Studies of the Forward Chamber in the Large Detector Concept

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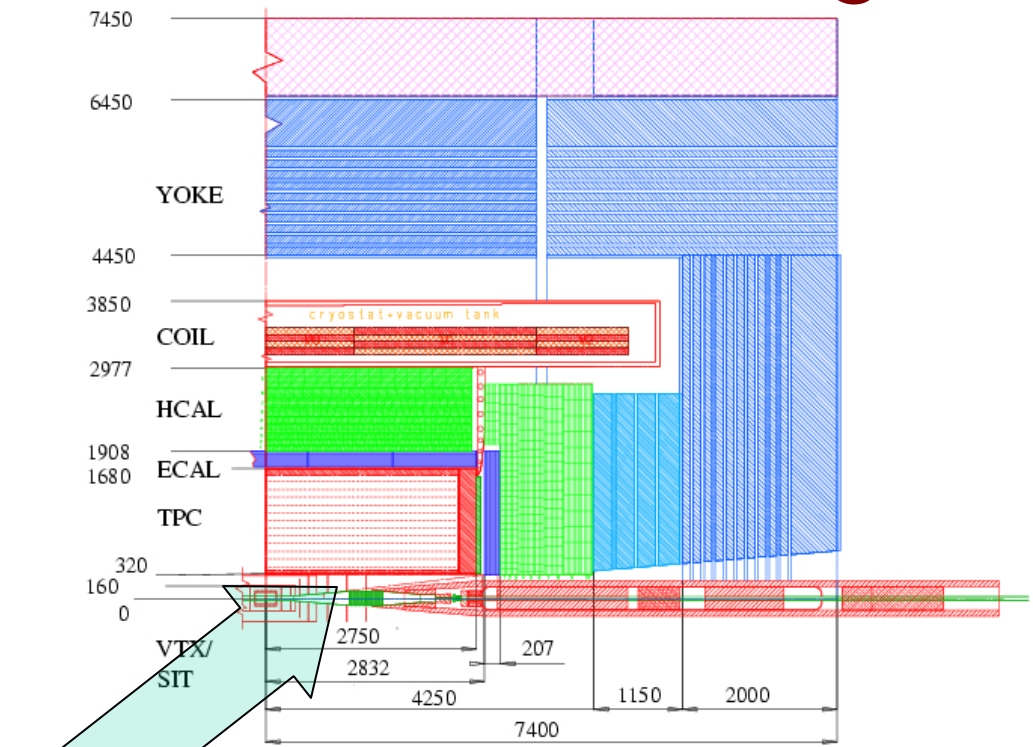
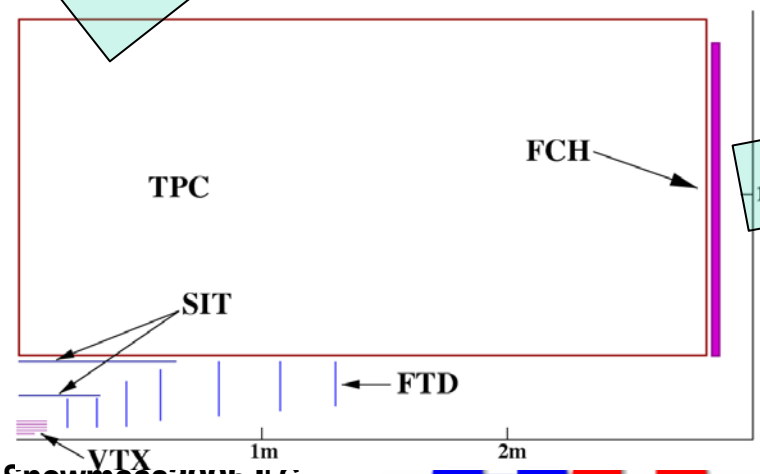
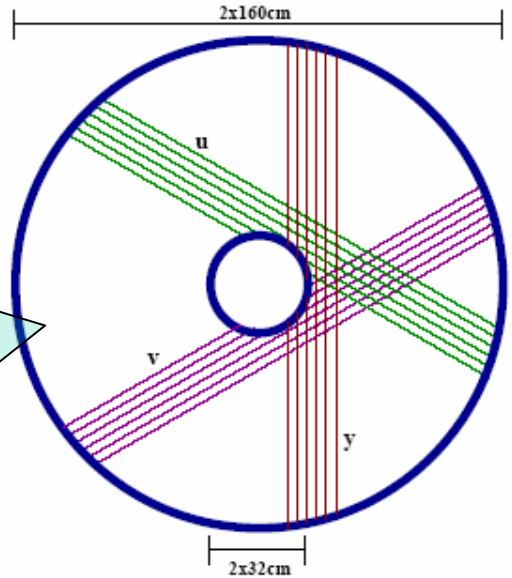
Forward Tracking in the TESLA Design



