$\chi_{b2}(2P)$

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

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

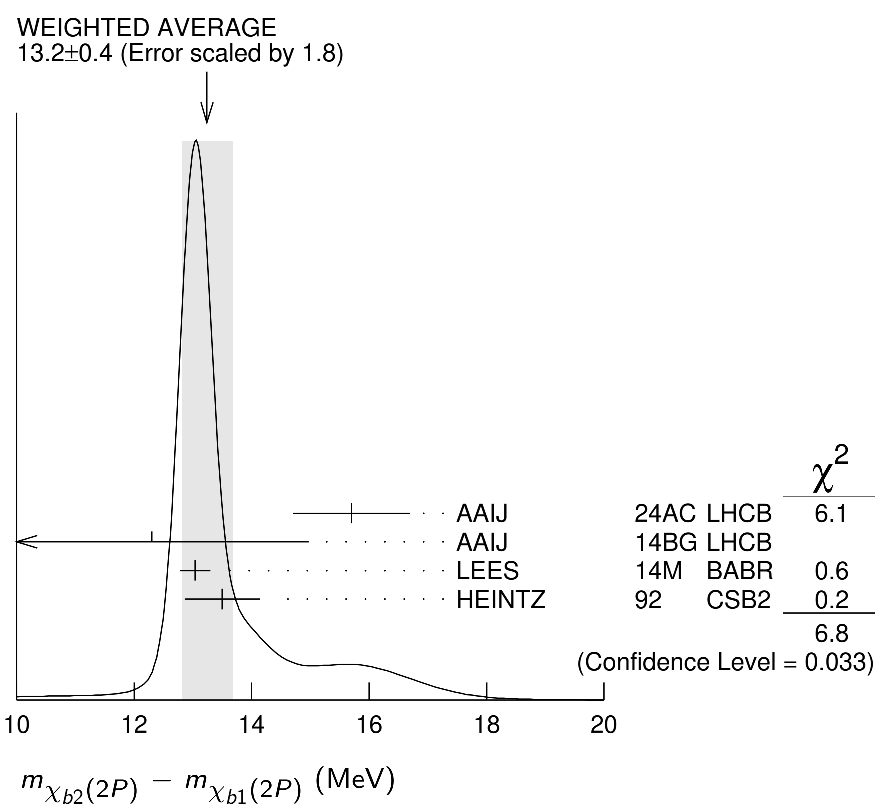
$\chi_{b2}(2P)$ MASS

VALUE (MeV)	DOCUMENT ID
10268.65±0.22±0.50 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)	EVTS	DOCUMENT ID		TECN	COMMENT
13.2 ±0.4 OUR AVERAGE		Error includes scale factor of 1.8. See the ideogram below.			
15.7 ±1.0	50	[1] AAIJ	24AC	LHCB	$\chi_b(2P) \to \Upsilon(1S)\mu^+\mu^-$
12.3 ±2.6 ±0.6		[2] AAIJ	14BG	LHCB	$pp \to \gamma\mu^+\mu^- X$
13.04±0.26		LEES	14M	BABR	$\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$
13.5 ±0.4 ±0.5		[3] HEINTZ	92	CSB2	$e^+e^- \to \gamma X, \ell^+\ell^-\gamma\gamma$

[1] Observed in prompt pp production.
[2] From the $\chi_{bj}(2P) \to \Upsilon(1S)\gamma$ transition.
[3] 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	$\Upsilon(3S) \to \gamma X$
86 ±1	101	CRAWFORD	92B	CLE2	$e^+ e^- \to \ell^+ \ell^- \gamma\gamma$
86.7 ±0.4	10319	[4] HEINTZ	92	CSB2	$e^+ e^- \to \gamma X$
86.9 ±0.4	157	[5] HEINTZ	92	CSB2	$e^+ e^- \to \ell^+ \ell^- \gamma\gamma$
86.4 ±0.1 ±0.4	30741	MORRISON	91	CLE2	$e^+ e^- \to \gamma X$

