Michel Electron Reconstruction

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ProtoDUNE Reconstruction Meeting

Introduction

- First year PhD Student at Oxford University
- Supervisor : Alfons Weber
- Will be located at CERN for 1+ years during the commissioning and running of ProtoDUNE-SP
- Start looking into Michel electron reconstruction
- Calibration tool for ProtoDUNE-SP

Michel Electron Reconstruction

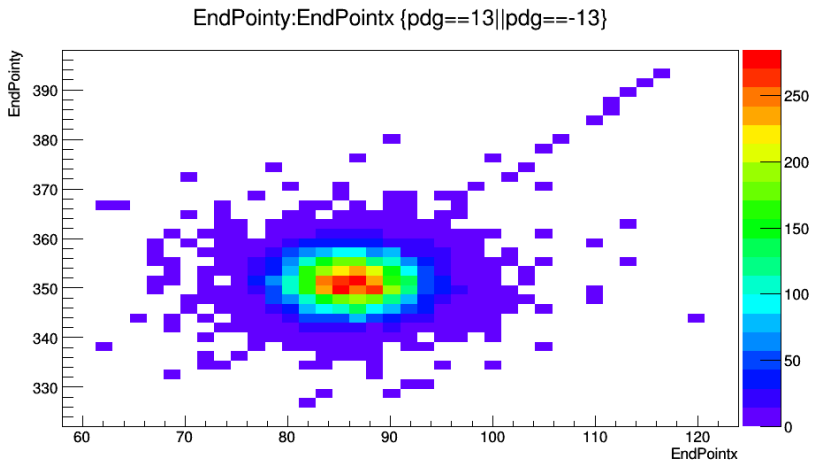
- I would like to study the reconstruction of Michel electrons in ProtoDUNE
- Michel electrons are "standard candles" for energy scale
- Study important effects in Michel electron energy resolution
  - Associating energy deposits from radiated photons to Michel electron
  - Associating energy deposits near decay vertex of muon to muon/Michel
- Measure energy resolution for $E \lesssim 60 MeV$

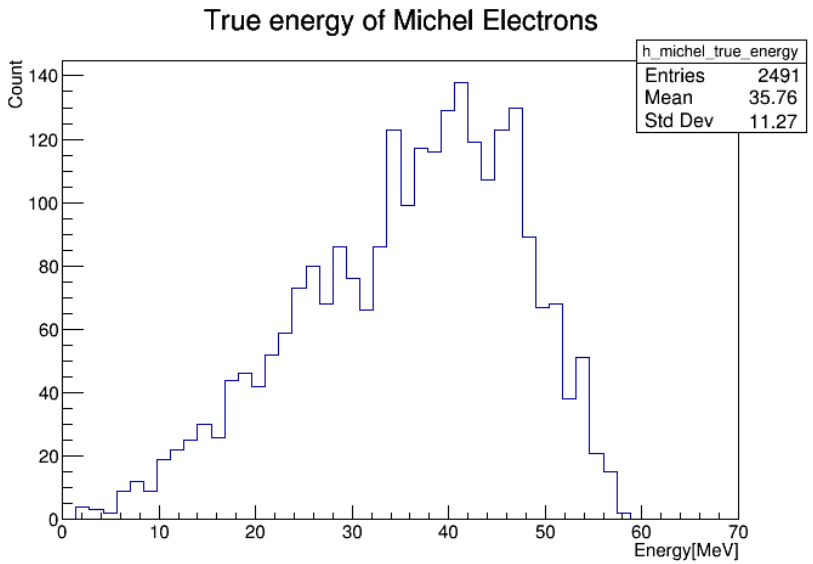
Current Status

- So far spent time doing graduate courses and understanding a bit about larsoft
  - Anatree
  - Gallery
  - FCL files
  - Running simulation
  - Event displays
- Also generated and looked at some simulation files
  - 200MeV Single Muons
  - Beam overlayed with cosmics

