

Title: *Measurement of Time-Dependent CP Violation in $B^0 \rightarrow \eta_c K_S^0$ at Belle Experiment, Optimization Studies of the Belle II Vertex Detector*

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Abstract: This doctoral thesis deals with two independent topics. In the first part we present a measurement of branching ratio(s) and time-dependent CP violation parameters in $B^0(B^\pm) \rightarrow \eta_c K_S^0(K^\pm)$, $\eta_c \rightarrow p\bar{p}$. The values of CP violation parameters have been found as follows: $\sin 2\phi_1$, denoted as an \mathcal{S}_{CP} parameter, equals: $\mathcal{S}_{CP} = 0.68_{-0.46}^{+0.38} \pm 0.13_{\text{sys}}$, the direct CP violation parameter, denoted as an \mathcal{A}_{CP} , is: $\mathcal{A}_{CP} = 0.00_{-0.31}^{+0.23} \pm 0.08_{\text{sys}}$. These results have been obtained with the final data sample of $772 \times 10^6 B\bar{B}$ pairs collected at $\Upsilon(4S)$ resonance with a Belle detector at the KEKB e^+e^- asymmetric collider machine in Japan. In the second part, we present our approach to the Monte Carlo (MC) simulation of Belle II vertex detector and its response to high energy particles. Belle II represents an upgrade of current Belle experiment and its designed vertex detector will consist of 2 layers of Depfet pixel detectors (PXD) and 4 layers of double-sided silicon micro-strip detectors (SVD). The MC simulation together with a charged particle reconstruction have been developed and implemented within a modular based ILC (International Linear Collider) software framework in order to find an optimal design of the Belle II vertex detector. From final optimization studies, we present a detailed study of expected material distributions in the vertex detector, optimization of the final pixel detector layout and its performance, study of slanted SVD detectors installation in the forward region and its impact on resolution, and finally, a study of expected impact parameter resolution of the whole vertex detector.

Keywords: *Belle, CP violation, $\sin 2\phi_1$, $c\bar{c}$ resonance, Belle II, vertex detector, pixel detector, Depfet, micro-strip detector, MC simulation, ILC software, digitization, clustering, impact parameter*