$\chi_{b1}(1P)$

$I^G(J^{PC}) = 0^+(1^{++})$
J needs confirmation.

Observed in radiative decay of the $\Upsilon(2S)$, therefore $C = +$. Branching ratio requires E1 transition, M1 is strongly disfavored, therefore $P = +$. $J = 1$ from SKWARNICKI 87.

$\chi_{b1}(1P)$ MASS

VALUE (MeV)	DOCUMENT ID
9892.78±0.26±0.31 OUR EVALUATION	From average γ energy below, using $\Upsilon(2S)$ mass = 10023.26 ± 0.31 MeV

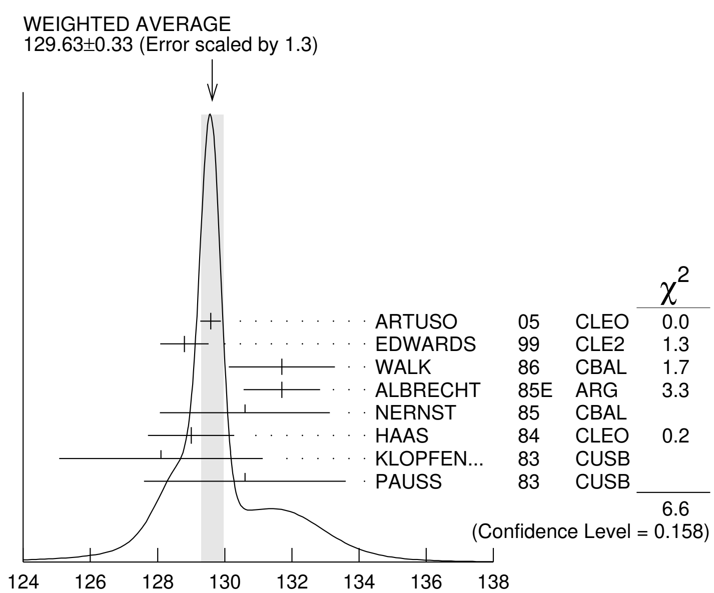
$m_{\chi_{b1}(1P)} - m_{\Upsilon(1S)}$

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
432.10±0.26±0.10	50	[1] AAIJ	24AC	LHCB	$\chi_{b1}(1P) \rightarrow \Upsilon(1S)\mu^+\mu^-$

[1] Observed in prompt pp production.

γ ENERGY IN $\Upsilon(2S)$ DECAY

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
129.63±0.33 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.			
129.58±0.09±0.29	ARTUSO	05	CLEO	$\Upsilon(2S) \rightarrow \gamma X$
128.8 ±0.4 ±0.6	EDWARDS	99	CLE2	$\Upsilon(2S) \rightarrow \gamma\chi(1P)$
131.7 ±0.9 ±1.3	WALK	86	CBAL	$\Upsilon(2S) \rightarrow \gamma\gamma\ell^+\ell^-$
131.7 ±0.3 ±1.1	ALBRECHT	85E	ARG	$\Upsilon(2S) \rightarrow$ conv. γX
130.6 ±0.8 ±2.4	NERNST	85	CBAL	$\Upsilon(2S) \rightarrow \gamma$X
129 ±0.8 ±1	HAAS	84	CLEO	$\Upsilon(2S) \rightarrow$ conv. γX
128.1 ±0.4 ±3.0	KLOPFEN...	83	CUSB	$\Upsilon(2S) \rightarrow \gamma$X
130.6 ±3.0	PAUSS	83	CUSB	$\Upsilon(2S) \rightarrow \gamma\gamma\ell^+\ell^-$



$\chi_{b1}(1P)$ mass (MeV)

