Swimming with Penguins: Measurements of $B^0_{(s)}$ lifetimes

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On behalf of the LHCb collaboration

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EFFECTIVE $B^0_{(s)} \to h^+ h^{'-}$ LIFETIMES

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- Measure the effective lifetimes of the $B^0_s \to K^+ K^-$, $B^0 \to K^+ \pi^-$ and $B^0_s \to \pi^+ K^-$ decays
- B^0, flavour-specific $B^0_s \to \pi^+ K^-$ and *CP*-eigenstate $B^0_s \to K^+ K^-$.
- Using $1\,\text{fb}^{-1}$ of 2011 LHCb data.
- Proceed through both tree and loop processes.
- New physics could enter and compete with SM processes.

EFFECTIVE $B^0_s \to K^+ K^-$ LIFETIME

Decay into a *CP* even final state: $K^+ K^-$

- Significant loop contributions in decay route
- *CP* conserved: only accessible from B_L, so measure Γ_L.
- *CP* violation: mix of B_L and B_H
- SM predicts very small *CP* violation, $A_{\Delta\Gamma}(B^0_s \to K^+ K^-) = -0.97^{+0.014}_{-0.009}$ (arXiv:1011.1096)

EFFECTIVE LIFETIME METHODOLOGY

Data driven method used to determine per-event acceptance function

- Trigger and Selection re-run for all hypothetical lifetimes
- The step function is parameterised by the parameter t_{min}
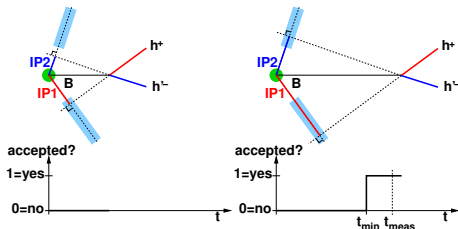
Fit methodology

- Fit factorised into invariant mass and reconstructed lifetime components
- Assumption that mass and lifetime are uncorrelated.
- Use *sWeights* to discriminate between signal and background.

Effective $B^0_{(s)} \to h^+ h'^-$ Lifetime Results
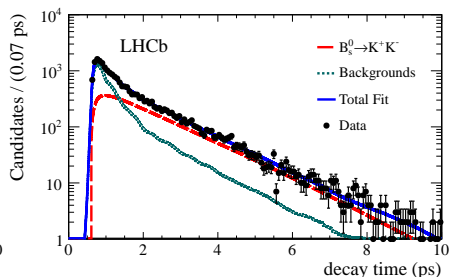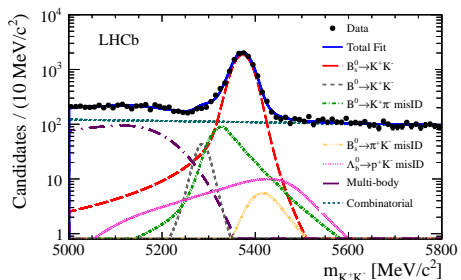
LHCb measurements (arXiv:1406.7204, submitted to Phys.Lett.B)

- $\hat{\tau}_{B^0_s \to K^+ K^-} = 1.407 \pm 0.016$ (stat) ± 0.007 (syst) ps
- $\Gamma^s_L = 0.711 \pm 0.008$ (stat) ± 0.004 (syst) ps^{-1}
- $\mathcal{A}_{\Delta\Gamma}(B^0_s \to K^+ K^-) = -0.87 \pm 0.17$ (stat) ± 0.13 (syst)
- $\hat{\tau}_{B^0 \to K^+ \pi^-} = 1.524 \pm 0.011$ (stat) ± 0.004 (syst) ps
- $\hat{\tau}_{B^0_s \to \pi^+ K^-} = 1.60 \pm 0.06$ (stat) ± 0.01 (syst) ps