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The LHCb VELO detector: design, operation and first results

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The LHCb experiment has been upgraded during the second long shutdown of the Large Hadron Collider at CERN, and the new detector is currently operating at the LHC. The Vertex Locator (VELO) is the detector surrounding the interaction region of the LHCb experiment, responsible of reconstructing the proton-proton collision (primary vertices) as well as the decay vertices of long-lived particles (secondary vertices). The VELO is composed by 52 modules with hybrid pixel detector technology, operating at just 5.1 mm from the beams. The sensors consist of 200 μm thick n-on-p planar silicon sensors, read out via 3 VeloPix ASICs. The sensors are attached to a 500 μm thick silicon plate, which embeds 19 micro-channels for the circulation of the CO_2 evaporative cooling. The VELO operates in an extreme environment, which poses significant challenges to its operation. During the lifetime of the detector, the sensors are foreseen to accumulate an integrated fluence of up to $8 \times 10^{15} \text{ 1MeV n}_{\text{eq}}\text{cm}^{-2}$, roughly equivalent to a dose of 400 MRad. Moreover, due to the geometry of the detector, the sensors will face a highly non-uniform irradiation, with fluences in the hottest regions expected to vary by a factor 400 within the same sensor. The highest occupancy ASICs foresee a maximum pixel hit rate of 900 Mhit/s and an output data rate exceeding 15 Gbit/s. The design, operation and early results obtained during the first year of commissioning will be presented.

Primary authors: DE CAPUA, Stefano (University of Manchester); COCO, Victor (CERN); AKIBA, Kazuyoshi (Nikhef)

Presenter: Dr LEMOS CID, Edgar (CERN)

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