ILD Tracking Status

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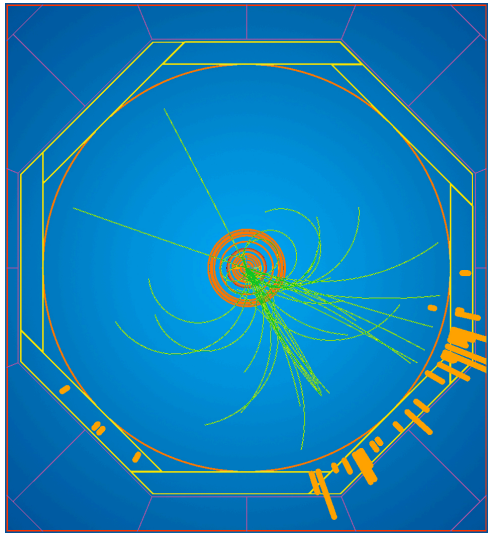
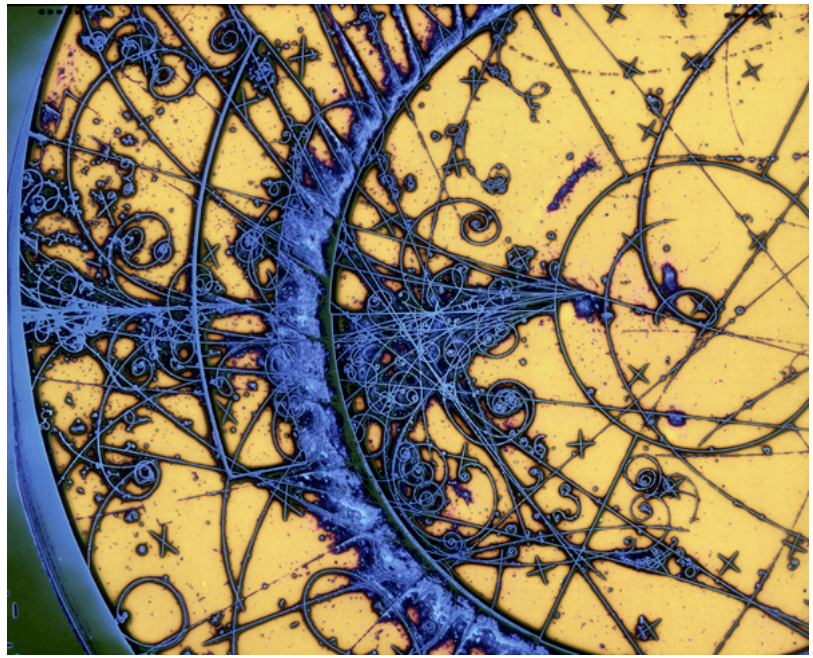
ILD Workshop 2012 at Kyushu
23rd May 2012



