

Upgrade to the Belle II Vertex Detector with CMOS pixel sensors

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The success of the Belle II experiment at KEK (Japan) relies on the very high instantaneous luminosity, close to $6 \times 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$, expected from the SuperKEKB collider. The beam conditions to reach such luminosity levels generate a large rate of background particles in the inner detection layers of Belle II, which exceeds by far the rate of particles stemming from elementary collisions. This beam-induced background creates stringent constraints on the vertex detector, in addition to the requirements coming from the physics performance needed.

The current Belle II vertex detector (VXD) has been operating very satisfactorily since the experiment started full operation in 2019. While efforts are still ongoing to mitigate beam-induced backgrounds, current prospects for the related occupancy rates in the VXD layers at full luminosity fall close to the acceptable limits of the employed technologies.

In this context, the Belle II collaboration is considering the possibility to install an upgraded VXD system on the time scale around 2026 and R&D activities on fully depleted CMOS sensors have started. Such an upgrade should provide a sufficient safety factor with respect to the background rate expected at the nominal luminosity and possibly enhance performances for tracking and vertexing.

New CMOS monolithic technologies for pixel sensors offer a combination of granularity, speed, low material budget and radiation tolerance matching well Belle II requirements and could be exploited to design a fully pixelated VXD, also benefiting from significant developments made in recent years for other experiments.

This talk will review the context of the proposed VXD upgrade with monolithic technologies in Belle II, providing details of the technological proposal and discussing performance expectations from simulations. Especially, recent progresses on integration system to achieve the requested exquisite low material budget will be presented.

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