

Studies of the Forward Chamber in the Large Detector Concept

Lee Sawyer

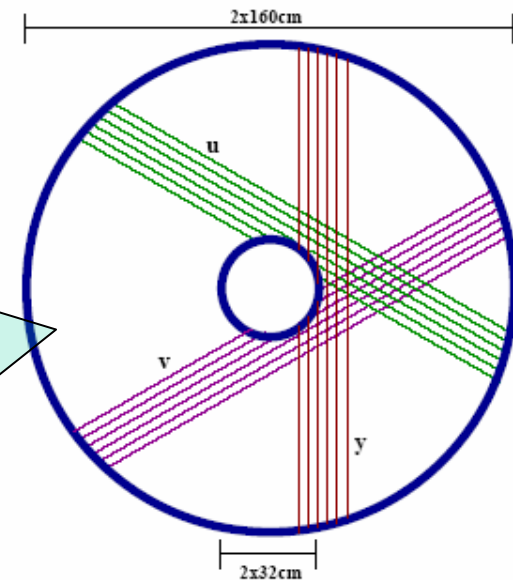
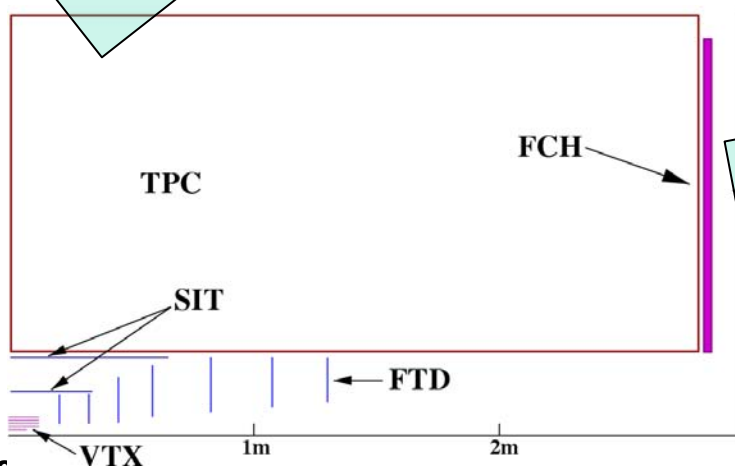
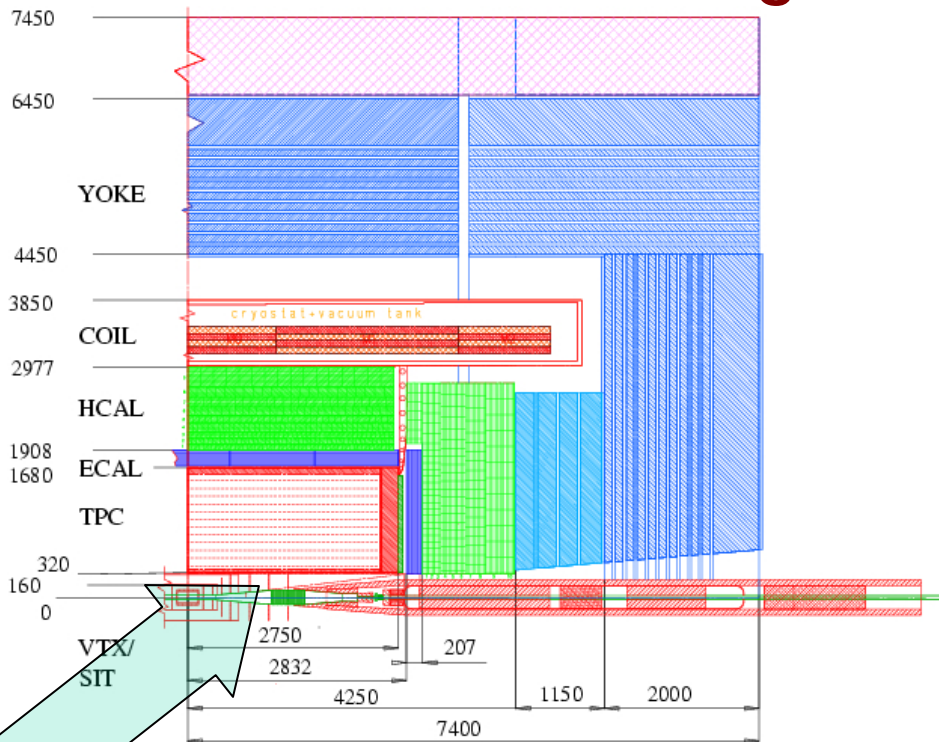
Louisiana Tech University

