# $\phi(1680)$

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

## $\phi(1680)$ 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. • • • | | | | | |
| 1645± 8 | 13 | AUBERT | 06D | BABR | 10.6 $e^+e^- \to \omega\eta\gamma$ |
| 1623±20 | 948 | [1] AKHMETSHIN | 03 | CMD2 | 1.05–1.38 $e^+e^- \to K^0_L K^0_S$ |
| ~ 1500 | | [2] ACHASOV | 98H | RVUE | $e^+e^- \to \pi^+\pi^-\pi^0$, $\omega\pi^+\pi^-$, $K^+K^-$ |
| ~ 1900 | | [3] ACHASOV | 98H | RVUE | $e^+e^- \to K^0_S K^\pm\pi^\mp$ |
| 1700±20 | | [4] 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 | | [5] BISELLO | 88B | DM2 | $e^+e^- \to K^+K^-$ |
| 1680±10 | | [6] BUON | 82 | DM1 | $e^+e^- \to$ hadrons |
| 1677±12 | | [7] MANE | 82 | DM1 | $e^+e^- \to K^0_S K\pi$ |

### PHOTOPRODUCTION

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1753± 3 | [8] LINK | 02K | FOCS | 20–160 $\gamma p \to K^+K^-p$ |
| 1726±22 | [8] BUSENITZ | 89 | TPS | $\gamma p \to K^+K^-X$ |
| 1760±20 | [8] ATKINSON | 85C | OMEG | 20–70 $\gamma p \to K\overline{K}X$ |
| 1690±10 | [8] ASTON | 81F | OMEG | 25–70 $\gamma p \to K^+K^-X$ |

### $p\overline{p}$ ANNIHILATION

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1700±8 | [9] AMSLER | 06 | CBAR | 0.9 $\overline{p}p \to K^+K^-\pi^0$ |

[1] From the combined fit of AKHMETSHIN 03 and MANE 81 also including $\rho$, $\omega$, and $\phi$. Neither isospin nor flavor structure known.

[2] Using data from IVANOV 81, BARKOV 87, BISELLO 88B, DOLINSKY 91, and ANTONELLI 92.

[3] Using the data from BISELLO 91C.

[4] Using BISELLO 88B and MANE 82 data.

[5] From global fit including $\rho$, $\omega$, $\phi$ and $\rho(1700)$ assume mass 1570 MeV and width 510 MeV for $\rho$ radial excitation.

[6] From global fit of $\rho$, $\omega$, $\phi$ 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 $\rho$ radial excitations, mass 1570 and width 500 MeV for $\omega$ radial excitation.

[7] Fit to one channel only, neglecting interference with $\omega$, $\rho(1700)$.

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

[9] 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. • • • | | | | | |
| 114±14 | 13 | AUBERT | 06D | BABR | 10.6 $e^+e^- \to \omega\eta\gamma$ |
| 139±60 | 948 | [10] AKHMETSHIN | 03 | CMD2 | 1.05–1.38 $e^+e^- \to K^0_L K^0_S$ |
| 300±60 | | [11] CLEGG | 94 | RVUE | $e^+e^- \to K^+K^-$, $K^0_S K\pi$ |
| 146±55 | 367 | BISELLO | 91C | DM2 | $e^+e^- \to K^0_S K^\pm\pi^\mp$ |
| 207±45 | | [12] BISELLO | 88B | DM2 | $e^+e^- \to K^+K^-$ |
| 185±22 | | [13] BUON | 82 | DM1 | $e^+e^- \to$ hadrons |
| 102±36 | | [14] MANE | 82 | DM1 | $e^+e^- \to K^0_S K\pi$ |

## PHOTOPRODUCTION

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 122±63 | [15] LINK | 02K | FOCS | 20–160 $\gamma p \to K^+K^-p$ |
| 121±47 | [15] BUSENITZ | 89 | TPS | $\gamma p \to K^+K^-X$ |
| 80±40 | [15] ATKINSON | 85C | OMEG | 20–70 $\gamma p \to K\overline{K}X$ |
| 100±40 | [15] ASTON | 81F | OMEG | 25–70 $\gamma p \to K^+K^-X$ |

## $p\overline{p}$ ANNIHILATION

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 143±24 | [16] AMSLER | 06 | CBAR | 0.9 $\overline{p}p \to K^+K^-\pi^0$ |

[10] From the combined fit of AKHMETSHIN 03 and MANE 81 also including $\rho$, $\omega$, and $\phi$. Neither isospin nor flavor structure known.
[11] Using BISELLO 88B and MANE 82 data.
[12] From global fit including $\rho$, $\omega$, $\phi$ and $\rho(1700)$
[13] From global fit of $\rho$, $\omega$, $\phi$ 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 $\rho$ radial excitations, mass 1570 and width 500 MeV for $\omega$ radial excitation.
[14] Fit to one channel only, neglecting interference with $\omega$, $\rho(1700)$.
[15] We list here a state decaying into $K^+K^-$ possibly different from $\phi(1680)$.
[16] Could also be $\rho(1700)$.

