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ILD optimisation workshop

Tracking tools

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Outline

Overview of ILD tracking

New developments on tracking

- DD4hep based tracking
- Pattern recognition

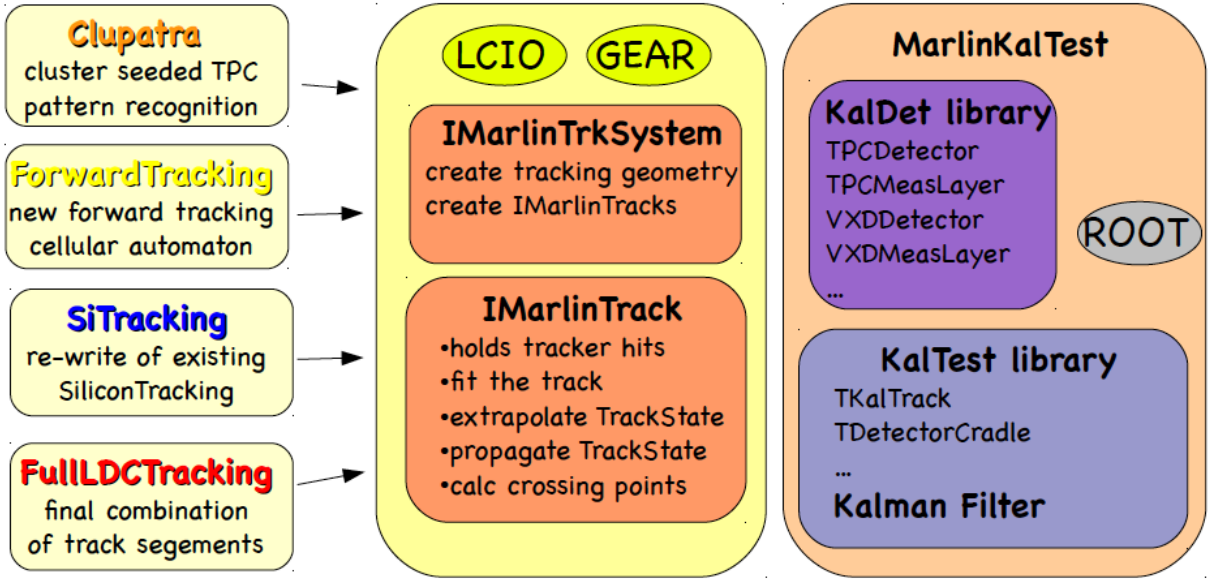
Overview of ILD track reconstruction

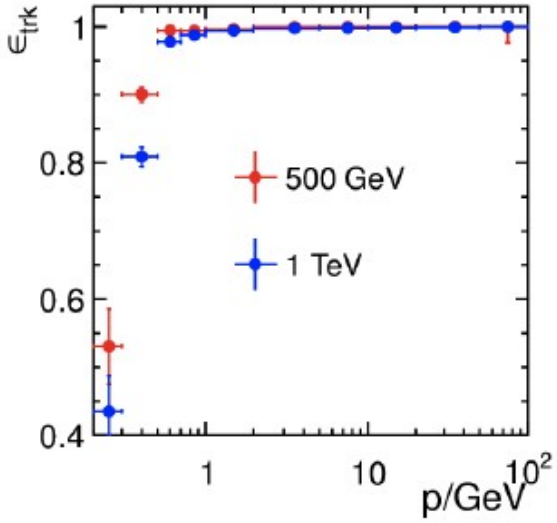
KalTest Kalman filter (KEK)

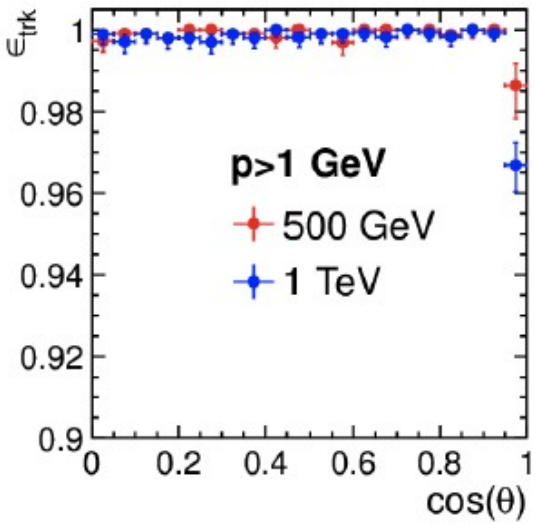
independent pattern recognition in TPC, Si, Fwd