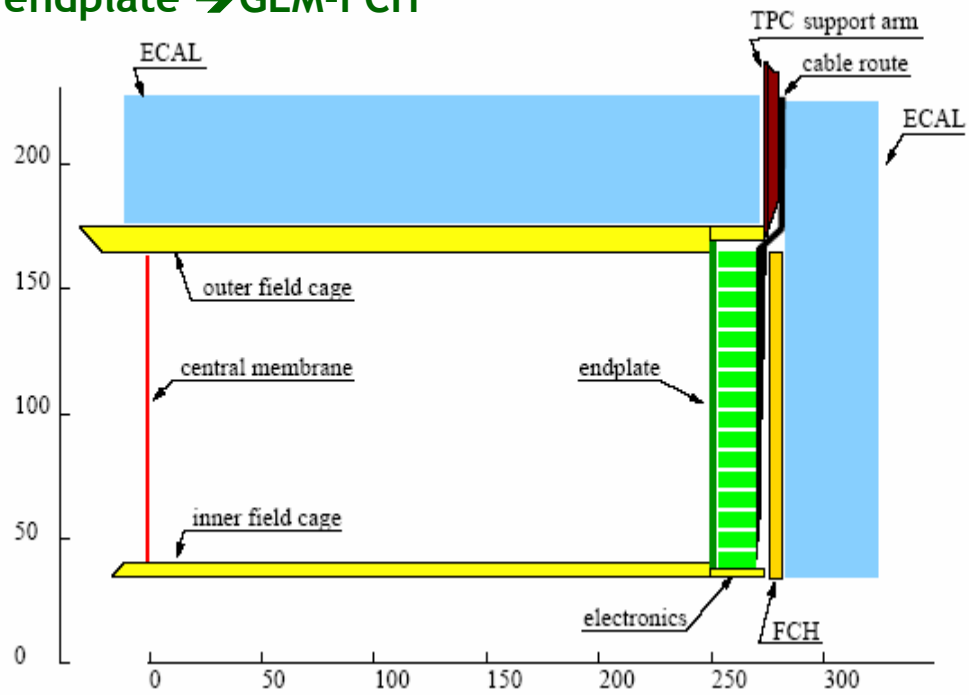
- FTD: Silicon Disks.
  - 7 Layers (3 Pixel Layers, 4 Strips)
  - Coverage from 25° to 7 °(436 to 122 mrad)
- FCH:
  - Straw Tubes: 6 2-layer chambers in TDR
  - Provides additional track hits in region of reduced TPC lever-arm and/or r/o pads
  - Must have a low overall profile
  - Other detector possibilities? Si Strips, Fibers, GEMs?



