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

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

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1665 to 1685 (≈ 1670) OUR ESTIMATE				
1678 ± 2	ZHANG	13A	DPWA	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)

Σ(1670) WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
40 to 80 (≈ 60) OUR ESTIMATE				
55 ± 4	ZHANG	13A	DPWA	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)

$\Sigma(1670)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1674	ZHANG	13A	DPWA	Multichannel

$-2\times$IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
54	ZHANG	13A	DPWA	Multichannel

$\Sigma(1670)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\overline{K}$	7–13 %
Γ_2	$\Lambda\pi$	5–15 %
Γ_3	$\Sigma\pi$	30–60 %
Γ_4	$\Lambda\pi\pi$	
Γ_5	$\Sigma\pi\pi$	
Γ_6	$\Sigma(1385)\pi$	
Γ_7	$\Sigma(1385)\pi$, S-wave	
Γ_8	$\Lambda(1405)\pi$	
Γ_9	$\Lambda(1520)\pi$	

The above branching fractions are our estimates, not fits or averages.

$\Sigma(1670)$ BRANCHING RATIOS

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

$\Gamma(N\overline{K})/\Gamma_{\text{total}}$ $\quad\Gamma_1/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.07 to 0.13 OUR ESTIMATE				
0.062±0.007	ZHANG	13A	DPWA	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. • • •				
0.08 ±0.03	GOPAL	77	DPWA	See GOPAL 80
0.07 or 0.07	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel

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

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	[2] MORRIS	78	DPWA	$K^- n \to \Lambda\pi^-$
+0.13 ±0.02	[2] MORRIS	78	DPWA	$K^- n \to \Lambda\pi^-$

$+0.10 \pm 0.02$	GOPAL	77	DPWA	$\overline{K}N$ multichannel
$+0.06 \pm 0.02$	BAILLON	75	IPWA	$\overline{K}N \rightarrow \Lambda\pi$
$+0.09 \pm 0.02$	VANHORN	75	DPWA	$K^- p \rightarrow \Lambda\pi^0$
$+0.018 \pm 0.060$	DEVENISH	74B		Fixed-t dispersion rel.
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$+0.08$ or $+0.08$	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
$+0.05$	DEBELLEFON	76	IPWA	$K^- p \rightarrow \Lambda\pi^0$
$+0.08 \pm 0.01$	PONTE	75	DPWA	$K^- p \rightarrow \Lambda\pi^0$ (sol. 1)
$+0.17 \pm 0.01$	PONTE	75	DPWA	$K^- p \rightarrow \Lambda\pi^0$ (sol. 2)

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

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.20 \pm 0.01$	ZHANG	13A	DPWA	Multichannel
$+0.20 \pm 0.02$	KOISO	85	DPWA	$K^- p \rightarrow \Sigma\pi$
$+0.21 \pm 0.02$	GOPAL	77	DPWA	$\overline{K}N$ multichannel
$+0.20 \pm 0.01$	HEPP	76B	DPWA	$K^- N \rightarrow \Sigma\pi$
$+0.21 \pm 0.03$	KANE	74	DPWA	$K^- p \rightarrow \Sigma\pi$
• • • 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

$\Gamma(\Lambda\pi\pi)/\Gamma_{total}$ — 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	[3] ARMENTEROS	68E	HBC	$K^- p$, $K^- d$ (Γ_1=0.09)

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(1670) \rightarrow \Sigma(1385)\pi$, S-wave — $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
$+0.11 \pm 0.03$	PREVOST	74	DPWA	$K^- N \rightarrow \Sigma(1385)\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.17 ± 0.02	[4] SIMS	68	DBC	$K^- N \rightarrow \Lambda\pi\pi$

$\Gamma(\Lambda(1405)\pi)/\Gamma_{total}$ — Γ_8/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • 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)

$\Gamma_i\Gamma_f/\Gamma^2_{total}$ in $N\overline{K} \rightarrow \Sigma(1670) \rightarrow \Lambda(1405)\pi$ — $\Gamma_1\Gamma_8/\Gamma^2$

VALUE	DOCUMENT ID		TECN	COMMENT
0.007 ± 0.002	[5] BRUCKER	70	DBC	$K^- N \rightarrow \Sigma\pi\pi$
• • • 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

$\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma(1385)\pi)$ — Γ_8/Γ_6

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

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(1670) \rightarrow \Lambda(1520)\pi$ — $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.081 ± 0.016	[6] CAMERON	77	DPWA	P-wave decay

$\Sigma(1670)$ FOOTNOTES

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] Results are with and without an S_{11} $\Sigma(1620)$ in the fit.
[3] Ratio only for $\Sigma 2\pi$ system in $I = 1$, which cannot be $\Sigma(1385)$.
[4] SIMS 68 uses only cross-section data. Result used as upper limit only.
[5] Assuming the $\Lambda(1405)\pi$ cross-section bump is due only to $3/2^-$ resonance.
[6] The CAMERON 77 upper limit on F-wave decay is 0.03.

$\Sigma(1670)$ REFERENCES

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	E.B. Brucker *et al.*	(FSU)	I
Hyperon Resonances, 1970					
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)	