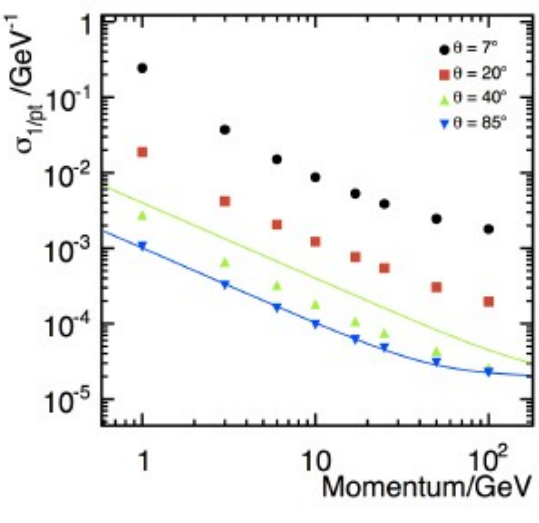
programmed against IMarlinTrk interface

achieves performance goals for ILC









Developments on tracking
Motivations

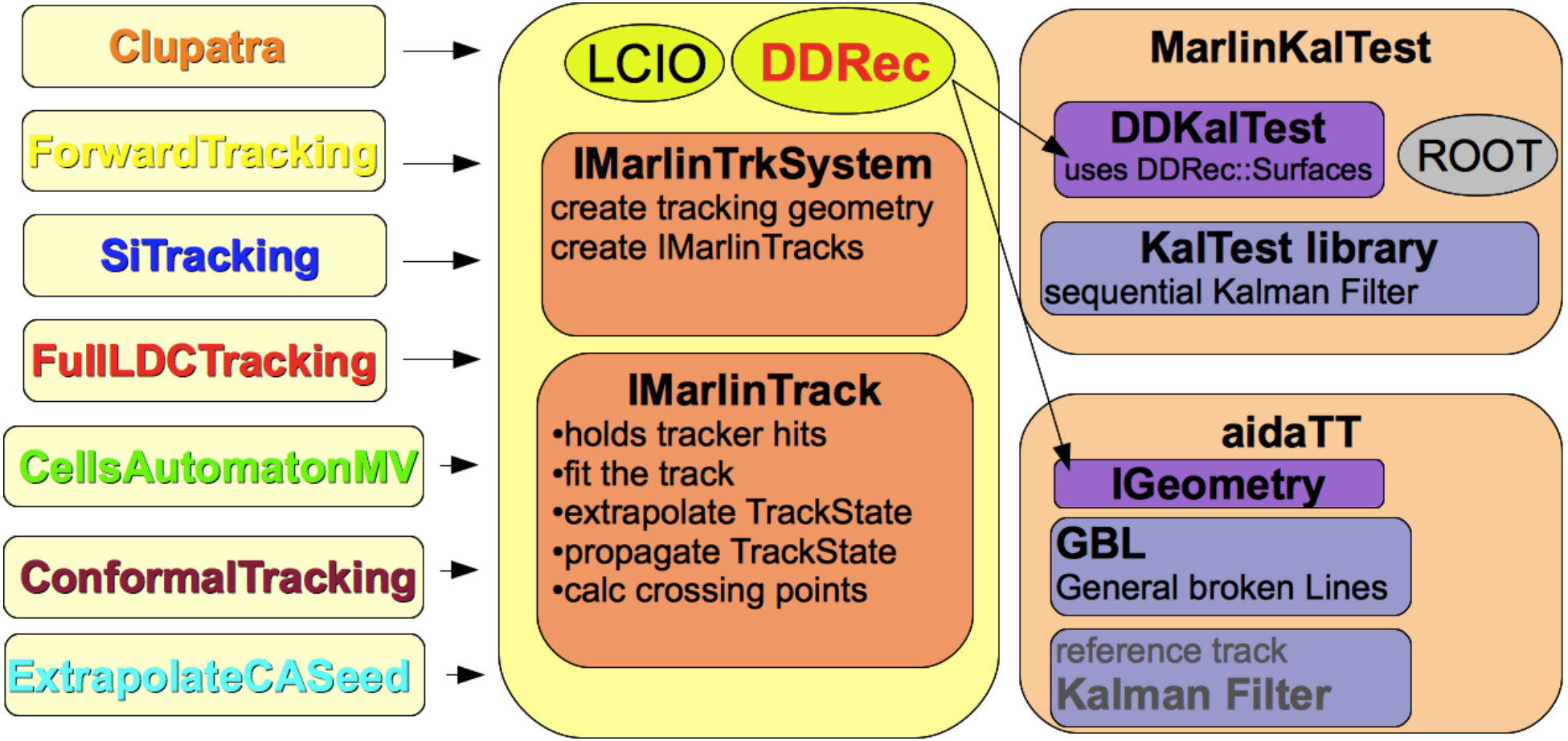
Moving to DD4hep based tracking

- LC moves towards common software tools
  - Flexibility
  - maintenance

Pattern recognition

- Low Pt track finding
- Robustness vs pair bkg
- Segment matching between subdetectors

Overview of new tracking



Surfaces

