

$\Sigma(1940) 3/2^-$ $I(J^P) = 1(\frac{3}{2}^-)$ Status: ***

For results published before 1974 (they are now obsolete), see our 1982 edition Physics Letters **111B** 1 (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>
1900 to 1950 (≈ 1940) OUR ESTIMATE			
1920 \pm 50	GOPAL	77	DPWA $\bar{K}N$ multichannel
1950 \pm 30	BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
1949 ⁺⁴⁰ ₋₆₀	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	¹ MARTIN	77	DPWA $\bar{K}N$ multichannel
1940	DEBELLEFON	76	IPWA $K^- p \rightarrow \Lambda\pi^0, F_{17}$ wave

 $\Sigma(1940)$ WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
150 to 300 (≈ 220) OUR ESTIMATE			
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 ⁺⁷⁰ ₋₄₀	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 ⁺³⁰ ₋₂₀	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	¹ MARTIN	77	DPWA $\bar{K}N$ multichannel

Σ(1940) DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\bar{K}$	<20 %
Γ_2 $\Lambda\pi$	seen
Γ_3 $\Sigma\pi$	seen
Γ_4 $\Sigma(1385)\pi$	seen
Γ_5 $\Sigma(1385)\pi$, <i>S</i> -wave	
Γ_6 $\Lambda(1520)\pi$	seen
Γ_7 $\Lambda(1520)\pi$, <i>P</i> -wave	
Γ_8 $\Lambda(1520)\pi$, <i>F</i> -wave	
Γ_9 $\Delta(1232)\bar{K}$	seen
Γ_{10} $\Delta(1232)\bar{K}$, <i>S</i> -wave	
Γ_{11} $\Delta(1232)\bar{K}$, <i>D</i> -wave	
Γ_{12} $N\bar{K}^*(892)$	seen
Γ_{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 Λ and Σ Resonances.

$\Gamma(N\bar{K})/\Gamma_{\text{total}}$	Γ_1/Γ
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
<0.2 OUR ESTIMATE	
<0.04	GOPAL 77 DPWA $\bar{K}N$ multichannel
0.14 or 0.13	¹ 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 ± 0.03	GOPAL 77 DPWA $\bar{K}N$ multichannel
-0.04 ± 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 ± 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	¹ 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 ± 0.04	GOPAL 77 DPWA $\bar{K}N$ multichannel
-0.14 ± 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 $+0.16$	¹ MARTIN 77 DPWA $\bar{K}N$ multichannel

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

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 $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Lambda(1520)\pi$, *F-wave* $(\Gamma_1 \Gamma_8)^{1/2} / \Gamma$

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 $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Delta(1232)\bar{K}$, *S-wave* $(\Gamma_1 \Gamma_{10})^{1/2} / \Gamma$

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 $N\bar{K} \rightarrow \Sigma(1940) \rightarrow \Delta(1232)\bar{K}$, *D-wave* $(\Gamma_1 \Gamma_{11})^{1/2} / \Gamma$

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
$+0.066 \pm 0.025$	² 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	³ CAMERON 78B	DPWA	$K^- p \rightarrow N\bar{K}^*$

$\Sigma(1940)$ 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.

$\Sigma(1940)$ REFERENCES

PDG 82	PL 111B 1	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	NP B126 266	B.R. Martin, M.K. Pidcock	(LOUC)
Also	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	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