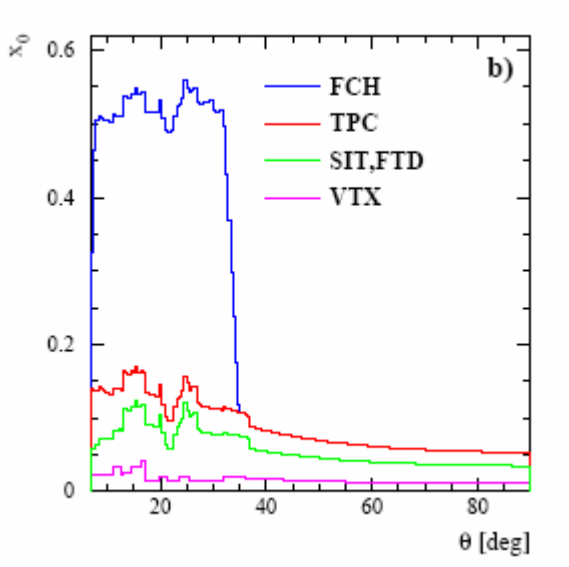


Forward Tracking and the TPC

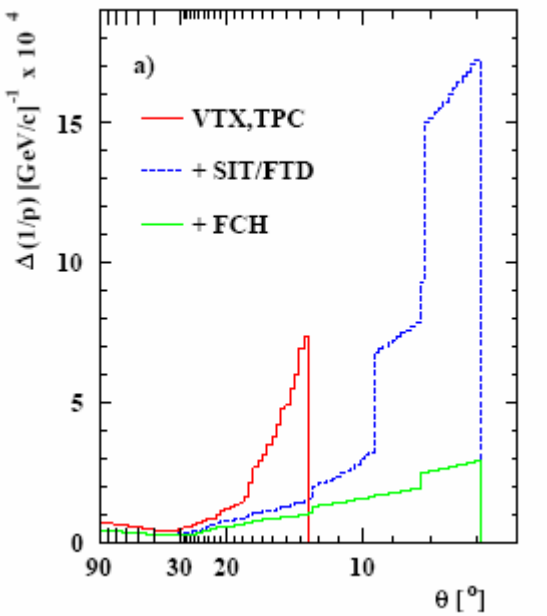
- Questions to be Considered at Snowmass2005:
  - How important is the FCH behind the TPC?
  - Do we need stand-alone tracking capability in there, or is a simple device which adds one or two hits sufficient?
  - Which technology is optimal for the FCH?
- Some FCH Proposals
  - Something standalone ➔ Strawtubes, Scintillating Fibers?
  - Something that integrates with the rest of the Silicon detectors ➔SiFCH
  - Something that "replicates" the TPC endplate ➔GEM-FCH
  - Just part of the ECAL
- Considerations
  - Terrible location => services for VTX, SIT, and TPC, readout cables
  - Impact on other systems => Mount to TPC or ECAL?
  - Cost Cost Cost



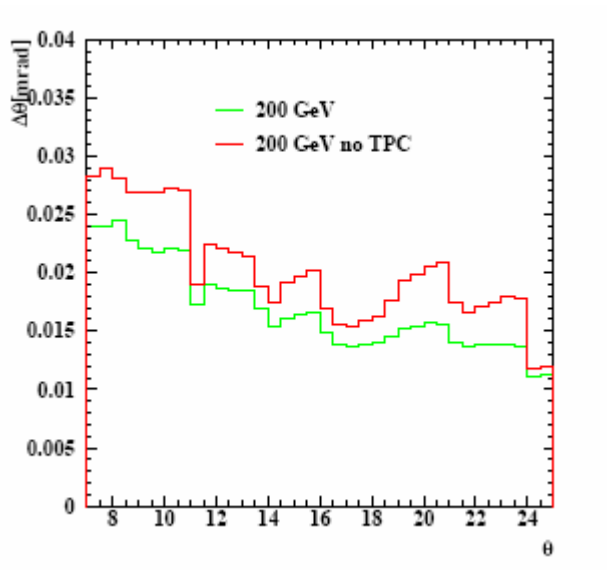
Forward Tracking Performance in the TESLA TDR