[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)	Confidence level
Γ_1	$\omega \Upsilon(1S)$	$(1.10^{+0.34}_{-0.30})$ %	
Γ_2	$\gamma \Upsilon(2S)$	(8.9 ± 1.2) %	
Γ_3	$\gamma \Upsilon(1S)$	(6.6 ± 0.8) %	
Γ_4	$\pi\pi\chi_{b2}(1P)$	$(5.1 \pm 0.9) \times 10^{-3}$	
Γ_5	$D^0 X$	< 2.4 %	90%
Γ_6	$\pi^+\pi^- K^+ K^- \pi^0$	$< 1.1 \times 10^{-4}$	90%
Γ_7	$2\pi^+\pi^- K^- K^0_S$	$< 9 \times 10^{-5}$	90%
Γ_8	$2\pi^+\pi^- K^- K^0_S 2\pi^0$	$< 7 \times 10^{-4}$	90%
Γ_9	$2\pi^+ 2\pi^- 2\pi^0$	$(3.9 \pm 1.6) \times 10^{-4}$	
Γ_{10}	$2\pi^+ 2\pi^- K^+ K^-$	$(9 \pm 4) \times 10^{-5}$	
Γ_{11}	$2\pi^+ 2\pi^- K^+ K^- \pi^0$	$(2.4 \pm 1.1) \times 10^{-4}$	
Γ_{12}	$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	$(4.7 \pm 2.3) \times 10^{-4}$	
Γ_{13}	$3\pi^+ 2\pi^- K^- K^0_S \pi^0$	$< 4 \times 10^{-4}$	90%
Γ_{14}	$3\pi^+ 3\pi^-$	$(9 \pm 4) \times 10^{-5}$	
Γ_{15}	$3\pi^+ 3\pi^- 2\pi^0$	$(1.2 \pm 0.4) \times 10^{-3}$	
Γ_{16}	$3\pi^+ 3\pi^- K^+ K^-$	$(1.4 \pm 0.7) \times 10^{-4}$	
Γ_{17}	$3\pi^+ 3\pi^- K^+ K^- \pi^0$	$(4.2 \pm 1.7) \times 10^{-4}$	
Γ_{18}	$4\pi^+ 4\pi^-$	$(9 \pm 5) \times 10^{-5}$	
Γ_{19}	$4\pi^+ 4\pi^- 2\pi^0$	$(1.3 \pm 0.5) \times 10^{-3}$	

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

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

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
$\mathbf{1.10^{+0.32}_{-0.28}{}^{+0.11}_{-0.10}}$	$20.1^{+5.8}_{-5.1}$	[6] CRONIN-HEN..04	CLE3	$\Upsilon(3S) \to \gamma\omega\Upsilon(1S)$

[6] 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	EVTS	DOCUMENT ID		TECN	COMMENT
0.089±0.012 OUR AVERAGE					
0.085±0.010±0.010		[7,8,9] LEES	14M	BABR	$\Upsilon(3S)\to\gamma\gamma\mu^+\mu^-$
0.084±0.011±0.010	2.5k	[10] LEES	11J	BABR	$\Upsilon(3S)\to X\gamma$
0.096±0.022±0.012		[8,11] CRAWFORD	92B	CLE2	$e^+e^-\to\ell^+\ell^-\gamma\gamma$
0.106±0.016±0.013		[8,12] HEINTZ	92	CSB2	$e^+e^-\to\ell^+\ell^-\gamma\gamma$

[7] LEES 14M quotes $\Gamma(\chi_{b2}(2P)\to\gamma\Upsilon(2S))/\Gamma_{total}\times\Gamma(\Upsilon(3S)\to\gamma\chi_{b2}(2P))/\Gamma_{total}$ $=(1.12\pm0.13)$% combining the results from samples of $\Upsilon(3S)\to\gamma\gamma\mu^+\mu^-$ with and without converted photons.

[8] Assuming B($\Upsilon(2S)\to\mu^+\mu^-$) = (1.93 ± 0.17)%.

[9] LEES 14M reports $[\Gamma(\chi_{b2}(2P)\to\gamma\Upsilon(2S))/\Gamma_{total}]\times[B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))]=(1.12\pm0.13)\times10^{-2}$ which we divide by our best value $B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))=(13.1\pm1.6)\times10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[10] LEES 11J reports $[\Gamma(\chi_{b2}(2P)\to\gamma\Upsilon(2S))/\Gamma_{total}]\times[B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))]=(1.1\pm0.1\pm0.1)\times10^{-2}$ which we divide by our best value $B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))=(13.1\pm1.6)\times10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[11] CRAWFORD 92B quotes $B(\Upsilon(3S)\to\gamma\chi_{b1}(2P))\times B(\chi_{b2}(2P)\to\gamma\Upsilon(2S))\times 2\,B(\Upsilon(2S)\to\ell^+\ell^-)=(4.98\pm0.94\pm0.62)\,10^{-4}$.

