Citation: K. Hagiwara *et al.* (Particle Data Group), Phys. Rev. D **66**, 010001 (2002) and 2003 partial update for edition 2004 (URL: http://pdg.lbl.gov)

$f_J(2220)$

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

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$f_J(2220)$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
2231.1± 3.5 OUR AVERAGE					
2235 ± 4 ± 6	74	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma\pi^+\pi^-$
2230 $^{+6}_{-7}$ ±16	46	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma K^+K^-$
2232 $^{+8}_{-7}$ ±15	23	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma K^0_S K^0_S$
2235 ± 4 ± 5	32	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma p\overline{p}$
2209 $^{+17}_{-15}$ ±10		ASTON	88F	LASS	11 $K^-p \to K^+K^-\Lambda$
2230 ±20		BOLONKIN	88	SPEC	40 $\pi^-p \to K^0_S K^0_S n$
2220 ±10	41	[1] ALDE	86B	GA24	38–100 $\pi p \to n\eta\eta'$
2230 ± 6 ±14	93	BALTRUSAIT...	86D	MRK3	$e^+e^- \to \gamma K^+K^-$
2232 ± 7 ± 7	23	BALTRUSAIT...	86D	MRK3	$e^+e^- \to \gamma K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2246 ±36		BAI	98H	BES	$J/\psi \to \gamma\pi^0\pi^0$

[1] ALDE 86B uses data from both the GAMS-2000 and GAMS-4000 detectors.

$f_J(2220)$ WIDTH

VALUE (MeV)	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
23 $^{+8}_{=7}$ OUR AVERAGE						
19 $^{+13}_{-11}$ ±12		74	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma\pi^+\pi^-$
20 $^{+20}_{-15}$ ±17		46	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma K^+K^-$
20 $^{+25}_{-16}$ ±14		23	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma K^0_S K^0_S$
15 $^{+12}_{-9}$ ± 9		32	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma p\overline{p}$
60 $^{+107}_{-57}$			ASTON	88F	LASS	11 $K^-p \to K^+K^-\Lambda$
80 ± 30			BOLONKIN	88	SPEC	40 $\pi^-p \to K^0_S K^0_S n$
26 $^{+20}_{-16}$ ±17		93	BALTRUSAIT...	86D	MRK3	$e^+e^- \to \gamma K^+K^-$
18 $^{+23}_{-15}$ ±10		23	BALTRUSAIT...	86D	MRK3	$e^+e^- \to \gamma K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<80	90		ALDE	87C	GAM2	38 $\pi^-p \to \eta'\eta n$

$f_J(2220)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$\pi\pi$	seen
Γ_2	$\pi^+\pi^-$	seen
Γ_3	$K\overline{K}$	seen
Γ_4	$p\overline{p}$	seen
Γ_5	$\gamma\gamma$	not seen
Γ_6	$\eta\eta'(958)$	seen
Γ_7	$\phi\phi$	not seen
Γ_8	$\eta\eta$	not seen

$f_J(2220)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(total)$

$\Gamma(K\overline{K}) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ $\Gamma_3\Gamma_5/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
< 1.4	95	[2] ACCIARRI	01H	L3	$\gamma\gamma \to K^0_S K^0_S$, E^{ee}_{cm}= 91, 183–209 GeV
< 5.6	95	[2] GODANG	97	CLE2	$\gamma\gamma \to K^0_S K^0_S$

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

< 86	95	[2] ALBRECHT	90G	ARG	$\gamma\gamma \to K^+K^-$
<1000	95	[3] ALTHOFF	85B	TASS	$\gamma\gamma$, $K\overline{K}\pi$

$\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ $\Gamma_1\Gamma_5/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<2.5	95	ALAM	98C	CLE2	$\gamma\gamma \to \pi^+\pi^-$

[2] Assuming $J^P = 2^+$.
[3] True for $J^P = 0^+$ and $J^P = 2^+$.

$f_J(2220)$ $\Gamma(i)\Gamma(p\overline{p})/\Gamma^2(total)$

$\Gamma(p\overline{p}) \times \Gamma(\pi\pi)/\Gamma^2_{total}$ $\Gamma_4\Gamma_1/\Gamma^2$

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<18	95	[4] AMSLER	01	CBAR	1.4–1.5 $p\overline{p} \to \pi^0\pi^0$

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

<(11–42)	99	[5] HASAN	96	SPEC	1.35–1.55 $p\overline{p} \to \pi^+\pi^-$

$\Gamma(p\overline{p}) \times \Gamma(\phi\phi)/\Gamma^2_{total}$ $\Gamma_4\Gamma_7/\Gamma^2$

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<6	95	[6] EVANGELISTA	98	SPEC	1.1-2.0 $p\overline{p} \to \phi\phi$

$\Gamma(p\overline{p}) \times \Gamma(\eta\eta)/\Gamma^2_{\text{total}}$ $\Gamma_4\Gamma_8/\Gamma^2$

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<4	95	[4] AMSLER	01	CBAR	1.4–1.5 $p\overline{p} \to \eta\eta$

[4] For $J^P = 2^+$ in the mass range 2222–2240 MeV and the total width between 10 and 20 MeV.
[5] For $J^P = 2^+$ and $J^P = 4^+$ in the mass range 2220–2245 MeV and the total width of 15 MeV.
[6] For $J^P = 2^+$, the mass of 2235 MeV and the total width of 15 MeV.

$f_J(2220)$ BRANCHING RATIOS

$\Gamma(p\overline{p})/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<3.0	95	[8] EVANGELISTA	97	SPEC	1.96-2.40 $\overline{p}p \to K^0_S K^0_S$
<1.1	99.7	[7] BARNES	93	SPEC	1.3-1.57 $\overline{p}p \to K^0_S K^0_S$
<2.6	99.7	[7] BARDIN	87	CNTR	1.3-1.5 $\overline{p}p \to K^+K^-$
<3.6	99.7	[7] SCULLI	87	CNTR	1.29-1.55 $\overline{p}p \to K^+K^-$

[7] Assuming Γ = 30-35 MeV, $J^P = 2^+$ and B($f_J(2220) \to K\overline{K}$) = 100%.

$\Gamma(\pi\pi)/\Gamma(K\overline{K})$ Γ_1/Γ_3

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

$\Gamma(p\overline{p})/\Gamma(K\overline{K})$ Γ_4/Γ_3

VALUE	DOCUMENT ID		TECN	COMMENT
0.17±0.09	BAI	96B	BES	$e^+e^- \to J/\psi \to \gamma p\overline{p}, K\overline{K}$

[8] Assuming $\Gamma \sim$ 20 MeV, $J^P = 2^+$ and B($f_J(2220) \to K\overline{K}$) = 100%.

$f_J(2220)$ REFERENCES

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BAI	98H	PRL 81 1179	J.Z. Bai *et al.*	(BES Collab.)
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GODANG	97	PRL 79 3829	R. Godang *et al.*	(CLEO Collab.)
BAI	96B	PRL 76 3502	J.Z. Bai *et al.*	(BES Collab.)
HASAN	96	PL B388 376	A. Hasan, D.V. Bugg	(BRUN, LOQM)
BARNES	93	PL B309 469	P.D. Barnes, P. Birien, W.H. Breunlich	
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