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

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

Σ(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	$\overline{K}N \rightarrow \Lambda\pi$
1949^{+40}_{-60}	VANHORN	75	DPWA	$K^- p \rightarrow \Lambda\pi^0$
1935±80	KANE	74	DPWA	$K^- p \rightarrow \Sigma\pi$
1940±20	LITCHFIELD	74B	DPWA	$K^- p \rightarrow \Lambda(1520)\pi^0$
1950±20	LITCHFIELD	74C	DPWA	$K^- p \rightarrow \Delta(1232)\overline{K}$
• • • 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	$K^- p \rightarrow \Lambda\pi^0$, F_{17} wave

Σ(1940) WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
150 to 300 (≈ 220) OUR ESTIMATE				
170±25	CAMERON	78B	DPWA	$K^- p \rightarrow N\overline{K}^*$
300±80	GOPAL	77	DPWA	$\overline{K}N$ multichannel
150±75	BAILLON	75	IPWA	$\overline{K}N \rightarrow \Lambda\pi$
160^{+70}_{-40}	VANHORN	75	DPWA	$K^- p \rightarrow \Lambda\pi^0$
330±80	KANE	74	DPWA	$K^- p \rightarrow \Sigma\pi$
60±20	LITCHFIELD	74B	DPWA	$K^- p \rightarrow \Lambda(1520)\pi^0$
70^{+30}_{-20}	LITCHFIELD	74C	DPWA	$K^- p \rightarrow \Delta(1232)\overline{K}$
• • • 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 (Γ_i/Γ)
Γ_1	$N\overline{K}$	<20 %
Γ_2	$\Lambda\pi$	seen
Γ_3	$\Sigma\pi$	seen
Γ_4	$\Sigma(1385)\pi$	seen
Γ_5	$\Sigma(1385)\pi$, S-wave	
Γ_6	$\Lambda(1520)\pi$	seen
Γ_7	$\Lambda(1520)\pi$, P-wave	
Γ_8	$\Lambda(1520)\pi$, F-wave	
Γ_9	$\Delta(1232)\overline{K}$	seen
Γ_{10}	$\Delta(1232)\overline{K}$, S-wave	
Γ_{11}	$\Delta(1232)\overline{K}$, D-wave	
Γ_{12}	$N\overline{K}^*(892)$	seen
Γ_{13}	$N\overline{K}^*(892)$, S=3/2, S-wave	

$\Sigma(1940)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on Λ and Σ Resonances.

$\Gamma(N\overline{K})/\Gamma_{\text{total}}$ — Γ_1/Γ

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
-0.06 ± 0.03	GOPAL	77	DPWA	$\overline{K}N$ multichannel
-0.04 ± 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 ± 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

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

VALUE	DOCUMENT ID		TECN	COMMENT
-0.08 ± 0.04	GOPAL	77	DPWA	$\overline{K}N$ multichannel
-0.14 ± 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 $N\overline{K} \rightarrow \Sigma(1940) \rightarrow \Lambda(1520)\pi$, *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	$K^- p \rightarrow \Lambda(1520)\pi^0$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(1940) \rightarrow \Lambda(1520)\pi$, *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	$K^- p \rightarrow \Lambda(1520)\pi^0$

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

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

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

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

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

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

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

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

$\Sigma(1940)$ 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.

$\Sigma(1940)$ 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