[12] Recalculated by us. HEINTZ 92 quotes $B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))\times B(\chi_{b2}(2P)\to\gamma\Upsilon(2S))=(1.90\pm0.23\pm0.18)$ % using $B(\Upsilon(2S)\to\mu^+\mu^-)=(1.44\pm0.10)$%. Supersedes HEINTZ 91.

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.066±0.008 OUR AVERAGE					
0.061±0.004±0.007		[13,14,15] LEES	14M	BABR	$\Upsilon(3S)\to\gamma\gamma\mu^+\mu^-$
0.070±0.004±0.008	11k	[16] LEES	11J	BABR	$\Upsilon(3S)\to X\gamma$
0.077±0.018±0.009		[14,17] CRAWFORD	92B	CLE2	$e^+e^-\to\ell^+\ell^-\gamma\gamma$
0.061±0.009±0.007		[14,18] HEINTZ	92	CSB2	$e^+e^-\to\ell^+\ell^-\gamma\gamma$

[13] LEES 14M quotes $\Gamma(\chi_{b2}(2P)\to\gamma\Upsilon(1S))/\Gamma_{total}\times\Gamma(\Upsilon(3S)\to\gamma\chi_{b2}(2P))/\Gamma_{total}$ $=(8.03\pm0.50)\times10^{-3}$ combining the results from samples of $\Upsilon(3S)\to\gamma\gamma\mu^+\mu^-$ with and without converted photons.

[14] Assuming B($\Upsilon(1S)\to\mu^+\mu^-$) = (2.48 ± 0.05)%.

[15] LEES 14M reports $[\Gamma(\chi_{b2}(2P)\to\gamma\Upsilon(1S))/\Gamma_{total}]\times[B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))]=(8.03\pm0.50)\times10^{-3}$ which we divide by our best value $B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))=(13.1\pm1.6)\times10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[16] LEES 11J reports $[\Gamma(\chi_{b2}(2P)\to\gamma\Upsilon(1S))/\Gamma_{total}]\times[B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))]=(9.2\pm0.3\pm0.4)\times10^{-3}$ which we divide by our best value $B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))=(13.1\pm1.6)\times10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[17] CRAWFORD 92B quotes $B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))\times B(\chi_{b2}(2P)\to\gamma\Upsilon(1S))\times 2\,B(\Upsilon(1S)\to\ell^+\ell^-)=(5.03\pm0.94\pm0.63)\,10^{-4}$.

[18] Recalculated by us. HEINTZ 92 quotes $B(\Upsilon(3S)\to\gamma\chi_{b2}(2P))\times B(\chi_{b2}(2P)\to\gamma\Upsilon(1S))=(0.77\pm0.11\pm0.05)$% using $B(\Upsilon(1S)\to\mu^+\mu^-)=(2.57\pm0.05)$%. Supersedes HEINTZ 91.

$\Gamma(\pi\pi\chi_{b2}(1P))/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
5.1±0.9 OUR AVERAGE					
4.9±0.7±0.6	17k	[19] LEES	11C	BABR	$e^+e^- \to \pi^+\pi^- X$
6.0±1.6±1.4		[20] CAWLFIELD	06	CLE3	$\Upsilon(3S) \to 2(\gamma\pi\ell)$

[19] $(0.64 \pm 0.05 \pm 0.08) \times 10^{-3}$. We derive the value assuming B($\Upsilon(3S) \to \chi_{b2}(2P)X$) = B($\Upsilon(3S) \to \chi_{b2}(2P)\gamma$) = $(13.1 \pm 1.6) \times 10^{-2}$.

[20] CAWLFIELD 06 quote $\Gamma(\chi_b(2P) \to \pi\pi\chi_b(1P)) = 0.83 \pm 0.22 \pm 0.08 \pm 0.19$ keV assuming I-spin conservation, no D-wave contribution, $\Gamma(\chi_{b1}(2P)) = 96 \pm 16$keV, and $\Gamma(\chi_{b2}(2P)) = 138 \pm 19$ keV.

$\Gamma(D^0 X)/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<2.4 × 10^{-2}	90	[21,22] BRIERE	08	CLEO	$\Upsilon(3S) \to \gamma D^0 X$

[21] For $p_{D^0} > 2.5$ GeV/c.

[22] The authors also present their result as $(0.2 \pm 1.4 \pm 0.1) \times 10^{-2}$.

