# $f_1(1420)$

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

See the minireview under $\eta(1405)$.

## $f_1(1420)$ MASS

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **1426.4± 0.9 OUR AVERAGE** | | Error includes scale factor of 1.1. | | | |
| 1434 ± 5 ± 5 | 133 | [1] ACHARD | 07 | L3 | 183–209 $e^+e^- \to e^+e^- K^0_S K^\pm \pi^\mp$ |
| 1426 ± 6 | 711 | ABDALLAH | 03H | DLPH | 91.2 $e^+e^- \to K^0_S K^\pm \pi^\mp + X$ |
| 1420 ±14 | 3651 | NICHITIU | 02 | OBLX | |
| 1428 ± 4 ± 2 | 20k | ADAMS | 01B | B852 | 18 GeV $\pi^- p \to K^+ K^- \pi^0 n$ |
| 1426 ± 1 | | BARBERIS | 97C | OMEG | 450 $pp \to pp K^0_S K^\pm \pi^\mp$ |
| 1425 ± 8 | | BERTIN | 97 | OBLX | 0.0 $\overline{p}p \to K^\pm (K^0) \pi^\mp \pi^+ \pi^-$ |
| 1435 ± 9 | | PROKOSHKIN | 97B | GAM4 | 100 $\pi^- p \to \eta \pi^0 \pi^0 n$ |
| 1430 ± 4 | | [2] ARMSTRONG | 92E | OMEG | 85,300 $\pi^+ p$, $pp \to \pi^+ p$, $pp(K\overline{K}\pi)$ |
| 1462 ±20 | | [3] AUGUSTIN | 92 | DM2 | $J/\psi \to \gamma K \overline{K} \pi$ |
| 1443 $^{+\ 7}_{-\ 6}$ $^{+\ 3}_{-\ 2}$ | 1100 | BAI | 90C | MRK3 | $J/\psi \to \gamma K^0_S K^\pm \pi^\mp$ |
| 1425 ±10 | 17 | BEHREND | 89 | CELL | $\gamma\gamma \to K^0_S K^\pm \pi^\mp$ |
| 1442 ± 5 $^{+10}_{-17}$ | 111 | BECKER | 87 | MRK3 | $e^+e^-$, $\omega K \overline{K} \pi$ |
| 1423 ± 4 | | GIDAL | 87B | MRK2 | $e^+e^- \to e^+e^- K\overline{K}\pi$ |
| 1417 ±13 | 13 | AIHARA | 86C | TPC | $e^+e^- \to e^+e^- K\overline{K}\pi$ |
| 1422 ± 3 | | CHAUVAT | 84 | SPEC | ISR 31.5 $pp$ |
| 1440 ±10 | | [4] BROMBERG | 80 | SPEC | 100 $\pi^- p \to K\overline{K}\pi X$ |
| 1426 ± 6 | 221 | DIONISI | 80 | HBC | 4 $\pi^- p \to K\overline{K}\pi n$ |
| 1420 ±20 | | DAHL | 67 | HBC | 1.6–4.2 $\pi^- p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 1430.8± 0.9 | | [5] SOSA | 99 | SPEC | $pp \to p_{\text{slow}} (K^0_S K^+ \pi^-)\ p_{\text{fast}}$ |
| 1433.4± 0.8 | | [5] SOSA | 99 | SPEC | $pp \to p_{\text{slow}} (K^0_S K^- \pi^+)\ p_{\text{fast}}$ |
| 1429 ± 3 | 389 | ARMSTRONG | 89 | OMEG | 300 $pp \to K\overline{K}\pi pp$ |
| 1425 ± 2 | 1520 | ARMSTRONG | 84 | OMEG | 85 $\pi^+ p$, $pp \to (\pi^+, p)(K\overline{K}\pi)p$ |
| ~ 1420 | | BITYUKOV | 84 | SPEC | 32 $K^- p \to K^+ K^- \pi^0 Y$ |

[1] From a fit with a width fixed at 55 MeV.
[2] This result supersedes ARMSTRONG 84, ARMSTRONG 89.
[3] From fit to the $K^*(892)K$ $1^{++}$ partial wave.
[4] Mass error increased to account for $a_0(980)$ mass cut uncertainties.

[5] No systematic error given.

