$\phi(1680)$

$I^G(J^{PC}) = 0^-(1^{--})$

$\phi(1680)$ MASS

e^+e^- PRODUCTION

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1680±20 OUR ESTIMATE					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1641^{+24}_{-18}		ACHASOV	19	SND	$e^+e^- \to \pi^+\pi^-\pi^0\eta$
$1667\pm 5\pm11$	3k	[1] IVANOV	19A	CMD3	1.59–2.007 $e^+e^- \to K^+K^-\eta$
1700 ± 23	2k	[2] ACHASOV	18A	SND	1.3–2.0 $e^+e^- \to K^0_S K^0_L \pi^0$
$1674\pm12\pm 6$	6.2k	[3] LEES	14H	BABR	$e^+e^- \to K^0_S K^0_L \gamma$
$1733\pm10\pm10$		[4] LEES	12F	BABR	10.6 $e^+e^- \to \phi\pi^+\pi^-\gamma$
$1689\pm 7\pm10$	4.8k	[5] SHEN	09	BELL	10.6 $e^+e^- \to K^+K^-\pi^+\pi^-\gamma$
$1709\pm20\pm43$		[6] AUBERT	08S	BABR	10.6 $e^+e^- \to$ hadrons
1623 ± 20	948	[7] AKHMETSHIN	03	CMD2	1.05–1.38 $e^+e^- \to K^0_L K^0_S$
~ 1500		[8] ACHASOV	98H	RVUE	$e^+e^- \to \pi^+\pi^-\pi^0$, $\omega\pi^+\pi^-$, K^+K^-
~ 1900		[9] ACHASOV	98H	RVUE	$e^+e^- \to K^0_S K^\pm \pi^\mp$
1700 ± 20		[10] CLEGG	94	RVUE	$e^+e^- \to K^+K^-$, $K^0_S K\pi$
1657 ± 27	367	BISELLO	91C	DM2	$e^+e^- \to K^0_S K^\pm \pi^\mp$
1655 ± 17		[11] BISELLO	88B	DM2	$e^+e^- \to K^+K^-$
1680 ± 10		[12] BUON	82	DM1	$e^+e^- \to$ hadrons
1677 ± 12		[13] MANE	82	DM1	$e^+e^- \to K^0_S K\pi$

[1] From a fit with coherent interference of the $\phi(1680)$ with a non-resonant contribution.
[2] Assuming the $K\overline{K}^*(892)+$ c.c. dynamics. Systematic uncertainties not estimated.
[3] Using a vector meson dominance model with contribution from $\phi(1020)$, $\phi(1680)$, and higher mass excitations of $\rho(770)$ and $\omega(782)$.
[4] Using events with $\pi\pi$ invariant mass less than 0.85 GeV.
[5] From a fit with two incoherent Breit-Wigners.
[6] From the simultaneous fit to the $K\overline{K}^*(892)+$ c.c. and $\phi\eta$ data from AUBERT 08S using the results of AUBERT 07AK.
[7] From the combined fit of AKHMETSHIN 03 and MANE 81 also including ρ, ω, and ϕ. Neither isospin nor flavor structure known.
[8] Using data from IVANOV 81, BARKOV 87, BISELLO 88B, DOLINSKY 91, and ANTONELLI 92.
[9] Using the data from BISELLO 91C.
[10] Using BISELLO 88B and MANE 82 data.
[11] From global fit including ρ, ω, ϕ and $\rho(1700)$ assume mass 1570 MeV and width 510 MeV for ρ radial excitation.
[12] From global fit of ρ, ω, ϕ and their radial excitations to channels $\omega\pi^+\pi^-$, K^+K^-, $K^0_S K^0_L$, $K^0_S K^\pm\pi^\mp$. Assume mass 1570 MeV and width 510 MeV for ρ radial excitations, mass 1570 and width 500 MeV for ω radial excitation.
[13] Fit to one channel only, neglecting interference with ω, $\rho(1700)$.

PHOTOPRODUCTION

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1753± 3	[1] LINK	02K	FOCS	20–160 $\gamma p \rightarrow K^+ K^- p$
1726±22	[1] BUSENITZ	89	TPS	$\gamma p \rightarrow K^+ K^- X$
1760±20	[1] ATKINSON	85C	OMEG	20–70 $\gamma p \rightarrow K \overline{K} X$
1690±10	[1] ASTON	81F	OMEG	25–70 $\gamma p \rightarrow K^+ K^- X$

[1] We list here a state decaying into $K^+ K^-$ possibly different from $\phi(1680)$.