# $\phi(1680)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $K\overline{K}^*(892)+$ c.c. | dominant |
| $\Gamma_2$ | $K^0_S K\pi$ | seen |
| $\Gamma_3$ | $K\overline{K}$ | seen |
| $\Gamma_4$ | $K^0_L K^0_S$ | |
| $\Gamma_5$ | $e^+e^-$ | seen |
| $\Gamma_6$ | $\omega\pi\pi$ | not seen |
| $\Gamma_7$ | $\omega\eta$ | |
| $\Gamma_8$ | $K^+K^-\pi^0$ | |

## $\phi(1680)\ \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$

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 $e^+e^-$.

### $\Gamma(K_L^0 K_S^0) \times \Gamma(e^+e^-)/\Gamma^2_{\text{total}}$ $\quad \Gamma_4\Gamma_5/\Gamma^2$

| *VALUE* (units $10^{-6}$) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $0.131 \pm 0.059$ | 948 | [17] AKHMETSHIN | 03 | CMD2 | 1.05–1.38 $e^+e^- \to K_L^0 K_S^0$ |

### $\Gamma(K\overline{K}^*(892)+\text{c.c.}) \times \Gamma(e^+e^-)/\Gamma^2_{\text{total}}$ $\quad \Gamma_1\Gamma_5/\Gamma^2$

| *VALUE* (units $10^{-6}$) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $3.29 \pm 1.57$ | 367 | [18] BISELLO | 91C | DM2 | 1.35–2.40 $e^+e^- \to K_S^0 K^\pm \pi^\mp$ |

### $\Gamma(\omega\eta) \times \Gamma(e^+e^-)/\Gamma^2_{\text{total}}$ $\quad \Gamma_7\Gamma_5/\Gamma^2$

| *VALUE* (units $10^{-6}$) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $0.57 \pm 0.06$ | 13 | AUBERT | 06D | BABR | 10.6 $e^+e^- \to \omega\eta\gamma$ |

[17] From the combined fit of AKHMETSHIN 03 and MANE 81 also including $\rho$, $\omega$, and $\phi$. Neither isospin nor flavor structure known. Recalculated by us.

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

## $\phi(1680)$ BRANCHING RATIOS

### $\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma(K_S^0 K\pi)$ $\quad \Gamma_1/\Gamma_2$

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

### $\Gamma(K\overline{K})/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ $\quad \Gamma_3/\Gamma_1$

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

### $\Gamma(\omega\pi\pi)/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ $\quad \Gamma_6/\Gamma_1$

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

# $\phi$(1680) REFERENCES


| | | | | |
|---|---|---|---|---|
| AMSLER | 06 | PL B639 165 | C. Amsler *et al.* | (CBAR Collab.) |
| AUBERT | 06D | PR D73 052003 | B. Aubert *et al.* | (BABAR 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) |


## OTHER RELATED PAPERS


| | | | | |
|---|---|---|---|---|
| ACHASOV | 06D | JETP 103 720 | N.N. Achasov *et al.* | (SND Collab.) |
| | | Translated from ZETF 130 831. | | |
| CLOSE | 02 | PR D65 092003 | F.E. Close, A. Donnachie, Yu.S. Kalashnikova | |
| LINK | 02K | PL B545 50 | J.M. Link *et al.* | (FNAL FOCUS Collab.) |
| ABELE | 99D | PL B468 178 | A. Abele *et al.* | (Crystal Barrel Collab.) |
| ACHASOV | 97F | PAN 60 2029 | N.N. Achasov, A.A. Kozhevnikov | (NOVM) |
| | | Translated from YAF 60 2212. | | |
| ATKINSON | 86C | ZPHY C30 541 | M. Atkinson *et al.* | (BONN, CERN, GLAS+) |
| ATKINSON | 84 | NP B231 15 | M. Atkinson *et al.* | (BONN, CERN, GLAS+) |
| ATKINSON | 84B | NP B231 1 | M. Atkinson *et al.* | (BONN, CERN, GLAS+) |
| ATKINSON | 83C | NP B229 269 | M. Atkinson *et al.* | (BONN, CERN, GLAS+) |
| CORDIER | 81 | PL 106B 155 | A. Cordier *et al.* | (ORSAY) |
| MANE | 81 | PL 99B 261 | F. Mane *et al.* | (ORSAY) |
| ASTON | 80F | NP B174 269 | D. Aston | (BONN, CERN, EPOL, GLAS, LANC+) |