$\Sigma(1775)$ 5/2$^-$

$I(J^P) = 1(\frac{5}{2}^-)$ Status: ∗∗∗∗

Discovered by GALTIERI 63, this resonance plays the same role as cornerstone for isospin-1 analyses in this region as the $\Lambda(1820)F_{05}$ does in the isospin-0 channel.

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

$\Sigma(1775)$ POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1760 to 1780 (≈ 1770) OUR ESTIMATE				
1767±4	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
1767^{+2}_{-2}	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1759	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				
122±8	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
128^{+4}_{-2}	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
118	ZHANG	13A	DPWA	$\overline{K}N$ multichannel

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

$\Sigma(1775)$ POLE RESIDUES

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

Normalized residue in $N\overline{K} \to \Sigma(1775) \to N\overline{K}$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.44 ±0.09	−17 ± 10	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.371	−32	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \to \Sigma(1775) \to \Sigma\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.13 ±0.03	10 ± 12	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.115	−24	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow \Lambda\pi$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.47 ±0.10	130 ± 15	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.325	157	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow \Sigma(1385)\pi$, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.391	137	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow \Sigma(1385)\pi$, G-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0129	−58	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow N\overline{K}^*(892)$, S=1/2, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.04±0.02	−100 ± 60	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow N\overline{K}^*(892)$, S=3/2, D-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.09±0.06	10 ± 50	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow N\overline{K}^*(892)$, S=3/2, G-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.04±0.02	−100 ± 60	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow \Xi K$

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.02±0.01	−90 ± 35	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow \Lambda(1520)\pi$, P-wave

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.09±0.03	10 ± 30	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow \Lambda(1520)\pi$, F-wave

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

Normalized residue in $N\overline{K} \rightarrow \Sigma(1775) \rightarrow \Delta\overline{K}$, D-wave

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

Σ(1775) MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1770 to 1780 (≈ 1775) OUR ESTIMATE				
1776± 4	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
1778± 1	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
1778± 5	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
1777± 5	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
1775±10	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$
1774±10	VANHORN	75	DPWA	$K^- p \to \Lambda\pi^0$
1772± 6	KANE	74	DPWA	$K^- p \to \Sigma\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1774± 5	GOPAL	77	DPWA	$\overline{K}N$ multichannel
1772 or 1777	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
1765	DEBELLEFON	76	IPWA	$K^- p \to \Lambda\pi^0$

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

Σ(1775) WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
105 to 135 (≈ 120) OUR ESTIMATE				
124± 8	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
131± 3	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
137±10	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
116±10	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
125±15	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$
146±18	VANHORN	75	DPWA	$K^- p \to \Lambda\pi^0$
154±10	KANE	74	DPWA	$K^- p \to \Sigma\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
130±10	GOPAL	77	DPWA	$\overline{K}N$ multichannel
102 or 103	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
120	DEBELLEFON	76	IPWA	$K^- p \to \Lambda\pi^0$

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

Σ(1775) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\overline{K}$	37–43%
Γ_2	$\Lambda\pi$	14–20%
Γ_3	$\Sigma\pi$	2–5%
Γ_4	$\Sigma(1385)\pi$	8–12%
Γ_5	$\Sigma(1385)\pi$, D-wave	
Γ_6	$\Sigma(1385)\pi$, G-wave	
Γ_7	$\Lambda(1520)\pi$, P-wave	17–23%
Γ_8	$\Sigma\pi\pi$	
Γ_9	$\Delta(1232)\overline{K}$, D-wave	
Γ_{10}	$N\overline{K}^*(892)$, S=1/2	
Γ_{11}	$N\overline{K}^*(892)$, S=1/2, D-wave	

Γ_{12} $N\overline{K}^*(892)$, S=3/2, D-wave
Γ_{13} $N\overline{K}^*(892)$, S=3/2, G-wave

Σ(1775) BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on Λ and Σ Resonances. Also, the errors quoted do not include uncertainties due to the parametrization used in the partial-wave analyses and are thus too small.

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.37 to 0.43 OUR ESTIMATE				
0.43 ±0.09	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
0.40 ±0.01	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
0.40 ±0.02	GOPAL	80	DPWA	$\overline{K}N \rightarrow \overline{K}N$
0.37 ±0.03	ALSTON-...	78	DPWA	$\overline{K}N \rightarrow \overline{K}N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.402	[1] KAMANO	15	DPWA	Multichannel
0.41 ±0.03	GOPAL	77	DPWA	See GOPAL 80
0.37 or 0.36	[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
0.49 ±0.10	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.244	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

$\Gamma(\Lambda\pi)/\Gamma(N\overline{K})$ — Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.33±0.05	UHLIG	67	HBC	$K^- p$ 0.9 GeV/c

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.035±0.010	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.042	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

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

$\Gamma(\Sigma(1385)\pi)/\Gamma(N\overline{K})$ — Γ_4/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.25±0.09	UHLIG	67	HBC	$K^- p$ 0.9 GeV/c

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

$\Gamma(\Sigma(1385)\pi\text{, }G\text{-wave})/\Gamma_{\text{total}}$ — Γ_6/Γ

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

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

$\Gamma(\Lambda(1520)\pi\text{, }P\text{-wave})/\Gamma_{\text{total}}$ — Γ_7/Γ

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

$\Gamma(\Lambda(1520)\pi\text{, }P\text{-wave})/\Gamma(N\overline{K})$ — Γ_7/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.28 ± 0.05	UHLIG	67	HBC	$K^- p$ 0.9 GeV/c

$\Gamma(\Sigma\pi\pi)/\Gamma_{\text{total}}$ — Γ_8/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.12	[1] ARMENTEROS	68C	HDBC	$K^- N \to \Sigma\pi\pi$

[1] For about 3/4 of this, the $\Sigma\pi$ system has $I = 0$ and is almost entirely $\Lambda(1520)$. For the rest, the $\Sigma\pi$ has $I = 1$, which is about what is expected from the known $\Sigma(1775) \to \Sigma(1385)\pi$ rate, as seen in $\Lambda\pi\pi$.

