CPP Muon Detector Simulation

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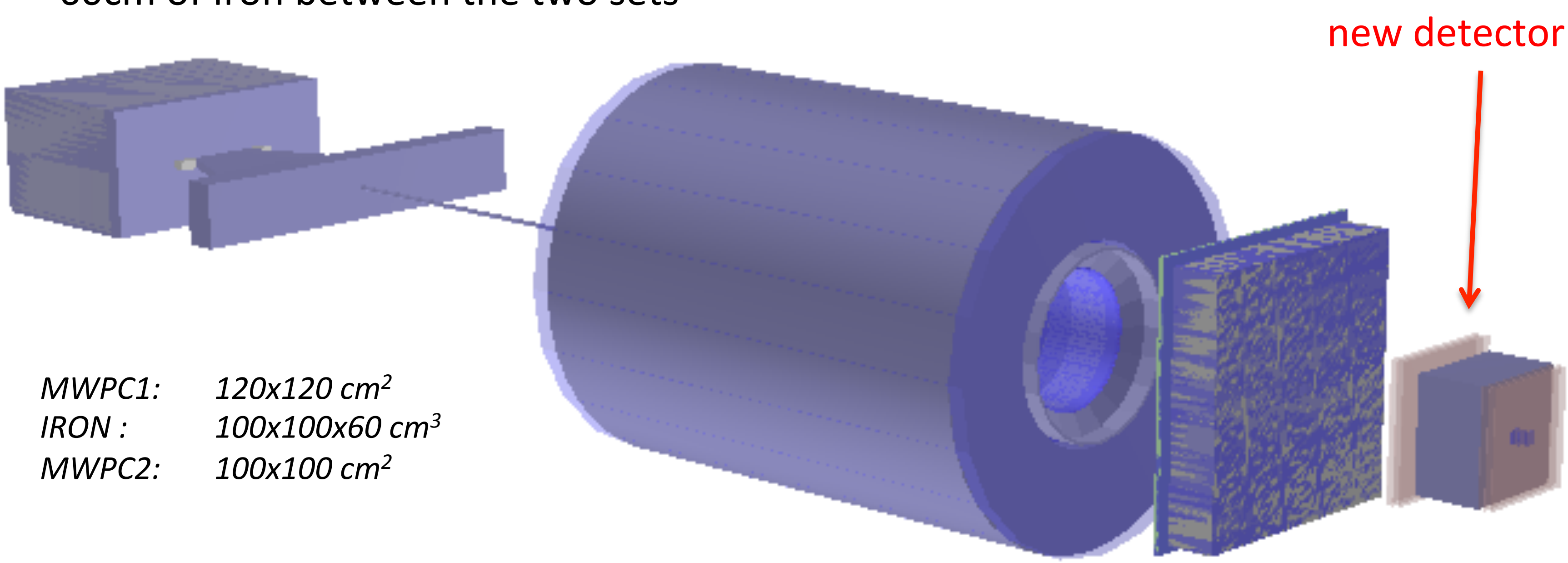
Current Issues

1. Downstream μ/π detector to suppress $\mu^+\mu^-$ background
   - Large background due to $\mu^+\mu^-$ pair production (~5x cross-section as $\pi^+\pi^-$ signal channel)
   - Occupies similar phase space as signal
   - Need to suppress by 2×10^{-3} (to get ~1% contamination)

2. FCAL response to hadrons for L1 trigger
   - Looking at FCAL as primary input to L1 trigger
   - Small amplitude would require low threshold which could lead to too high of rate
   - Conflicting evidence from literature and from Richard's Rad-Φ analysis