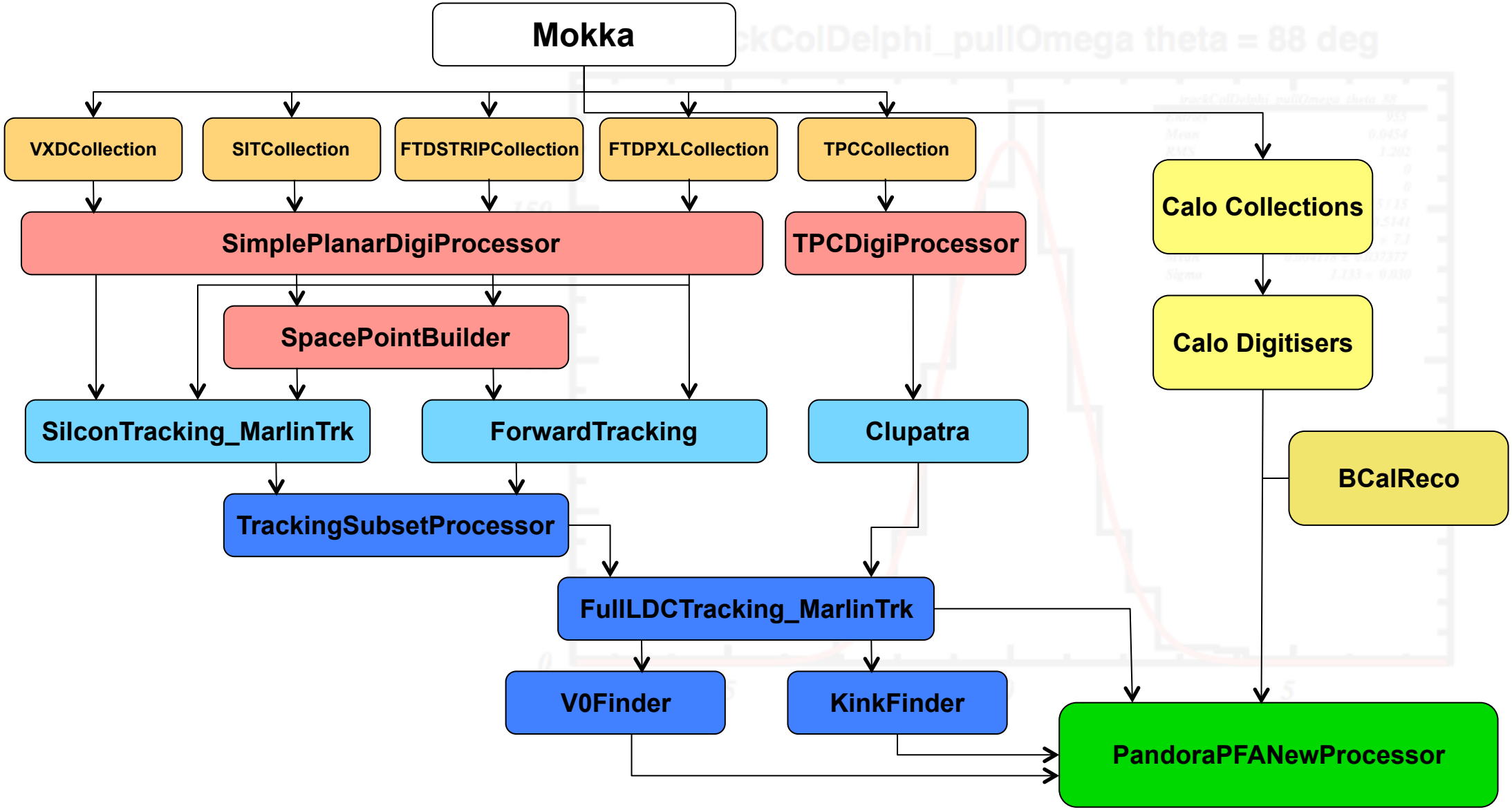
iLC SOft

Overview

- **Track Reconstruction Overview**
- **Current Status**



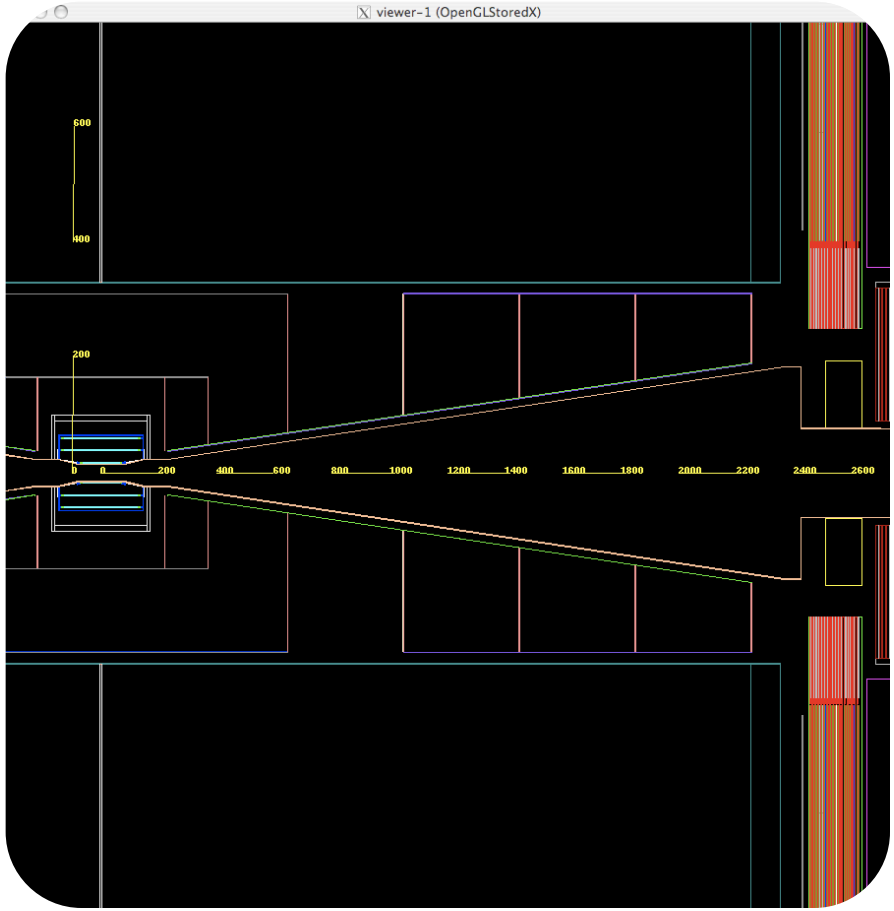
ILD Track Reconstruction Overview

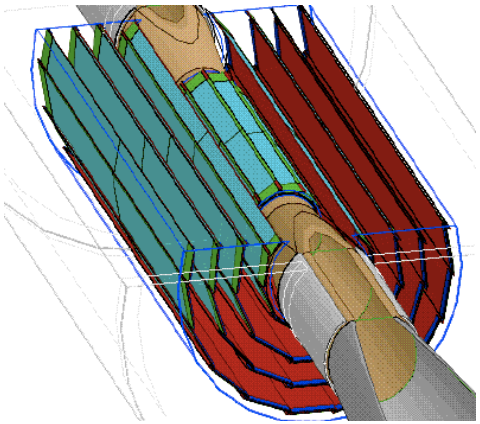


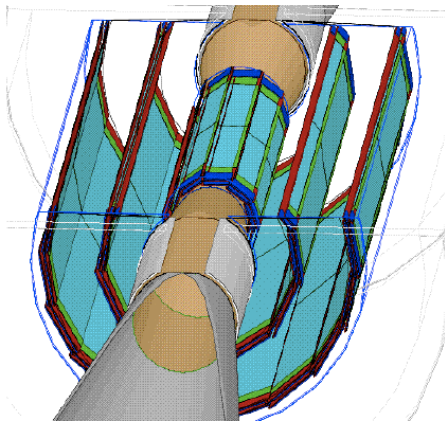
ILD Tracker Simulation

DBD calls for more realistic detector descriptions

LoI Simulation used a mixture of realistic and simplified detector descriptions



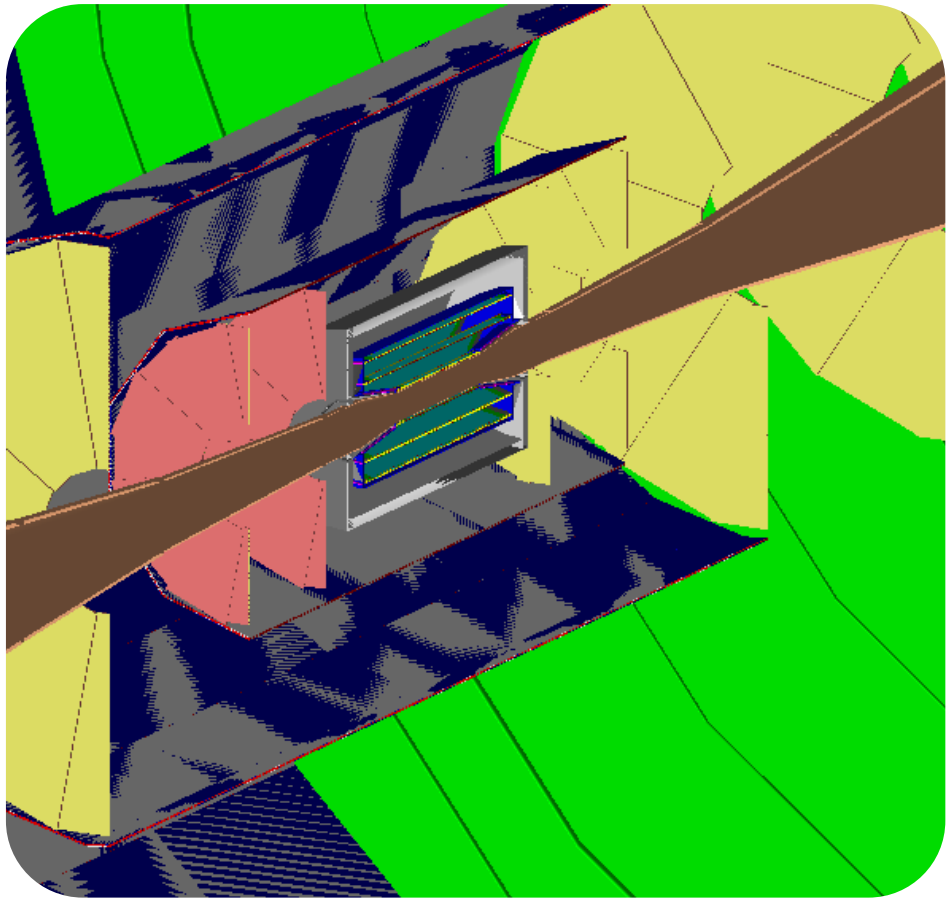


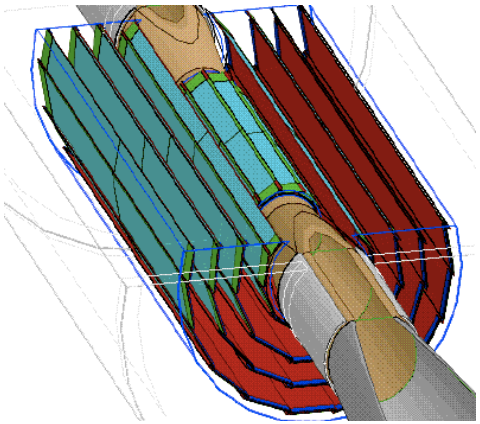


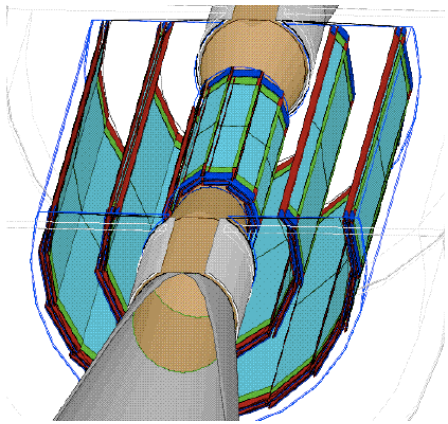
ILD Tracker Simulation

DBD calls for more realistic detector descriptions

Silicon Trackers have now been revised to bring them up to the same level of realism



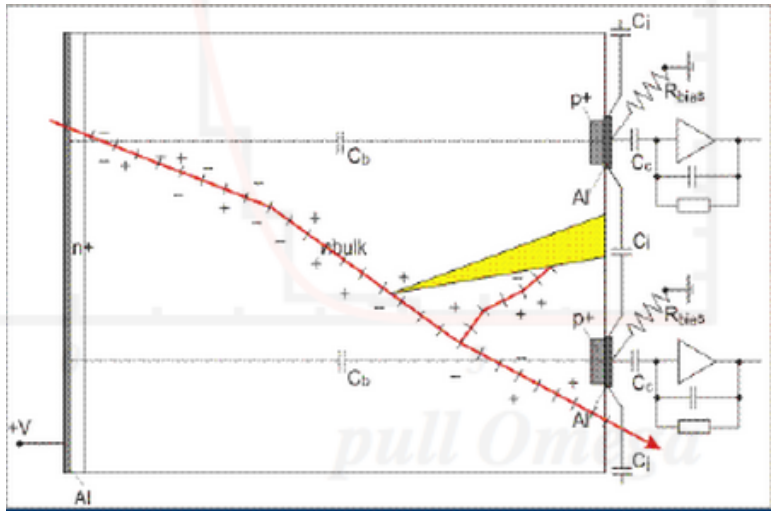




Digitisation

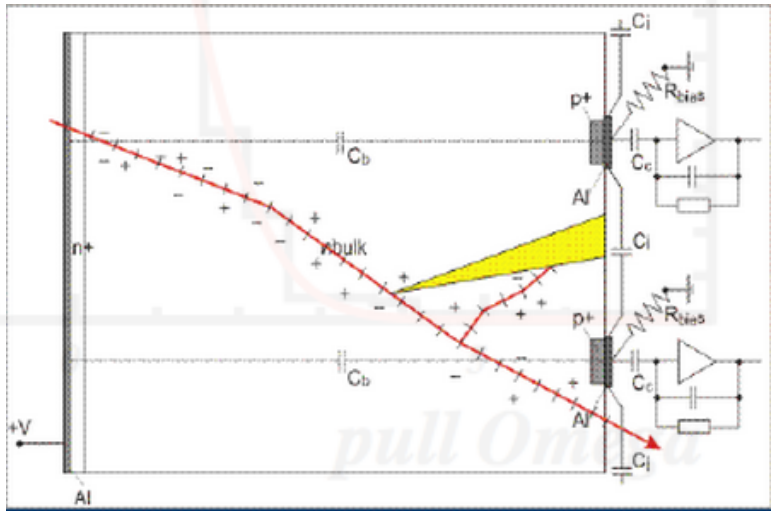
- TPC uses well established parameterised smearing defined by the LC-TPC Group.
- Silicon Detectors: VXD, SIT, SET and FTD
  - We have code which is able to perform detailed channel by channel digitisation based on the code written by Zbynek Drásal (Charles University Prague).
  - We also have detailed digitisation in the case of FPCCD (Daisuke Kamai).
  - For simplicity and CPU efficiency we will use a gaussian smearing approach for the DBD mass production.

