

$\Sigma(1940) D_{13}$  $I(J^P) = 1(\frac{3}{2}^-)$  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  $K^- n \rightarrow (\Sigma\pi)^-$  nor by the GOPAL 80 analysis of  $K^- n \rightarrow K^- n$ . See also HEMINGWAY 75.

 **$\Sigma(1940)$  MASS**

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u>  | <u>TECN</u> | <u>COMMENT</u>  |
|---|---------------------|-------------|---|
| <b>1900 to 1950 (<math>\approx</math> 1940) OUR ESTIMATE</b>                  |                     |             |   |
| 1920 $\pm$ 50   | GOPAL               | 77          | DPWA $\bar{K}N$ multichannel                          |
| 1950 $\pm$ 30   | BAILLON             | 75          | IPWA $\bar{K}N \rightarrow \Lambda\pi$                |
| 1949 <sup>+40</sup> <sub>-60</sub>  | VANHORN             | 75          | DPWA $K^- p \rightarrow \Lambda\pi^0$                 |
| 1935 $\pm$ 80   | KANE                | 74          | DPWA $K^- p \rightarrow \Sigma\pi$                    |
| 1940 $\pm$ 20   | LITCHFIELD          | 74B         | DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$           |
| 1950 $\pm$ 20   | LITCHFIELD          | 74C         | DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$          |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                     |             |   |
| 1886 or 1893  | <sup>1</sup> MARTIN | 77          | DPWA $\bar{K}N$ multichannel                          |
| 1940  | DEBELLEFON          | 76          | IPWA $K^- p \rightarrow \Lambda\pi^0, F_{17}$<br>wave |

 **$\Sigma(1940)$  WIDTH**

| <u>VALUE (MeV)</u>  | <u>DOCUMENT ID</u>  | <u>TECN</u> | <u>COMMENT</u>                               |
|---|---------------------|-------------|--|
| <b>150 to 300 (<math>\approx</math> 220) OUR ESTIMATE</b>                     |                     |             |  |
| 170 $\pm$ 25  | CAMERON             | 78B         | DPWA $K^- p \rightarrow N\bar{K}^*$          |
| 300 $\pm$ 80  | GOPAL               | 77          | DPWA $\bar{K}N$ multichannel                 |
| 150 $\pm$ 75  | BAILLON             | 75          | IPWA $\bar{K}N \rightarrow \Lambda\pi$       |
| 160 <sup>+70</sup> <sub>-40</sub>   | VANHORN             | 75          | DPWA $K^- p \rightarrow \Lambda\pi^0$        |
| 330 $\pm$ 80  | KANE                | 74          | DPWA $K^- p \rightarrow \Sigma\pi$           |
| 60 $\pm$ 20   | LITCHFIELD          | 74B         | DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$  |
| 70 <sup>+30</sup> <sub>-20</sub>  | LITCHFIELD          | 74C         | DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                     |             |  |
| 157 or 159  | <sup>1</sup> MARTIN | 77          | DPWA $\bar{K}N$ multichannel                 |

## Σ(1940) DECAY MODES

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

## Σ(1940) BRANCHING RATIOS

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

| $\Gamma(N\bar{K})/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$   |
|--|---|
| <u>VALUE</u>                             | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>             |
| <b>&lt;0.2 OUR ESTIMATE</b>              |   |
| <0.04                                    | GOPAL    77    DPWA $\bar{K}N$ multichannel               |
| 0.14 or 0.13                             | <sup>1</sup> MARTIN    77    DPWA $\bar{K}N$ multichannel |

| $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Lambda\pi$ | $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$                         |
|--|---|
| <u>VALUE</u>   | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>             |
| $-0.06 \pm 0.03$   | GOPAL    77    DPWA $\bar{K}N$ multichannel               |
| $-0.04 \pm 0.02$   | BAILLON    75    IPWA $\bar{K}N \rightarrow \Lambda\pi$   |
| $-0.05^{+0.03}_{-0.02}$  | VANHORN    75    DPWA $K^-p \rightarrow \Lambda\pi^0$     |
| $-0.153 \pm 0.070$   | DEVENISH    74B    Fixed- <i>t</i> dispersion rel.        |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                  |   |
| $-0.15$ or $-0.14$   | <sup>1</sup> MARTIN    77    DPWA $\bar{K}N$ multichannel |