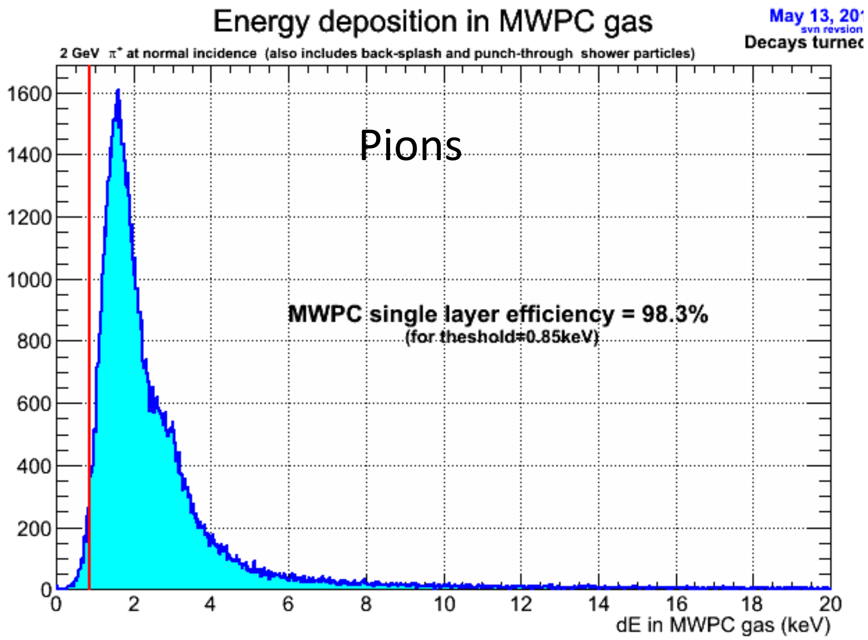
π/μ Detector Geometry

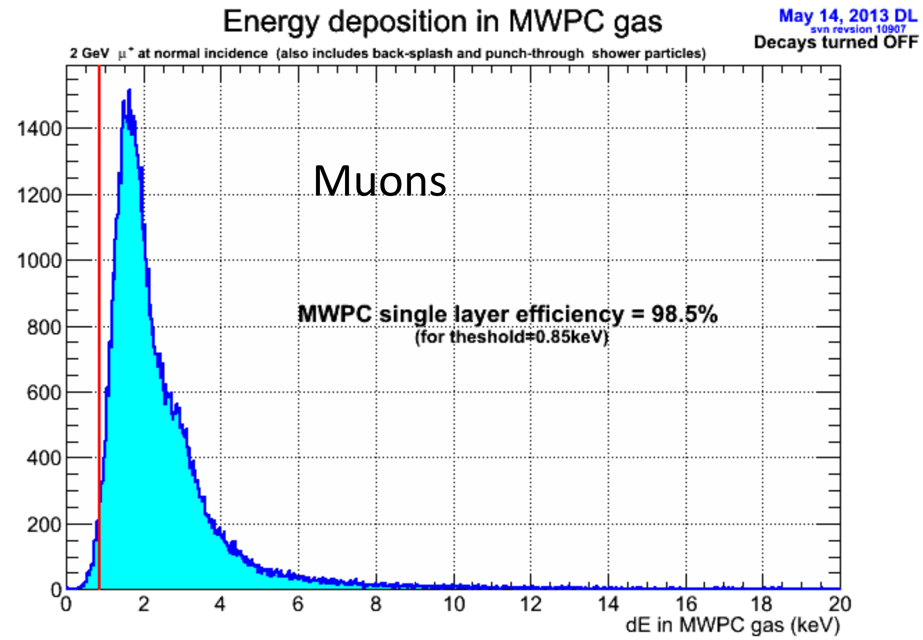
- Geometry is integrated into full GlueX detector geometry and data model (but in private area of repository)
- 2 sets of chambers, 3 chambers per set
- Upstream chambers identified as layers 1,2,3 while downstream are layers 4,5,6
- 60cm of Iron between the two sets



