

$\Sigma(1660) 1/2^+$  $I(J^P) = 1(\frac{1}{2}^+)$  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>
--------------------	--------------------	-------------	----------------

<b>1585 ± 20</b>	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
------------------	--------------	------	-------------------------

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

$1547^{+111}_{-59}$	<sup>1</sup> KAMANO 15	DPWA	$\bar{K}N$ multichannel
---------------------	------------------------	------	-------------------------

<sup>1</sup>From 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>
--------------------	--------------------	-------------	----------------

<b>290<sup>+140</sup><sub>-40</sub></b>	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
---	--------------	------	-------------------------

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

$183^{+86}_{-78}$	<sup>1</sup> KAMANO 15	DPWA	$\bar{K}N$ multichannel
-------------------	------------------------	------	-------------------------

<sup>1</sup>From 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>
----------------	------------------	--------------------	-------------	----------------

<b>0.07 ± 0.03</b>	<b>−165 ± 35</b>	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
--------------------	------------------	--------------	------	-------------------------

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

0.0247	168	<sup>1</sup> KAMANO 15	DPWA	$\bar{K}N$ multichannel
--------	-----	------------------------	------	-------------------------

<sup>1</sup>From 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>
----------------	------------------	--------------------	-------------	----------------

<b>0.17 ± 0.04</b>	<b>150 ± 20</b>	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
--------------------	-----------------	--------------	------	-------------------------

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

0.16	78	<sup>1</sup> KAMANO 15	DPWA	$\bar{K}N$ multichannel
------	----	------------------------	------	-------------------------

<sup>1</sup>From 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>
----------------	------------------	--------------------	-------------	----------------

<b>0.16 ± 0.05</b>	<b>0 ± 25</b>	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
--------------------	---------------	--------------	------	-------------------------

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

0.0614	−84	<sup>1</sup> KAMANO 15	DPWA	$\bar{K}N$ multichannel
--------	-----	------------------------	------	-------------------------

<sup>1</sup>From the preferred solution A in KAMANO 15.

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

<u>MODULUS</u>	<u>PHASE (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.14±0.06</b>	<b>-150 ± 30</b>	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 (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
----------------	------------------------------------	--------------------	-------------	----------------

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

0.0513	-44	<sup>1</sup> KAMANO 15	DPWA	Multichannel
--------	-----	------------------------	------	--------------

<sup>1</sup>From 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 (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.06±0.03</b>	<b>-90 ± 25</b>	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 (<math>^\circ</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.04±0.02</b>	<b>5 ± 20</b>	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel

 **$\Sigma(1660)$  MASS**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
--------------------	--------------------	-------------	----------------

**1640 to 1680 ( $\approx 1660$ ) OUR ESTIMATE**

1665 ± 20	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
1633 ± 3	GAO 12	DPWA	$\bar{K}N \rightarrow \Lambda\pi$
1665.1±11.2	<sup>1</sup> 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	<sup>2</sup> MARTIN 77	DPWA	$\bar{K}N$ multichannel
1660 ± 30	<sup>3</sup> BAILLON 75	IPWA	$\bar{K}N \rightarrow \Lambda\pi$
1671 ± 2	<sup>4</sup> PONTE 75	DPWA	$K^-p \rightarrow \Lambda\pi^0$

<sup>1</sup>The evidence of KOISO 85 is weak.

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

<sup>3</sup>From solution 1 of BAILLON 75; not present in solution 2.

<sup>4</sup>From 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>
--------------------	--------------------	-------------	----------------

**100 to 300 ( $\approx 200$ ) OUR ESTIMATE**

300 $\begin{matrix} +140 \\ -40 \end{matrix}$	SARANTSEV 19	DPWA	$\bar{K}N$ multichannel
121 $\begin{matrix} +4 \\ -7 \end{matrix}$	GAO 12	DPWA	$\bar{K}N \rightarrow \Lambda\pi$
81.5± 22.2	<sup>1</sup> 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	<sup>2</sup> MARTIN	77	DPWA $\bar{K}N$ multichannel
80 ± 40	<sup>3</sup> BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
81 ± 10	<sup>4</sup> PONTE	75	DPWA $K^- p \rightarrow \Lambda\pi^0$

<sup>1</sup>The evidence of KOISO 85 is weak.

