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LHCb VELO: Performance and Radiation Damage in LHC Run 1 and Preparation for Run 2

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LHCb is a dedicated experiment to study New Physics in the decays of heavy hadrons at the Large Hadron Collider (LHC) at CERN. Heavy hadrons are identified through their flight distance in the Vertex Locator (VELO).

The VELO comprises 42 modules made of two n+-on-n 300 um thick half-disc silicon sensors with R-measuring and Phi-measuring micro-strips. In order to allow retracting the detector, the VELO is installed as two movable halves containing 21 modules each. The detectors are operated in a secondary vacuum and are cooled by a bi-phase CO2 cooling system.

During data taking in LHC Run 1 the LHCb VELO has operated with an extremely high efficiency and excellent performance. The track finding efficiency is typically greater than 98%. An impact parameter resolution of less than 35 um is achieved for particles with transverse momentum greater than 1 GeV/c. An overview of all important performance parameters will be given.

The VELO sensors have received a large and non-uniform radiation dose of up to 1.2×10^{14} 1 MeV neutron equivalent / cm² over the first LHC run. Type-inversion has been observed in regions close to the interaction point. Results of various radiation damage analyses will be presented.

The preparations for LHC Run 2 are well under way and the VELO has already recorded tracks from injection line tests. The current status and plans for new operational procedures addressing the non-uniform radiation damage will be discussed.

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