Upstream Material Profile in Radiation Lengths



Momentum resolution for 250 GeV muons as a function of polar angle

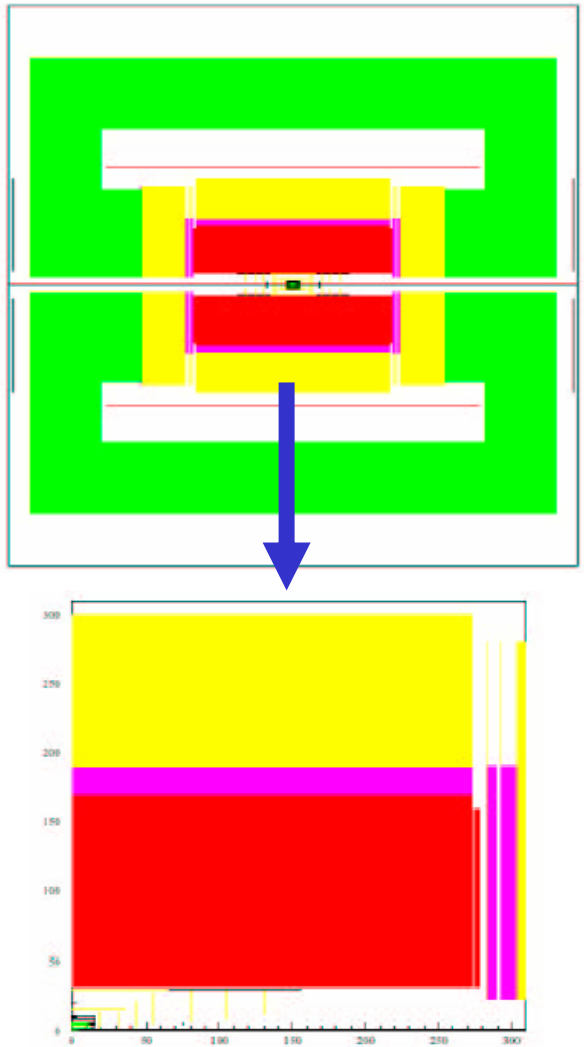


Polar Angle resolution for 200 GeV muons

- **Momentum resolution Goal is 5×10^{-5} $(GeV/c)^{-1}$ overall**
- **Polar angle resolution goal of < 5 μrad down to θ ≈100 mrad**

