$$\chi_{b0}(2P)$$

$$I^G(J^{PC}) = 0^+(0^{++})$$

J needs confirmation.

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

$\chi_{b0}(2P)$ MASS

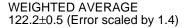
VALUE (MeV) DOCUMENT ID

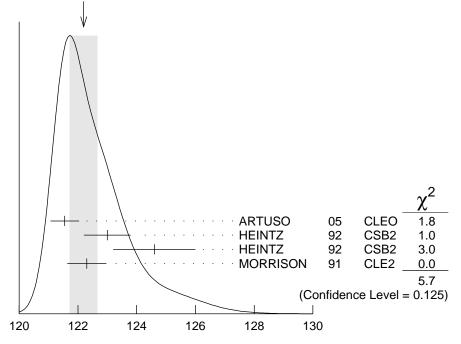
10232.5\pm0.4\pm0.5 OUR EVALUATION From γ energy below, using $\varUpsilon(3S)$ mass = 10355.2 \pm 0.5 MeV

VALUE (MeV)DOCUMENT IDTECNCOMMENT23.8 \pm 1.7LEES14M BABR $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$

γ ENERGY IN $\Upsilon(3S)$ DECAY

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
121.9 ±0.4 OUR E	VALUATIO	N Treating system	natic e	errors as	correlated
122.2 ±0.5 OUR A	VERAGE	Error includes scale	facto	r of 1.4.	See the ideogram below.
$121.55 \pm 0.16 \pm 0.46$		ARTUSO	05	CLEO	$\Upsilon(3S) \rightarrow \gamma X$
123.0 ± 0.8	4959	$^{ m 1}$ HEINTZ	92	CSB2	$e^+e^- \rightarrow \gamma X$
124.6 ± 1.4	17	² HEINTZ	92	CSB2	$e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$
$122.3 \pm 0.3 \pm 0.6$	9903	MORRISON	91	CLE2	$e^+e^- \rightarrow \gamma X$





 γ energy in $\Upsilon(3S)$ decay (MeV)

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$\chi_{b0}(2P)$ DECAY MODES

	Mode	Fraction (Γ_{i}	/Γ)	Confidence level
$\overline{\Gamma_1}$	$\gamma \varUpsilon(2S)$	(1.38±0.3	0) %	
Γ_2	$\gamma \ \Upsilon(1S)$	(3.8 ± 1.7)	$) \times 10^{-3}$	3
Γ_3	$D^0 X$	< 8.2	%	90%
Γ_4	$\pi^+\pi^-$ K $^+$ K $^-\pi^0$	< 3.4	\times 10 ⁻¹	5 90%
Γ_5	$2\pi^{+}\pi^{-}K^{-}K^{0}_{S}$	< 5	\times 10 ⁻¹	5 90%
Γ_6	$2\pi^+\pi^-$ K $^-$ K $^{reve{0}}_{S}$ $2\pi^0$	< 2.2	× 10 ⁻⁴	4 90%
Γ_7	$2\pi^{+}2\pi^{-}2\pi^{0}$	< 2.4	\times 10 ⁻⁴	90%
Γ ₈	$2\pi^{+}2\pi^{-}$ K^{+} K^{-}	< 1.5	\times 10 ⁻⁴	90%
Γ ₉	$2\pi^{+}2\pi^{-}\mathit{K}^{+}\mathit{K}^{-}\pi^{0}$	< 2.2	\times 10 ⁻⁴	90%
Γ_{10}	$2\pi^{+}2\pi^{-}K^{+}K^{-}2\pi^{0}$	< 1.1	\times 10 ⁻³	90%
Γ_{11}	$3\pi^{+}2\pi^{-}$ K^{-} K^{0}_{S} π^{0}	< 7	× 10 ⁻⁴	90%
Γ_{12}	$3\pi^{+}3\pi^{-}$	< 7	\times 10 ⁻¹	5 90%
Γ_{13}	$3\pi^{+}3\pi^{-}2\pi^{0}$	< 1.2	\times 10 ⁻³	90%
Γ_{14}	$3\pi^{+}3\pi^{-}K^{+}K^{-}$	< 1.5	\times 10 ⁻⁴	90%
Γ ₁₅	$3\pi^{+}3\pi^{-}K^{+}K^{-}\pi^{0}$	< 7	\times 10 ⁻⁴	90%
Γ_{16}	$4\pi^+4\pi^-$	< 1.7	\times 10 ⁻⁴	90%
Γ ₁₇	$4\pi^{+}4\pi^{-}2\pi^{0}$	< 6	× 10 ⁻⁴	90%