18 Aug 2005



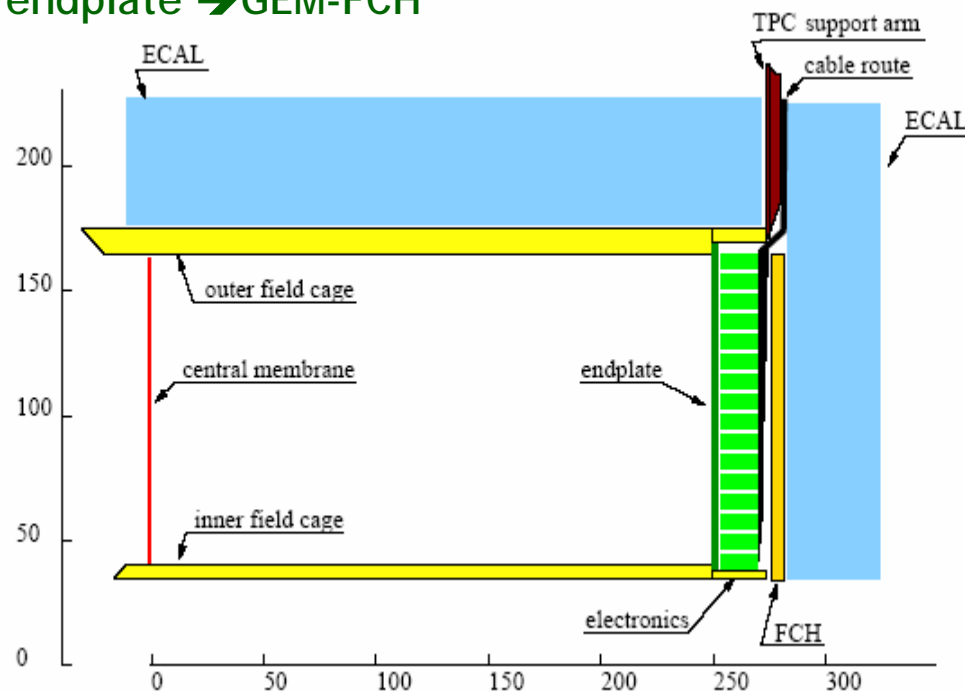
Forward Tracking in the TESLA Design

- 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?

