# Tracking Studies for ILD: ILCSoft

LCWS08 UIC

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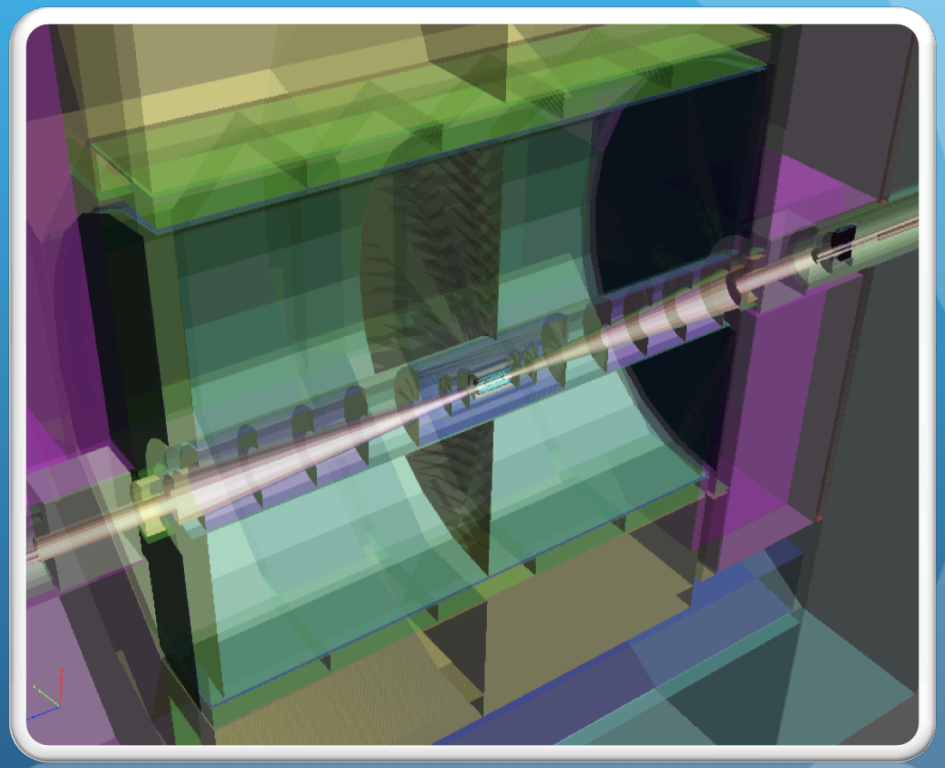
DESY IT and MPI Munich

