$\chi_{b2}(1P)$

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

Observed in radiative decay of the $\Upsilon(2S)$, therefore $C = +$. Branching ratio requires E1 transition, M1 is strongly disfavored, therefore $P = +$. $J = 2$ from SKWARNICKI 87.

$\chi_{b2}(1P)$ MASS

VALUE (MeV)	*DOCUMENT ID*
9912.21±0.26±0.31 OUR EVALUATION	From average γ energy below, using $\Upsilon(2S)$ mass = 10023.26 ± 0.31 MeV

$m_{\chi_{b2}(1P)} - m_{\chi_{b1}(1P)}$

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
19.17±0.20 OUR AVERAGE					
19.4 ±0.4	50	[1] AAIJ	24AC	LHCB	$\chi_b(1P) \to \Upsilon(1S)\mu^+\mu^-$
19.81±0.65±0.20		[2] AAIJ	14BG	LHCB	$pp \to \gamma\mu^+\mu^- X$
19.01±0.24		LEES	14M	BABR	$\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$

[1] Observed in prompt pp production.
[2] From the $\chi_{bj}(1P) \to \Upsilon(1S)\gamma$ transition.

γ ENERGY IN $\Upsilon(2S)$ DECAY

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
110.44±0.29 OUR AVERAGE	Error includes scale factor of 1.1.			
110.58±0.08±0.30	ARTUSO	05	CLEO	$\Upsilon(2S) \to \gamma X$
110.8 ±0.3 ±0.6	EDWARDS	99	CLE2	$\Upsilon(2S) \to \gamma\chi(1P)$
107.0 ±1.1 ±1.3	WALK	86	CBAL	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$
110.6 ±0.3 ±0.9	ALBRECHT	85E	ARG	$\Upsilon(2S) \to$ conv. γX
110.4 ±0.8 ±2.2	NERNST	85	CBAL	$\Upsilon(2S) \to \gamma X$
109.5 ±0.7 ±1.0	HAAS	84	CLEO	$\Upsilon(2S) \to$ conv. γX
108.2 ±0.3 ±2.0	KLOPFEN...	83	CUSB	$\Upsilon(2S) \to \gamma X$
108.8 ±4.0	PAUSS	83	CUSB	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$

$\chi_{b2}(1P)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\gamma\,\Upsilon(1S)$	(18.0±1.0) %	
Γ_2	$D^0 X$	< 7.9 %	90%
Γ_3	$\pi^+\pi^- K^+ K^- \pi^0$	(8 ±5) $\times 10^{-5}$	
Γ_4	$2\pi^+\pi^- K^- K^0_S$	< 1.0 $\times 10^{-4}$	90%
Γ_5	$2\pi^+\pi^- K^- K^0_S 2\pi^0$	(5.3±2.4) $\times 10^{-4}$	
Γ_6	$2\pi^+ 2\pi^- 2\pi^0$	(3.5±1.4) $\times 10^{-4}$	
Γ_7	$2\pi^+ 2\pi^- K^+ K^-$	(1.1±0.4) $\times 10^{-4}$	
Γ_8	$2\pi^+ 2\pi^- K^+ K^- \pi^0$	(2.1±0.9) $\times 10^{-4}$	
Γ_9	$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	(3.9±1.8) $\times 10^{-4}$	

Γ_{10}	$3\pi^+ 2\pi^- K^- K^0_S \pi^0$	$< 5 \times 10^{-4}$	90%
Γ_{11}	$3\pi^+ 3\pi^-$	$(7.0\pm3.1) \times 10^{-5}$	
Γ_{12}	$3\pi^+ 3\pi^- 2\pi^0$	$(1.0\pm0.4) \times 10^{-3}$	
Γ_{13}	$3\pi^+ 3\pi^- K^+ K^-$	$< 8 \times 10^{-5}$	90%
Γ_{14}	$3\pi^+ 3\pi^- K^+ K^- \pi^0$	$(3.6\pm1.5) \times 10^{-4}$	
Γ_{15}	$4\pi^+ 4\pi^-$	$(8 \pm4) \times 10^{-5}$	
Γ_{16}	$4\pi^+ 4\pi^- 2\pi^0$	$(1.8\pm0.7) \times 10^{-3}$	
Γ_{17}	$J/\psi J/\psi$	$< 4 \times 10^{-5}$	90%
Γ_{18}	$J/\psi \psi(2S)$	$< 5 \times 10^{-5}$	90%
Γ_{19}	$\psi(2S) \psi(2S)$	$< 1.6 \times 10^{-5}$	90%
Γ_{20}	$J/\psi(1S)$ anything	$(1.5\pm0.4) \times 10^{-3}$	

