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LHCb VELO and Silicon Tracker: Operational experience, performance and lessons learned

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The Large Hadron Collider Beauty (LHCb) detector is a single-arm forward spectrometer, designed to detect decays of beauty and charm hadrons. High-precision track and vertex reconstruction in regions with the highest particle occupancies are enabled by a set of silicon-strip detectors: the VErtex LOcator (VELO) surrounding the interaction region, a large-area Tracker Turicensis (TT) located upstream of the LHCb dipole magnet, and the Inner Tracker (IT) placed around the beam pipe in the three tracking stations downstream of the magnet.
These detectors have successfully operated for the last 10 years, maintaining a high data-taking efficiency even with the reduced bunch separation and higher particle multiplicities of the LHC Run 2 environment. The cumulative radiation damage poses challenges in reaching full depletion in the most irradiated zones of the detectors, which have highly non-uniform exposure, with fluences of $0.01 - 4 \times 10^{14}$ 1 MeV-n_{eq} cm^{-2} in the same sensor. Radiation damage in the detectors is monitored using multiple methods, including measurements of bias current versus voltage and temperature, and periodic charge collection efficiency (CCE) scans. This talk will summarise the operational experience and performance of the detectors from 2010-2018. In particular, a recent analysis of the correlation of cluster finding efficiency with the distance of the silicon strip to a second metal layer routing line in the VELO and comparisons with 2D and 3D TCAD simulations will be presented.

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