$\Sigma(1670)\ 3/2^-$

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

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

Results from production experiments are listed separately in the next entry.

Σ(1670) POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1655 to 1675 (≈ 1662) OUR ESTIMATE				
1661±3	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
1669^{+7}_{-7}	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1674	ZHANG	13A	DPWA	$\overline{K}N$ multichannel

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

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
45 to 65 (≈ 55) OUR ESTIMATE				
52± 6	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
64^{+10}_{-14}	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
54	ZHANG	13A	DPWA	$\overline{K}N$ multichannel

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

Σ(1670) POLE RESIDUES

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

Normalized residue in $N\overline{K} \to \Sigma(1670) \to N\overline{K}$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.10 ±0.02	**−31 ± 12**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.129	−20	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Sigma\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.25 ±0.05	**−25 ± 10**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.249	−21	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Lambda\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.09 ±0.03	**−52 ± 12**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0818	−7	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Xi K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.02±0.01	**160 ± 20**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Sigma\sigma$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.08±0.03	**−25 ± 15**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Sigma(1385)\pi$, S-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.228	167	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Sigma(1385)\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0915	141	KAMANO	15	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Lambda(1405)\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.03±0.02	**160 ± 15**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Lambda(1520)\pi$, P-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.04±0.02	**120 ± 20**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Lambda(1520)\pi$, F-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.01±0.01		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to \Delta\overline{K}$, S-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.01±0.01		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to N\overline{K}^*(892)$, S=3/2, S-wave

VALUE	DOCUMENT ID		TECN	COMMENT
0.05+-0.030 50+-60	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to N\overline{K}^*(892)$, S=3/2, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.01±0.01		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Sigma(1670) \to N\overline{K}^*(892)$, S=1/2, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.03±0.02		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Σ(1670) MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1665 to 1685 (≈ 1675) OUR ESTIMATE				
1665 ± 3	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
1678 ± 2	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
1673 ± 1	GAO	12	DPWA	$\overline{K}N \to \Lambda\pi$
1665.1 ± 4.1	KOISO	85	DPWA	$K^- p \to \Sigma\pi$
1682 ± 5	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
1679 ± 10	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
1670 ± 5	GOPAL	77	DPWA	$\overline{K}N$ multichannel
1670 ± 6	HEPP	76B	DPWA	$K^- N \to \Sigma\pi$
1685 ± 20	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$
$1659 {}^{+12}_{-5}$	VANHORN	75	DPWA	$K^- p \to \Lambda\pi^0$
1670 ± 2	KANE	74	DPWA	$K^- p \to \Sigma\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1667 or 1668	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
1650	DEBELLEFON	76	IPWA	$K^- p \to \Lambda\pi^0$
1671 ± 3	PONTE	75	DPWA	$K^- p \to \Lambda\pi^0$ (sol. 1)
1655 ± 2	PONTE	75	DPWA	$K^- p \to \Lambda\pi^0$ (sol. 2)

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

Σ(1670) WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
40 to 100 (≈ 70) OUR ESTIMATE				
54 ± 6	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
55 ± 4	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
$52 {}^{+5}_{-2}$	GAO	12	DPWA	$\overline{K}N \to \Lambda\pi$
65.0 ± 7.3	KOISO	85	DPWA	$K^- p \to \Sigma\pi$
79 ± 10	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
56 ± 20	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
50 ± 5	GOPAL	77	DPWA	$\overline{K}N$ multichannel
56 ± 3	HEPP	76B	DPWA	$K^- N \to \Sigma\pi$
85 ± 25	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$
32 ± 11	VANHORN	75	DPWA	$K^- p \to \Lambda\pi^0$
79 ± 6	KANE	74	DPWA	$K^- p \to \Sigma\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
46 or 46	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
80	DEBELLEFON	76	IPWA	$K^- p \to \Lambda\pi^0$
44 ± 11	PONTE	75	DPWA	$K^- p \to \Lambda\pi^0$ (sol. 1)
76 ± 5	PONTE	75	DPWA	$K^- p \to \Lambda\pi^0$ (sol. 2)