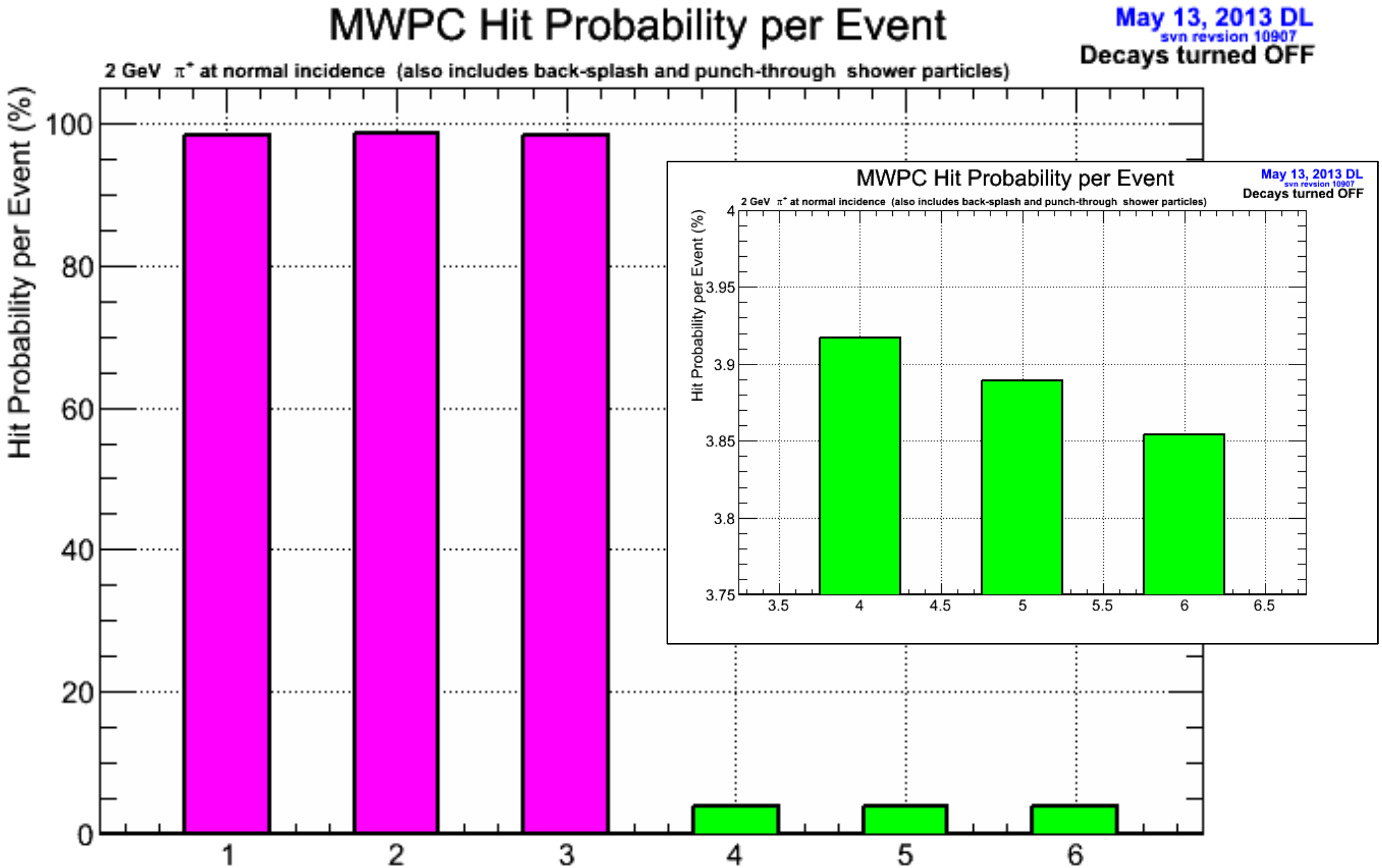
“Hit” definition

Hits defined by >0.85keV deposition in gas (same gas as used for FDC)

