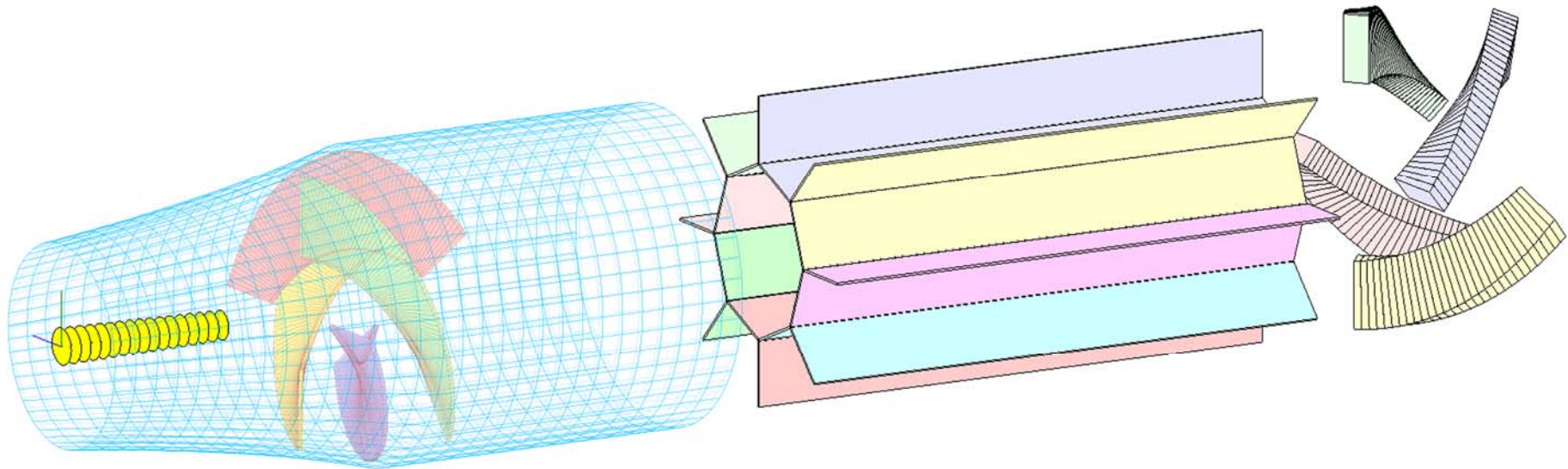
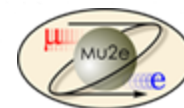


dE/dx and Particle Identification Inside L-Tracker



Matthew McHugh



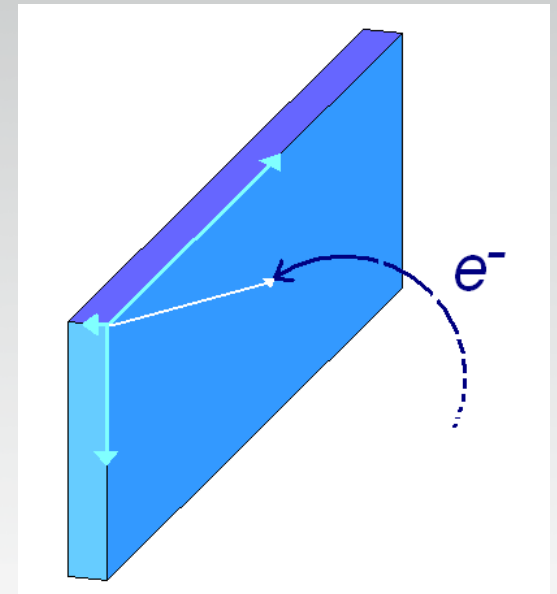
The Point

- Differentiate between particles based on their relative energy losses
- Particles providing false positive results
 - Simulated particles have 105 MeV/c
- Electron, Pion, Muon

