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Beam background study for the Belle II Silicon Vertex Detector

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The Belle II experiment aims to accumulate 50 ab^{-1} of e^+e^- collision data at the SuperKEKB asymmetric energy collider (Tsukuba, Japan). The first physics data using all Belle II detectors were taken in spring 2019.

In the vast physics program of the Belle II experiment, the vertex detector plays a crucial role for the determination of the B-mesons decay vertices. It consists of two inner layers of pixelated silicon detectors and four outer layers of double-sided silicon strip detectors (SVD).

To achieve a design luminosity of $8 \times 10^{35} \mathrm{cm}^{-2}\mathrm{s}^{-1}$, 40 times higher than the recorded luminosity of its predecessor, the SuperKEKB collider squeezes the beams to a vertical size of 50 nm ("nano-beam scheme") and doubles the beam currents.

Therefore, the detectors are required to tolerate intense beam backgrounds due to the upgrade. During the 2019 spring run we measured beam background levels in the SVD, as the strip occupancy of each sensor. With the low initial luminosity, the observed beam backgrounds mostly originated from Touschek and beam-gas scattering in individual beams. Since the scattering rates show different dependencies on beam conditions, such as the beam current, beam size and pressure, these contributions can be decomposed. We estimated the background rate and spatial distribution of each contribution and compared them with simulated ones. The results enable us to predict the background levels at increased beam currents and luminosity in the coming years. They also hint remedies to mitigate the beam backgrounds. In the poster, we will report the results of the beam background studies and the prospect for the SVD beam backgrounds in the future operation.

Submission declaration

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