

$\Sigma(1660) 1/2^+$ $I(J^P) = 1(\frac{1}{2}^+)$ Status: ***

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

 $\Sigma(1660)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1585 ± 20	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1547^{+111}_{-59}	¹ KAMANO 15	DPWA	$\bar{K}N$ multichannel

¹From the preferred solution A in KAMANO 15. Solution B reports $M = 1457^{+5}_{-1}$ MeV.

−2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
290⁺¹⁴⁰_{−40}	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
183^{+86}_{-78}	¹ KAMANO 15	DPWA	$\bar{K}N$ multichannel

¹From the preferred solution A in KAMANO 15. Solution B reports $\Gamma = 78^{+2}_{-8}$ MeV.

 $\Sigma(1660)$ POLE RESIDUES

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

Normalized residue in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow N\bar{K}$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.07 ± 0.03	−165 ± 35	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0247	168	¹ KAMANO 15	DPWA	$\bar{K}N$ multichannel

¹From the preferred solution A in KAMANO 15.

Normalized residue in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow \Sigma\pi$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.17 ± 0.04	150 ± 20	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.16	78	¹ KAMANO 15	DPWA	$\bar{K}N$ multichannel

¹From the preferred solution A in KAMANO 15.

Normalized residue in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow \Lambda\pi$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.16 ± 0.05	0 ± 25	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0614	−84	¹ KAMANO 15	DPWA	$\bar{K}N$ multichannel

¹From the preferred solution A in KAMANO 15.

Normalized residue in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow \Sigma\sigma$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.14±0.06	-150 ± 30	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel

Normalized residue in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow \Sigma(1385)\pi$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.0513	-44	¹ KAMANO 15	DPWA	Multichannel

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

¹From the preferred solution A in KAMANO 15.

Normalized residue in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow \Lambda(1405)\pi$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.06±0.03	-90 ± 25	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel

Normalized residue in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow \Lambda(1520)\pi$

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.04±0.02	5 ± 20	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel

$\Sigma(1660)$ MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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1640 to 1680 (≈ 1660) OUR ESTIMATE

1643.2± 4.5±7.6	ABLIKIM	25AF	BES3 $\psi(3686) \rightarrow \Lambda\bar{\Sigma}^0\pi^0 + \text{c.c.}$ (PWA)
1665 ± 20	SARANTSEV	19	DPWA $\bar{K}N$ multichannel
1633 ± 3	GAO	12	DPWA $\bar{K}N \rightarrow \Lambda\pi$
1665.1±11.2	¹ KOISO	85	DPWA $K^-p \rightarrow \Sigma\pi$
1670 ± 10	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
1679 ± 10	ALSTON-...	78	DPWA $\bar{K}N \rightarrow \bar{K}N$
1668 ± 25	VANHORN	75	DPWA $K^-p \rightarrow \Lambda\pi^0$
1670 ± 20	KANE	74	DPWA $K^-p \rightarrow \Sigma\pi$

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

1676 ± 15	GOPAL	77	DPWA $\bar{K}N$ multichannel
1565 or 1597	² MARTIN	77	DPWA $\bar{K}N$ multichannel
1660 ± 30	³ BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
1671 ± 2	⁴ PONTE	75	DPWA $K^-p \rightarrow \Lambda\pi^0$

¹The evidence of KOISO 85 is weak.

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

³From solution 1 of BAILLON 75; not present in solution 2.

⁴From solution 2 of PONTE 75; not present in solution 1.

$\Sigma(1660)$ WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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100 to 300 (≈ 200) OUR ESTIMATE

221.3± 13.1±41.1	ABLIKIM	25AF	BES3 $\psi(3686) \rightarrow \Lambda\bar{\Sigma}^0\pi^0 + \text{c.c.}$ (PWA)
300 ⁺¹⁴⁰ / ₋₄₀	SARANTSEV	19	DPWA $\bar{K}N$ multichannel
121 ⁺⁴ / ₋₇	GAO	12	DPWA $\bar{K}N \rightarrow \Lambda\pi$
81.5± 22.2	¹ KOISO	85	DPWA $K^-p \rightarrow \Sigma\pi$

152 ± 20	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
38 ± 10	ALSTON-...	78	DPWA $\bar{K}N \rightarrow \bar{K}N$
230 ⁺¹⁶⁵ ₋₆₀	VANHORN	75	DPWA $K^- p \rightarrow \Lambda\pi^0$
250 ± 110	KANE	74	DPWA $K^- p \rightarrow \Sigma\pi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
120 ± 20	GOPAL	77	DPWA $\bar{K}N$ multichannel
202 or 217	² MARTIN	77	DPWA $\bar{K}N$ multichannel
80 ± 40	³ BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
81 ± 10	⁴ PONTE	75	DPWA $K^- p \rightarrow \Lambda\pi^0$

¹The evidence of KOISO 85 is weak.

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

³From solution 1 of BAILLON 75; not present in solution 2.