$\Gamma(\pi^+\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.1	90	[23] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma\pi^+\pi^- K^+ K^- \pi^0$

[23] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to \pi^+\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] < 14 \times 10^{-6}$ which we divide by our best value B($\Upsilon(3S) \to \gamma\chi_{b2}(2P)$) = 13.1×10^{-2}.

$\Gamma(2\pi^+\pi^- K^- K^0_S)/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<0.9	90	[24] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 2\pi^+\pi^- K^- K^0_S$

[24] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 2\pi^+\pi^- K^- K^0_S)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] < 12 \times 10^{-6}$ which we divide by our best value B($\Upsilon(3S) \to \gamma\chi_{b2}(2P)$) = 13.1×10^{-2}.

$\Gamma(2\pi^+\pi^- K^- K^0_S 2\pi^0)/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<7	90	[25] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 2\pi^+\pi^- K^- 2\pi^0$

[25] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 2\pi^+\pi^- K^- K^0_S 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] < 87 \times 10^{-6}$ which we divide by our best value B($\Upsilon(3S) \to \gamma\chi_{b2}(2P)$) = 13.1×10^{-2}.

$\Gamma(2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
3.9±1.6±0.5	23	[26] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 2\pi^+ 2\pi^- 2\pi^0$

[26] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] = (51 \pm 16 \pm 13) \times 10^{-6}$ which we divide by our best value B($\Upsilon(3S) \to \gamma\chi_{b2}(2P)$) = $(13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{total}$ Γ_{10}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.9±0.4±0.1	11	[27] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 2\pi^+ 2\pi^- K^+ K^-$

[27] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (12 \pm 4 \pm 3) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(2\pi^+ 2\pi^- K^+ K^- \pi^0)/\Gamma_{total}$ Γ_{11}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
2.4±1.0±0.3	16	[28] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 2\pi^+ 2\pi^- K^+ K^- \pi^0$

[28] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 2\pi^+ 2\pi^- K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (32 \pm 11 \pm 8) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(2\pi^+ 2\pi^- K^+ K^- 2\pi^0)/\Gamma_{total}$ Γ_{12}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
4.7±2.2±0.6	14	[29] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$

[29] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 2\pi^+ 2\pi^- K^+ K^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (62 \pm 23 \pm 17) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(3\pi^+ 2\pi^- K^- K^0_S \pi^0)/\Gamma_{total}$ Γ_{13}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<4	90	[30] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 3\pi^+ 2\pi^- K^- K^0_S \pi^0$

[30] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 3\pi^+ 2\pi^- K^- K^0_S \pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] < 58 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = 13.1 \times 10^{-2}$.

$\Gamma(3\pi^+ 3\pi^-)/\Gamma_{total}$ Γ_{14}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.9±0.4±0.1	14	[31] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 3\pi^+ 3\pi^-$

[31] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 3\pi^+ 3\pi^-)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (12 \pm 4 \pm 3) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{total}$ Γ_{15}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
12±4±1	45	[32] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 3\pi^+ 3\pi^- 2\pi^0$

[32] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (159 \pm 33 \pm 43) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.4±0.7±0.2	12	[33] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 3\pi^+ 3\pi^- K^+ K^-$

[33] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (19 \pm 7 \pm 5) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{total}$ — Γ_{17}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
4.2±1.7±0.5	16	[34] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$

[34] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (55 \pm 16 \pm 15) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(4\pi^+ 4\pi^-)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.9±0.4±0.1	9	[35] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 4\pi^+ 4\pi^-$

[35] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 4\pi^+ 4\pi^-)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (12 \pm 5 \pm 3) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{total}$ — Γ_{19}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
13±5±2	27	[36] ASNER	08A	CLEO	$\Upsilon(3S) \to \gamma 4\pi^+ 4\pi^- 2\pi^0$

[36] ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \to 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (165 \pm 46 \pm 50) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\chi_{b2}(2P)$ Cross-Particle Branching Ratios

$\Gamma(\chi_{b2}(2P) \to \gamma \Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(3S) \to \gamma \chi_{b2}(2P))/\Gamma_{total}$ — $\Gamma_3/\Gamma \times \Gamma_{20}^{\Upsilon(3S)}/\Gamma^{\Upsilon(3S)}$

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
9.2±0.3±0.4	11k	LEES	11J	BABR	$\Upsilon(3S) \to X\gamma$

