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Material budget estimation of the CMS tracker with triplet method

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Silicon trackers are used extensively in high energy physics experiments. e.g. in ATLAS and CMS experiments at LHC, Belle II experiment at KeK. A common feature in these tracking systems is that they have multiple layers of silicon detectors. As charged particles pass through the silicon sensors, ionization gives rise to signal in individual channels of each detector. Hits in multiple layers of a tracking system are then used to reconstruct the tracks of the charged particles. The design of these tracking systems are optimized keeping in mind the material budget of the system. The alignment of the silicon detectors and the estimation of the material budget of tracking detectors is crucial for the physics programme of any experiment, especially for precision measurements, since they contibute to the relative precision of measurement of the transverse momentum. The CMS experiment is planning to perform a measurement of the W boson mass with a precision of at least 10 MeV: this requires the measurement of muon transverse momentum to a relative precision better than $10-4$. In this presentation, we shall propose a novel method to locally calibrate a multi layered silicon tracking system in a collider based experiment with the magnetic field along the beam direction. The idea is to use a small track segment, a triplet, built out of hits in three consecutive layers in the tracker and use the local sagitta of this triplet to estimate the material in the middle layer, and the relative alignment of the modules in the transverse plane which will ultimately be provided as input to the transverse momemtum calibration. A comparison will be made between the results obtained from collision data and simulated events from the CMS detector.

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