$\chi_{b0}(2P)$ BRANCHING RATIOS

 $\Gamma(\gamma \Upsilon(2S))/\Gamma_{\mathsf{total}}$ Γ_1/Γ CL% VALUE (%) DOCUMENT ID COMMENT **TFCN**

-						
	1.38±0.30 OUR AV	'ERAGE				
	$1.31 \pm 0.27 {+0.13 \atop -0.12}$		3,4 LEES	14M	BABR	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$
	$3.6 \pm 1.6 \pm 0.3$		^{3,5} HEINTZ	92	CSB2	$e^+e^- ightarrow \ell^+\ell^-\gamma\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<2.8 90 6 LEES 11J BABR
$$\Upsilon(3S) \rightarrow X \gamma$$

<8.9 90 7 CRAWFORD 92B CLE2 $e^+e^- \rightarrow \ell^+\ell^- \gamma \gamma$

¹A systematic uncertainty on the energy scale of 0.9% not included. Supersedes NARAIN 91.

²A systematic uncertainty on the energy scale of 0.9% not included. Supersedes HEINTZ 91.

³ Assuming B($\Upsilon(2S) \to \mu^+ \mu^-$) = (1.93 ± 0.17)%.

⁴ LEES 14M reports $[\Gamma(\chi_{b0}(2P) \to \gamma \Upsilon(2S))/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b0}(2P))] = (7.7 \pm 1.6) \times 10^{-4}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b0}(2P)) = (5.9 \pm 0.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

⁵ Recalculated by us. HEINTZ 92 quotes B($\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)$) \times B($\chi_{b0}(2P) \rightarrow \gamma \chi_{b0}(2P)$ $\gamma \Upsilon(2S)$) = (0.28 ± 0.12 ± 0.03)% using B($\Upsilon(2S) \rightarrow \mu^{+}\mu^{-}$) = (1.44 ± 0.10)%. Supersedes HEINTZ 91.

⁶ LEES 11J quotes a central value of $\Gamma(\chi_{b0}(2P) \to \gamma \Upsilon(2S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \to \gamma \Upsilon(2S))$ $\gamma \chi_{b0}(2P))/\Gamma_{total} = (-0.3 \pm 0.2 ^{+0.5}_{-0.4})\%.$

⁷ Using B(Υ (2S) → $\mu^+\mu^-$) = (1.37 ± 0.26)%, B(Υ (3S) → $\gamma\gamma$ Υ (2S))×2 B(Υ (2S) → $\mu^+\mu^-$) < 1.19 × 10⁻⁴, and B(Υ (3S) → χ_{b0} (2P) γ) = 0.049.

TECN COMMENT

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

 Γ_2/Γ

0.38 ± 0.17 OUR AVERAGI	E		
$0.36\!\pm\!0.17\!\pm\!0.03$	8,9,10 LEES	14M BABR	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$
$0.9\ \pm 0.7\ \pm 0.1$	^{9,11} HEINTZ	92 CSB2	$e^+e^- ightarrow \ell^+\ell^-\gamma\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • •

<1.2 90
12
 LEES 11J BABR $\Upsilon(3S) \rightarrow X\gamma$
<2.5 90 13 CRAWFORD 92B CLE2 $e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$

⁸ LEES 14M quotes $\Gamma(\chi_{b0}(2P) \to \gamma \Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(3S) \to \gamma \chi_{b0}(2P))/\Gamma_{total} = (2.1 \pm 1.0) \times 10^{-4}$ combining the results from $\Upsilon(3S) \to \gamma \gamma \mu^+ \mu^-$ samples with and without photon conversions.