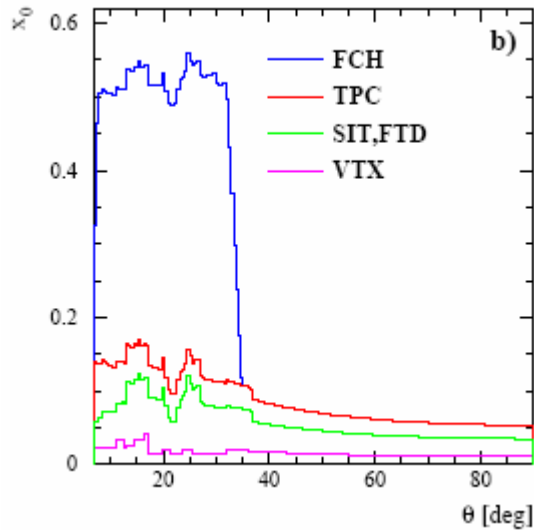


Forward Tracking and the TPC

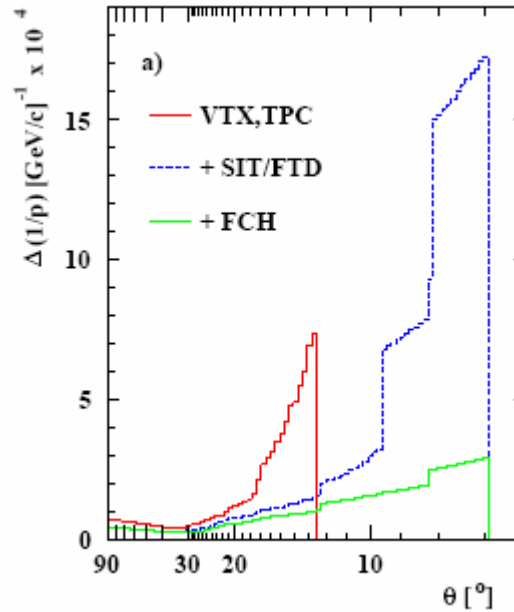
- Questions to be Considered at Snowmass2005:
 - How important is the FCH behind the TPC?
 - Do we need stand-alone tracking capability in there, or is a simple device which adds one or two hits sufficient?
 - Which technology is optimal for the FCH?
- Some FCH Proposals
 - Something standalone → Strawtubes, 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



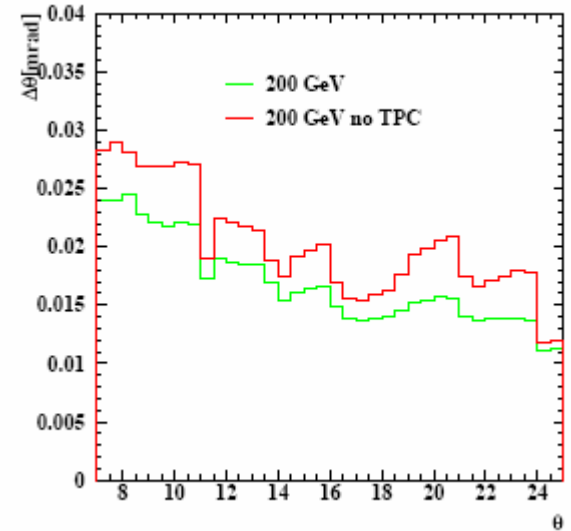
Forward Tracking Performance in the TESLA TDR



Upstream Material Profile
in Radiation Lengths



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



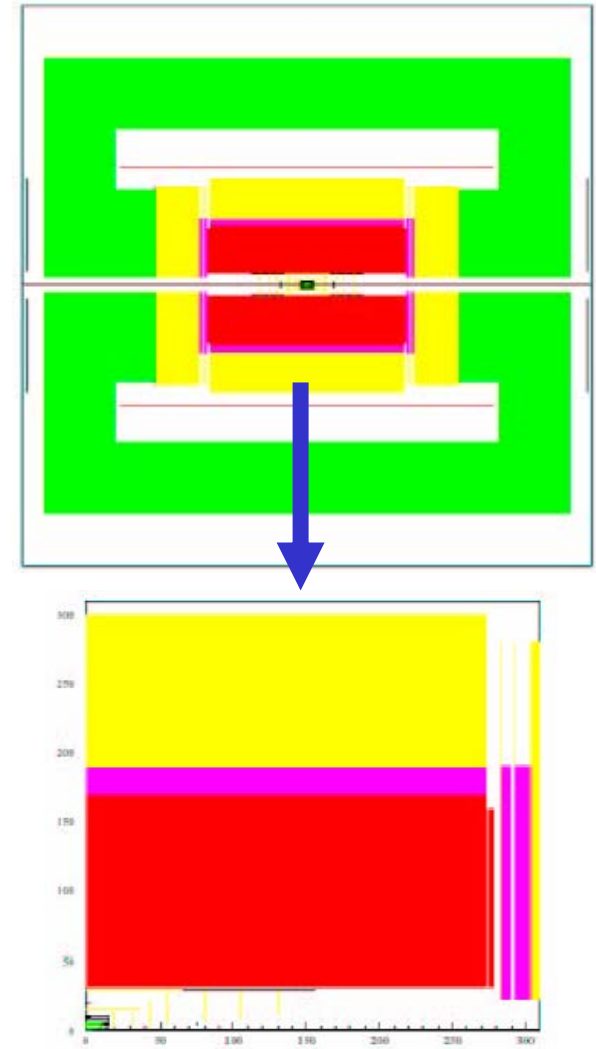
Polar Angle resolution
for 200 GeV muons

