Belle II Background Studies

– few introductory remarks –

FSP Slow Pion Workshop

09 November 2021

SuperKEKB & Beam Backgrounds

SuperKEKB

▸ Initial design peak luminosity: 8 x 10E35 /cm² /s ("nominal" case in many existing studies) → expect to be lower in reality

▸ Final configurations to reach the target luminosity currently unknown

Beam background studies

▸ Background contributions are carefully studied by the background detectors and Belle II sub-detectors

▸ Dedicated study runs to understand dependence on machine parameters
→ see detailed example of PXD background analysis in the next talk by Lu Cao

Very brief overview on current understanding & status

▸ Luminosity background: rate proportional to inst. luminosity & generally well represented in simulation

▸ Single beam background: dependence on key beam parameters understood though dedicated studies, and data-MC ratio now O(1), HOWEVER, the absolute level depends on what collimator settings can be achieved in reality

▸ Injection background: recent efforts to quantify the level and understand the correlation to beam & injection parameters

Very difficult to predict how background levels would be at higher inst. luminosity

Beam Background in Tracking / Vertex Detectors

Main issues & concerns on detectors

- CDC: neutrons causing SEU, high currents from injection

- SVD & PXD: high average & instantaneous occupancy > readout limit / leading to unstable operation, damage from large beam losses
  (no long-term damage yet on SVD, dead/inefficient region on PXD currently ~4–5% of all channels)

High inst. occupancy is a common issue in reconstruction for all detectors

Occupancy limit & expectation @nominal luminosity (simulation with measured data/MC scale factor)

- SVD: ~4.7% limit, ~3% in Layer 3 @nominal [1/2 from single beam LER, ‹1/4 from two-photon]

- PXD: 3% limit, 1% in Layer 1 @nominal [3/4 from two-photon]

N.B. with relatively large uncertainty (final optics settings not yet known, missing background contributions e.g. injection etc)

Recent reports (last background meeting during B2GM)

- CDC background summary

- SVD background summary, SVD injection background

- PXD – see next talks