⁹ Assuming B($\Upsilon(1S) \rightarrow \mu^+ \mu^-$) = (2.48 \pm 0.05)%.

¹⁰ LEES 14M reports $[\Gamma(\chi_{b0}(2P) \to \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(3S) \to \gamma \chi_{b0}(2P))] = (2.1 \pm 1.0) \times 10^{-4}$ which we divide by our best value $B(\Upsilon(3S) \to \gamma \chi_{b0}(2P)) = (5.9 \pm 0.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

¹¹ Recalculated by us. HEINTZ 92 quotes B($\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)$) \times B($\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S)$) = (0.05 \pm 0.04 \pm 0.01)% using B($\Upsilon(1S) \rightarrow \mu^+ \mu^-$) = (2.57 \pm 0.05)%. Supersedes HEINTZ 91.

¹² LEES 11J quotes a central value of $\Gamma(\chi_{b0}(2P) \to \gamma \Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(3S) \to \gamma \chi_{b0}(2P))/\Gamma_{total} = (3.9 \pm 2.2 ^{+1.2}_{-0.6}) \times 10^{-4}$.

13 Using B($\Upsilon(1S) \rightarrow \mu^+ \mu^-$) = (2.57 ± 0.07)%, B($\Upsilon(3S) \rightarrow \gamma \gamma \Upsilon(1S)$)×2 B($\Upsilon(1S) \rightarrow \mu^+ \mu^-$) < 0.63 × 10⁻⁴, and B($\Upsilon(3S) \rightarrow \chi_{b0}(2P)\gamma$) = 0.049.

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

 Γ_3/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$< 8.2 \times 10^{-2}$	90	14,15 BRIERE	08	CLEO	$ \gamma(3S) \rightarrow \gamma D^0 X $

¹⁴ For $p_{D^0} > 2.5 \text{ GeV/c.}$

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

 Γ_4/Γ

VALUE (units 10 T)	CL%	DC	CUMENT ID		IECN	COMMENT
<0.34	90	16 AS	SNER	08A	CLEO	$\gamma(3S) \rightarrow \gamma \pi^{+} \pi^{-} K^{+} K^{-} \pi^{0}$
¹⁶ ASNER 08A	reports	$[\Gamma(\chi_L)]$	$_{00}(2P) \rightarrow$	$\pi^+\pi$	- K+ K	$(-\pi^0)/\Gamma_{total}$ × [B($\Upsilon(3S)$ \rightarrow
20.	_	$0^{-6} v$	which we div	vide by	our best	t value B($\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)$)
$= 5.9 \times 10^{-2}$	2					

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

 Γ_5/Γ

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VALUE (units 10)	CL/0	DOCUMENT ID		ILCIV	COMMENT
<0.5	90	17 ASNER	08A	CLEO	$ \gamma(3S) \rightarrow \gamma 2\pi^{+}\pi^{-}K^{-}K^{0}S $
¹⁷ ASNER 08A	reports	$[\Gamma(\chi_{b0}(2P) \rightarrow$	$2\pi^+$	$\pi^- K^-$	$(\kappa_S^0)/\Gamma_{total} \times [B(\Upsilon(3S))] \rightarrow$
$\gamma \chi_{h0}(2P))]$	$< 3 \times 10$	0^{-6} which we divid	de by o	ur best	value B($\Upsilon(3S) \rightarrow \gamma \chi_{h0}(2P)$)

 $= 5.9 \times 10^{\textstyle -2}$

¹⁵ The authors also present their result as $(4.1 \pm 3.0 \pm 0.4) \times 10^{-2}$.