$p\overline{p}$ ANNIHILATION

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1700±8	[1] AMSLER	06	CBAR	0.9 $\overline{p} p \rightarrow K^+ K^- \pi^0$

[1] Could also be $\rho(1700)$.

$\phi(1680)$ WIDTH

$e^+ e^-$ PRODUCTION

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
150±50 OUR ESTIMATE This is only an educated guess; the error given is larger than the error on the average of the published values.					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
103^{+26}_{-24}		ACHASOV	19	SND	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \eta$
176±23± 38	3k	[1] IVANOV	19A	CMD3	1.59–2.007 $e^+ e^- \rightarrow K^+ K^- \eta$
300±50	2k	[2] ACHASOV	18A	SND	1.3–2.0 $e^+ e^- \rightarrow K^0_S K^0_L \pi^0$
165±38± 70	6.2k	[3] LEES	14H	BABR	$e^+ e^- \rightarrow K^0_S K^0_L \gamma$
300±15± 37		[4] LEES	12F	BABR	10.6 $e^+ e^- \rightarrow \phi \pi^+ \pi^- \gamma$
211±14± 19	4.8k	[5] SHEN	09	BELL	10.6 $e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$
322±77±160		[6] AUBERT	08S	BABR	10.6 $e^+ e^- \rightarrow$ hadrons
139±60	948	[7] AKHMETSHIN	03	CMD2	1.05–1.38 $e^+ e^- \rightarrow K^0_L K^0_S$
300±60		[8] CLEGG	94	RVUE	$e^+ e^- \rightarrow K^+ K^-$, $K^0_S K \pi$
146±55	367	BISELLO	91C	DM2	$e^+ e^- \rightarrow K^0_S K^\pm \pi^\mp$
207±45		[9] BISELLO	88B	DM2	$e^+ e^- \rightarrow K^+ K^-$
185±22		[10] BUON	82	DM1	$e^+ e^- \rightarrow$ hadrons
102±36		[11] MANE	82	DM1	$e^+ e^- \rightarrow K^0_S K \pi$

[1] From a fit with coherent interference of the $\phi(1680)$ with a non-resonant contribution.
[2] Assuming the $K \overline{K}^*(892)+$ c.c. dynamics. Systematic uncertainties not estimated.
[3] Using a vector meson dominance model with contribution from $\phi(1020)$, $\phi(1680)$, and higher mass excitations of $\rho(770)$ and $\omega(782)$.
[4] Using events with $\pi \pi$ invariant mass less than 0.85 GeV.
[5] From a fit with two incoherent Breit-Wigners.
[6] From the simultaneous fit to the $K \overline{K}^*(892)+$ c.c. and $\phi \eta$ data from AUBERT 08S using the results of AUBERT 07AK.
[7] From the combined fit of AKHMETSHIN 03 and MANE 81 also including ρ, ω, and ϕ. Neither isospin nor flavor structure known.
[8] Using BISELLO 88B and MANE 82 data.
[9] From global fit including ρ, ω, ϕ and $\rho(1700)$
[10] From global fit of ρ, ω, ϕ and their radial excitations to channels $\omega \pi^+ \pi^-$, $K^+ K^-$, $K^0_S K^0_L$, $K^0_S K^\pm \pi^\mp$. Assume mass 1570 MeV and width 510 MeV for ρ radial excitations, mass 1570 and width 500 MeV for ω radial excitation.
[11] Fit to one channel only, neglecting interference with ω, $\rho(1700)$.

PHOTOPRODUCTION

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
122±63	[1] LINK	02K	FOCS	20–160 $\gamma p \rightarrow K^+ K^- p$
121±47	[1] BUSENITZ	89	TPS	$\gamma p \rightarrow K^+ K^- X$
80±40	[1] ATKINSON	85C	OMEG	20–70 $\gamma p \rightarrow K \overline{K} X$
100±40	[1] ASTON	81F	OMEG	25–70 $\gamma p \rightarrow K^+ K^- X$

[1] We list here a state decaying into $K^+ K^-$ possibly different from $\phi(1680)$.

$p\overline{p}$ ANNIHILATION

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
143±24	[1] AMSLER	06	CBAR	0.9 $\overline{p} p \rightarrow K^+ K^- \pi^0$

[1] Could also be $\rho(1700)$.

