Target Analysis Update for G_E^n Collaboration

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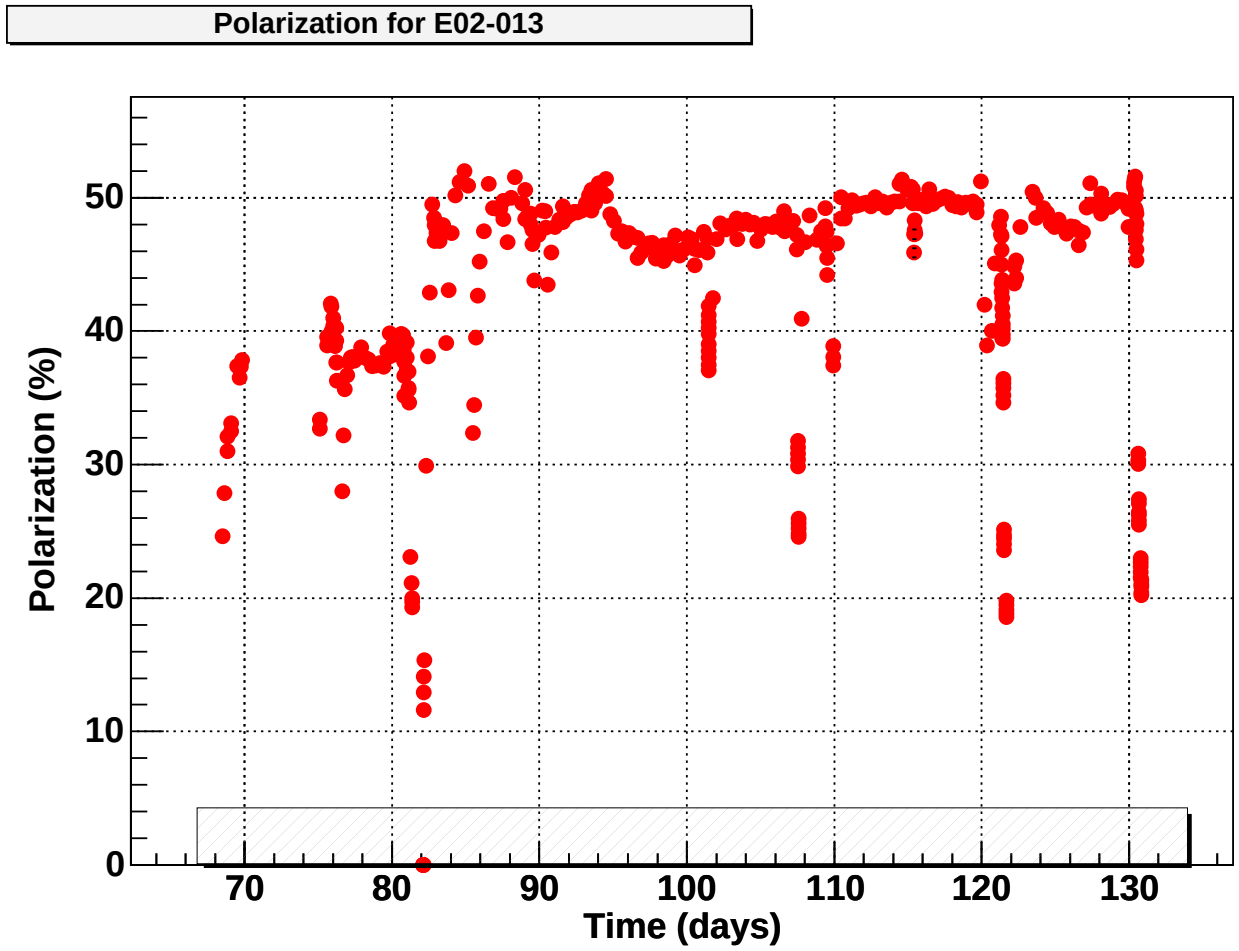
Outline

1. Target Polarization Analysis
   (a) Current State of Analysis
   (b) Proposed Improvement – κ_0
2. Big Bite Asymmetry Analysis
   (a) The Method
   (b) Pion Asymmetry
   (c) Pion Asymmetry and Polarization
   (d) Electron Asymmetry
   (e) Electron Asymmetry and Polarization
3. Aidan Timeline

Target Polarization

Current State



Shown is the uncertainty on each measurement. The systematic uncertainty is still approximately 4.25% (relative).

Proposed Improvement

EPR is the only absolute polarization measurement used by E02-013.

