

$\chi_{b1}(3P)$

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

Observed in the radiative decay to $\Upsilon(1S, 2S, 3S)$, therefore $C = +$.
 J needs confirmation.

$\chi_{b1}(3P)$ MASS

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
10512.1 ± 2.1 ± 0.9	351	¹ AAIJ	14BG LHCB	$pp \rightarrow \gamma \mu^+ \mu^- X$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
10515.7 ^{+2.2+1.5} _{-3.9-2.1}	169	² AAIJ	14BG LHCB	$pp \rightarrow \gamma \mu^+ \mu^- X$
10511.3 ± 1.7 ± 2.5	182	³ AAIJ	14BI LHCB	$pp \rightarrow \gamma \mu^+ \mu^- X$
10530 ± 5 ± 9		⁴ AAD	12A ATLS	$pp \rightarrow \gamma \mu^+ \mu^- X$
10551 ± 14 ± 17		⁴ ABAZOV	12Q D0	$p\bar{p} \rightarrow \gamma \mu^+ \mu^- X$

¹ The mass of the $\chi_{b1}(3P)$ state obtained by combining the results of AAIJ 14BG with that of AAIJ 14BI. The first uncertainty is experimental and the second attributable to the unknown mass splitting, assumed to be $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$ MeV.

² From $\chi_{b1}(3P) \rightarrow \Upsilon(1S, 2S)\gamma$ transitions assuming $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$ MeV and allowing for $\pm 30\%$ variation in the $\chi_{b2}(3P)$ production rate relative to that of $\chi_{b1}(3P)$.

³ From $\chi_{b1}(3P) \rightarrow \Upsilon(3S)\gamma$ transition assuming $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$ MeV.

⁴ The mass barycenter of the merged lineshapes from the $J = 1$ and 2 states.

$\chi_{b1}(3P)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $\Upsilon(1S)\gamma$	seen
Γ_2 $\Upsilon(2S)\gamma$	seen
Γ_3 $\Upsilon(3S)\gamma$	seen

$\chi_{b1}(3P)$ BRANCHING RATIOS

<u>$\Gamma(\Upsilon(1S)\gamma)/\Gamma_{\text{total}}$</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>Γ_1/Γ</u>
seen	169	⁵ AAIJ	14BG LHCB	$pp \rightarrow \gamma \mu^+ \mu^- X$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
seen		AAD	12A ATLS	$pp \rightarrow \gamma \mu^+ \mu^- X$	
seen		ABAZOV	12Q D0	$p\bar{p} \rightarrow \gamma \mu^+ \mu^- X$	

⁵ From $\chi_{b1}(3P) \rightarrow \Upsilon(1S, 2S)\gamma$ transitions assuming $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$ MeV and allowing for $\pm 30\%$ variation in the $\chi_{b2}(3P)$ production rate relative to that of $\chi_{b1}(3P)$.

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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seen	169	⁶ AAIJ	14BG LHCB	$pp \rightarrow \gamma\mu^+\mu^-X$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

seen		AAD	12A ATLS	$pp \rightarrow \gamma\mu^+\mu^-X$
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⁶ From $\chi_{b1}(3P) \rightarrow \Upsilon(1S, 2S)\gamma$ transitions assuming $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$ MeV and allowing for $\pm 30\%$ variation in the $\chi_{b2}(3P)$ production rate relative to that of $\chi_{b1}(3P)$.

$\Gamma(\Upsilon(3S)\gamma)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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seen	182	AAIJ	14BI LHCB	$pp \rightarrow \gamma\mu^+\mu^-X$
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$\chi_{b1}(3P)$ REFERENCES

AAIJ	14BG	JHEP 1410 088	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	14BI	EPJ C74 3092	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAD	12A	PRL 108 152001	G. Aad <i>et al.</i>	(ATLAS Collab.)
ABAZOV	12Q	PR D86 031103	V.M. Abazov <i>et al.</i>	(D0 Collab.)