NODE=M081

$\chi_{b2}(2P)$

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

NODE=M081

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

NODE=M081M

NODE=M081M
→ UNCHECKED ←

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

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

NODE=M081M2

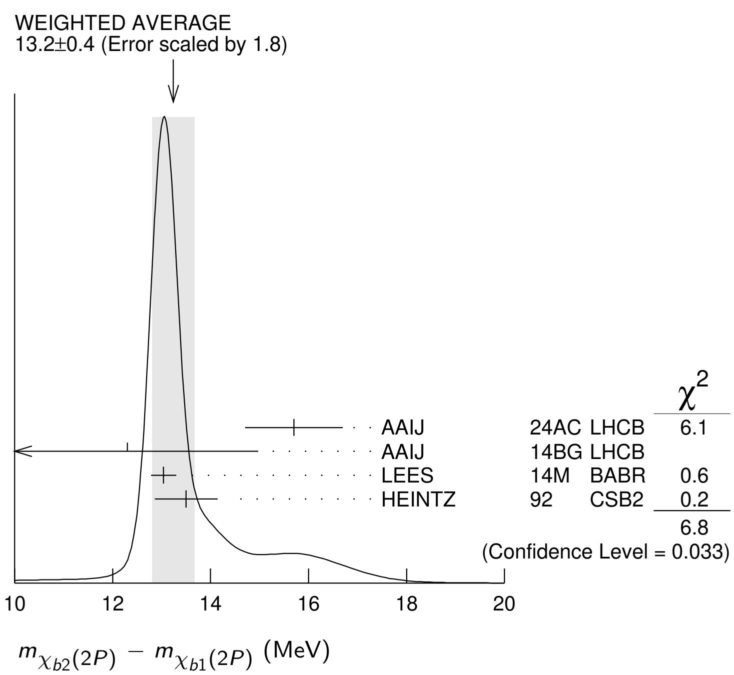
NODE=M081M2

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. NODE=M081M2;LINKAGE=C

[2] From the $\chi_{bj}(2P) \to \Upsilon(1S)\gamma$ transition. NODE=M081M2;LINKAGE=B

[3] From the average photon energy for inclusive and exclusive events. Supersedes NARAIN 91. NODE=M081M2;LINKAGE=A



γ ENERGY IN $\Upsilon(3S)$ DECAY

NODE=M081DM

NODE=M081DM
→ UNCHECKED ←

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	$e^+e^- \to \gamma X$

OCCUR=2

[4] A systematic uncertainty on the energy scale of 0.9% not included. Supersedes NARAIN 91. NODE=M081DM;LINKAGE=A

[5] A systematic uncertainty on the energy scale of 0.9% not included. Supersedes HEINTZ 91. NODE=M081DM;LINKAGE=B

