

**$f_J(2220)$** 

$$I^G(J^{PC}) = 0^+(2^{++} \text{ or } 4^{++})$$

## OMITTED FROM SUMMARY TABLE

Needs confirmation. See our mini-review in the 2004 edition of this Review, PDG 04.

 **$f_J(2220)$  MASS**

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2231.1 ± 3.5</b>	<b>OUR AVERAGE</b>			
2235 ± 4 ± 6	74	BAI	96B BES	$e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$
2230 $^{+6}_{-7}$ ± 16	46	BAI	96B BES	$e^+e^- \rightarrow J/\psi \rightarrow \gamma K^+K^-$
2232 $^{+8}_{-7}$ ± 15	23	BAI	96B BES	$e^+e^- \rightarrow J/\psi \rightarrow \gamma K_S^0 K_S^0$
2235 ± 4 ± 5	32	BAI	96B BES	$e^+e^- \rightarrow J/\psi \rightarrow \gamma p\bar{p}$
2209 $^{+17}_{-15}$ ± 10		ASTON	88F LASS	11 $K^-p \rightarrow K^+K^-\Lambda$
2230 ± 20		BOLONKIN	88 SPEC	40 $\pi^-p \rightarrow K_S^0 K_S^0 n$
2220 ± 10	41	<sup>1</sup> ALDE	86B GA24	38–100 $\pi p \rightarrow n\eta\eta'$
2230 ± 6 ± 14	93	BALTRUSAIT..86D	MRK3	$e^+e^- \rightarrow \gamma K^+K^-$
2232 ± 7 ± 7	23	BALTRUSAIT..86D	MRK3	$e^+e^- \rightarrow \gamma K_S^0 K_S^0$

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

2223.9 ± 2.5		<sup>2</sup> VLADIMIRSK...08	SPEC	40 $\pi^-p \rightarrow K_S^0 K_S^0 n + m\pi^0$
2246 ± 36		BAI	98H BES	$J/\psi \rightarrow \gamma\pi^0\pi^0$

<sup>1</sup>ALDE 86B uses data from both the GAMS-2000 and GAMS-4000 detectors.<sup>2</sup> $J^{PC} = 2^{++}$ . Systematic uncertainties not evaluated **$f_J(2220)$  WIDTH**

VALUE (MeV)	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>23 <math>^{+}_{-}</math> <math>^{8}_{7}</math></b>	<b>OUR AVERAGE</b>				
19 $^{+}_{-}$ $^{13}_{11}$ ± 12		74	BAI	96B BES	$e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$
20 $^{+}_{-}$ $^{20}_{15}$ ± 17		46	BAI	96B BES	$e^+e^- \rightarrow J/\psi \rightarrow \gamma K^+K^-$
20 $^{+}_{-}$ $^{25}_{16}$ ± 14		23	BAI	96B BES	$e^+e^- \rightarrow J/\psi \rightarrow \gamma K_S^0 K_S^0$
15 $^{+}_{-}$ $^{12}_{9}$ ± 9		32	BAI	96B BES	$e^+e^- \rightarrow J/\psi \rightarrow \gamma p\bar{p}$
60 $^{+}_{-}$ $^{107}_{57}$			ASTON	88F LASS	11 $K^-p \rightarrow K^+K^-\Lambda$
80 ± 30			BOLONKIN	88 SPEC	40 $\pi^-p \rightarrow K_S^0 K_S^0 n$
26 $^{+}_{-}$ $^{20}_{16}$ ± 17		93	BALTRUSAIT..86D	MRK3	$e^+e^- \rightarrow \gamma K^+K^-$
18 $^{+}_{-}$ $^{23}_{15}$ ± 10		23	BALTRUSAIT..86D	MRK3	$e^+e^- \rightarrow \gamma K_S^0 K_S^0$

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



$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\eta\eta)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma \times \Gamma_8/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;4</b>	95	<sup>6</sup> AMSLER	01	CBAR 1.4–1.5 $p\bar{p} \rightarrow \eta\eta$

<sup>6</sup> For  $J^P = 2^+$  in the mass range 2222–2240 MeV and the total width between 10 and 20 MeV.

<sup>7</sup> For  $J^P = 2^+$  and  $J^P = 4^+$  in the mass range 2220–2245 MeV and the total width of 15 MeV.

<sup>8</sup> For  $J^P = 2^+$ , the mass of 2235 MeV and the total width of 15 MeV.