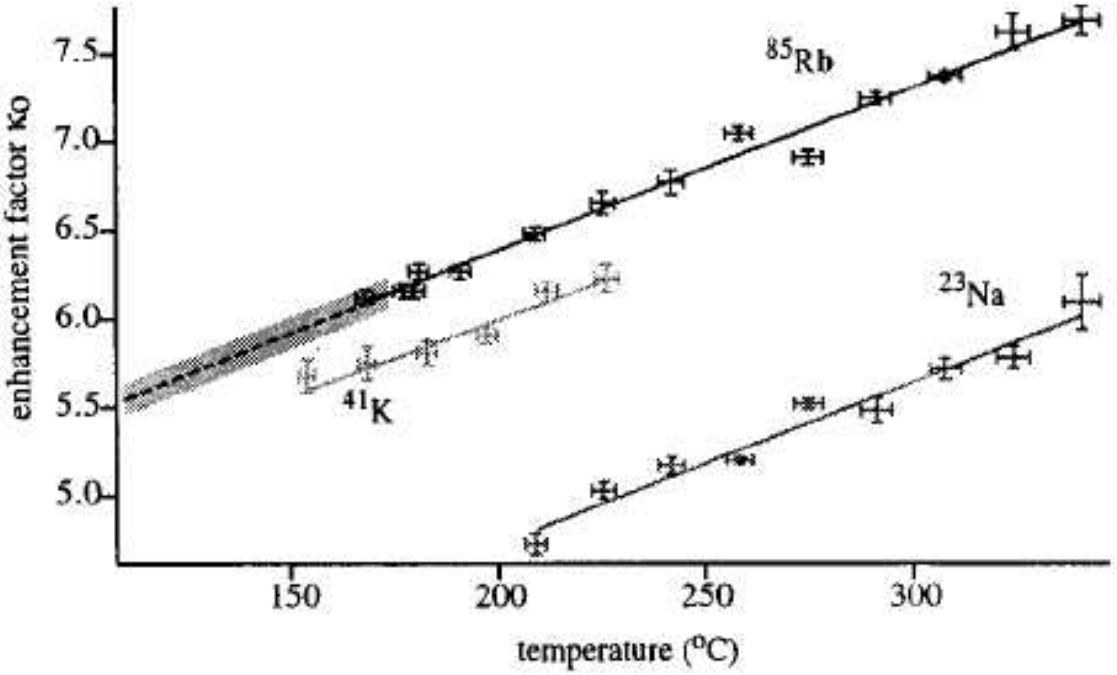
κ_0 is a constant in the equation used to extract polarization from the EPR frequency shift:

$$\Delta\nu_{\mathrm{EPR}} = \frac{8\pi}{3}\frac{d\nu_{\mathrm{EPR}}(F,M)}{dB}\kappa_0\mu_{He}n_{He}P_{He}$$

Our uncertainty on κ_0 for He-K at our desired temperatures is our leading systematic error.

Summer Work

Students at W&M confirmed the ratio $\frac{\kappa_0^K}{\kappa_0^{Rb}}$ at previously measured temperatures.



Babcock *et al*, Phys Rev A **71**, 013414 (2005)

Lessons Learned

1. Summer work was proof of principle – ratio of EPR provides ratio of κ_0!

2. Limited by poor lifetime cell; noisy EPR.

3. Must improve EPR (especially at higher temp).

4. Unusually difficult fill may have lead to poor cell performance.

Continued Work

1. Use special cell to calibrate temperature of gas with lasers on.

2. New tech at W&M lab.

3. “a requirement for graduation” – T.D. Averett.

