NODE=M195

$T_{c\bar{c}1}(4430)^+$

$I^G(J^{PC}) = 1^+(1^{+-})$
G, C need confirmation.

was $Z_c(4430)$, $X(4430)^\pm$

Properties incompatible with a $q\bar{q}$ structure (exotic state). See the review on non-$q\bar{q}$ states. NODE=M195

First seen by CHOI 08 in $B \to K\pi^+\psi(2S)$ decays, confirmed by AAIJ 14AG, and confirmed in a model-independent way by AAIJ 15BH. Also seen by CHILIKIN 14 in $B \to K^+\pi J/\psi$ decays. J^P was determined by CHILIKIN 13 and AAIJ 14AG.

$T_{c\bar{c}1}(4430)^+$ MASS

NODE=M195M

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
4478^{+15}_{-18} OUR AVERAGE				
$4475 \pm 7^{+15}_{-25}$	[1] AAIJ	14AG	LHCB	$\overline{B}^0 \to K^-\pi^+\psi(2S)$
$4485 \pm 22^{+28}_{-11}$	[1] CHILIKIN	13	BELL	$B^0 \to K^+\pi^-\psi(2S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4443^{+15+19}_{-12-13}	[2] MIZUK	09	BELL	$B \to K\pi^+\psi(2S)$
$4433 \pm 4 \pm 2$	[3] CHOI	08	BELL	$B \to K\pi^+\psi(2S)$

[1] From a four-dimensional amplitude analysis. NODE=M195M;LINKAGE=A
[2] From a Dalitz plot analysis. Superseded by CHILIKIN 13. NODE=M195M;LINKAGE=MI
[3] Superseded by MIZUK 09 and CHILIKIN 13. NODE=M195M;LINKAGE=CH

$T_{c\bar{c}1}(4430)^+$ WIDTH

NODE=M195W

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
181 ± 31 OUR AVERAGE				
$172 \pm 13^{+37}_{-34}$	[1] AAIJ	14AG	LHCB	$\overline{B}^0 \to K^-\pi^+\psi(2S)$
200^{+41+26}_{-46-35}	[1] CHILIKIN	13	BELL	$B^0 \to K^+\pi^-\psi(2S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
107^{+86+74}_{-43-56}	[2] MIZUK	09	BELL	$B \to K\pi^+\psi(2S)$
45^{+18+30}_{-13-13}	[3] CHOI	08	BELL	$B \to K\pi^+\psi(2S)$

[1] From a four-dimensional amplitude analysis. NODE=M195W;LINKAGE=A
[2] From a Dalitz plot analysis. Superseded by CHILIKIN 13. NODE=M195W;LINKAGE=MI
[3] Superseded by MIZUK 09 and CHILIKIN 13. NODE=M195W;LINKAGE=CH

$T_{c\bar{c}1}(4430)^+$ DECAY MODES

NODE=M195215;NODE=M195

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$\pi^+\psi(2S)$	seen	DESIG=1
Γ_2	$\pi^+ J/\psi$	seen	DESIG=2

$T_{c\bar{c}1}(4430)^+$ BRANCHING RATIOS

NODE=M195225

$\Gamma(\pi^+\psi(2S))/\Gamma_{total}$ **Γ_1/Γ** NODE=M195R01

VALUE	DOCUMENT ID		TECN	COMMENT	NODE=M195R01
seen	[1] AAIJ	14AG	LHCB	$\overline{B}^0 \to K^-\pi^+\psi(2S)$	
seen	[2] CHILIKIN	13	BELL	$B^0 \to K^+\pi^-\psi(2S)$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
not seen	[3] AUBERT	09AA	BABR	$B \to K\pi^+\psi(2S)$	
seen	[4] MIZUK	09	BELL	$B \to K\pi^+\psi(2S)$	

[1] From a four-dimensional amplitude analysis. No product of branching fractions quoted. NODE=M195R01;LINKAGE=AA