$\chi_{b1}(1P)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\gamma\,\Upsilon(1S)$	$(35.2\ \pm2.0)$ %	
Γ_2	$D^0 X$	$(12.6\ \pm2.2)$ %	
Γ_3	$\pi^+\pi^- K^+ K^- \pi^0$	$(\ 2.0\ \pm0.6) \times 10^{-4}$	
Γ_4	$2\pi^+\pi^- K^- K^0_S$	$(\ 1.3\ \pm0.5) \times 10^{-4}$	
Γ_5	$2\pi^+\pi^- K^- K^0_S 2\pi^0$	$<\ 6\ \times 10^{-4}$	90%
Γ_6	$2\pi^+ 2\pi^- 2\pi^0$	$(\ 8.0\ \pm2.5) \times 10^{-4}$	
Γ_7	$2\pi^+ 2\pi^- K^+ K^-$	$(\ 1.5\ \pm0.5) \times 10^{-4}$	
Γ_8	$2\pi^+ 2\pi^- K^+ K^- \pi^0$	$(\ 3.5\ \pm1.2) \times 10^{-4}$	
Γ_9	$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	$(\ 8.6\ \pm3.2) \times 10^{-4}$	
Γ_{10}	$3\pi^+ 2\pi^- K^- K^0_S \pi^0$	$(\ 9.3\ \pm3.3) \times 10^{-4}$	
Γ_{11}	$3\pi^+ 3\pi^-$	$(\ 1.9\ \pm0.6) \times 10^{-4}$	
Γ_{12}	$3\pi^+ 3\pi^- 2\pi^0$	$(\ 1.7\ \pm0.5) \times 10^{-3}$	
Γ_{13}	$3\pi^+ 3\pi^- K^+ K^-$	$(\ 2.6\ \pm0.8) \times 10^{-4}$	
Γ_{14}	$3\pi^+ 3\pi^- K^+ K^- \pi^0$	$(\ 7.5\ \pm2.6) \times 10^{-4}$	
Γ_{15}	$4\pi^+ 4\pi^-$	$(\ 2.6\ \pm0.9) \times 10^{-4}$	
Γ_{16}	$4\pi^+ 4\pi^- 2\pi^0$	$(\ 1.4\ \pm0.6) \times 10^{-3}$	
Γ_{17}	ω anything	$(\ 4.9\ \pm1.4)$ %	
Γ_{18}	$\quad\omega X_{tetra}$	$<\ 4.44\ \times 10^{-4}$	90%
Γ_{19}	$J/\psi\, J/\psi$	$<\ 2.7\ \times 10^{-5}$	90%
Γ_{20}	$J/\psi\, \psi(2S)$	$<\ 1.7\ \times 10^{-5}$	90%
Γ_{21}	$\psi(2S)\, \psi(2S)$	$<\ 6\ \times 10^{-5}$	90%
Γ_{22}	$J/\psi(1S)$ anything	$<\ 1.1\ \times 10^{-3}$	90%
Γ_{23}	$\quad J/\psi(1S)\, X_{tetra}$	$<\ 2.27\ \times 10^{-4}$	90%

$\chi_{b1}(1P)$ BRANCHING RATIOS

$\Gamma(\gamma\,\Upsilon(1S))/\Gamma_{\text{total}}$ $\qquad\Gamma_1/\Gamma$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.352±0.020 OUR AVERAGE					
$0.356^{+0.016}_{-0.022}\pm0.019$	964k	[1] FULSOM	18	BELL	$\Upsilon(2S) \to \gamma X$
$0.364\pm0.017\pm0.019$		[2,3,4] LEES	14M	BABR	$\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$
$0.331\pm0.018\pm0.017$	3222	[4,5] KORNICER	11	CLEO	$e^+e^- \to \gamma\gamma\ell^+\ell^-$
$0.350\pm0.023\pm0.018$	13k	[6] LEES	11J	BABR	$\Upsilon(2S) \to X\gamma$
$0.34\ \pm0.07\ \pm0.02$	53	[4,7,8] WALK	86	CBAL	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$
$0.47\ \pm0.18$		KLOPFEN...	83	CUSB	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$

[1] FULSOM 18 reports $[\Gamma(\chi_{b1}(1P) \to \gamma\,\Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (2.45 \pm 0.02^{+0.11}_{-0.15}) \times 10^{-2}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

[2] LEES 14M quotes $\Gamma(\chi_{b1}(1P) \to \gamma \Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(2S) \to \gamma \chi_{b1}(1P))/\Gamma_{total}$ = (2.51 ± 0.12) % combining the results from samples of $\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$ with and without converted photons.

[3] LEES 14M reports $[\Gamma(\chi_{b1}(1P) \to \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))]$ = $(2.51 \pm 0.12) \times 10^{-2}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

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

[5] KORNICER 11 reports $[\Gamma(\chi_{b1}(1P) \to \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))]$ = $(22.8 \pm 0.4 \pm 1.2) \times 10^{-3}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

[6] LEES 11J reports $[\Gamma(\chi_{b1}(1P) \to \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))]$ = $(24.1 \pm 0.6 \pm 1.5) \times 10^{-3}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

[7] WALK 86 quotes $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) \times B(\chi_{b1}(1P) \to \gamma \Upsilon(1S)) \times B(\Upsilon(1S) \to \ell^+\ell^-) = (5.8 \pm 0.9 \pm 0.7)\ \%$.

