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Searches for Λ^0_b and Ξ^0_b decays to $K^0_S p\pi^-$ and $K^0_S pK^-$ final states at LHCb

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Rafael Silva Coutinho

On behalf of the LHCb Collaboration

THE UNIVERSITY OF WARWICK

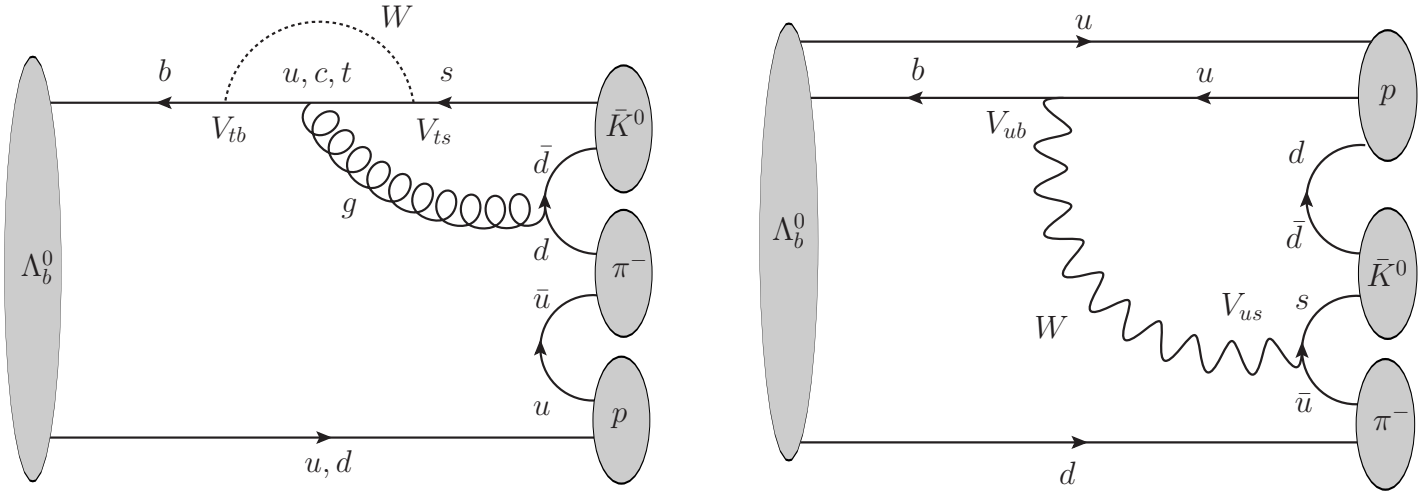
erc European Research Council

LHCb

Charmless three body b-baryon decays

The study of b-baryon decays is still at an early stage (where LHCb has been taking the lead). Among the possible ground states with spin-parity $J^P = ½^+$, no hadronic three-body decay to a charmless final state had been observed.

- Conservation of baryon number allows *CP* violation searches without the need to identify the flavour of the initial state.
- Search for direct *CP* violation in baryonic decays (no mixing).
- Dalitz plot analyses provide more sensitivity to *CP* violation observables.
- Searches for Λ^0_b decays also consider the Ξ^0_b mass region.



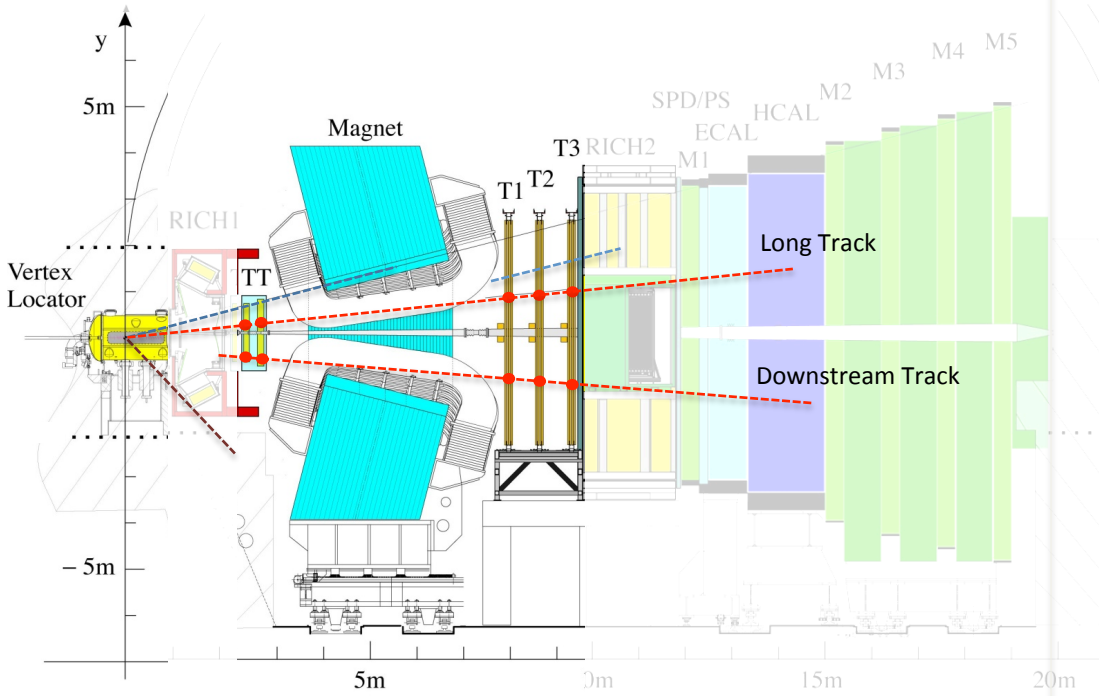
Analysis strategy for $\Lambda^0_b(\Xi^0_b)$ decays