$\Gamma(2\pi^+\pi^-K^-K^0_52\pi^0)/\Gamma_{\text{total}}$ VALUE (units 10⁻⁴) CL% DOCUMENT ID

 Γ_6/Γ

VALUE (units 10)	CL%	DOCUMENT	וט	TECN	COMMENT
<2.2	90	18 ASNER	08A	CLEO	$\gamma(3S) \rightarrow \gamma 2\pi^{+}\pi^{-}K^{-}2\pi^{0}$
¹⁸ ASNER 08A	reports	$[\Gamma(\chi_{b0}(2P) \rightarrow$	$2\pi^{+}\pi^{-}$	$\kappa^- \kappa_S^0$	$2\pi^0$)/ Γ_{total}] \times [B($\Upsilon(3S) \rightarrow$
		10^{-6} which we d	ivide by c	ur best	value B($\Upsilon(3S) o \gamma \chi_{b0}(2P)$)
-5.0×10^{-2}	<u>′</u>				

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

 Γ_7/Γ

<i>VALUE</i> (units 10 ⁻⁴)	CL%	DOCUMENT I	ID	TECN	COMMENT		
<2.4	90	¹⁹ ASNER	08A	CLEO	$\Upsilon(3S) \rightarrow$	$\gamma 2\pi + 2\pi$	$-2\pi^{0}$
¹⁹ ASNER 08A repo	orts [$\Gamma(\chi_L)$	$_{00}(2P) \rightarrow 2\pi^{+} 2\pi^{+}$	$\pi^{-}2\pi^{0})$	/Γ _{total}]	\times [B($\Upsilon(3S)$	$\rightarrow \gamma \chi_{b0}$	(2P))]
$< 14 \times 10^{-6} \text{ w}$	hich we d	ivide by our best	value B('	$\Upsilon(3S)$ –	$\rightarrow \gamma \chi_{ho}(2P)$	$1) = 5.9 \times$	10^{-2} .

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

 Γ_8/Γ

VALUE (units 10	⁴) <i>CL%</i>	DOCUMENT ID		TECN	COMMENT		
<1.5	90	²⁰ ASNER	08A	CLEO	$\Upsilon(3S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^-$		
					$+ K^{-})/\Gamma_{total}$ \times [B($\Upsilon(3S) \rightarrow$		
$\gamma \chi_{b0}(2P))] < 9 \times 10^{-6}$ which we divide by our best value B($\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)$)							
$= 5.9 \times 10$	-2						

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

٦/و٦

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT			
<2.2	90	²¹ ASNER	08A	CLEO	$\Upsilon(3S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^- \pi^0$			
²¹ ASNER 08A	report	as $[\Gamma(\chi_{b0}(2P) \rightarrow$	$2\pi^+$	$2\pi^-K^-$	$^+\kappa^-\pi^0)/\Gamma_{total}] \times [B(\varUpsilon(3S) \to$			
$\gamma \chi_{b0}(2P))] < 13 \times 10^{-6}$ which we divide by our best value B($\Upsilon(3S) \to \gamma \chi_{b0}(2P)$)								
$= 5.9 \times 10^{-2}$	<u>)</u>							

$\Gamma(2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}$ VALUE (units 10⁻⁴) CL% DOCUMENT ID

 Γ_{10}/Γ

VALUE (units 10) CL 70	DOCUMENT IL		IECIV	COMMENT
<11	90	²² ASNER	08A	CLEO	$r(3S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$
					$+ \kappa^{-} 2\pi^{0})/\Gamma_{total}] \times [B(\varUpsilon(3S) \rightarrow$
		$ imes$ 10 $^{-6}$ which w	e divide	by our	best value B($\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)$)
$= 5.9 \times 1$	0^{-2} .				

$\Gamma \big(3\pi^+2\pi^-\,{\it K}^-\,{\it K}^0_S\,\pi^0\big)/\Gamma_{\rm total}$