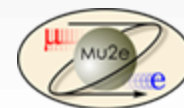
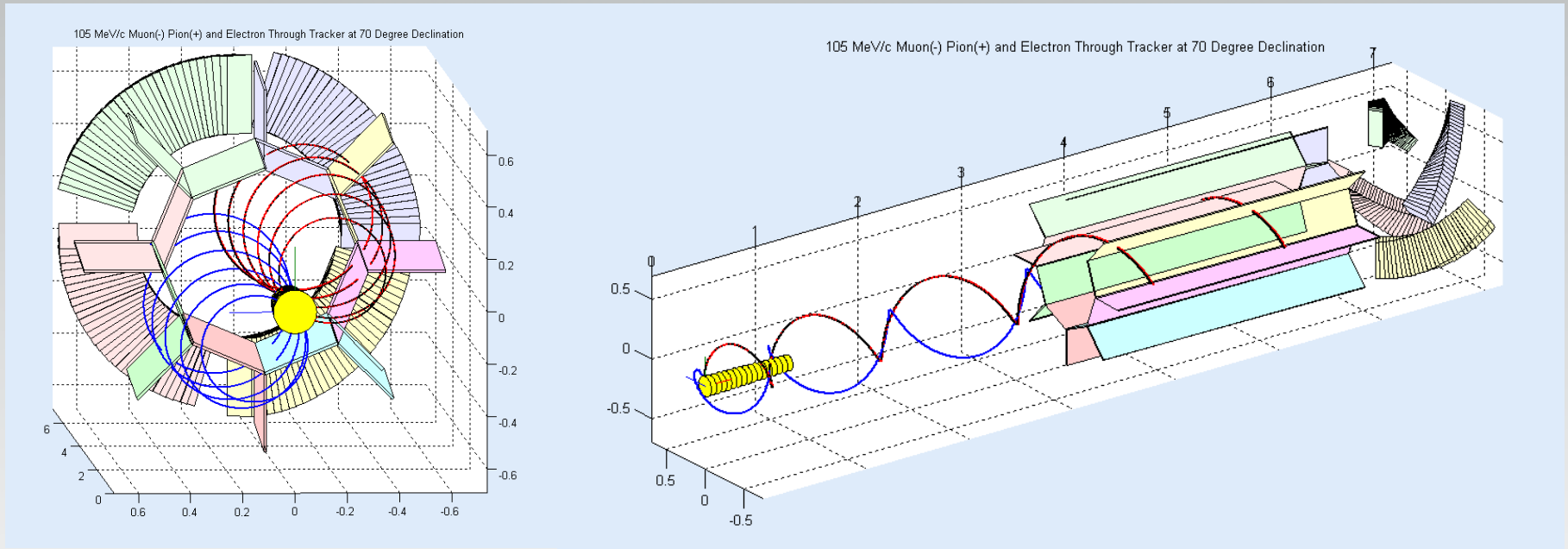


Method of Tracking

- Monte Carlo tracking system
 - ‘Swim’ particles through tracker
- Fourth Order Runge-Kutta
 - Accurate, coinciding paths
 - 1 picosecond intervals
- Coordinate transformation
 - Particle *within* tracker vane