**$f_J(2220)$  BRANCHING RATIOS**

$\Gamma(p\bar{p})/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
--------------------------	-----	-------------	------	---------

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

not seen		<sup>9</sup> AUBERT	07AV	BABR $B \rightarrow p\bar{p}K^{(*)}$
not seen		WANG	05A	BELLE $B^+ \rightarrow \bar{p}pK^+$
<3.0	95	<sup>10</sup> EVANGELIS...	97	SPEC 1.96-2.40 $\bar{p}p \rightarrow K_S^0 K_S^0$
<1.1	99.7	<sup>11</sup> BARNES	93	SPEC 1.3-1.57 $\bar{p}p \rightarrow K_S^0 K_S^0$
<2.6	99.7	<sup>11</sup> BARDIN	87	CNTR 1.3-1.5 $\bar{p}p \rightarrow K^+ K^-$
<3.6	99.7	<sup>11</sup> SCULLI	87	CNTR 1.29-1.55 $\bar{p}p \rightarrow K^+ K^-$

<sup>9</sup> Assuming  $\Gamma < 30$  MeV.

<sup>10</sup> Assuming  $\Gamma \sim 20$  MeV,  $J^P = 2^+$  and  $B(f_J(2220) \rightarrow K\bar{K}) = 100\%$ .

<sup>11</sup> Assuming  $\Gamma = 30\text{--}35$  MeV,  $J^P = 2^+$  and  $B(f_J(2220) \rightarrow K\bar{K}) = 100\%$ .

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

VALUE	DOCUMENT ID	TECN	COMMENT
<b>1.0±0.5</b>	BAI	96B	BES $e^+e^- \rightarrow J/\psi \rightarrow \gamma 2\pi, K\bar{K}$

$\Gamma(p\bar{p})/\Gamma(K\bar{K})$   $\Gamma_4/\Gamma_3$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.17±0.09</b>	BAI	96B	BES $e^+e^- \rightarrow J/\psi \rightarrow \gamma p\bar{p}, K\bar{K}$

**$f_J(2220)$  REFERENCES**

VLADIMIRSK... 08	PAN 71 2129	V.V. Vladimirov <i>et al.</i>	(ITEP)
	Translated from YAF 71 2166.		
AUBERT 07AV	PR D76 092004	B. Aubert <i>et al.</i>	(BABAR Collab.)
WANG 05A	PL B617 141	M.-Z. Wang <i>et al.</i>	(BELLE Collab.)
PDG 04	PL B592 1	S. Eidelman <i>et al.</i>	(PDG Collab.)
ACCIARRI 01H	PL B501 173	M. Acciarri <i>et al.</i>	(L3 Collab.)
AMSLER 01	PL B520 175	C. Amsler <i>et al.</i>	(Crystal Barrel Collab.)
ALAM 98C	PRL 81 3328	M.S. Alam <i>et al.</i>	(CLEO Collab.)
BAI 98H	PRL 81 1179	J.Z. Bai <i>et al.</i>	(BES Collab.)
EVANGELIS... 98	PR D57 5370	C. Evangelista <i>et al.</i>	(JETSET Collab.)
EVANGELIS... 97	PR D56 3803	C. Evangelista <i>et al.</i>	(LEAR Collab.)
GODANG 97	PRL 79 3829	R. Godang <i>et al.</i>	(CLEO Collab.)
BAI 96B	PRL 76 3502	J.Z. Bai <i>et al.</i>	(BES Collab.)
HASAN 96	PL B388 376	A. Hasan, D.V. Bugg	(BRUN, LOQM)

BARNES	93	PL B309 469	P.D. Barnes <i>et al.</i>	(PS185 Collab.)
ALBRECHT	90G	ZPHY C48 183	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
ASTON	88F	PL B215 199	D. Aston <i>et al.</i>	(SLAC, NAGO, CINC, INUS) JP
BOLONKIN	88	NP B309 426	B.V. Bolonkin <i>et al.</i>	(ITEP, SERP)
ALDE	87C	SJNP 45 255	D. Alde <i>et al.</i>	
		Translated from YAF 45 405.		
BARDIN	87	PL B195 292	G. Bardin <i>et al.</i>	(SACL, FERR, CERN, PADO+)
SCULLI	87	PRL 58 1715	J. Sculli <i>et al.</i>	(NYU, BNL)
ALDE	86B	PL B177 120	D.M. Alde <i>et al.</i>	(SERP, BELG, LANL, LAPP)
BALTRUSAITIS...	86D	PRL 56 107	R.M. Baltrusaitis	(CIT, UCSC, ILL, SLAC+)
ALTHOFF	85B	ZPHY C29 189	M. Althoff <i>et al.</i>	(TASSO Collab.)

### OTHER RELATED PAPERS

DEL-AMO-SA... 100	PRL 105 172001	P. del Amo Sanchez <i>et al.</i>	(BABAR Collab.)
-------------------	----------------	----------------------------------	-----------------

---