$\chi_{b1}(1P)$

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

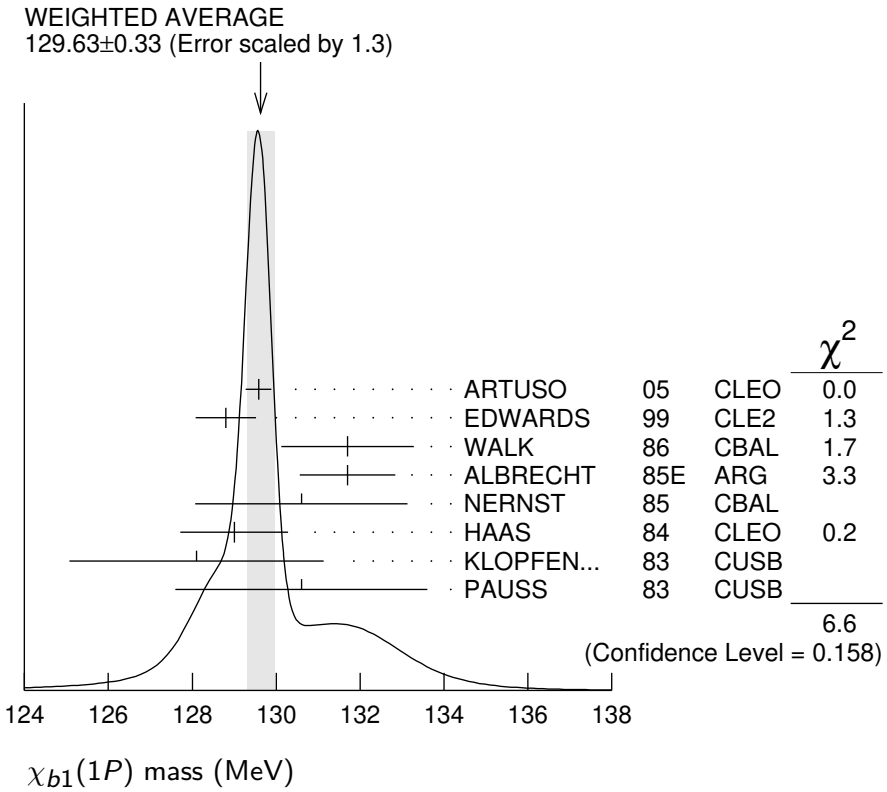
Observed in radiative decay of the $\Upsilon(2S)$, therefore $C = +$. Branching ratio requires E1 transition, M1 is strongly disfavored, therefore $P = +$. $J = 1$ from SKWARNICKI 87.

$\chi_{b1}(1P)$ 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

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	$\Upsilon(2S) \rightarrow \gamma\gamma\ell^+\ell^-$



