$\Sigma(1750)\ 1/2^-$

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

For most results published before 1974 (they are now obsolete), see our 1982 edition Physics Letters **111B** 1 (1982).

There is evidence for this state in many partial-wave analyses, but with wide variations in the mass, width, and couplings. The latest analyses indicated significant couplings to $N\overline{K}$ and $\Lambda\pi$, as well as to $\Sigma\eta$ whose threshold is at 1746 MeV (JONES 74).

Σ(1750) POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1689±11	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1704^{+3}_{-6}	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
1708	ZHANG	13A	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15. Solution B reports two poles at M = 1551^{+2}_{-9} MeV and 1940^{+2}_{-2} MeV.

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
206±18	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
86^{+14}_{-4}	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
158	ZHANG	13A	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15. Solution B Reports two poles with Γ = 376^{+12}_{-2} and 172^{+4}_{-4} MeV.

Σ(1750) POLE RESIDUES

The normalized residue is the residue divided by $\Gamma_{pole}/2$.

Normalized residue in $N\overline{K} \rightarrow \Sigma(1750) \rightarrow N\overline{K}$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.46 ±0.09	**−144 ± 15**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0982	178	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

Normalized residue in $N\overline{K} \rightarrow \Sigma(1750) \rightarrow \Sigma\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.27 ±0.05	**100 ± 18**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.192	137	[1] KAMANO	15	DPWA	Multichannel

[1] From the preferred solution A in KAMANO 15.

Normalized residue in $N\overline{K} \to \Sigma(1750) \to \Sigma\eta$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.05±0.03		SARANTSEV 19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1750) \to \Lambda\pi$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.26 ±0.06	**115 ± 15**	SARANTSEV 19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.207	169	[1] KAMANO 15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

Normalized residue in $N\overline{K} \to \Sigma(1750) \to \Xi K$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.02±0.02		SARANTSEV 19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1750) \to \Sigma(1385)\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.04 ±0.03		SARANTSEV 19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0536	73	[1] KAMANO 15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

Normalized residue in $N\overline{K} \to \Sigma(1750) \to \Lambda(1520)\pi$

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.15±0.07	**−25 ± 40**	SARANTSEV 19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1750) \to N\overline{K}^*(892)$, S=1/2, S-wave

MODULUS	PHASE (°)	DOCUMENT ID	TECN	COMMENT
0.05±0.03	**−100 ± 35**	SARANTSEV 19	DPWA	$\overline{K}N$ multichannel

Σ(1750) MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1700 to 1800 (≈ 1750) OUR ESTIMATE			
1692±11	SARANTSEV 19	DPWA	$\overline{K}N$ multichannel
1739± 8	ZHANG 13A	DPWA	$\overline{K}N$ multichannel
1756±10	GOPAL 80	DPWA	$\overline{K}N \to \overline{K}N$
1770±10	ALSTON-... 78	DPWA	$\overline{K}N \to \overline{K}N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1770±15	GOPAL 77	DPWA	$\overline{K}N$ multichannel
1800 or 1813	[1] MARTIN 77	DPWA	$\overline{K}N$ multichannel
1715±10	[2] CARROLL 76	DPWA	Isospin-1 total σ
1730	DEBELLEFON 76	IPWA	$K^- p \to \Lambda\pi^0$
1780±30	BAILLON 75	IPWA	$\overline{K}N \to \Lambda\pi$ (sol. 1)
1700±30	BAILLON 75	IPWA	$\overline{K}N \to \Lambda\pi$ (sol. 2)
1697^{+20}_{-10}	VANHORN 75	DPWA	$K^- p \to \Lambda\pi^0$
1785±12	CHU 74	DBC	Fits $\sigma(K^- n \to \Sigma^-\eta)$
1760± 5	[3] JONES 74	HBC	Fits $\sigma(K^- p \to \Sigma^0\eta)$
1739±10	PREVOST 74	DPWA	$K^- N \to \Sigma(1385)\pi$

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] A total cross-section bump with $(J+1/2)\ \Gamma_{el}\ /\ \Gamma_{total} = 0.30$.
[3] An S-wave Breit-Wigner fit to the threshold cross section with no background and errors statistical only.

Σ(1750) WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
100 to 200 (≈ 150) OUR ESTIMATE				
208±18	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
182±60	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
64±10	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
161±20	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
60±10	GOPAL	77	DPWA	$\overline{K}N$ multichannel
117 or 119	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
10	[2] CARROLL	76	DPWA	Isospin-1 total σ
110	DEBELLEFON	76	IPWA	$K^- p \to \Lambda\pi^0$
140±30	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$ (sol. 1)
160±50	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$ (sol. 2)
66^{+14}_{-12}	VANHORN	75	DPWA	$K^- p \to \Lambda\pi^0$
89±33	CHU	74	DBC	Fits $\sigma(K^- n \to \Sigma^- \eta)$
92± 7	[3] JONES	74	HBC	Fits $\sigma(K^- p \to \Sigma^0 \eta)$
108±20	PREVOST	74	DPWA	$K^- N \to \Sigma(1385)\pi$

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] A total cross-section bump with $(J+1/2)\ \Gamma_{el}\ /\ \Gamma_{total} = 0.30$.
[3] An S-wave Breit-Wigner fit to the threshold cross section with no background and errors statistical only.

