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

$I(J^P) = 1(\frac{7}{2}^+)$ 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** 1 (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** S1 (1984).

## $\Sigma(2030)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **2025 to 2040 (≈ 2030) OUR ESTIMATE** | | | | |
| 2036± 5 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 2038±10 | CORDEN | 77B | | $K^-N \rightarrow N\overline{K}^*$ |
| 2040± 5 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 2030± 3 | [1] CORDEN | 76 | DPWA | $K^-n \rightarrow \Lambda\pi^-$ |
| 2035±15 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ |
| 2038±10 | HEMINGWAY | 75 | DPWA | $K^-p \rightarrow \overline{K}N$ |
| 2042±11 | VANHORN | 75 | DPWA | $K^-p \rightarrow \Lambda\pi^0$ |
| 2020± 6 | KANE | 74 | DPWA | $K^-p \rightarrow \Sigma\pi$ |
| 2035±10 | LITCHFIELD | 74B | DPWA | $K^-p \rightarrow \Lambda(1520)\pi^0$ |
| 2020±30 | LITCHFIELD | 74C | DPWA | $K^-p \rightarrow \Delta(1232)\overline{K}$ |
| 2025±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

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

• • • 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 $K^-p \to \Lambda(1820)\pi^0$ |

## Σ(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.

## Σ(2030) BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on Λ and Σ 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 |
|---|---|---|---|---|
| $+0.18 \pm 0.02$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $+0.20 \pm 0.01$ | [1] CORDEN | 76 | DPWA | $K^- n \to \Lambda\pi^-$ |
| $+0.18 \pm 0.02$ | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $+0.20 \pm 0.01$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| $+0.195 \pm 0.053$ | 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 |
|---|---|---|---|---|
| $-0.09 \pm 0.01$ | [2] CORDEN | 77C | | $K^- n \to \Sigma\pi$ |
| $-0.06 \pm 0.01$ | [2] CORDEN | 77C | | $K^- n \to \Sigma\pi$ |
| $-0.15 \pm 0.03$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.10 \pm 0.01$ | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-0.085 \pm 0.02$ | [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 |
|---|---|---|---|---|
| $0.14 \pm 0.02$ | CORDEN | 75B | DBC | $K^- n \to N\overline{K}\pi^-$ |
| $0.18 \pm 0.04$ | 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 |
|---|---|---|---|---|
| $+0.114 \pm 0.010$ | [4] CAMERON | 77 | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| $0.14 \pm 0.03$ | LITCHFIELD | 74B | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $0.10 \pm 0.03$ | [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 |
|---|---|---|---|---|
| $+0.146 \pm 0.010$ | [4] CAMERON | 77 | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| $0.02 \pm 0.02$ | 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 |
|---|---|---|---|---|
| $0.16 \pm 0.03$ | LITCHFIELD | 74C | DPWA | $K^- p \to \Delta(1232)\overline{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $0.17 \pm 0.03$ | [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 |
|---|---|---|---|---|
| $0.00 \pm 0.02$ | 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 |
|---|---|---|---|---|
| $+0.153 \pm 0.026$ | [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 |
|---|---|---|---|---|
| $+0.06 \pm 0.03$ | [4] CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |
| $-0.02 \pm 0.01$ | 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 |
|---|---|---|---|---|
| $+0.04 \pm 0.03$ | [6] CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |
| $-0.12 \pm 0.02$ | CORDEN | 77B | | $K^- d \to NN\overline{K}^*$ |

## $\Sigma(2030)$ 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.

## $\Sigma(2030)$ REFERENCES


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| GOPAL | 80 | Toronto Conf. 159 | G.P. Gopal | (RHEL) IJP |
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| CAMERON | 77 | NP B131 399 | W. Cameron *et al.* | (RHEL, LOIC) IJP |
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| GOPAL | 77 | NP B119 362 | G.P. Gopal *et al.* | (LOIC, RHEL) IJP |
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| BAILLON | 75 | NP B94 39 | P.H. Baillon, P.J. Litchfield | (CERN, RHEL) IJP |
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| LITCHFIELD | 74B | NP B74 19 | P.J. Litchfield *et al.* | (CERN, HEIDH) IJP |
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| MULLER | 69B | Thesis UCRL 19372 | R.A. Muller | (LRL) |
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