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Tracking and vertexing in LHCb

The LHCb detector is a multipurpose single-arm forward spectrometer. The main goal of its design is heavy flavor physics, covering large range of topics such as rare beauty and charm decays, CP violation and dark matter searches.

It's excellent resolution and reconstruction efficiency in the rapidity region of $2 < \eta < 5$ makes much broader physics program possible, including searches for new particles or heavy-ion collision studies.

LHCb tracking system consists of the Vertex Locator (VELO), a high granularity silicon-strip vertex detector, the Tracker Turicensis (TT), a silicon strip detector upstream of the magnet, and three Tracking Stations (T-Stations), consisting of the Inner Tracker (IT) in the inner area and the Outer Tracker (OT) in the outer area. The IT is a silicon strip detector, while the OT is made of straw drift tubes. In the most upstream region, five rectangular muon stations, based on the multi wire proportional chamber technology, are placed. This design is very heterogeneous and requires a complex system of charged particle reconstruction algorithms. LHCb has set up a real-time fully automated alignment systems to ensure offline data precision already at the online data level.

In this talk, the alignment, the track reconstruction and primary vertex reconstruction will be presented, with focus on the overall performance. Several data-driven studies were developed in order to describe the tracking efficiencies with outstanding precision. Such study is an important part of all analyses, crucial for any high-precision measurements. While most methods are based on clean muon samples, due to recent hints of lepton universality violation, method for the evaluation of the efficiency dedicated to electrons is being developed. Moreover, LHCb's unique trigger setup allows prompt access to such muon and electron samples. Such robust techniques with fast accessibility to data does not only directly impact the quality of the LHCb results, but also serve as a basis for the upcoming upgrade.

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