Study of the $\Lambda_b^0 \to D^0pK^-$ decay for a future measurement of the CKM angle $\gamma$ at the LHCb experiment

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Motivation

• The CKM angle $\gamma$ is, within the unitarity triangle, the angle known with the worst experimental uncertainty

\[ \gamma = \arg \left( \frac{V_{us}V_{ub}^*}{V_{cd}V_{cb}^*} \right) \]

Direct measurement

\[ \gamma = (65.6 \pm 1.1)° \]

Theoretical clean measurement

• CP violation never measured in baryons

Technique

Gronau, London, Wyler (GLW) method $\to D^0$ decays into CP eigenstates

• CP-even eigenstates: $K^-K^+, \pi^-\pi^+$

• CP-odd eigenstates: $K_0^0, K_{S0}^0, \ldots$

\[ A_{CP} = \frac{\Gamma(\Lambda_b^0 \to D_{cp}pK^-) - \Gamma(\Lambda_b^0 \to D_{cp}pK^+)}{\Gamma(\Lambda_b^0 \to D_{cp}pK^-) + \Gamma(\Lambda_b^0 \to D_{cp}pK^+)} = \frac{2m_b\sin\delta_{cp}}{1 + m_b^2 + 2m_b\cos\delta_{cp}} \]

Analysis strategy

• Analysis performed on RunI and RunII (2011 - 2018) data sample collected by LHCb (9 fb$^{-1}$ of integrated luminosity of $pp$ collisions)

• Wide use of control channel $\Lambda_b^0 \to D^0p\pi^-$

\[ B(\Lambda_b^0 \to D^0p\pi^-) = (6.3 \pm 0.7) \times 10^{-4} \]

\[ B(\Lambda_b^0 \to D^0p\pi^-) = (4.6 \pm 0.8) \times 10^{-5} \]

• Preselection on PID of $p, h^-_{\pi^0}$

\[ S_{\text{rec}} = \frac{S}{\sqrt{S + B}} = \frac{e_\pi e_{\pi^0}}{\sqrt{e_\pi S_0 + e_{\pi^0} B_0}} \]

The fit

To further constrain the possible charmless contribution, a simultaneous fit is realised between the $\Lambda_b^0$ and $D^0$ invariant mass distributions

Prospects and next steps

• Expected sensitivity on $\gamma = 10°$

• Angular analysis of $\Lambda_b^0 \to D^0pK^-$ foreseen

• Joint measurement of $\gamma$ with $\Lambda_b^0 \to D^0pK^-$, where $D^0$ is decaying to 4-body

• Analysis on RunIII data

12th LHC students poster session