

$$d_2^n$$

A Probe of the Color Force

On Behalf of the E06014 Collaboration

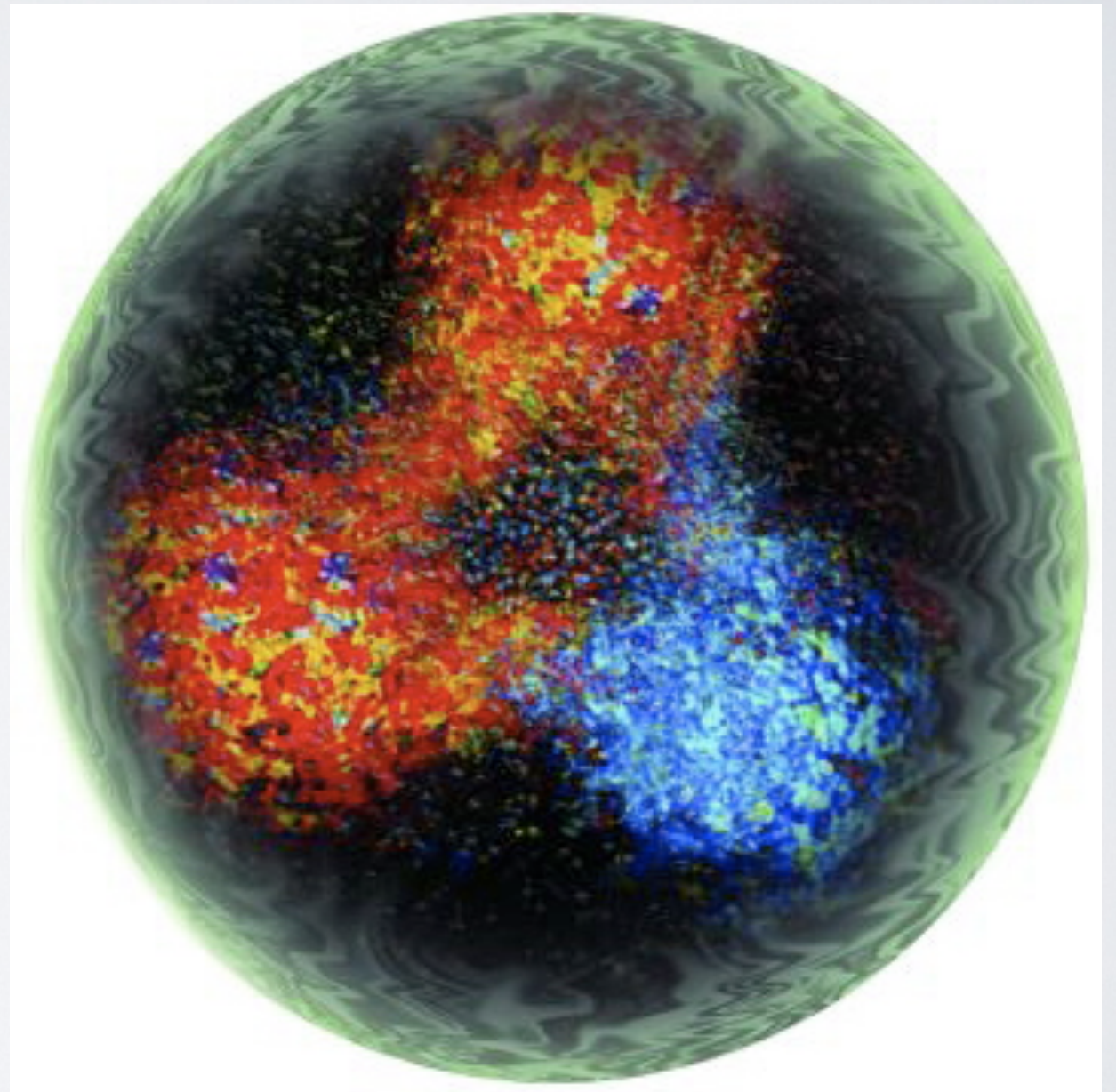
Hall A Collaboration Meeting
09 December 2010

