# Measurement of time-integrated raw asymmetry in $D^0 \longrightarrow K^+K^-$ decay

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**Abstract**

The decay $D^0 \longrightarrow K^0_s K^0_s$ is a singly Cabibbo-suppressed transition that involves the interference between $c\overline{u} \longrightarrow s\overline{s}$ and $c\overline{u} \longrightarrow d\overline{d}$ amplitudes, mediated by the exchange of a W boson at the tree level, that can generate CP asymmetries at the 1% level, even if the Cabibbo-Kobayashi-Maskawa phase is the only source of CP. Current experimental measurements of the CP asymmetry in $D^0 \longrightarrow K^0_s K^0_s$ decays are still limited by the statistical precision, with the best measurement performed by Belle experiment using data at an integrated luminosity of 921 fb$^{-1}$: $\mathcal{A}_{CP}(D^0 \longrightarrow K^0_S K^0_S) = (-0.02 \pm 1.53 \pm 0.02 \pm 0.17)\%$, where the first uncertainty is statistical, the second systematic and the third due to the CP asymmetry of the reference $D^0 \longrightarrow K^0_s \pi^0$ mode. $\mathcal{A}_{CP}$ in $D^0 \longrightarrow K^+K^-$ is measured with 0.11% precision, Therefore, using $D^0 \longrightarrow K^+K^-$ as the control mode reduces the uncertainty due to the control mode in addition to making the analysis simpler. In this work, we report the preliminary measurement of the raw asymmetry of the $D^0 \longrightarrow K^+K^-$decay using the Belle II Simulation. The final goal of this analysis is to measure the CP asymmetry in $D^0 \longrightarrow K^0_s K^0_s$ ,$D^0 \longrightarrow K^+K^-$ using as the reference mode.

# 1 Introduction

$D^0 \longrightarrow K^0_S K^0_S$ is an important mode to understand CP Violation in charm decays [1]. Most precise experimental measurements of $\mathcal{A}_{CP}$ asymmetry in this decay is $\mathcal{A}_{CP}$ is given by Belle [2]. In this work, we use $D^0 \longrightarrow K^+K^-$ as the reference mode, with an aim to reduce the uncertainty on the Belle measurement. The signal yield and corresponding $A_{raw}$ for $D^0 \longrightarrow K^+K^-$ is measured using Belle II Monte Carlo samples of integrated luminosity 88 fb$^{-1}$. The Belle II [3] is an experimental facility at SuperKEKB located in Tsukuba, Japan.

# 2 Reconstruction of $D^0 \longrightarrow K^+K^-$

The $D^0 \longrightarrow K^+K^-$ decay is reconstructed using the tracks of two oppositely charged kaons with the kaon identification probablity, $\mathcal{L}_K/(\mathcal{L}_K + \mathcal{L}_{\pi(e)})$ exceeding 0.6(0.1), where, $\mathcal{L}$ denotes log likelihood of the particle being identified as a kaon. The $D^0$ candidates thus reconstructed is combined with low momentum pions to form the $D^{*+} \longrightarrow D^0\pi^+$ decay.

# 3 Results

A detailed background study is carried out for $D^0 \longrightarrow K^+K^-$ and a simultaneous, unbinned maximum likelihood fit to $(m(K^+K^-), m(D^0\pi^+))$ is performed. The mass of $D^0$ is denoted by $m(K^+K^-)$ and $m(D^0\pi^+)$ is the mass of the $D^{*+}$, without any mass hypothesis on the $D^0$ daughters [4]. As shown in Figure 1, the signal shape (shown in red) is modelled using the sum of a double Gaussian and a Johnson's S distribution. The measured signal yield for $D^0 \longrightarrow K^+K^-$ is $= 36795 \pm 199$, and the corresponding is $A_{raw}$ is $0.0231 \pm 0.0054$. The background components of the fit are random pion (yellow), $D^0 \longrightarrow$ *multibody* (black), combinatorial (magenta), $D^0 \longrightarrow K^-\pi^+$ (green) and $D_s \longrightarrow K^+K^-\pi^+$ (cyan).

# 4 Summary

The signal yield for $D^0 \longrightarrow K^+K^-$ is measured to be $= 36795 \pm 199$, and the corresponding $A_{raw}$ is $0.0231 \pm 0.0054$.

