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The LumiTracker: a hybrid pixel detector for luminosity measurements

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The LumiTracker is a newly proposed detector upstream of the LHCb interaction point. It consists of a compact telescope design, composed of six consecutive planes, each one based on hybrid silicon pixel detectors. The main goal is to provide a real-time luminosity estimate by reconstructing tracks. Two construction phases are already envisioned: an initial demonstrator using 200 μm n-on-p sensors read out by VeloPix ASICs to be installed in the end of the year shutdown of 2023/2024; Followed by a state-of-the-art detector equipped with thinner sensors (100 μm or below are considered) bonded to Timepix4 chips.

Detailed simulation studies were performed to optimise the detector layout. Our results show that a 1% precision is achievable over an integration time of 5 seconds, considering an average number of 7.6 proton interactions per bunch crossing. In particular, the LumiTracker is designed to perform measurements of the longitudinal profile of the luminous region with an expected resolution of order of 1 mm per track. With the improved track time resolution of better than 200 ps, the LumiTracker would be the first detector at LHCb to exploit precise timing information for track reconstruction and thus an important stepping-stone for future upgrades of the experiment. In addition, the LumiTracker would be able to identify spurious collisions caused by satellite bunches.

In this talk, the feasibility studies together with the LumiTracker projected performance and the detector planning and specifications within the global LHCb detector framework are presented.

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