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

<sup>3</sup>From solution 1 of BAILLON 75; not present in solution 2.

<sup>4</sup>From solution 2 of PONTE 75; not present in solution 1.

### Σ(1660) DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\bar{K}$	0.05 to 0.15 ( $\approx 010$ )
$\Gamma_2$ $\Lambda\pi$	(35 ± 12 ) %
$\Gamma_3$ $\Sigma\pi$	(37 ± 10 ) %
$\Gamma_4$ $\Sigma\sigma$	(20 ± 8 ) %
$\Gamma_5$ $\Sigma(1385)\pi$	
$\Gamma_6$ $\Lambda(1405)\pi$	( 4.0 ± 2.0 ) %
$\Gamma_7$ $\Lambda(1520)\pi$	

### Σ(1660) BRANCHING RATIOS

See “Sign conventions for resonance couplings” in the Note on  $\Lambda$  and  $\Sigma$  Resonances.

$\Gamma(N\bar{K})/\Gamma_{\text{total}}$	$\Gamma_1/\Gamma$		
VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.05 to 0.15 (<math>\approx 010</math>) OUR ESTIMATE</b>			
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	<sup>1</sup> KAMANO	15	DPWA $\bar{K}N$ multichannel
<0.04	GOPAL	77	DPWA See GOPAL 80
0.27 or 0.29	<sup>2</sup> MARTIN	77	DPWA $\bar{K}N$ multichannel
<sup>1</sup> From the preferred solution A in KAMANO 15.			
<sup>2</sup> The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.			

$\Gamma(\Lambda\pi)/\Gamma_{\text{total}}$	$\Gamma_2/\Gamma$		
VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.35 ± 0.12</b>			
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.128	<sup>1</sup> KAMANO	15	DPWA $\bar{K}N$ multichannel
<sup>1</sup> From the preferred solution A in KAMANO 15.			

$\Gamma(\Sigma\pi)/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma$

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

$\Gamma(\Sigma\sigma)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma$

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

$\Gamma(\Sigma(1385)\pi)/\Gamma_{\text{total}}$   $\Gamma_5/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.001	<sup>1</sup> KAMANO 15	DPWA	Multichannel
<sup>1</sup> From the preferred solution A in KAMANO 15.			

$\Gamma(\Lambda(1405)\pi)/\Gamma_{\text{total}}$   $\Gamma_6/\Gamma$

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

$\Gamma(\Lambda(1520)\pi)/\Gamma_{\text{total}}$   $\Gamma_7/\Gamma$

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 $-0.11$	<sup>1</sup> MARTIN 77	DPWA	$\bar{K}N$ multichannel
$-0.04 \pm 0.02$	<sup>2</sup> BAILLON 75	IPWA	$\bar{K}N \rightarrow \Lambda\pi$
$+0.16 \pm 0.01$	<sup>3</sup> PONTE 75	DPWA	$K^-p \rightarrow \Lambda\pi^0$
<sup>1</sup> The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.			
<sup>2</sup> From solution 1 of BAILLON 75; not present in solution 2.			
<sup>3</sup> 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
$-0.13 \pm 0.04$	<sup>1</sup> KOISO 85	DPWA	$K^-p \rightarrow \Sigma\pi$
$-0.16 \pm 0.03$	GOPAL 77	DPWA	$\bar{K}N$ multichannel
$-0.11 \pm 0.01$	KANE 74	DPWA	$K^-p \rightarrow \Sigma\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$-0.34$ or $-0.37$	<sup>2</sup> MARTIN 77	DPWA	$\bar{K}N$ multichannel
not seen	HEPP 76B	DPWA	$K^-N \rightarrow \Sigma\pi$
<sup>1</sup> The evidence of KOISO 85 is weak.			
<sup>2</sup> The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.			

## Σ(1660) REFERENCES

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>	(HELSE, 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

---