ϕ(1680) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$K \overline{K}^*(892)$+ c.c.	seen
Γ_2	$K^0_S K \pi$	seen
Γ_3	$K \overline{K}$	seen
Γ_4	$K^0_L K^0_S$	
Γ_5	$e^+ e^-$	seen
Γ_6	$\omega \pi \pi$	not seen
Γ_7	$\phi \pi \pi$	
Γ_8	$K^+ K^- \pi^+ \pi^-$	seen
Γ_9	$\eta \phi$	seen
Γ_{10}	$K^+ K^- \eta$	
Γ_{11}	$\eta \gamma$	seen
Γ_{12}	$K^+ K^- \pi^0$	

ϕ(1680) $\Gamma(i)\Gamma(e^+ e^-)/\Gamma(\text{total})$

This combination of a partial width with the partial width into $e^+ e^-$ and with the total width is obtained from the integrated cross section into channel (I) in $e^+ e^-$ annihilation. We list only data that have not been used to determine the partial width Γ(I) or the branching ratio Γ(I)/total.

$\Gamma(K^0_L K^0_S) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_4\Gamma_5/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
14.3±2.4±6.2	6.2k	[1] LEES	14H	BABR	$e^+ e^- \rightarrow K^0_S K^0_L \gamma$

[1] Using a vector meson dominance model with contribution from $\phi(1020)$, $\phi(1680)$, and higher mass excitations of $\rho(770)$ and $\omega(782)$.

$\Gamma(\phi\pi\pi) \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_7\Gamma_5/\Gamma$

VALUE (10^{-2} keV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$4.2\pm0.2\pm0.3$	LEES	12F	BABR	$10.6\ e^+e^- \rightarrow \phi\pi^+\pi^-\gamma$

$\Gamma(\eta\phi) \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_9\Gamma_5/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$94\pm13\pm15$	3k	[1] IVANOV	19A	CMD3	1.59–2.007 $e^+e^- \rightarrow K^+K^-\eta$

[1] From a fit with coherent interference of the $\phi(1680)$ with a non-resonant contribution.

$\phi(1680)$ $\Gamma(i)\Gamma(e^+e^-)/\Gamma^2(total)$

This combination of a branching ratio into channel (i) and branching ratio into e^+e^- is directly measured and obtained from the cross section at the peak. We list only data that have not been used to determine the branching ratio into (i) or e^+e^-.

$\Gamma(K^0_L K^0_S)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_4/\Gamma \times \Gamma_5/\Gamma$

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.131 ± 0.059	948	[1] AKHMETSHIN	03	CMD2	1.05–1.38 $e^+e^- \rightarrow K^0_L K^0_S$

[1] From the combined fit of AKHMETSHIN 03 and MANE 81 also including ρ, ω, and ϕ. Neither isospin nor flavor structure known. Recalculated by us.

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_1/\Gamma \times \Gamma_5/\Gamma$

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.15\pm0.16\pm0.01$		[1] AUBERT	08S	BABR	$10.6\ e^+e^- \rightarrow K\overline{K}^*(892)\gamma$ + c.c.
3.29 ± 1.57	367	[2] BISELLO	91C	DM2	1.35–2.40 $e^+e^- \rightarrow K^0_S K^\pm\pi^\mp$

[1] From the simultaneous fit to the $K\overline{K}^*(892)+$ c.c. and $\phi\eta$ data from AUBERT 08S using the results of AUBERT 07AK.

[2] Recalculated by us with the published value of B($K\overline{K}^*(892)$ + c.c.) $\times\ \Gamma(e^+e^-)$.

$\Gamma(\phi\pi\pi)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_7/\Gamma \times \Gamma_5/\Gamma$

VALUE (units 10^{-7})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.86\pm0.14\pm0.21$	4.8k	[1] SHEN	09	BELL	$10.6\ e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$

[1] Multiplied by 3/2 to take into account the $\phi\pi^0\pi^0$ mode. Using B($\phi \rightarrow K^+K^-$) = $(49.2 \pm 0.6)\%$.

$\Gamma(\eta\phi)/\Gamma_{total} \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_9/\Gamma \times \Gamma_5/\Gamma$

VALUE (units 10^{-7})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$5.64^{+1.74}_{-1.80}$		ACHASOV	19	SND	$e^+e^- \to \pi^+\pi^-\pi^0\eta$
$5.3 \pm 0.6 \pm 0.9$	3k	[1] IVANOV	19A	CMD3	1.59–2.007 $e^+e^- \to K^+K^-\eta$
$4.3 \pm 1.0 \pm 0.9$		[2] AUBERT	08S	BABR	10.6 $e^+e^- \to \phi\eta\gamma$

[1] From a fit with coherent interference of the $\phi(1680)$ with a non-resonant contribution.
[2] From the simultaneous fit to the $K\overline{K}^*(892)+$ c.c. and $\phi\eta$ data from AUBERT 08S using the results of AUBERT 07AK.