Single Muon Sample

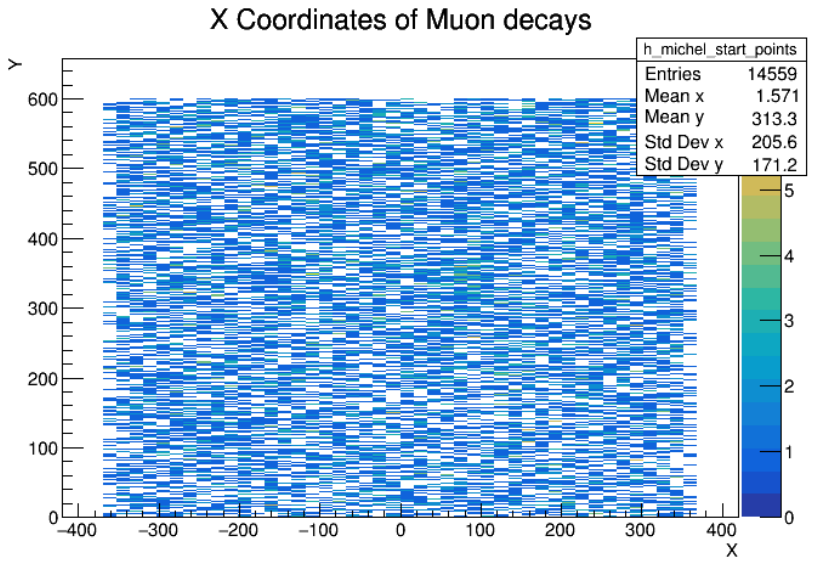
- 10000 μ^- at 200MeV
- Most muons stopped in active volume
- Energies of electrons with Process
  - Decay : 26
  - CaptureAtRest : 4560
- Ignore E < 2MeV : 2000
  - Better way to remove low energy events ?
- EM shower particles not stored $\rightarrow$ no info on radiated energy

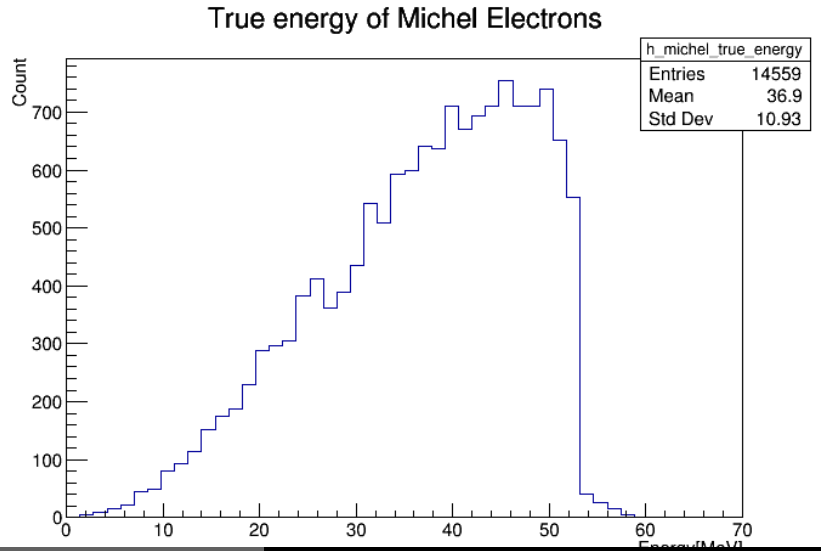




Beam Overlay Sample

- Most recent beam overlay simulation
  - 2GeV Beam
  - Cosmics
  - Noise Low
- Covers more of the active volume
- Energies of electrons with Process
  - Decay : 12025
  - CaptureAtRest : 4516
- Steeper drop $\rightarrow$ less radiative effects





Energy Reconstruction Study

- I would like to work towards testing the energy reconstruction for Michel electrons
- To do this I should understand
  - Amount of energy lost to radiated photons
  - Associating ionisation deposits from radiated photons to the Michel electron
  - Associating ionisation near muon decay vertex to Michel or muon
- So I need MC samples which will allow me to fulfill these requirements

Generating Samples

- I would now like to generate suitable MC for the study
- A MicroBooNE Michel study (Public Note 1008) had 2 samples
  - Single particle stopping μ^+ sample
    - 40k Stopping Muons
    - Many incident directions$\rightarrow$ increase coverage
    - Study details of radiated energy deposition at truth/reco level
  - Cosmic simulation
    - Truth studies
    - Data-MC comparisons
    - Energy resolution studies
    - MC validation studies
- Any input on how to make/find suitable samples would be appreciated