## $f_1(1420)$ WIDTH

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **54.9± 2.6 OUR AVERAGE** | | | | | |
| 51 ±14 | 711 | ABDALLAH | 03H | DLPH | 91.2 $e^+e^- \to K^0_S K^\pm \pi^\mp + X$ |
| 61 ± 8 | 3651 | NICHITIU | 02 | OBLX | |
| 38 ± 9 ±6 | 20k | ADAMS | 01B | B852 | 18 GeV $\pi^- p \to K^+ K^- \pi^0 n$ |
| 58 ± 4 | | BARBERIS | 97C | OMEG | 450 $pp \to p p K^0_S K^\pm \pi^\mp$ |
| 45 ±10 | | BERTIN | 97 | OBLX | 0.0 $\overline{p}p \to K^\pm (K^0) \pi^\mp \pi^+ \pi^-$ |
| 90 ±25 | | PROKOSHKIN | 97B | GAM4 | 100 $\pi^- p \to \eta \pi^0 \pi^0 n$ |
| 58 ±10 | | [6] ARMSTRONG | 92E | OMEG | 85,300 $\pi^+ p$, $pp \to \pi^+ p$, $pp(K\overline{K}\pi)$ |
| 129 ±41 | | [7] AUGUSTIN | 92 | DM2 | $J/\psi \to \gamma K \overline{K} \pi$ |
| 68 $^{+29}_{-18}$ $^{+8}_{-9}$ | 1100 | BAI | 90C | MRK3 | $J/\psi \to \gamma K^0_S K^\pm \pi^\mp$ |
| 42 ±22 | 17 | BEHREND | 89 | CELL | $\gamma\gamma \to K^0_S K^\pm \pi^\mp$ |
| 40 $^{+17}_{-13}$ ±5 | 111 | BECKER | 87 | MRK3 | $e^+e^- \to \omega K \overline{K} \pi$ |
| 35 $^{+47}_{-20}$ | 13 | AIHARA | 86C | TPC | $e^+e^- \to e^+e^- K \overline{K} \pi$ |
| 47 ±10 | | CHAUVAT | 84 | SPEC | ISR 31.5 $pp$ |
| 62 ±14 | | BROMBERG | 80 | SPEC | 100 $\pi^- p \to K \overline{K} \pi X$ |
| 40 ±15 | 221 | DIONISI | 80 | HBC | 4 $\pi^- p \to K \overline{K} \pi n$ |
| 60 ±20 | | DAHL | 67 | HBC | 1.6–4.2 $\pi^- p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 68.7± 2.9 | | [8] SOSA | 99 | SPEC | $pp \to p_{\text{slow}} (K^0_S K^+ \pi^-)\, p_{\text{fast}}$ |
| 58.8± 3.3 | | [8] SOSA | 99 | SPEC | $pp \to p_{\text{slow}} (K^0_S K^- \pi^+)\, p_{\text{fast}}$ |
| 58 ± 8 | 389 | ARMSTRONG | 89 | OMEG | 300 $pp \to K \overline{K} \pi p p$ |
| 62 ± 5 | 1520 | ARMSTRONG | 84 | OMEG | 85 $\pi^+ p$, $pp \to (\pi^+, p)(K\overline{K}\pi) p$ |
| ~ 50 | | BITYUKOV | 84 | SPEC | 32 $K^- p \to K^+ K^- \pi^0 Y$ |

[6] This result supersedes ARMSTRONG 84, ARMSTRONG 89.
[7] From fit to the $K^*(892) K$ $1^{++}$ partial wave.
[8] No systematic error given.

## $f_1(1420)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $K\overline{K}\pi$ | dominant |
| $\Gamma_2$ | $K\overline{K}^*(892)+$ c.c. | dominant |
| $\Gamma_3$ | $\eta\pi\pi$ | possibly seen |
| $\Gamma_4$ | $a_0(980)\pi$ | |
| $\Gamma_5$ | $\pi\pi\rho$ | |
| $\Gamma_6$ | $4\pi$ | |
| $\Gamma_7$ | $\rho^0\gamma$ | |
| $\Gamma_8$ | $\phi\gamma$ | seen |

## $f_1(1420)$ $\Gamma$(i)$\Gamma(\gamma\gamma)/\Gamma$(total)

### $\Gamma(K\overline{K}\pi)\ \times\ \Gamma(\gamma\gamma^*)/\Gamma_{\text{total}}$

| VALUE (keV) | CL% | EVTS | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|---|---|
| **1.9±0.4 OUR AVERAGE** | | | | | | | |
| 3.2±0.6±0.7 | | 133 | [9,10] | ACHARD | 07 | L3 | 183–209 $e^+e^- \to e^+e^- K^0_S K^\pm\pi^\mp$ |
| 3.0±0.9±0.7 | | | [11,12] | BEHREND | 89 | CELL | $e^+e^- \to e^+e^- K^0_S K\pi$ |
| $2.3^{+1.0}_{-0.9}\pm0.8$ | | | | HILL | 89 | JADE | $e^+e^- \to e^+e^- K^\pm K^0_S\pi^\mp$ |
| 1.3±0.5±0.3 | | | | AIHARA | 88B | TPC | $e^+e^- \to e^+e^- K^\pm K^0_S\pi^\mp$ |
| 1.6±0.7±0.3 | | | [11,13] | GIDAL | 87B | MRK2 | $e^+e^- \to e^+e^- K\overline{K}\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | | |
| <8.0 | 95 | | | JENNI | 83 | MRK2 | $e^+e^- \to e^+e^- K\overline{K}\pi$ |