4. Ongoing scheduling discussions.

Asymmetry Analysis

Motivation

1. Data already collected

2. Measurement at point of interaction

3. Good double polarization observable

Asymmetry Analysis

The Method

1. Identify good pion events originating within the target cell

   (a) Cut on pre-shower energy

   (b) Cut on tracks originating in the target cell

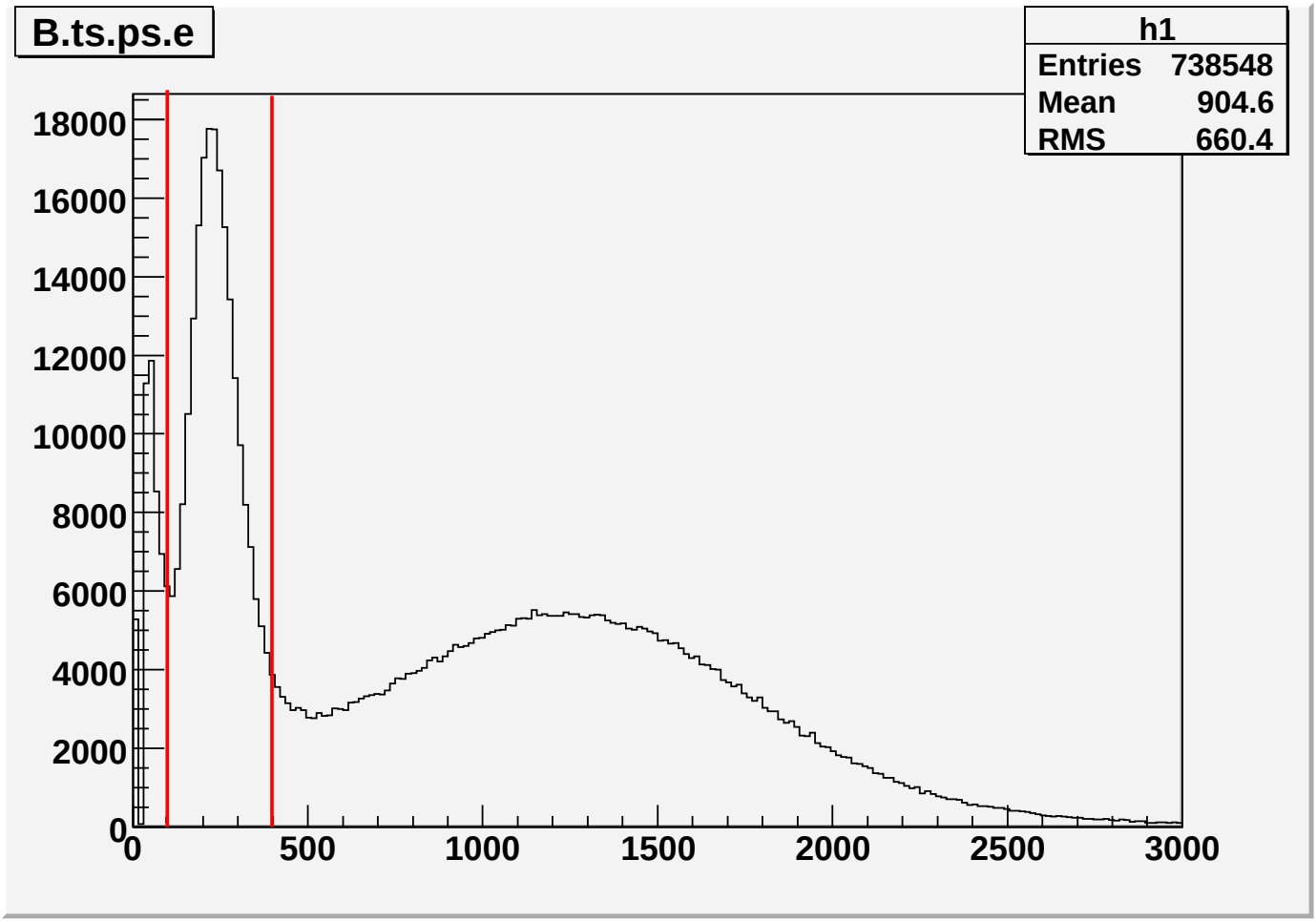
2. Use T2s (BigBite singles)

