Angular analyses of $b \to s \ell^+\ell^-$ decays at LHCb

**Why $b \to s \ell^+\ell^-$ decays?**

1. In the SM, electroweak penguin decays are rare since they are forbidden at tree-level.
2. NP can modify significantly the SM predictions.
3. NP can be interpreted with the model independent effective hamiltonian describing $b \to s \ell^+\ell^-$ decays.

$$\mathcal{H}_{\text{eff}} = -\frac{4G_F}{\sqrt{2}} V_{tb} V_{ts}^* \sum_i C_i O_i$$

**New Physics (NP)**

**Why the LHCb detector?**

- $b\bar{b}$ pairs produced predominantly in forward region 
- Single arm forward spectrometer 
- Excellent vertex and momentum resolution 
- Good particle identification

Ideal for flavour physics precision measurements

**Angular fit of pseudo-experiments**

**Angular observables are able to characterise NP.**

Measure the differential decay width ... 

$$\frac{1}{d \Gamma} \frac{d^4 \Gamma}{d \phi d \cos \theta d \cos \theta'} \approx \frac{1}{4} \left( 1 + 3 \cos^2 \theta \right) \left( L_{1c} \cos \theta \cos \theta'L_{1c} \cos \theta + L_{2x} \sin \theta \theta' \right)$$

... as a function of the decay angles ... 

... and the angular coefficients $L$.

**Angular fit model is chosen to include dominant spin-3/2 and underlying spin-1/2 $A$ resonances.**

**How to get the angular observables?**

Perform an angular fit on realistic pseudo-experiments:

$$\theta' = \frac{1}{d \Gamma} \frac{d^4 \Gamma}{d \phi d \cos \theta d \cos \theta'}$$

Expected yields in $A_b \to (1520) \mu^+\mu^-$ are around 1/10 of the ones in $B^0 \to K^{*0} \mu^+\mu^-$. 

Working on angular fit validation with $A_b \to pK^-/\phi(\mu^+\mu^-)$ decays. Exciting possibilities for Run 3 and further thanks to increase of luminosity.

**Physics Focus**

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Measurements deviate from the SM prediction.

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**Example $A_b \to (1520) \to pK^- \mu^+\mu^-$**

First angular analysis using $A_b \to pK^- \mu^+\mu^-$ at LHCb. Complementary to existing angular analyses.

Several resonances present in the $pK^-$ mass spectrum. Focus on $A(1520)$ resonance being the dominant one.

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