- Momentum resolution Goal is $5 \times 10^{-5} \text{ (GeV/c)}^{-1}$ overall
- Polar angle resolution goal of $< 5 \text{ } \mu\text{rad}$ down to $\theta \approx 100 \text{ mrad}$



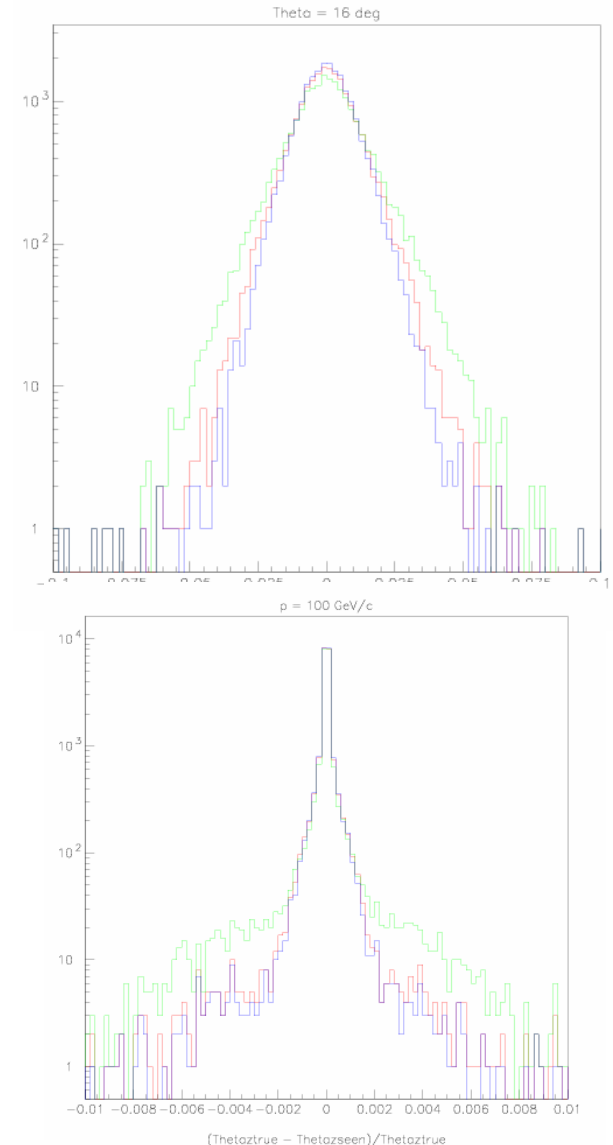
Fast Simulation Studies With SGV

- *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, TELSAs/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