3. Add in "random" (really, untimed) T3s

4. Form asymmetry.

Asymmetry Analysis

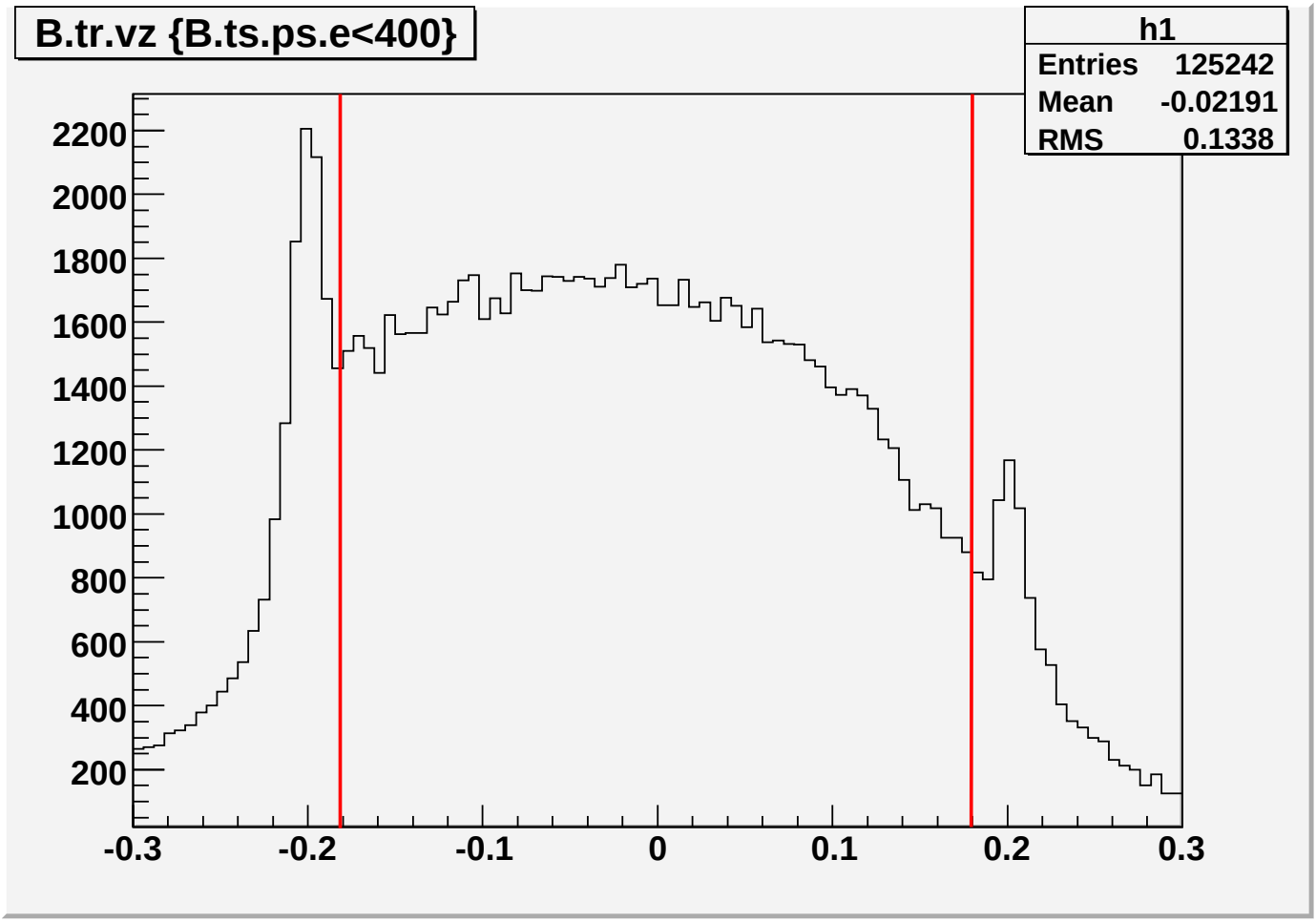
Energy Cut



Cut is between 100 and 400 (arb. units) on the preshower energy

