

Elastic Electron Scattering off ^3He and ^4He (E04-018)

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Kent State University

Hall A Collaboration Meeting

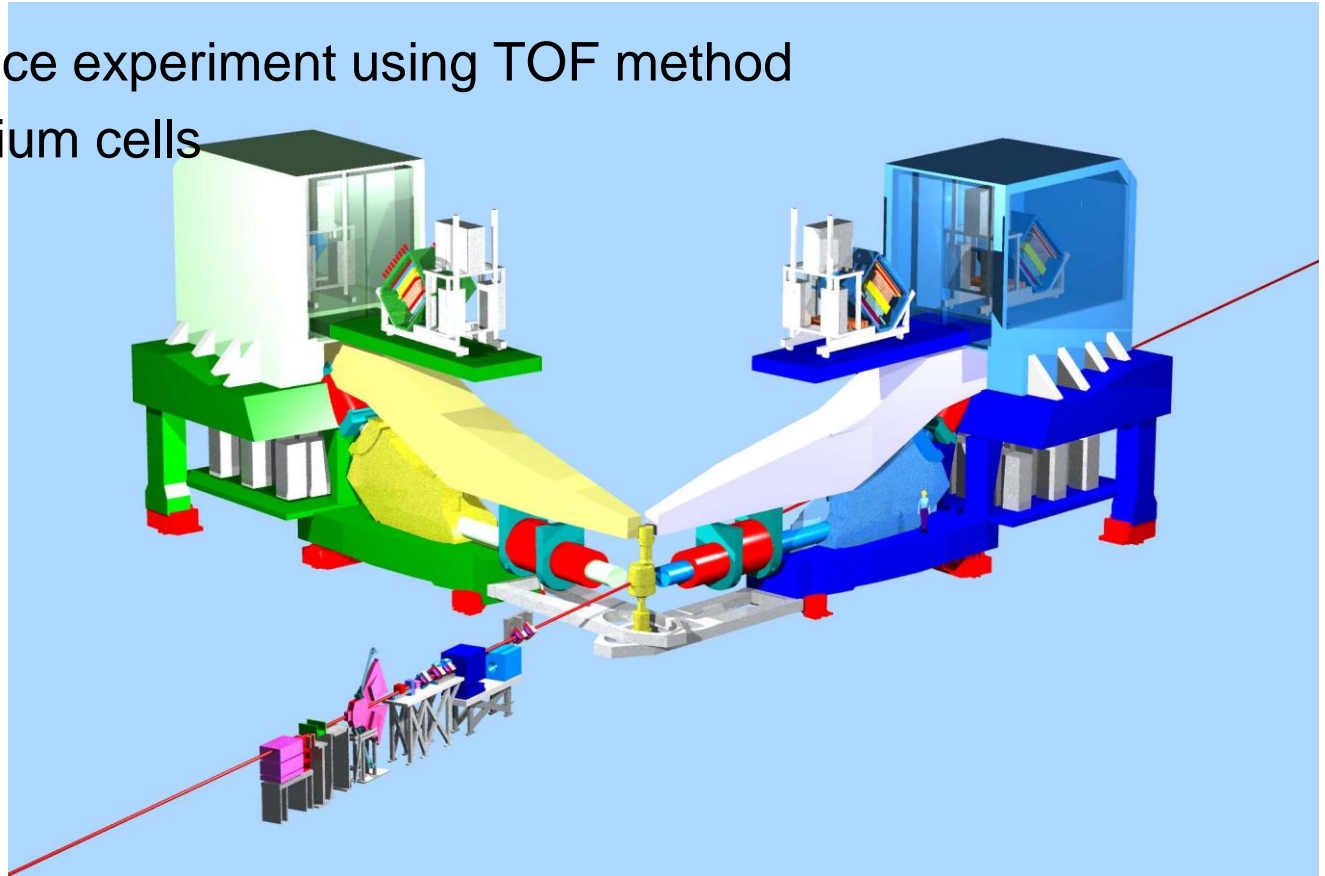
Jefferson Lab, June 2008

Objective

- Elastic scattering off helium's stable isotopes at large momentum transfers
- Extraction of He3 charge and magnetic and He4 charge form factors