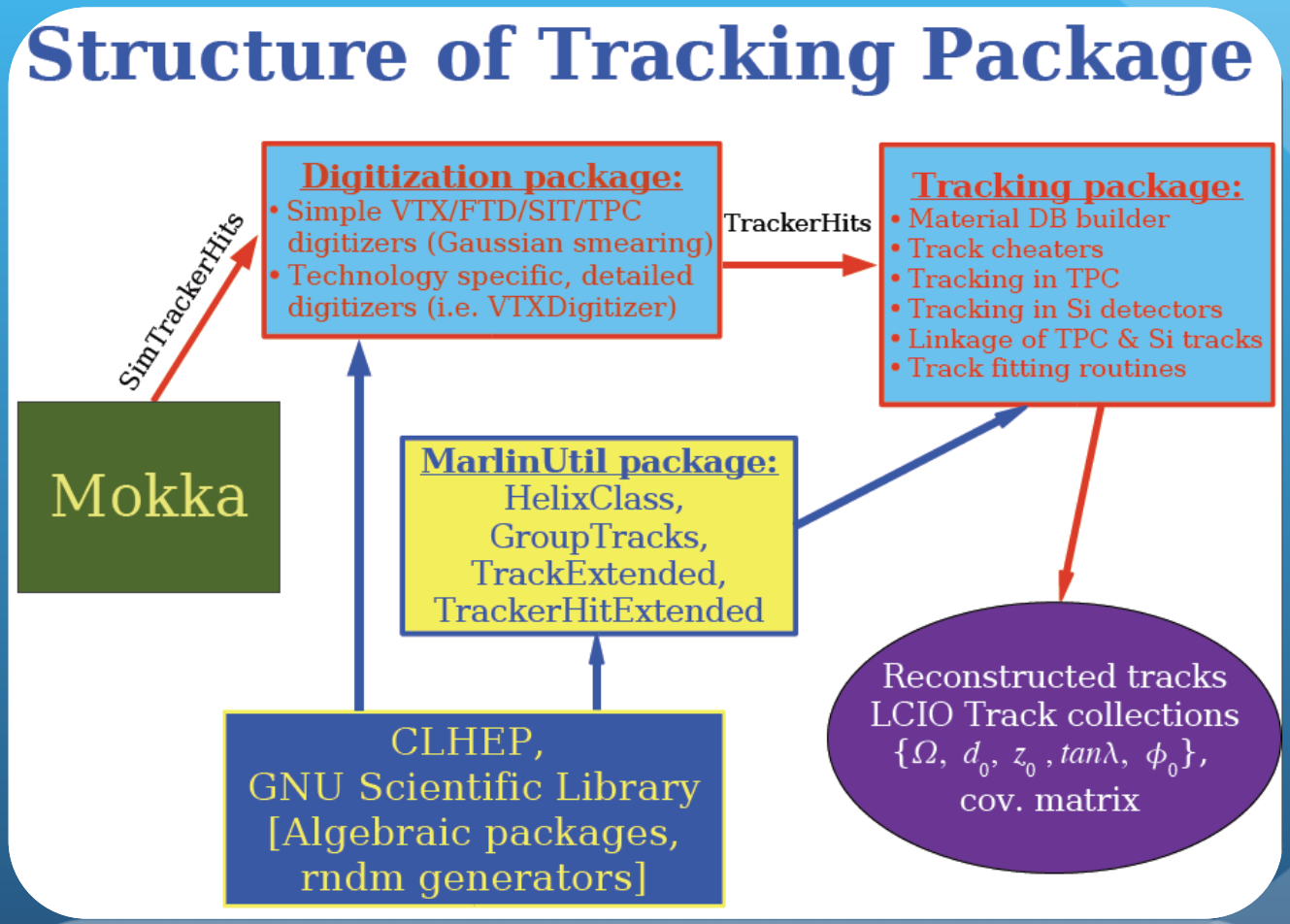
18th November 2008

# Overview

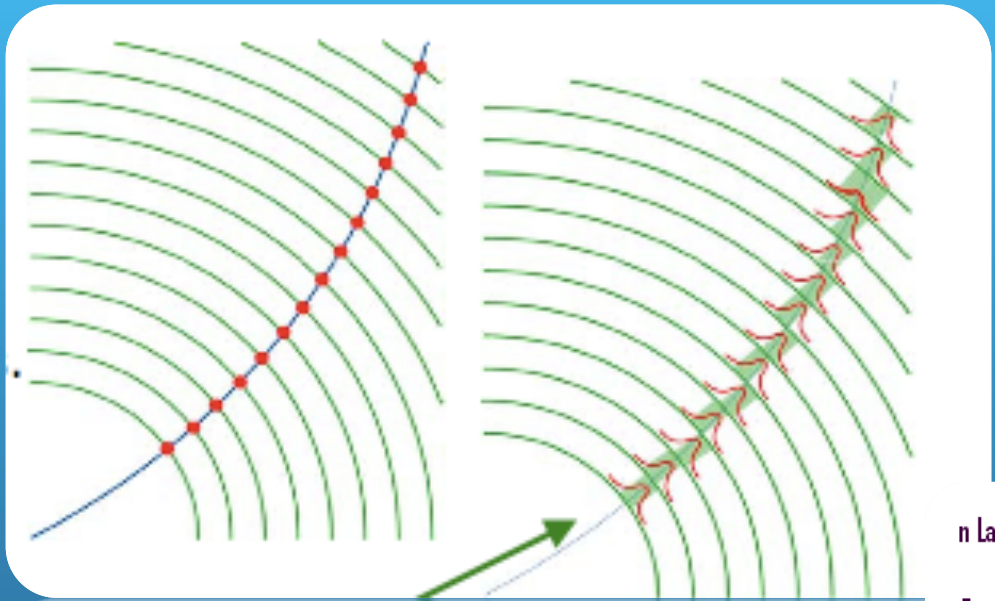
- Digitisation
- Reconstruction
- Results on Detector Models

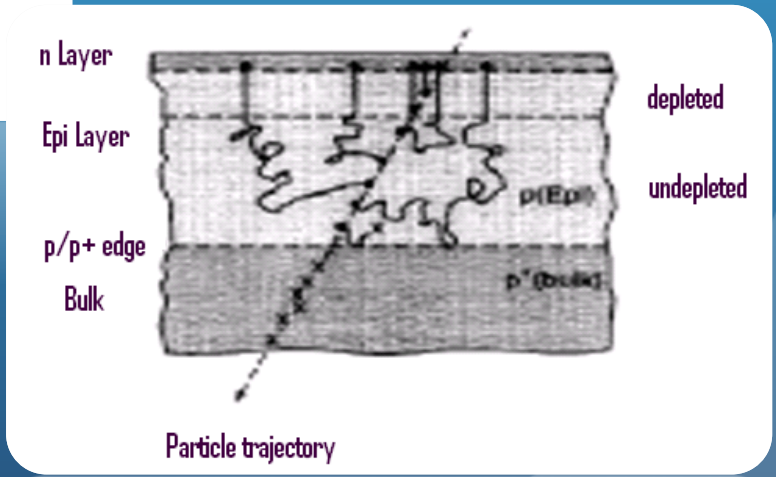


# Overview


Structure of Tracking Package
Digitization package:
• Simple VTX/FTD/SIT/TPC digitizers (Gaussian smearing)
• Technology specific, detailed digitizers (i.e. VTXDigitizer)
TrackerHits
Tracking package:
• Material DB builder
• Track cheaters
• Tracking in TPC
• Tracking in Si detectors
• Linkage of TPC & Si tracks
• Track fitting routines
SimTrackerHits
Mokka
MarlinUtil package:
HelixClass,
GroupTracks,
TrackExtended,
TrackerHitExtended
CLHEP,
GNU Scientific Library
[Algebraic packages,
rndm generators]
Reconstructed tracks
LCIO Track collections
{Ω, d0, z0, tanλ, φ0},
cov. matrix

# Digitisation





# Digitisation

- To keep things simple for now we have opted for simple smearing based on well defined distributions
- For the large MC sample this is preferable due to the differing technology options and to provide a well understood basis for developing the reconstruction algorithms
- It is always possible to choose conservative parameters
- CPU Performance considerations

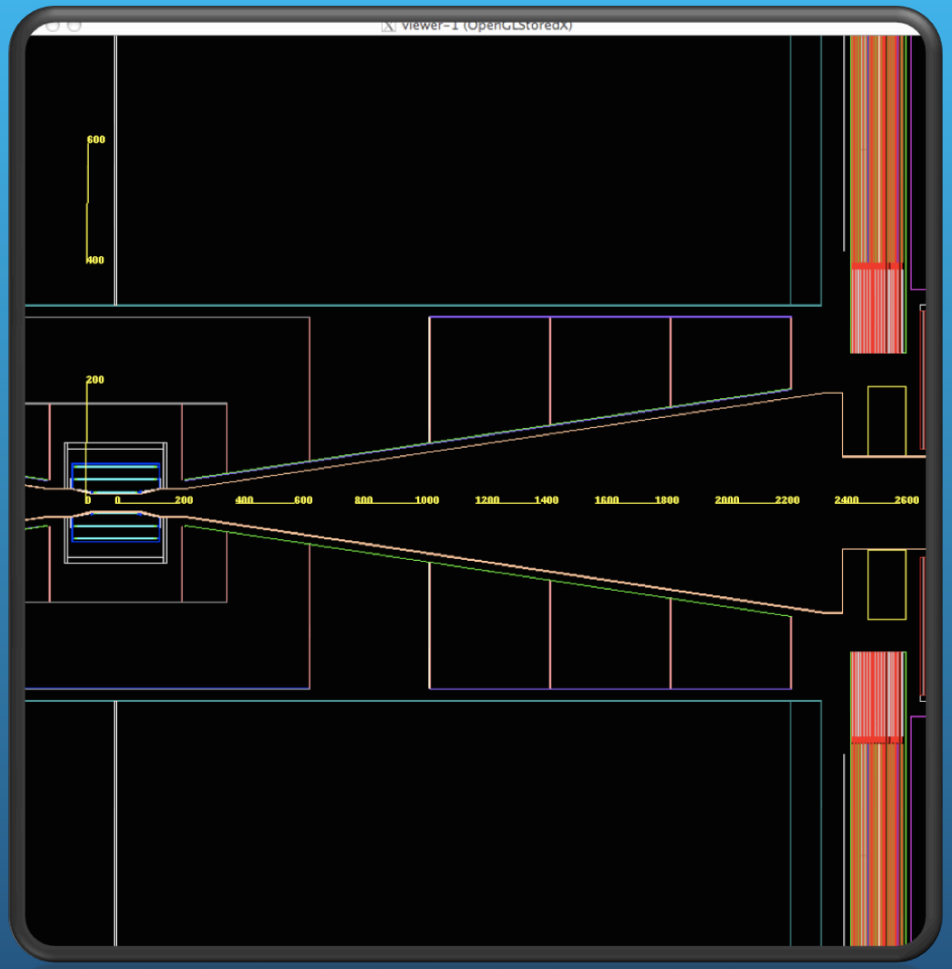
# Digitisation

- TPC: Parameterised Gaussian Smearing
  - $\sigma_{r\phi}^2 = \sigma_0^2 + D^2.L_{drift} / N_{eff}$
  - $\sigma_z^2 = ( 400\mu m^2 ) + L_{drift}$ [cm] . ( 80 $\mu m^2$ ) /cm
- Silicon: Simple Gaussian Point Smearing

