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Current and prospective performance of the LHCb tracking system

The LHCb tracking system consists of a Vertex Locator around the interaction point, a tracking station with four layers of silicon strip detectors in front of the magnet, and three tracking stations, using either straw-tubes or silicon strip detectors, behind the magnet. This system allows to reconstruct charged particles with a high efficiency (typically > 95% for particles with momentum > 5 GeV) and an excellent momentum resolution (0.5% for particles with momentum < 20 GeV). The high momentum resolution results in very narrow mass peaks, leading to a very good signal-to-background ratio in such key channels as Bs -> mu mu. Furthermore an optimal decay time resolution is an essential element in the studies of time dependent CP violation. Thanks to the excellent performance of the tracking system, a decay time resolution of ˜50 fs is obtained, allowing to resolve the fast B0s oscillation with a mixing frequency of 17.7 ps-1. In this talk, we will give an overview of the track reconstruction in LHCb and review its performance in Run I of the LHC. We will highlight the challenges and improvements of the track reconstruction for the data taking period from 2015 on, discussing efforts to improve the timing in the online reconstruction as well as approaches to unify the online and offline reconstruction. The upgrade of the LHCb experiment will run at an increased instantaneous luminosity of 2x10ˆ33 cmˆ-2 sˆ-1 with a fully software based trigger, allowing to read out the detector at a rate of 40MHz. For this purpose, the full tracking system will be newly developed. We will present the performance of the tracking system for the LHCb upgrade, highlighting the improvements with respect to the current tracking system of LHCb, and review the track finding strategy. Special emphasize will be put on the need for fast track reconstruction in the software trigger, also giving examples of the potential use of parallelism in the pattern recognition. Finally, we will give some prospects of the physics performance with the LHCb upgrade for channels relying on excellent tracking capabilities.

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