

$\chi_{b2}(2P)$

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

J needs confirmation.

Observed in radiative decay of the $\Upsilon(3S)$, therefore $C = +$. Branching ratio requires E1 transition, M1 is strongly disfavored, therefore $P = +$.

$\chi_{b2}(2P)$ MASS

<u>VALUE (GeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
10.2685 ± 0.0004 OUR AVERAGE			
10.2681 ± 0.0004 ± 0.0010	¹ HEINTZ	92 CSB2	$e^+e^- \rightarrow \gamma X, \ell^+\ell^- \gamma\gamma$
10.2685 ± 0.0004	² MORRISON	91 CLE2	$e^+e^- \rightarrow \gamma X$

¹ From the average photon energy for inclusive and exclusive events and assuming $\Upsilon(3S)$ mass = 10355.3 ± 0.5 MeV. Supersedes HEINTZ 91 and NARAIN 91.

² From γ energy below, assuming $\Upsilon(3S)$ mass = 10355.3 ± 0.5 MeV. The error on the $\Upsilon(3S)$ mass is not included in the individual measurements. It is included in the final average.

$m_{\chi_{b2}(2P)} - m_{\chi_{b1}(2P)}$

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
13.5 ± 0.4 ± 0.5			
	³ HEINTZ	92 CSB2	$e^+e^- \rightarrow \gamma X, \ell^+\ell^- \gamma\gamma$

³ From the average photon energy for inclusive and exclusive events. Supersedes NARAIN 91.

γ ENERGY IN $\Upsilon(3S)$ DECAY

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
86.64 ± 0.23 OUR AVERAGE				
86 ± 1	101	CRAWFORD	92B CLE2	$e^+e^- \rightarrow \ell^+\ell^- \gamma\gamma$
86.7 ± 0.4	10319	⁴ HEINTZ	92 CSB2	$e^+e^- \rightarrow \gamma X$
86.9 ± 0.4	157	⁵ HEINTZ	92 CSB2	$e^+e^- \rightarrow \ell^+\ell^- \gamma\gamma$
86.4 ± 0.1 ± 0.4	30741	MORRISON	91 CLE2	$e^+e^- \rightarrow \gamma X$

⁴ A systematic uncertainty on the energy scale of 0.9% not included. Supersedes NARAIN 91.

⁵ A systematic uncertainty on the energy scale of 0.9% not included. Supersedes HEINTZ 91.

$\chi_{b2}(2P)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)
$\Gamma_1 \quad \gamma \Upsilon(2S)$	(16.2 ± 2.4) %
$\Gamma_2 \quad \gamma \Upsilon(1S)$	(7.1 ± 1.0) %

$\chi_{b2}(2P)$ BRANCHING RATIOS

$\Gamma(\gamma \Upsilon(2S))/\Gamma_{\text{total}}$ Γ_1/Γ

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0.162 ± 0.024 OUR AVERAGE

0.135 ± 0.025 ± 0.035	⁶ CRAWFORD	92B	CLE2	$e^+e^- \rightarrow l^+l^-\gamma\gamma$
0.173 ± 0.021 ± 0.019	⁷ HEINTZ	92	CSB2	$e^+e^- \rightarrow l^+l^-\gamma\gamma$

⁶ Using $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.37 \pm 0.26)\%$, $B(\Upsilon(3S) \rightarrow \gamma\gamma \Upsilon(2S)) \times 2 B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (4.98 \pm 0.94 \pm 0.62) \times 10^{-4}$, and $B(\Upsilon(3S) \rightarrow \gamma\chi_{b2}(2P)) = 0.135 \pm 0.003 \pm 0.017$.

⁷ Using $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.44 \pm 0.10)\%$, $B(\Upsilon(3S) \rightarrow \gamma\chi_{b2}(2P)) = (11.1 \pm 0.5 \pm 0.4)\%$ and assuming $e\mu$ universality. Supersedes HEINTZ 91.

$\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE DOCUMENT ID TECN COMMENT

0.071 ± 0.010 OUR AVERAGE

0.072 ± 0.014 ± 0.013	⁸ CRAWFORD	92B	CLE2	$e^+e^- \rightarrow l^+l^-\gamma\gamma$
0.070 ± 0.010 ± 0.006	⁹ HEINTZ	92	CSB2	$e^+e^- \rightarrow l^+l^-\gamma\gamma$

⁸ Using $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.57 \pm 0.07)\%$, $B(\Upsilon(3S) \rightarrow \gamma\gamma \Upsilon(2S)) \times 2 B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (5.03 \pm 0.94 \pm 0.63) \times 10^{-4}$, and $B(\Upsilon(3S) \rightarrow \gamma\chi_{b2}(2P)) = 0.135 \pm 0.003 \pm 0.017$.

⁹ Using $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.57 \pm 0.07)\%$, $B(\Upsilon(3S) \rightarrow \gamma\chi_{b2}(2P)) = (11.1 \pm 0.5 \pm 0.4)\%$ and assuming $e\mu$ universality. Supersedes HEINTZ 91.

$\chi_{b2}(2P)$ REFERENCES

CRAWFORD	92B	PL B294 139	G. Crawford, R. Fulton	(CLEO Collab.)
HEINTZ	92	PR D46 1928	U. Heintz <i>et al.</i>	(CUSB II Collab.)
HEINTZ	91	PRL 66 1563	U. Heintz <i>et al.</i>	(CUSB Collab.)
MORRISON	91	PRL 67 1696	R.J. Morrison <i>et al.</i>	(CLEO Collab.)
NARAIN	91	PRL 66 3113	M. Narain <i>et al.</i>	(CUSB Collab.)

OTHER RELATED PAPERS

EIGEN	82	PRL 49 1616	G. Eigen <i>et al.</i>	(CUSB Collab.)
HAN	82	PRL 49 1612	K. Han <i>et al.</i>	(CUSB Collab.)