Full Scale Tracker Alignment with Millepede II and CMSSW

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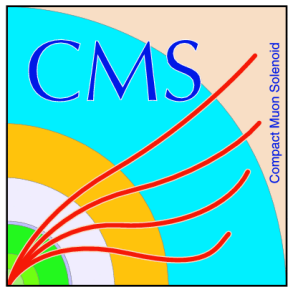
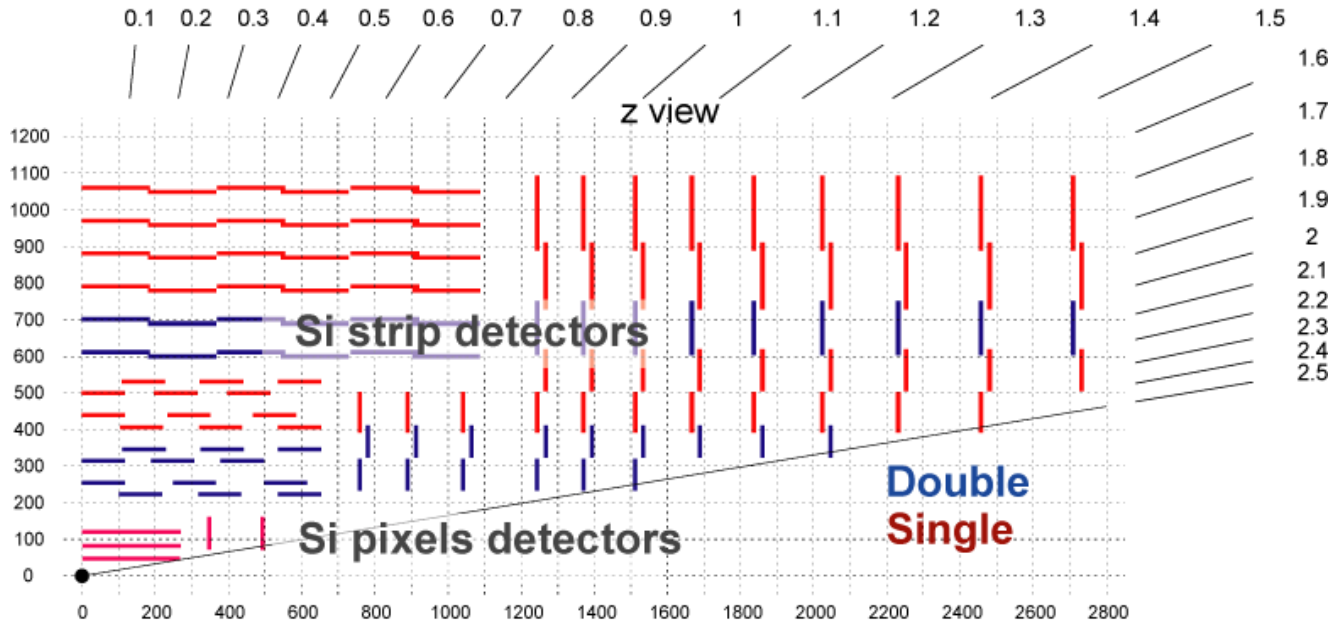


Outline

- Introduction
- Data Sets
  - Cosmics production
- Scenario and Pede Settings
- Pixel Endcap Hit Statistics
- Alignment Result
- Comparison with ORCA Study
- Summary and Outlook

