NODE=M206

$\chi_{b1}(3P)$

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

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

NODE=M206

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

NODE=M206M

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
10513.42± 0.41± 0.53		[1] SIRUNYAN	18N	CMS	$pp \to \gamma\mu^+\mu^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$10515.7 \; {}^{+\,2.2}_{-\,3.9} \pm {}^{+\,1.5}_{-\,2.1}$	169	[2] AAIJ	14BG	LHCB	$pp \to \gamma\mu^+\mu^- X$
10512.1 ± 2.1 ± 0.9	351	[3] AAIJ	14BG	LHCB	$pp \to \gamma\mu^+\mu^- X$
10511.3 ± 1.7 ± 2.5	182	[4] AAIJ	14BI	LHCB	$pp \to \gamma\mu^+\mu^- X$
10530 ± 5 ± 9		[5] AAD	12A	ATLS	$pp \to \gamma\mu^+\mu^- X$
10551 ±14 ±17		[5] ABAZOV	12Q	D0	$p\overline{p} \to \gamma\mu^+\mu^- X$

NODE=M206M

NODE=M206M

OCCUR=2

[1] Systematic error includes an additional 0.5 MeV for the uncertainty on the $\Upsilon(3S)$ mass. Also measures $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.60 \pm 0.64 \pm 0.17$ MeV. A total of 372 $\chi_{b1}(3P)$ and $\chi_{b2}(3P)$ events was observed.

NODE=M206M;LINKAGE=D

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

NODE=M206M;LINKAGE=A

[3] 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.

NODE=M206M;LINKAGE=B

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

NODE=M206M;LINKAGE=C

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

NODE=M206M;LINKAGE=AA

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

NODE=M206215;NODE=M206

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

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

NODE=M206225

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

NODE=M206R01
NODE=M206R01

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	169	[1] AAIJ	14BG	LHCB	$pp \to \gamma\mu^+\mu^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen		AAD	12A	ATLS	$pp \to \gamma\mu^+\mu^- X$
seen		ABAZOV	12Q	D0	$p\overline{p} \to \gamma\mu^+\mu^- X$

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

NODE=M206R01;LINKAGE=A

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

NODE=M206R02
NODE=M206R02

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	169	[1] AAIJ	14BG	LHCB	$pp \to \gamma\mu^+\mu^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen		AAD	12A	ATLS	$pp \to \gamma\mu^+\mu^- X$

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

NODE=M206R02;LINKAGE=A

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

NODE=M206R03
NODE=M206R03

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen		SIRUNYAN	18N	CMS	$pp \to \gamma\mu^+\mu^- X$
seen	182	AAIJ	14BI	LHCB	$pp \to \gamma\mu^+\mu^- X$

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

NODE=M206

SIRUNYAN	18N	PRL 121 092002	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=58873
AAIJ	14BG	JHEP 1410 088	R. Aaij *et al.*	(LHCb Collab.)	REFID=56199
AAIJ	14BI	EPJ C74 3092	R. Aaij *et al.*	(LHCb Collab.)	REFID=56235
AAD	12A	PRL 108 152001	G. Aad *et al.*	(ATLAS Collab.)	REFID=54037
ABAZOV	12Q	PR D86 031103	V.M. Abazov *et al.*	(D0 Collab.)	REFID=54264