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

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\gamma\,\Upsilon(1S)$	(35.2 ±2.0) %	
Γ_2	$D^0 X$	(12.6 ±2.2) %	
Γ_3	$\pi^+\pi^- K^+ K^- \pi^0$	(2.0 ±0.6) × 10^{-4}	
Γ_4	$2\pi^+\pi^- K^- K^0_S$	(1.3 ±0.5) × 10^{-4}	
Γ_5	$2\pi^+\pi^- K^- K^0_S 2\pi^0$	< 6 × 10^{-4}	90%
Γ_6	$2\pi^+ 2\pi^- 2\pi^0$	(8.0 ±2.5) × 10^{-4}	
Γ_7	$2\pi^+ 2\pi^- K^+ K^-$	(1.5 ±0.5) × 10^{-4}	
Γ_8	$2\pi^+ 2\pi^- K^+ K^- \pi^0$	(3.5 ±1.2) × 10^{-4}	
Γ_9	$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	(8.6 ±3.2) × 10^{-4}	
Γ_{10}	$3\pi^+ 2\pi^- K^- K^0_S \pi^0$	(9.3 ±3.3) × 10^{-4}	
Γ_{11}	$3\pi^+ 3\pi^-$	(1.9 ±0.6) × 10^{-4}	
Γ_{12}	$3\pi^+ 3\pi^- 2\pi^0$	(1.7 ±0.5) × 10^{-3}	
Γ_{13}	$3\pi^+ 3\pi^- K^+ K^-$	(2.6 ±0.8) × 10^{-4}	
Γ_{14}	$3\pi^+ 3\pi^- K^+ K^- \pi^0$	(7.5 ±2.6) × 10^{-4}	
Γ_{15}	$4\pi^+ 4\pi^-$	(2.6 ±0.9) × 10^{-4}	
Γ_{16}	$4\pi^+ 4\pi^- 2\pi^0$	(1.4 ±0.6) × 10^{-3}	
Γ_{17}	ω anything	(4.9 ±1.4) %	
Γ_{18}	ωX_{tetra}	< 4.44 × 10^{-4}	90%
Γ_{19}	$J/\psi\,J/\psi$	< 2.7 × 10^{-5}	90%
Γ_{20}	$J/\psi\,\psi(2S)$	< 1.7 × 10^{-5}	90%
Γ_{21}	$\psi(2S)\,\psi(2S)$	< 6 × 10^{-5}	90%
Γ_{22}	$J/\psi(1S)$ anything	< 1.1 × 10^{-3}	90%
Γ_{23}	$J/\psi(1S)\,X_{tetra}$	< 2.27 × 10^{-4}	90%

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

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

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±0.017±0.019		[2,3,4] LEES	14M	BABR	$\Upsilon(2S) \to \gamma\gamma\mu^+\mu^-$
0.331±0.018±0.017	3222	[4,5] KORNICER	11	CLEO	$e^+e^- \to \gamma\gamma\ell^+\ell^-$
0.350±0.023±0.018	13k	[6] LEES	11J	BABR	$\Upsilon(2S) \to X\gamma$
0.34 ±0.07 ±0.02	53	[4,7,8] WALK	86	CBAL	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$
0.47 ±0.18		KLOPFEN...	83	CUSB	$\Upsilon(2S) \to \gamma\gamma\ell^+\ell^-$

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

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

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

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

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

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

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

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

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

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

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

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

$\Gamma(2\pi^+2\pi^-2\pi^0)/\Gamma_{total}$ 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 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 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 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 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 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 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 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 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 $[\Gamma(\chi_{b1}(1P) \to 3\pi^+2\pi^-K^-K^0_S\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (64 \pm 16 \pm 16) \times 10^{-6}$ which we divide by our best 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 value.

$\Gamma(3\pi^+3\pi^-)/\Gamma_{total}$ 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 $[\Gamma(\chi_{b1}(1P) \to 3\pi^+3\pi^-)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (13 \pm 3 \pm 3) \times 10^{-6}$ which we divide by our best 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 value.

$\Gamma(3\pi^+3\pi^-2\pi^0)/\Gamma_{total}$ 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 $[\Gamma(\chi_{b1}(1P) \to 3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (119 \pm 18 \pm 32) \times 10^{-6}$ which we divide by our best 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 value.

$\Gamma(3\pi^+3\pi^-K^+K^-)/\Gamma_{total}$ 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 $[\Gamma(\chi_{b1}(1P) \to 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (18 \pm 4 \pm 4) \times 10^{-6}$ which we divide by our best 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 value.

$\Gamma(3\pi^+3\pi^-K^+K^-\pi^0)/\Gamma_{total}$ 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 $[\Gamma(\chi_{b1}(1P) \to 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (52 \pm 11 \pm 14) \times 10^{-6}$ which we divide by our best 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 value.

