$f_J(2220)$

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

OMITTED FROM SUMMARY TABLE

THE $f_J(2220)$

Updated April 2002 by M. Doser (CERN).

This state has been seen in $J/\psi(1S)$ radiative decay into $K\overline{K}$ (K^+K^- and $K^0_SK^0_S$ modes seen (BALTRUSAITIS 86D, BAI 96B)). An upper limit from DM2 for these modes (AUGUSTIN 88) is at the level at which observation is claimed. There are also indications for further decay modes ($\pi^+\pi^-$ and $\overline{p}p$ (BAI 96B) and $\pi^0\pi^0$ (BAI 98H)) in the same production process, although again at the level at which previous upper limits had been obtained (BALTRUSAITIS 86D). This is also seen in $\eta\eta$ (ALDE 86B), $K^0_SK^0_S$ (ASTON 88D), and in K^+K^- (ALDE 88F), albeit with very low statistics. Its J^{PC} is determined from the angular distributions of these observations. It is not seen in Υ radiative decays (BARU 89), B inclusive decays (BEHRENDS 84), nor in $\gamma\gamma$ (GODANG 97, ALAM 98C, ACCIARRI 01H), which would not be surprising if it were a glueball, since its two-photon width would then be expected to be small. It is also not seen in formation in $\overline{p}p \to K^+K^-$ (BARDIN 87, SCULLI 87), in $\overline{p}p \to K_SK_S$ (BARNES 93, EVANGELISTA 97), $\overline{p}p \to \phi\phi$ (EVANGELISTA 98), in $\overline{p}p \to \eta\eta$ (AMSLER 01), nor in $\overline{p}p \to \pi\pi$ (HASAN 96, AMSLER 01). The upper limit in $\overline{p}p$ formation can be related to the claimed decay into $\overline{p}p$ to give a lower limit for the process $J/\psi(1S) \to \gamma\xi$ of $\sim 2.3 \times 10^{-3}$ (GODFREY 99). Such a signal should be visible in the inclusive photon spectrum (BLOOM 85). The limit also leads to the conclusion that the reported two-body final states constitute only a small fraction of all decay modes of the ξ. Observation of further decay modes and confirmation of the $\overline{p}p$ decay would be very desirable.

References

References may be found at the end of the $f_J(2220)$ Listing.

$f_J(2220)$ MASS

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

[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	$e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$
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	$e^+ e^- \rightarrow J/\psi \rightarrow \gamma K^0_S K^0_S$
15$^{+12}_{-9}$± 9		32	BAI	96B	BES	$e^+ e^- \rightarrow J/\psi \rightarrow \gamma p \overline{p}$
60$^{+107}_{-57}$			ASTON	88F	LASS	11 $K^- p \rightarrow K^+ K^- \Lambda$
80± 30			BOLONKIN	88	SPEC	40 $\pi^- p \rightarrow K^0_S K^0_S n$
26$^{+20}_{-16}$±17		93	BALTRUSAIT...	86D	MRK3	$e^+ e^- \rightarrow \gamma K^+ K^-$
18$^{+23}_{-15}$±10		23	BALTRUSAIT...	86D	MRK3	$e^+ e^- \rightarrow \gamma K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<80	90		ALDE	87C	GAM2	38 $\pi^- p \rightarrow \eta' \eta n$

$f_J(2220)$ 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

$f_J(2220)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

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

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	$\gamma\gamma$, $K\overline{K}\pi$

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

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 $J^P = 2^+$.

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

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

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 $p\overline{p} \to \pi^+\pi^-$

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

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

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

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

[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

$\Gamma(p\overline{p})/\Gamma_{total}$ — 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 $\overline{p}p \rightarrow K^0_S K^0_S$
<1.1	99.7	[7] BARNES	93	SPEC	1.3-1.57 $\overline{p}p \rightarrow K^0_S K^0_S$
<2.6	99.7	[7] BARDIN	87	CNTR	1.3-1.5 $\overline{p}p \rightarrow K^+K^-$
<3.6	99.7	[7] SCULLI	87	CNTR	1.29-1.55 $\overline{p}p \rightarrow K^+K^-$

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

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

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

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

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

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

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