# Trackers in ILD

- TPC: Large Time Projection Chamber
- VXD: 5 single layer or 3 doublet Vertex detector
- FTD: Pixel/Strip Silicon Disks in the low angle forward region
- SIT/SET: 2 Cylindrical layers of Silicon Strips inside & outside the TPC
- ETD: XUV Planar Silicon Strips on the far side of the TPC End-Plate

# Trackers in ILD



# Trackers in ILD

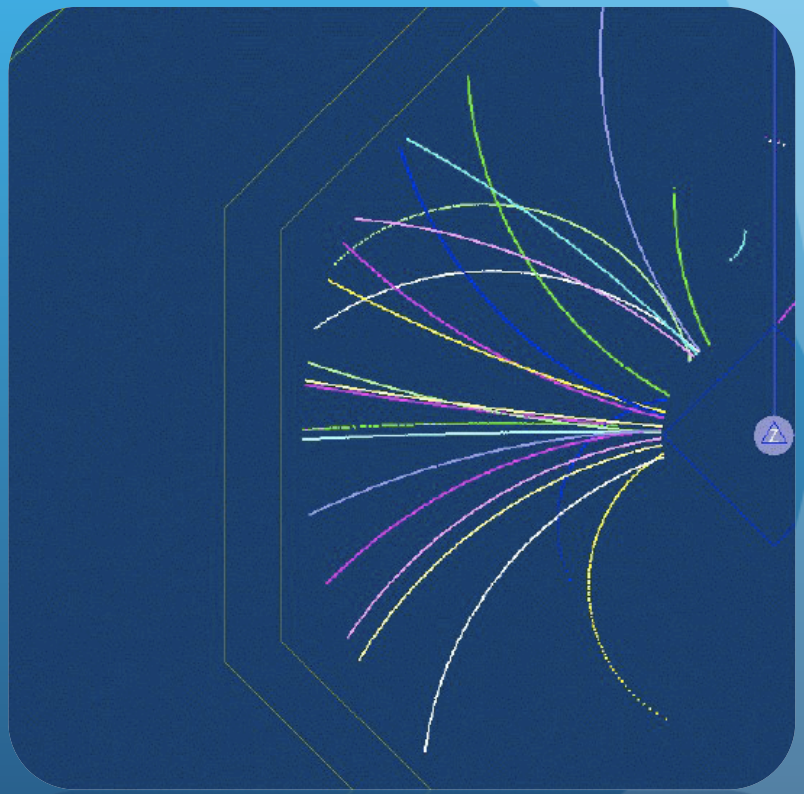
- TPC: $\sigma_{rphi} < 100\ \mu m$
- VXD: $\sigma_0 < 2.8\ \mu m$
- SIT/SET: $\sigma_{rphi} = 7\ \mu m$ $\sigma_z = 100\ \mu m$
- ETD: $\sigma_{rphi} = 7\ \mu m$
- FTD: $\sigma_{rphi} = 7\ \mu m$

# Track Reconstruction

- Initially adopted Tracking Code used at LEP
- TPC pattern recognition taken from ALEPH (F77)
- Track Fitting taken from DELPHI (C)
- C++ pattern recognition in Silicon Trackers
- C++ code for Si – TPC Track association
- Fortran Code wrapped in C++ to create Marlin Processors

# Track Reconstruction: TPC Patrec

- Hits sorted by radius and phi
- Chains created Out to In
- Initial search stops half R
- Circle Fit used to fit chains
- Chains then moved in picking up hits towards closer to the IP



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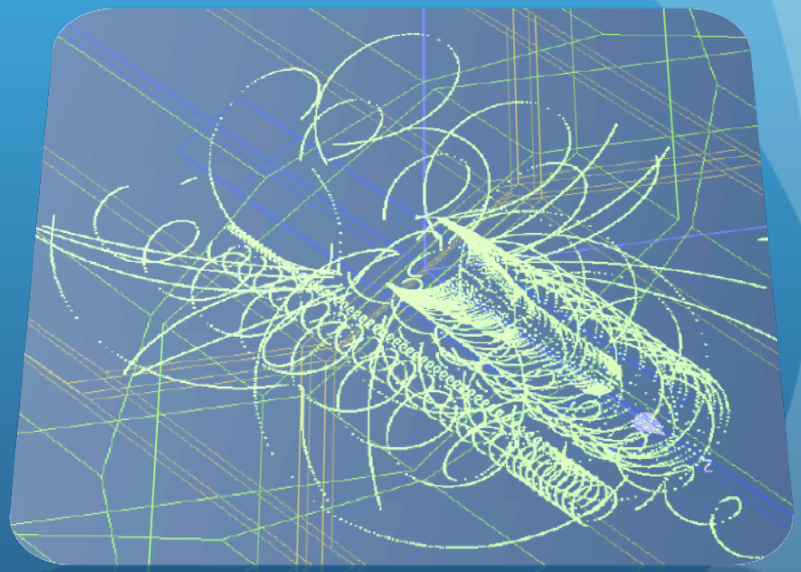
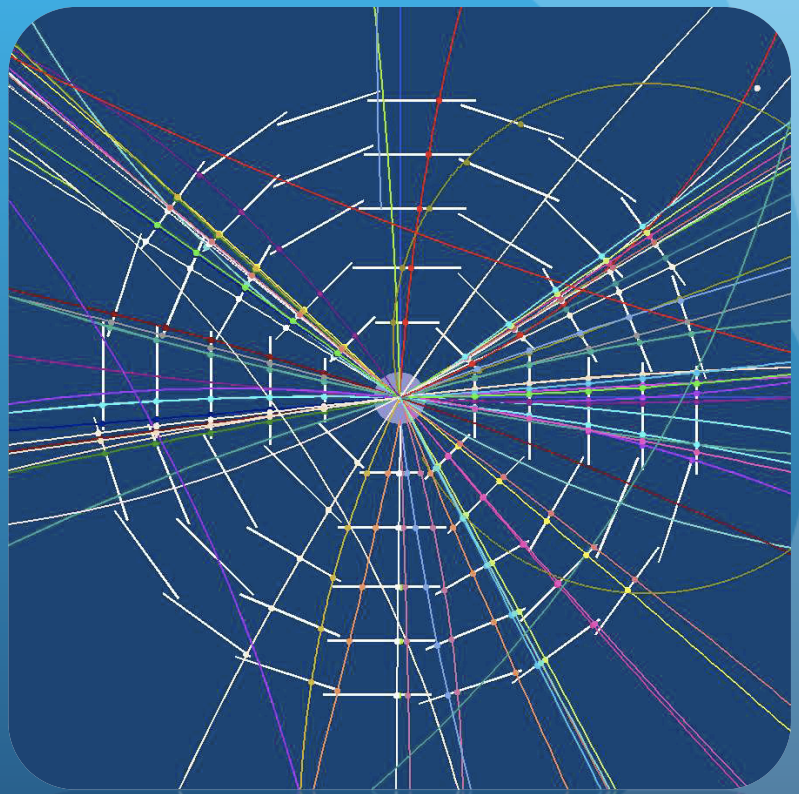


