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## [D04] Vertex detector for LHCb Upgrade II

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LHCb has recently submitted a document describing the physics case for Upgrade II of the detector to begin operation in 2031. The Upgrade II of LHCb is planned to run at an instantaneous luminosity of  $2 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ , an order of magnitude above that of Upgrade I, which will be commissioned in 2021. The goal of Upgrade II is to accumulate a sample of at least  $300 \text{ fb}^{-1}$  in about 5 years. At this luminosity the mean number of interactions per crossing will be 56, producing around 2500 charged particles within the LHCb acceptance every bunch crossing. To meet this challenge it is foreseen to modify the existing spectrometer, exploiting precision timing in the event reconstruction.

The LHCb upgrade physics programme relies in particular on an efficient and precise vertex detector (VELO). The higher luminosity poses significant challenges and require the construction of a new VELO with enhanced capabilities. Compared to Upgrade I there will be an order of magnitude increase in data output rate and hence also an order of magnitude increases in radiation levels, giving a lifetime fluence of nearly  $1 \times 10^{17} \text{ 1 MeV neqcm}^{-2}$ .

Similarly to Upgrade I, the next detector generation will not have a trigger at the hardware level, and event selection will be done by complete event reconstruction in real time in a CPU farm. To cope with the large increase in pile-up, new techniques to efficiently assign each b-hadron to the primary vertex from which it originates are needed.

Therefore a new hybrid pixel detector with enhanced rate and timing capabilities in the ASIC and sensor will be developed.

The most promising technologies to be used for this future HL-LHCb upgrade will be presented, with emphasis on the timing precision as a tool for vertexing in the next generation detectors. The most recent results from beam tests, focussing on time measurements, will be shown together with possible R&D scenarios for the future upgrade.

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**Session Classification:** Timing Detector I