[2] From a four-dimensional amplitude analysis. Measured a product of branching fractions $B(B^0 \to T_{c\bar{c}1}(4430)^- K^+) \times B(T_{c\bar{c}1}(4430)^- \to \psi(2S)\pi^-) = (6.0^{+1.7}_{-2.0}{}^{+2.5}_{-1.4}) \times 10^{-5}$. NODE=M195R01;LINKAGE=A

[3] AUBERT 09AA quotes $B(B^+ \to \overline{K}^0 T_{c\bar{c}1}(4430)^+) \times B(T_{c\bar{c}1}(4430)^+ \to \pi^+ \psi(2S)) < 4.7 \times 10^{-5}$ and $B(\overline{B}^0 \to K^- T_{c\bar{c}1}(4430)^+) \times B(T_{c\bar{c}1}(4430)^+ \to \pi^+ \psi(2S)) < 3.1 \times 10^{-5}$ at 95% CL. NODE=M195R01;LINKAGE=AU

[4] Measured a product of branching fractions $B(\overline{B}^0 \to K^- T_{c\bar{c}1}(4430)^+) \times B(T_{c\bar{c}1}(4430)^+ \to \pi^+ \psi(2S)) = (3.2^{+1.8}_{-0.9}{}^{+5.3}_{-1.6}) \times 10^{-5}$. Superseded by CHILIKIN 13. NODE=M195R01;LINKAGE=MI

$\Gamma(\pi^+ J/\psi)/\Gamma_{\text{total}}$ Γ_2/Γ

NODE=M195R02

NODE=M195R02

VALUE	DOCUMENT ID		TECN	COMMENT
seen	[1,2] CHILIKIN	14	BELL	$\overline{B}^0 \to K^- \pi^+ J/\psi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	[3] AUBERT	09AA	BABR	$B \to K \pi^+ J/\psi$

[1] CHILIKIN 14 reports $B(\overline{B}^0 \to T_{c\bar{c}1}(4430)^+ K^-) \times B(T_{c\bar{c}1}(4430)^+ \to J/\psi\pi^+) = (5.4^{+4.0}_{-1.0}{}^{+1.1}_{-0.9}) \times 10^{-6}$. NODE=M195R02;LINKAGE=A

[2] A broad enhancement seen by AAIJ 19R in the decays $B^0 \to J/\psi\pi^+ K^-$ at 4600 MeV can be due to an interplay of $T_{c\bar{c}1}(4430)$, $T_{c\bar{c}1}(4200)$ and the fitting polynomials. NODE=M195R02;LINKAGE=E

[3] AUBERT 09AA quotes $B(B^+ \to \overline{K}^0 T_{c\bar{c}1}(4430)^+) \times B(T_{c\bar{c}1}(4430)^+ \to \pi^+ J/\psi) < 1.5 \times 10^{-5}$ and $B(\overline{B}^0 \to K^- T_{c\bar{c}1}(4430)^+) \times B(T_{c\bar{c}1}(4430)^+ \to \pi^+ J/\psi) < 0.4 \times 10^{-5}$ at 95% CL. NODE=M195R02;LINKAGE=AU

$T_{c\bar{c}1}(4430)^+$ REFERENCES

NODE=M195

AAIJ	19R	PRL 122 152002	R. Aaij *et al.*	(LHCb Collab.)	REFID=59776
AAIJ	15BH	PR D92 112009	R. Aaij *et al.*	(LHCb Collab.)	REFID=57110
AAIJ	14AG	PRL 112 222002	R. Aaij *et al.*	(LHCb Collab.) JP	REFID=55896
CHILIKIN	14	PR D90 112009	K. Chilikin *et al.*	(BELLE Collab.)	REFID=56344
CHILIKIN	13	PR D88 074026	K. Chilikin *et al.*	(BELLE Collab.) JP	REFID=55551
AUBERT	09AA	PR D79 112001	B. Aubert *et al.*	(BABAR Collab.)	REFID=52940
MIZUK	09	PR D80 031104	R. Mizuk *et al.*	(BELLE Collab.)	REFID=52960
CHOI	08	PRL 100 142001	S.-K. Choi *et al.*	(BELLE Collab.)	REFID=52178