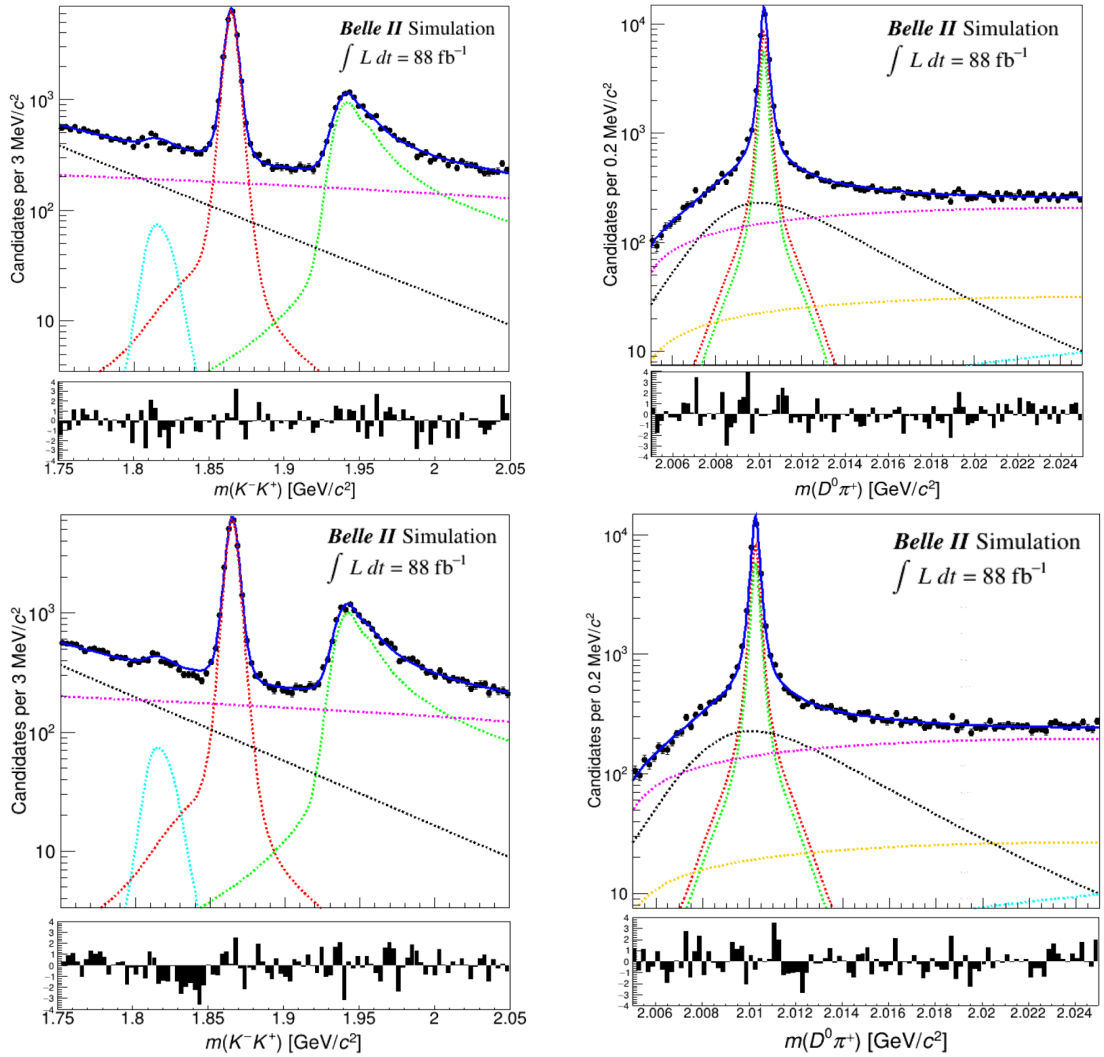


Figure 1: Distributions of $m(K^+K^-)$ (left) and $m(D^0\pi^+)$ (right) for $D^0$ (top) and $\overline{D}^0$ (bottom) samples, with fit projections overlaid.

# References


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4. Di Canto A. Measurement of CP Violating Asymmetries in $D^0 \longrightarrow \pi^+\pi^-$ and $D^0 \to K^+K^-$ Decays at CDF. 2012.