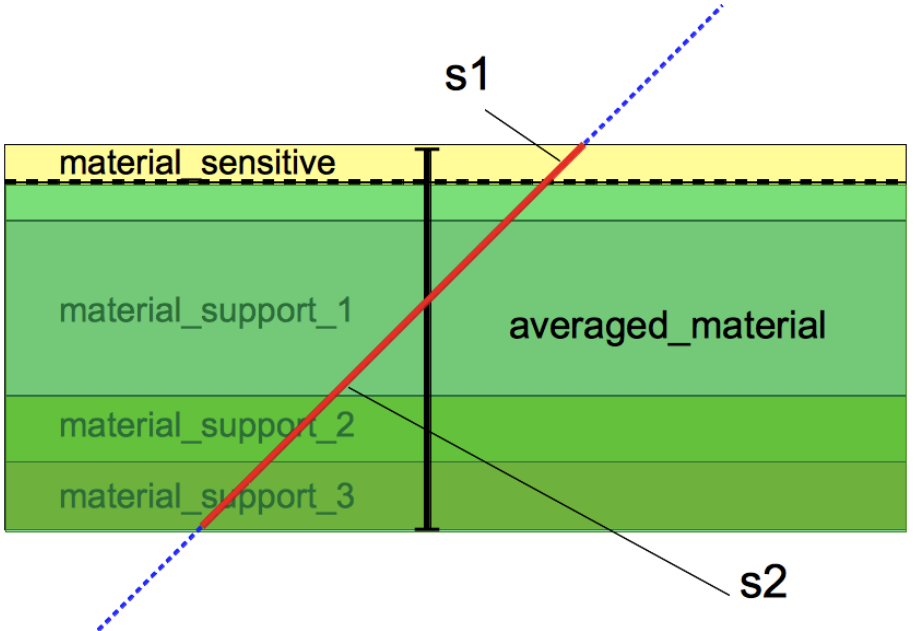
Geometry interface to tracking

We need to know the measurement surfaces and the dead material

Surfaces are attached to volumes which define the boundaries

Surfaces provide

- Normal vector
- Inner & outer thicknesses
- Material (automatically averaged from detailed model)
- Global to local (and vice-versa) transformation



- roughly equivalent to individual materials for Bethe-Bloch
- identical for multiple scattering

