

# $f_J(2220)$

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

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 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>^{+8}_{-7}</math> 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. •••

$8.6 \pm 2.5$		<sup>3</sup> VLADIMIRSK...08	SPEC	40	$\pi^- p \rightarrow K_S^0 K_S^0 n$	
					$+ m\pi^0$	
<80	90	ALDE	87C	GAM2	38 $\pi^- p \rightarrow \eta' \eta n$	
$^3 J^P C = 2^+ +$ . Systematic uncertainties not evaluated						

### $f_J(2220)$ DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $\pi\pi$	seen
$\Gamma_2$ $\pi^+\pi^-$	seen
$\Gamma_3$ $K\bar{K}$	seen
$\Gamma_4$ $p\bar{p}$	
$\Gamma_5$ $\gamma\gamma$	not seen
$\Gamma_6$ $\eta\eta'(958)$	seen
$\Gamma_7$ $\phi\phi$	not seen
$\Gamma_8$ $\eta\eta$	not seen

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

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

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
< 1.4	95	<sup>4</sup> ACCIARRI 01H	L3	$\gamma\gamma \rightarrow K_S^0 K_S^0$ , $E_{\text{cm}}^{\text{ee}} = 91, 183\text{--}209$ GeV

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

< 5.6	95	<sup>4</sup> GODANG 97	CLE2	$\gamma\gamma \rightarrow K_S^0 K_S^0$
< 86	95	<sup>4</sup> ALBRECHT 90G	ARG	$\gamma\gamma \rightarrow K^+ K^-$
<1000	95	<sup>5</sup> ALTHOFF 85B	TASS	$\gamma\gamma, K\bar{K}\pi$

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

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

<sup>4</sup> Assuming  $J^P = 2^+$ .

<sup>5</sup> True for  $J^P = 0^+$  and  $J^P = 2^+$ .

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

$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\pi\pi)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma \times \Gamma_1/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<18	95	<sup>6</sup> AMSLER 01	CBAR	1.4–1.5 $p\bar{p} \rightarrow \pi^0\pi^0$

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

<(11–42)	99	<sup>7</sup> HASAN 96	SPEC	1.35–1.55 $p\bar{p} \rightarrow \pi^+\pi^-$
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$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\phi\phi)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma \times \Gamma_7/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<6	95	<sup>8</sup> EVANGELIS... 98	SPEC	1.1–2.0 $p\bar{p} \rightarrow \phi\phi$

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

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

<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**

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

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

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

<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  $\Gamma = 30$ -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 $e^+e^- \rightarrow J/\psi \rightarrow \gamma 2\pi, K\bar{K}$

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

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

**$f_J(2220)$  REFERENCES**

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