

The LHCb Upgrade Programme and the VELO

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The LHCb Upgrade I, currently under construction and scheduled to start data taking in Run 3, will transform the experiment to a triggerless system reading out the full detector at 40 MHz event rate. The increased luminosity and trigger efficiency anticipated at the upgrade will allow a huge increase in precision, in many cases to the theoretical limit, and the ability to perform studies beyond the reach of the current detector. In order to allow the triggerless readout the front end electronics of all subdetectors will be changed, and many subdetectors will be upgraded to cope with the increased occupancy and radiation levels. The Vertex Locator (VELO) is the detector surrounding the interaction region, and will be a hybrid pixel system, featuring silicon pixel sensors with $55 \times 55 \mu\text{m}$ pitch, read out by the VeloPix ASIC. The sensors and ASICs will approach the interaction point to within 5.1 mm and be exposed to a radiation dose of up to 370 MRad or $8.1015 \text{ MeV neqcm}^{-2}$. The ASICs must sustain pixel hit rates of over 800 Mhits/s with an output data rate of 15 Gbit/s. The pixel modules are cooled via evaporative CO_2 circulating in microchannels embedded within a silicon substrate. In parallel to the construction efforts for the Upgrade I, LHCb has recently submitted a physics case for an Upgrade II detector to begin operation in 2031. Here major parts of the detector will be replaced and functionality added to enable the detector to run at a further luminosity step of up to $2 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. It is anticipated to collect approximately 300 fb^{-1} at Upgrade II. In the case of the VELO further enhancements will be needed to address the problems of real time pattern recognition and increased radiation doses. The current status of the VELO Upgrade I construction will be described and concepts for a future Upgrade II VELO presented.

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