.01 | [1] CORDEN | 76 | DPWA | $K^- n \to \Lambda\pi^-$ |
| +0.18 ±0.02 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| +0.20 ±0.01 | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| +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 | $K^- p \to \Lambda\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.09 ±0.01 | [2] CORDEN | 77C | | $K^- n \to \Sigma\pi$ |
| −0.06 ±0.01 | [2] CORDEN | 77C | | $K^- n \to \Sigma\pi$ |
| −0.15 ±0.03 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.10 ±0.01 | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.085±0.02 | [3] GOYAL | 77 | DPWA | $K^- N \to \Sigma\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Xi K$ — $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.023 | MULLER | 69B | DPWA | $K^- p \to \Xi K$ |
| <0.05 | BURGUN | 68 | DPWA | $K^- p \to \Xi K$ |
| <0.05 | TRIPP | 67 | RVUE | $K^- p \to \Xi K$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Lambda(1820)\pi$, *P*-wave — $(\Gamma_1\Gamma_{16})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.14±0.02 | CORDEN | 75B | DBC | $K^- n \to N\overline{K}\pi^-$ |
| 0.18±0.04 | LITCHFIELD | 74D | DPWA | $K^- p \to \Lambda(1820)\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Lambda(1520)\pi$, *D*-wave — $(\Gamma_1\Gamma_8)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.114±0.010 | [4] CAMERON | 77 | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| 0.14 ±0.03 | LITCHFIELD | 74B | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.10 ±0.03 | [5] CORDEN | 75B | DBC | $K^- n \to N\overline{K}\pi^-$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Lambda(1520)\pi$, *G*-wave — $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.146±0.010 | [4] CAMERON | 77 | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| 0.02 ±0.02 | LITCHFIELD | 74B | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Delta(1232)\overline{K}$, *F*-wave — $(\Gamma_1\Gamma_{11})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.16±0.03 | LITCHFIELD | 74C | DPWA | $K^- p \to \Delta(1232)\overline{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.17±0.03 | [5] CORDEN | 75B | DBC | $K^- n \to N\overline{K}\pi^-$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Delta(1232)\overline{K}$, *H*-wave $(\Gamma_1\Gamma_{12})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.00 ± 0.02 | LITCHFIELD | 74C | DPWA | $K^- p \to \Delta(1232)\overline{K}$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to \Sigma(1385)\pi$ $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.153 ± 0.026 | [4] CAMERON | 78 | DPWA | $K^- p \to \Sigma(1385)\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to N\overline{K}^*(892)$, *S*=1/2, *F*-wave $(\Gamma_1\Gamma_{14})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.06 ± 0.03 | [4] CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |
| −0.02 ± 0.01 | CORDEN | 77B | | $K^- d \to NN\overline{K}^*$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(2030) \to N\overline{K}^*(892)$, *S*=3/2, *F*-wave $(\Gamma_1\Gamma_{15})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.04 ± 0.03 | [6] CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |
| −0.12 ± 0.02 | CORDEN | 77B | | $K^- d \to NN\overline{K}^*$ |

## Σ(2030) FOOTNOTES

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

## Σ(2030) REFERENCES


| | | | | |
|---|---|---|---|---|
| PDG | 84 | RMP 56 No. 2 Pt. II | Wohl, Cahn, Rittenberg+ | (LBL, CIT, CERN) |
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) IJP |
| CAMERON | 78 | NP B143 189 | +Franek, Gopal, Bacon, Butterworth+ | (RHEL, LOIC) IJP |
| CAMERON | 78B | NP B146 327 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| CAMERON | 77 | NP B131 399 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| CORDEN | 77B | NP B121 365 | +Cox, Kenyon, O'Neale, Stubbs, Sumorok+ | (BIRM) IJP |
| CORDEN | 77C | NP B125 61 | +Cox, Kenyon, O'Neale, Stubbs, Sumorok+ | (BIRM) IJP |
| DECLAIS | 77 | CERN 77-16 | +Duchon, Louvel, Patry, Seguinot+ | (CAEN, CERN) IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| GOYAL | 77 | PR D16 2746 | +Sodhi | (DELH) IJP |
| CORDEN | 76 | NP B104 382 | +Cox, Dartnell, Kenyon, O'Neale+ | (BIRM) IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |

| | | | | | |
|---|---|---|---|---|---|
| CORDEN | 75B | NP B92 365 | +Cox, Dartnell, Kenyon, O'Neale+ | (BIRM) | IJP |
| HEMINGWAY | 75 | NP B91 12 | +Eades, Harmsen+ | (CERN, HEIDH, MPIM) | IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) | IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) | IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) | |
| KANE | 74 | LBL-2452 | | (LBL) | IJP |
| LITCHFIELD | 74B | NP B74 19 | +Hemingway, Baillon+ | (CERN, HEIDH) | IJP |
| LITCHFIELD | 74C | NP B74 39 | +Hemingway, Baillon+ | (CERN, HEIDH) | IJP |
| LITCHFIELD | 74D | NP B74 12 | +Hemingway, Baillon+ | (CERN, HEIDH) | IJP |
| MULLER | 69B | Thesis UCRL 19372 | | (LRL) | |
| BURGUN | 68 | NP B8 447 | +Meyer, Pauli, Tallini+ | (SACL, CDEF, RHEL) | |
| TRIPP | 67 | NP B3 10 | +Leith+ | (LRL, SLAC, CERN, HEID, SACL) | |
| COOL | 66 | PRL 16 1228 | +Giacomelli, Kycia, Leontic, Lundby+ | (BNL) | |
| WOHL | 66 | PRL 17 107 | +Solmitz, Stevenson | (LRL) | IJP |