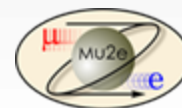


What it looks like



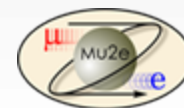
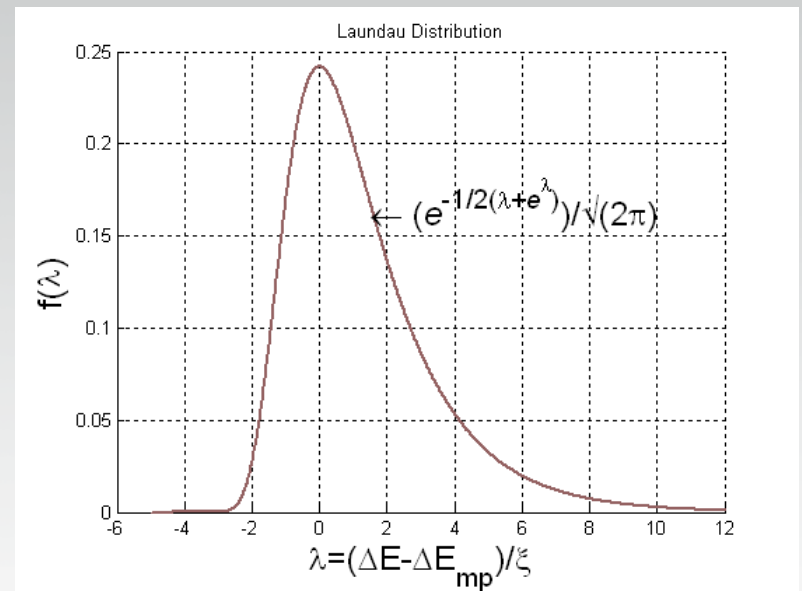
Stopping Power, dE/dx

- Approximate material as homogenous
- Bethe-Bloch for heavy particles
 - Ionization and atomic excitation
- *Bremsstrahlung* for electrons
 - Radiative losses dominate
- Energy recalculated at each step

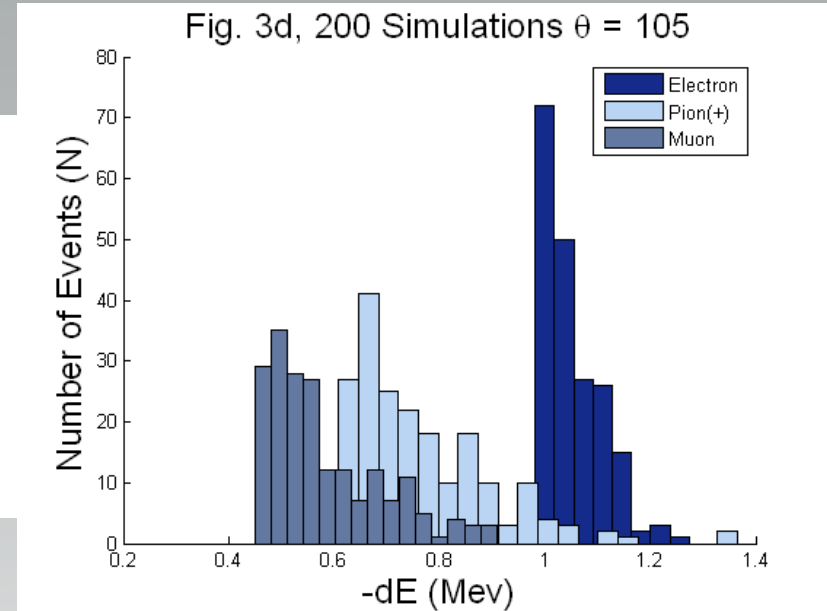
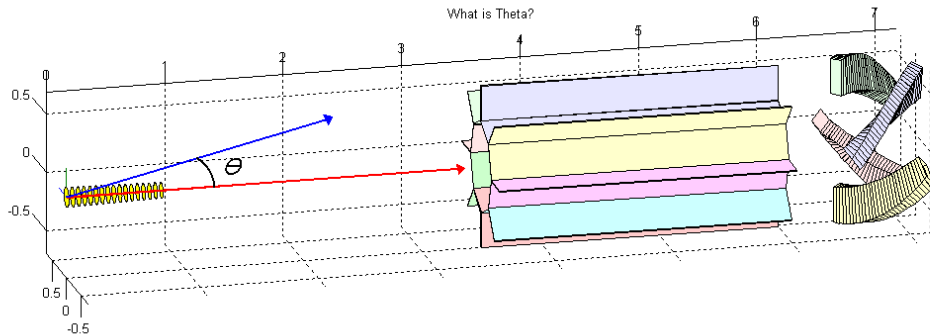