	$\sigma_{r-\phi}/\mu\mathrm{m}$	$\sigma_z/\mu\mathrm{m}$		$\sigma_{r-\phi}/\mu\mathrm{m}$	$\sigma_z/\mu\mathrm{m}$
VTX	2.8	2.8	FTD	5.8	5.8
SIT/SET	7.0	50.0	ETD	7.0	7.0
TPC	$\sigma^2_{r\phi} = 50^2 + 900^2 \sin^2\phi + \left((25^2/22) \times (4/B)^2 \sin\theta\right) z\,\mu\mathrm{m}^2$ $\sigma^2_z = 40^2 + 8^2 \times z\,\mu\mathrm{m}^2$				

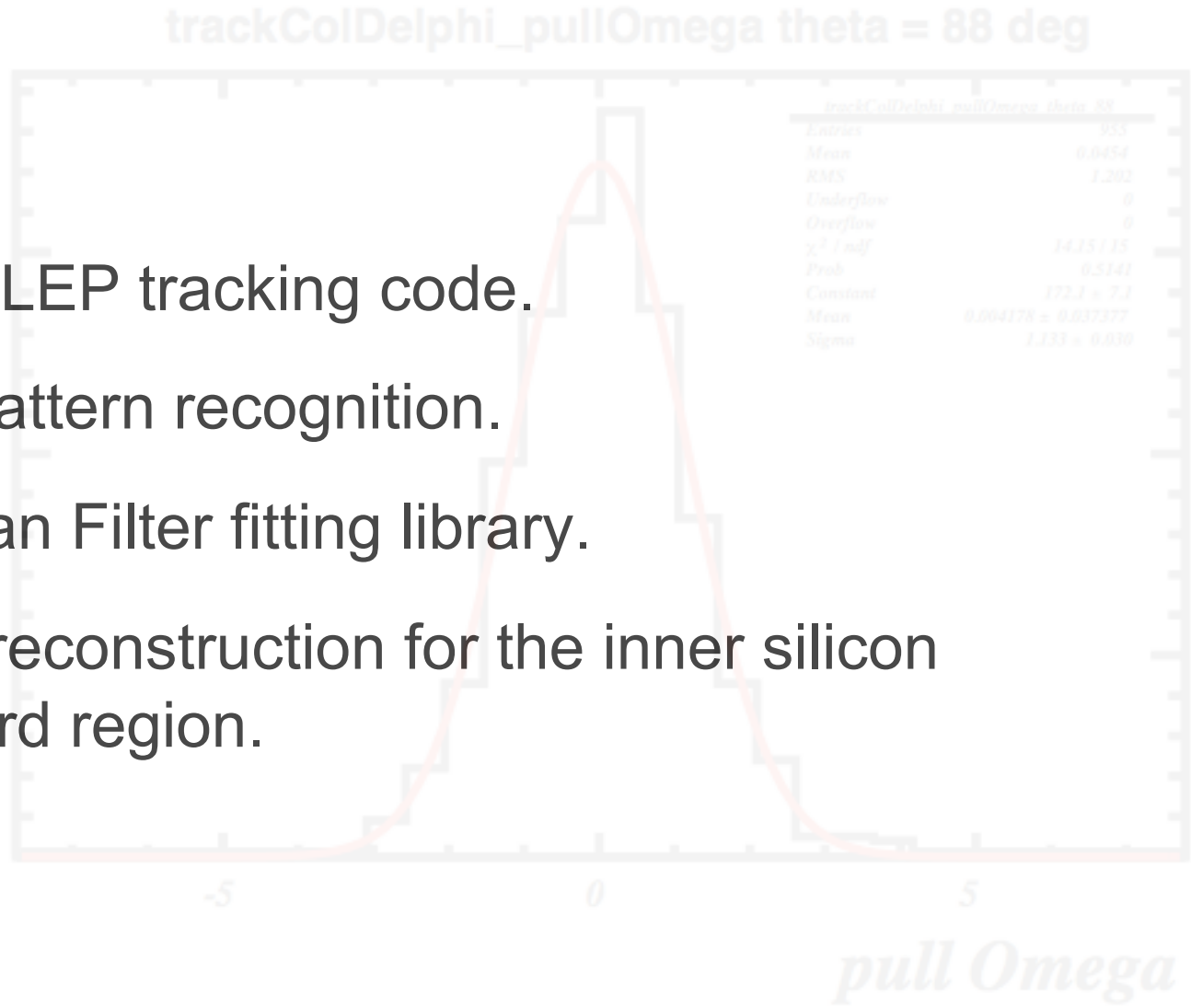


Digitisation

- FTD and SIT strip detectors are now correctly treated in the reconstruction.
- Hits are constrained to individual sensors.
- In the FTD Strip Discs and SIT, pairs of back-to-back sensors are used to form composite space-points which can be used in pattern recognition.
- These 3D space-points are complete with the correct covariance matrix for global x,y,z coordinates, meaning that they can be used in quick pre-fits during pat-rec.

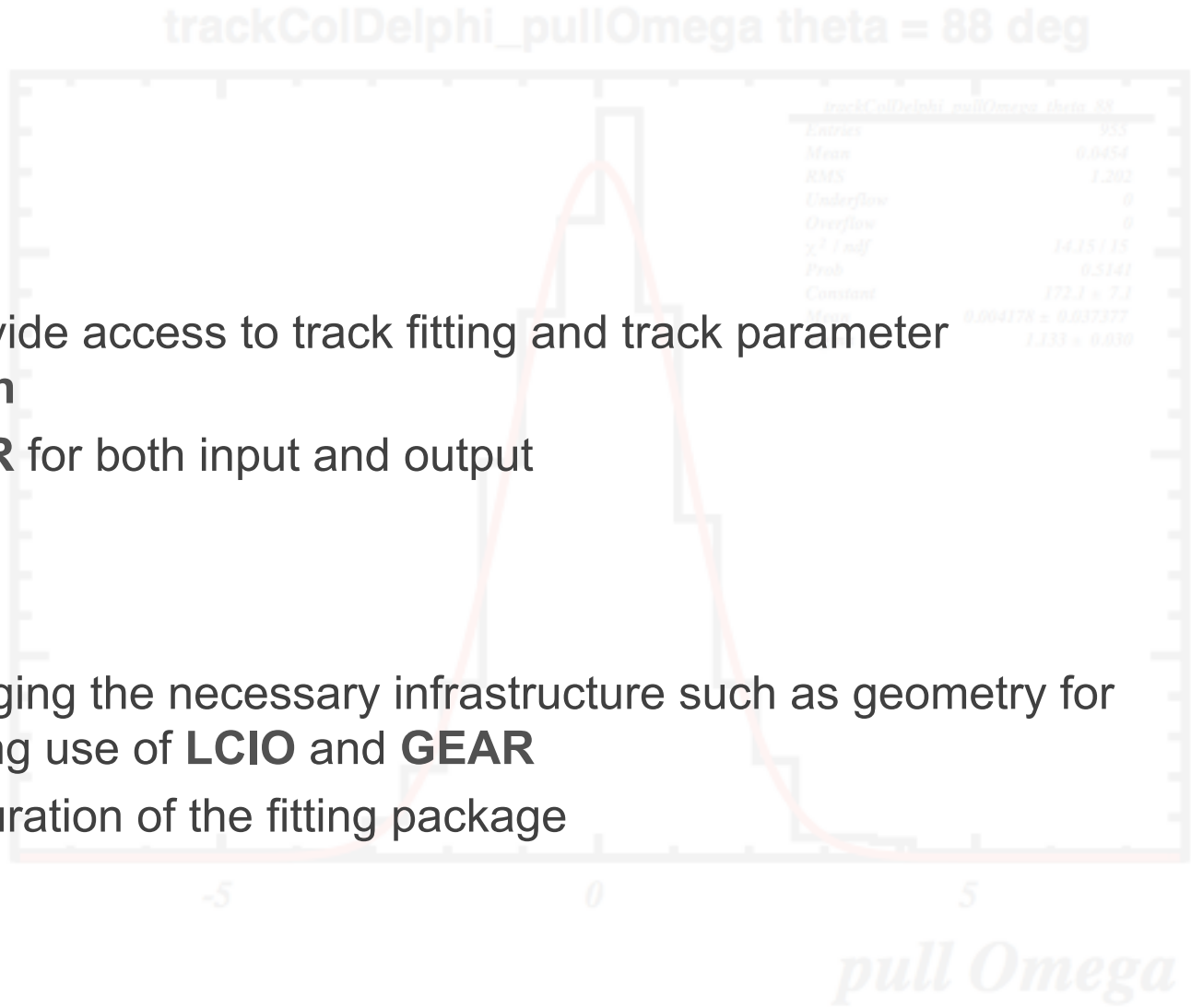


Tracking Code rewrite for the DBD



- Leave behind F77 LEP tracking code.
- Rewrite the TPC pattern recognition.
- Use KalTest Kalman Filter fitting library.
- Stand alone track reconstruction for the inner silicon trackers and forward region.