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

NODE=M081215;NODE=M081

	Mode	Fraction (Γ_i/Γ)	Confidence level	
Γ_1	$\omega\,\Upsilon(1S)$	$(1.10^{+0.34}_{-0.30})$ %		DESIG=3
Γ_2	$\gamma\,\Upsilon(2S)$	$(8.9\ \pm1.2\ )$ %		DESIG=2
Γ_3	$\gamma\,\Upsilon(1S)$	$(6.6\ \pm0.8\ )$ %		DESIG=1
Γ_4	$\pi\pi\chi_{b2}(1P)$	$(5.1\ \pm0.9\ )\times10^{-3}$		DESIG=4
Γ_5	$D^0 X$	<2.4 %	90%	DESIG=5
Γ_6	$\pi^+\pi^-K^+K^-\pi^0$	$<1.1\times10^{-4}$	90%	DESIG=6
Γ_7	$2\pi^+\pi^-K^-K^0_S$	$<9\times10^{-5}$	90%	DESIG=7
Γ_8	$2\pi^+\pi^-K^-K^0_S2\pi^0$	$<7\times10^{-4}$	90%	DESIG=8
Γ_9	$2\pi^+2\pi^-2\pi^0$	$(3.9\ \pm1.6\ )\times10^{-4}$		DESIG=9
Γ_{10}	$2\pi^+2\pi^-K^+K^-$	$(9\ \pm4\ )\times10^{-5}$		DESIG=10
Γ_{11}	$2\pi^+2\pi^-K^+K^-\pi^0$	$(2.4\ \pm1.1\ )\times10^{-4}$		DESIG=11
Γ_{12}	$2\pi^+2\pi^-K^+K^-2\pi^0$	$(4.7\ \pm2.3\ )\times10^{-4}$		DESIG=12
Γ_{13}	$3\pi^+2\pi^-K^-K^0_S\pi^0$	$<4\times10^{-4}$	90%	DESIG=13
Γ_{14}	$3\pi^+3\pi^-$	$(9\ \pm4\ )\times10^{-5}$		DESIG=14
Γ_{15}	$3\pi^+3\pi^-2\pi^0$	$(1.2\ \pm0.4\ )\times10^{-3}$		DESIG=15
Γ_{16}	$3\pi^+3\pi^-K^+K^-$	$(1.4\ \pm0.7\ )\times10^{-4}$		DESIG=16
Γ_{17}	$3\pi^+3\pi^-K^+K^-\pi^0$	$(4.2\ \pm1.7\ )\times10^{-4}$		DESIG=17
Γ_{18}	$4\pi^+4\pi^-$	$(9\ \pm5\ )\times10^{-5}$		DESIG=18
Γ_{19}	$4\pi^+4\pi^-2\pi^0$	$(1.3\ \pm0.5\ )\times10^{-3}$		DESIG=19

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

NODE=M081220

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

NODE=M081R3

NODE=M081R3

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
$\mathbf{1.10^{+0.32+0.11}_{-0.28-0.10}}$	$20.1^{+5.8}_{-5.1}$	[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)%.

NODE=M081R3;LINKAGE=CR

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

NODE=M081R2

NODE=M081R2

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 ± 0.13)% combining the results from samples of $\Upsilon(3S)\to\gamma\gamma\mu^+\mu^-$ with and without converted photons.

NODE=M081R2;LINKAGE=D

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

NODE=M081R2;LINKAGE=E

[9] LEES 14M reports [$\Gamma(\chi_{b2}(2P)\to\gamma\,\Upsilon(2S))/\Gamma_{total}$] × [B($\Upsilon(3S)\to\gamma\chi_{b2}(2P)$)] = (1.12 ± 0.13) × 10^{-2} which we divide by our best value B($\Upsilon(3S)\to\gamma\chi_{b2}(2P)$) = (13.1 ± 1.6) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R2;LINKAGE=F

[10] LEES 11J reports [$\Gamma(\chi_{b2}(2P)\to\gamma\,\Upsilon(2S))/\Gamma_{total}$] × [B($\Upsilon(3S)\to\gamma\chi_{b2}(2P)$)] = (1.1 ± 0.1 ± 0.1) × 10^{-2} which we divide by our best value B($\Upsilon(3S)\to\gamma\chi_{b2}(2P)$) = (13.1 ± 1.6) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R2;LINKAGE=LE

[11] CRAWFORD 92B quotes B($\Upsilon(3S)\to\gamma\chi_{b1}(2P)$) ×B($\chi_{b2}(2P)\to\gamma\,\Upsilon(2S)$) × 2 B($\Upsilon(2S)\to\ell^+\ell^-$) = (4.98 ± 0.94 ± 0.62) 10^{-4}.

NODE=M081R2;LINKAGE=B

[12] Recalculated by us. HEINTZ 92 quotes B($\Upsilon(3S)\to\gamma\chi_{b2}(2P)$) ×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)%. Supersedes HEINTZ 91.