 Γ_{11}/Γ

$\Gamma(3\pi^+3\pi^-)/\Gamma_{\text{total}}$			Γ ₁₂ /Γ	
VALUE (units 10^{-4})	CL%DOCUME!	IT ID TECN	COMMENT	
			$\gamma(3S) \rightarrow \gamma 3\pi^{+} 3\pi^{-}$	
²⁴ ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 3\pi^+ 3\pi^-)/\Gamma_{total}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))]$ < 4×10^{-6} which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = 5.9 \times 10^{-2}$.				
$\Gamma(3\pi^+3\pi^-2\pi^0)/\Gamma_{\text{tota}}$	l		Γ ₁₃ /Γ	
VALUE (units 10 ⁻⁴) CL%	<u>DOCUMENT</u>	ID TECN C	OMMENT	
<12 90			$\gamma(3S) \to \gamma 3\pi^{+} 3\pi^{-} 2\pi^{0}$	
			$[B(\Upsilon(3S) \to \gamma \chi_{b0}(2P))]$ $[\gamma \chi_{b0}(2P)) = 5.9 \times 10^{-2}.$	
$\Gamma(3\pi^+3\pi^-K^+K^-)/\Gamma$	total		Γ ₁₄ /Γ	
VALUE (units 10^{-4}) CL%		TECN COMME	NT	
<1.5 90	²⁶ ASNER 0	8A CLEO $\Upsilon(3S)$	$\rightarrow \gamma 3\pi^{+} 3\pi^{-} K^{+} K^{-}$	
²⁶ ASNER 08A reports				
$\gamma \chi_{b0}(2P))] < 9 \times 10$ = 5.9 × 10 ⁻² .) ^{—6} which we divid	e by our best value	$B(\varUpsilon(3S)\to \gamma\chi_{b0}(2P))$	
$\Gamma(3\pi^{+}3\pi^{-}K^{+}K^{-}\pi^{0})$	/Γ _{total}		Γ ₁₅ /Γ	
VALUE (units 10^{-4}) CL%	DOCUMENT ID			
<7 90 ²⁷	ASNER 08	CLEO $\Upsilon(3S)$ –	$\gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$	
			$/\Gamma_{total}] \times [B(\varUpsilon(3S) \to B(\varUpsilon(3S) \to \gamma \chi_{b0}(2P))]$	
$\Gamma(4\pi^+4\pi^-)/\Gamma_{ m total}$			Γ ₁₆ /Γ	
VALUE (units 10^{-4})	CL%DOCUME!	IT ID TECN	COMMENT	
<1.7	90 ²⁸ ASNER	08A CLEO	$\Upsilon(3S) \rightarrow \gamma 4\pi^+ 4\pi^-$	
			$3(\Upsilon(3S) \to \gamma \chi_{b0}(2P))]$ $\gamma \chi_{b0}(2P)) = 5.9 \times 10^{-2}.$	
$\Gamma(4\pi^+4\pi^-2\pi^0)/\Gamma_{ m total}$	I		Γ ₁₇ /Γ	
VALUE (units 10 ⁻⁴) CL% <6 90	DOCUMENT I	D TECN CO		
<6 90	²⁹ ASNER	08A CLEO γ	$(3S) \rightarrow \gamma 4\pi^{+} 4\pi^{-} 2\pi^{0}$	
²⁹ ASNER 08A reports [Γ($(\chi_{b0}(2P) \rightarrow 4\pi^{+}4$	$(\tau^- 2\pi^0)/\Gamma_{ ext{total}}] imes 1$	$[B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))]$	
$< 38 \times 10^{-6}$ which we	e divide by our best	value B($\varUpsilon(3S) ightarrow \gamma$	$\chi_{b0}(2P)) = 5.9 \times 10^{-2}.$	
$\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S))$	$))/\Gamma_{total} imes \Gamma(au)$		$(r)/\Gamma_{\text{total}}$ $(r)/\Gamma_{\text{total}}$ $(r)/\Gamma_{\text{total}}$	
VALUE (units 10^{-4})	CL%DOCUMEI	IT ID TECN	COMMENT	
<u>VALUE (units 10^{−4})</u>				
³⁰ LEES 11J quotes a ce	ntral value of $\Gamma(\chi_b)$	$\gamma (2P) \rightarrow \gamma \gamma (1S)$	$)/\Gamma_{total} \times \Gamma(\Upsilon(3S) \to$	
$\gamma \chi_{b0}(2P))/\Gamma_{total} =$	$(3.9 \pm 2.2^{+1.2}_{-0.6}) \times$	10^{-4} and derives	a 90% CL upper limit of	
$B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S))$	(5)) < 1.2% using B	$(\Upsilon(3S) \to \gamma \chi_{b0}(2))$	$(2P)) = (5.9 \pm 0.6)\%.$	