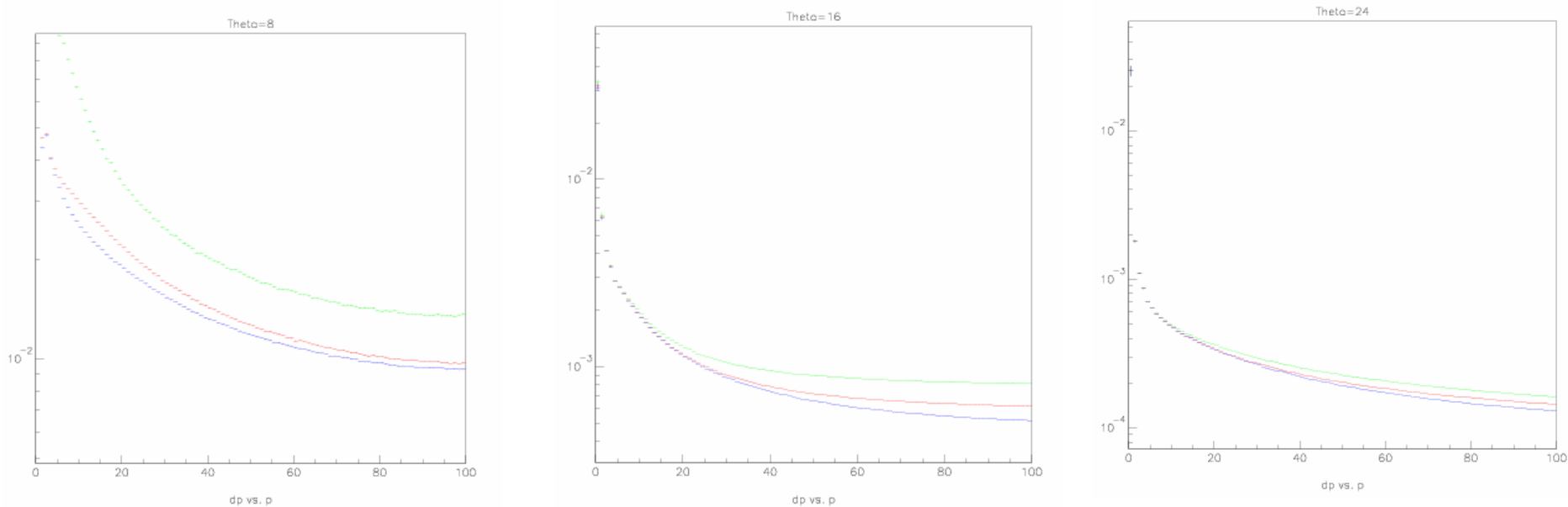


Single Particle Scans

- 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 $100 \mu\text{m}$
 - Variations in σ_{FCH} not visible at this level of simulation



