

# $f_1(1420)$

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

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

## $f_1(1420)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1426.4 ± 0.9 OUR AVERAGE</b>		Error includes scale factor of 1.1.		
1434 ± 5 ± 5	133	<sup>1</sup> ACHARD 07	L3	183–209 $e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$
1426 ± 6	711	ABDALLAH 03H	DLPH	91.2 $e^+e^- \rightarrow K_S^0K^\pm\pi^\mp + X$
1420 ± 14	3651	NICHITIU 02	OBLX	
1428 ± 4 ± 2	20k	ADAMS 01B	B852	18 GeV $\pi^-p \rightarrow K^+K^-\pi^0n$
1426 ± 1		BARBERIS 97C	OMEG	450 $pp \rightarrow ppK_S^0K^\pm\pi^\mp$
1425 ± 8		BERTIN 97	OBLX	0.0 $\bar{p}p \rightarrow K^\pm(K^0)\pi^\mp\pi^+\pi^-$
1435 ± 9		PROKOSHKIN 97B	GAM4	100 $\pi^-p \rightarrow \eta\pi^0\pi^0n$
1430 ± 4		<sup>2</sup> ARMSTRONG 92E	OMEG	85,300 $\pi^+p, pp \rightarrow \pi^+p, pp(K\bar{K}\pi)$
1462 ± 20		<sup>3</sup> AUGUSTIN 92	DM2	$J/\psi \rightarrow \gamma K\bar{K}\pi$
1443 + 7 - 6 + 3 - 2	1100	BAI 90C	MRK3	$J/\psi \rightarrow \gamma K_S^0K^\pm\pi^\mp$
1425 ± 10	17	BEHREND 89	CELL	$\gamma\gamma \rightarrow K_S^0K^\pm\pi^\mp$
1442 ± 5 + 10 - 17	111	BECKER 87	MRK3	$e^+e^-, \omega K\bar{K}\pi$
1423 ± 4		GIDAL 87B	MRK2	$e^+e^- \rightarrow e^+e^-K\bar{K}\pi$
1417 ± 13	13	AIHARA 86C	TPC	$e^+e^- \rightarrow e^+e^-K\bar{K}\pi$
1422 ± 3		CHAUVAT 84	SPEC	ISR 31.5 $pp$
1440 ± 10		<sup>4</sup> BROMBERG 80	SPEC	100 $\pi^-p \rightarrow K\bar{K}\pi X$
1426 ± 6	221	DIONISI 80	HBC	4 $\pi^-p \rightarrow K\bar{K}\pi n$
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		<sup>5</sup> SOSA 99	SPEC	$pp \rightarrow p_{\text{slow}}(K_S^0K^+\pi^-)p_{\text{fast}}$
1433.4 ± 0.8		<sup>5</sup> SOSA 99	SPEC	$pp \rightarrow p_{\text{slow}}(K_S^0K^-\pi^+)p_{\text{fast}}$
1429 ± 3	389	ARMSTRONG 89	OMEG	300 $pp \rightarrow K\bar{K}\pi pp$
1425 ± 2	1520	ARMSTRONG 84	OMEG	85 $\pi^+p, pp \rightarrow (\pi^+, p)(K\bar{K}\pi)p$
~ 1420		BITYUKOV 84	SPEC	32 $K^-p \rightarrow K^+K^-\pi^0\gamma$

<sup>1</sup> From a fit with a width fixed at 55 MeV.

<sup>2</sup> This result supersedes ARMSTRONG 84, ARMSTRONG 89.

<sup>3</sup> From fit to the  $K^*(892)K$   $1^{++}$  partial wave.

<sup>4</sup> Mass error increased to account for  $a_0(980)$  mass cut uncertainties.

<sup>5</sup>No systematic error given.