[8] WALK 86 reports $[\Gamma(\chi_{b1}(1P) \to \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))]$ = $(23.4 \pm 3.63 \pm 2.82) \times 10^{-3}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

$\Gamma(D^0 X)/\Gamma_{total}$ — Γ_2/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
12.6±1.9±1.1	2310	[1] BRIERE	08	CLEO	$\Upsilon(2S) \to \gamma D^0 X$

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

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
2.0±0.6±0.1	18	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma \pi^+\pi^- K^+ K^- \pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to \pi^+\pi^- K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))] = (14 \pm 3 \pm 3) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.3±0.5±0.1	11	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+\pi^- K^- K^0_S$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 2\pi^+\pi^- K^- K^0_S)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))] = (9 \pm 3 \pm 2) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<6	90	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+\pi^- K^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 2\pi^+\pi^- K^- K^0_S 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] < 42 \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = 6.9 \times 10^{-2}$.

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
8.0±2.4±0.4	46	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+ 2\pi^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (55 \pm 9 \pm 14) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.5±0.5±0.1	18	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+ 2\pi^- K^+ K^-$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (10 \pm 3 \pm 2) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
3.5±1.2±0.2	22	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+ 2\pi^- K^+ K^- \pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 2\pi^+ 2\pi^- K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (24 \pm 6 \pm 6) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) 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
8.6±3.2±0.4	26	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 2\pi^+ 2\pi^- K^+ K^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (59 \pm 14 \pm 17) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

$\Gamma(3\pi^+ 2\pi^- K^- K^0_S \pi^0)/\Gamma_{total}$ Γ_{10}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
9.3±3.3±0.5	21	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 2\pi^- K^- K^0_S \pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 3\pi^+ 2\pi^- K^- K^0_S \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (64 \pm 16 \pm 16) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

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

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1.9±0.6±0.1	25	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 3\pi^-$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 3\pi^+ 3\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (13 \pm 3 \pm 3) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

$\Gamma(3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}$ — Γ_{12}/Γ

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
17±5±1	56	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 3\pi^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (119 \pm 18 \pm 32) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

$\Gamma(3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}$ — Γ_{13}/Γ

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
2.6±0.8±0.1	21	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 3\pi^- K^+ K^-$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (18 \pm 4 \pm 4) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

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

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
7.5±2.6±0.4	28	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (52 \pm 11 \pm 14) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

$\Gamma(4\pi^+ 4\pi^-)/\Gamma_{\text{total}}$ — Γ_{15}/Γ

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
2.6±0.9±0.1	24	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 4\pi^+ 4\pi^-$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 4\pi^+ 4\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (18 \pm 4 \pm 5) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

$\Gamma(4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
14±5±1	26	[1] ASNER	08A	CLEO	$\Upsilon(2S) \to \gamma 4\pi^+ 4\pi^- 2\pi^0$

[1] ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \to 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))] = (96 \pm 24 \pm 29) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

$\Gamma(\omega\,\text{anything})/\Gamma_{total}$ — Γ_{17}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
4.9±1.3±0.6	51k	JIA	17A	BELL	$e^+ e^- \to$ hadrons

$\Gamma(\omega X_{tetra})/\Gamma_{total}$ — Γ_{18}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<44.4 × 10^{-5}	90	[1] JIA	17A	BELL	$e^+ e^- \to$ hadrons

[1] For a tetraquark state X_{tetra}, with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of X_{tetra} mass and width range from 3.3×10^{-5} to 44.4×10^{-5}.

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

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<2.7	90	[1] SHEN	12	BELL	$\Upsilon(2S) \to \gamma \psi X$

[1] SHEN 12 reports $< 2.7 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b1}(1P) \to J/\psi J/\psi)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))]$ assuming $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$.

$\Gamma(J/\psi \psi(2S))/\Gamma_{total}$ — Γ_{20}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.7	90	[1] SHEN	12	BELL	$\Upsilon(2S) \to \gamma \psi X$

[1] SHEN 12 reports $< 1.7 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b1}(1P) \to J/\psi \psi(2S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))]$ assuming $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$.

$\Gamma(\psi(2S) \psi(2S))/\Gamma_{total}$ — Γ_{21}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<6	90	[1] SHEN	12	BELL	$\Upsilon(2S) \to \gamma \psi X$

[1] SHEN 12 reports $< 6.2 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b1}(1P) \to \psi(2S) \psi(2S))/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma \chi_{b1}(1P))]$ assuming $B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$.

$\Gamma(J/\psi(1S)\,\text{anything})/\Gamma_{total}$ — Γ_{22}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.1 × 10^{-3}	90	JIA	17A	BELL	$e^+ e^- \to$ hadrons

$\Gamma(J/\psi(1S) X_{tetra})/\Gamma_{total}$ — Γ_{23}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<22.7 × 10^{-5}	90	[1] JIA	17A	BELL	$e^+ e^- \to$ hadrons

[1] For a tetraquark state X_{tetra}, with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of X_{tetra} mass and width range from 1.8×10^{-5} to 22.7×10^{-5}.