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

$\Sigma(1670)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\overline{K}$	0.06 to 0.12
Γ_2	$\Lambda\pi$	5–15 %
Γ_3	$\Sigma\pi$	30–60 %
Γ_4	$\Lambda\pi\pi$	
Γ_5	$\Sigma\pi\pi$	
Γ_6	$\Sigma\sigma$	(7.0 ±3.0) %
Γ_7	$\Sigma(1385)\pi$	
Γ_8	$\Sigma(1385)\pi$, S-wave	
Γ_9	$\Sigma(1385)\pi$, D-wave	
Γ_{10}	$N\overline{K}^*(892)$, S=1/2, D-wave	
Γ_{11}	$N\overline{K}^*(892)$, S=3/2, S-wave	
Γ_{12}	$N\overline{K}^*(892)$, S=3/2, D-wave	
Γ_{13}	$\Lambda(1405)\pi$	
Γ_{14}	$\Lambda(1520)\pi$	

$\Sigma(1670)$ 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				
0.10 ±0.02	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
0.062±0.007	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
0.10 ±0.03	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
0.11 ±0.03	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.121	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
0.08 ±0.03	GOPAL	77	DPWA	See GOPAL 80
0.07 or 0.07	[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
0.09 ±0.02	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.058	[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
0.70 ±0.15	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.465	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

$\Gamma(\Lambda\pi\pi)/\Gamma_{total}$ Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.11	ARMENTEROS	68E	HBC	$K^- p$ (Γ_1=0.09)

$\Gamma(\Sigma\pi\pi)/\Gamma_{total}$ Γ_5/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.14	[1] ARMENTEROS	68E	HBC	$K^- p$, $K^- d$ (Γ_1=0.09)

[1] Ratio only for $\Sigma 2\pi$ system in $I = 1$, which cannot be $\Sigma(1385)$.

$\Gamma(\Sigma\sigma)/\Gamma_{total}$ Γ_6/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.07±0.03	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

$\Gamma(\Sigma(1385)\pi, S\text{-wave})/\Gamma_{total}$ Γ_8/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.309	[1] KAMANO	15	DPWA	Multichannel

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

$\Gamma(\Sigma(1385)\pi, D\text{-wave})/\Gamma_{total}$ Γ_9/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.044	[1] KAMANO	15	DPWA	Multichannel

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

$\Gamma(N\overline{K}^*(892), S=1/2, D\text{-wave})/\Gamma_{total}$ Γ_{10}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.001	[1] KAMANO	15	DPWA	Multichannel

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

$\Gamma(N\overline{K}^*(892), S=3/2, S\text{-wave})/\Gamma_{total}$ Γ_{11}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.002	[1] KAMANO	15	DPWA	Multichannel

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

$\Gamma(N\overline{K}^*(892), S=3/2, D\text{-wave})/\Gamma_{total}$ Γ_{12}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.001	[1] KAMANO	15	DPWA	Multichannel

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

$\Gamma(\Lambda(1405)\pi)/\Gamma_{total}$ — Γ_{13}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.01±0.01	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.06	ARMENTEROS	68E	HBC	$K^- p$, $K^- d$ (Γ_1=0.09)

$\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma(1385)\pi)$ — Γ_{13}/Γ_7

VALUE	DOCUMENT ID		TECN	COMMENT
0.23±0.08	BRUCKER	70	DBC	$K^- N \to \Sigma\pi\pi$