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<i>VALUE</i> (units 10 ⁻⁵)	$(1)) \times B(\Upsilon(3S) \rightarrow DOCUMENT)$			COMMENT
1.4±0.9 OUR AVERAGE		<u>10 1</u>	LCIV	COMMENT
$1.7 + 1.5 + 0.1 \\ -1.4 - 1.2$	³¹ LEES	14M B	BABR	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-}$
$-1.4 - 1.2$ $1.3 \pm 1.0 \pm 0.3$	³² HEINTZ			$\gamma(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-}$
31 From a sample of $\varUpsilon(35)$	$(5) \rightarrow \gamma \gamma \mu^+ \mu^- \text{ with }$, , , , ,
32 Calculated by us. HE γ	EINTZ 92 quotes B($\Upsilon(3S) \rightarrow$	$\gamma \chi_{b0}$	$_{0}(2P)) \times B(\chi_{b0}(2P) \rightarrow$
$[B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S))]$		$\gamma \chi_{b0}(2l)$	P))] /	$'[B(\chi_{b1}(2P) \to$
VALUE (%)	DOCUMENT	ID T	ECN	COMMENT
1.71±0.80				$ \gamma(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-} $
33 From a sample of $\varUpsilon(35)$	$(5) \rightarrow \gamma \gamma \mu^+ \mu^- \text{ with}$	out convert	ted pho	otons.
$\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S))$	$)/\Gamma_{total} \times \Gamma(\Upsilon(3.5))$	S) → 7 X I	տ(2 <i>P</i>))/[_{total}
(1000)	// total (()	- / //		$/\Gamma \times \Gamma_{22}^{\Upsilon(3S)}/\Gamma^{\Upsilon(3S)}$
$VALUE$ (units 10^{-3}) C	CL% DOCUMENT	ID T	_	
<1.6 9	0 34 LEES	11.1 E	BABR	$\Upsilon(3S) \rightarrow X\gamma$
34 LEES 11J quotes a cen				
$\gamma \chi_{b0}(2P))/\Gamma_{total} = B(\chi_{b0}(2P) \to \gamma \Upsilon(2S))$	$(-0.3 \pm 0.2^{+0.5}_{-0.4})\%$	and deriv	es a	90% CL upper limit of
$B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S))$)) \times B($\Upsilon(3S) \rightarrow$	$\gamma \chi_{b0}$ (2F	P)) ×	$B(\varUpsilon(2S)\to\ \ell^+\ell^-)$
	DOCUMENT	ID T	ECN	COMMENT
VALUE (units 10^{-5})	DOCOMENT	<u> 10 </u>		
4.4±1.6 OUR AVERAGE				
	³⁵ LEES	14M B	BABR	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$
4.4±1.6 OUR AVERAGE 6.6 ^{+4.9} +2.0 6.6 ^{-4.0} -0.3 4.0±1.7±0.3	³⁵ LEES ³⁶ HEINTZ	14M B	SABR SB2	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ $\Upsilon(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-}$
4.4 \pm 1.6 OUR AVERAGE $6.6^{+4.9}_{-4.0}^{+2.0}_{-0.3}$ $4.0\pm1.7\pm0.3$ 35 From a sample of $\Upsilon(35)$ 36 Calculated by us. HE	35 LEES 36 HEINTZ $^{5)} ightarrow \ \gamma \gamma \mu^+ \mu^-$ with EINTZ 92 quotes B(14 M B 92 C one conver $\varUpsilon(3S)$ $ ightarrow$	BABR SB2 rted ph $\gamma \chi_{b0}$	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ $\Upsilon(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-}$ noton. $\gamma(2P) \times B(\chi_{b0}(2P) \rightarrow \mathcal{B})$