Σ(1750) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\overline{K}$	0.06 to 0.12
Γ_2	$\Lambda\pi$	(14 ±5) %
Γ_3	$\Sigma\pi$	(16 ±4) %
Γ_4	$\Sigma\eta$	15–55 %
Γ_5	$\Sigma(1385)\pi$, D-wave	< 1 %
Γ_6	$\Lambda(1520)\pi$	(2.0 ±1.0) %
Γ_7	$N\overline{K}^*(892)$, S=1/2	(8 ±4) %
Γ_8	$N\overline{K}^*(892)$, S=3/2, D-wave	

Σ(1750) BRANCHING RATIOS

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.06 to 0.12 OUR ESTIMATE				
0.46 ±0.09	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
0.09 ±0.07	ZHANG	13A	DPWA	Multichannel
0.14 ±0.03	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
0.33 ±0.05	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.154	[1] KAMANO	15	DPWA	Multichannel
0.15 ±0.03	GOPAL	77	DPWA	See GOPAL 80
0.06 or 0.05	[2] MARTIN	77	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.
[2] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.

$\Gamma(\Lambda\pi)/\Gamma_{total}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.14 ±0.05	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.435	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

$\Gamma(\Sigma\pi)/\Gamma_{total}$ — Γ_3/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.16 ±0.04	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.373	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

$\Gamma(\Lambda(1520)\pi)/\Gamma_{total}$ — Γ_6/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.02±0.01	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

$\Gamma(\Sigma(1385)\pi, D\text{-wave})/\Gamma_{total}$ — Γ_5/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
<0.01	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.024	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

$\Gamma(N\overline{K}^*(892), S=1/2)/\Gamma_{total}$ — Γ_7/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
~ 0	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
0.08 ±0.04	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.004	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

$\Gamma(N\overline{K}^*(892), S{=}3/2, D\text{-wave})/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.01	[1] KAMANO	15	DPWA	Multichannel

[1] From the preferred solution A in KAMANO 15.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1750) \to \Lambda\pi$ $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.10 \pm 0.04$	ZHANG	13A	DPWA	Multichannel
0.04 ± 0.03	GOPAL	77	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.10 or -0.09	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
-0.12	DEBELLEFON	76	IPWA	$K^- p \to \Lambda\pi^0$
-0.12 ± 0.02	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$ (sol. 1)
-0.13 ± 0.03	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$ (sol. 2)
-0.13 ± 0.04	VANHORN	75	DPWA	$K^- p \to \Lambda\pi^0$
-0.120 ± 0.077	DEVENISH	74B		Fixed-t dispersion rel.

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1750) \to \Sigma\pi$ $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.17 \pm 0.07$	ZHANG	13A	DPWA	Multichannel
-0.09 ± 0.05	GOPAL	77	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$+0.06$ or $+0.06$	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
0.13 ± 0.02	LANGBEIN	72	IPWA	$\overline{K}N$ multichannel

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1750) \to \Sigma\eta$ $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.23 ± 0.01	[1] JONES	74	HBC	Fits $\sigma(K^- p \to \Sigma^0\eta)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	CLINE	69	DBC	Threshold bump

[1] An S-wave Breit-Wigner fit to the threshold cross section with no background and errors statistical only.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1750) \to \Sigma(1385)\pi$, D-wave $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.17 \pm 0.07$	ZHANG	13A	DPWA	Multichannel
$+0.18 \pm 0.15$	PREVOST	74	DPWA	$K^- N \to \Sigma(1385)\pi$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1750) \to \Lambda(1520)\pi$ $(\Gamma_1\Gamma_6)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.032 ± 0.021	CAMERON	77	DPWA	P-wave decay

Σ(1750) REFERENCES

SARANTSEV	19	EPJ A55 180	A.V. Sarantsev *et al.*	(BONN, PNPI)	
KAMANO	15	PR C92 025205	H. Kamano *et al.*	(ANL, OSAK)	
ZHANG	13A	PR C88 035205	H. Zhang *et al.*	(KSU)	
PDG	82	PL 111B 1	M. Roos *et al.*	(HELS, CIT, CERN)	
GOPAL	80	Toronto Conf. 159	G.P. Gopal	(RHEL)	IJP
ALSTON-...	78	PR D18 182	M. Alston-Garnjost *et al.*	(LBL, MTHO+)	IJP
Also		PRL 38 1007	M. Alston-Garnjost *et al.*	(LBL, MTHO+)	IJP
CAMERON	77	NP B131 399	W. Cameron *et al.*	(RHEL, LOIC)	IJP
GOPAL	77	NP B119 362	G.P. Gopal *et al.*	(LOIC, RHEL)	IJP
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
CARROLL	76	PRL 37 806	A.S. Carroll *et al.*	(BNL)	I
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
VANHORN	75	NP B87 145	A.J. van Horn	(LBL)	IJP
Also		NP B87 157	A.J. van Horn	(LBL)	IJP
CHU	74	NC 20A 35	R.Y.L. Chu *et al.*	(PLAT, TUFTS, BRAN)	IJP
DEVENISH	74B	NP B81 330	R.C.E. Devenish, C.D. Froggatt, B.R. Martin	(DESY+)	
JONES	74	NP B73 141	M.D. Jones	(CHIC)	IJP
PREVOST	74	NP B69 246	J. Prevost *et al.*	(SACL, CERN, HEID)	
LANGBEIN	72	NP B47 477	W. Langbein, F. Wagner	(MPIM)	IJP
CLINE	69	LNC 2 407	D. Cline, R. Laumann, J. Mapp	(WISC)	