# Track Reconstruction: Si Patrec

- Initial search for hit triplets in VXD+SIT or FTD starting from Out to In
- Special treatment of VXD-FTD transition region in θ. Combined triplet search 2+1 or 1+2 patterns
- Inward extrapolation of helices defined by triplets, picking up additional hit closer to the IP



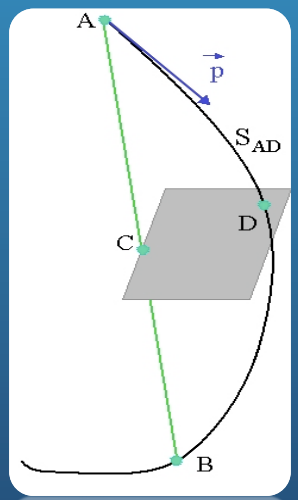
# Track Reconstruction: Fitting

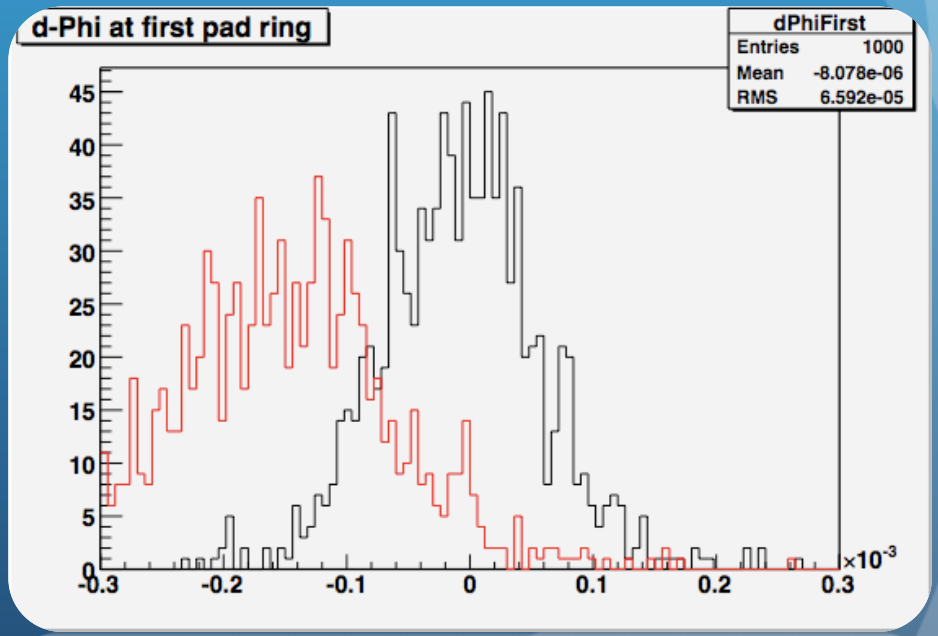
- FullLDCTracking Processor serves as a both the track association algorithm, as well as a front end for the DELPHI Fitting code
- Recovers a large number of split TPC loopers
- Kalman filter, Outlier rejection
- Reconstruction of $V^0$'s implemented in separate processor V0FinderProcessor

# Problem with B Field in GEANT4

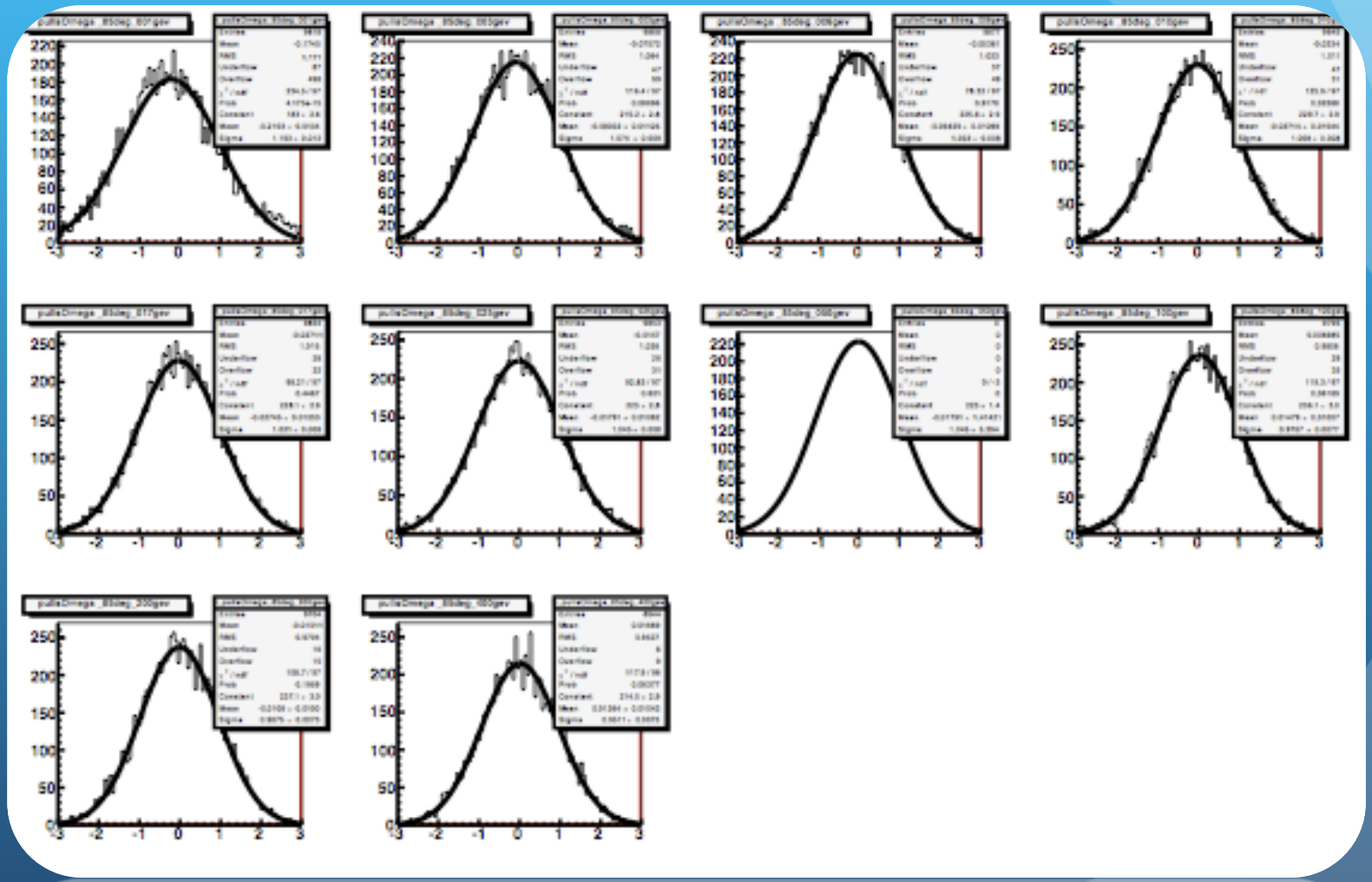
- Tracking over small volumes in a B Field one must be careful to correctly set the GEANT4 Parameter:
  - fieldMgr->SetDeltaIntersection(1e-5 * mm);