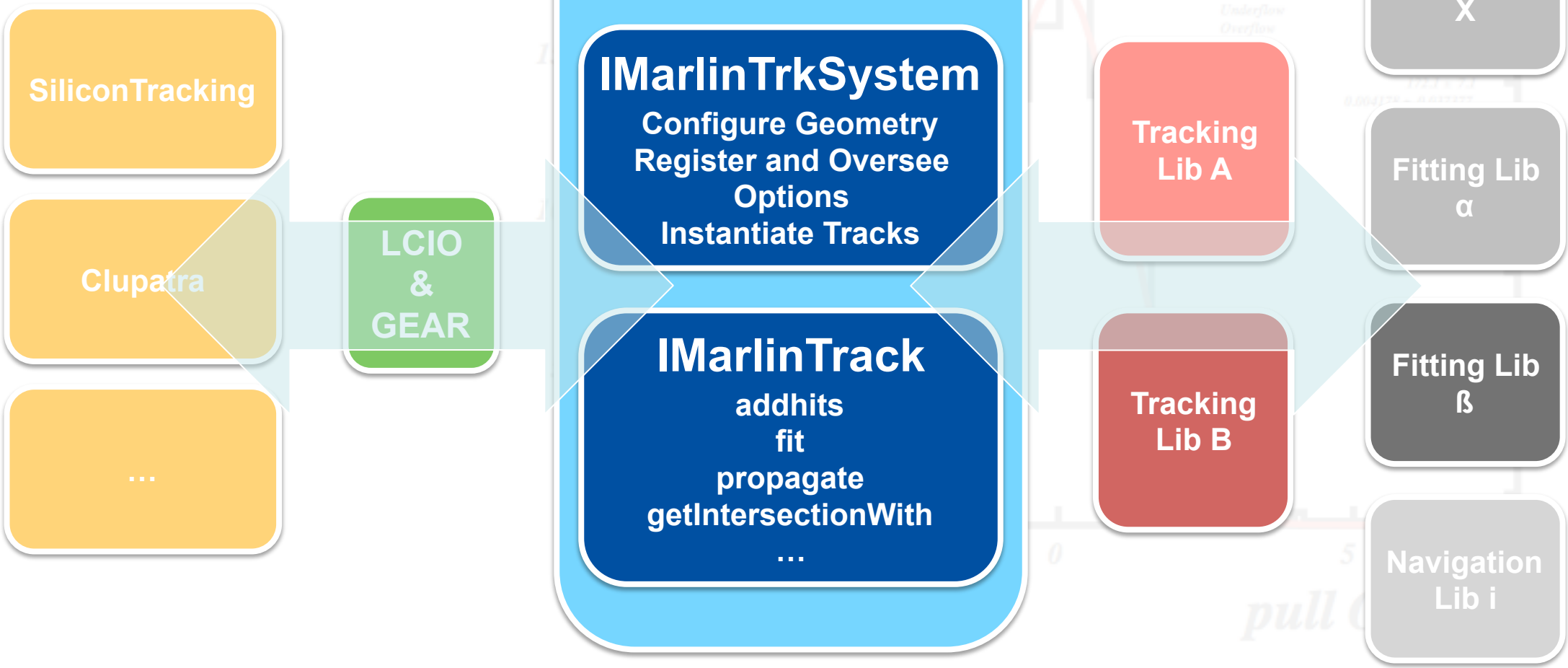
IMarlinTrack and IMarlinTrkSystem



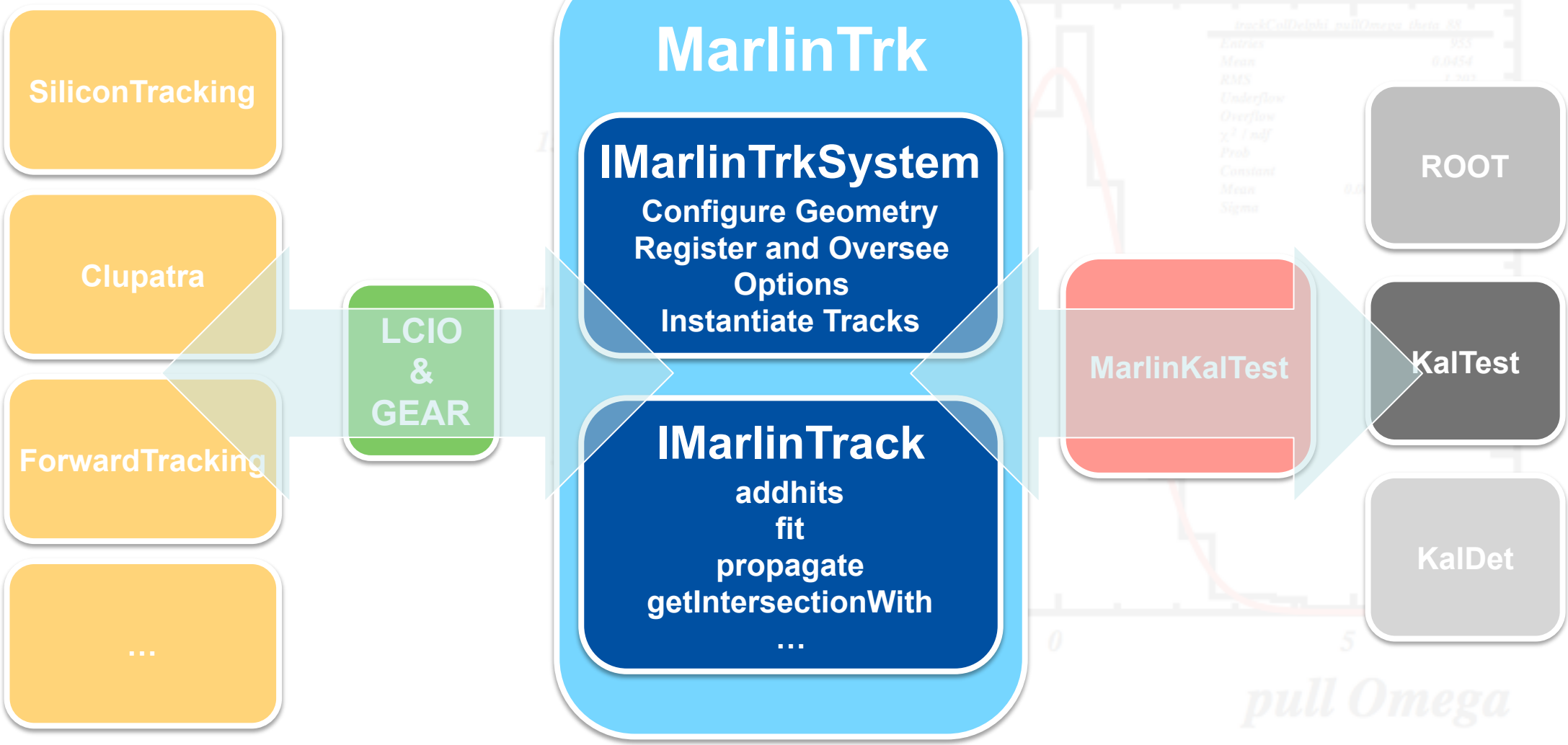
- **IMarlinTrack**
  - interface class to provide access to track fitting and track parameter manipulation in **Marlin**
  - uses **LCIO** and **GEAR** for both input and output

- **IMarlinTrkSystem**
  - responsible for managing the necessary infrastructure such as geometry for the track fitting, making use of **LCIO** and **GEAR**
  - controlling the configuration of the fitting package