⁴From solution 2 of PONTE 75; not present in solution 1.

Σ(1660) DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\bar{K}$	0.05 to 0.15 (≈ 0.10)
Γ_2 $\Lambda\pi$	(35 ± 12) %
Γ_3 $\Sigma\pi$	(37 ± 10) %
Γ_4 $\Sigma\sigma$	(20 ± 8) %
Γ_5 $\Sigma(1385)\pi$	
Γ_6 $\Lambda(1405)\pi$	(4.0 ± 2.0) %
Γ_7 $\Lambda(1520)\pi$	

Σ(1660) BRANCHING RATIOS

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

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

VALUE	DOCUMENT ID	TECN	COMMENT
0.05 to 0.15 (≈ 0.10) OUR ESTIMATE			
0.07 ± 0.03	SARANTSEV	19	DPWA $\bar{K}N$ multichannel
0.12 ± 0.03	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
0.10 ± 0.05	ALSTON-...	78	DPWA $\bar{K}N \rightarrow \bar{K}N$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.005	¹ KAMANO	15	DPWA $\bar{K}N$ multichannel
<0.04	GOPAL	77	DPWA See GOPAL 80
0.27 or 0.29	² MARTIN	77	DPWA $\bar{K}N$ multichannel

¹From the preferred solution A in KAMANO 15.

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

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

VALUE	DOCUMENT ID	TECN	COMMENT
0.35 ± 0.12			
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.128	¹ KAMANO	15	DPWA $\bar{K}N$ multichannel

¹From the preferred solution A in KAMANO 15.

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

VALUE	DOCUMENT ID	TECN	COMMENT
0.37 ± 0.10	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.865	¹ KAMANO 15	DPWA	$\bar{K}N$ multichannel
¹ From the preferred solution A in KAMANO 15.			

$\Gamma(\Sigma\sigma)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
0.20 ± 0.08	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel

$\Gamma(\Sigma(1385)\pi)/\Gamma_{\text{total}}$ Γ_5/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.			

$\Gamma(\Lambda(1405)\pi)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
0.04 ± 0.02	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel

$\Gamma(\Lambda(1520)\pi)/\Gamma_{\text{total}}$ Γ_7/Γ

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

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow \Lambda\pi$ $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.064^{+0.005}_{-0.003}$	GAO 12	DPWA	$\bar{K}N \rightarrow \Lambda\pi$
< 0.04	GOPAL 77	DPWA	$\bar{K}N$ multichannel
$0.12^{+0.12}_{-0.04}$	VANHORN 75	DPWA	$K^-p \rightarrow \Lambda\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.10 or -0.11	¹ MARTIN 77	DPWA	$\bar{K}N$ multichannel
-0.04 ± 0.02	² BAILLON 75	IPWA	$\bar{K}N \rightarrow \Lambda\pi$
$+0.16 \pm 0.01$	³ PONTE 75	DPWA	$K^-p \rightarrow \Lambda\pi^0$
¹ The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.			
² From solution 1 of BAILLON 75; not present in solution 2.			
³ From solution 2 of PONTE 75; not present in solution 1.			

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1660) \rightarrow \Sigma\pi$ $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
-0.13 ± 0.04	¹ KOISO 85	DPWA	$K^-p \rightarrow \Sigma\pi$
-0.16 ± 0.03	GOPAL 77	DPWA	$\bar{K}N$ multichannel
-0.11 ± 0.01	KANE 74	DPWA	$K^-p \rightarrow \Sigma\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.34 or -0.37	² MARTIN 77	DPWA	$\bar{K}N$ multichannel
not seen	HEPP 76B	DPWA	$K^-N \rightarrow \Sigma\pi$
¹ The evidence of KOISO 85 is weak.			
² The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.			

$\Sigma(1660)$ REFERENCES

ABLIKIM	25AF	JHEP 2502 212	M. Ablikim <i>et al.</i>	(BESIII Collab.)
SARANTSEV	19	EPJ A55 180	A.V. Sarantsev <i>et al.</i>	(BONN, PNPI)
KAMANO	15	PR C92 025205	H. Kamano <i>et al.</i>	(ANL, OSAK)
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 <i>et al.</i>	(TOKY, MASA)
PDG	82	PL 111B 1	M. Roos <i>et al.</i>	(HELS, CIT, CERN)
GOPAL	80	Toronto Conf. 159	G.P. Gopal	(RHEL) IJP
ALSTON-...	78	PR D18 182	M. Alston-Garnjost <i>et al.</i>	(LBL, MTHO+) IJP
Also		PRL 38 1007	M. Alston-Garnjost <i>et al.</i>	(LBL, MTHO+) IJP
GOPAL	77	NP B119 362	G.P. Gopal <i>et al.</i>	(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
HEPP	76B	PL 65B 487	V. Hepp <i>et al.</i>	(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 <i>et al.</i>	(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
KANE	74	LBL-2452	D.F. Kane	(LBL) IJP