The CMS Silicon Tracker

...is one of the main components of the CMS experiment at the LHC. It consists of ~16000 silicon strip and pixel sensors covering an active area of ~200m² within the tracker volume of 24.4m³.

**Components of the Tracker**

The Barrel strip detector consists of 4 inner (TIB) and 6 outer (TOB) layers. The first two layers in TIB and TOB use double-sided sensors. The Endcap strip detector is made of 3 inner (TID) and 9 outer (TEC) discs (rings 1.2 and 5 are double sided). The Pixel detector consists of 3 barrel layers at r= 4.4, 7.3 and 10.2 cm, and of two endcap discs.

The Strip Sensors consist of 512 or 768 strips with a pitch of 80...200μm. Their resolution in the precise coordinate is in the range 20...50μm. The sensors are made of pixels of size 100(μ)x 150(μ)μm², with a resolution of 10...15μm.

**Tracker Material Budget**

A large fraction of the tracker material consists of electrical cables, cooling pipes, support structures, electronics etc. As a result, the tracker material budget can exceed the equivalent of one radiation length for certain regions of η, which affects hadron and electron reconstruction.

**Track Reconstruction**

The baseline algorithm for track reconstruction in CMS is the Combinatorial Kalman Filter. Track reconstruction proceeds through the following four stages:

- **Trajectory Seeding**
  Trajectory seeds, the starting points for track finding, are reconstructed from pairs of hits in the pixel detector and a vertex constraint.

- **Pattern Recognition**
  Trajectory building using the Kalman filter proceeds inside-out, propagating from layer to layer and taking the effects of energy loss and multiple scattering into account. Trajectory candidates are added for each compatible hit, and the best candidates are grown in parallel up to the outermost layers.

- **Trajectory Cleaning**
  Ambiguities which would lead to track double counting are resolved, using the fraction of shared hits for any pair of trajectories.

- **Track fitting and smoothing**
  The final track parameters are obtained by running two Kalman filters in opposite directions. The smoothed track states correspond to the weighted mean.

**Alignment of the CMS Tracker**

The alignment of the CMS tracker requires O(100k) alignment parameters to be determined with a precision of ~10μm, in order not to degrade the very good intrinsic resolution of the silicon modules. In addition to the knowledge of the positions of the modules from measurements at construction time, alignment will proceed by two means:

- **Laser Alignment System**
  The Laser Alignment system will be used to monitor movements of the larger tracker structures (half-barrels and endcap discs) on a continuous basis at the level of 10μm.

**Impact of Misalignment**

Alignment and tracking parameters will be determined from hits in the pixel detector and a Kalman filter alignment: Residuals in local x for TIB layers 1 (left) and 2 (right) as a function of η.

**References**


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