Molière and Landau

- Molière
 - Multiple Coulomb scattering
- Landau distribution
 - Energy loss stochastic, fluctuations
 - Little likelihood of large energy loss
 - Generally, $\Delta E \ll E_0$

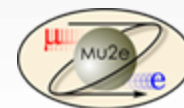


dE at Fixed Theta



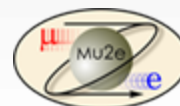
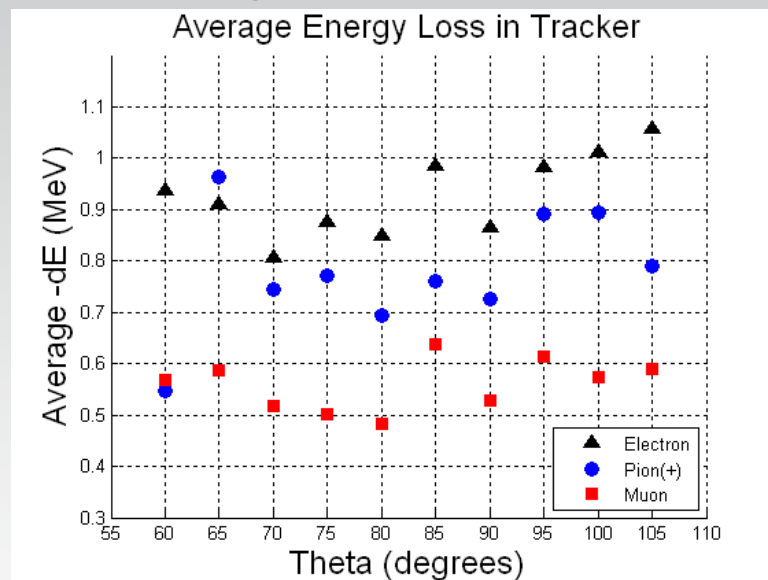
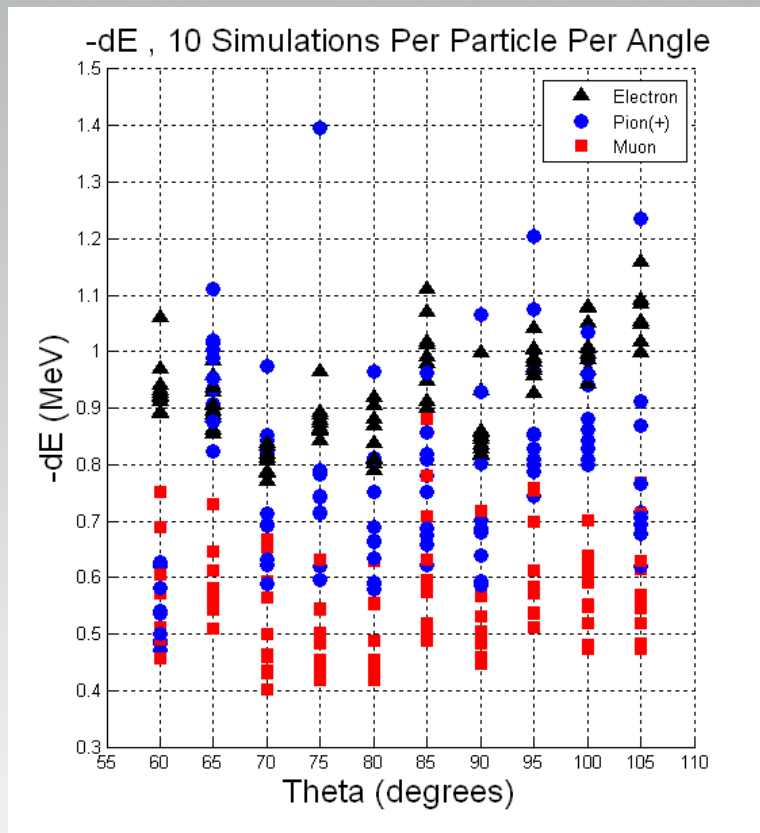
- 200 simulations per particle per angle
- Tightly packed distributions
 - Easily discernable peaks
- Overlap of distributions
- Energy loss ratios