$\chi_{b1}(1P)$ Cross-Particle Branching Ratios

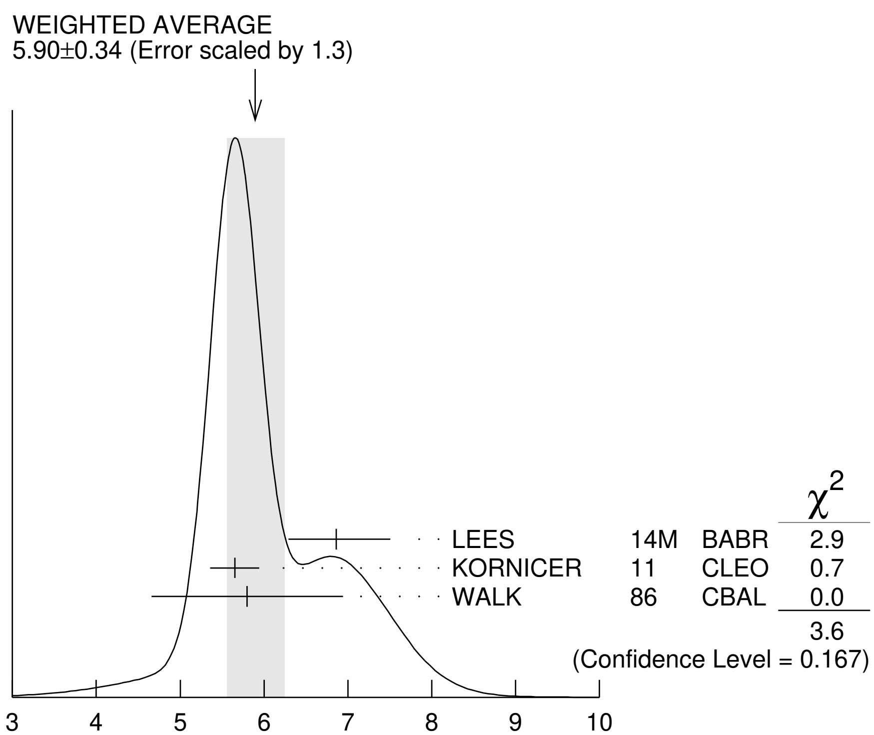
$\Gamma(\chi_{b1}(1P) \to \gamma \Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(2S) \to \gamma \chi_{b1}(1P))/\Gamma_{total}$ $\Gamma_1/\Gamma \times \Gamma_{78}^{\Upsilon(2S)}/\Gamma^{\Upsilon(2S)}$

VALUE (units 10^{-3})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
24.1±0.6±1.5	13k	LEES	11J	BABR	$\Upsilon(2S) \to X\gamma$

$B(\chi_{b1}(1P) \to \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) \times B(\Upsilon(1S) \to \ell^+ \ell^-)$

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
5.90±0.34 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.				
$6.86^{+0.47}_{-0.45}{}^{+0.44}_{-0.35}$		[1] LEES	14M	BABR	$\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$
5.65±0.11±0.27	3222	KORNICER	11	CLEO	$e^+e^- \to \gamma\gamma\ell^+\ell^-$
5.8 ±0.9 ±0.7	53	WALK	86	CBAL	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$

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



$B(\chi_{b1}(1P) \to \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \to \gamma \chi_{b1}(1P)) \times B(\Upsilon(1S) \to \ell^+ \ell^-)$ (units 10^{-4})

$B(\chi_{b1}(1P) \to \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \to \gamma \chi_{b1}(1P)) \times B(\Upsilon(1S) \to \ell^+ \ell^-)$

VALUE (units 10^{-5})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1.30±0.34 OUR AVERAGE					
$1.16^{+0.78}_{-0.67}{}^{+0.14}_{-0.16}$		[1] LEES	14M	BABR	$\Upsilon(3S) \to \gamma\gamma\mu^+\mu^-$

$1.33 \pm 0.30 \pm 0.23$	50	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.

$B(\chi_{b2}(1P) \to pX + \overline{p}X)/B(\chi_{b1}(1P) \to pX + \overline{p}X)$

VALUE	DOCUMENT ID		TECN	COMMENT
$1.068 \pm 0.010 \pm 0.040$	BRIERE	07	CLEO	$\Upsilon(2S) \to \gamma \chi_{bJ}(1P)$

$B(\chi_{b0}(1P) \to pX + \overline{p}X)/B(\chi_{b1}(1P) \to pX + \overline{p}X)$

VALUE	DOCUMENT ID		TECN	COMMENT
$1.11 \pm 0.15 \pm 0.20$	BRIERE	07	CLEO	$\Upsilon(2S) \to \gamma \chi_{bJ}(1P)$

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