Surfaces – based tracking

DDKalTest

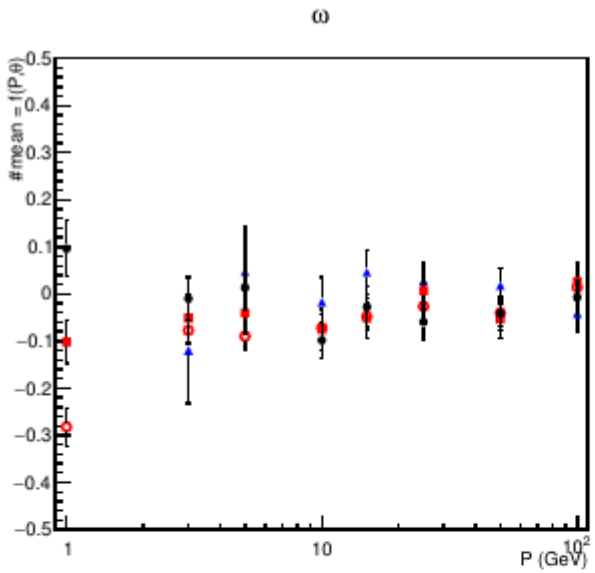
- Implementation of surface & hit classes needed from Kalman filter
- Re-implement some classes which used gear now to use surfaces
- DDPlanarMeasLayer
  - Planar detectors (eg VXD, SIT)
- DDCylinderMeasLayer
  - TPC
- Kalman filter can run at any detector where surfaces has been implemented – w/o need for additional code

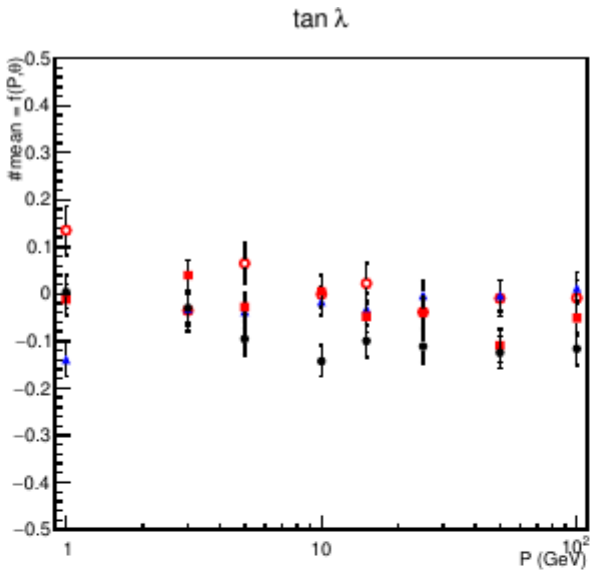
Aida tracking toolkit

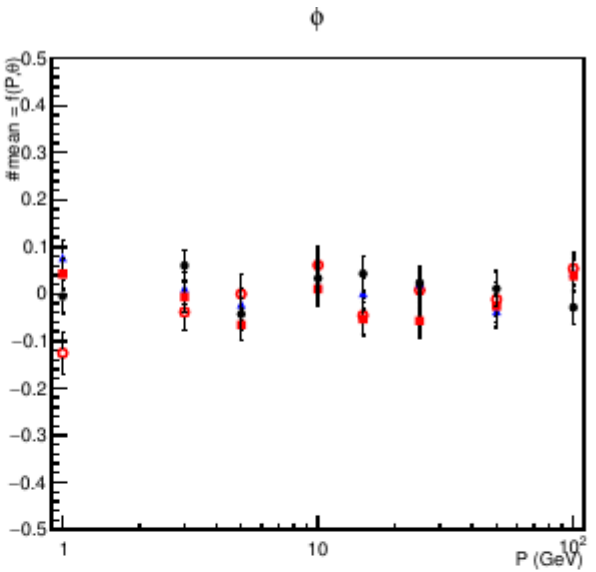
- Uses GBL algorithm – provides interface to alignment

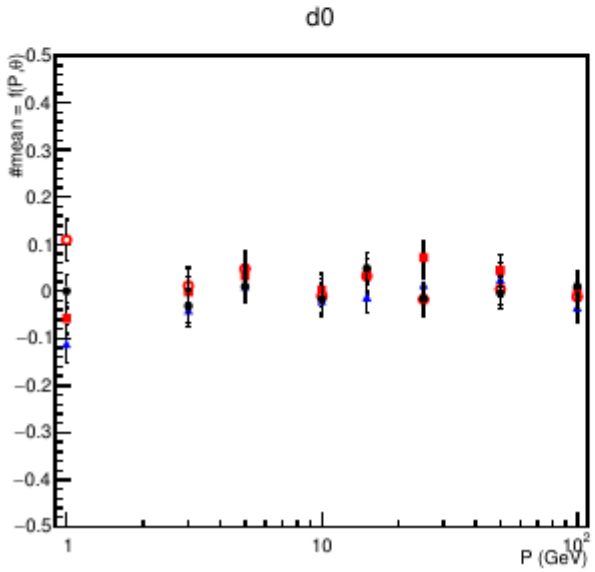
Lets have a look to new tracking performance