[9] From a fit with a width fixed at 55 MeV.
[10] The form factor parameter from the fit is 926 ± 78 MeV.
[11] Assume a $\rho$-pole form factor.
[12] A $\phi$ - pole form factor gives considerably smaller widths.
[13] Published value divided by 2.

## $f_1(1420)$ BRANCHING RATIOS

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.76±0.06 | BROMBERG | 80 | SPEC | 100 $\pi^- p \to K\overline{K}\pi X$ |
| 0.86±0.12 | DIONISI | 80 | HBC | 4 $\pi^- p \to K\overline{K}\pi n$ |

### $\Gamma(\pi\pi\rho)/\Gamma(K\overline{K}\pi)$ $\Gamma_5/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.3 | 95 | CORDEN | 78 | OMEG | 12–15 $\pi^- p$ |
| <2.0 | | DAHL | 67 | HBC | 1.6–4.2 $\pi^- p$ |

## $\Gamma(\eta\pi\pi)/\Gamma(K\overline{K}\pi)$ $\Gamma_3/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.1** | 95 | ARMSTRONG | 91B | OMEG | 300 $pp \to pp\eta\pi^+\pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 1.35±0.75 | | KOPKE | 89 | MRK3 | $J/\psi \to \omega\eta\pi\pi(K\overline{K}\pi)$ |
| <0.6 | 90 | GIDAL | 87 | MRK2 | $e^+e^- \to e^+e^-\eta\pi^+\pi^-$ |
| <0.5 | 95 | CORDEN | 78 | OMEG | 12–15 $\pi^- p$ |
| 1.5 ±0.8 | | DEFOIX | 72 | HBC | 0.7 $\overline{p}p$ |

## $\Gamma(a_0(980)\pi)/\Gamma(\eta\pi\pi)$ $\Gamma_4/\Gamma_3$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **>0.1** | 90 | PROKOSHKIN | 97B | GAM4 | 100 $\pi^- p \to \eta\pi^0\pi^0 n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| not seen in either mode | | ANDO | 86 | SPEC | 8 $\pi^- p$ |
| not seen in either mode | | CORDEN | 78 | OMEG | 12–15 $\pi^- p$ |
| 0.4±0.2 | | DEFOIX | 72 | HBC | 0.7 $\overline{p}p \to 7\pi$ |

## $\Gamma(4\pi)/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ $\Gamma_6/\Gamma_2$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.90 | 95 | DIONISI | 80 | HBC | 4 $\pi^- p$ |

## $\Gamma(K\overline{K}\pi)/[\Gamma(K\overline{K}^*(892)+\text{c.c.})+\Gamma(a_0(980)\pi)]$ $\Gamma_1/(\Gamma_2+\Gamma_4)$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.65±0.27 | [14] DIONISI | 80 | HBC | 4 $\pi^- p$ |

[14] Calculated using $\Gamma(K\overline{K})/\Gamma(\eta\pi) = 0.24 \pm 0.07$ for $a_0(980)$ fractions.

## $\Gamma(a_0(980)\pi)/\Gamma(K\overline{K}^*(892)+\text{c.c.})$ $\Gamma_4/\Gamma_2$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.04±0.01 ±0.01** | | BARBERIS | 98C | OMEG | 450 $pp \to p_f f_1(1420) p_s$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.04 | 68 | ARMSTRONG | 84 | OMEG | 85 $\pi^+ p$ |

## $\Gamma(4\pi)/\Gamma(K\overline{K}\pi)$ $\Gamma_6/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.62** | 95 | ARMSTRONG | 89G | OMEG | 85 $\pi p \to 4\pi X$ |

## $\Gamma(\rho^0\gamma)/\Gamma_{\text{total}}$ $\Gamma_7/\Gamma$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| <0.08 | 95 | [15] ARMSTRONG | 92C | SPEC | 300 $pp \to pp\pi^+\pi^-\gamma$ |

[15] Using the data on the $\overline{K}K\pi$ mode from ARMSTRONG 89.