IMarlinTrack and IMarlinTrkSystem

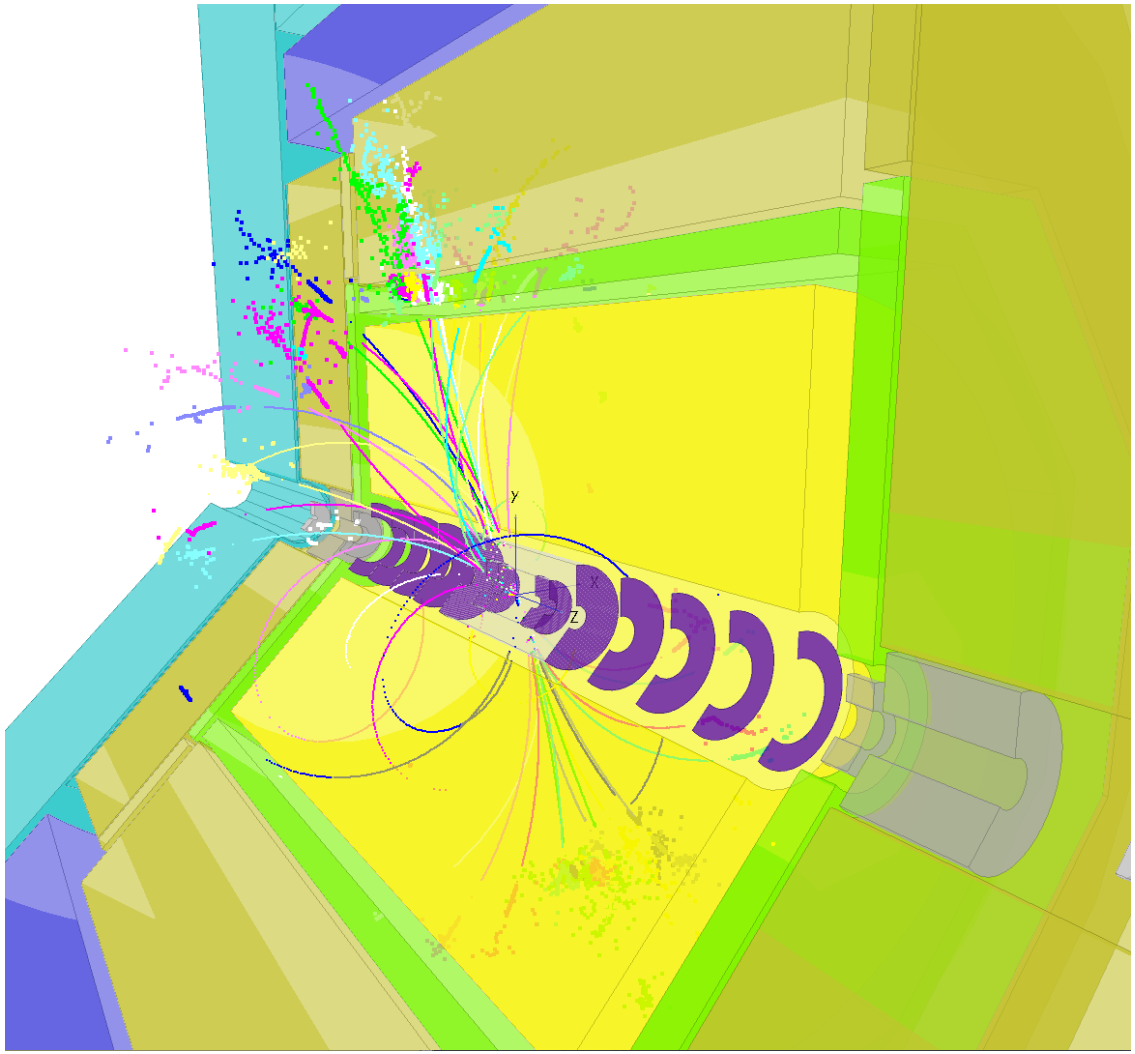


MarlinTrk KalTest Implementation

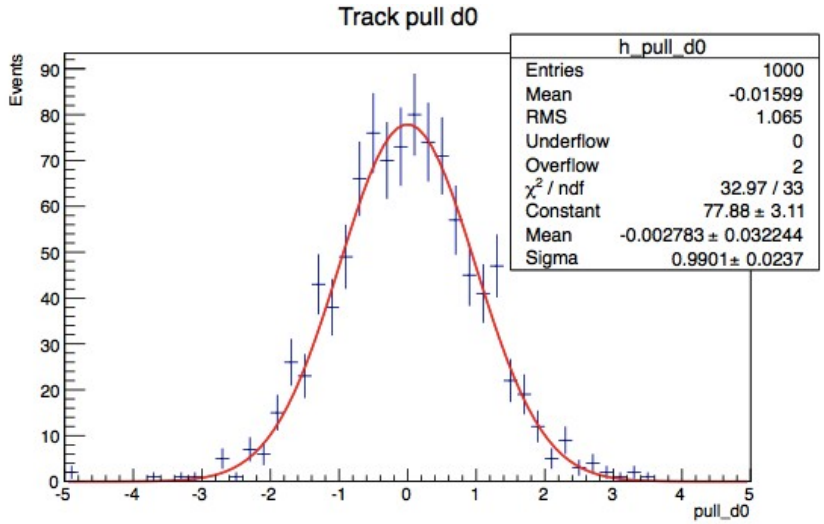


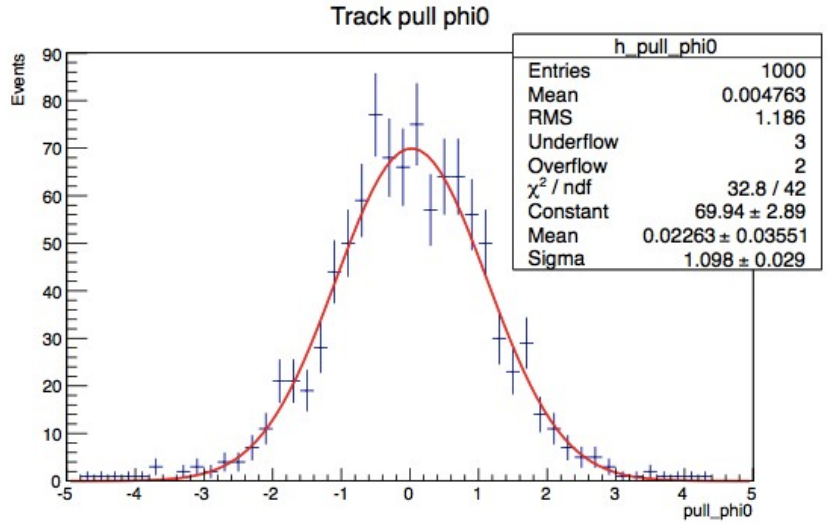
Track Fitting with Kaltest

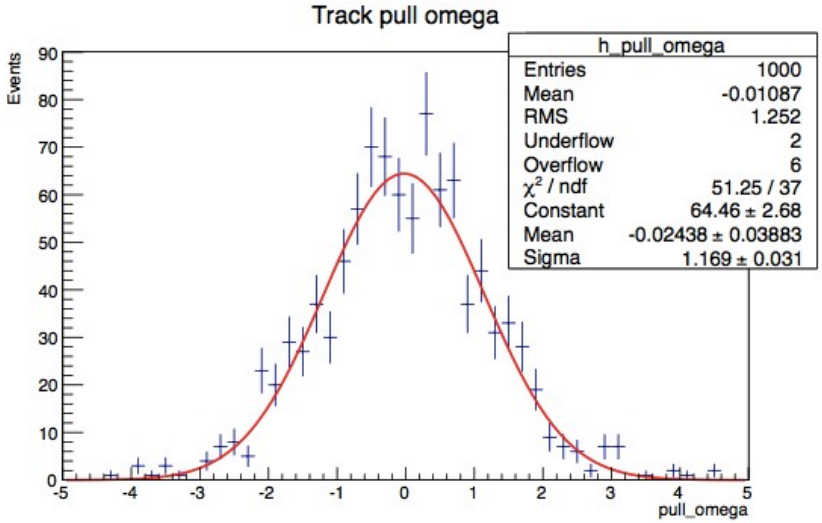
- Used throughout the Track Reconstruction for ILD, includes measurements from VXD, SIT, FTD, TPC and SET using **Shallow Stereo Angle Strips**.
- Dimensionality of measurements is treated correctly, no approximations using sqrt(L/12) which could introduce biases.
- Track parameters are made available at the IP, first hit, last hit, and the extrapolation to the calo face.