Asymmetry Analysis

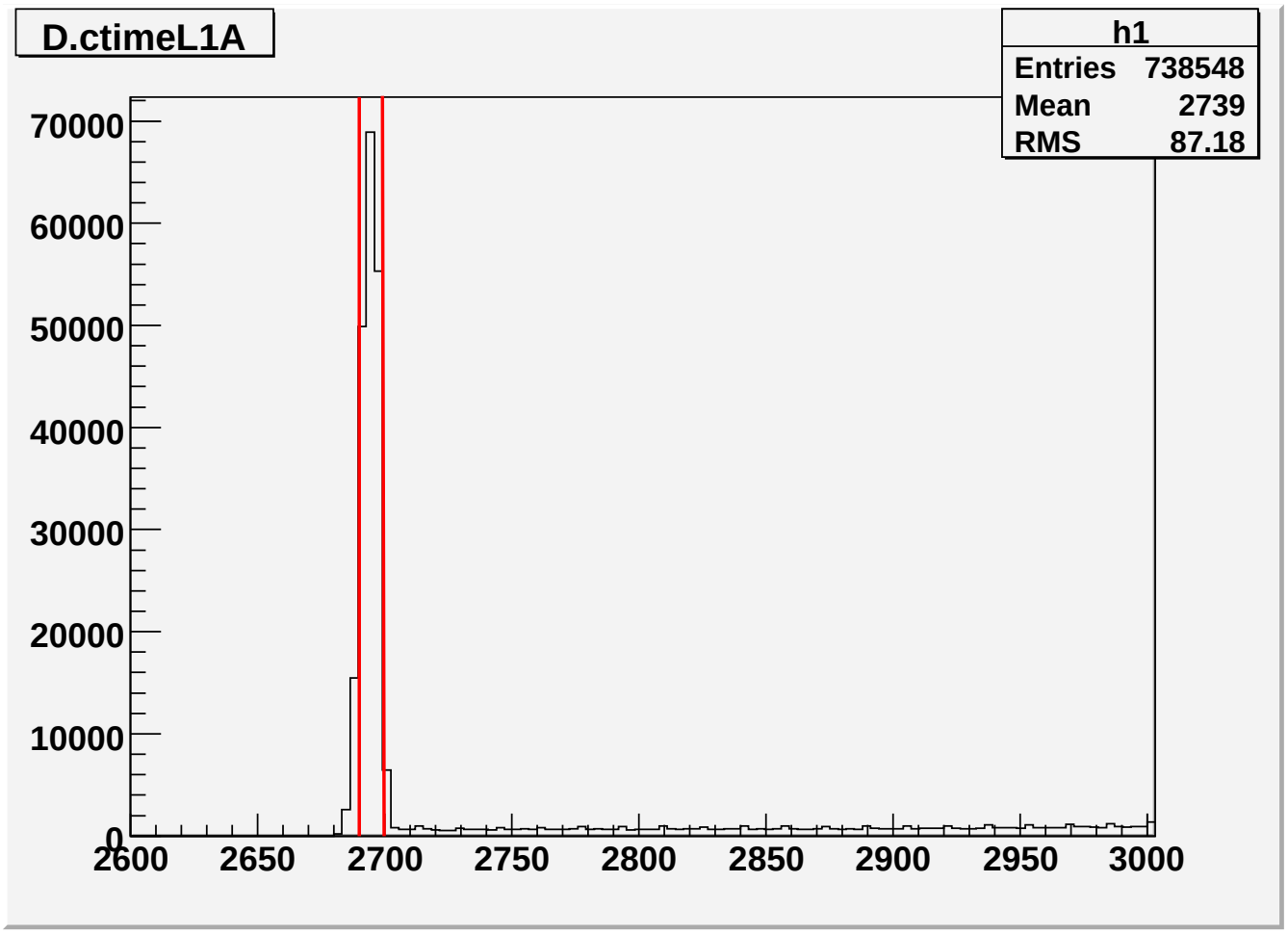
Position Cut



Cut on events originating in the target (requires a track). Pion events only shown for clarity.