4.4 \pm 1.6 OUR AVERAGE $6.6^{+4.9}_{-4.0} + 2.0$ $6.6^{+4.9}_{-4.0} + 2.0$ $4.0\pm1.7\pm0.3$ 35 From a sample of $\Upsilon(3.5)$ 36 Calculated by us. HE $\gamma \Upsilon(2S)) = (0.28\pm0.3)$	35 LEES 36 HEINTZ $^{5)} ightarrow \gamma \gamma \mu^+ \mu^-$ with EINTZ 92 quotes B($^{12}\pm0.03)\%$ using B(14 M B 92 C one convert $\Upsilon(3S) ightharpoonup (\Upsilon(2S) ightharp$	SABR SSB2 rted ph $\gamma \chi_{b0}$ $\mu^+\mu^-$	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ $\Upsilon(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-}$ noton. $\gamma(2P) \times \beta(\chi_{b0}(2P) \rightarrow \chi_{b0}(2P)) \times \beta(\chi_{b0}(2P) \rightarrow \chi_{b0}(2P)) \times \beta(\chi_{b0}(2P)) \times$
4.4±1.6 OUR AVERAGE $6.6^{+4.9}_{-4.0}^{+2.0}_{-0.3}$ $4.0\pm1.7\pm0.3$ $^{35}_{36}$ From a sample of $\Upsilon(3.5)_{36}^{36}$ Calculated by us. HE $\gamma \Upsilon(2S)) = (0.28 \pm 0.3)_{36}^{36}$ [B($\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S)$	35 LEES 36 HEINTZ 6) $\rightarrow \gamma\gamma\mu^{+}\mu^{-}$ with EINTZ 92 quotes B($^{12} \pm 0.03$)% using B(6)) \times B(7 (3 6) \rightarrow	14 M B 92 C one convert $\Upsilon(3S) ightharpoonup (\Upsilon(2S) ightharp$	SABR SSB2 rted ph $\gamma \chi_{b0}$ $\mu^+\mu^-$	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ $\Upsilon(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-}$ noton. $\gamma(2P) \times \beta(\chi_{b0}(2P) \rightarrow \chi_{b0}(2P)) \times \beta(\chi_{b0}(2P) \rightarrow \chi_{b0}(2P)) \times \beta(\chi_{b0}(2P)) \times$
4.4 \pm 1.6 OUR AVERAGE $6.6^{+4.9}_{-4.0} + 2.0$ $6.6^{+4.9}_{-4.0} + 2.0$ $4.0\pm1.7\pm0.3$ $\frac{35}{36}$ From a sample of $\Upsilon(35,35)$ Calculated by us. HE $\gamma \Upsilon(2S)) = (0.28\pm0.3)$	35 LEES 36 HEINTZ $^{5)} \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ with EINTZ 92 quotes B($^{12} \pm 0.03)\%$ using B($^{5)}$) × B(7 (3S) → $^{7}\chi_{b1}$ (2P))]	14M B 92 C 1 one convert $\Upsilon(3S) ightharpoonup \Upsilon(2S) ightharpoonup \Upsilon(2S) ightharpoonup \Upsilon(2S)$	SABR SSB2 $\gamma \chi_{b0}$ $\mu^+\mu^-$ P))] /	$ \gamma(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-} $ $ \gamma(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-} $ noton. $ \rho(2P)) \times B(\chi_{b0}(2P) \rightarrow \Gamma) = (1.44 \pm 0.10)\%. $ $ \gamma' [B(\chi_{b1}(2P) \rightarrow \Gamma)] $
4.4±1.6 OUR AVERAGE $6.6^{+4.9}_{-4.0} + 2.0$ $6.6^{+4.9}_{-4.0} + 2.0$ $4.0\pm 1.7\pm 0.3$ 35 From a sample of $\Upsilon(35)$ 36 Calculated by us. HE $\gamma \Upsilon(25)) = (0.28 \pm 0.3)$ $\Upsilon(25) \times \Upsilon(25) \times \Upsilon(35) \times \Upsilon($	35 LEES 36 HEINTZ $^{5)} \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ with EINTZ 92 quotes B($^{12} \pm 0.03)\%$ using B($^{5)}$) × B(7 (3S) → $^{7}\chi_{b1}$ (2P))]	14M B 92 C 1 one convert $\Upsilon(3S) ightharpoonup \Upsilon(2S) ightharpoonup \Upsilon(2S) ightharpoonup \Upsilon(2S)$	SABR SSB2 $\gamma \chi_{b0}$ $\mu^+\mu^-$ P))] /	$\Upsilon(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ $\Upsilon(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-}$ noton. $\gamma(2P) \times \beta(\chi_{b0}(2P) \rightarrow 1) = (1.44 \pm 0.10)\%$.
