

$P_{c\bar{c}}(4457)^+$

$I(J^P) = \frac{1}{2}(??)$ Status: *

OMITTED FROM SUMMARY TABLE
was $P_c(4450)$

A resonance seen in $\Lambda_b^0 \rightarrow P_c^+ K^-$, then $P_c \rightarrow J/\psi p$, with a significance of 12 standard deviations. The $J/\psi p$ quark content is $uudc\bar{c}$, a pentaquark. See also the $P_{c\bar{c}}(4380)^+$. In the best amplitude fit, the two states have opposite parity, one having $J = 3/2$, the other $J = 5/2$.

Extraction of the pentaquark signals requires some understanding of the dominant $K^- p$ background. AAIJ 15P used a model-dependent approach. AAIJ 16AG reanalyzed the data making minimal assumptions about the $K^- p$ background, and thus confirmed the strong significance of the pentaquark signals.

$P_{c\bar{c}}(4457)^+$ MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
$4457.3 \pm 0.6^{+4.1}_{-1.7}$	AAIJ	19W	LHCB pp at 7, 8, 13 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$4449.8 \pm 1.7 \pm 2.5$	¹ AAIJ	15P	LHCB Repl. by AAIJ 19W
¹ Considering $P_{c\bar{c}}(4440)$ and $P_{c\bar{c}}(4457)$ as a single resonance.			

$P_{c\bar{c}}(4457)^+$ WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
$6.4 \pm 2.0^{+5.7}_{-1.9}$	AAIJ	19W	LHCB pp at 7, 8, 13 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$39 \pm 5 \pm 19$	¹ AAIJ	15P	LHCB Repl. by AAIJ 19W
¹ Considering $P_{c\bar{c}}(4440)$ and $P_{c\bar{c}}(4457)$ as a single resonance.			

$P_{c\bar{c}}(4457)^+$ DECAY MODES

Mode	Fraction (Γ_i/Γ)
$\Gamma_1 \quad J/\psi p$	seen
$\Gamma_2 \quad \Lambda_c^+ \bar{D}^0$	not seen
$\Gamma_3 \quad \Lambda_c^+ \pi^+ D^-$	not seen
$\Gamma_4 \quad \Sigma_c(2455)^{++} D^-$	not seen
$\Gamma_5 \quad \Sigma_c(2520)^{++} D^-$	not seen
$\Gamma_6 \quad \bar{\Lambda}_c^- \pi^+ D^+$	[a] not seen
$\Gamma_7 \quad \bar{\Sigma}_c(2455)^0 D^+$	[a] not seen

Γ_8	$\bar{\Sigma}_c(2520)^0 D^+$	[a] not seen
Γ_9	$\Lambda_c^+ \pi^+ D^{*-}$	not seen
Γ_{10}	$\bar{\Lambda}_c^- \pi^+ D^{*+}$	[a] not seen

[a] Searched for the charge conjugate mode from $\bar{P}_{c\bar{c}}^-$ decays.

$P_{c\bar{c}}(4457)^+$ BRANCHING RATIOS

$\Gamma(J/\psi p)/\Gamma_{\text{total}}$				Γ_1/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
seen	¹ POPOV	21	D0	$p\bar{p}$ at 1.96 TeV
seen	AAIJ	19W	LHCB	pp at 7, 8, 13 TeV
seen	AAIJ	15P	LHCB	pp at 7, 8 TeV

¹ Search for J/ψ inclusive production in association with a charged particle, assumed to be a proton. POPOV 21 observes a resonant signal consistent with a superposition of the $P_{c\bar{c}}(4440)^+$ and $P_{c\bar{c}}(4457)^+$, using masses and widths measured by AAIJ 19W, at significance of 3σ .

$\Gamma(\Lambda_c^+ \bar{D}^0)/\Gamma_{\text{total}}$				Γ_2/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	AAIJ	24Z	LHCB	pp , 5.7 fb^{-1} at 13 TeV

$\Gamma(\Lambda_c^+ \pi^+ D^-)/\Gamma_{\text{total}}$				Γ_3/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	AAIJ	24Z	LHCB	pp , 5.7 fb^{-1} at 13 TeV

$\Gamma(\Sigma_c(2455)^{++} D^-)/\Gamma_{\text{total}}$				Γ_4/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	AAIJ	24Z	LHCB	pp , 5.7 fb^{-1} at 13 TeV

$\Gamma(\Sigma_c(2520)^{++} D^-)/\Gamma_{\text{total}}$				Γ_5/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	AAIJ	24Z	LHCB	pp , 5.7 fb^{-1} at 13 TeV

$\Gamma(\bar{\Lambda}_c^- \pi^+ D^+)/\Gamma_{\text{total}}$				Γ_6/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	AAIJ	24Z	LHCB	$\bar{P}_{c\bar{c}}^- \rightarrow \Lambda_c^+ \pi^- D^-$

$\Gamma(\bar{\Sigma}_c(2455)^0 D^+)/\Gamma_{\text{total}}$				Γ_7/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	AAIJ	24Z	LHCB	$\bar{P}_{c\bar{c}}^- \rightarrow \Sigma_c(2455)^0 D^-$

$\Gamma(\bar{\Sigma}_c(2520)^0 D^+)/\Gamma_{\text{total}}$				Γ_8/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	AAIJ	24Z	LHCB	$\bar{P}_{c\bar{c}}^- \rightarrow \Sigma_c(2520)^0 D^-$

$\Gamma(\Lambda_c^+ \pi^+ D^{*-})/\Gamma_{\text{total}}$				Γ_9/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	AAIJ	24Z	LHCB	pp , 5.7 fb^{-1} at 13 TeV

$\Gamma(\bar{\Lambda}_c^- \pi^+ D^{*+})/\Gamma_{\text{total}}$					Γ_{10}/Γ
VALUE	DOCUMENT ID	TECN	COMMENT		
not seen	AAIJ	24Z	LHCB	$\bar{P}_{c\bar{c}}^- \rightarrow \Lambda_c^+ \pi^- D^{*-}$	

$P_{c\bar{c}}(4457)^+$ REFERENCES

AAIJ	24Z	PR D110 032001	R. Aaij <i>et al.</i>	(LHCb Collab.)
POPOV	21	PAN 83 1383	A.V. Popov <i>et al.</i>	(D0 Collab.)
AAIJ	19W	PRL 122 222001	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	16AG	PRL 117 082002	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	15P	PRL 115 072001	R. Aaij <i>et al.</i>	(LHCb Collab.)