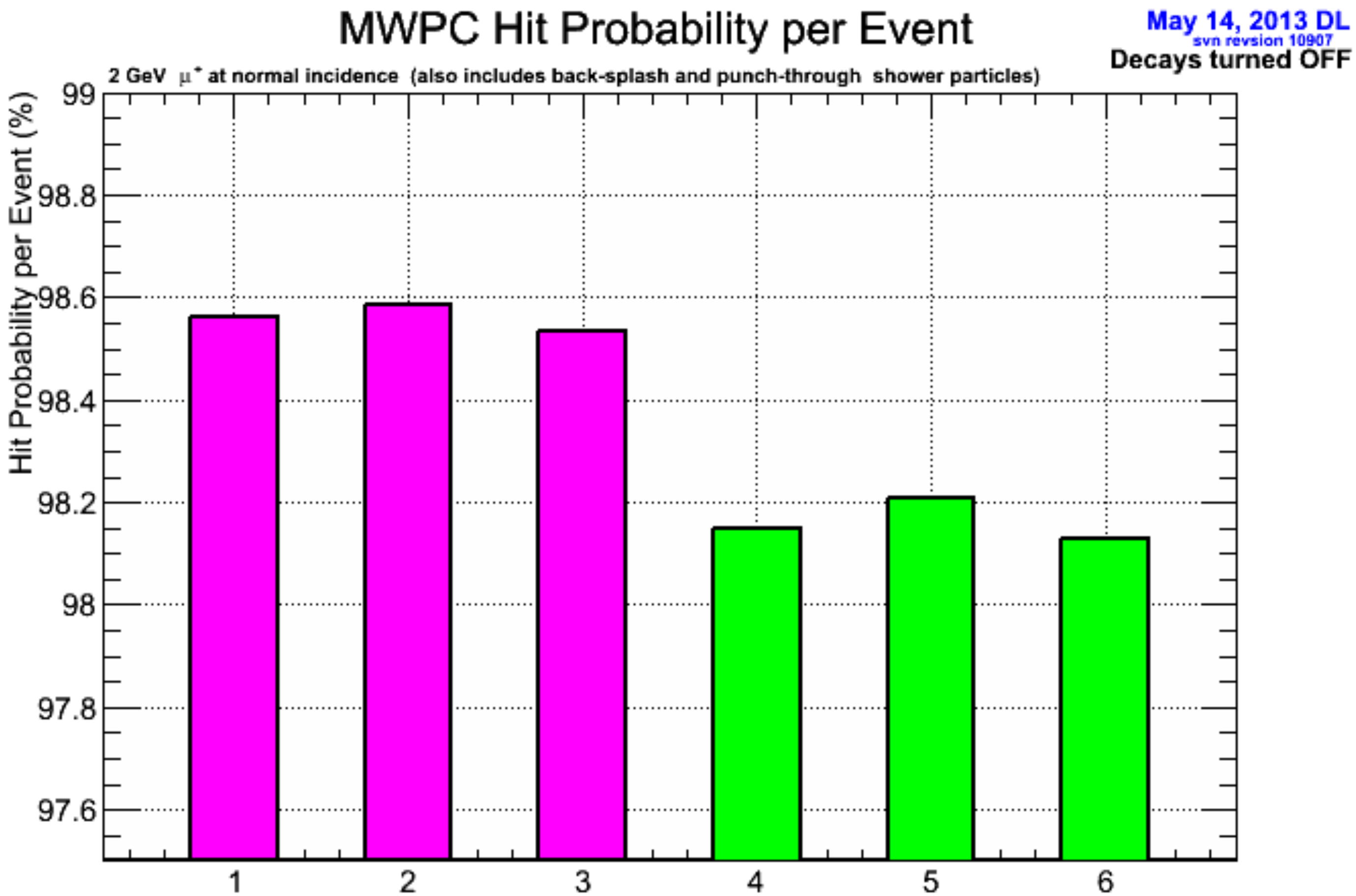




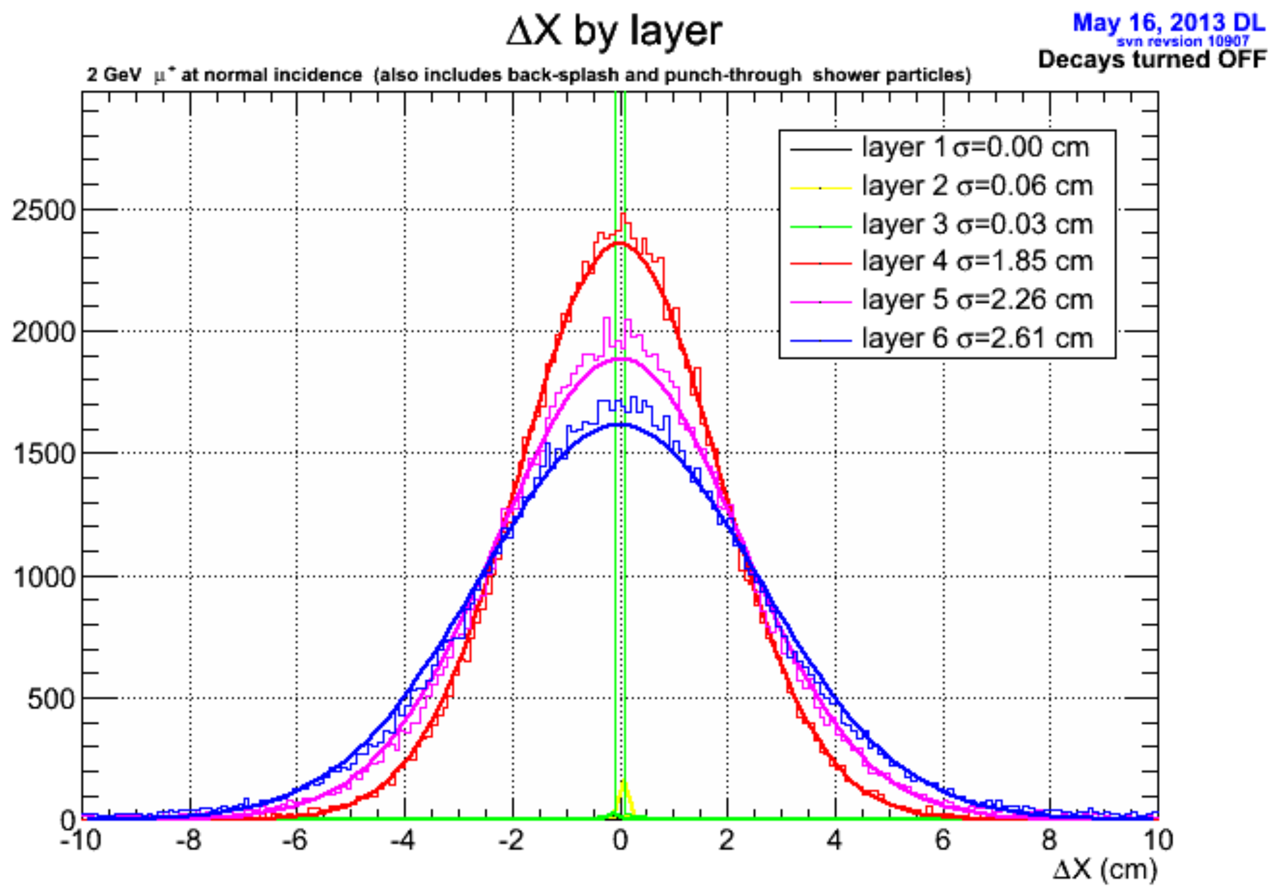
Pion hit probability by layer



Muon hit probability by layer (zoomed in)



