1. BELLE DETECTOR

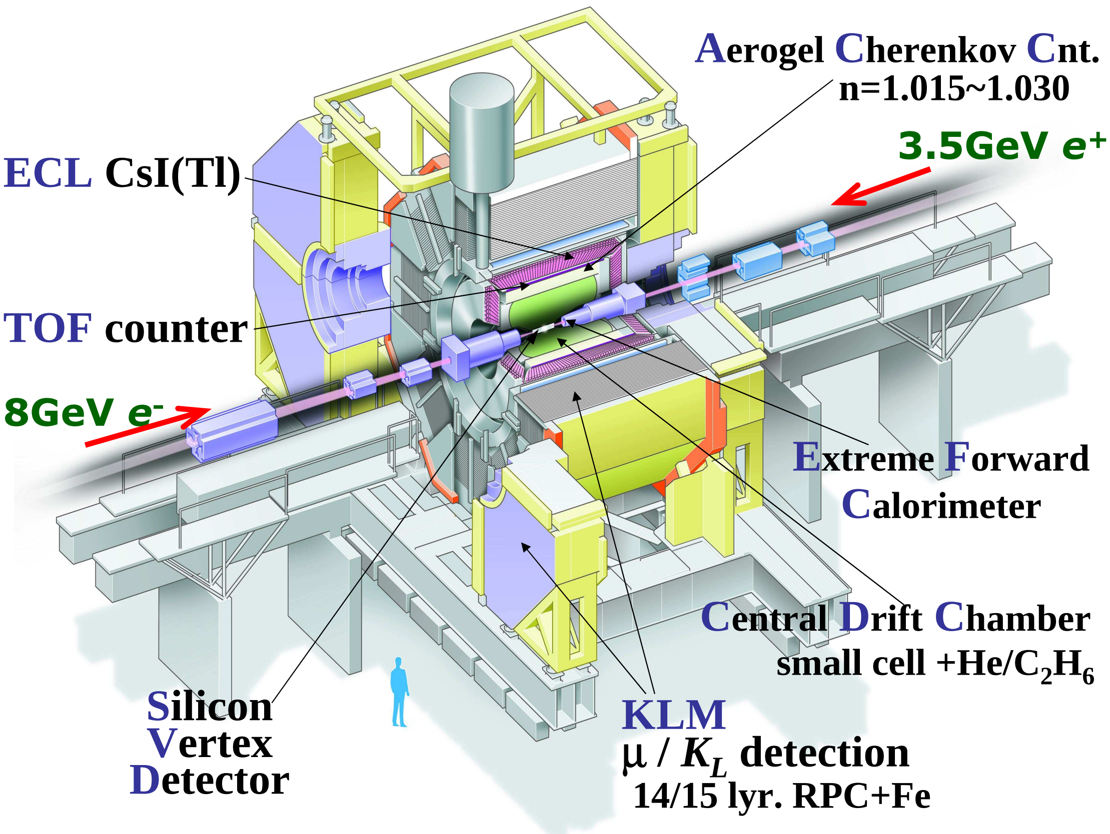

FIG. 1:

The Belle detector is a large-solid-angle magnetic spectrometer that consists of a silicon vertex detector (SVD), a 50-layer central drift chamber (CDC), an array of aerogel threshold Cherenkov counters (ACC), time-of-flight scintillation counters (TOF), and an array of CsI(Tl) crystals, all located inside a superconducting solenoid coil that provides a 1.5 T magnetic field. An iron flux-return located outside the coil is instrumented to detect K_L^0 mesons and to identify muons. Two different inner detector configurations were used. For the first sample of 152 million $B\overline{B}$ pairs, a 2.0 cm radius beampipe and a 3-layer silicon vertex detector (SVD1) were used; for the latter 383 million $B\overline{B}$ pairs, a 1.5 cm radius beampipe, a 4-layer silicon detector (SVD2) and a small-cell inner drift chamber were used.