Experimental Apparatus

- Coincidence experiment using TOF method
- 20 cm helium cells



Elastic Electron-Helium Scattering

- ^3He charge and magnetic form factors:

$$\frac{d\sigma}{d\Omega} = \frac{Z^2 \alpha^2 E'}{4 E^3 \sin^4\left(\frac{\theta}{2}\right)} \left[A \left(\frac{e}{2m} \right)^2 \cos^2\left(\frac{\theta}{2}\right) + B \left(\frac{e}{2m} \right)^2 \sin^2\left(\frac{\theta}{2}\right) \right], \quad Q^2 = 4 E E' \sin^2\left(\frac{\theta}{2}\right)$$

$$Q^2 = \text{const}$$

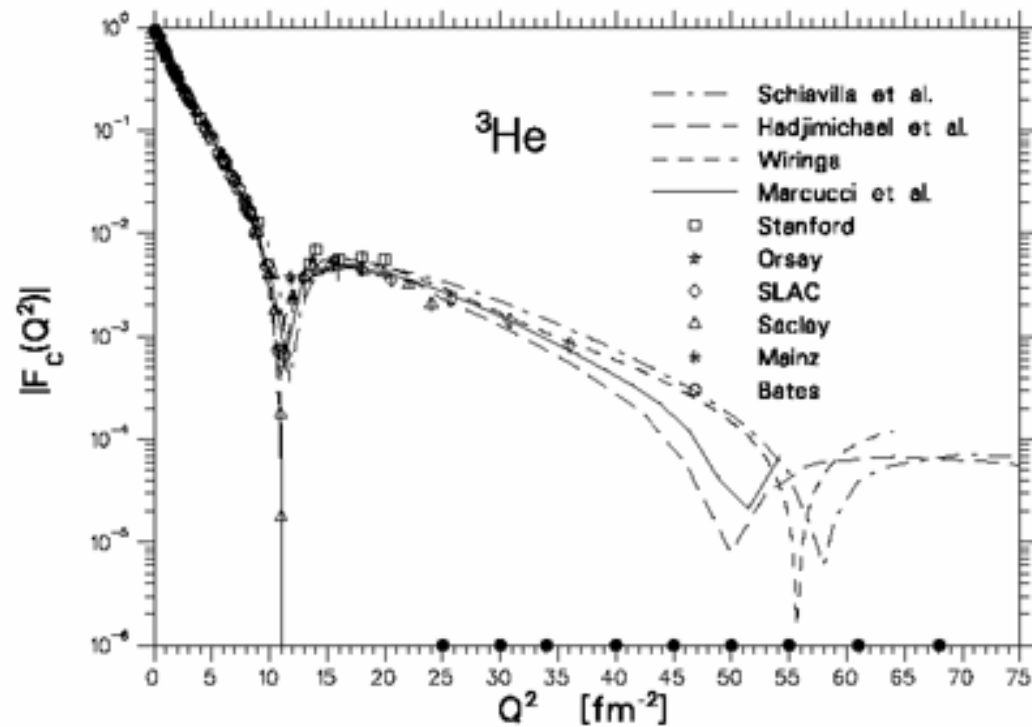
$$A \left(\frac{e}{2m} \right)^2 = \frac{F_C^2 \left(\frac{e}{2m} \right)^2 + \mu^2 \tau F_M^2 \left(\frac{e}{2m} \right)^2}{1 + \tau}$$

$$B \left(\frac{e}{2m} \right)^2 = 2\tau \mu^2 F_M^2 \left(\frac{e}{2m} \right)^2$$

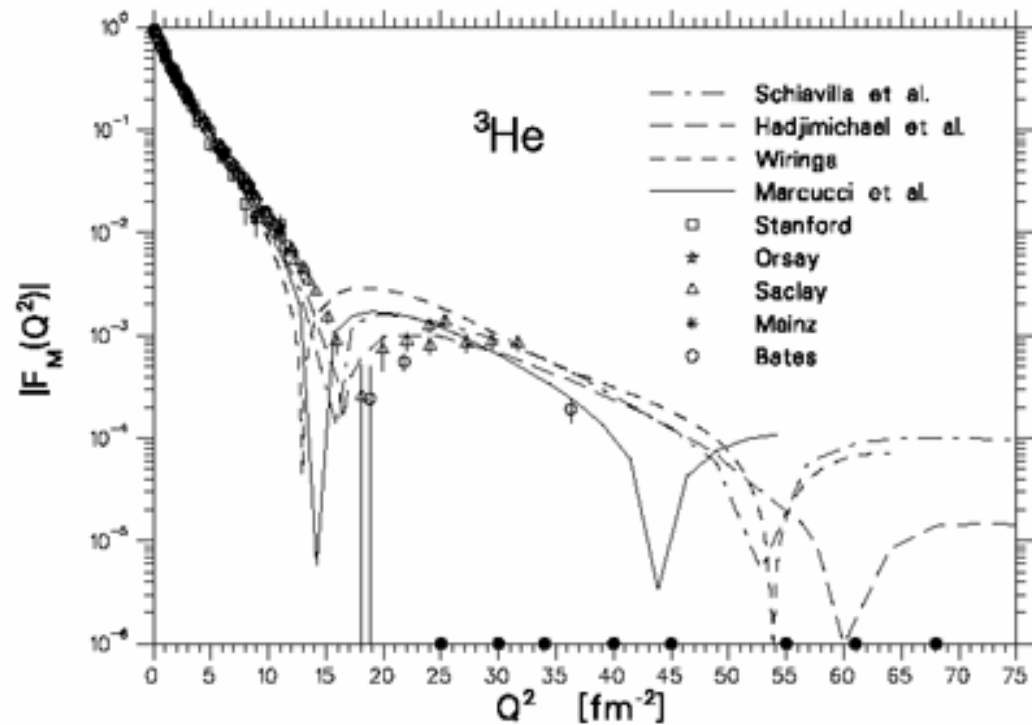
- ^4He charge form factor:

$$\frac{d\sigma}{d\Omega} = \frac{Z^2 \alpha^2 E' \cos^2\left(\frac{\theta}{2}\right)}{4 E^3 \sin^4\left(\frac{\theta}{2}\right)} F_C^2 \left(\frac{e}{2m} \right)^2$$

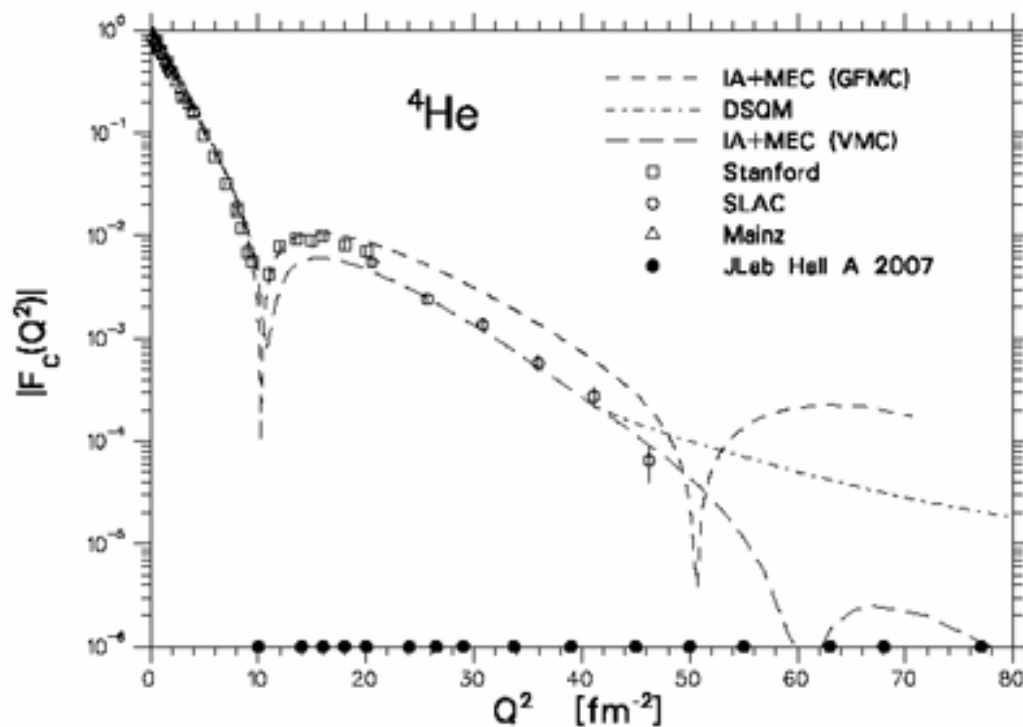
Data range



Data range



Data range

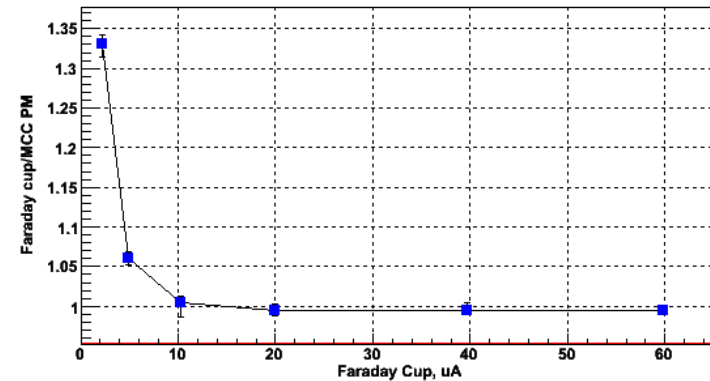


Analysis projects