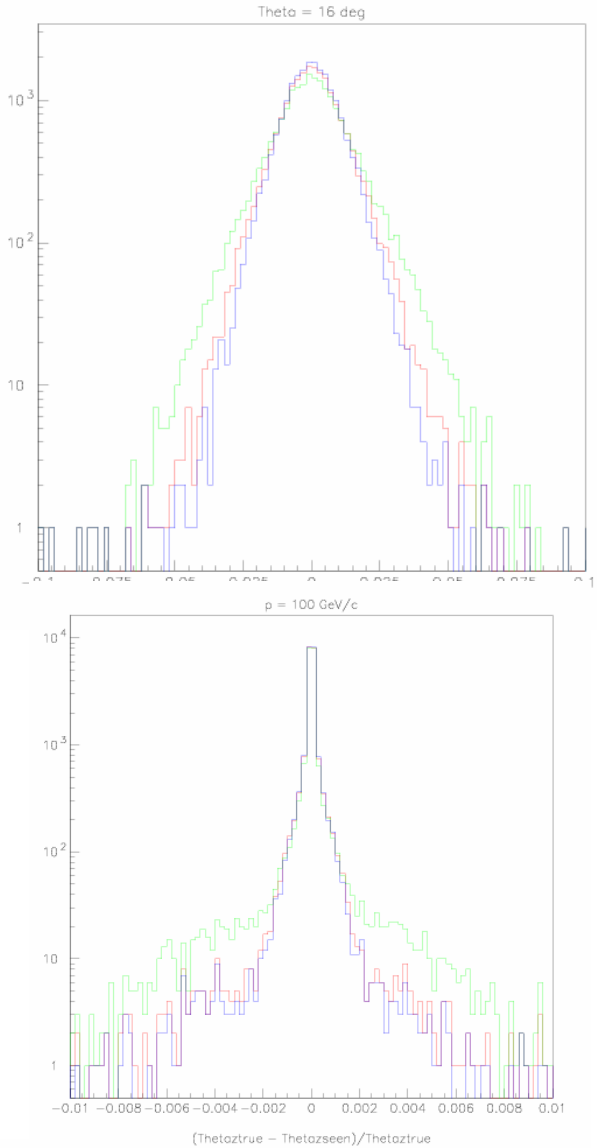
Fast Simulation Studies With SGV

- *Simulation a Grande Vitesse*
- **SGV is a fast simulation that reproduces parameterized detector hits, returns track covariance matrix**
  - Developed by Mikael Berggren (LPNHE)
    - Used in DELPHI, TELSA/SiLC studies
  - Advantages: Very fast, flexible detector geometry, tracking hits, calorimeter clusters
  - Geriatric friendly: Written in FORTRAN, uses HBOOK
  - Disadvantages: Not integrated with the "standard" LC software development

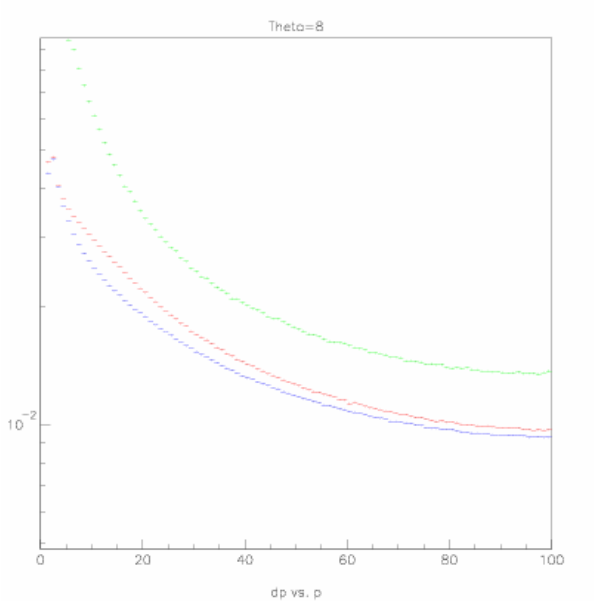


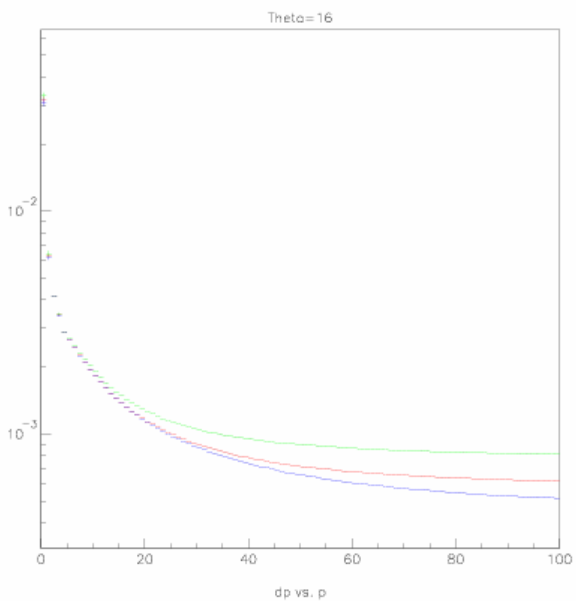
Single Particle Scans

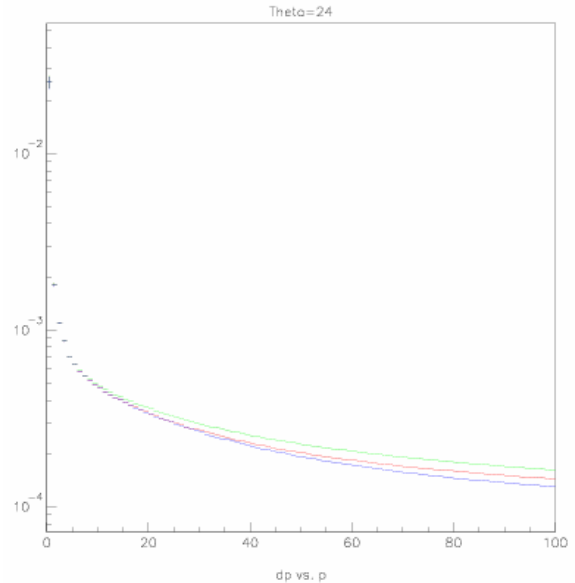
- Studied electrons in the angular coverage of the FCH ($7^\circ < \theta < 24^\circ$)
- Scanned in both momentum and angle
  - Momentum error taken from cov matrix
- Compared three detector configurations
  - No FCH
  - 3 layers of FCH
  - 10 layers of FCH
- Used FCH point resolution of 100 μm
  - Variations in σ_{FCH} not visible at this level of simulation