$\Gamma(N\overline{K}^*(892)\text{, }S{=}1/2\text{, }D\text{-wave})/\Gamma_{\text{total}}$ — Γ_{11}/Γ

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

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.003	[1] KAMANO	15	DPWA	Multichannel

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

$\Gamma(N\overline{K}^*(892)\text{, }S{=}3/2\text{, }G\text{-wave})/\Gamma_{\text{total}}$ — Γ_{13}/Γ

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

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

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1775) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
-0.31 ± 0.01	ZHANG	13A	DPWA	Multichannel
-0.28 ± 0.03	GOPAL	77	DPWA	$\overline{K}N$ multichannel
-0.25 ± 0.02	BAILLON	75	IPWA	$\overline{K}N \to \Lambda\pi$
$-0.28^{+0.04}_{-0.05}$	VANHORN	75	DPWA	$K^- p \to \Lambda\pi^0$
-0.259 ± 0.048	DEVENISH	74B		Fixed-t dispersion rel.

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

−0.29 or −0.28	[1] MARTIN	77	DPWA	$\overline{K}N$ multichannel
−0.30	DEBELLEFON	76	IPWA	$K^- p \to \Lambda\pi^0$

[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 $N\overline{K} \to \Sigma(1775) \to \Sigma\pi$ $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+0.08±0.01	ZHANG	13A	DPWA	Multichannel
+0.13±0.02	GOPAL	77	DPWA	$\overline{K}N$ multichannel
0.09±0.01	KANE	74	DPWA	$K^- p \to \Sigma\pi$
• • • 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

[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 $N\overline{K} \to \Sigma(1775) \to \Sigma(1385)\pi$, D-wave $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
−0.12 ±0.01	ZHANG	13A	DPWA	Multichannel
−0.184±0.011	[1] CAMERON	78	DPWA	$K^- p \to \Sigma(1385)\pi$
+0.20 ±0.02	PREVOST	74	DPWA	$K^- N \to \Sigma(1385)\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.32 ±0.06	SIMS	68	DBC	$K^- N \to \Lambda\pi\pi$
0.24 ±0.03	ARMENTEROS	67C	HBC	$K^- p \to \Lambda\pi\pi$

[1] The CAMERON 78 upper limit on G-wave decay is 0.03.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1775) \to \Lambda(1520)\pi$, P-wave $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
−0.06 ±0.01	ZHANG	13A	DPWA	Multichannel
−0.305±0.010	[1] CAMERON	77	DPWA	$K^- p \to \Lambda(1520)\pi^0$
0.31 ±0.02	BARLETTA	72	DPWA	$K^- p \to \Lambda(1520)\pi^0$
0.27 ±0.03	ARMENTEROS	65C	HBC	$K^- p \to \Lambda(1520)\pi^0$

[1] This rate combines P-wave- and F-wave decays. The CAMERON 77 results for the separate P-wave- and F-wave decays are −0.303 ± 0.010 and −0.037 ± 0.014. The published signs have been changed here to be in accord with the baryon-first convention.

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1775) \to \Delta(1232)\overline{K}$, D-wave $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+0.06±0.03	ZHANG	13A	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1775) \to N\overline{K}^*(892)$, S=1/2 $(\Gamma_1\Gamma_{10})^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+0.04±0.01	ZHANG	13A	DPWA	Multichannel

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1775) \to N\overline{K}^*(892)$, S=3/2, D-wave $(\Gamma_1\Gamma_{12})^{1/2}/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
+0.04±0.01	ZHANG	13A	DPWA	Multichannel

Σ(1775) 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	78	NP B143 189	W. Cameron *et al.*	(RHEL, LOIC)	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
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
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)	
BARLETTA	72	NP B40 45	W.A. Barletta	(EFI)	IJP
Also		PRL 17 841	S. Fenster *et al.*	(CHIC, ANL, CERN)	IJP
ARMENTEROS	68C	NP B8 216	R. Armenteros *et al.*	(CERN, HEID, SACL)	I
SIMS	68	PRL 21 1413	W.H. Sims *et al.*	(FSU, TUFTS, BRAN)	
ARMENTEROS	67C	ZPHY 202 486	R. Armenteros *et al.*	(CERN, HEID, SACL)	
UHLIG	67	PR 155 1448	R.P. Uhlig *et al.*	(UMD, NRL)	
ARMENTEROS	65C	PL 19 338	R. Armenteros *et al.*	(CERN, HEID, SACL)	IJP
GALTIERI	63	PL 6 296	A. Galtieri, A. Hussain, R. Tripp	(LRL)	IJ