20 GeV mu+ 85 degrees



# Tracking Performance: Pulls Ω



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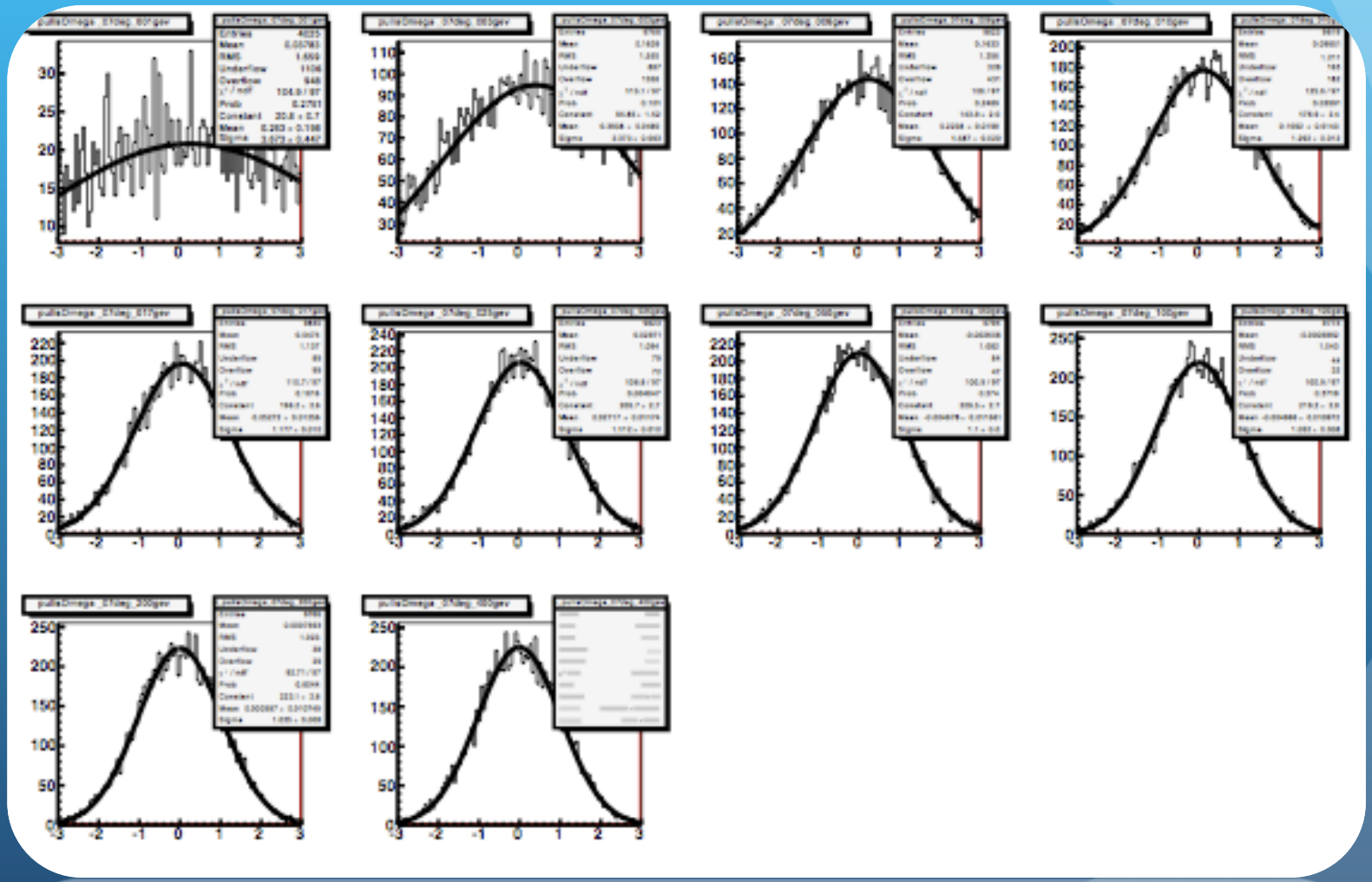
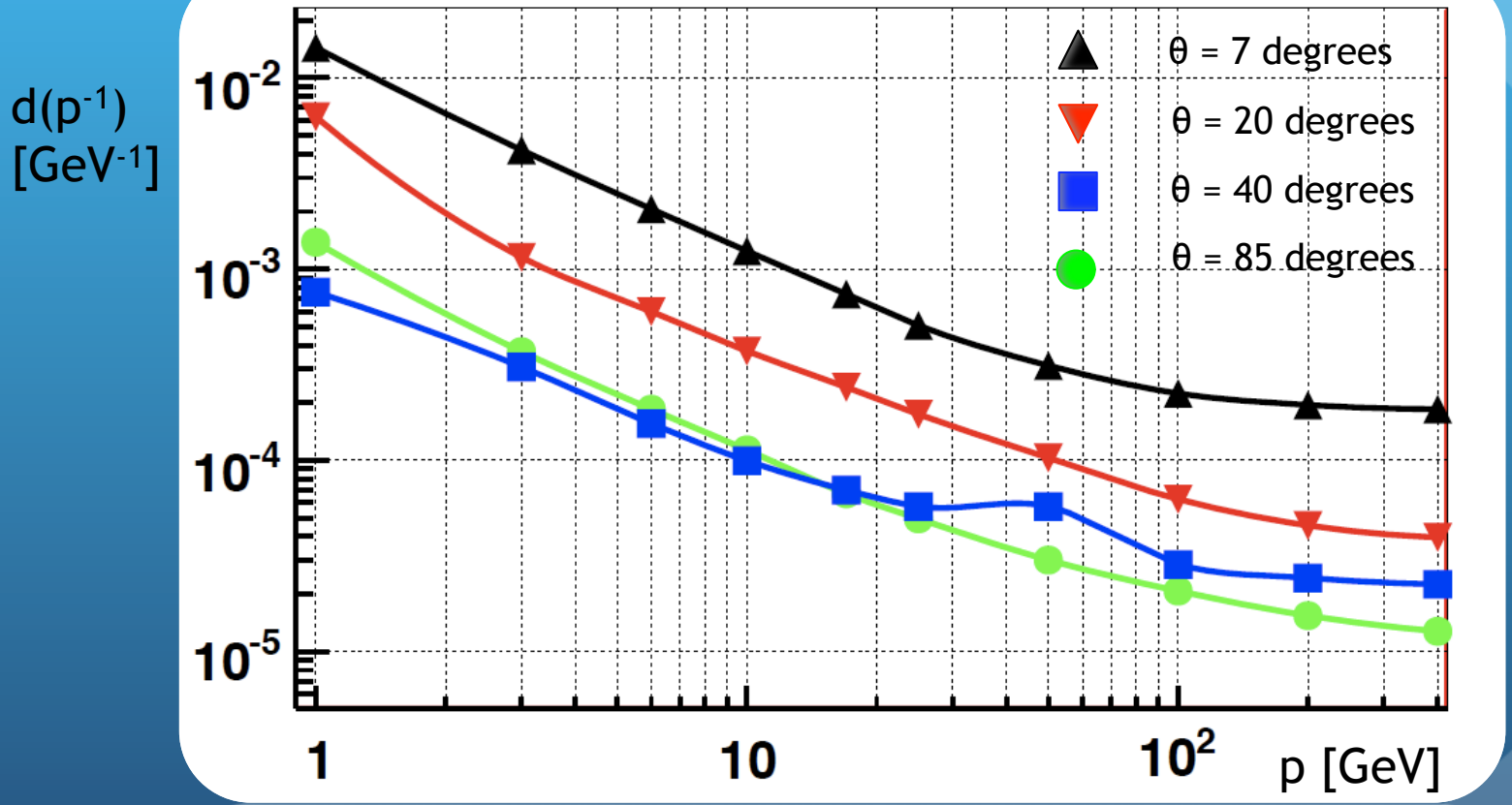