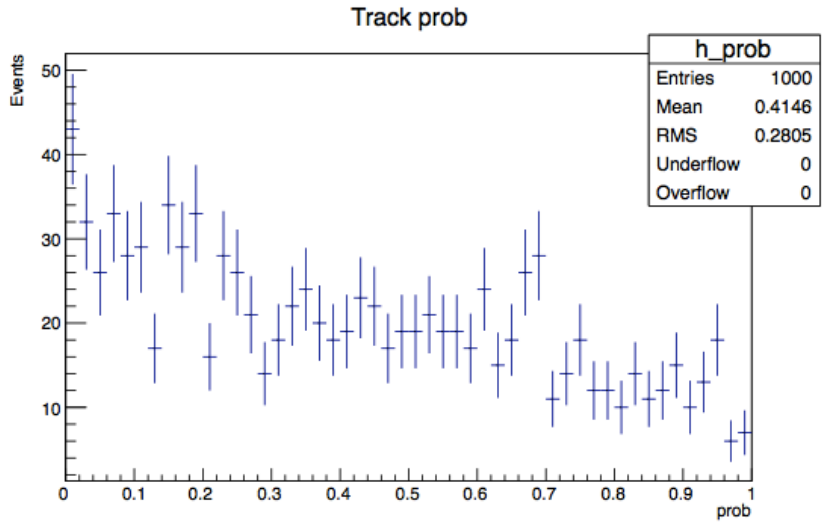


Central tracks 10 Gev Muons at 87 degrees

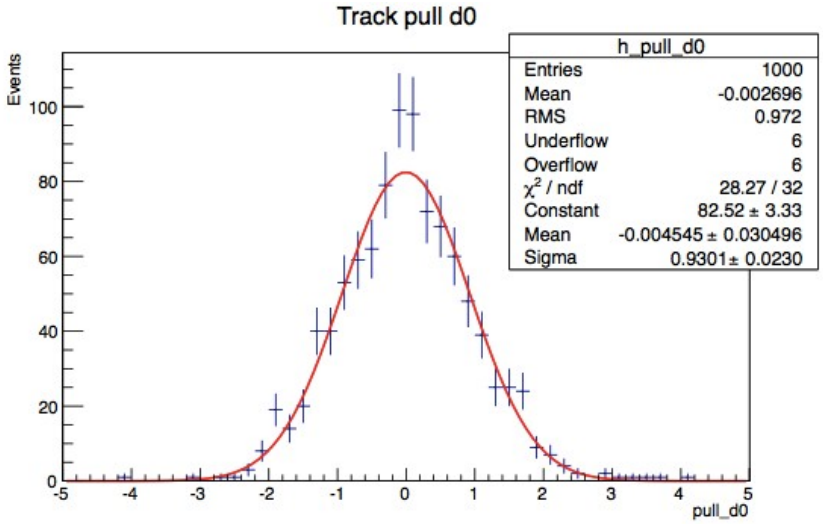


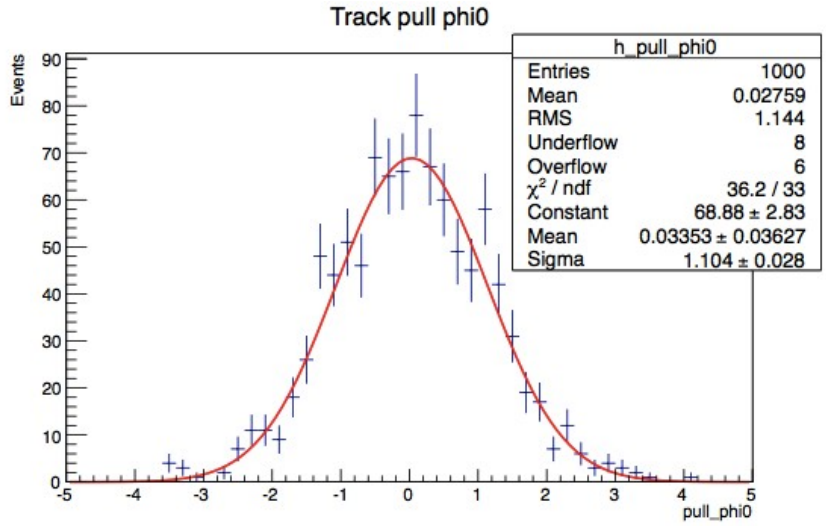


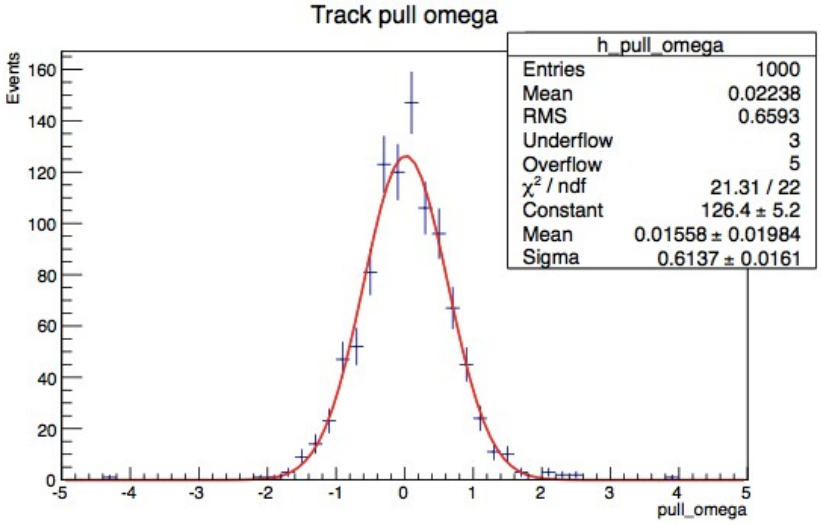


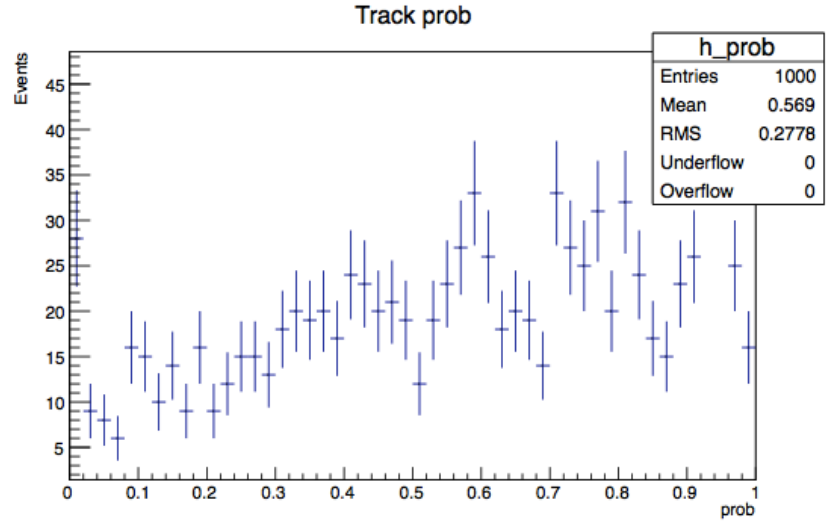


Forward tracks 3 Gev Muons at 8 degrees



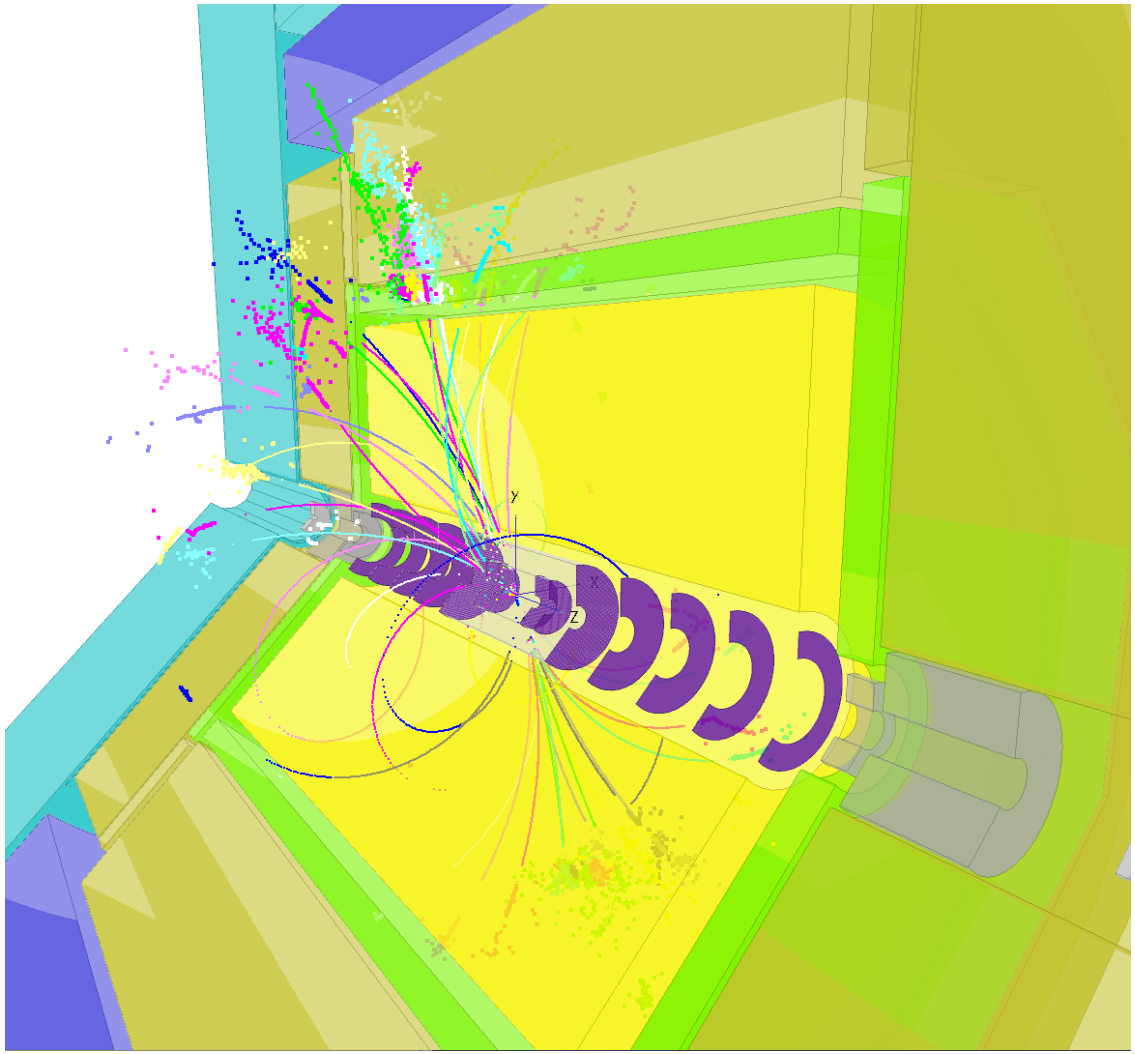






Track Reconstruction

- Clupatra is used for finding tracks in the TPC.
- SiliconTracking_MarlinTrk is used for standalone tracking using hits from VXD and FTD Pixels, and Space-Points from the SIT and FTD strip sensors.
- Merge Track collections from SiliconTracking and ForwardTracking to produce a **Single Track Collection** using TrackingSubSetProcessor.
- Send these two track collections to FullLDCTracking_MarlinTrk for the final track matching and ambiguity resolution.