Momentum Tracking Error







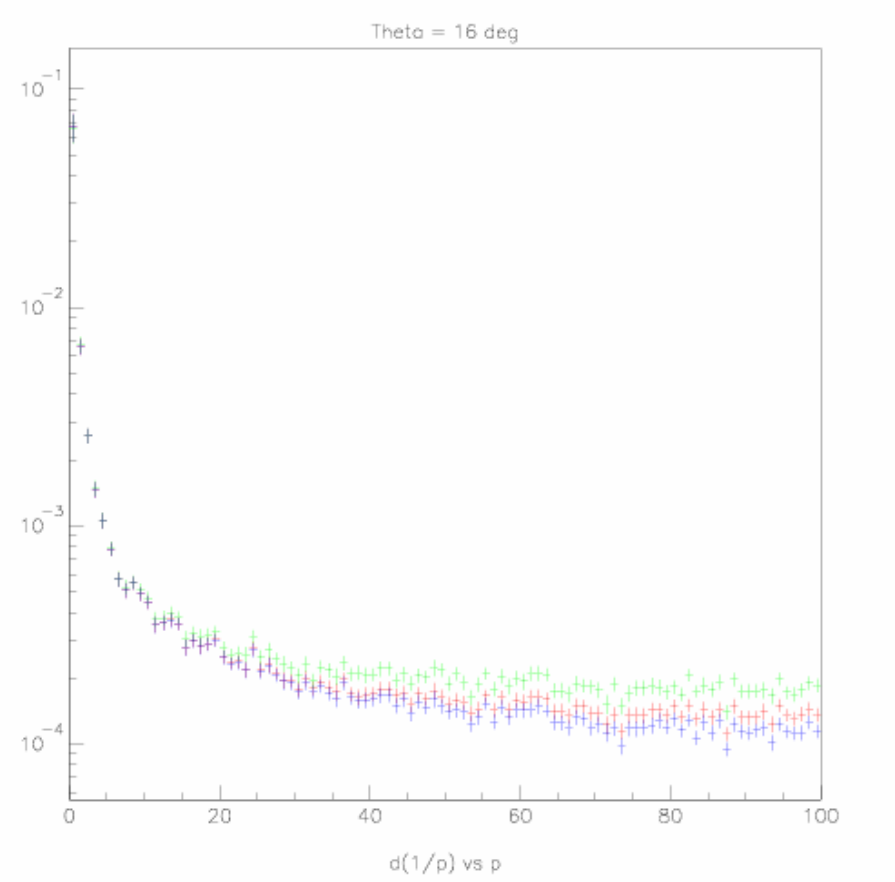
•Improvement in momentum error, even at large angles