Graduate Students: David Flay (Temple), Diana Parno (CMU)

Matthew Posik
Temple University

OUTLINE

- **What d_2^n is**
- **Experimental Set-Up**
- **LHRS**
- **BigBite**
- Optics
- MWDC
- Cherenkov



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Probing QCD Through Color

- d_2^n gives access to quark-gluon correlations

$$d_2^n = \int_0^1 x^2 [2g_1^n(x, Q^2) + 3g_2^n(x, Q^2)] dx$$

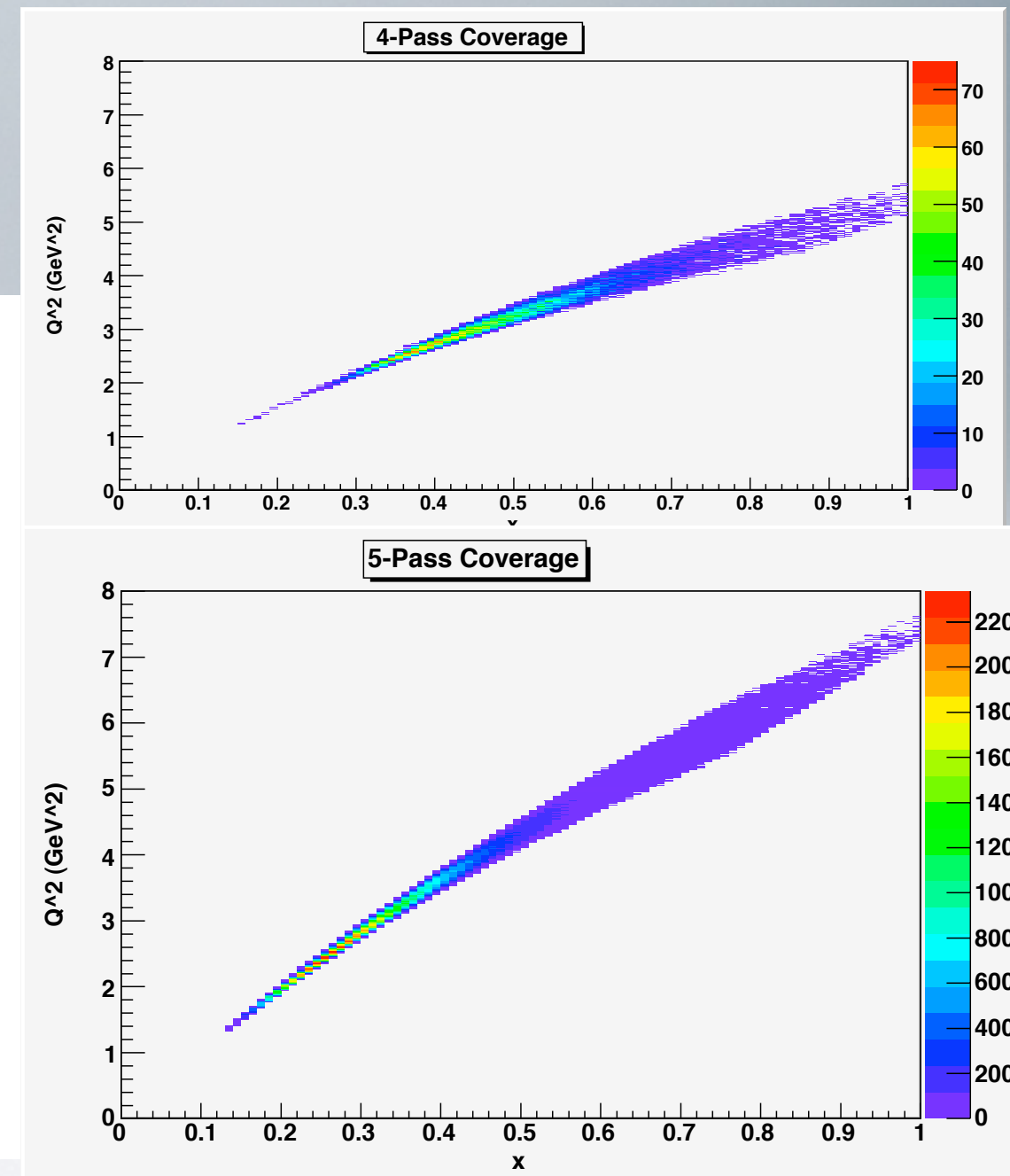
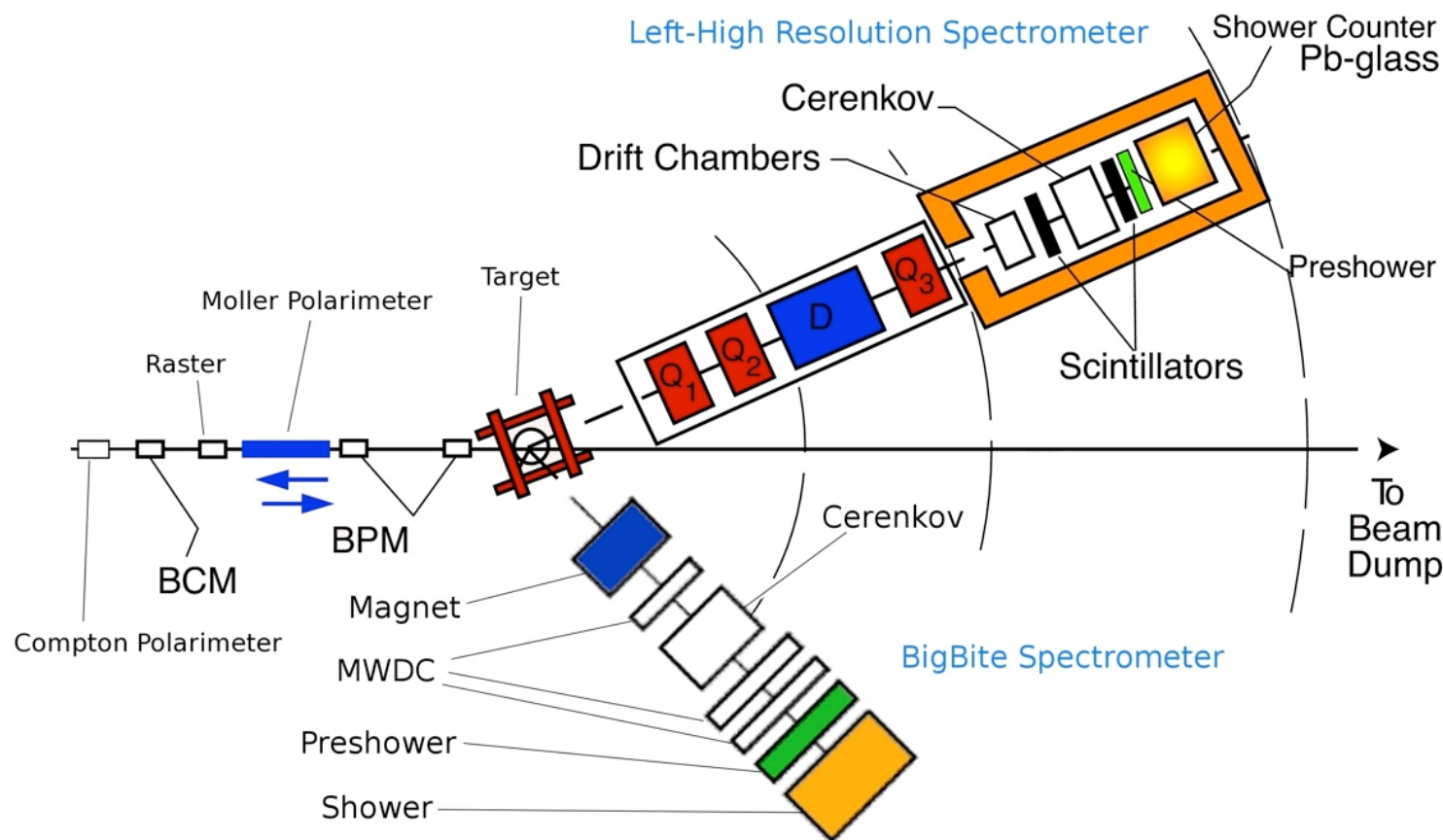
- How do we interpret d_2^n ?
 - Average transverse force on a quark just after interaction with a virtual photon (M. Burkardt)

