

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

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

$J$  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>
<b>10.2685 ± 0.0004 OUR AVERAGE</b>			
10.2681 ± 0.0004 ± 0.0010	<sup>1</sup> HEINTZ	92 CSB2	$e^+e^- \rightarrow \gamma X, \ell^+\ell^- \gamma\gamma$
10.2685 ± 0.0004	<sup>2</sup> MORRISON	91 CLE2	$e^+e^- \rightarrow \gamma X$

<sup>1</sup> 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.

<sup>2</sup> From  $\gamma$  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>
<b>13.5 ± 0.4 ± 0.5</b>			
	<sup>3</sup> HEINTZ	92 CSB2	$e^+e^- \rightarrow \gamma X, \ell^+\ell^- \gamma\gamma$

<sup>3</sup> From the average photon energy for inclusive and exclusive events. Supersedes NARAIN 91.

## $\gamma$ ENERGY IN $\Upsilon(3S)$ DECAY

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

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

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

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

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

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

$\Gamma(\gamma \Upsilon(2S))/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
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**0.162 ± 0.024 OUR AVERAGE**

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

<sup>6</sup> 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  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b2}(2P)) = 0.135 \pm 0.003 \pm 0.017$ .

<sup>7</sup> 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.

$\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
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**0.071 ± 0.010 OUR AVERAGE**

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

<sup>8</sup> 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  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b2}(2P)) = 0.135 \pm 0.003 \pm 0.017$ .

<sup>9</sup> 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.)