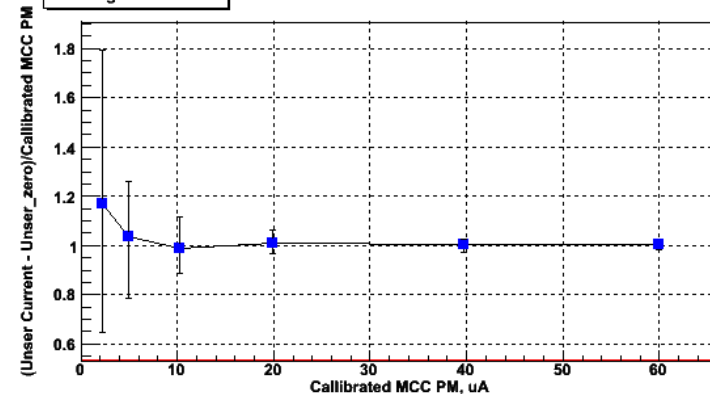
Current Calibration

- 2 current calibrations
- Normalization of the current at the injector cavity to the Faraday cup
- Cross-check with the Unser current

BcmLog 108/109 files



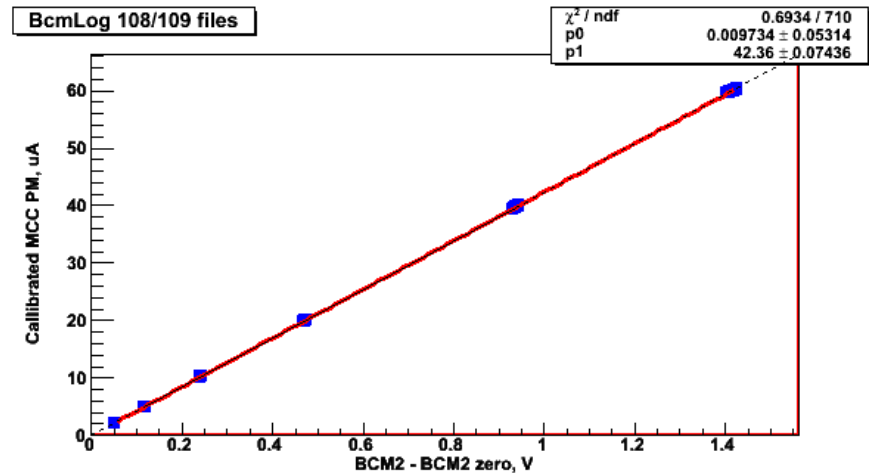
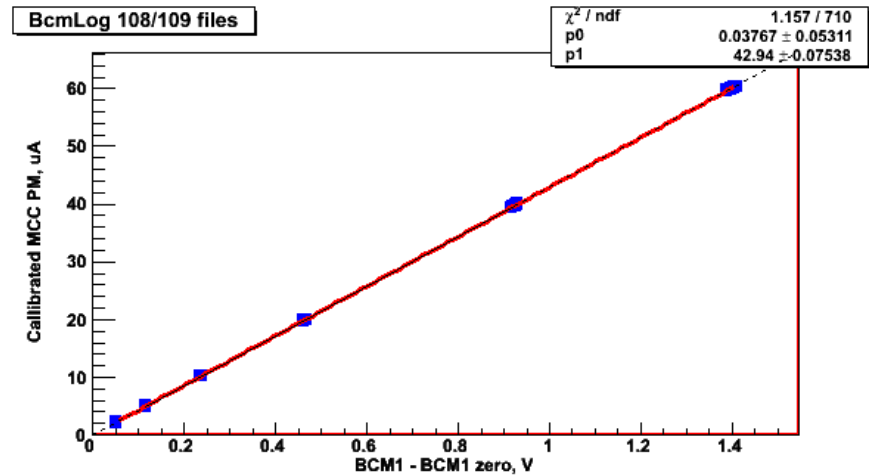
BcmLog 108/109 files