# Tracking Performance

single muons

ILD _00



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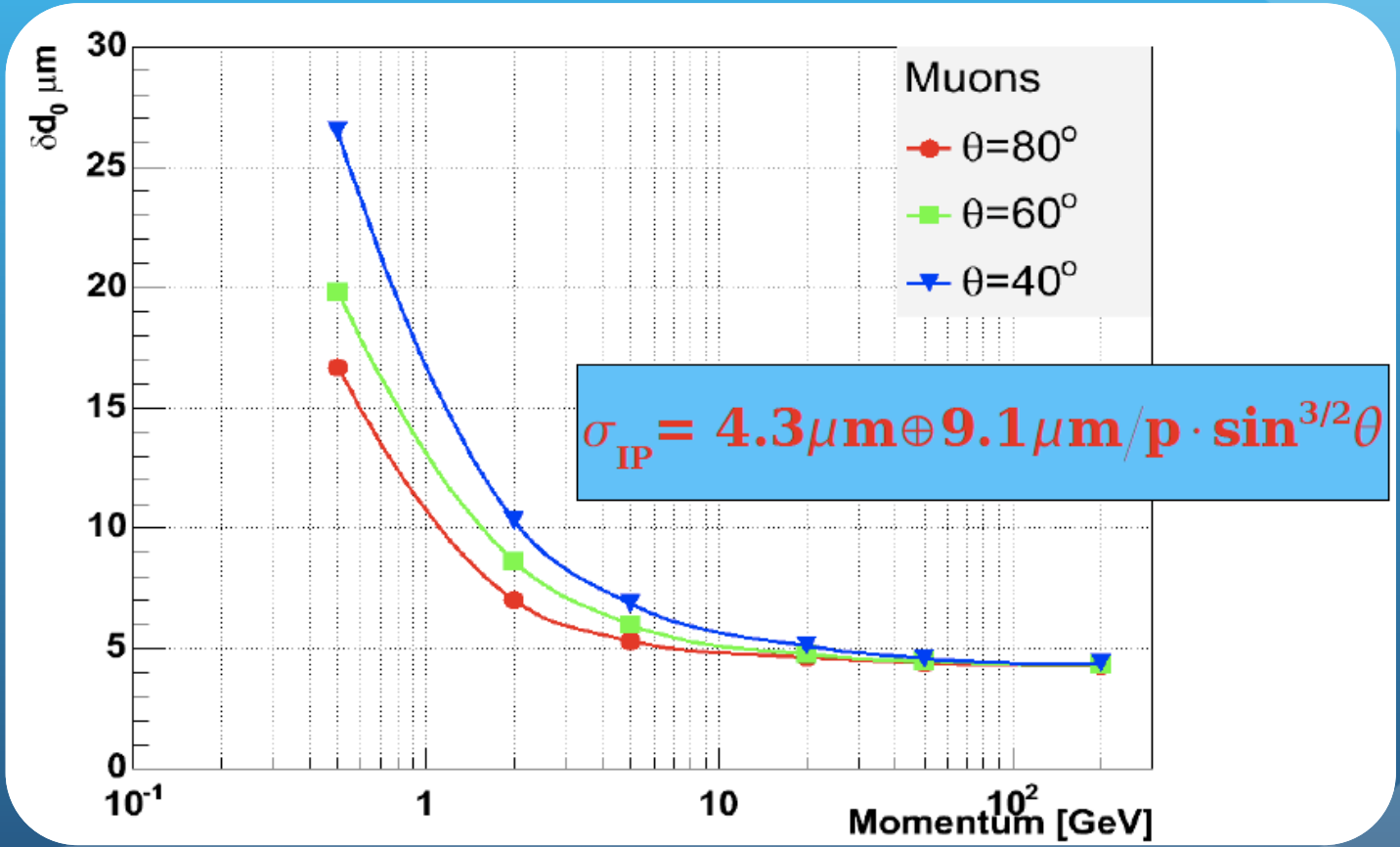
single muons