Silicon Tracking

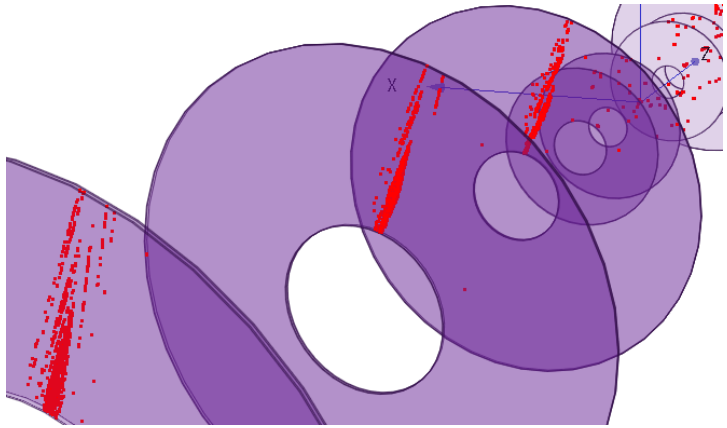
- SiliconTracking, as well as being adapted to use the new MarlinTrk fitting code, has been reworked to remove some of the previous limitations in its search strategy. Namely the use of Space-Points from the strip detectors and the criteria for the number of hits vs the chi2 probability cut.

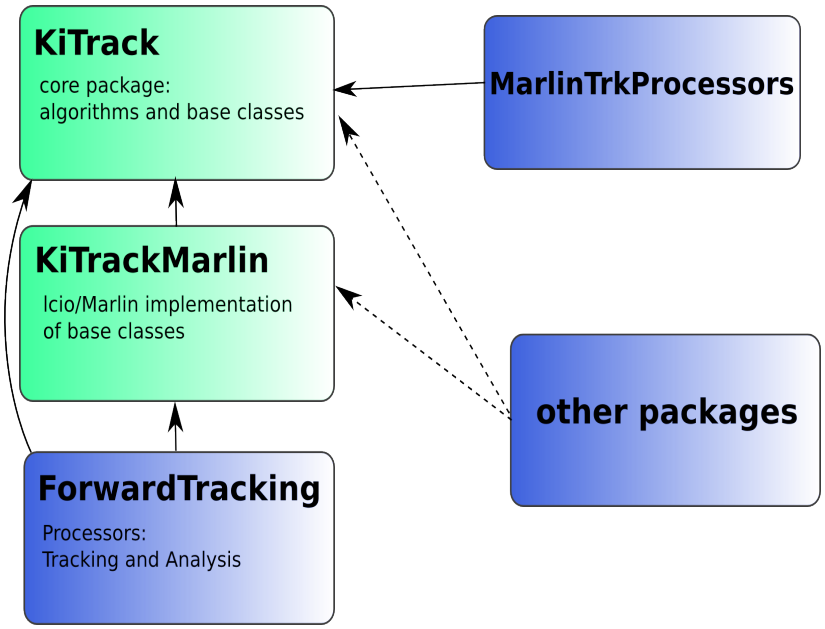
- Very recently a significant problem concerning the dropping of SIT hits has been traced to a bias in the position of the Space-Points. This has been addressed and the fix is included in the latest software release v01-13-06.

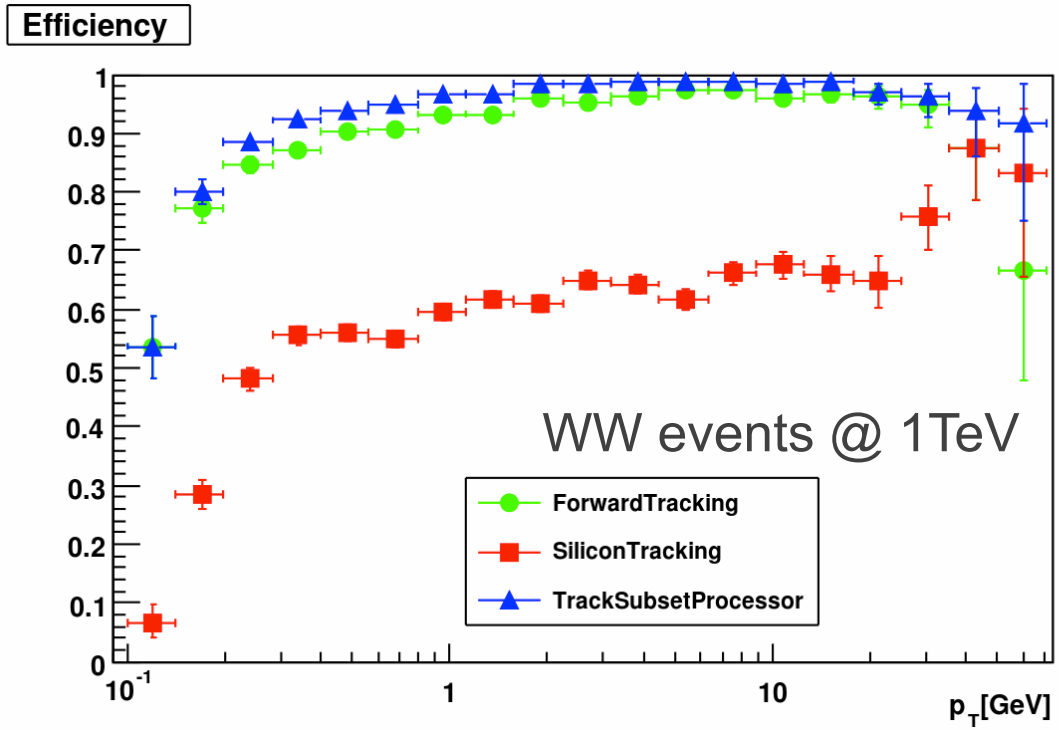
- The next step is to perform scans of the complete angular and momentum space to check for areas of inefficiency.

Forward Tracking

- Standalone forward tracking based on cellular automatons and Hopfield networks.
- Well established in iLCSoft releases
- Currently being optimised for dense jets at high energy – 1TeV.

