

$\Sigma(1940) D_{13}$

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

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>1900 to 1950 (<math>\approx 1940</math>) 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 $K^- p \rightarrow \Lambda\pi^0, F_{17}$ wave

### $\Sigma(1940)$ WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>150 to 300 (<math>\approx 220</math>) 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

## $\Sigma(1940)$ 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
$\Gamma_{13}$ $N\bar{K}^*(892)$ , <i>S</i> =3/2, <i>S</i> -wave	

## $\Sigma(1940)$ 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