| $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Sigma\pi$ | $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$                         |
|---|---|
| <u>VALUE</u>  | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>             |
| $-0.08 \pm 0.04$  | GOPAL    77    DPWA $\bar{K}N$ multichannel               |
| $-0.14 \pm 0.04$  | KANE    74    DPWA $K^-p \rightarrow \Sigma\pi$           |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                 |   |
| $+0.16$ or $+0.16$  | <sup>1</sup> MARTIN    77    DPWA $\bar{K}N$ multichannel |

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Lambda(1520)\pi$ , <i>P-wave</i> | $(\Gamma_1 \Gamma_7)^{1/2} / \Gamma$                       |
|---|--|
| VALUE   | DOCUMENT ID TECN COMMENT                                   |
| < 0.03  | CAMERON 77 DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$     |
| -0.11 ± 0.04  | LITCHFIELD 74B DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$ |

  

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Lambda(1520)\pi$ , <i>F-wave</i> | $(\Gamma_1 \Gamma_8)^{1/2} / \Gamma$                       |
|---|--|
| VALUE   | DOCUMENT ID TECN COMMENT                                   |
| 0.062 ± 0.021   | CAMERON 77 DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$     |
| -0.08 ± 0.04  | LITCHFIELD 74B DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$ |

  

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Delta(1232)\bar{K}$ , <i>S-wave</i> | $(\Gamma_1 \Gamma_{10})^{1/2} / \Gamma$                     |
|--|---|
| VALUE  | DOCUMENT ID TECN COMMENT                                    |
| -0.16 ± 0.05   | LITCHFIELD 74C DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$ |

  

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Delta(1232)\bar{K}$ , <i>D-wave</i> | $(\Gamma_1 \Gamma_{11})^{1/2} / \Gamma$                     |
|--|---|
| VALUE  | DOCUMENT ID TECN COMMENT                                    |
| -0.14 ± 0.05   | LITCHFIELD 74C DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$ |

  

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Sigma(1385)\pi$ | $(\Gamma_1 \Gamma_4)^{1/2} / \Gamma$                             |
|--|--|
| VALUE  | DOCUMENT ID TECN COMMENT   |
| +0.066 ± 0.025   | <sup>2</sup> CAMERON 78 DPWA $K^- p \rightarrow \Sigma(1385)\pi$ |

  

| $(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1940) \rightarrow N\bar{K}^*(892)$ | $(\Gamma_1 \Gamma_{12})^{1/2} / \Gamma$                      |
|--|--|
| VALUE  | DOCUMENT ID TECN COMMENT                                     |
| -0.09 ± 0.02   | <sup>3</sup> CAMERON 78B DPWA $K^- p \rightarrow N\bar{K}^*$ |

### Σ(1940) FOOTNOTES

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

### Σ(1940) REFERENCES

|            |     |                   |   |                         |
|------------|-----|-------------------|---|-------------------------|
| PDG        | 82  | PL 111B           | M. Roos <i>et al.</i>                       | (HELS, CIT, CERN)       |
| GOPAL      | 80  | Toronto Conf. 159 | G.P. Gopal                                  | (RHEL)                  |
| 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        |
| 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)                  |
| MARTIN     | 77  | NP B127 349       | B.R. Martin, M.K. Pidcock, R.G. Moorhouse   | (LOUC+) IJP             |
| Also       | 77B | NP B126 266       | B.R. Martin, M.K. Pidcock                   | (LOUC)                  |
| Also       | 77C | NP B126 285       | B.R. Martin, M.K. Pidcock                   | (LOUC) 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        |
| 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+) IJP             |
| 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       |