Wrong-Sign to Right-Sign Yield in Flavor Tagged D⁰ → Kπ Data at LHCb

First results on the wrong-sign mode in the decay channel D⁰ → Kπ⁻ are presented: the selection criteria, the yield, and the time-integrated ratio of wrong-sign D⁰ → K⁺π⁻ to right-sign D⁰ → K⁻π⁺ decays. This analysis is the first step towards a measurement of the time-dependent wrong-sign/right-sign ratio from which D⁰ mixing parameters may be extracted. The time-integrated ratio corrected for decay time acceptance is measured to be R = 0.409% ± 0.031% (stat.) ± 0.039% (sys.).

**Introduction**

Neutral mesons like D⁰ can oscillate into their own antiparticles [1]. The mass eigenstates are |D⁺⟩ and |D⁻⟩ with |D⁺⟩ = pD⁰/(2|m|) and |D⁻⟩ = qD⁻/(2|m|), masses m_D and decay width Γₜ. Mixing is parameterized by:

\[ x = \frac{m_\pi}{m_D} \quad \text{and} \quad y = \frac{\Gamma_\pi}{\Gamma_\tau} \quad \text{with} \quad \Gamma = \Gamma_\tau + \Gamma_\pi. \]

The D⁰ decays to K⁺π⁻ (right-sign) and K⁻π⁺ (wrong-sign) are considered.

**Data and selection**

The 2010 data corresponds to an integrated luminosity of ∫ L = 36.4 pb⁻¹.

For flavor tagging, the decay D^*⁺ → D^0 π⁺ is used. To improve the signal to background ratio, we exploit the decay kinematics and particle identification.

As kinematic variables, the D⁰ mass m(D⁰) and the reconstructed mass difference Δm = m(D⁺) – m(D⁻) are used.

**Results**

From our signal yields, R = \frac{N_{\text{WS}}}{N_{\text{RS}}} = (0.442 ± 0.033)\% is calculated.

**Corrections**

Systematic effects from production and reconstruction asymmetries and the misidentification of D⁺ → D⁰π⁺ have been found to be negligible after removing events with the procedure described above.

As the ratio \frac{N_{\text{WS}}}{N_{\text{RS}}} is increasing with time, any acceptance function of the D⁰ lifetime measurement requires a correction of the measured ratio. The correction depends on mixing parameters (R_0, y, Δm).

The lifetime acceptance is determined from data. The mixing parameter values are taken from the PDG [3]. This yields a correction of 7.4%.

**Systematic errors**

Both samples are kinematically identical, therefore contributions to the systematic error due to trigger and tracking efficiencies cancel. Contributions due to the fit model and the choice of the signal range in Δm are found to be important.

<table>
<thead>
<tr>
<th>Fit model</th>
<th>systematic error (%)</th>
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<tbody>
<tr>
<td>signal box range in Δm</td>
<td>0.036</td>
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<tr>
<td>Δm = 0.150 GeV</td>
<td>0.004</td>
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**Final result**

WS/RS of D⁰ → Kπ⁻ decays (%):

| R(measured) | (0.442 ± 0.031)\% (stat.) ± 0.034\% (sys.) |
| R(corrected) | (0.419 ± 0.031)\% (stat.) ± 0.030\% (sys.) |
| R(PDG) | 0.390 ± 0.018 |

**References**


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