

**$Z_c(4430)$** 

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

$G, C$  need confirmation.

was  $X(4430)^\pm$ 

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

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

 **$Z_c(4430)$  MASS**

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

<sup>1</sup> From a four-dimensional amplitude analysis.<sup>2</sup> From a Dalitz plot analysis. Superseded by CHILIKIN 13.<sup>3</sup> Superseded by MIZUK 09 and CHILIKIN 13. **$Z_c(4430)$  WIDTH**

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

<sup>1</sup> From a four-dimensional amplitude analysis.<sup>2</sup> From a Dalitz plot analysis. Superseded by CHILIKIN 13.<sup>3</sup> Superseded by MIZUK 09 and CHILIKIN 13.

**Z<sub>c</sub>(4430) DECAY MODES**

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $\pi^+ \psi(2S)$	seen
$\Gamma_2$ $\pi^+ J/\psi$	seen

**Z<sub>c</sub>(4430) BRANCHING RATIOS**

$\Gamma(\pi^+ \psi(2S))/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>seen</b>	<sup>1</sup> AAIJ	14AG LHCB	$B^0 \rightarrow K^+ \pi^- \psi(2S)$
<b>seen</b>	<sup>2</sup> CHILIKIN	13 BELL	$B^0 \rightarrow K^+ \pi^- \psi(2S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
not seen	<sup>3</sup> AUBERT	09AA BABR	$B \rightarrow K \pi^+ \psi(2S)$
seen	<sup>4</sup> MIZUK	09 BELL	$B \rightarrow K \pi^+ \psi(2S)$

<sup>1</sup> From a four-dimensional amplitude analysis. No product of branching fractions quoted.

<sup>2</sup> From a four-dimensional amplitude analysis. Measured a product of branching fractions  $B(B^0 \rightarrow Z_c(4430)^- K^+) \times B(Z_c(4430)^- \rightarrow \psi(2S) \pi^-) = (6.0^{+1.7+2.5}_{-2.0-1.4}) \times 10^{-5}$ .

<sup>3</sup> AUBERT 09AA quotes  $B(B^+ \rightarrow \bar{K}^0 Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+ \psi(2S)) < 4.7 \times 10^{-5}$  and  $B(\bar{B}^0 \rightarrow K^- Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+ \psi(2S)) < 3.1 \times 10^{-5}$  at 95% CL.

<sup>4</sup> Measured a product of branching fractions  $B(\bar{B}^0 \rightarrow K^- Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+ \psi(2S)) = (3.2^{+1.8+5.3}_{-0.9-1.6}) \times 10^{-5}$ . Superseded by CHILIKIN 13.

$\Gamma(\pi^+ J/\psi)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>seen</b>	<sup>1,2</sup> CHILIKIN	14 BELL	$\bar{B}^0 \rightarrow K^- \pi^+ J/\psi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
not seen	<sup>3</sup> AUBERT	09AA BABR	$B \rightarrow K \pi^+ J/\psi$

<sup>1</sup> CHILIKIN 14 reports  $B(\bar{B}^0 \rightarrow Z_c(4430)^+ K^-) \times B(Z_c(4430)^+ \rightarrow J/\psi \pi^+) = (5.4^{+4.0+1.1}_{-1.0-0.9}) \times 10^{-6}$ .

<sup>2</sup> A broad enhancement seen by AAIJ 19R in the decays  $B^0 \rightarrow J/\psi \pi^+ K^-$  at 4600 MeV can be due to an interplay of  $Z_c(4430)$ ,  $Z_c(4200)$  and the fitting polynomials.

<sup>3</sup> AUBERT 09AA quotes  $B(B^+ \rightarrow \bar{K}^0 Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+ J/\psi) < 1.5 \times 10^{-5}$  and  $B(\bar{B}^0 \rightarrow K^- Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+ J/\psi) < 0.4 \times 10^{-5}$  at 95% CL.

**Z<sub>c</sub>(4430) REFERENCES**

AAIJ	19R	PRL 122 152002	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	15BH	PR D92 112009	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	14AG	PRL 112 222002	R. Aaij <i>et al.</i>	(LHCb Collab.) JP
CHILIKIN	14	PR D90 112009	K. Chilikin <i>et al.</i>	(BELLE Collab.)
CHILIKIN	13	PR D88 074026	K. Chilikin <i>et al.</i>	(BELLE Collab.) JP
AUBERT	09AA	PR D79 112001	B. Aubert <i>et al.</i>	(BABAR Collab.)
MIZUK	09	PR D80 031104	R. Mizuk <i>et al.</i>	(BELLE Collab.)
CHOI	08	PRL 100 142001	S.-K. Choi <i>et al.</i>	(BELLE Collab.)