2. SIGNAL EXTRACTION

CP-violating asymmetries for $B \to K\pi/\pi\pi$ decays are obtained by performing an unbinned maximum likelihood fit with input variables $M_{\rm bc}$ and ΔE. Three background components are considered in the fit: the continuum, charmless three-body B decays and two-body B decay background due to kaon/pion misidentification.

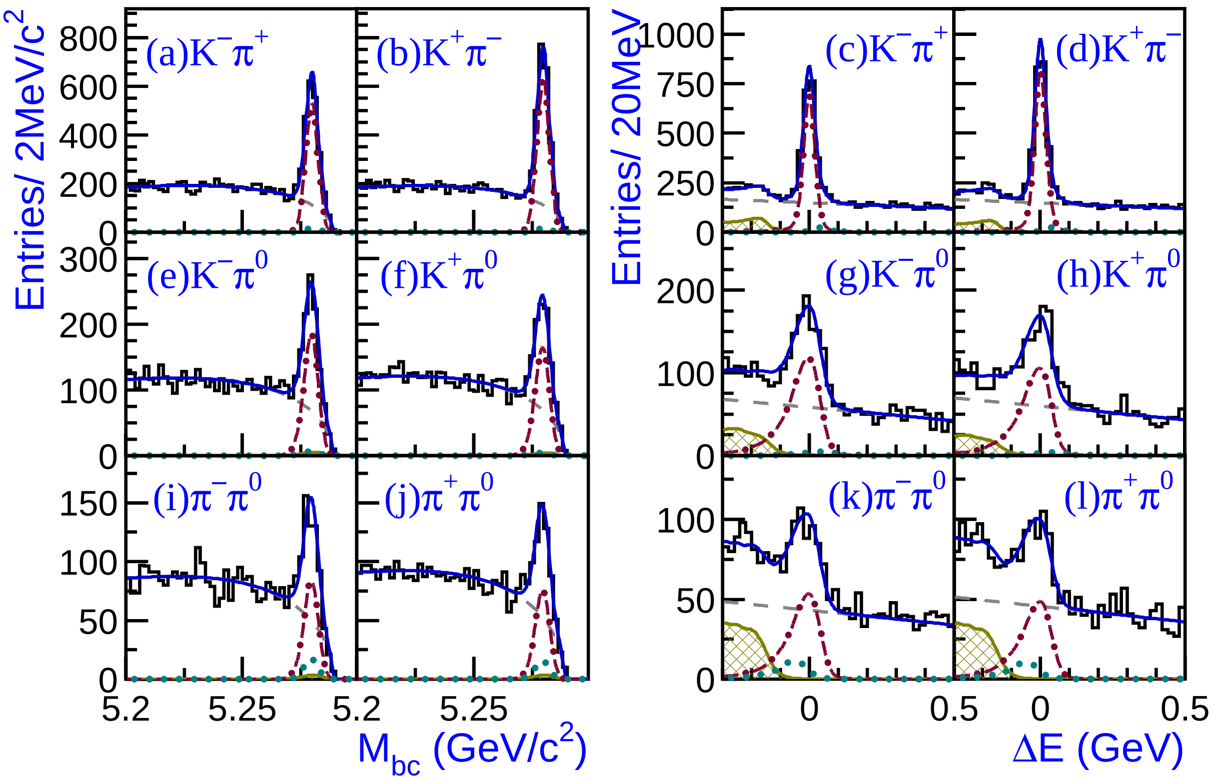

FIG. 2:

When a likelihood fit is performed, the amount of $B \to \pi^+\pi^-$ crossfeed in the $K^\pm\pi^\mp$ sample is fixed to the value estimated using the world average of the $B \to \pi^+\pi^-$ branching fraction and the probability that pions are misidentified as kaons. For the $K^\pm\pi^0$ and $\pi^\pm\pi^0$ samples, a simultaneous fit is performed with the crossfeed fractions constrained based on the identification efficiencies and fake rates of kaons and pions. Figure 2 shows $M_{\rm bc}$ and ΔE projections for (a,c) $K^-\pi^+$, (b,d) $K^+\pi^-$, (e,g) $K^-\pi^0$, (f,h) $K^+\pi^0$, (i,k) $\pi^-\pi^0$ and (j,l) $\pi^+\pi^0$ candidates. Histograms are data, solid blue lines are the fit projections, point-dashed lines are the signal components, dashed lines are the continuum background, gray dotted lines are the background due to the K-π misidentification, and green hatched areas are the background of three-body B decays. The $M_{\rm bc}$ projections are made by requiring $|\Delta E| < 0.06$ GeV for $K^\pm\pi^\mp$ and $-0.14 < \Delta E < 0.06$ GeV for the others, while the ΔE projections are displayed by applying $M_{\rm bc} > 5.27$ GeV/c^2. Since the branching fraction of $B^\pm \to K^\pm\pi^0$ is larger than that of $B^\pm \to \pi^\pm\pi^0$ and kaons are easier to be misidentified as pions, a larger $K^\pm\pi^0$ crossfeed in the $\pi^\pm\pi^0$ sample is expected, compared to the $\pi^\pm\pi^0$ crossfeed in the $K^\pm\pi^0$ sample.

3. SYSTEMATIC UNCERTAINTY

TABLE I: Systematic uncertainties for CP-violating asymmetries.

	$K^\pm\pi^\mp$	$K^\pm\pi^0$	$\pi^\pm\pi^0$
Signal PDF	$^{+0.0003}_{-0.0002}$	±0.0004	±0.0018
Charmless B fraction	±0.0001	$^{+0.0006}_{-0.0004}$	$^{+0.0003}_{-0.0004}$
$\pi^+\pi^-$ amount	$^{+0.0003}_{-0.0001}$	–	–
Fake rate of $\pi^+\pi^-$ to $K^+\pi^-$	±0.0013	–	–
Detector bias	±0.0081	±0.0056	±0.0064
Total	±0.0082	±0.0056	±0.0067

Systematic uncertainties of CP-violating asymmetries arise from the parameters fixed in the unbinned likelihood fit and from the possible detector bias. The fixed parameters include the peak position and resolutions of signal PDFs, the amount of the expected charmless three-body B background and the asymmetries of the two-body B background due to the K/π fake rate difference between positively and negatively charged particles. Systematic uncertainties due to the signal PDFs used in the fit are estimated by performing the fit after varying the signal peak positions and resolutions by one standard deviation (σ). We also vary the expected amount of charmless B background by $\pm1\sigma$ and take the deviation of the signal asymmetry as the systematic errors. Uncertainties arising from the fake rate difference between positively and negatively charged particles are evaluated by varying their corresponding fake rates according to the study of $\overline{D}^0 \to K^+\pi^-$ data. In the analysis of the $K^\pm\pi^\mp$ the amount of $\pi^\pm\pi^\mp$ is fixed based on its branching fraction and pion misidentification rate. The corresponding systematic error is obtained by floating the $\pi^\pm\pi^\mp$ component and varying the branching fraction of $\pi^\pm\pi^\mp$ by its uncertainty. The detector bias test for the $B \to K^\pm\pi^\mp$ mode is performed by using D^{*+} tagged $D^0 \to \pi^+\pi^-, K^-\pi^+, K^+K^-$ and $K^0_S\pi^0$, where $D^{*+} \to D^0\pi^+$. For the $B^\pm \to h^\pm\pi^0$ modes, the uncertainty of partial-rate asymmetry for the continuum component is used as the uncertainty due to the detector bias. The uncertainty due to the likelihood ratio requirement is examined by varying the requirement values or including the likelihood ratio parameter in the fit; the uncertainty is found negligible. The final systematic uncertainty is obtained by quadratically summing all the errors, as shown in Table I.