Theta	$\langle \Delta E_{\pi} / \Delta E_e \rangle$	$\langle \Delta E_{\mu} / \Delta E_e \rangle$
70	0.8886	0.5991
80	0.8865	0.6208
90	0.8106	0.6368
105	0.7290	0.5521



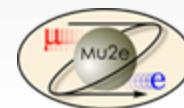
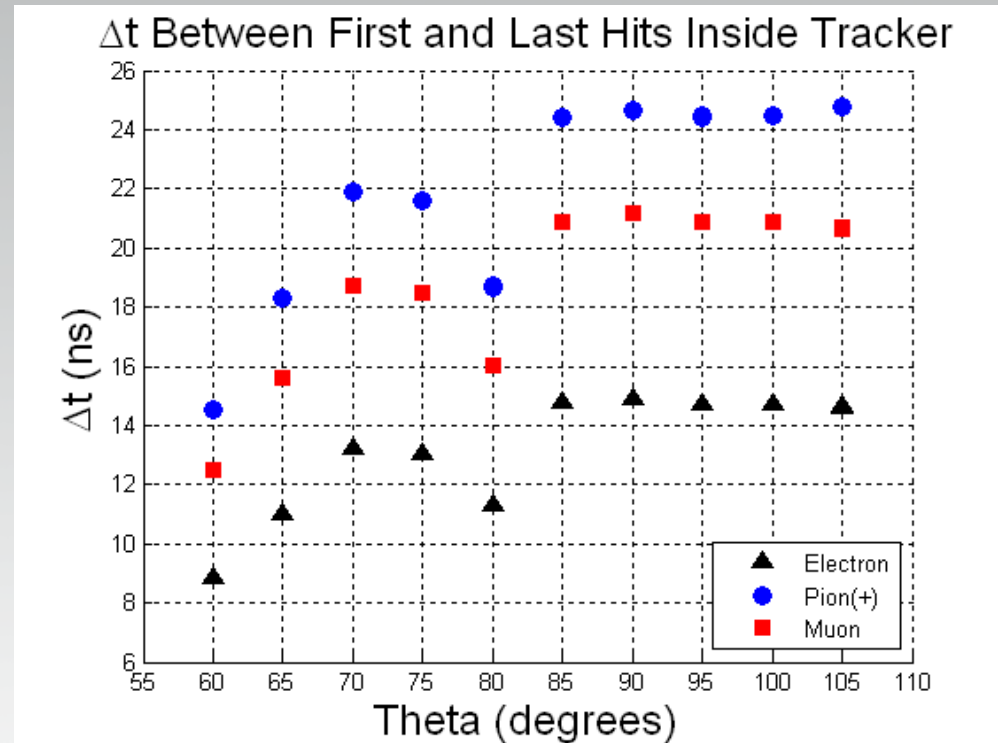
dE, Theta Spectrum

- dE discernable across broad spectrum
 - Muons almost out of picture
- Inconsistencies
 - ‘Skimming’



Timing

- First and last hits in tracking chamber
- At given theta, difference of ~ 2 ns



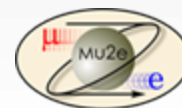
So What?

- Ratios of energy loss tell us approximate ratio of dE/dx
- Ratio is indicative of relative signal strengths in drift chambers
- Timing difference between signals to be used to determining velocity/momentum differences, information about motion



Points of Error and Next Step

- This is a baseline study
 - Approximation of tracker material
 - Step sizes, skimming
- Next
 - Take time data of hits on individual tracker sections and calorimeter
 - Allow for more freedom in particle propagation



Conclusion

- Study of energy loss can narrow scope of data considered, increase confidence level of detection of conversion e^-
- More sophisticated studies should be done in the future to more accurately model dE/dx
 - Useful tool on data analysis
- Time resolution should be about one nanosecond

