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Simulation of an all-layer monolithic pixel vertex detector for the Belle II upgrade

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The Belle II experiment at the SuperKEKB e^+e^- collider has started developing an upgrade program on the time frame of 2026-2027 to improve the detector performance and robustness against beam-induced backgrounds.

To replace the current Belle II pixel and strip system (VXD), the VTX detector concept has been developed, a fully pixelated system based on thin Depleted Monolithic Active Pixel Sensors organized in 5, or possibly more, barrel layers.

To optimize the VTX design and compare it with the VXD system, a full simulation framework has been developed and integrated with the standard Geant4-based Belle II simulation, allowing direct comparison among different layouts.

This is made possible by the flexibility of the Belle II track reconstruction code, which can be retrained to operate on any detector layout without changing the code itself.

This poster will present the VTX detector concept, the development of the simulation framework, and the simulation results obtained, such as tracking efficiency and vertex resolution on benchmark physics channels (including D mesons from B decays), showing significant improvements with respect to the VXD.

This simulation work forms the basis for further optimization of the VTX design.

Collaboration

Belle II

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