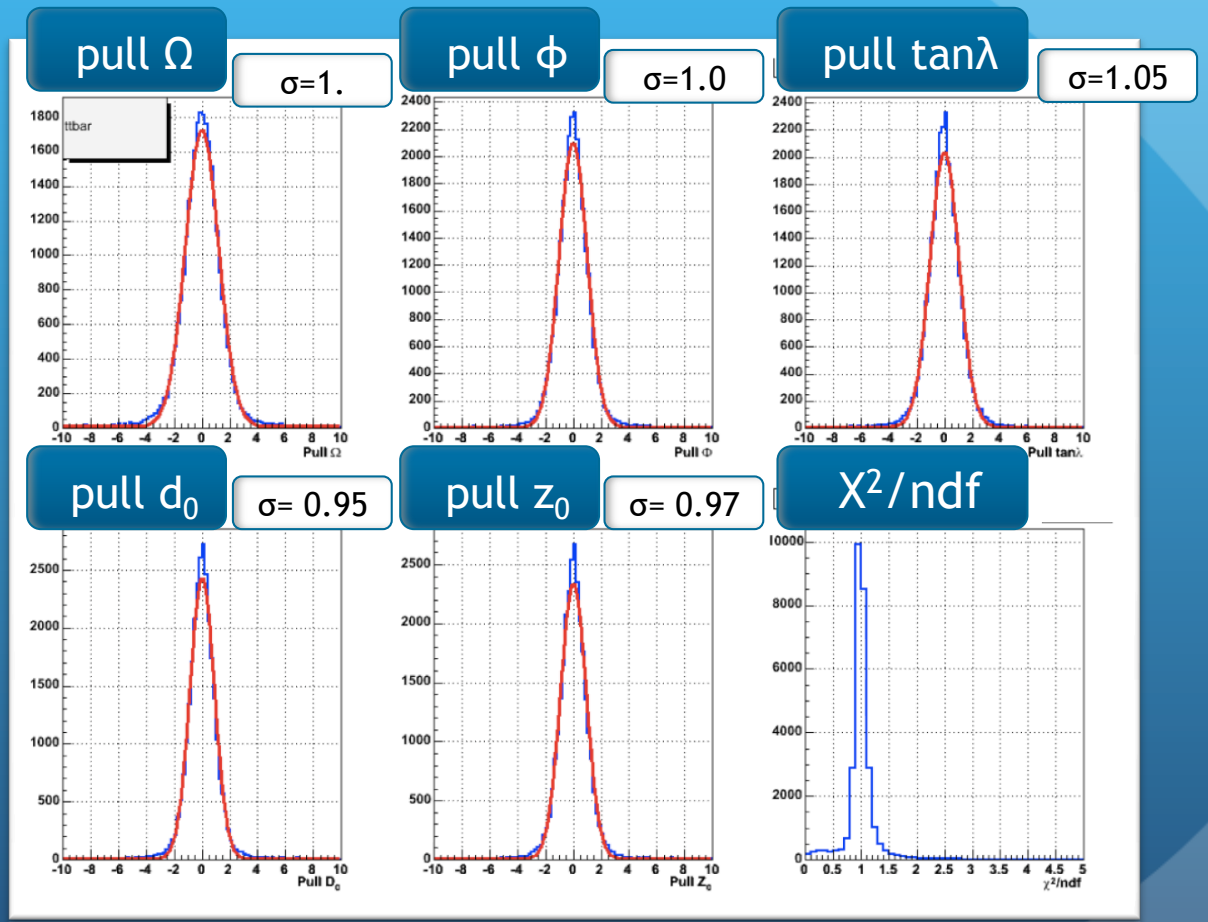
LDCPrime_02Sc



# Tracking Performance

LDCPrime_02Sc

ttbar @ 500GeV:



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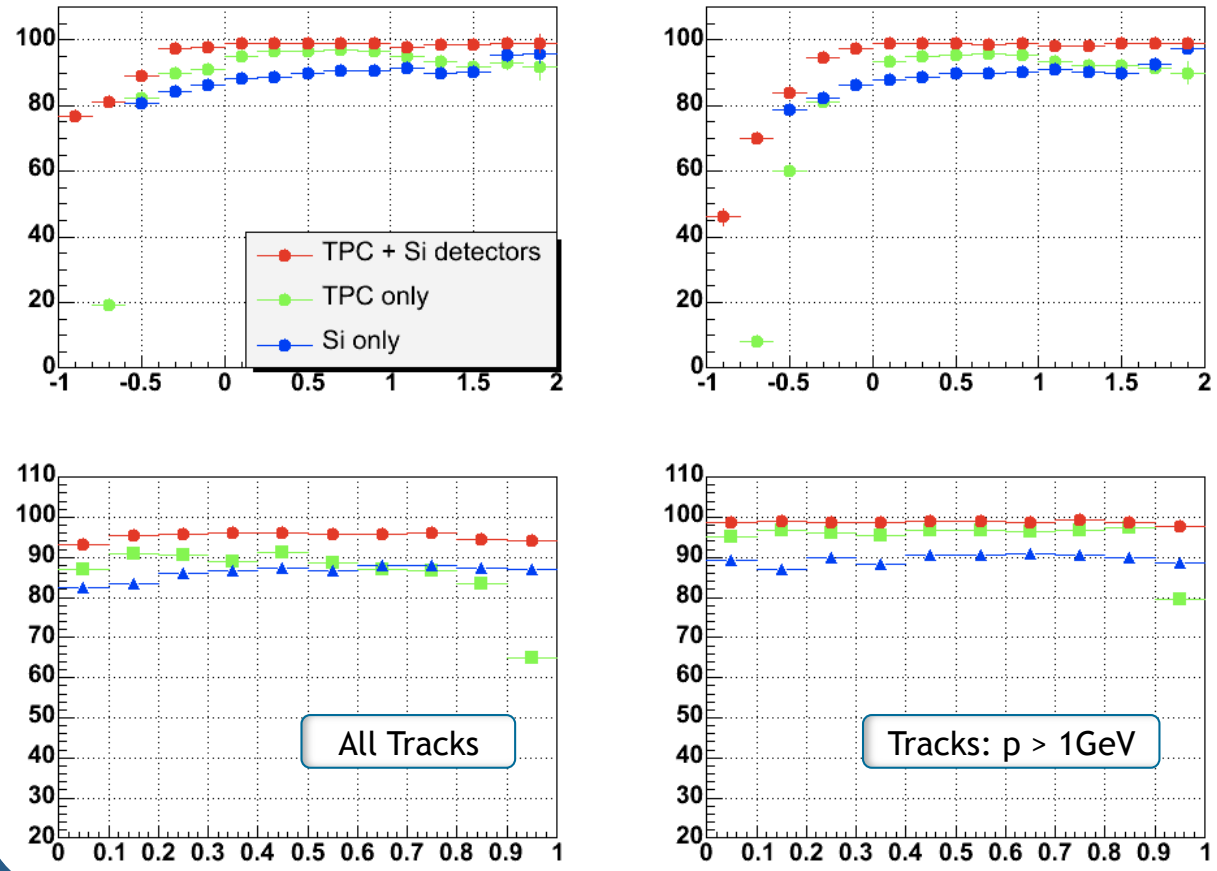
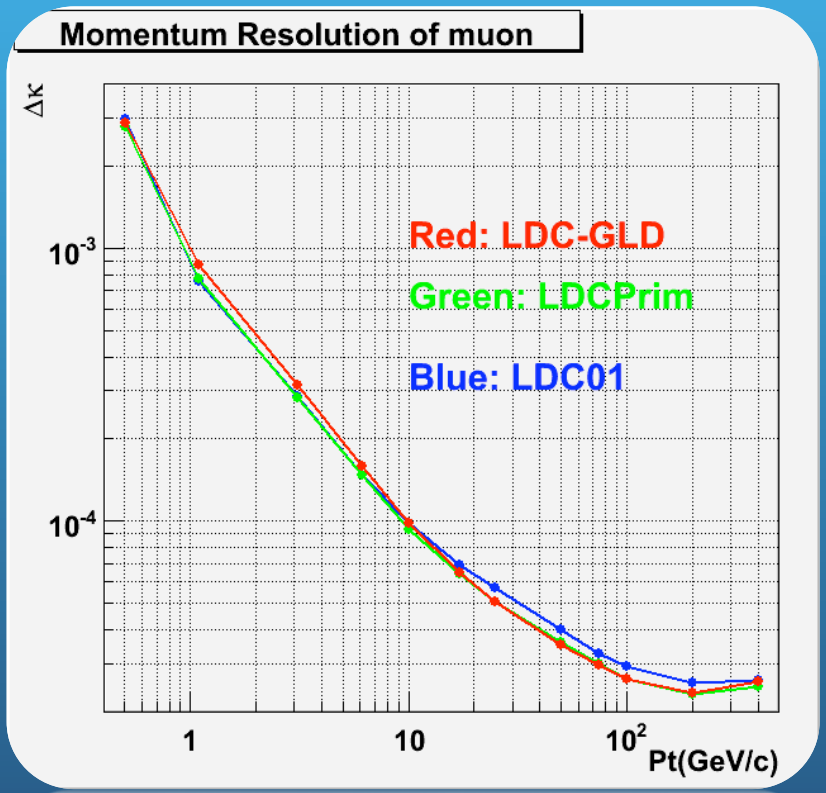
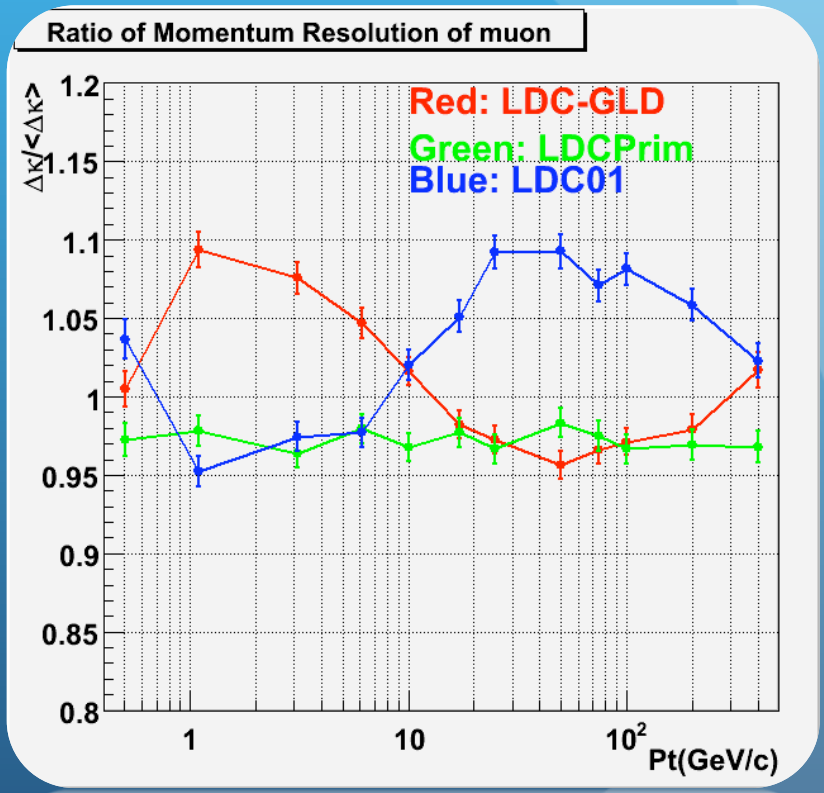