Momentum Tracking Error

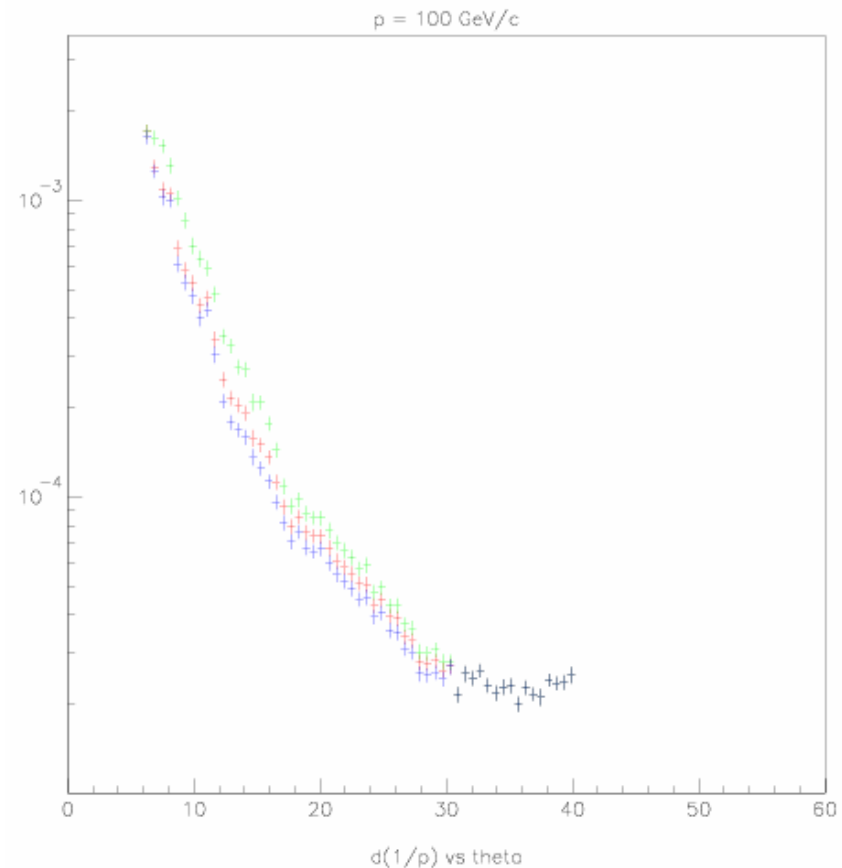
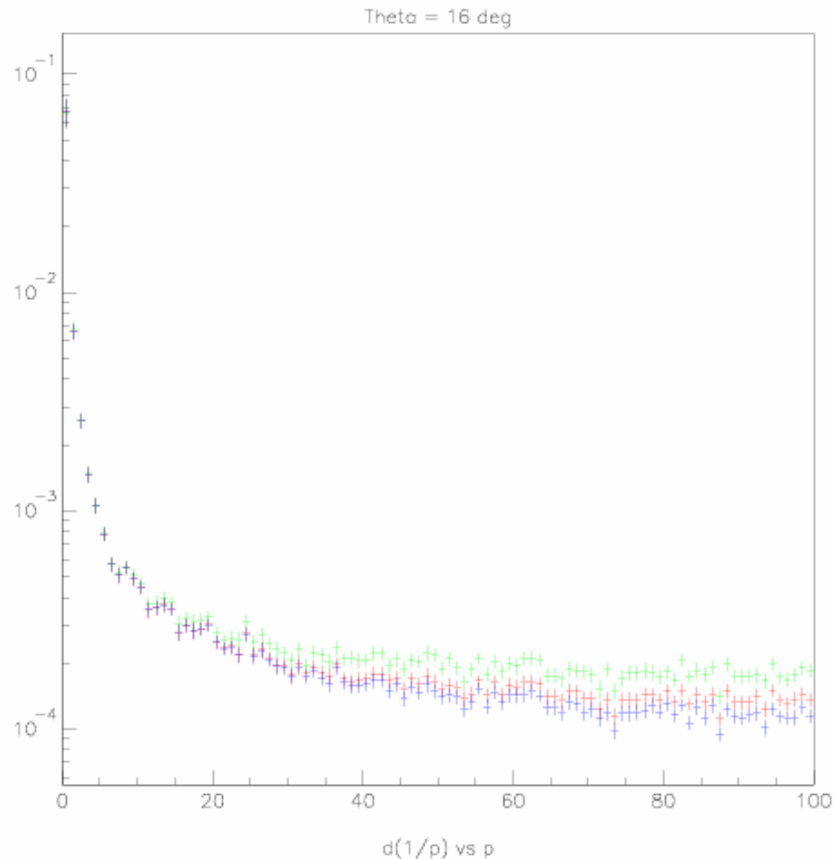