### $f_1(1420)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>54.9 ± 2.6 OUR AVERAGE</b>				
51 ± 14	711	ABDALLAH	03H DLPH	91.2 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp + X$
61 ± 8	3651	NICHITIU	02 OBLX	
38 ± 9 ± 6	20k	ADAMS	01B B852	18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$
58 ± 4		BARBERIS	97C OMEG	450 $pp \rightarrow pp K_S^0 K^\pm \pi^\mp$
45 ± 10		BERTIN	97 OBLX	0.0 $\bar{p}p \rightarrow K^\pm (K^0) \pi^\mp \pi^+ \pi^-$
90 ± 25		PROKOSHKIN	97B GAM4	100 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$
58 ± 10		<sup>6</sup> ARMSTRONG	92E OMEG	85,300 $\pi^+ p, pp \rightarrow \pi^+ p, pp (K \bar{K} \pi)$
129 ± 41		<sup>7</sup> AUGUSTIN	92 DM2	$J/\psi \rightarrow \gamma K \bar{K} \pi$
68 $\begin{smallmatrix} +29 \\ -18 \end{smallmatrix}$ $\begin{smallmatrix} +8 \\ -9 \end{smallmatrix}$	1100	BAI	90C MRK3	$J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$
42 ± 22	17	BEHREND	89 CELL	$\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$
40 $\begin{smallmatrix} +17 \\ -13 \end{smallmatrix}$ ± 5	111	BECKER	87 MRK3	$e^+e^- \rightarrow \omega K \bar{K} \pi$
35 $\begin{smallmatrix} +47 \\ -20 \end{smallmatrix}$	13	AIHARA	86C TPC	$e^+e^- \rightarrow e^+e^- K \bar{K} \pi$
47 ± 10		CHAUVAT	84 SPEC	ISR 31.5 $pp$
62 ± 14		BROMBERG	80 SPEC	100 $\pi^- p \rightarrow K \bar{K} \pi X$
40 ± 15	221	DIONISI	80 HBC	4 $\pi^- p \rightarrow K \bar{K} \pi n$
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		<sup>8</sup> SOSA	99 SPEC	$pp \rightarrow p_{\text{slow}} (K_S^0 K^+ \pi^-) p_{\text{fast}}$
58.8 ± 3.3		<sup>8</sup> SOSA	99 SPEC	$pp \rightarrow p_{\text{slow}} (K_S^0 K^- \pi^+) p_{\text{fast}}$
58 ± 8	389	ARMSTRONG	89 OMEG	300 $pp \rightarrow K \bar{K} \pi pp$
62 ± 5	1520	ARMSTRONG	84 OMEG	85 $\pi^+ p, pp \rightarrow (\pi^+, p) (K \bar{K} \pi) p$
~ 50		BITYUKOV	84 SPEC	32 $K^- p \rightarrow K^+ K^- \pi^0 \gamma$

<sup>6</sup>This result supersedes ARMSTRONG 84, ARMSTRONG 89.

<sup>7</sup>From fit to the  $K^*(892) K 1^{++}$  partial wave.

<sup>8</sup>No systematic error given.

## $f_1(1420)$ DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $K\bar{K}\pi$	dominant
$\Gamma_2$ $K\bar{K}^*(892) + \text{c.c.}$	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

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

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

VALUE (keV)	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.9±0.4 OUR AVERAGE</b>					
3.2±0.6±0.7		133	<sup>9,10</sup> ACHARD	07 L3	183–209 $e^+e^- \rightarrow e^+e^- K_S^0 K^\pm \pi^\mp$
3.0±0.9±0.7			<sup>11,12</sup> BEHREND	89 CELL	$e^+e^- \rightarrow e^+e^- K_S^0 K\pi$
2.3 <sup>+1.0</sup> ±0.8 -0.9±0.8			HILL	89 JADE	$e^+e^- \rightarrow e^+e^- K^\pm K_S^0 \pi^\mp$
1.3±0.5±0.3			AIHARA	88B TPC	$e^+e^- \rightarrow e^+e^- K^\pm K_S^0 \pi^\mp$
1.6±0.7±0.3			<sup>11,13</sup> GIDAL	87B MRK2	$e^+e^- \rightarrow e^+e^- K\bar{K}\pi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
<8.0	95		JENNI	83 MRK2	$e^+e^- \rightarrow e^+e^- K\bar{K}\pi$

<sup>9</sup> From a fit with a width fixed at 55 MeV.

<sup>10</sup> The form factor parameter from the fit is  $926 \pm 78$  MeV.

<sup>11</sup> Assume a  $\rho$ -pole form factor.

<sup>12</sup> A  $\phi$ -pole form factor gives considerably smaller widths.

<sup>13</sup> Published value divided by 2.

### $f_1(1420)$ BRANCHING RATIOS

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

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 $\pi^- p \rightarrow K\bar{K}\pi X$
0.86±0.12	DIONISI	80 HBC	4 $\pi^- p \rightarrow K\bar{K}\pi n$

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

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 $\pi^- p$

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

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

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

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&gt;0.1</b>	90	PROKOSHKIN 97B	GAM4	100 $\pi^-p \rightarrow \eta\pi^0\pi^0n$
● ● ● 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 $\bar{p}p \rightarrow 7\pi$

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

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

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.65 ± 0.27	<sup>14</sup> DIONISI 80	HBC	4 $\pi^-p$
<sup>14</sup> Calculated using $\Gamma(K\bar{K})/\Gamma(\eta\pi) = 0.24 \pm 0.07$ for $a_0(980)$ fractions.			

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

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

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

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;0.62</b>	95	ARMSTRONG 89G	OMEG	85 $\pi p \rightarrow 4\pi X$

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

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<0.08	95	<sup>15</sup> ARMSTRONG 92C	SPEC	300 $pp \rightarrow p\rho\pi^+\pi^-\gamma$
<sup>15</sup> Using the data on the $\bar{K}K\pi$ mode from ARMSTRONG 89.				

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

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;0.02</b>	95	BARBERIS 98C	OMEG	450 $pp \rightarrow p_f f_1(1420) p_s$

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.003±0.001±0.001</b>	BARBERIS	98C OMEG	450 $p\bar{p} \rightarrow p_f f_1(1420) p_S$

 **$f_1(1420)$  REFERENCES**

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