# Model Comparisons

single muons



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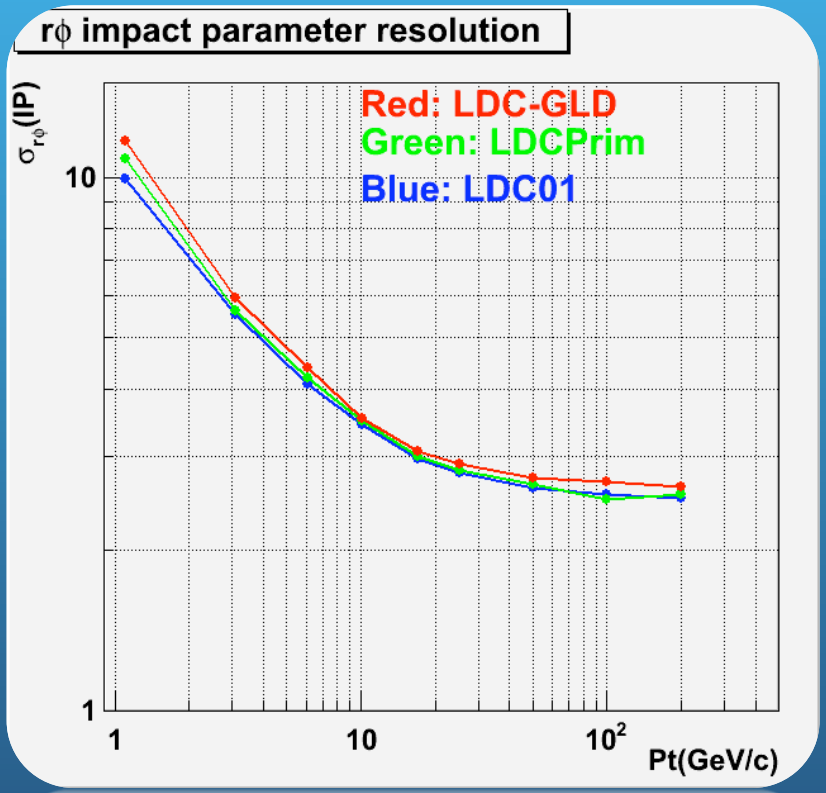


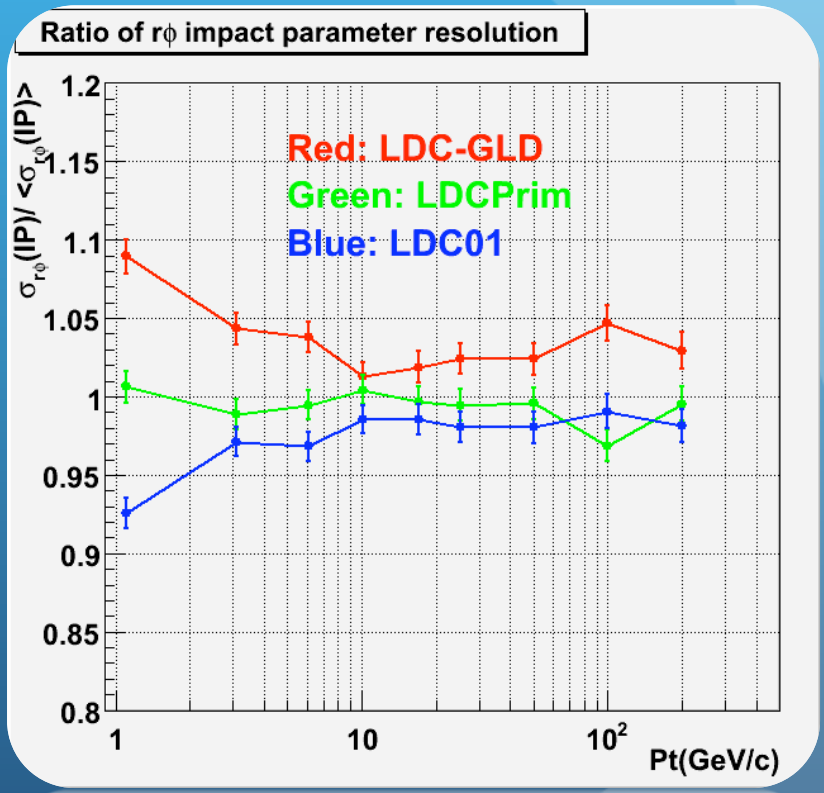

# Summary

- As expected there is no great difference between the different detector models
- Track Reconstruction is ready for LOI MCData production
- Still need to check it thoroughly against ILD_00
- Incorporate Background into studies
- Try to work on lower momentum spectrum