The CMS Tracker



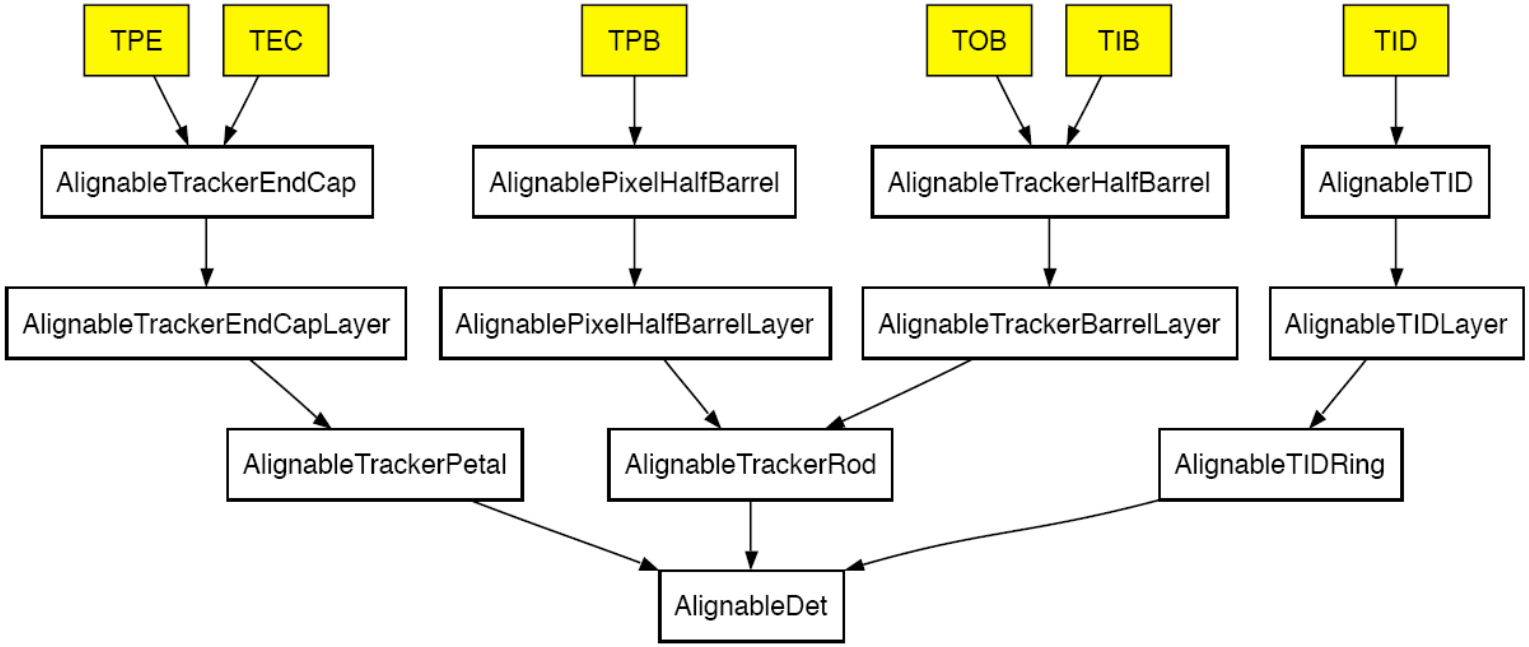
The layout of the CMS inner tracker

rz-view

(upper right quarter)

- 15148 silicon strip modules
- 1440 silicon pixel modules
  $\Rightarrow 16588 \times 6 = 99528$ rigid body parameters
- some insensitive, e.g. global z of single sided barrel strips
- separate modules of “double sided” strip layers treated as one in Alignment
  $\Rightarrow$ about 45 000 parameters used

Tracker Hierachy



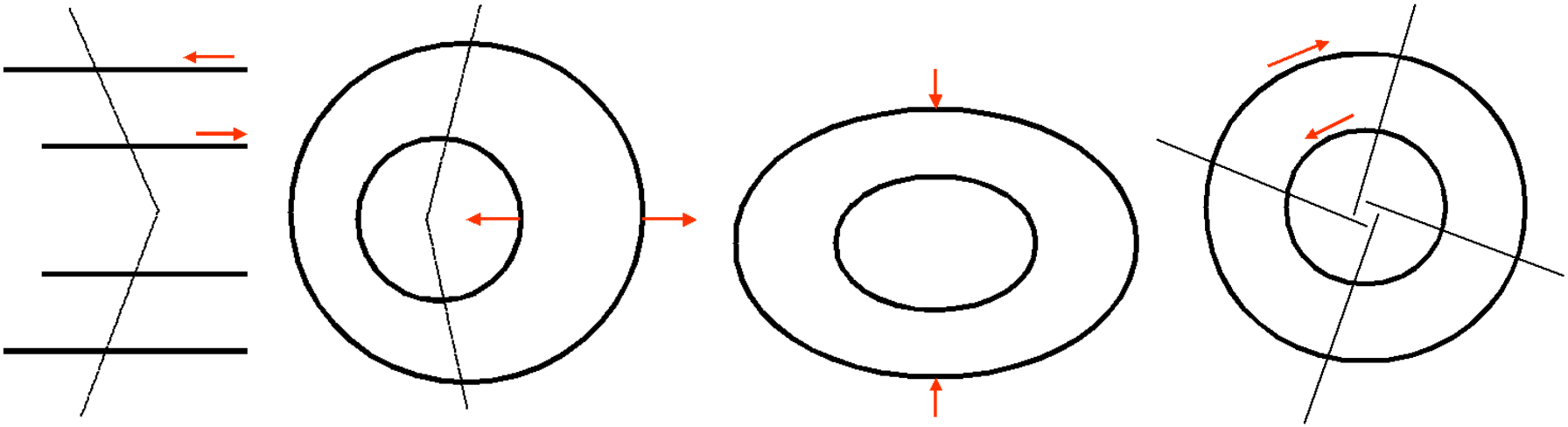
Placement w.r.t.	TOB	TIB	TEC
Module vs. rod/shell/petal	$100\mu m$	$200\mu m$	$[\mathbf{50} - 100]\mu m$
Rod/shell/petal vs. disc/cylinder/disc	$[\mathbf{100} - 500]\mu m$	$200\mu m$	$[\mathbf{100} - 200]\mu m$
Disc/cylinder/disc vs. disc/cylinder/disc	$[100 - \mathbf{500}]\mu m$	$[100 - \mathbf{500}]\mu m$	$[100 - \mathbf{500}]\mu m$

Alignment follows construction hierarchy (being revisited)

- Flexibel: align large structures with low statistics
- Simultaneous alignment: easier understanding of correlated movements
  (constraints to remove “double defined” degrees of freedom)

Distortions

Minimising χ^2 can be insensitive to certain global distortions.



(There are more less obvious modes!)

- Intrinsic to problem, independent of method.
- Dependent on data fed into matrix.
- Biases measurements.
- Cosmics vital to fix some of them.
- Lack of tracks with “known” momentum as e.g. $e^+e^- \rightarrow \mu^+\mu^-$.