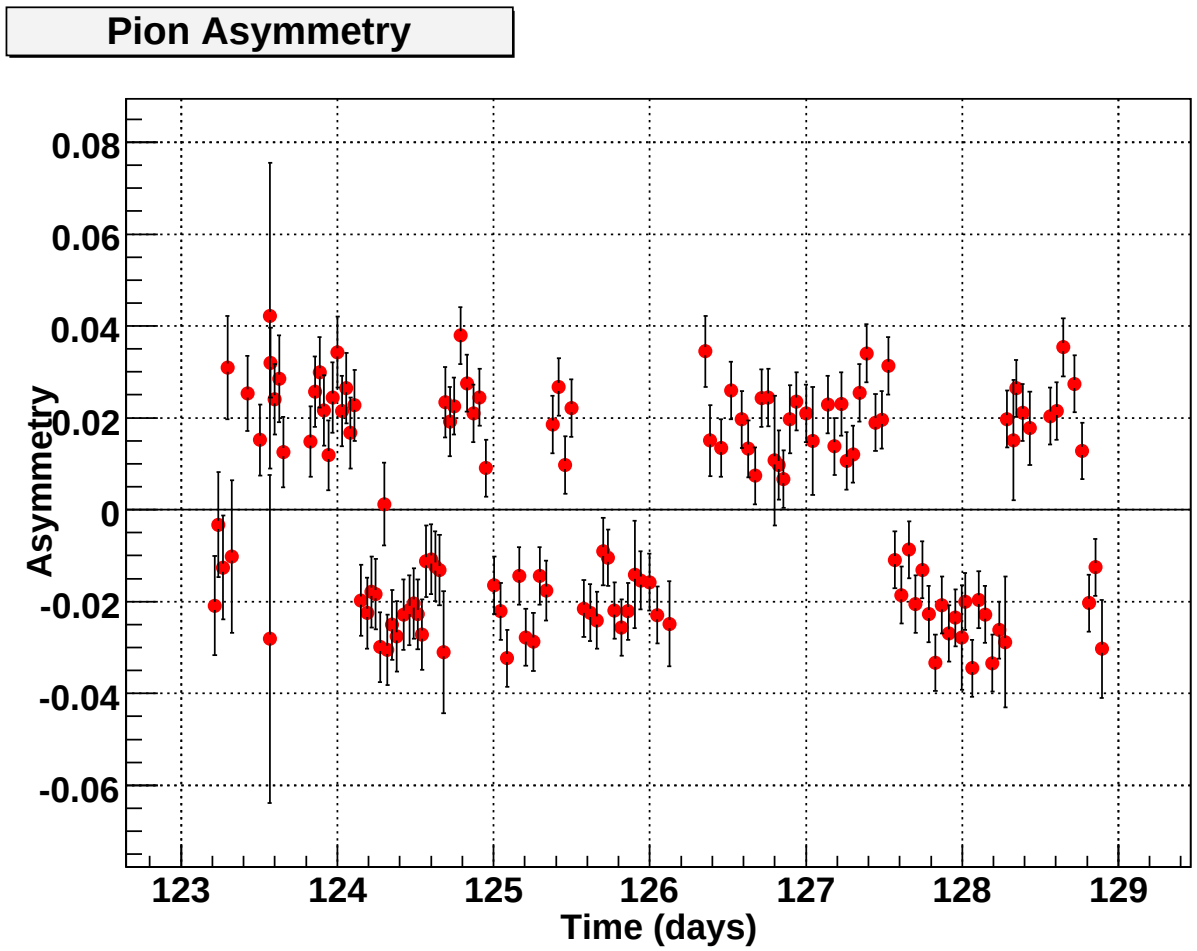
Asymmetry Analysis

Out of Time T3s



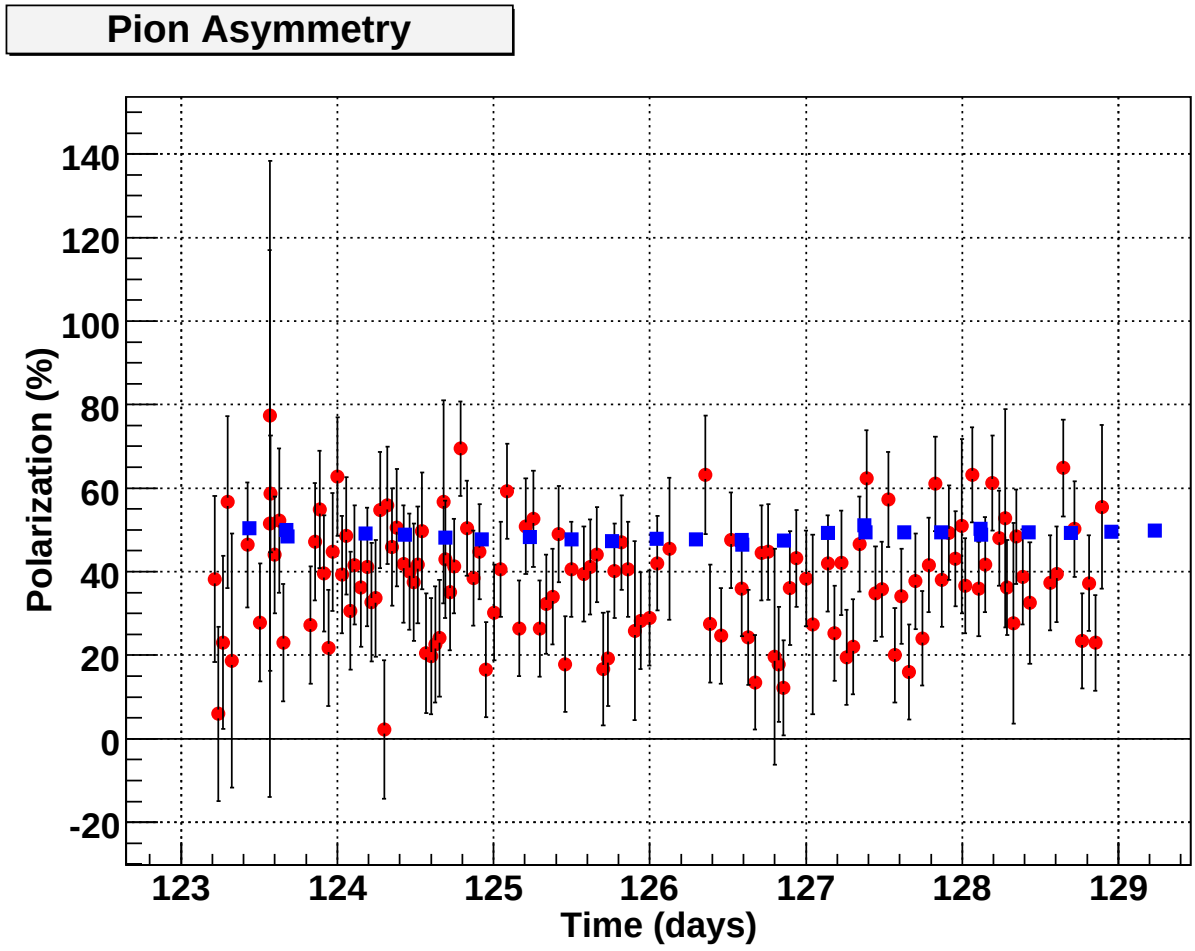
http://hallaweb.jlab.org/experiment/E02-013/wiki/ti
index.php?page=D.ctimeL1A