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1670) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+0.08 ±0.01	ZHANG	13A	DPWA	Multichannel
$+0.081^{+0.002}_{-0.004}$	GAO	12	DPWA	$\overline{K}N \to \Lambda\pi$
+0.17 ±0.03	[1] MORRIS	78	DPWA	$K^- n \to \Lambda\pi^-$
+0.13 ±0.02	[1] MORRIS	78	DPWA	$K^- n \to \Lambda\pi^-$
+0.10 ±0.02	GOPAL	77	DPWA	$\overline{K}N$ multichannel
+0.06 ±0.02	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$
+0.09 ±0.02	VANHORN	75	DPWA	$K^- p \to \Lambda\pi^0$
+0.018±0.060	DEVENISH	74B		Fixed-t dispersion rel.
• • • We do not use the following data for averages, fits, limits, etc. • • •				
+0.08 or +0.08	[2] MARTIN	77	DPWA	$\overline{K}N$ multichannel
+0.05	DEBELLEFON	76	IPWA	$K^- p \to \Lambda\pi^0$
+0.08 ±0.01	PONTE	75	DPWA	$K^- p \to \Lambda\pi^0$ (sol. 1)
+0.17 ±0.01	PONTE	75	DPWA	$K^- p \to \Lambda\pi^0$ (sol. 2)

[1] Results are with and without an S_{11} $\Sigma(1620)$ in the fit.

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

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1670) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+0.20±0.01	ZHANG	13A	DPWA	Multichannel
+0.20±0.02	KOISO	85	DPWA	$K^- p \to \Sigma\pi$
+0.21±0.02	GOPAL	77	DPWA	$\overline{K}N$ multichannel
+0.20±0.01	HEPP	76B	DPWA	$K^- N \to \Sigma\pi$
+0.21±0.03	KANE	74	DPWA	$K^- p \to \Sigma\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
+0.18 or +0.17	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel

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

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1670) \to \Sigma(1385)\pi$, S-wave — $(\Gamma_1\Gamma_8)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+0.11±0.03	PREVOST	74	DPWA	$K^- N \to \Sigma(1385)\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.17±0.02	[1] SIMS	68	DBC	$K^- N \to \Lambda\pi\pi$

[1] SIMS 68 uses only cross-section data. Result used as upper limit only.

$\Gamma_i\Gamma_f/\Gamma^2_{total}$ in $N\overline{K} \to \Sigma(1670) \to \Lambda(1405)\pi$ $\qquad\Gamma_1\Gamma_{13}/\Gamma^2$

VALUE	DOCUMENT ID		TECN	COMMENT
0.007±0.002	[1] BRUCKER	70	DBC	$K^- N \to \Sigma\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.03	BERLEY	69	HBC	$K^- p$ 0.6–0.82 GeV/c

[1] Assuming the $\Lambda(1405)\pi$ cross-section bump is due only to $3/2^-$ resonance.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1670) \to \Lambda(1520)\pi$ $\qquad(\Gamma_1\Gamma_{14})^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.081±0.016	[1] CAMERON	77	DPWA	P-wave decay

[1] The CAMERON 77 upper limit on F-wave decay is 0.03.

$\Sigma(1670)$ 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)	
GAO	12	PR C86 025201	P. Gao, J. Shi, B.S. Zou	(BHEP, BEIJT)	
Also		NP A867 41	P. Gao, B.S. Zou, A. Sibirtsev	(BHEP, BEIJT+)	
KOISO	85	NP A433 619	H. Koiso et al.	(TOKY, MASA)	
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
MORRIS	78	PR D17 55	W.A. Morris et al.	(FSU)	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
DEBELLEFON	76	NP B109 129	A. de Bellefon, A. Berthon	(CDEF)	IJP
HEPP	76B	PL 65B 487	V. Hepp et al.	(CERN, HEIDH, MPIM)	IJP
BAILLON	75	NP B94 39	P.H. Baillon, P.J. Litchfield	(CERN, RHEL)	IJP
PONTE	75	PR D12 2597	R.A. Ponte et al.	(MASA, TENN, UCR)	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+)	
KANE	74	LBL-2452	D.F. Kane	(LBL)	IJP
PREVOST	74	NP B69 246	J. Prevost et al.	(SACL, CERN, HEID)	
BRUCKER	70	Duke Conf. 155 Hyperon Resonances, 1970	E.B. Brucker et al.	(FSU)	I
BERLEY	69	PL 30B 430	D. Berley et al.	(BNL)	
ARMENTEROS	68E	PL 28B 521	R. Armenteros et al.	(CERN, HEID, SACL)	I
SIMS	68	PRL 21 1413	W.H. Sims et al.	(FSU, TUFTS, BRAN)	