4.4±1.6 OUR AVERAGE $6.6^{+4.9}_{-4.0}^{+2.0}_{-0.3}$ $4.0\pm1.7\pm0.3$ $^{35}_{36}$ From a sample of $\Upsilon(35^{36}_{36})$ Calculated by us. HE $\gamma \Upsilon(2S)) = (0.28 \pm 0.3)$ $\Upsilon(2S) \times \Upsilon(2S) \times \Upsilon(3S) \times \Upsilon$	35 LEES 36 HEINTZ $5) \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ with EINTZ 92 quotes B($12 \pm 0.03)\%$ using B($5)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$ $\frac{DOCUMENT}{37}$ LEES	14M B 92 C 1 one convert $\Upsilon(3S) ightharpoonup (2S) ightharpoonup (2S)$ $\Upsilon(2S) ightharpoonup (2S)$ 14M B	BABR SSB2 $\gamma \chi_{b0}$ $\mu^+\mu^ P))] / SABR$	$ \gamma(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-} $ $ \gamma(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-} $ noton. $ \gamma(2P) \times B(\chi_{b0}(2P) \rightarrow \Gamma) = (1.44 \pm 0.10)\%. $ $ \gamma(B(\chi_{b1}(2P) \rightarrow \Gamma) $ $ \gamma(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-} $
4.4±1.6 OUR AVERAGE $6.6^{+4.9}_{-4.0} + 2.0$ $6.6^{+4.9}_{-4.0} + 2.0$ $4.0\pm1.7\pm0.3$ $^{35}_{36}$ From a sample of $\Upsilon(3S)$ $^{36}_{36}$ Calculated by us. HE $\gamma \Upsilon(2S)) = (0.28 \pm 0.3)$ $[B(\chi_{b0}(2P) \rightarrow \Upsilon(2S)) \times B(\Upsilon(3S) - 2S)$ $^{VALUE}(\%)$ 3.31±0.56	35 LEES 36 HEINTZ $5) \rightarrow \gamma \gamma \mu^{+} \mu^{-}$ with EINTZ 92 quotes B($12 \pm 0.03)\%$ using B($5)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$ $\frac{DOCUMENT}{37}$ LEES	14M B 92 C 1 one convert $\Upsilon(3S) \rightarrow \Upsilon(2S) \rightarrow \Upsilon(2$	BABR SSB2 $\gamma \chi_{b0}$ $\mu^+\mu^ P))] / SABR$	$ \gamma(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-} $ $ \gamma(3S) \rightarrow \gamma \gamma \ell^{+} \ell^{-} $ noton. $ \gamma(2P) \times B(\chi_{b0}(2P) \rightarrow \Gamma) = (1.44 \pm 0.10)\%. $ $ \gamma(B(\chi_{b1}(2P) \rightarrow \Gamma) $ $ \gamma(3S) \rightarrow \gamma \gamma \mu^{+} \mu^{-} $

LEES	14M	PR D90 112010	J.P. Lees et al.	(BABAR Collab.)
LEES	11J	PR D84 072002	J.P. Lees <i>et al.</i>	(BABAR Collab.)
ASNER	08A	PR D78 091103	D.M. Asner et al.	(CLEO Collab.)
BRIERE	80	PR D78 092007	R.A. Briere et al.	(CLEO Collab.)
ARTUSO	05	PRL 94 032001	M. Artuso <i>et al.</i>	(CLEO Collab.)

CRAWFORD	92B	PL B294 139	G. Crawford et al.	(CLEO Collab.)
HEINTZ	92	PR D46 1928	U. Heintz <i>et al.</i>	(CÙSB II Collab.)
HEINTZ	91	PRL 66 1563	U. Heintz <i>et al.</i>	(CUSB Collab.)
MORRISON	91	PRL 67 1696	R.J. Morrison et al.	(CLEO Collab.)
NARAIN	91	PRL 66 3113	M. Narain <i>et al.</i>	(CUSB Collab.)