Pion Asymmetry



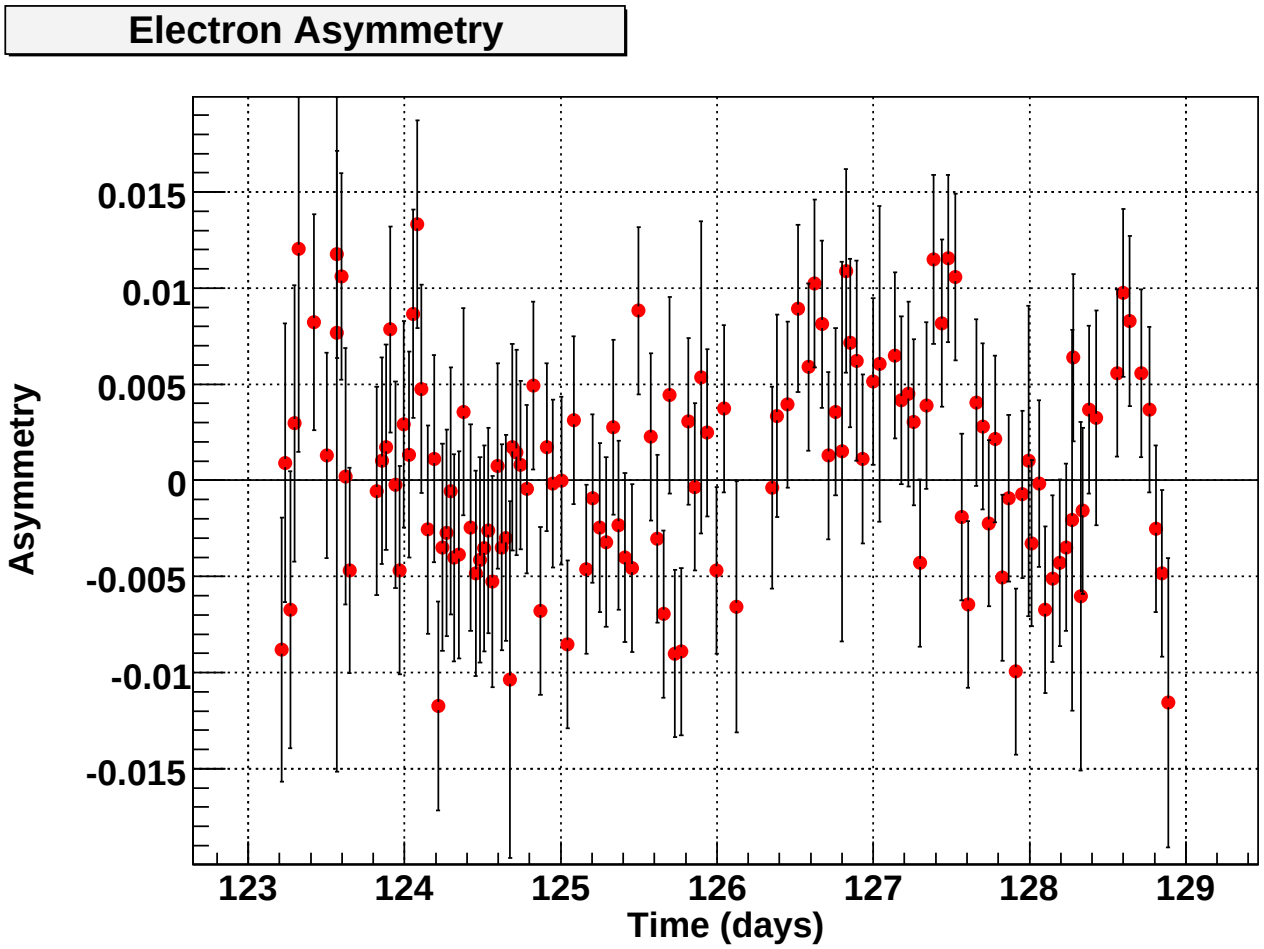
Typically seeing an asymmetry of 2-3%, with an uncertainty of 0.6% (30-20% relative). This is every production run for kin 4.