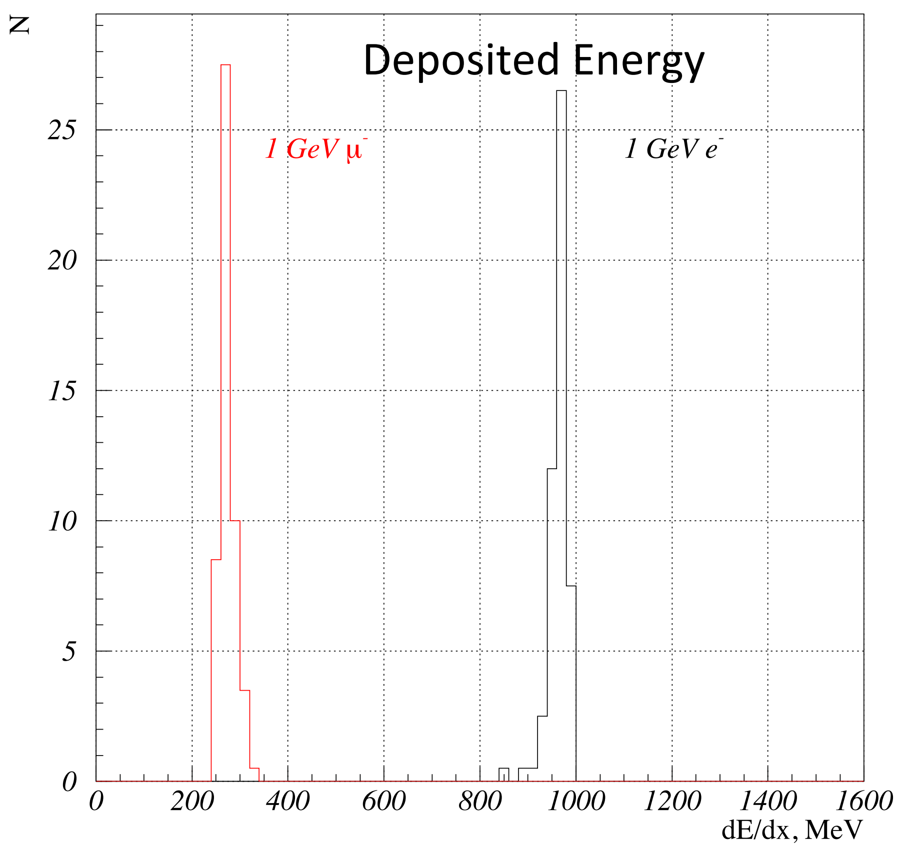
Muon position spread

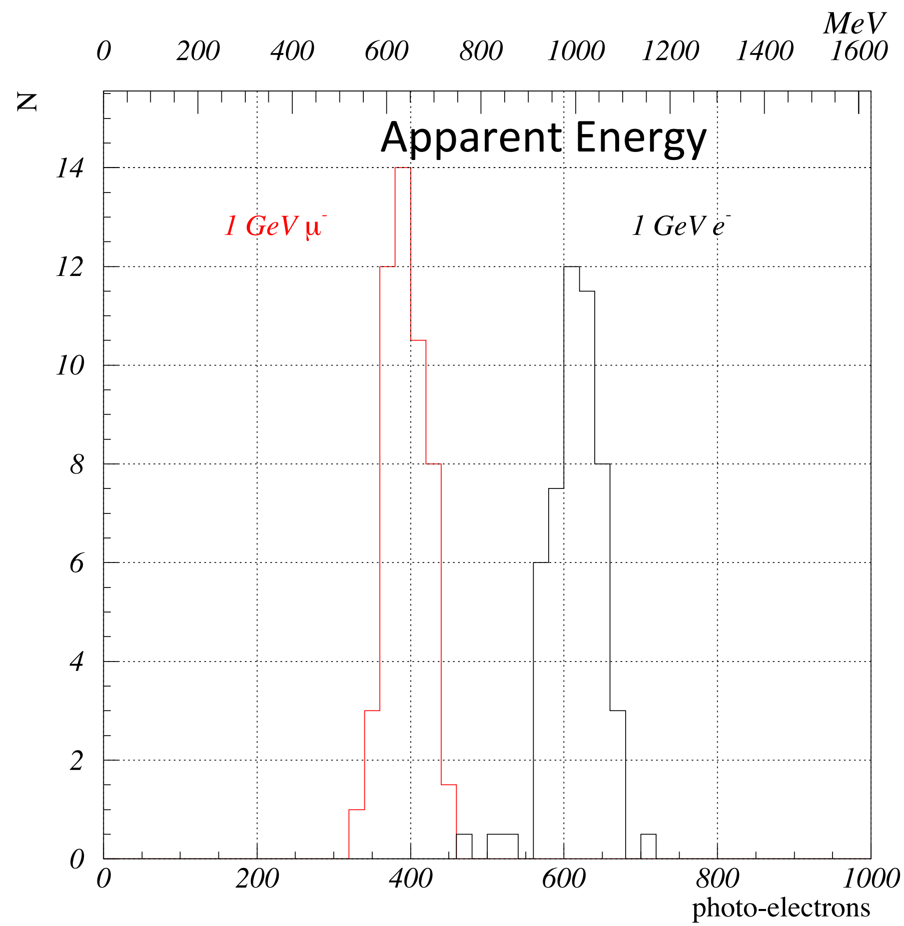


- Single muons were sent through the detector at normal incidence at x=25cm
- Difference between hit locations in each chamber and generated trajectory are shown here
