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Radiation length imaging with high resolution telescopes

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The construction of low mass vertex detectors with a high level of system integration is of great interest for next generation collider experiments. Radiation length images with a sufficient spatial resolution can be used to measure and disentangle complex radiation length X/X0 profiles and contribute to the understanding of vertex detector systems. Test beam experiments with multi GeV particle beams and high resolution tracking telescopes provide an opportunity to obtain precise 2D images of the radiation length of thin planar objects. At the heart of the X/X0 imaging is a spatially resolved measurement of the scattering angles of particles traversing the object under study. The main challenges are the alignment of the reference telescope and the calibration of its angular resolution. Systematical uncertainties can be minimized by conducting a calibration measurement, where the module under study is replaced by an aluminum target with a well known thickness profile. In order to demonstrate the capabilities of X/X0 imaging, a test beam experiment has been conducted. The devices under test were two mechanical prototype modules of the Belle II vertex detector. A data sample of 100 million tracks at 4 GeV has been collected, which is sufficient to resolve complex material profiles on the 30μm scale.

Summary

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