PHY310: Lecture 25

Confidence Intervals

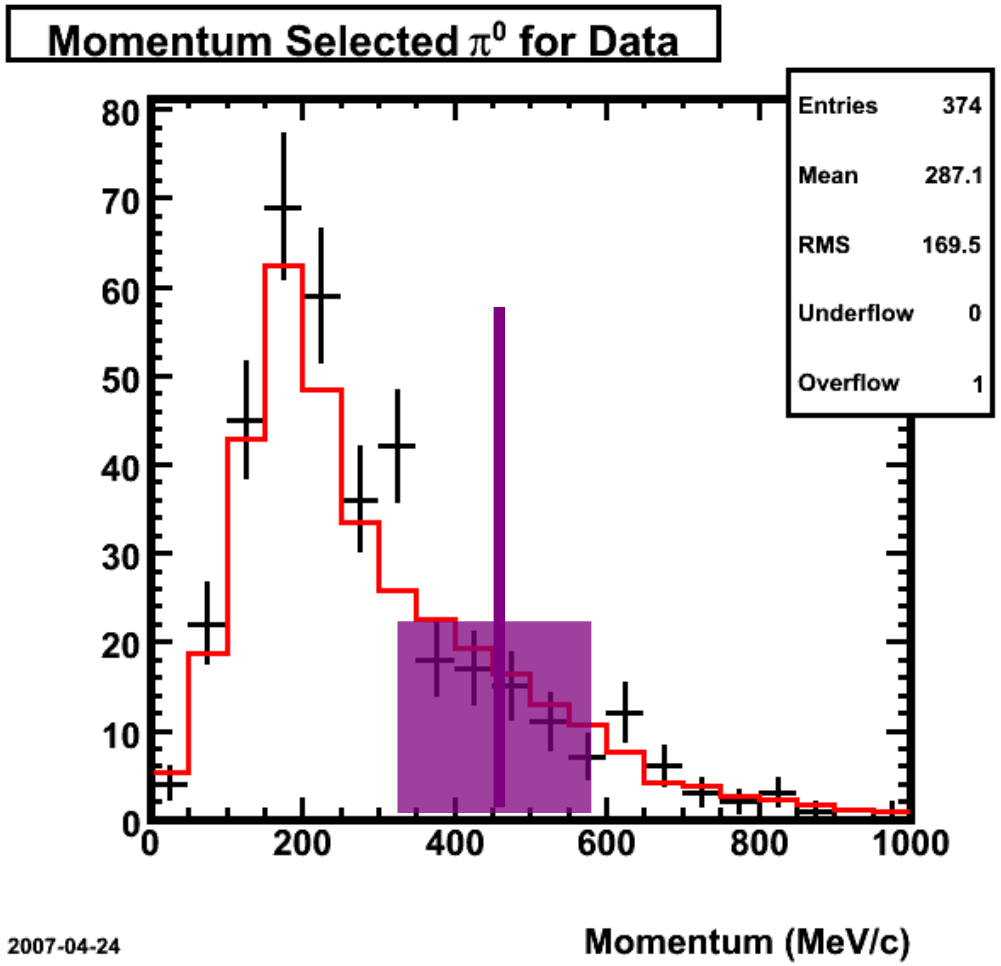
Road Map

- Figures for the Lecture
  - Number of events vs Momentum
  - Background Subtracted Data vs Momentum
  - Background Subtracted Data fitted to Neutron Decay Expectation.

Recap: What We Know

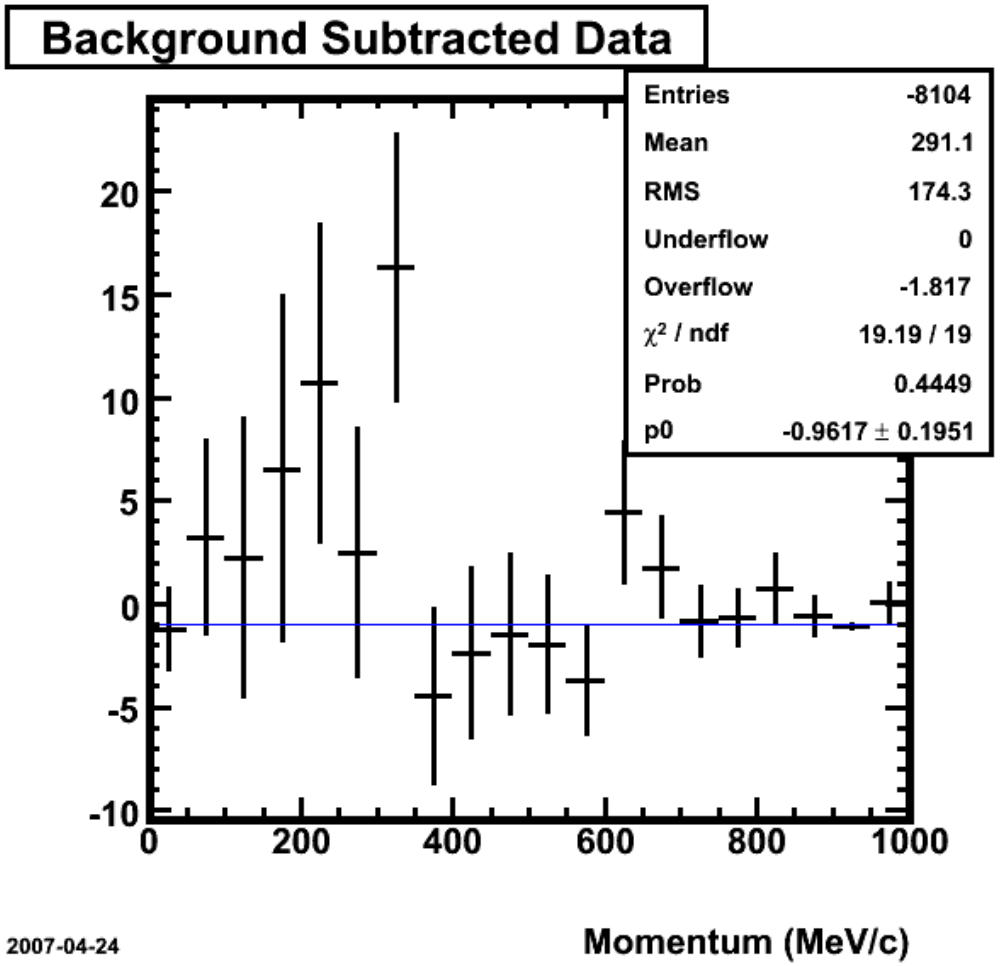
- π° Selection
  - No Muon Decays
  - Two gamma-ray like tracks
  - Lowest energy gamma ray with more than 10% of total energy
  - Reconstructed invariant mass between 110 MeV/c and 170 MeV/c
- π° momentum from proton decay is 460 MeV/c
- π° momentum resolution is 4.8% ($\rightarrow$ 22 MeV/c)
- Fermi momentum is 225 MeV/c
  - Estimate a Gaussian width as (225MeV/c - (-225MeV/c))/sqrt(12)
  - This is a Gaussian width of 130 MeV/c
    - Two sigma peak is 200 MeV/c – 720 MeV/c