Searches for the unobserved decays $\Lambda^0_b(\Xi^0_b) \to K^0_S p\pi^-$ and $\Lambda^0_b(\Xi^0_b) \to K^0_S pK^-$ with respect to the $B^0 \to K^0_S\pi^+\pi^-$ decay (BF measurement), with the data collected by LHCb during 2011 – 1fb^{-1}.

- Decays reconstructed in two K^0_S categories – Downstream and Long Tracks.
- Multivariate boosted decision tree and PID selection trained for each K^0_S type, and optimised by (blind analysis):

$$\mathrm{FoM} = \frac{\epsilon_{\mathrm{sig}}}{(3/2 + \sqrt{B})}$$

- Separate charmless decays from those via $\Lambda^+_c \to K^0_S p$ and $D^-_s \to K^0_S K$.
- Dynamical structure of Dalitz plot is accounted for to correct the non-uniform ε_{sig} over the phase space.



$\Lambda^0_b(\Xi^0_b) \to K^0_S p h^-$ results

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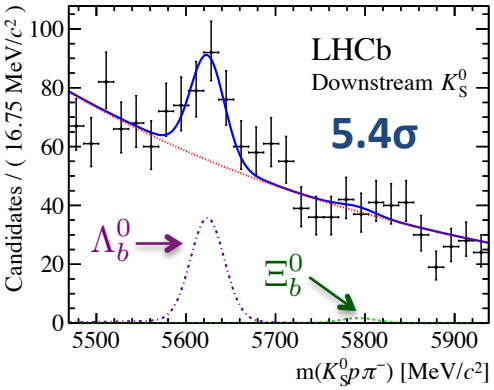
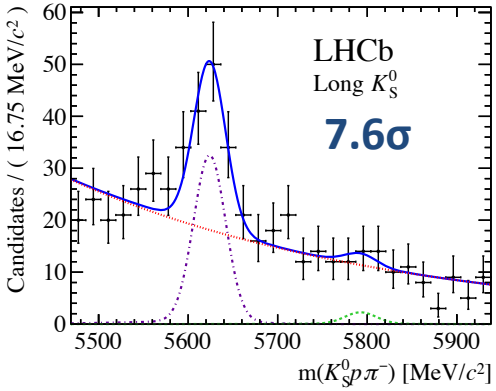
$\mathcal{B}(\Lambda_b^0 \to \overline{K}^0 p\pi^-) = (1.26 \pm 0.19 \pm 0.09 \pm 0.34 \pm 0.05) \times 10^{-5}$

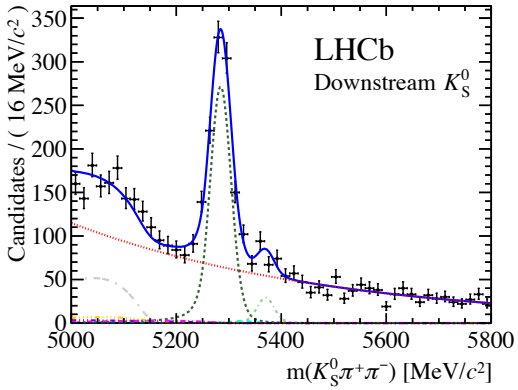
$\Lambda^0_b(\Xi^0_b) \to K^0_S p\pi^-$





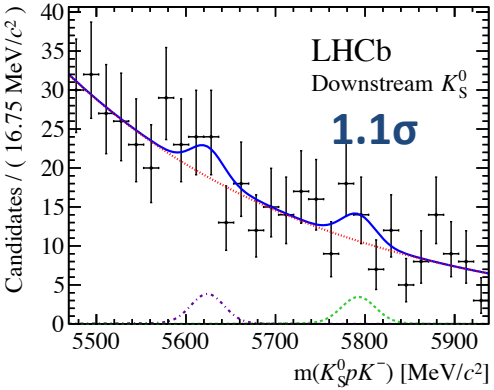
First observation!