NODE=M081R2;LINKAGE=C

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

NODE=M081R1
NODE=M081R1

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 $\Gamma(\chi_{b2}(2P) \to \gamma\Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(3S) \to \gamma\chi_{b2}(2P))/\Gamma_{total} = (8.03 \pm 0.50) \times 10^{-3}$ combining the results from samples of $\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$ with and without converted photons. NODE=M081R1;LINKAGE=D

[14] Assuming $B(\Upsilon(1S) \to \mu^+\mu^-) = (2.48 \pm 0.05)\%$. NODE=M081R1;LINKAGE=E

[15] LEES 14M reports $[\Gamma(\chi_{b2}(2P) \to \gamma\Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] = (8.03 \pm 0.50) \times 10^{-3}$ 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. NODE=M081R1;LINKAGE=F

[16] LEES 11J reports $[\Gamma(\chi_{b2}(2P) \to \gamma\Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] = (9.2 \pm 0.3 \pm 0.4) \times 10^{-3}$ 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. NODE=M081R1;LINKAGE=LE

[17] CRAWFORD 92B quotes $B(\Upsilon(3S) \to \gamma\chi_{b2}(2P)) \times B(\chi_{b2}(2P) \to \gamma\Upsilon(1S)) \times 2\,B(\Upsilon(1S) \to \ell^+\ell^-) = (5.03 \pm 0.94 \pm 0.63)\ 10^{-4}$. NODE=M081R1;LINKAGE=B

[18] Recalculated by us. HEINTZ 92 quotes $B(\Upsilon(3S) \to \gamma\chi_{b2}(2P)) \times B(\chi_{b2}(2P) \to \gamma\Upsilon(1S)) = (0.77 \pm 0.11 \pm 0.05)\%$ using $B(\Upsilon(1S) \to \mu^+\mu^-) = (2.57 \pm 0.05)\%$. Supersedes HEINTZ 91. NODE=M081R1;LINKAGE=C

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

NODE=M081R4
NODE=M081R4

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 $B(\Upsilon(3S) \to \chi_{b2}(2P)X) = B(\Upsilon(3S) \to \chi_{b2}(2P)\gamma) = (13.1 \pm 1.6) \times 10^{-2}$. NODE=M081R4;LINKAGE=LE

[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. NODE=M081R4;LINKAGE=CA

$\Gamma(D^0X)/\Gamma_{total}$ — Γ_5/Γ

NODE=M081R01
NODE=M081R01

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. NODE=M081R01;LINKAGE=BR

[22] The authors also present their result as $(0.2 \pm 1.4 \pm 0.1) \times 10^{-2}$. NODE=M081R01;LINKAGE=RI

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

NODE=M081R02
NODE=M081R02

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 $[\Gamma(\chi_{b2}(2P) \to \pi^+\pi^-K^+K^-\pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] < 14 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma\chi_{b2}(2P)) = 13.1 \times 10^{-2}$. NODE=M081R02;LINKAGE=AS

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

NODE=M081R03
NODE=M081R03

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 $[\Gamma(\chi_{b2}(2P) \to 2\pi^+\pi^-K^-K^0_S)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] < 12 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma\chi_{b2}(2P)) = 13.1 \times 10^{-2}$. NODE=M081R03;LINKAGE=AS

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

NODE=M081R04
NODE=M081R04

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 $[\Gamma(\chi_{b2}(2P) \to 2\pi^+\pi^-K^-K^0_S 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma\chi_{b2}(2P))] < 87 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma\chi_{b2}(2P)) = 13.1 \times 10^{-2}$. NODE=M081R04;LINKAGE=AS

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

NODE=M081R05
NODE=M081R05

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 $[\Gamma(\chi_{b2}(2P) \to 2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b2}(2P))] = (51 \pm 16 \pm 13) \times 10^{-6}$ 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.

NODE=M081R05;LINKAGE=AS

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

NODE=M081R06
NODE=M081R06

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.

NODE=M081R06;LINKAGE=AS

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

NODE=M081R07
NODE=M081R07

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.

NODE=M081R07;LINKAGE=AS

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

NODE=M081R08
NODE=M081R08

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.

NODE=M081R08;LINKAGE=AS

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

NODE=M081R09
NODE=M081R09

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 $B(\Upsilon(3S) \to \gamma \chi_{b2}(2P)) = 13.1 \times 10^{-2}$.