$\Gamma(4\pi^+4\pi^-)/\Gamma_{total}$ 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 $[\Gamma(\chi_{b1}(1P) \to 4\pi^+ 4\pi^-)/\Gamma_{total}] \times [B(\Upsilon(2S) \to \gamma\chi_{b1}(1P))] = (18 \pm 4 \pm 5) \times 10^{-6}$ which we divide by our best 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 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 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 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
$<44.4\times10^{-5}$	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 $<2.7\times10^{-5}$ 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 $B(\Upsilon(2S)\to\gamma\chi_{b1}(1P))=(6.9\pm0.4)\times10^{-2}$.

$\Gamma(J/\psi\psi(2S))/\Gamma_{total}$ 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 $<1.7\times10^{-5}$ 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 $B(\Upsilon(2S)\to\gamma\chi_{b1}(1P))=(6.9\pm0.4)\times10^{-2}$.

$\Gamma(\psi(2S)\psi(2S))/\Gamma_{total}$ 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 $<6.2\times10^{-5}$ 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 $B(\Upsilon(2S)\to\gamma\chi_{b1}(1P))=(6.9\pm0.4)\times10^{-2}$.

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.1\times10^{-3}$	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
$<22.7\times10^{-5}$	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

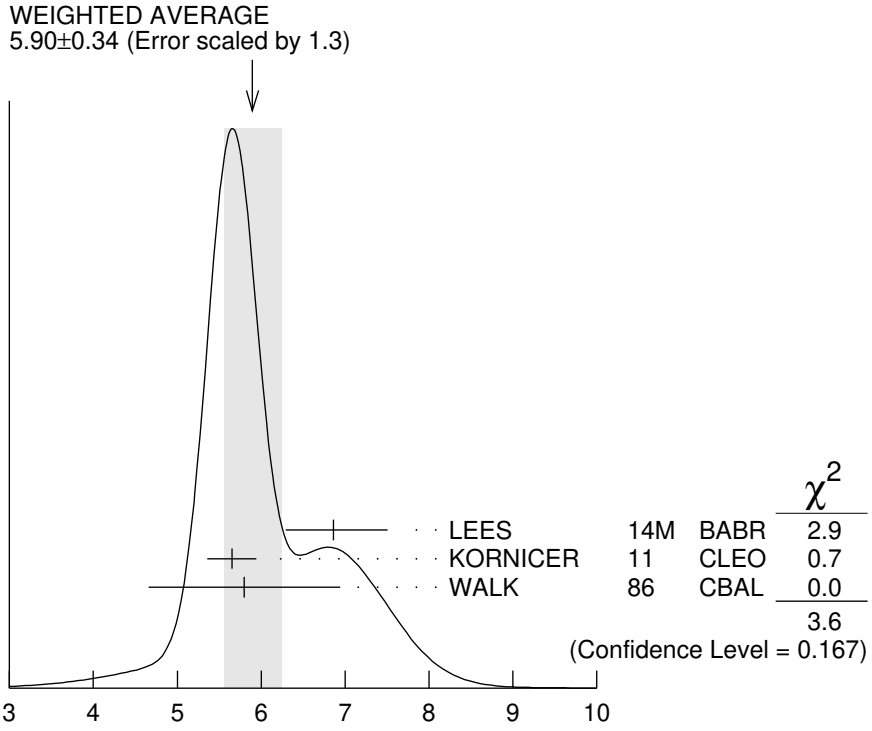
$\Gamma(\chi_{b1}(1P)\to\gamma\Upsilon(1S))/\Gamma_{total}\times\Gamma(\Upsilon(2S)\to\gamma\chi_{b1}(1P))/\Gamma_{total}$ $\Gamma_1/\Gamma\times\Gamma_{59}^{\Upsilon(2S)}/\Gamma^{\Upsilon(2S)}$

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$24.1\pm0.6\pm1.5$	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±0.30±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.

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

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

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

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

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

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JIA	17A	PR D96 112002	S. Jia *et al.*	(BELLE 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.)
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BRIERE	08	PR D78 092007	R.A. Briere *et al.*	(CLEO Collab.)
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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.)
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