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The Silicon Vertex Detector of the Belle II Experiment

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In June 2022 the data-taking of the Belle II experiment was stopped for the Long Shutdown 1, primarily required to install the new two-layer DEPFET detector (PXD) and upgrade components of the accelerator. In May 2023 the whole silicon tracker (VXD) was extracted from Belle II and the new VXD commissioning phase began to be ready to take data by the end of 2023. We describe the challenges and status of this upgrade.

We report on the performance of the SVD in terms of the high hit efficiency and the large signal-to-noise ratio. A novel procedure to group SVD hits event-by-event, based on their time, during reconstruction allows to significantly reduce the fake rate while preserving the tracking efficiency.

In the layer closest to the I.P., the SVD average occupancy has been less 0.5%, well below the estimated limit for acceptable tracking performance. Higher machine backgrounds are expected at increased luminosity and the excellent SVD hit-time information can be exploited for background rejection. We have developed a method that uses the SVD hit-time to estimate the collision time (event-T0) with similar precision to the estimate based on the drift chamber with an execution time three orders of magnitude faster. Furthermore, the front-end chip (APV25) is operated in "multi-peak"mode, reading six samples. To reduce background occupancy, trigger dead-time and data size, a 3/6-mixed acquisition mode, based on the timing precision of the trigger, has been successfully tested in physics runs.

Concerning the radiation damage, the SVD dose is estimated by the correlation of the SVD occupancy with the dose measured by the diamonds of the beam-abort system. Although the moderate increase shown by sensor current and the strip noise due to radiation, we expect that the detector performance will not be seriously degraded during the lifespan of the detector.

Your name

stefano bettarini

Institute

University of Pisa and INFN

Email address

stefano.bettarini@pi.infn.it

Presenter: WANG, Zihan (the University of Tokyo)

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