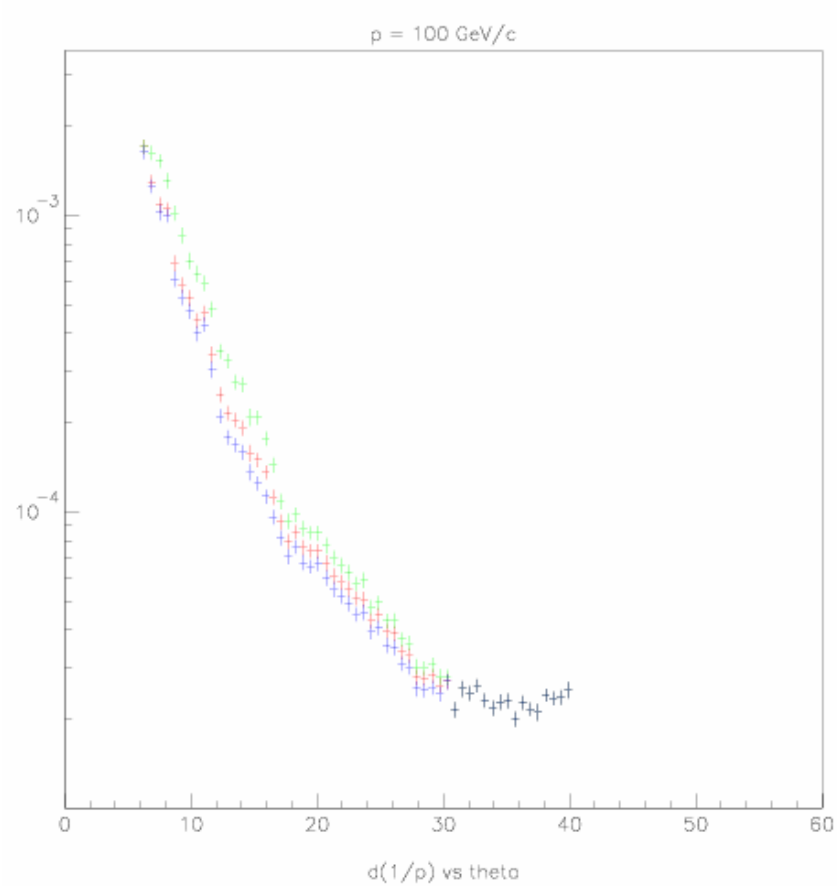
No FCH

FCH with 3 layers

FCH with 10 layers

Momentum Resolution



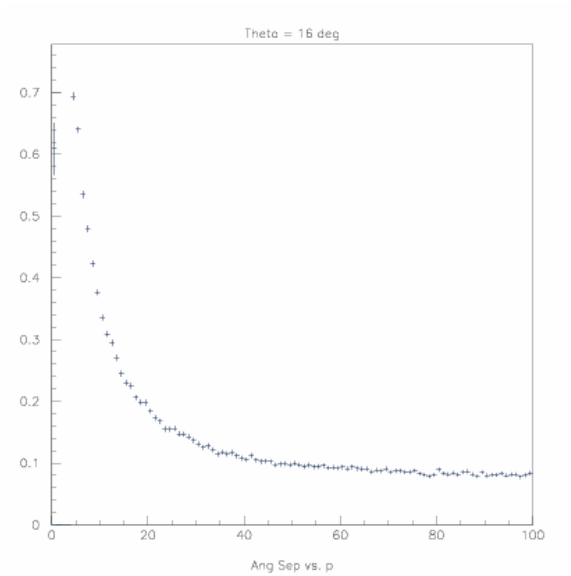


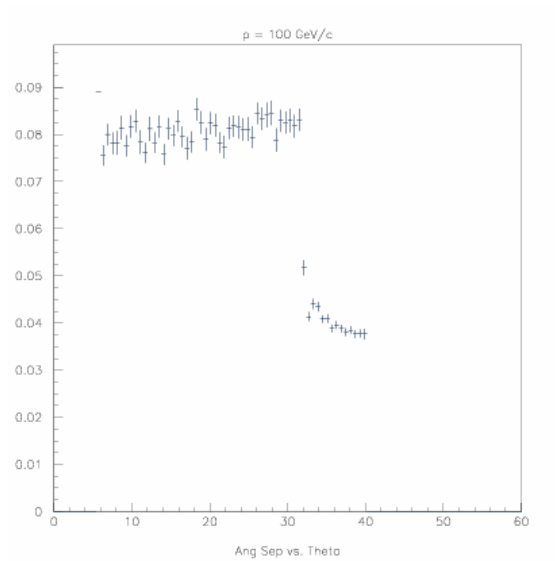
For comparison, the TESLA TDR gives
$\Delta(1/p) = 3.2 \times 10^{-4}$ (GeV/c)$^{-1}$ for cos(θ) = 0.9
using full BRAHMS simulation