- Muons that scatter into beam hole would look like pions due to absence of signal in downstream chambers

Simulation of FCAL response to Muons

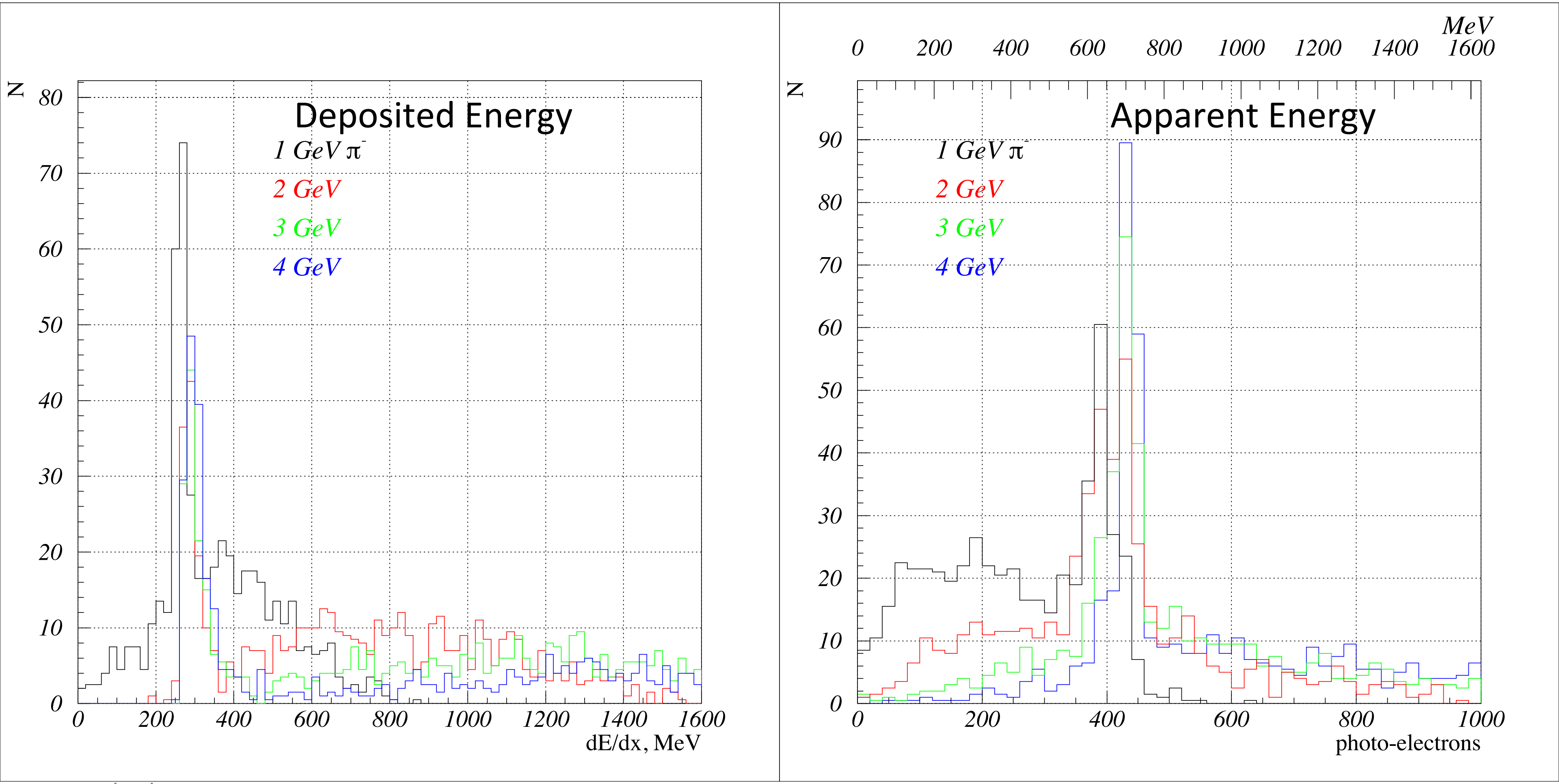
- Simulation of Cerenkov photon production and optics done
  (simulation and plots by Lubomir Pentchev)