$\Gamma(\chi_{b2}(2P) \to \gamma \Upsilon(2S))/\Gamma_{total} \times \Gamma(\Upsilon(3S) \to \gamma \chi_{b2}(2P))/\Gamma_{total}$ — $\Gamma_2/\Gamma \times \Gamma_{20}^{\Upsilon(3S)}/\Gamma^{\Upsilon(3S)}$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.1±0.1±0.1	2.5k	LEES	11J	BABR	$\Upsilon(3S) \to X\gamma$

$B(\chi_{b2}(2P) \to \chi_{b2}(1P)\pi^+\pi^-) \times B(\Upsilon(3S) \to \chi_{b2}(2P)X)$

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.64±0.05±0.08	17k	LEES	11C	BABR	$e^+e^- \to \pi^+\pi^- X$

$B(\chi_{b2}(2P) \to \gamma\Upsilon(1S)) \times B(\Upsilon(3S) \to \gamma\chi_{b2}(2P)) \times B(\Upsilon(1S) \to \ell^+\ell^-)$

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
2.02±0.18 OUR AVERAGE					
$1.95^{+0.22}_{-0.21}{}^{+0.10}_{-0.16}$		[37] LEES	14M	BABR	$\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$
2.52±0.47±0.32	48	[38] CRAWFORD	92B	CLE2	$\Upsilon(3S) \to \gamma\gamma\ell^+\ell^-$
1.98±0.28±0.12		[39] HEINTZ	92	CSB2	$\Upsilon(3S) \to \gamma\gamma\ell^+\ell^-$

[37] From a sample of $\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$ with converted photons.

[38] CRAWFORD 92B quotes $2\times B(\Upsilon(3S) \to \gamma\chi_{bJ}(2P))$ $B(\chi_{bJ}(2P) \to \gamma\Upsilon(nS))$ $B(\Upsilon(nS) \to \ell^+\ell^-)$.

[39] Calculated by us. HEINTZ 92 quotes $B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))\times B(\chi_{b2}(2P) \to \gamma\Upsilon(1S))$ =(0.77 ± 0.11 ± 0.05)% using$B(\Upsilon(1S) \to \mu^+\mu^-)$ = (2.57 ± 0.05)%.

$[B(\chi_{b2}(2P) \to \gamma\Upsilon(1S)) \times B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))]$ / $[B(\chi_{b1}(2P) \to \gamma\Upsilon(1S)) \times B(\Upsilon(3S) \to \gamma\chi_{b1}(2P))]$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
66.6±3.0	[40] LEES	14M	BABR	$\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$

[40] From a sample of $\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$ events without converted photons.

$B(\chi_{b2}(2P) \to \gamma\Upsilon(2S)) \times B(\Upsilon(3S) \to \gamma\chi_{b2}(2P)) \times B(\Upsilon(2S) \to \ell^+\ell^-)$

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
2.74±0.29 OUR AVERAGE					
$3.22^{+0.58}_{-0.53}{}^{+0.16}_{-0.71}$		[41] LEES	14M	BABR	$\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$
2.49±0.47±0.31	53	[42] CRAWFORD	92B	CLE2	$\Upsilon(3S) \to \gamma\gamma\ell^+\ell^-$
2.74±0.33±0.18		[43] HEINTZ	92	CSB2	$\Upsilon(3S) \to \gamma\gamma\ell^+\ell^-$

[41] From a sample of $\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$ with converted photons.

[42] CRAWFORD 92B quotes $2\times B(\Upsilon(3S) \to \gamma\chi_{bJ}(2P))$ $B(\chi_{bJ}(2P) \to \gamma\Upsilon(nS))$ $B(\Upsilon(nS) \to \ell^+\ell^-)$.

[43] Calculated by us. HEINTZ 92 quotes $B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))$ $\times B(\chi_{b2}(2P) \to \gamma\Upsilon(2S))$ = (1.90 ± 0.23 ± 0.18) % using $B(\Upsilon(2S) \to \mu^+\mu^-)$ = (1.44 ± 0.10)%.

$[B(\chi_{b2}(2P) \to \gamma\Upsilon(2S)) \times B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))]$ / $[B(\chi_{b1}(2P) \to \gamma\Upsilon(2S)) \times B(\Upsilon(3S) \to \gamma\chi_{b1}(2P))]$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
46.9±2.0	[44] LEES	14M	BABR	$\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$

[44] From a sample of $\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$ without converted photons.

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

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