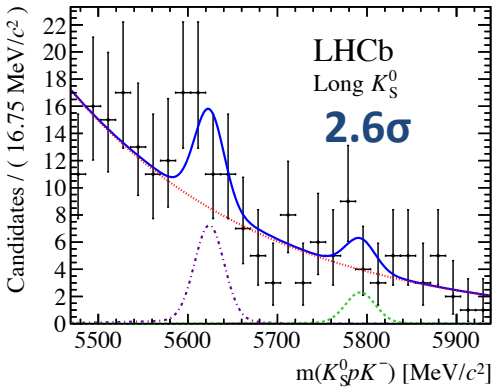
$B^0 \to K^0_S \pi^+ \pi^-$

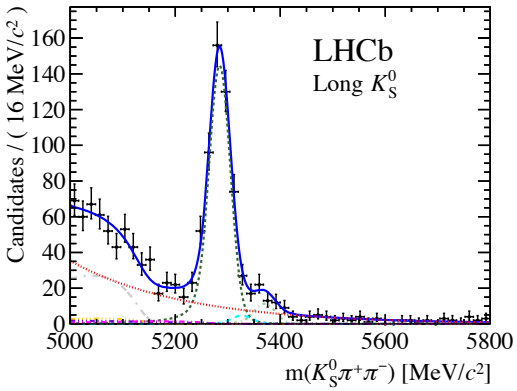


$\mathcal{B}(\Lambda_b^0 \to K^0 p K^-) < 3.5\ (4.0) \times 10^{-6}$ at 90 % (95 %) CL

$\Lambda^0_b(\Xi^0_b) \to K^0_S p K^-$







$\Lambda^0_b(\Xi^0_b)$ decays to $\Lambda^0_c h^-$ and $D^-_s p$ final states

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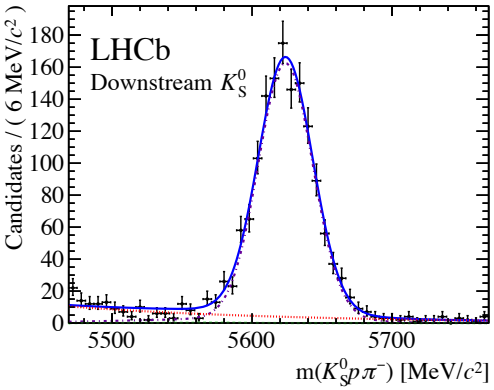
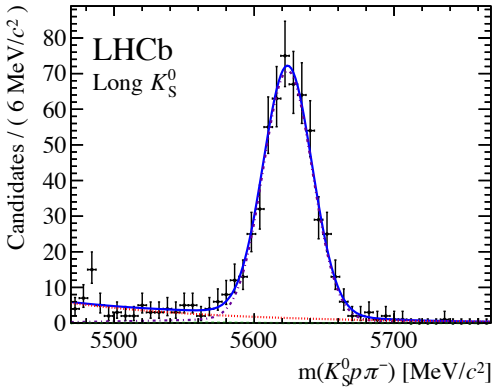
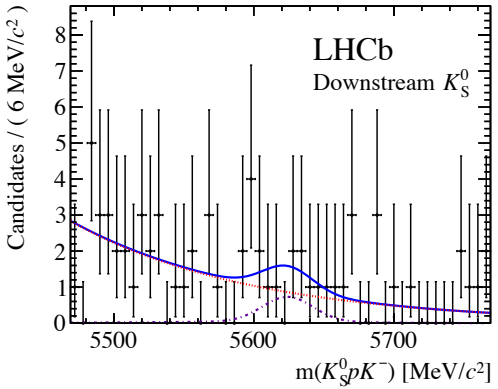
$\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+ \pi^-) = (5.97 \pm 0.28 \pm 0.34 \pm 0.70 \pm 0.24) \times 10^{-3}$

