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Investigation of injection-related beam loss at SuperKEKB

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The current achieved highest luminosity at SuperKEKB is only one-tenth of the design value, and beam injection is one of the most serious issues in achieving the target luminosity. Recent operations in both the HER and LER rings have shown insufficient injection efficiencies and detector backgrounds. The achieved injection efficiency falls short of the required level, sometimes leading to difficulties in injecting the beam at high current values. Following each injection, significant signals from particle losses are detected in several Belle II detector components, particularly the vertex detector, resulting in saturating the data acquisition with a dead time exceeding 10ms. The complexity of the injection, and critical factors like injected beam quality, beam lifetime, dynamic aperture, machine errors, nonlinearity, as well as the collimation system, makes the optimization challenging. Detailed injection simulations are essential to understand the issues of the injection and guide adjustments to maximize the injection efficiency and mitigate the injection background. This paper presents the findings of HER injection simulations and their experimental validation.

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