NODE=M081R09;LINKAGE=AS

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

NODE=M081R10
NODE=M081R10

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.

NODE=M081R10;LINKAGE=AS

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

NODE=M081R11
NODE=M081R11

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.

NODE=M081R11;LINKAGE=AS

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

NODE=M081R12
NODE=M081R12

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.

NODE=M081R12;LINKAGE=AS

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

NODE=M081R13

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.

NODE=M081R13;LINKAGE=AS

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

NODE=M081R14

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.

NODE=M081R14;LINKAGE=AS

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

NODE=M081R15

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.

NODE=M081R15;LINKAGE=AS

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

NODE=M081230

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

NODE=M081B01

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

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

NODE=M081B02

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

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

NODE=M081R16

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

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

NODE=M081A01

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
2.02±0.18 OUR AVERAGE					
$1.95^{+0.22+0.10}_{-0.21-0.16}$		[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.

NODE=M081A01;LINKAGE=A

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

NODE=M081A01;LINKAGE=C

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

NODE=M081A01;LINKAGE=B

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

NODE=M081A00

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.

NODE=M081A00;LINKAGE=A

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

NODE=M081A02
NODE=M081A02

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. NODE=M081A02;LINKAGE=A

[42] CRAWFORD 92B quotes $2\times B(\Upsilon(3S) \to \gamma\chi_{bJ}(2P))$ $B(\chi_{bJ}(2P) \to \gamma\Upsilon(nS))$ $B(\Upsilon(nS) \to \ell^+\ell^-)$. NODE=M081A02;LINKAGE=C

[43] Calculated by us. HEINTZ 92 quotes $B(\Upsilon(3S) \to \gamma\chi_{b2}(2P)) \times B(\chi_{b2}(2P) \to \gamma\Upsilon(2S)) = (1.90 \pm 0.23 \pm 0.18)$ % using $B(\Upsilon(2S) \to \mu^+\mu^-) = (1.44 \pm 0.10)$%. NODE=M081A02;LINKAGE=B

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

NODE=M081A03
NODE=M081A03

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. NODE=M081A03;LINKAGE=A

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

NODE=M081

AAIJ	24AC	JHEP 2410 122	R. Aaij *et al.*	(LHCb Collab.)	REFID=63036
AAIJ	14BG	JHEP 1410 088	R. Aaij *et al.*	(LHCb Collab.)	REFID=56199
LEES	14M	PR D90 112010	J.P. Lees *et al.*	(BABAR Collab.)	REFID=56343
LEES	11C	PR D84 011104	J.P. Lees *et al.*	(BABAR Collab.)	REFID=16775
LEES	11J	PR D84 072002	J.P. Lees *et al.*	(BABAR Collab.)	REFID=53936
ASNER	08A	PR D78 091103	D.M. Asner *et al.*	(CLEO Collab.)	REFID=52574
BRIERE	08	PR D78 092007	R.A. Briere *et al.*	(CLEO Collab.)	REFID=52577
CAWLFIELD	06	PR D73 012003	C. Cawlfield *et al.*	(CLEO Collab.)	REFID=50997
ARTUSO	05	PRL 94 032001	M. Artuso *et al.*	(CLEO Collab.)	REFID=50454
CRONIN-HEN...	04	PRL 92 222002	D. Cronin-Hennessy *et al.*	(CLEO Collab.)	REFID=49766
CRAWFORD	92B	PL B294 139	G. Crawford *et al.*	(CLEO Collab.)	REFID=43177
HEINTZ	92	PR D46 1928	U. Heintz *et al.*	(CUSB II Collab.)	REFID=43604
HEINTZ	91	PRL 66 1563	U. Heintz *et al.*	(CUSB Collab.)	REFID=41580
MORRISON	91	PRL 67 1696	R.J. Morrison *et al.*	(CLEO Collab.)	REFID=41634
NARAIN	91	PRL 66 3113	M. Narain *et al.*	(CUSB Collab.)	REFID=41586