- Improvement in momentum error, even at large angles

— No FCH
— FCH with 3 layers
— FCH with 10 layers



Momentum Resolution



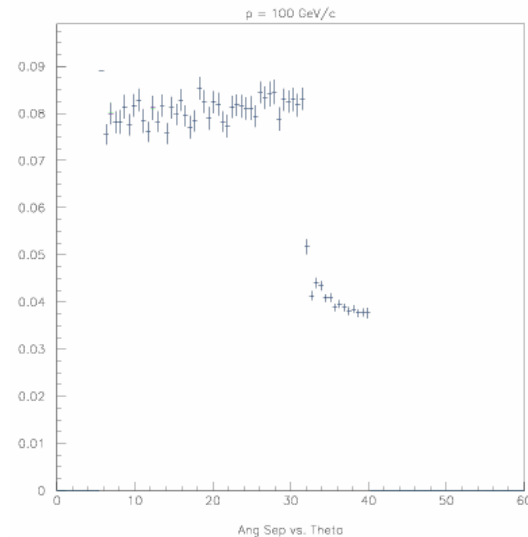
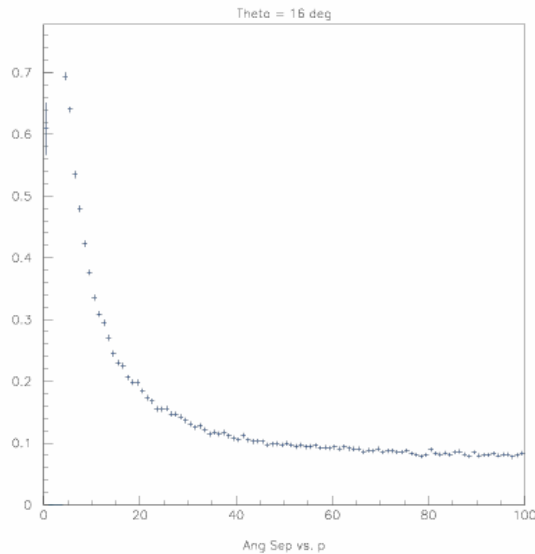
For comparison, the TESLA TDR gives
 $\Delta(1/p) = 3.2 \times 10^{-4} \text{ (GeV/c)}^{-1}$ for $\cos(\theta) = 0.9$
using full BRAHMS simulation

— 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



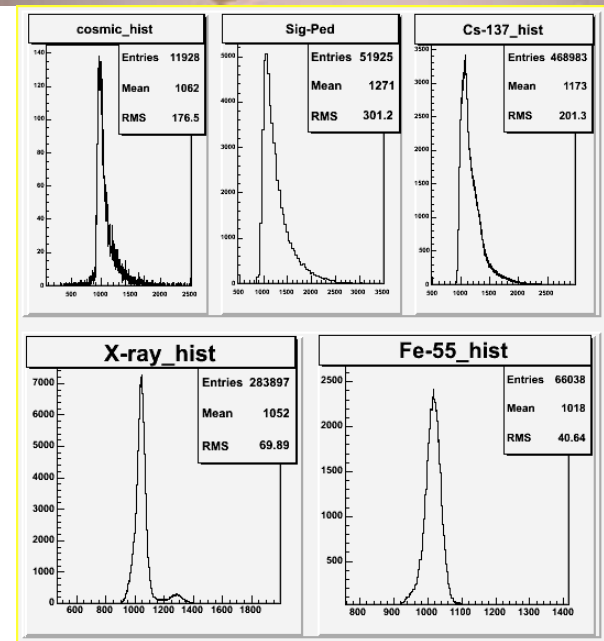
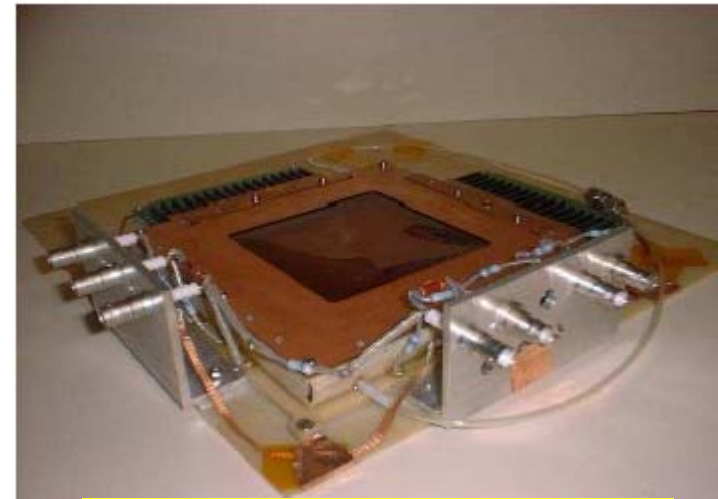
Running MOKKA

- 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