## $\Gamma(\rho^0\gamma)/\Gamma(K\overline{K}\pi)$ $\Gamma_7/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.02** | 95 | BARBERIS | 98C | OMEG | 450 $pp \to p_f f_1(1420) p_s$ |

## $\Gamma(\phi\gamma)/\Gamma(K\overline{K}\pi)$ $\Gamma_8/\Gamma_1$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **0.003±0.001 ±0.001** | BARBERIS | 98C | OMEG | 450 $pp \rightarrow p_f f_1(1420) p_s$ |

## $f_1(1420)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| ACHARD | 07 | JHEP 0703 018 | P. Achard *et al.* | (L3 Collab.) |
| ABDALLAH | 03H | PL B569 129 | J. Abdallah *et al.* | (DELPHI Collab.) |
| NICHITIU | 02 | PL B545 261 | F. Nichitiu *et al.* | (OBELIX Collab.) |
| ADAMS | 01B | PL B516 264 | G.S. Adams *et al.* | (BNL E852 Collab.) |
| SOSA | 99 | PRL 83 913 | M. Sosa *et al.* | |
| BARBERIS | 98C | PL B440 225 | D. Barberis *et al.* | (WA 102 Collab.) |
| BARBERIS | 97C | PL B413 225 | D. Barberis *et al.* | (WA 102 Collab.) |
| BERTIN | 97 | PL B400 226 | A. Bertin *et al.* | (OBELIX Collab.) |
| PROKOSHKIN | 97B | SPD 42 298 | Yu.D. Prokoshkin, S.A. Sadovsky | |
| | | Translated from DANS 354 751. | | |
| ARMSTRONG | 92C | ZPHY C54 371 | T.A. Armstrong *et al.* | (ATHU, BARI, BIRM+) |
| ARMSTRONG | 92E | ZPHY C56 29 | T.A. Armstrong *et al.* | (ATHU, BARI, BIRM+) JPC |
| AUGUSTIN | 92 | PR D46 1951 | J.E. Augustin, G. Cosme | (DM2 Collab.) |
| ARMSTRONG | 91B | ZPHY C52 389 | T.A. Armstrong *et al.* | (ATHU, BARI, BIRM+) |
| BAI | 90C | PRL 65 2507 | Z. Bai *et al.* | (Mark III Collab.) |
| ARMSTRONG | 89 | PL B221 216 | T.A. Armstrong *et al.* | (CERN, CDEF, BIRM+) JPC |
| ARMSTRONG | 89G | ZPHY C43 55 | T.A. Armstrong *et al.* | (CERN, BIRM, BARI+) |
| BEHREND | 89 | ZPHY C42 367 | H.J. Behrend *et al.* | (CELLO Collab.) |
| HILL | 89 | ZPHY C42 355 | P. Hill *et al.* | (JADE Collab.) JP |
| KOPKE | 89 | PRPL 174 67 | L. Kopke *et al.* | (CERN) |
| AIHARA | 88B | PL B209 107 | H. Aihara *et al.* | (TPC-2$\gamma$ Collab.) |
| BECKER | 87 | PRL 59 186 | J.J. Becker *et al.* | (Mark III Collab.) JP |
| GIDAL | 87 | PRL 59 2012 | G. Gidal *et al.* | (LBL, SLAC, HARV) |
| GIDAL | 87B | PRL 59 2016 | G. Gidal *et al.* | (LBL, SLAC, HARV) |
| AIHARA | 86C | PRL 57 2500 | H. Aihara *et al.* | (TPC-2$\gamma$ Collab.) JP |
| ANDO | 86 | PRL 57 1296 | A. Ando *et al.* | (KEK, KYOT, NIRS, SAGA+) |
| ARMSTRONG | 84 | PL 146B 273 | T.A. Armstrong *et al.* | (ATHU, BARI, BIRM+) JP |
| BITYUKOV | 84 | SJNP 39 735 | S. Bityukov *et al.* | (SERP) |
| | | Translated from YAF 39 1165. | | |
| CHAUVAT | 84 | PL 148B 382 | P. Chauvat *et al.* | (CERN, CLER, UCLA+) |
| JENNI | 83 | PR D27 1031 | P. Jenni *et al.* | (SLAC, LBL) |
| BROMBERG | 80 | PR D22 1513 | C.M. Bromberg *et al.* | (CIT, FNAL, ILLC+) |
| DIONISI | 80 | NP B169 1 | C. Dionisi *et al.* | (CERN, MADR, CDEF+) IJP |
| CORDEN | 78 | NP B144 253 | M.J. Corden *et al.* | (BIRM, RHEL, TELA+) |
| DEFOIX | 72 | NP B44 125 | C. Defoix *et al.* | (CDEF, CERN) |
| DAHL | 67 | PR 163 1377 | O.I. Dahl *et al.* | (LRL) IJP |
| Also | | PRL 14 1074 | D.H. Miller *et al.* | (LRL, UCB) |