STUDY OF THE $B_c \to J/\psi\, D_s$ AND $B_c \to J/\psi\, D_s^*$ DECAYS WITH THE ATLAS DETECTOR

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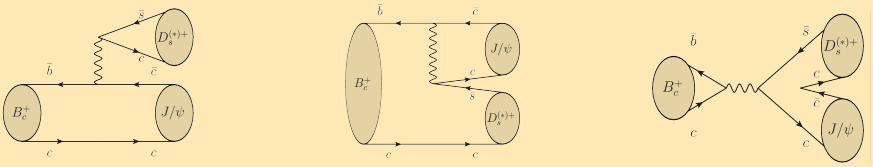
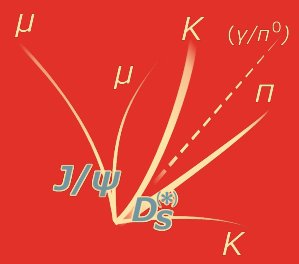
INTRODUCTION

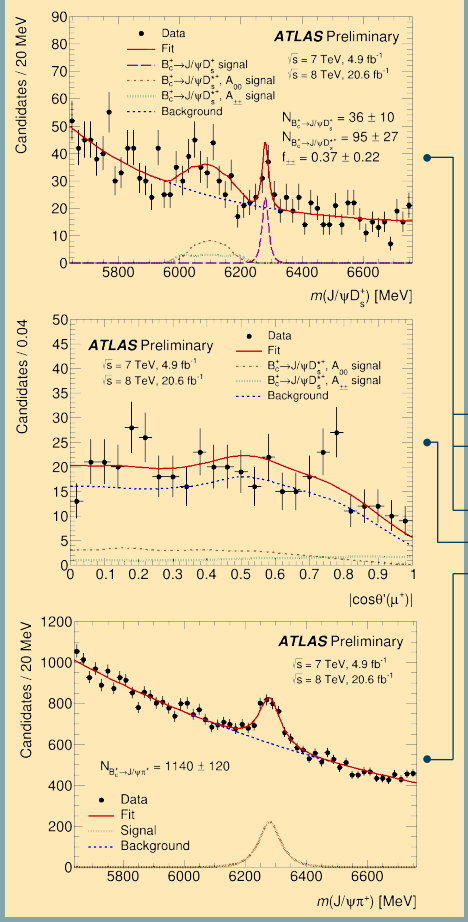
The B_c meson is the only known weakly decaying particle consisting of two heavy quarks. Their presence affects calculations of decay properties. The decays $B_c \to J/\psi\, D_s$ and $B_c \to J/\psi\, D_s^*$ provide means to test numerous theoretical predictions.



Feynman diagrams for coulor favoured, coulor suppressed and colour annihilation topologies



- $B_c \to J/\psi(\mu\mu)\, D_s[\phi(KK)\, \pi]$
- $B_c \to J/\psi(\mu\mu)\, D_s^*(D_s\, \gamma/\pi^0)$, γ/π^0 not reconstructed
- Spin: $J/\psi(1)$, $D_s(0)$, $D_s^*(1)$



ANALYSIS PROCEDURE

MEASURED PARAMETERS

- Relative branching fractions

$$B_{D_s} / B_\pi = B(B_c \to J/\psi D_s) / B(B_c \to J/\psi \pi)$$
$$B_{D_s^*} / B_\pi = B(B_c \to J/\psi D_s^*) / B(B_c \to J/\psi \pi)$$
$$B_{D_s^*} / B_{D_s} = B(B_c \to J/\psi D_s^*) / B(B_c \to J/\psi D_s)$$

- Fraction of transverse polarization

$$\Gamma_{\pm\pm} / \Gamma = \Gamma_{\pm\pm}(B_c \to J/\psi D_s^*) / \Gamma(B_c \to J/\psi D_s^*)$$

FIT TO THE INVARIANT MASS AND HELICITY ANGLE DISTRIBUTIONS

$J/\psi D_s$ narrow mass peak	modified gaussian
$J/\psi D_s^*$ broad mass peak	MC templates for $\lvert A_{\pm\pm}\rvert^2$ and $\lvert A_{00}\rvert^2$ components
Mass background distribution	exponential function
Helicity angle $\lvert\cos(\theta^*)\rvert$ distribution	MC and sideband data templates
Reference $B_c \to J/\psi\, \pi$ mass plot	modified gaussian + exponential

PARAMETERS EXTRACTION

$$\mathcal{R}_{D_s^{(*)+}/\pi^+} = \frac{\mathcal{B}_{B_c^+ \to J/\psi D_s^{(*)+}}}{\mathcal{B}_{B_c^+ \to J/\psi \pi^+}} = \frac{1}{\mathcal{B}_{D_s^+ \to \phi(K^+K^-)\pi^+}} \times \frac{\mathcal{A}_{B_c^+ \to J/\psi \pi^+}}{\mathcal{A}_{B_c^+ \to J/\psi D_s^{(*)+}}} \times \frac{N_{B_c^+ \to J/\psi D_s^{(*)+}}}{N_{B_c^+ \to J/\psi \pi^+}}$$

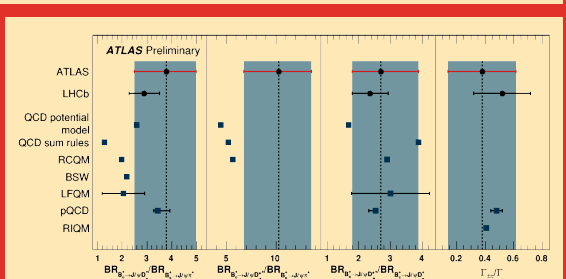
Number of decays $N[B_c \to J/\psi\, D_s^{(*)}]$ and $N(B_c \to J/\psi\, \pi)$	max. likelihood fit
Branching fraction $B[D_s \to \phi(KK)\pi]$	CLEO*
Acceptances $A(B_c \to J/\psi\, D_s)$ and $A(B_c \to J/\psi\, \pi)$	MC simulation

* Phys. Rev. Lett. 100 (2008) 161804

RESULTS & CONCLUSIONS

$$B_{D_s} / B_\pi = 3.8 \pm 1.1\,(\text{stat.})\, ^{+0.2}_{-0.6}\,(\text{syst.}) \pm 0.2\,(\text{BF})$$
$$B_{D_s^*} / B_\pi = 10.3 \pm 3.1\,(\text{stat.})\, ^{+0.8}_{-1.5}\,(\text{syst.}) \pm 0.6\,(\text{BF})$$
$$B_{D_s^*} / B_{D_s} = 2.7\, ^{+1.1}_{-0.8}\,(\text{stat.})\, ^{+0.4}_{-0.3}\,(\text{syst.})$$
$$\Gamma_{\pm\pm} / \Gamma = 0.38 \pm 0.23\,(\text{stat.})\, ^{+0.06}_{-0.07}\,(\text{syst.})$$

The polarisation is found to be well described by the available theoretical approaches. The measured ratios of the branching fraction are generally well described by perturbative QCD, sum rules and relativistic quark models. The measurement results agree with those published by the LHCb experiment.



LHCb	Phys. Rev. D 87 (2013) 112012
QCD potential model	Phys. Rev. D 61 (2000) 034012
QCD sum rules	arXiv: hep-ph/0211021
RCQM	Phys. Rev. D 73 (2006) 054024
BSW	Phys. Rev. D 79 (2009) 034004
LFQM	Phys. Rev. D 89 (2014) 017501
pQCD	Phys. Rev. D 90 (2014) 114030
RIQM	Phys. Rev. D 88 (2013) 094014

ATLAS Experiment