Simulation of FCAL response to Pions

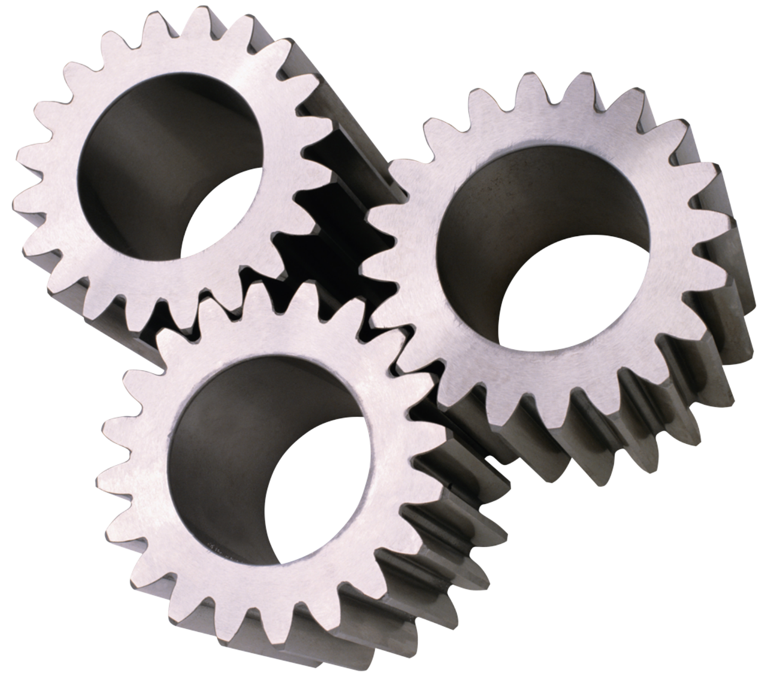
- FCAL is ~1.2 nuclear interaction lengths so some hadronic showers occur
- L1 trigger will be due to 2 pions whose energy adds to incident photon energy (~5.5GeV)



Summary and To Do

- μ/π detector integrated into *HDDS, HDDM, sim-recon* (private versions)
  - GEANT3 indicates good separation between π's and μ's
  - GEANT4 simulation is in progress to confirm
  - Alternate geometry being considered with more detector layers interleaved with absorber
- Detailed simulations of FCAL response to hadrons is underway
  - Initial results very encouraging and support claims found in literature
  - M.C. Calculations planned for 2 particle L1 trigger response