$\chi_{b2}(1P)$ BRANCHING RATIOS

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.180±0.010 OUR AVERAGE					
$0.164^{+0.009}_{-0.010}\pm0.008$	503k	[1] FULSOM	18	BELL	$\Upsilon(2S) \to \gamma X$
$0.185\pm0.008\pm0.009$		[2,3,4] LEES	14M	BABR	$\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$
$0.186\pm0.011\pm0.009$	1770	[4,5] KORNICER	11	CLEO	$e^+e^- \to \gamma\gamma\ell^+\ell^-$
$0.194^{+0.014}_{-0.017}\pm0.009$	8k	[6] LEES	11J	BABR	$\Upsilon(2S) \to X\gamma$
$0.25 \pm0.06 \pm0.01$	35	[4,7,8] WALK	86	CBAL	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$
0.20 ± 0.05		KLOPFEN...	83	CUSB	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$

[1] FULSOM 18 reports $[\Gamma(\chi_{b2}(1P) \to \gamma\Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (1.17 \pm 0.01^{+0.06}_{-0.07}) \times 10^{-2}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] LEES 14M quotes $\Gamma(\chi_{b2}(1P) \to \gamma\Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(2S) \to \gamma\chi_{b2}(1P))/\Gamma_{total} = (1.32 \pm 0.06)\%$ combining the results from samples of $\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$ with and without converted photons.

[3] LEES 14M reports $[\Gamma(\chi_{b2}(1P) \to \gamma\Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (1.32 \pm 0.06) \times 10^{-2}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

[5] KORNICER 11 reports $[\Gamma(\chi_{b2}(1P) \to \gamma\Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (1.33 \pm 0.04 \pm 0.07) \times 10^{-2}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[6] LEES 11J reports $[\Gamma(\chi_{b2}(1P) \to \gamma\Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (13.9 \pm 0.5^{+0.9}_{-1.1}) \times 10^{-3}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[7] WALK 86 quotes $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) \times B(\chi_{b2}(1P) \to \gamma\Upsilon(1S)) \times B(\Upsilon(1S) \to \ell^+\ell^-) = (4.4 \pm 0.9 \pm 0.5)$ %.

[8] WALK 86 reports $[\Gamma(\chi_{b2}(1P) \to \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b2}(1P))] = (17.7 \pm 3.6 \pm 2.0) \times 10^{-3}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(D^0 X)/\Gamma_{total}$ Γ_2/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<7.9 \times 10^{-2}$	90	[1,2] BRIERE	08	CLEO	$\Upsilon(2S) \to \gamma D^0 X$

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

[2] The authors also present their result as $(5.4 \pm 1.9 \pm 0.5) \times 10^{-2}$.

$\Gamma(\pi^+\pi^- K^+ K^- \pi^0)/\Gamma_{total}$ Γ_3/Γ

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.84±0.50±0.04	8	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma \pi^+\pi^- K^+ K^- \pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to \pi^+\pi^- K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b2}(1P))] = (6 \pm 3 \pm 2) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(2\pi^+\pi^- K^- K^0_S)/\Gamma_{total}$ Γ_4/Γ

VALUE (units 10^{-4})	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<1.0	90	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+\pi^- K^- K^0_S$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 2\pi^+\pi^- K^- K^0_S)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b2}(1P))] < 7 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma \chi_{b2}(1P)) = 7.15 \times 10^{-2}$.

$\Gamma(2\pi^+\pi^- K^- K^0_S 2\pi^0)/\Gamma_{total}$ Γ_5/Γ

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
5.3±2.4±0.3	11	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+\pi^- K^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 2\pi^+\pi^- K^- K^0_S 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b2}(1P))] = (38 \pm 14 \pm 10) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{total}$ Γ_6/Γ

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
3.5±1.4±0.2	19	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+ 2\pi^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b2}(1P))] = (25 \pm 8 \pm 6) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. 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_7/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.1±0.4±0.1	14	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+ 2\pi^- K^+ K^-$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 2\pi^+2\pi^-K^+K^-)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (8 \pm 2 \pm 2) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. 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_8/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
2.1±0.9±0.1	13	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+ 2\pi^- K^+ K^- \pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (15 \pm 5 \pm 4) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. 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_9/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
3.9±1.8±0.2	11	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (28 \pm 11 \pm 7) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. 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_{10}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<5	90	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 2\pi^- K^- K^0_S \pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 3\pi^+2\pi^-K^-K^0_S\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] < 36 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = 7.15 \times 10^{-2}$.

$\Gamma(3\pi^+3\pi^-)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.70±0.31±0.03	9	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 3\pi^-$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 3\pi^+3\pi^-)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (5 \pm 2 \pm 1) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. 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_{12}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
10.2±3.6±0.5	34	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 3\pi^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 3\pi^+3\pi^-2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (73 \pm 16 \pm 20) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. 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_{13}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<0.8	90	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 3\pi^- K^+ K^-$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] < 6 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = 7.15 \times 10^{-2}$.

