

# The LHCb VELO Upgrade

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The LHCb experiment is a detector at the LHC designed to capture decays of b- and c-hadrons for the study of CP violation and rare decays. At the end of Run-II, many of the LHCb measurements remain statistically dominated. For this reason the experiment is currently being transformed, in the Upgrade I programme, to run at higher luminosity from Run III onwards. The trigger scheme will be transformed to read out at 40 MHz to a flexible software trigger. In order to allow the new readout scheme the front end electronics will be changed, and the detectors need cope with the increased occupancy and radiation levels anticipated at the upgrade. The Vertex Locator (VELO) surrounding the interaction region, whose role is to reconstruct and trigger on the primary and secondary vertices of the events.

The upgraded VELO is composed of 52 hybrid silicon pixel modules placed along the beam axis, divided into 2 retractable halves. Each module is equipped with 4 silicon pixel tiles, each read out by 3 VeloPix ASICs. The pixels have a square pitch of 55 microns and the sensors are produced in 0.2 mm thick p-in-n type silicon. The sensors must withstand an integrated fluence of  $\mu\text{m}^2$ , a roughly equivalent dose of 400 MRad. The highest occupancy ASICs will have pixel hit rates of 800 Mhit/sf, with a total rate of 1.6 Tbit/s for the whole detector. The VELO upgrade tiles are mounted onto a cooling substrate made of thin silicon plates with embedded micro-channels that allow the flow of liquid  $\text{CO}_2$ . The secondary vacuum in which the modules are located is separated from the beam vacuum by a thin custom made foil. This foil is manufactured through a novel milling process and possibly thinned further by chemical etching. The upgraded VELO is currently under construction. The detector R\&D, module thermal performance, and the VELO Upgrade production status will be presented.

## I read the instructions

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