Pion Asymmetry and Polarization



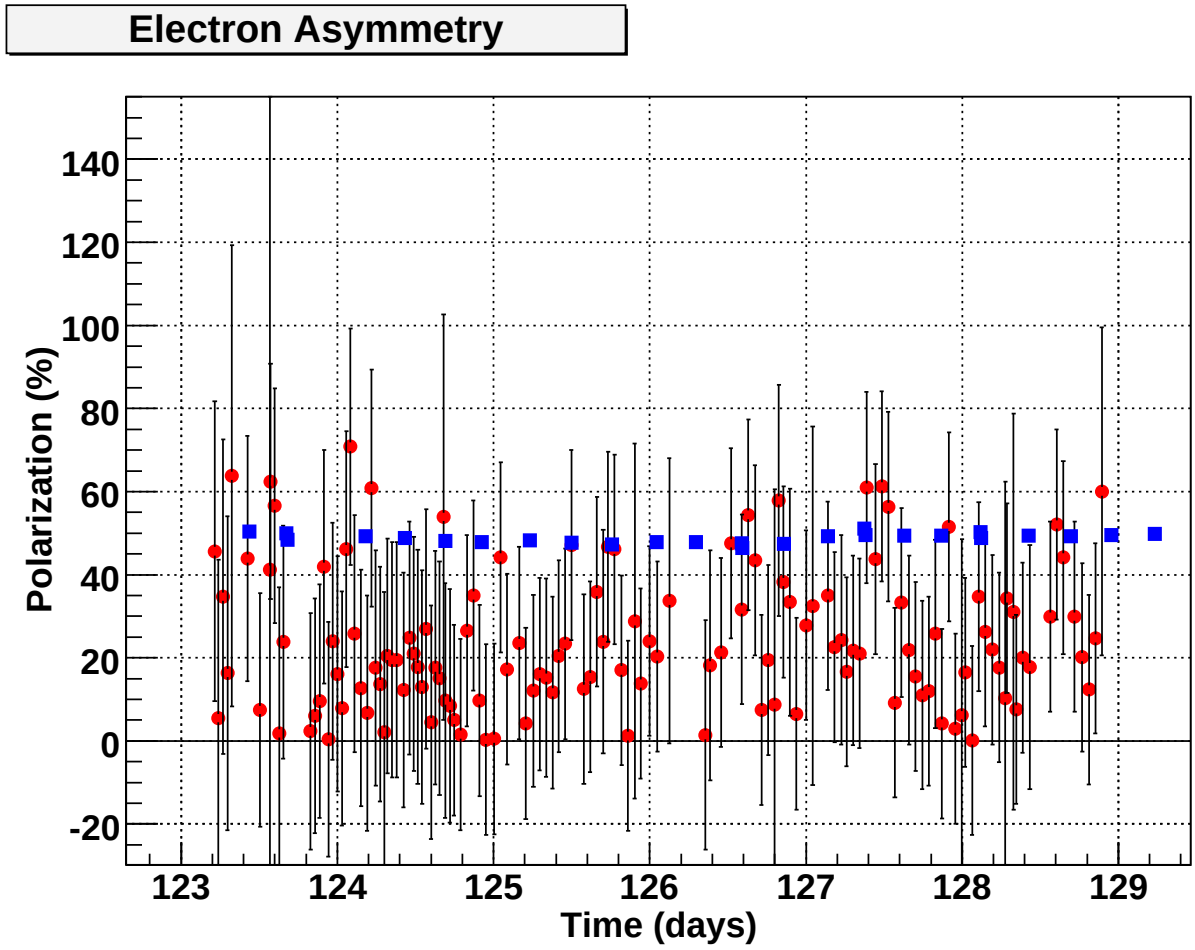
Absolute value of pion asymmetry normalized to polarization measurement (red circles), plotted with polarization measurement (blue squares).

Electron Asymmetry



Also looked at electrons (smaller asymmetry, but higher statistics)

Electron Asymmetry w/ Polarization



Conclusions/Thoughts

- Straightforward method, clearly limited by statistics

- Will run for kin3; expect same results

- Need higher statistics: don't prescale T2, more tracks.

Aidan Timeline

- Schedule driver $\rightarrow$ Make accurate measurement of κ_0.

- Other highest priority $\rightarrow$ G_E^n analysis.
  - Have some PODD experience now.
  - "Catch-up" before people start graduating!

- Documentation, documentation, documentation.
  - Would like κ_0 first.