# $\Sigma(1940)\ D_{13}$

$I(J^P) = 1(\frac{3}{2}^-)$ Status: ***

For results published before 1974 (they are now obsolete), see our 1982 edition Physics Letters **111B** (1982).

Not all analyses require this state. It is not required by the GOYAL 77 analysis of $K^- n \to (\Sigma\pi)^-$ nor by the GOPAL 80 analysis of $K^- n \to K^- n$. See also HEMINGWAY 75.

## $\Sigma(1940)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1900 to 1950 (≈ 1940) OUR ESTIMATE** | | | | |
| 1920±50 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 1950±30 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $1949^{+40}_{-60}$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| 1935±80 | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| 1940±20 | LITCHFIELD | 74B | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| 1950±20 | LITCHFIELD | 74C | DPWA | $K^- p \to \Delta(1232)\overline{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1886 or 1893 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 1940 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$, $F_{17}$ wave |

## $\Sigma(1940)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **150 to 300 (≈ 220) OUR ESTIMATE** | | | | |
| 170±25 | CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |
| 300±80 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 150±75 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $160^{+70}_{-40}$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| 330±80 | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| 60±20 | LITCHFIELD | 74B | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| $70^{+30}_{-20}$ | LITCHFIELD | 74C | DPWA | $K^- p \to \Delta(1232)\overline{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 157 or 159 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

## $\Sigma(1940)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | <20 % |
| $\Gamma_2$ | $\Lambda\pi$ | seen |
| $\Gamma_3$ | $\Sigma\pi$ | seen |
| $\Gamma_4$ | $\Sigma(1385)\pi$ | seen |
| $\Gamma_5$ | $\Sigma(1385)\pi$, $S$-wave | |
| $\Gamma_6$ | $\Lambda(1520)\pi$ | seen |
| $\Gamma_7$ | $\Lambda(1520)\pi$, $P$-wave | |
| $\Gamma_8$ | $\Lambda(1520)\pi$, $F$-wave | |
| $\Gamma_9$ | $\Delta(1232)\overline{K}$ | seen |
| $\Gamma_{10}$ | $\Delta(1232)\overline{K}$, $S$-wave | |
| $\Gamma_{11}$ | $\Delta(1232)\overline{K}$, $D$-wave | |
| $\Gamma_{12}$ | $N\overline{K}^*(892)$ | seen |
| $\Gamma_{13}$ | $N\overline{K}^*(892)$, $S$=3/2, $S$-wave | |

## $\Sigma(1940)$ 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 |
|---|---|---|---|---|
| **<0.2 OUR ESTIMATE** | | | | |
| <0.04 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 0.14 or 0.13 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to \Lambda\pi$ $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.06 \pm 0.03$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.04 \pm 0.02$ | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $-0.05\ ^{+0.03}_{-0.02}$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| $-0.153 \pm 0.070$ | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-0.15$ or $-0.14$ | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to \Sigma\pi$ $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.08 \pm 0.04$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.14 \pm 0.04$ | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $+0.16$ or $+0.16$ | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to \Lambda(1520)\pi$, $P$-wave $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| < 0.03 | CAMERON | 77 | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| $-0.11 \pm 0.04$ | LITCHFIELD | 74B | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to \Lambda(1520)\pi$, $F$-wave $(\Gamma_1\Gamma_8)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $0.062 \pm 0.021$ | CAMERON | 77 | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |
| $-0.08 \pm 0.04$ | LITCHFIELD | 74B | DPWA | $K^- p \to \Lambda(1520)\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to \Delta(1232)\overline{K}$, $S$-wave $(\Gamma_1\Gamma_{10})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.16 \pm 0.05$ | LITCHFIELD | 74C | DPWA | $K^- p \to \Delta(1232)\overline{K}$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to \Delta(1232)\overline{K}$, $D$-wave $(\Gamma_1\Gamma_{11})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.14 \pm 0.05$ | LITCHFIELD | 74C | DPWA | $K^- p \to \Delta(1232)\overline{K}$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to \Sigma(1385)\pi$ $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $+0.066 \pm 0.025$ | [2] CAMERON | 78 | DPWA | $K^- p \to \Sigma(1385)\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to N\overline{K}^*(892)$ $(\Gamma_1\Gamma_{12})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.09 \pm 0.02$ | [3] CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |

## $\Sigma(1940)$ FOOTNOTES

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] The published sign has been changed to be in accord with the baryon-first convention.
[3] Upper limits on the $D_1$ and $D_3$ waves are each 0.03.

## Σ(1940) REFERENCES


| | | | | |
|---|---|---|---|---|
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) |
| 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 |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| GOYAL | 77 | PR D16 2746 | +Sodhi | (DELH) |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) 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 |