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First look at CKM parameters from early Belle II data

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The Belle II experiment at the SuperKEKB energy-asymmetric e^+e^- collider is a substantial upgrade of the B factory facility at the Japanese KEK laboratory. The design luminosity of the machine is $8 \times 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$ and the Belle II experiment aims to record 50 ab^{-1} of data, a factor of 50 more than its predecessor. From February to July 2018, the machine has completed a commissioning run, achieved a peak luminosity of $5.5 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$, and Belle II has recorded a data sample of about 0.5 fb^{-1} . Main operation of SuperKEKB has started in March 2019.

We use the early Belle II data to characterize the performance of the detector regarding the tracking of charged particles, the reconstruction of known resonances, and the capability of identifying displaced decay vertices.

A first benchmark towards analysing time-dependent CP violation consists in the measurement of the lifetime of B mesons and of the $B^0 - \bar{B}^0$ mixing frequency. We present the first results, based on samples of B mesons that decay to hadronic and semileptonic final states. We further present estimates of the sensitivity to β in the golden channels $B \rightarrow c\bar{c}s$ and in the penguin-dominated modes $B^0 \rightarrow \eta' K^0, \phi K^0, K_S \pi^0(\gamma)$. A study of the time-dependent analysis of $B^0 \rightarrow \pi^0 \pi^0$, relevant for the measurement of α , and feasible only in the clean environment of an e^+e^- collider, will also be given.

Belle II can also measure γ , the third and least well known CKM angle, through the interference between $B^+ \rightarrow D^0 K^+$ and $B^+ \rightarrow \bar{D}^0 K^+$ decays, which occurs if the final state of the charm-meson decay is accessible to both the D^0 and \bar{D}^0 mesons. We will also discuss the precision that Belle II will be achieved in this measurement.

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