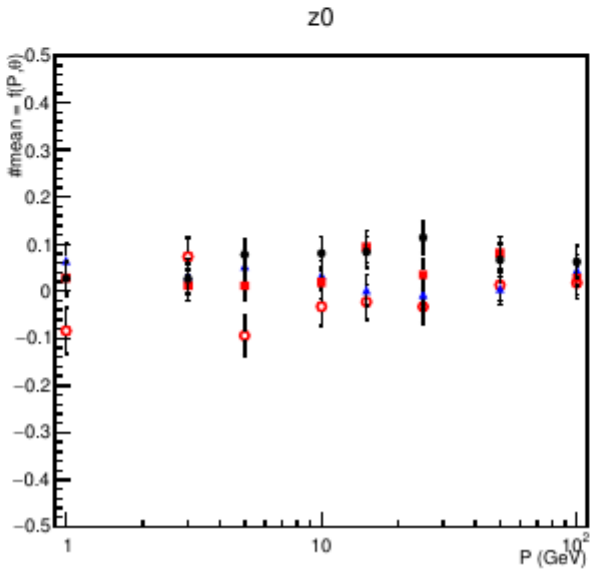
DDKalTest pulls: μ

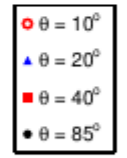




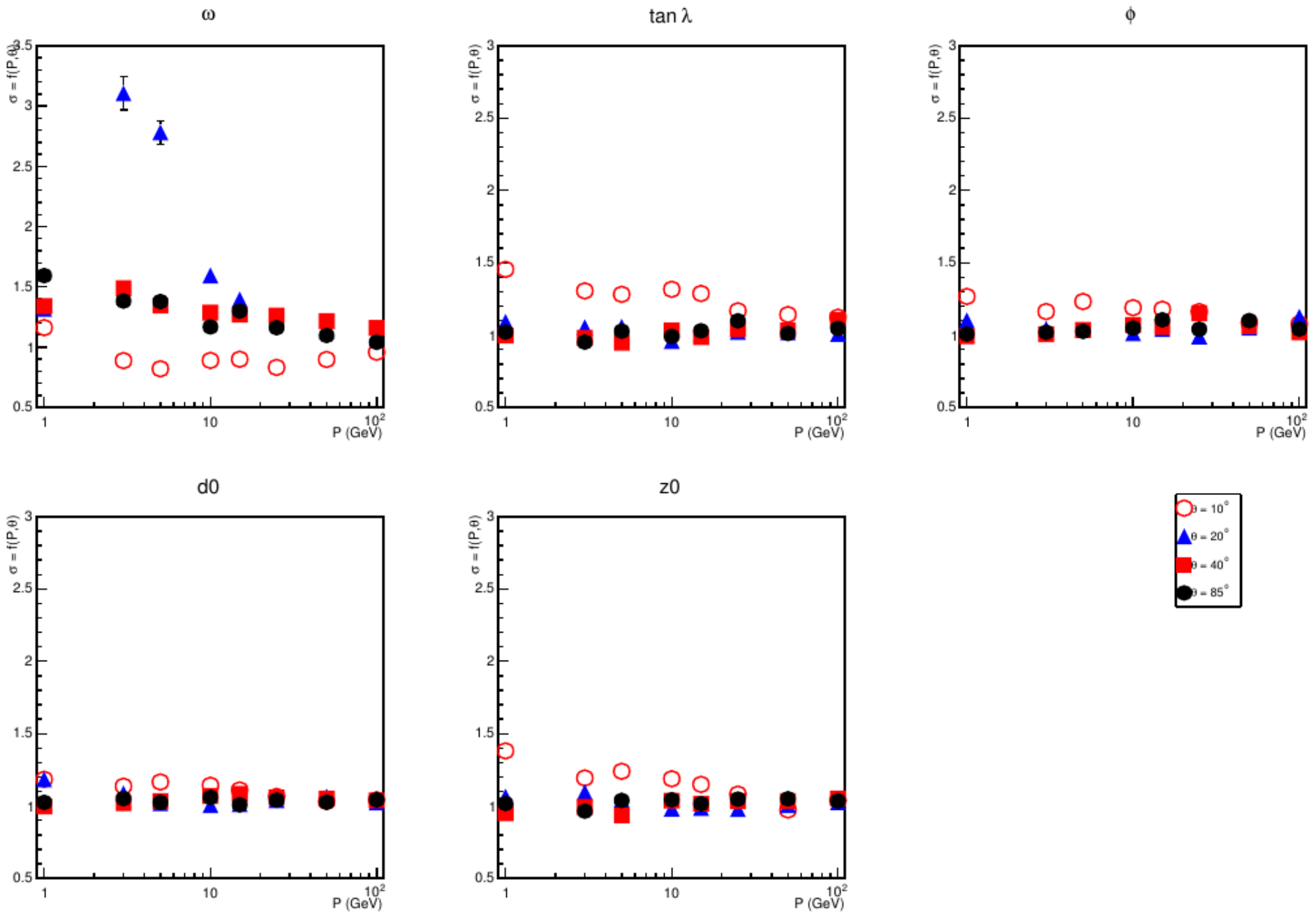




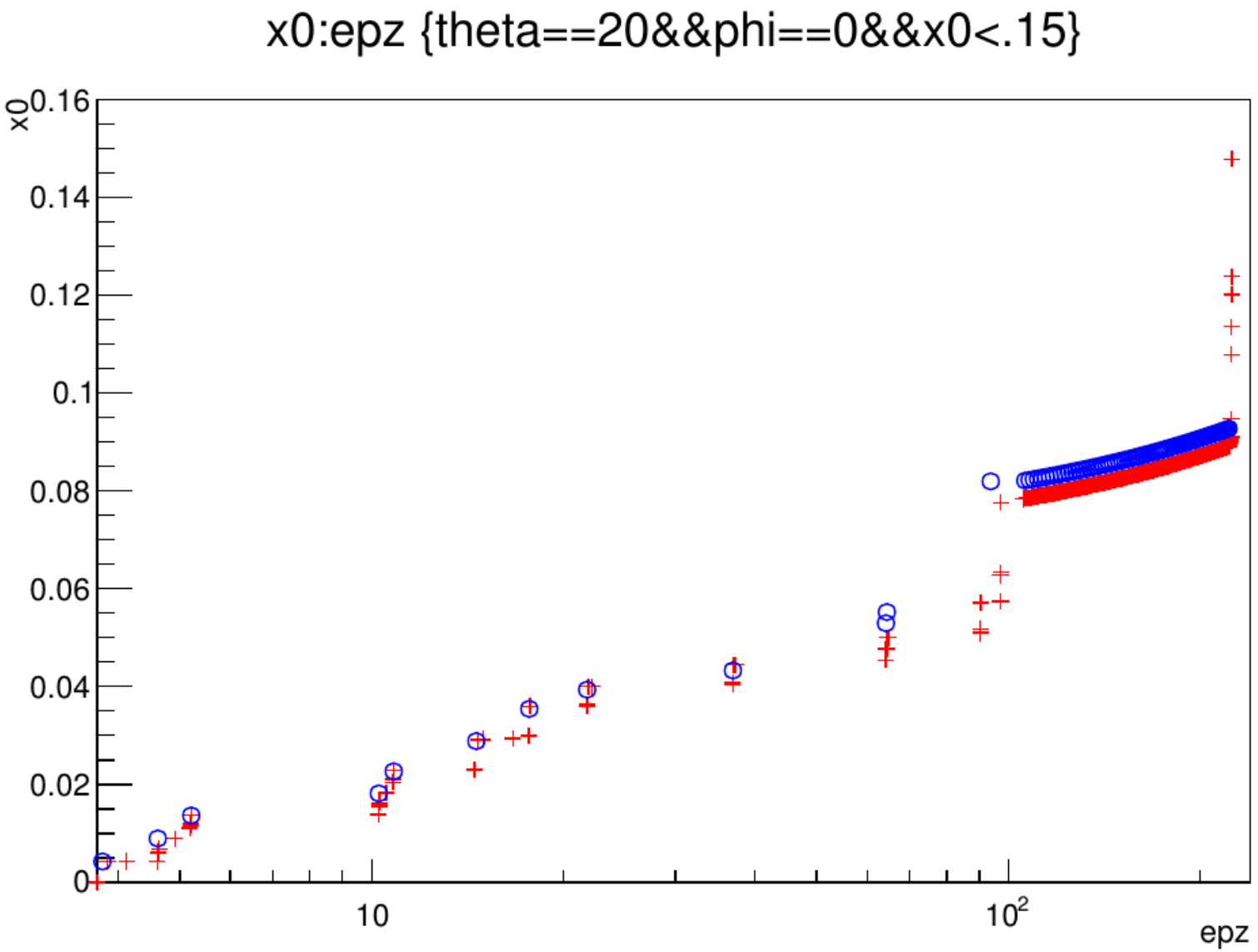




DDKalTest pulls : σ



Material description in θ = 20



+: detailed description

O: surfaces

DDKalTest performance discussion

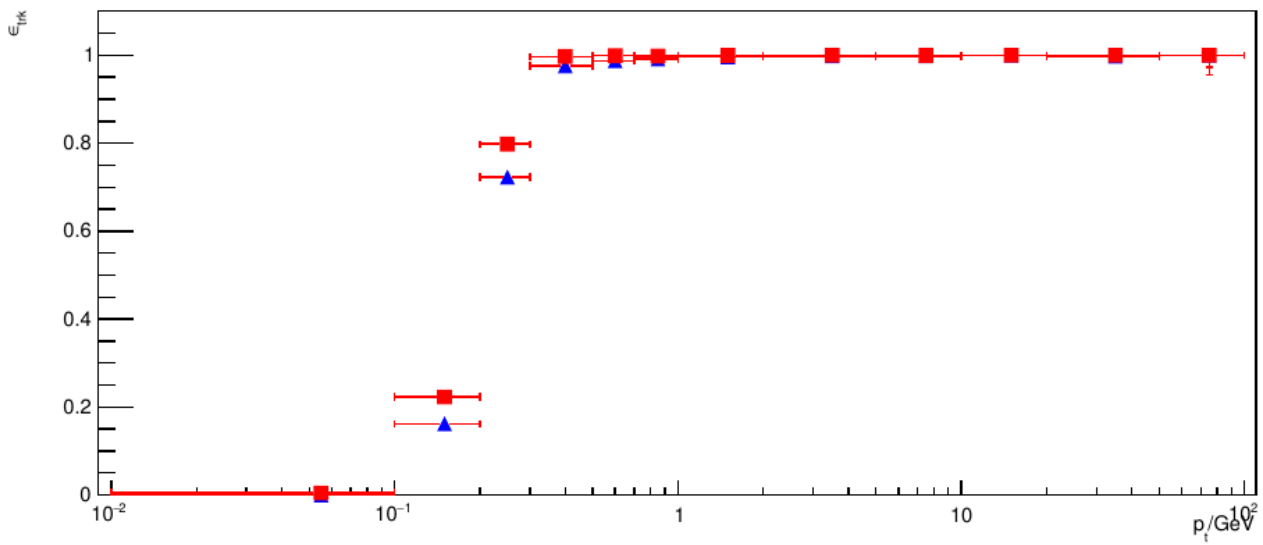
Looks ok at central region

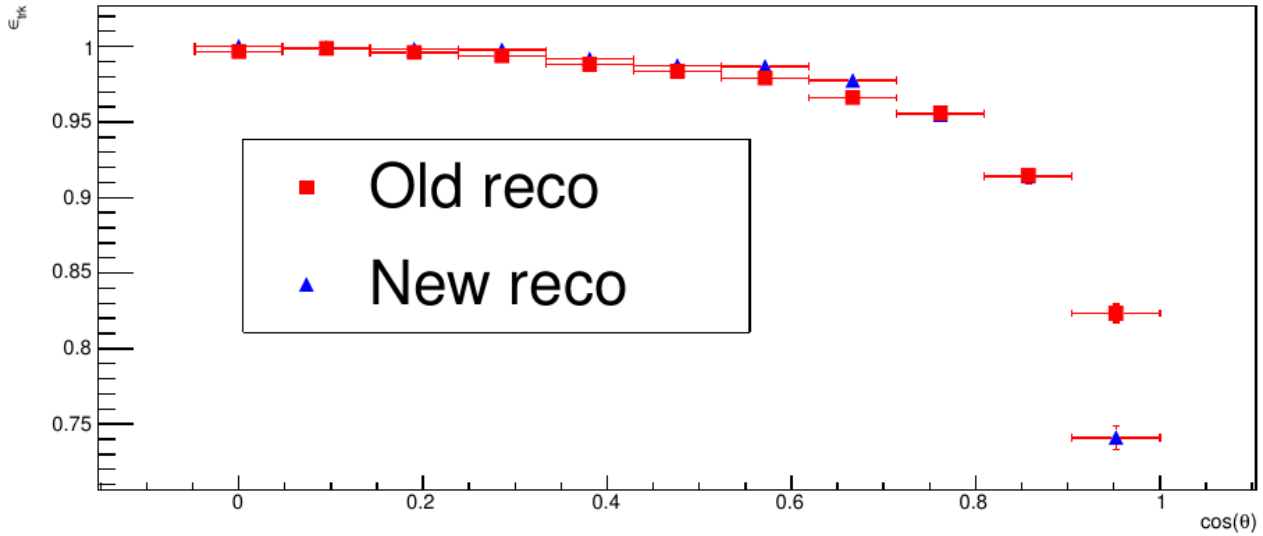
- Even have some improvement for low momenta compared to mokka

Still quite some work to, especially at the central / forward transition region

- Spacepoint builder / spacepoint fitting
- Material description in general okayish
