Preliminary measurements of $A_{CP}(B^0 \rightarrow K\pi)$ and $A_{CP}(B_s \rightarrow \pi K)$ at LHCb

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On behalf of the LHCb Collaboration

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• Many decay modes
  • $B^0 \rightarrow K\pi$, $B_s \rightarrow \pi K$, $B^0 \rightarrow \pi\pi$, $B_s \rightarrow KK$, $\Lambda_b \rightarrow pK$, $\Lambda_b \rightarrow p\pi$, $B^0 \rightarrow KK$, $B_s \rightarrow \pi\pi$
  • both direct and time-dependent CP asymmetries can be measured

• In this talk we present preliminary measurement of direct CP asymmetries in $B^0 \rightarrow K\pi$ and $B_s \rightarrow \pi K$ decays using data collected by LHCb during 2010 $\int Ldt \approx 37$ pb$^{-1}$

• Main steps of the analysis:
  • Calibration of particle identification
  • Determination of instrumental asymmetries
  • Measurement of B meson production asymmetry

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Calibration of PID

• Crucial aspect of this analysis:
  • PID needed to separate the sample into different final states
  • relative PID efficiencies needed in order to determine the yields of cross-feed backgrounds
• PID information obtained from the two RICH sub-detectors
• PID variables (ΔlogL) distributions for true π, K and p can be obtained from D*→D⁰(Kπ)π and Λ→pπ decays, but different phase space with respect to B→hh'

• ΔlogL distributions from calibration sample have been reweighted considering the different phase spaces
Raw CP asymmetries

\[ A_{CP} = \frac{(N_{B \to K^-} - N_{B \to K^+})}{(N_{B \to K^-} + N_{B \to K^+})} \]

Raw \( A_{CP}(B^0 \to K\pi) = -0.086 \pm 0.033 \)

3-body \( B \) decays

Selection optimized for \( A_{CP}(B^0 \to K\pi) \)

\( B^0 \to K\pi \) yield

1447 ± 50 events
Raw CP asymmetries

\[ A_{CP} = \frac{N_{B \rightarrow f} - N_{B \rightarrow \bar{f}}}{N_{B \rightarrow f} + N_{B \rightarrow \bar{f}}} \]

Raw \( A_{CP}(B_s \rightarrow \pi K) = -0.15 \pm 0.19 \)

Selection optimized for \( A_{CP}(B_s \rightarrow \pi K) \)

\( B_s \rightarrow \pi K \) yield
52 ± 10 events
**Corrections to the raw CP-asymmetry**

**Raw asymmetry measured in data**

\[ A_{CP} = A_{CP}^{\text{RAW}} - A_D(K\pi) - \kappa A_P \]

- \( A_D(K\pi) = -0.004 \pm 0.004 \) (stat.)
  - Determined using \( D^* \rightarrow D^0(K\pi)\pi \), \( D^* \rightarrow D^0(KK)\pi \), \( D^* \rightarrow D^0(\pi\pi)\pi \) and untagged \( D^0 \rightarrow K\pi \) decays
- \( A_P = -0.025 \pm 0.014 \) (stat.) \( \pm 0.010 \) (syst.)
  - Determined using \( B^\pm \rightarrow J/\psi K^\pm \) decays
  - \( \kappa \) factor depends on the selection and on the time-evolution of the B-meson

<table>
<thead>
<tr>
<th>Channel</th>
<th>( \kappa )</th>
</tr>
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<tbody>
<tr>
<td>( B^0 \rightarrow K^+\pi^- )</td>
<td>0.33</td>
</tr>
<tr>
<td>( B^0_s \rightarrow \pi^+K^- )</td>
<td>0.015</td>
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**Neutral B-meson production asymmetry**

\( D^0 \rightarrow K\pi \)

\( D^0 \rightarrow K\pi \)

\( D^* \rightarrow D^0(K\pi)\pi \)

\( B^\pm \rightarrow J/\psi K^\pm \)
Results and outlook

- Using data collected during 2010 we provide a preliminary measurement of the direct CP asymmetries $A_{CP}(B^0 \rightarrow K\pi)$ and $A_{CP}(B_s \rightarrow \pi K)$:

  **LHCb preliminary**
  
  \[
  A_{CP}(B^0 \rightarrow K^+\pi^-) = -0.074 \pm 0.033 \pm 0.008 \\
  A_{CP}(B^0_s \rightarrow \pi^+K^-) = 0.15 \pm 0.19 \pm 0.02
  \]

  **HFAG averages**
  
  \[
  A_{CP}(B^0 \rightarrow K^+\pi^-) = -0.098^{+0.012}_{-0.011} \\
  A_{CP}(B^0_s \rightarrow \pi^+K^-) = 0.39 \pm 0.17
  \]

  Measurements already competitive with only 37 pb$^{-1}$ of integrated luminosity

  **LHCb is expected to significantly contribute to the world average by 2011**

- Other measurements to come in 2011
  - relative branching fractions of all decay modes
  - direct CP asymmetries in $\Lambda_b \rightarrow pK$ and $\Lambda_b \rightarrow p\pi$ decays
  - time-dependent CP asymmetries of $B^0 \rightarrow \pi^+\pi^-$ and $B_s \rightarrow K^+K^-$
Backup
Selection optimized for $A_{CP}(B^0 \to K\pi)$

$B^0 \to \pi^+\pi^-$ yield: $275 \pm 24$

$B_s \to K^+K^-$ yield: $333 \pm 21$

Cross feed backgrounds dominated by $B^0 \to K\pi$ decays
Λ_b → pK and Λ_b → pπ

Selection optimized for A_{CP}(B^0 → Kπ)

Λ_b → pK yield: 76 ± 12
Λ_b → pπ yield: 41 ± 10