$\mathcal{B}(\Lambda_b^0 \to D_s^- p) < 4.8 \times 10^{-4}$ at 90 % CL

$\Lambda_b^0 \to \Lambda_c^+ [pK_S^0]\pi^-$



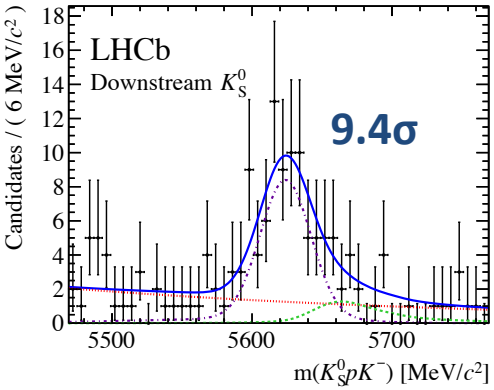


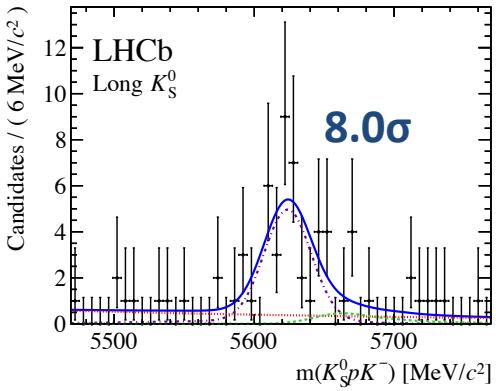


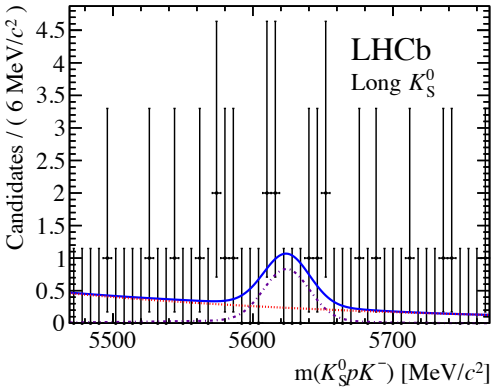
$\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+ K^-) = (3.55 \pm 0.44 \pm 0.24 \pm 0.41 \pm 0.14) \times 10^{-4}$

$\Lambda_b^0 \to D_s^- [K_S^0 K^-] p$

$\Lambda_b^0 \to \Lambda_c^+ [pK_S^0] K^-$







$\Lambda^0_b \to K^0_S p\pi$ A^{CP} measurement

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The significant signal observed for the $\Lambda^0_b \to K_S p\pi^-$ channel allows a measurement of its phase-space integrated *CP* asymmetry, which may be determined from the raw asymmetry :

$$\mathcal{A}_{CP}^{\rm RAW} = \frac{N_{\bar{f}} - N_f}{N_{\bar{f}} + N_f} \qquad \text{where} \quad \mathcal{A}_{CP} = \mathcal{A}_{CP}^{\rm RAW} - \mathcal{A}_P - \mathcal{A}_D$$

Detection and production asymmetries can be conveniently cancelled with $\Lambda^0_b \to \Lambda^+_c(K^0_S p)\pi^-$ decays (in which the expected *CP* violation is negligible).

The inclusive raw asymmetries are found to be :

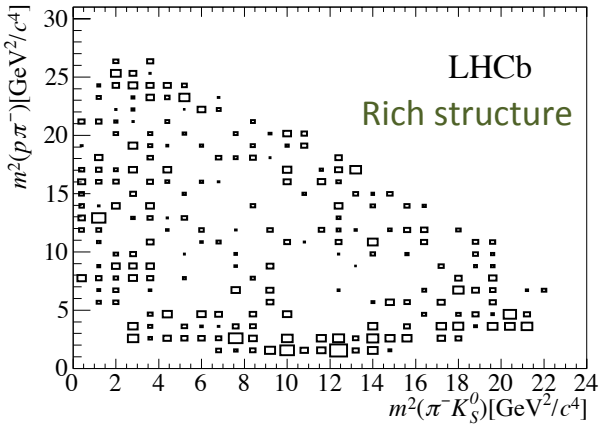
$$\mathcal{A}_{CP}^{\rm RAW}(\Lambda_b^0 \to \Lambda_c^+(K_S^0 p)\pi^-) = -0.05 \pm 0.03$$
$$\mathcal{A}_{CP}^{\rm RAW}(\Lambda_b^0 \to K_S^0 p\pi^-) = 0.17 \pm 0.13$$

Finally, the CP asymmetry is measured to be :

$$\mathcal{A}^{CP}(\Lambda_b^0 \to K_S^0 p\pi^-) = 0.22 \pm 0.13(\text{stat.}) \pm 0.03(\text{syst.})$$

A future update of this analysis with 2012 (2 fb^{-1}) data has a clear appeal !

A first inspection of the distribution of $\Lambda^0_b \to K^0_S p\pi^-$ decays across the phase space shows that an amplitude analysis is an exciting future prospect!



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