- Still some regions where material from surfaces differs significantly from simulation

Efficiency





- ttbar sample
- DBD pat rec on both

Pattern recognition

Silicon tracking in ILD

DBD silicon tracking

- Shows poor performance in realistic conditions (inclusion of beam bkg)

Post DBD efforts

- FPCCD tracking
  - Improved version of DBD tracking
    - Improved perf. in terms of efficiency, “bad” track rate*, CPU needs
  - Require ≥ 1 SIT hits to deal with combinatorics during seed formation
- Cellular automaton mini-vector tracking
  - Standalone VXD tracking able to cope with pairs
  - Make sense in specific VXD designs (alternation of fast/precise layers)
  - High efficiency in low momentum tracks

Which one to use?

- DBD si tracking should be phased out
- Both new approaches are under validation with physics studies
- Answer depends strongly on VXD sensor technology...

* **'bad' tracks: ghosts or real tracks of beam bkg particles**

Segment merging

FullLDCTracking: assignment of leftover hits and refitting

- Leftover assignment not efficient
- FullLDCTracking should be carefully reviewed, and possibly restructured & renamed

Subset processor: ambiguity resolution and track selection between FTD and VXD – SIT

- Improvement by Frank: preference to tracks that have hits both from VXD and SIT
- Could be nice if someone had a look there as well

Summary – outlook

Moving to common tracking tools within the LC community

ILD tracking tools have been adapted to DD4hep

KalTest has been reimplemented usi surfaces

- Ok in barrel, needs more understanding in transition region
- Extensive testing & validation is on going

GBL track fitting is now available in MarlinTrk

- However we still have a number of issues to deal in AidaTT

Several improvements & bug fixes (e.g. ndf, subset processor)

New silicon tracking pattern recognition has been developed

- Shows better tracking performance than DBD si tracking
- Under validation in physics studies (taking into account the pair bkg)
  - Higgsinos (FPCCD & CA), flavour tagging (FPCCD), vertex charge (CA – see Sviatoslav talk)