$\Gamma(3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{total}$ Γ_{14}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
3.6±1.5±0.2	14	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (26 \pm 8 \pm 7) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. 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_{15}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.84±0.40±0.04	7	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 4\pi^+ 4\pi^-$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 4\pi^+ 4\pi^-)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (6 \pm 2 \pm 2) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. 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_{16}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
18±7±1	29	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 4\pi^+ 4\pi^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \to 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))] = (132 \pm 31 \pm 40) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(J/\psi J/\psi)/\Gamma_{total}$ Γ_{17}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<5	90	[1] SHEN	12	BELL	$\Upsilon(2S) \to \gamma\psi X$

[1] SHEN 12 reports $< 4.5 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b2}(1P) \to J/\psi J/\psi)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))]$ assuming $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$.

$\Gamma(J/\psi\psi(2S))/\Gamma_{total}$ Γ_{18}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<5	90	[1] SHEN	12	BELL	$\Upsilon(2S) \to \gamma\psi X$

[1] SHEN 12 reports $< 4.9 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b2}(1P) \to J/\psi\psi(2S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))]$ assuming $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$.

$\Gamma(\psi(2S)\psi(2S))/\Gamma_{total}$ — Γ_{19}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.6	90	[1] SHEN	12	BELL	$\Upsilon(2S) \to \gamma\psi X$

[1] SHEN 12 reports $< 1.6 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b2}(1P) \to \psi(2S)\psi(2S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b2}(1P))]$ assuming $B(\Upsilon(2S) \to \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$.

$\Gamma(J/\psi(1S)\text{anything})/\Gamma_{total}$ — Γ_{20}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.50±0.34±0.22	462	JIA	17A	BELL	$e^+e^- \to$ hadrons

$\chi_{b2}(1P)$ Cross-Particle Branching Ratios

$\Gamma(\chi_{b2}(1P) \to \gamma\Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(2S) \to \gamma\chi_{b2}(1P))/\Gamma_{total}$ — $\Gamma_1/\Gamma \times \Gamma_{72}^{\Upsilon(2S)}/\Gamma^{\Upsilon(2S)}$

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$13.9\pm0.5^{+0.9}_{-1.1}$	8k	LEES	11J	BABR	$\Upsilon(2S) \to X\gamma$

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
3.38±0.16 OUR AVERAGE					
$3.63^{+0.36}_{-0.34}{}^{+0.18}_{-0.19}$		[1] LEES	14M	BABR	$\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$
3.29±0.09±0.16	1770	KORNICER	11	CLEO	$e^+e^- \to \gamma\gamma\ell^+\ell^-$
4.4 ±0.9 ±0.5	35	WALK	86	CBAL	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$

[1] From a sample of $\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$ with converted photons.

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

VALUE (%)	DOCUMENT ID		TECN	COMMENT
55.6±1.6	[1] LEES	14M	BABR	$\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$

[1] From a sample of $\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$ events without converted photons.

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

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
3.8 ±0.5 OUR AVERAGE					
$4.68^{+0.99}_{-0.92}\pm0.37$		[1] LEES	14M	BABR	$\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$
3.56±0.40±0.41	126	KORNICER	11	CLEO	$e^+e^- \to \gamma\gamma\ell^+\ell^-$

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

$\chi_{b2}(1P)$ REFERENCES

AAIJ	24AC	JHEP 2410 122	R. Aaij *et al.*	(LHCb Collab.)
FULSOM	18	PRL 121 232001	B.G. Fulsom *et al.*	(BELLE Collab.)
JIA	17A	PR D96 112002	S. Jia *et al.*	(BELLE Collab.)
AAIJ	14BG	JHEP 1410 088	R. Aaij *et al.*	(LHCb Collab.)
LEES	14M	PR D90 112010	J.P. Lees *et al.*	(BABAR Collab.)
SHEN	12	PR D85 071102	C.P. Shen *et al.*	(BELLE Collab.)
KORNICER	11	PR D83 054003	M. Kornicer *et al.*	(CLEO Collab.)
LEES	11J	PR D84 072002	J.P. Lees *et al.*	(BABAR Collab.)
ASNER	08A	PR D78 091103	D.M. Asner *et al.*	(CLEO Collab.)
BRIERE	08	PR D78 092007	R.A. Briere *et al.*	(CLEO Collab.)
ARTUSO	05	PRL 94 032001	M. Artuso *et al.*	(CLEO Collab.)
EDWARDS	99	PR D59 032003	K.W. Edwards *et al.*	(CLEO Collab.)
SKWARNICKI	87	PRL 58 972	T. Skwarnicki *et al.*	(Crystal Ball Collab.) J
WALK	86	PR D34 2611	W.S. Walk *et al.*	(Crystal Ball Collab.)
ALBRECHT	85E	PL 160B 331	H. Albrecht *et al.*	(ARGUS Collab.)
NERNST	85	PRL 54 2195	R. Nernst *et al.*	(Crystal Ball Collab.)
HAAS	84	PRL 52 799	J. Haas *et al.*	(CLEO Collab.)
KLOPFEN...	83	PRL 51 160	C. Klopfenstein *et al.*	(CUSB Collab.)
PAUSS	83	PL 130B 439	F. Pauss *et al.*	(MPIM, COLU, CORN, LSU+)