π° Momentum



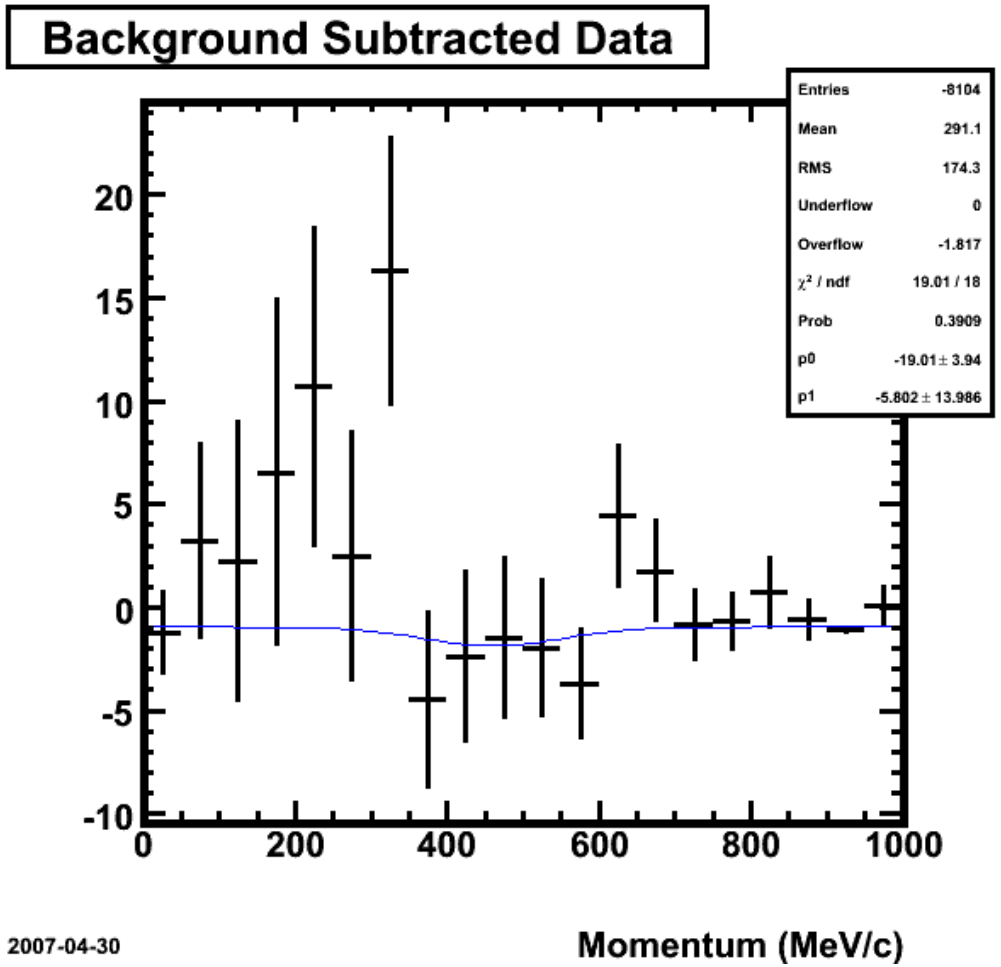
- Momentum of π° candidates after all selection criteria
  - Background MC scaled to data exposure
- Expected signal at
  - 460 MeV/c ± 130 MeV/c

Subtract Expected Background



- MC background prediction subtracted from measured data
  - MC scaled to data exposure
- Difference is fit to a flat line
  - Net deficit of data of 0.96 events per bin
    - Total deficit is 19.2
    - Recall flux uncertainty ~ 15% or about 56 events, so it's consistent

Fit to Nucleon Decay Expectation



- Fit to flat background and Gaussian
  - Background: -19.0 ± 3.9 events
    - There is a ± 56 from flux uncertainty, so -19 is "very" consistent with zero
  - Signal: - 5.8 ± 14.0 events
    - Determined from the deviation of measured signal from a "flat" expectation
- Need to translate into an upper limit on number of decay events.