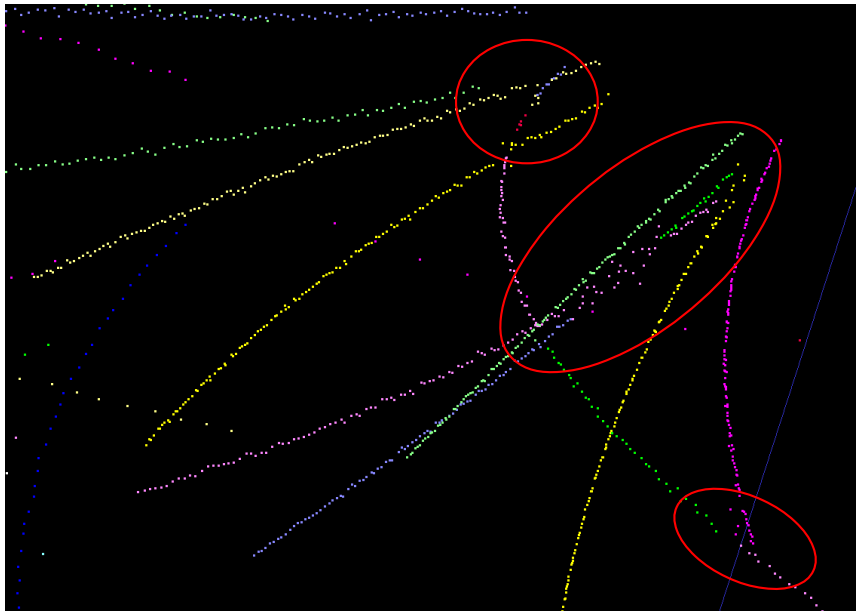


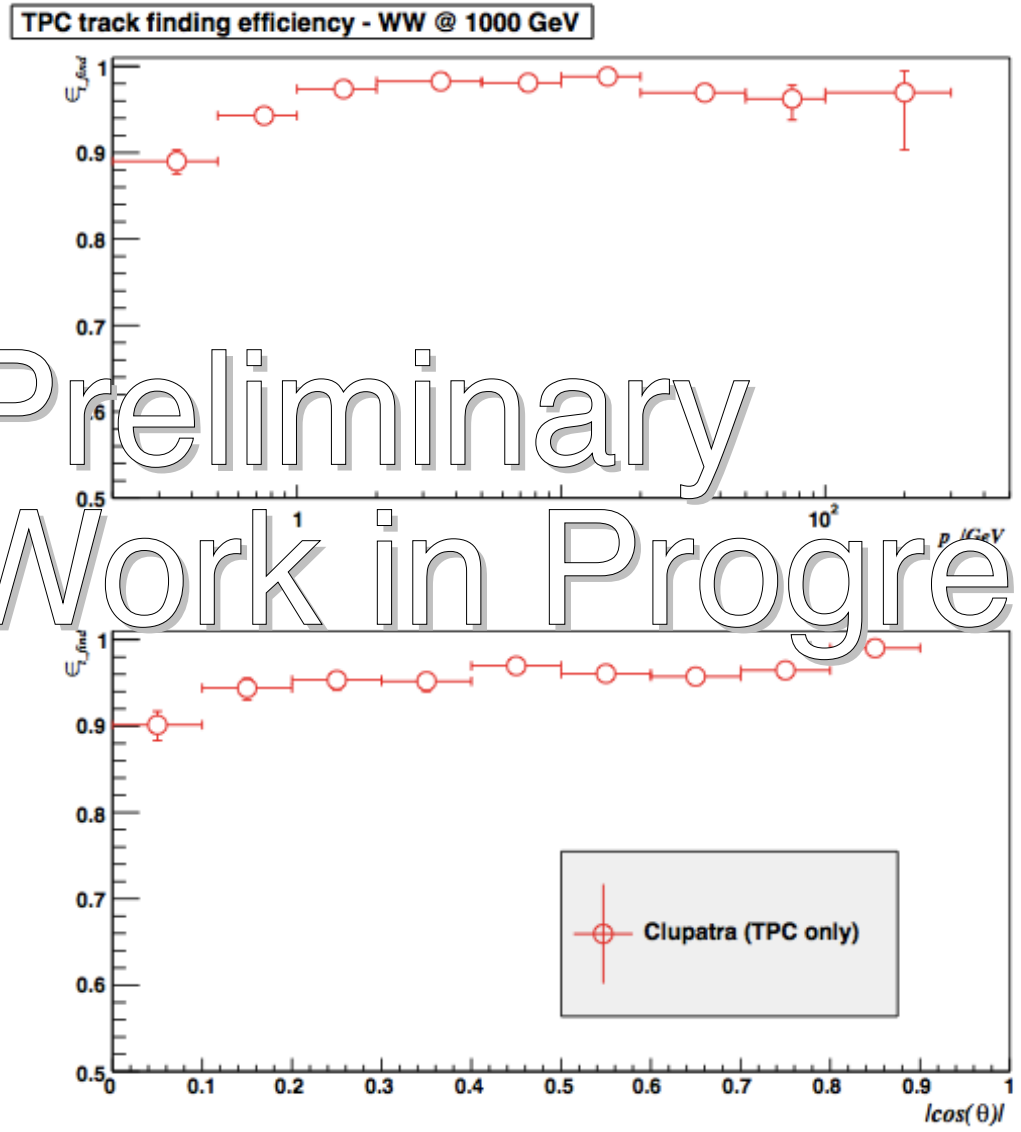




Clupatra

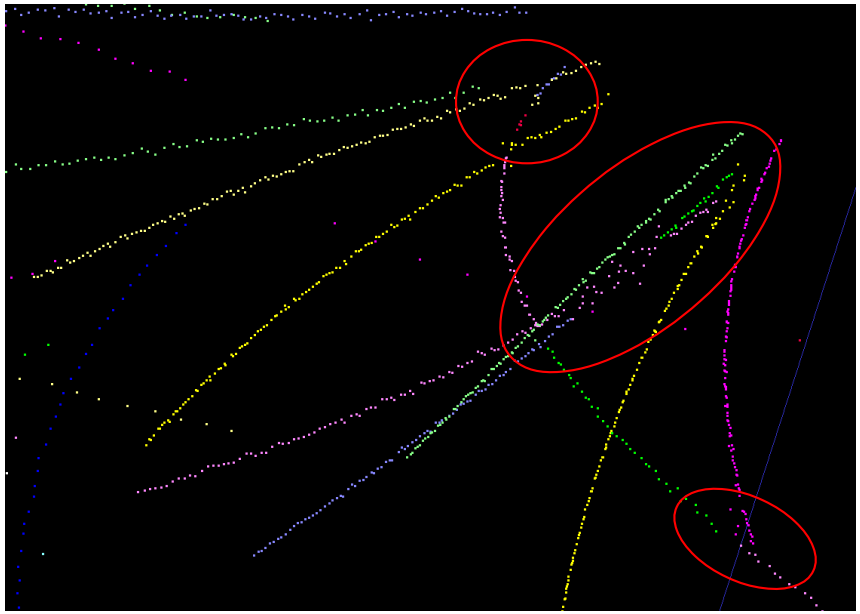
- NN-Clustering in pad row ranges (e.g. 15 rows)
- Identify clean track seeds and extrapolate these both inwards and outwards
- Major area of work at present is merging split tracks in high density jets @ 1TeV

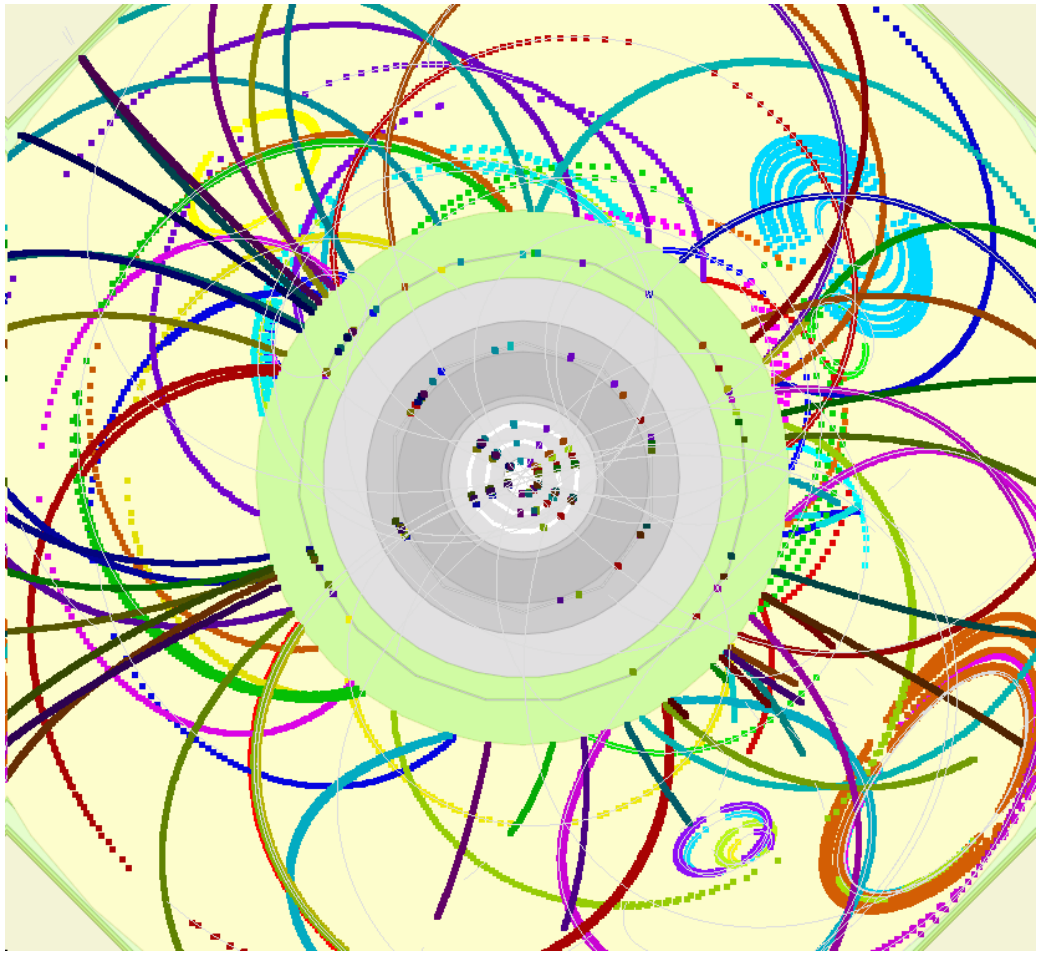




Clupatra

- Another area of activity is using the TPC tracks established in the main algorithm and trying to extrapolate these inwards into the inner silicon detectors.
- Could be used as a back-up strategy for large backgrounds.





- Fish-eye view of Cluptra Tracks with VXD and SIT hits picked up.

Summary

- iLCSoft Release v01-13-06 contains fully functioning track reconstruction code for the ILD_OX_v03 model series, which incorporates hits from all of the tracking systems, correctly treating them according to their correct dimensionality, in both pat-rec and fitting.
- Pattern recognition needs to be refined now that the software technicalities have been ironed out.
- The final global Track Collection presented to PandoraPFANew needs to iterated on and finalised, and the final track efficiencies determined.
- Material description needs finalising now that we have finalised the Mokka models.