$\chi_{b2}(2P)$

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

VALUE (GeV)	*DOCUMENT ID*
10.26865±0.00022±0.00050 OUR EVALUATION	From γ energy below, using $\Upsilon(3S)$ mass = 10355.2 ± 0.5 MeV

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

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
13.5±0.4±0.5	[1] HEINTZ	92	CSB2	$e^+e^- \rightarrow \gamma X, \ell^+\ell^-\gamma\gamma$

[1] From the average photon energy for inclusive and exclusive events. Supersedes NARAIN 91.

γ ENERGY IN $\Upsilon(3S)$ DECAY

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
86.19±0.22 OUR EVALUATION		Treating systematic errors as correlated			
86.40±0.18 OUR AVERAGE					
86.04±0.06±0.27		ARTUSO	05	CLEO	$\Upsilon(3S) \rightarrow \gamma X$
86 ±1	101	CRAWFORD	92B	CLE2	$e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$
86.7 ±0.4	10319	[2] HEINTZ	92	CSB2	$e^+e^- \rightarrow \gamma X$
86.9 ±0.4	157	[3] HEINTZ	92	CSB2	$e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$
86.4 ±0.1 ±0.4	30741	MORRISON	91	CLE2	$e^+e^- \rightarrow \gamma X$

[2] A systematic uncertainty on the energy scale of 0.9% not included. Supersedes NARAIN 91.
[3] 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)
Γ_1	$\omega\,\Upsilon(1S)$	($1.10^{+0.34}_{-0.30}$) %
Γ_2	$\gamma\,\Upsilon(2S)$	(16.2 ±2.4) %
Γ_3	$\gamma\,\Upsilon(1S)$	(7.1 ±1.0) %

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

$\Gamma(\omega\Upsilon(1S))/\Gamma_{total}$ — Γ_1/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
$\mathbf{1.10^{+0.32+0.11}_{-0.28-0.10}}$	$20.1^{+5.8}_{-5.1}$	[4] CRONIN-HEN..04	CLE3	$\Upsilon(3S) \to \gamma\omega\Upsilon(1S)$

[4] Using B($\Upsilon(3S) \to \gamma\chi_{b2}(2P)$) = 11.4 ± 0.8% and B($\Upsilon(1S) \to \ell^+\ell^-$) = 2 B($\Upsilon(1S) \to \mu^+\mu^-$) = 2 (2.48 ± 0.06)%.

$\Gamma(\gamma\Upsilon(2S))/\Gamma_{total}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.162±0.024 OUR AVERAGE				
0.135±0.025±0.035	[5] CRAWFORD	92B	CLE2	$e^+e^- \to \ell^+\ell^-\gamma\gamma$
0.173±0.021±0.019	[6] HEINTZ	92	CSB2	$e^+e^- \to \ell^+\ell^-\gamma\gamma$

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

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

$\Gamma(\gamma\Upsilon(1S))/\Gamma_{total}$ — Γ_3/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.071±0.010 OUR AVERAGE				
0.072±0.014±0.013	[7] CRAWFORD	92B	CLE2	$e^+e^- \to \ell^+\ell^-\gamma\gamma$
0.070±0.010±0.006	[8] HEINTZ	92	CSB2	$e^+e^- \to \ell^+\ell^-\gamma\gamma$

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

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

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

ARTUSO	05	PRL 94 032001	M. Artuso *et al.*	(CLEO Collab.)
CRONIN-HEN...	04	PRL 92 222002	D. Cronin-Hennessy *et al.*	(CLEO3 Collab.)
CRAWFORD	92B	PL B294 139	G. Crawford, R. Fulton	(CLEO Collab.)
HEINTZ	92	PR D46 1928	U. Heintz *et al.*	(CUSB II Collab.)
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MORRISON	91	PRL 67 1696	R.J. Morrison *et al.*	(CLEO Collab.)
NARAIN	91	PRL 66 3113	M. Narain *et al.*	(CUSB Collab.)

OTHER RELATED PAPERS

EIGEN	82	PRL 49 1616	G. Eigen *et al.*	(CUSB Collab.)
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