Analysis projects

Current Calibration

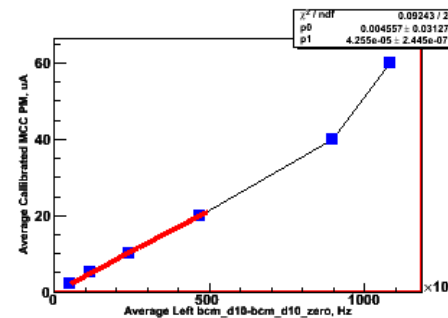
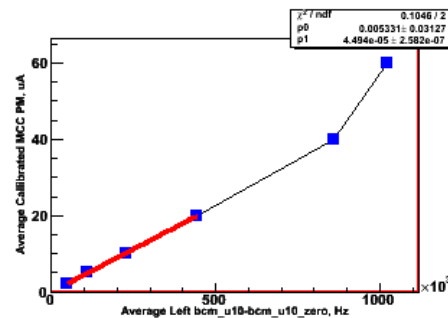
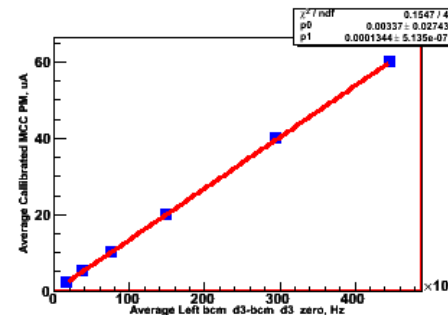
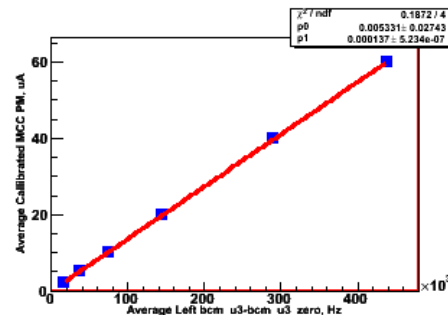
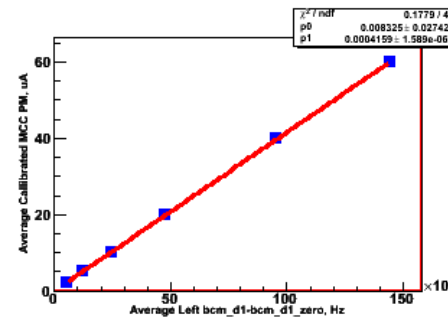
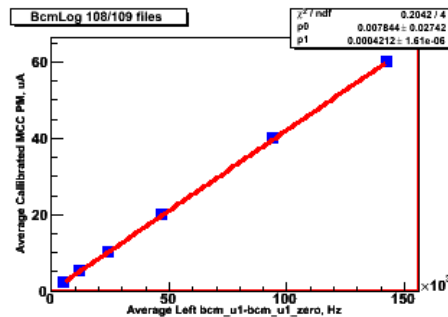
- Normalization of the two BCM cavities to the calibrated injector cavity



Analysis projects

Current Calibration

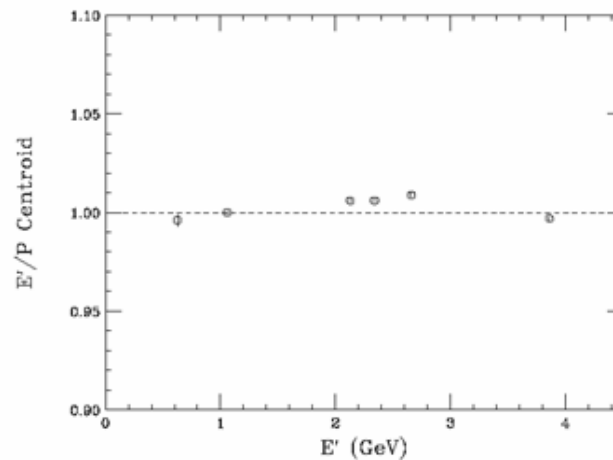
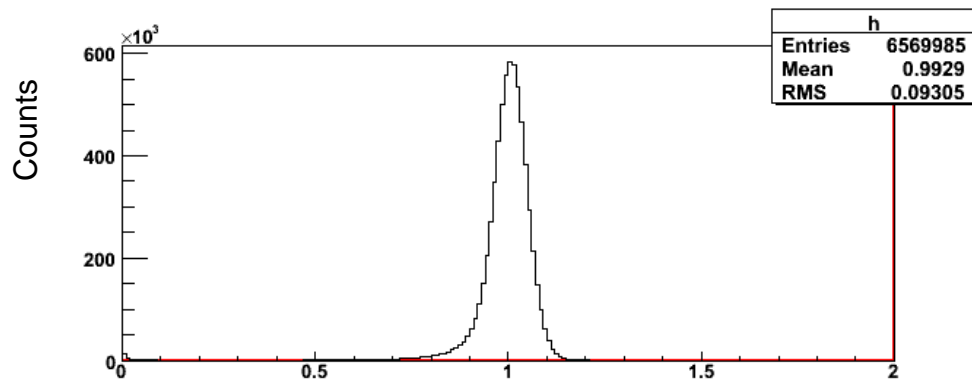
- Normalization of the scalers frequency (right, left) to the average value of the calibrated injector cavity current