No FCH
FCH with 3 layers
FCH with 10 layers

Angular Separation

- Looked at the angular separation between the "reconstructed" track and calorimeter cluster
- Little difference seen between the 3 configurations
  - Probably requires a detailed simulation



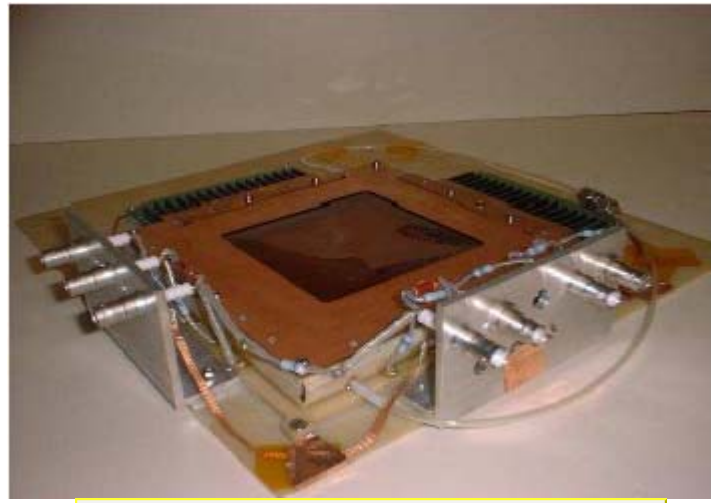


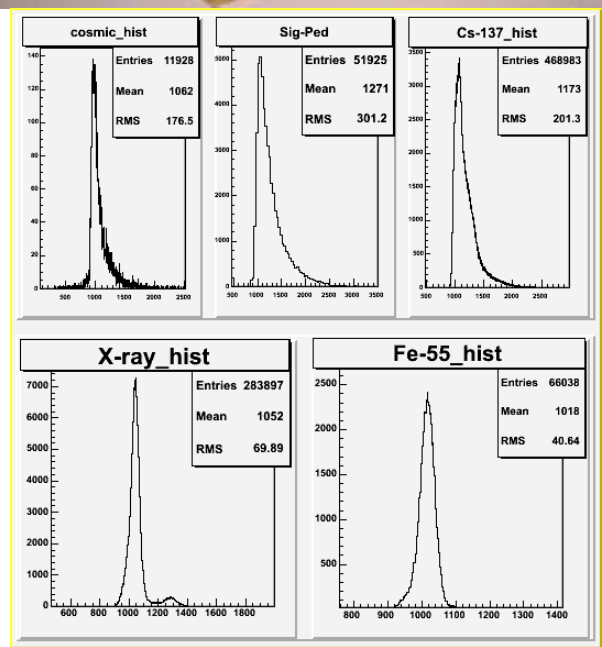
Running MOKKA

- Next step is to run detailed simulations using Mokka
- Have already generated small datasets at LA Tech with D10 and LDC00 geometries
- Have not installed the latest version of MARLIN/MarlinReco
  - Began analysis with org.lcsim but need compact detector description for LDC

Update on GEM R/D

- Two 10 cm prototype chambers built and tested
- These are prototypes for the QWEAK chambers to be built next year
- We will receive part of the 30 cm GEM foils made by 3M
  - Some Q/A questions are still to be resolved
- 30 cm charge collector will be designed this fall and built at CERN
- Main problem is the HELIX readout chip
  - Problems with programming, ground loops





Some Conclusions

- The need for an FCH to improve momentum resolution at intermediate to forward angles probably established
  - Fast simulation studies reproduce earlier SGV, BRAHMS studies
  - Still need to understand if this detector matters when optimized against particle flow
  - Studies do not establish a technology
    - Point resolution of around 100 mm probably sufficient
    - Number of layer depends on necessity of standalone tracking capability
- Detailed studies using MOKKA beginning
  - Will try to test running on LONI computing grid
- Detector R/D also continuing
  - Expect to have solution to HELIX problems within the next month
  - Also exploring other r/o chips