$\phi(1680)$ BRANCHING RATIOS

$\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(K^0_S K\pi)$ — Γ_1/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
dominant	MANE	82	DM1	$e^+e^- \to K^0_S K^\pm\pi^\mp$

$\Gamma(K\overline{K})/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ — Γ_3/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.07 ± 0.01	BUON	82	DM1	e^+e^-

$\Gamma(\omega\pi\pi)/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ — Γ_6/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
<0.10	BUON	82	DM1	e^+e^-

$\Gamma(\eta\phi)/\Gamma_{total}$ — Γ_9/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	35	[1] ACHASOV	14	SND	1.15–2.00 $e^+e^- \to \eta\gamma$

[1] From a phenomenological model based on vector meson dominance with $\rho(1450)$ and $\phi(1680)$ masses and widths from the PDG 12.

$\Gamma(\eta\phi)/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ — Γ_9/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
≈ 0.37	[1] AUBERT	08S	BABR	10.6 $e^+e^- \to$ hadrons

[1] From the fit including data from AUBERT 07AK.

$\Gamma(\eta\gamma)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	35	[1] ACHASOV	14	SND	1.15–2.00 $e^+e^- \to \eta\gamma$

[1] From a phenomenological model based on vector meson dominance with $\rho(1450)$ and $\phi(1680)$ masses and widths from the PDG 12.

$\phi(1680)$ REFERENCES

ACHASOV	19	PR D99 112004	M.N. Achasov *et al.*	(SND Collab.)
IVANOV	19A	PL B798 134946	V.L. Ivanov *et al.*	(CMD-3 Collab.)
ACHASOV	18A	PR D97 032011	M.N. Achasov *et al.*	(SND Collab.)
ACHASOV	14	PR D90 032002	M.N. Achasov *et al.*	(SND Collab.)
LEES	14H	PR D89 092002	J.P. Lees *et al.*	(BABAR Collab.)
LEES	12F	PR D86 012008	J.P. Lees *et al.*	(BABAR Collab.)
PDG	12	PR D86 010001	J. Beringer *et al.*	(PDG Collab.)
SHEN	09	PR D80 031101	C.P. Shen *et al.*	(BELLE Collab.)
AUBERT	08S	PR D77 092002	B. Aubert *et al.*	(BABAR Collab.)
AUBERT	07AK	PR D76 012008	B. Aubert *et al.*	(BABAR Collab.)
AMSLER	06	PL B639 165	C. Amsler *et al.*	(CBAR Collab.)
AKHMETSHIN	03	PL B551 27	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
Also		PAN 65 1222	E.V. Anashkin, V.M. Aulchenko, R.R. Akhmetshin	
		Translated from YAF 65 1255.		
LINK	02K	PL B545 50	J.M. Link *et al.*	(FNAL FOCUS Collab.)
ACHASOV	98H	PR D57 4334	N.N. Achasov, A.A. Kozhevnikov	
CLEGG	94	ZPHY C62 455	A.B. Clegg, A. Donnachie	(LANC, MCHS)
ANTONELLI	92	ZPHY C56 15	A. Antonelli *et al.*	(DM2 Collab.)
BISELLO	91C	ZPHY C52 227	D. Bisello *et al.*	(DM2 Collab.)
DOLINSKY	91	PRPL 202 99	S.I. Dolinsky *et al.*	(NOVO)
BUSENITZ	89	PR D40 1	J.K. Busenitz *et al.*	(ILL, FNAL)
BISELLO	88B	ZPHY C39 13	D. Bisello *et al.*	(PADO, CLER, FRAS+)
BARKOV	87	JETPL 46 164	L.M. Barkov *et al.*	(NOVO)
		Translated from ZETFP 46 132.		
ATKINSON	85C	ZPHY C27 233	M. Atkinson *et al.*	(BONN, CERN, GLAS+)
BUON	82	PL 118B 221	J. Buon *et al.*	(LALO, MONP)
MANE	82	PL 112B 178	F. Mane *et al.*	(LALO)
ASTON	81F	PL 104B 231	D. Aston	(BONN, CERN, EPOL, GLAS, LANC+)
IVANOV	81	PL 107B 297	P.M. Ivanov *et al.*	(NOVO)
MANE	81	PL 99B 261	F. Mane *et al.*	(ORSAY)