Analysis projects

Calorimeter calibration

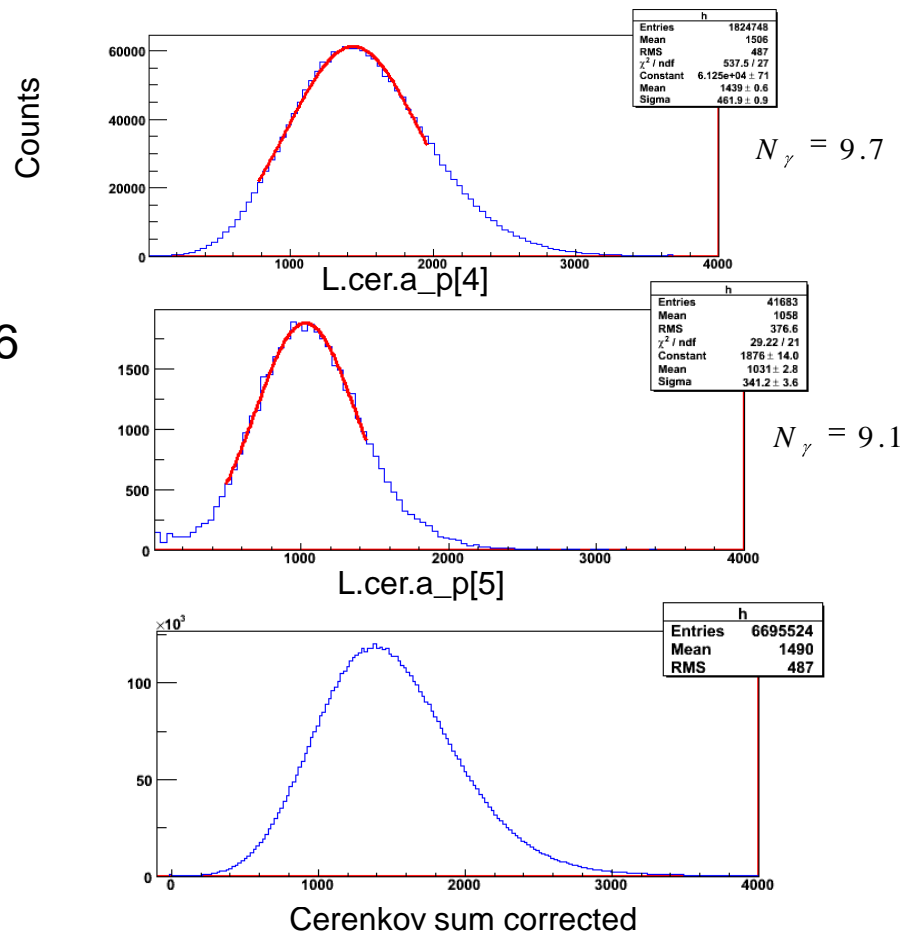
- 6x6 blocks calibration
- MC simulation for energy deposited in first and second layers
- 1222 – 1273 runs
ep elastic, 2.13 GeV
- E/p vs E