Backups

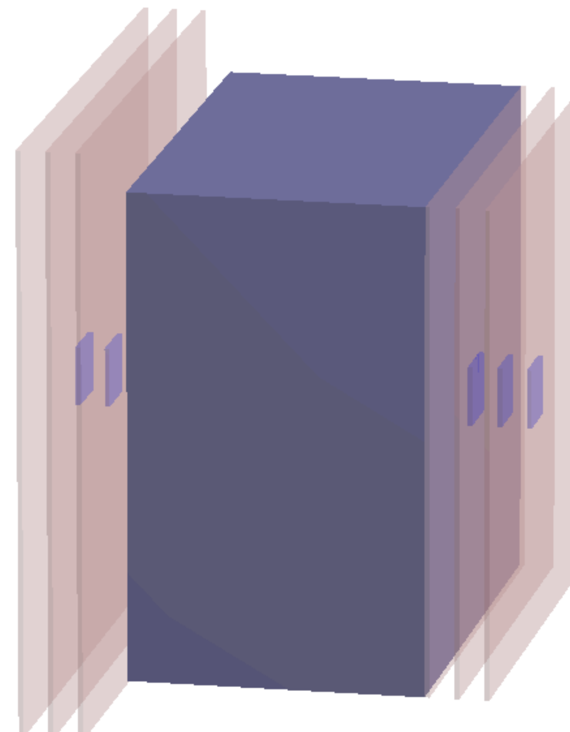


Geometry

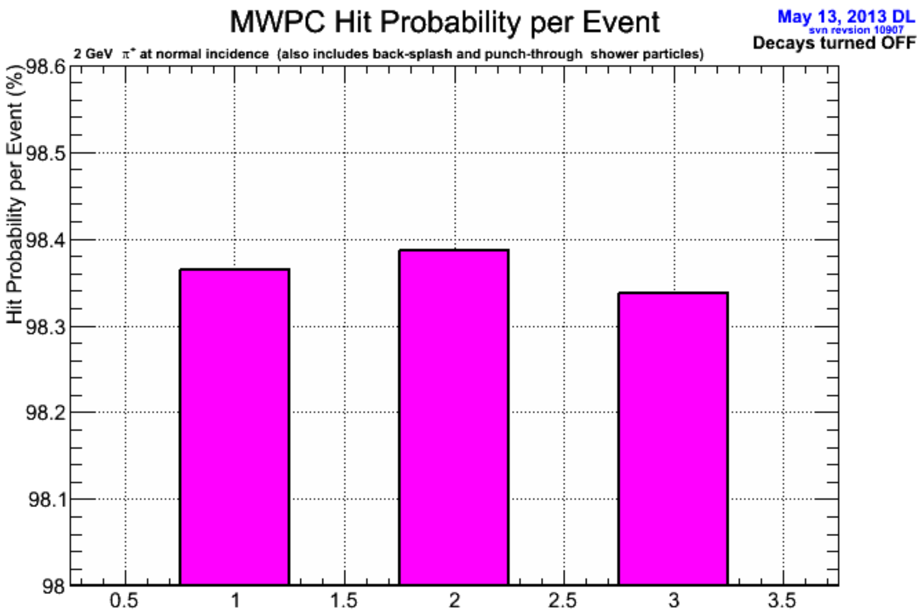
From comments in ForwardMuonDetector.xml
"MWPC1: 120x120 cm^2 cross-sectional area, 3 wire planes
IRON : 100x100x60 cm^3 (n.b. text says 60 cm but figure shows 50 cm!)
MWPC2: 100x100 cm^2 cross-sectional area, 3 wire planes

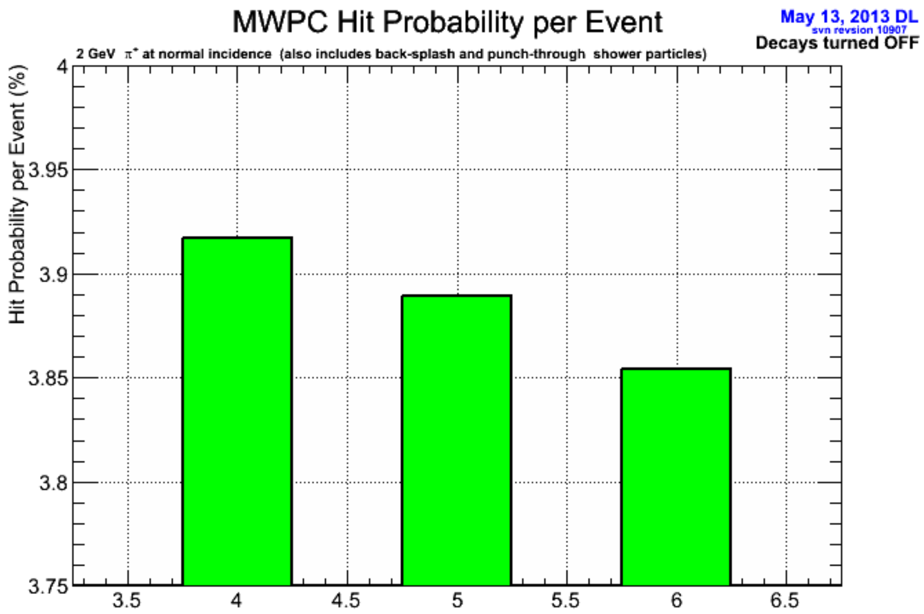
Note that while the text and figure indicate the chambers are 20 cm thick, we use 1cm thick gas volumes here, similar to the FDC. The chambers are separated by 5cm air gaps.

For the beam hole, we want a 12x12 cm^2 hole. To achieve this, appropriately sized volumes of air are placed inside the chamber and absorber volumes."



Pion hit probability by layer (zoomed in)





Muon hit probability by layer