Analysis projects

Cerenkov Gain Equalization

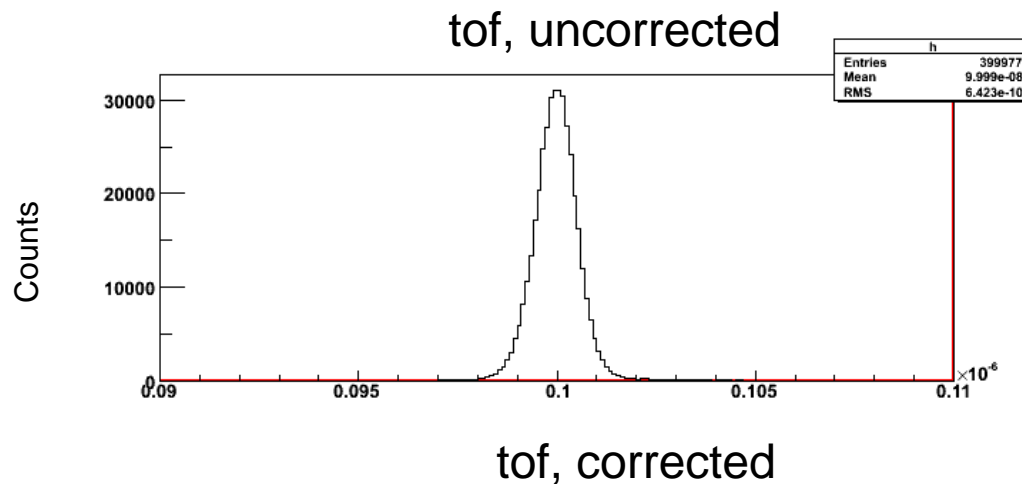
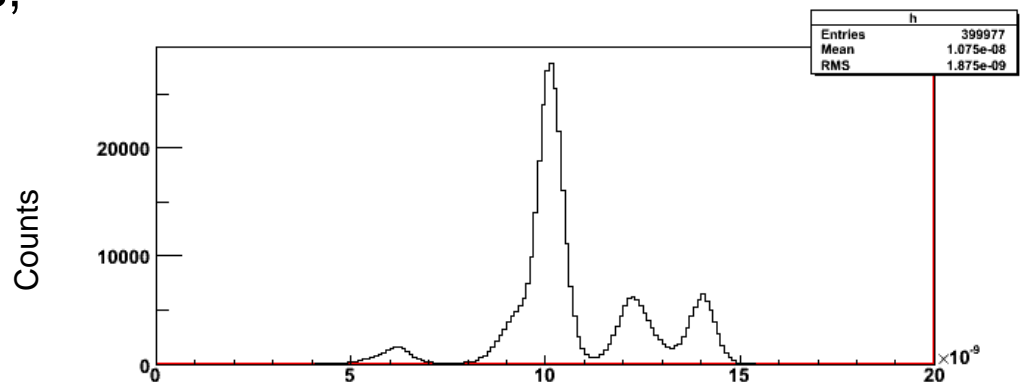
- With cuts on >99% of total light in one particular tube
- Number of photoelectrons > 6
- Cerenkov efficiency close to 100%
- 1222 – 1273 runs
ep elastic, 2.13 GeV



Analysis projects

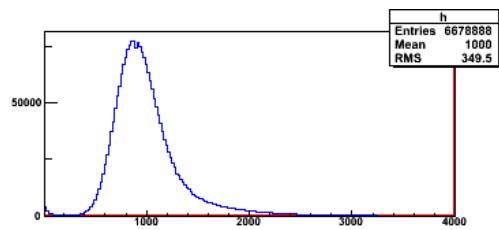
Timing Offsets Correction

- 1232 – 1233 runs,
ep elastic
2.34 GeV

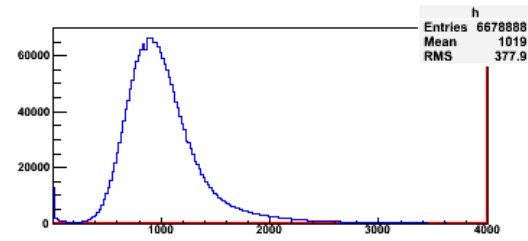


Analysis projects

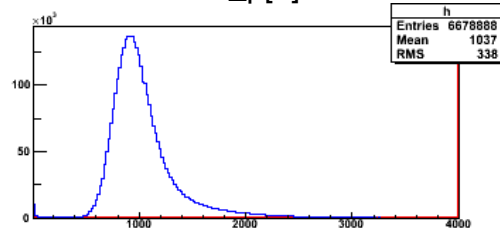
Scintillators ADC Equalization



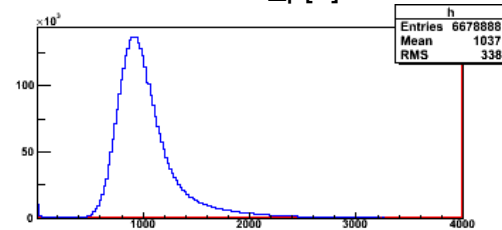
L.s1.la_p[2]



L.s1.ra_p[2]

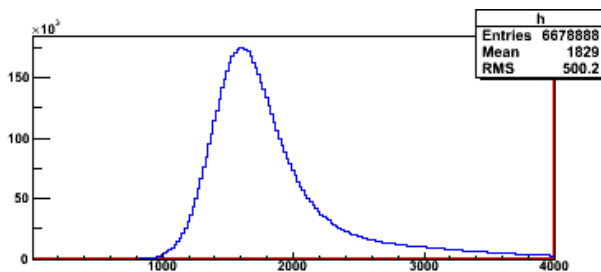


L.s1.la_p[3]



L.s1.ra_p[3]

- 1222 – 1273 runs
ep elastic, 2.13 GeV

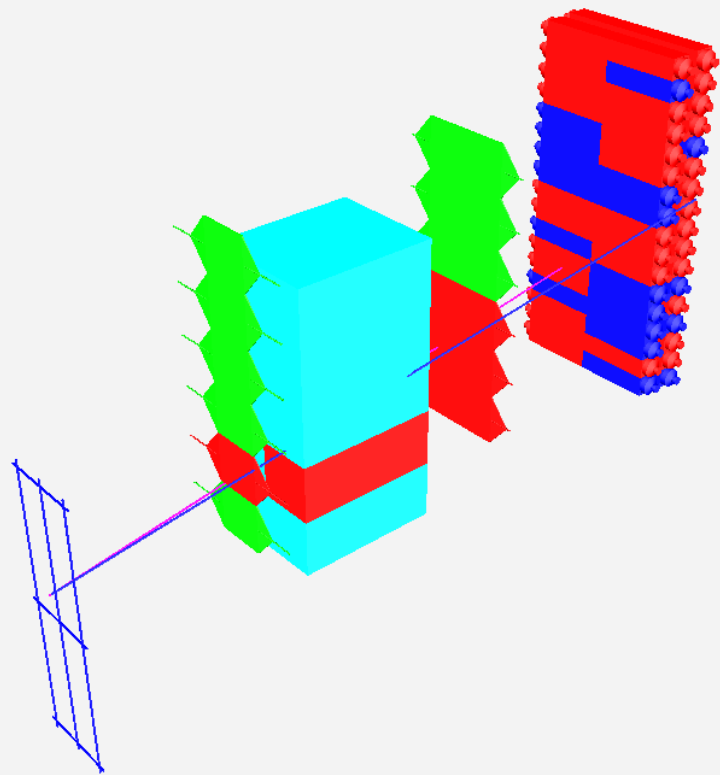


L.s1.la_c[*] + L.s1.ra_c[*]

Analysis projects

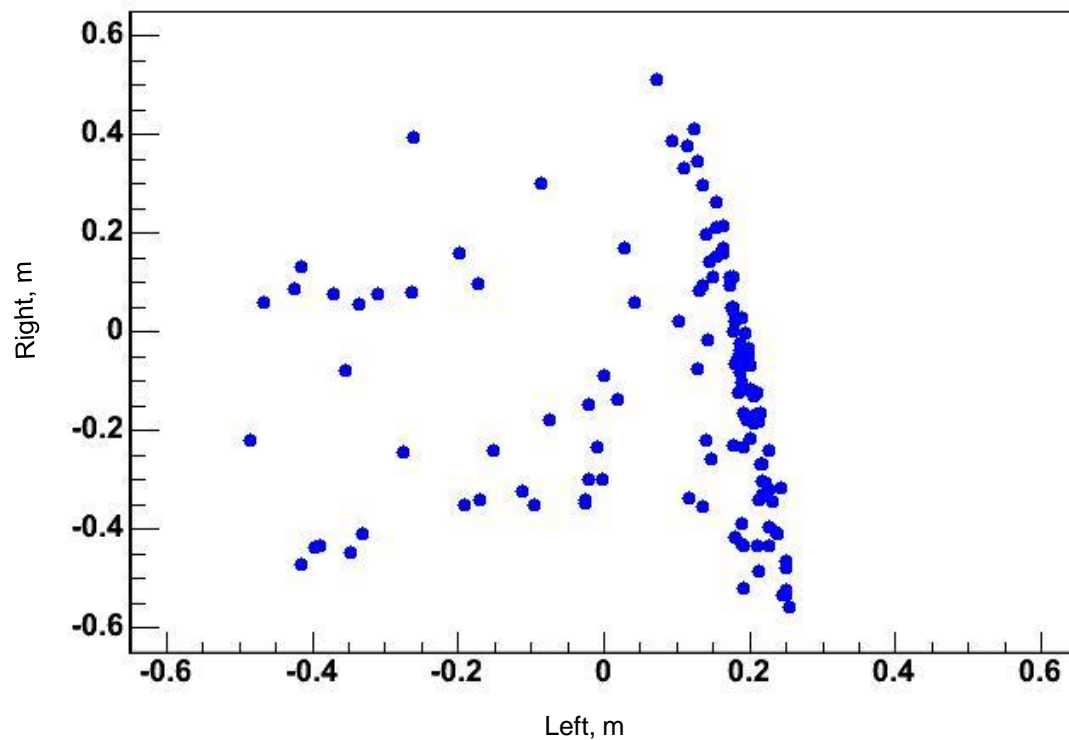
Event Display

- 3D event display
- For all tracks from the analyzer LHRS and RHRS
- Cuts for “fired” blocks
- In progress



Elastic stripe

- $Q^2 = 40 \text{ fm}^{-2}$, $e^3\text{He}$



Summary

- Finalization of the detector calibrations
- Improving tracking routine
- Ready for mass analysis