Experimental Set-Up For E06014

- Scatter longitudinally polarized electron beam from a polarized He^3 target
- Change target directions to measure parallel and perpendicular asymmetries

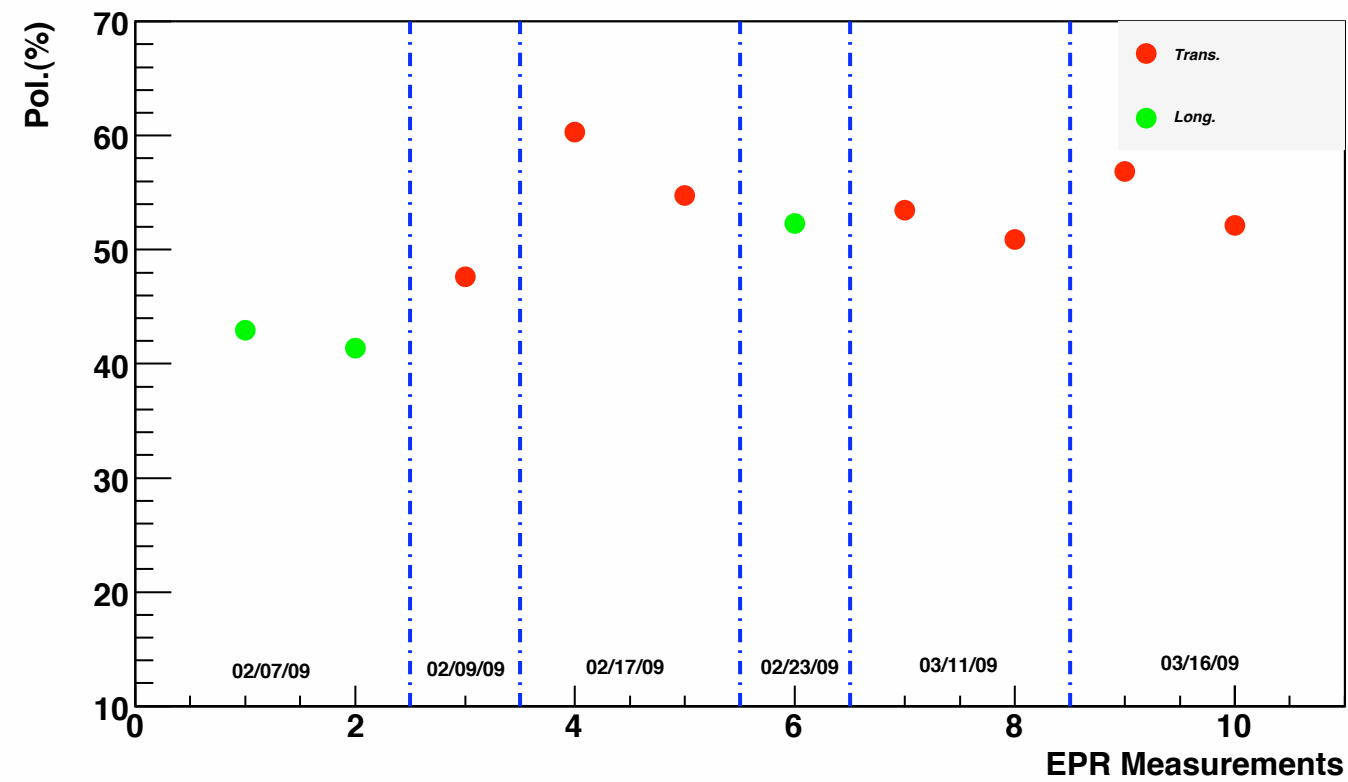
$$0.2 < x < 0.7$$

$$2 < Q^2 < 6 \text{ GeV}^2$$

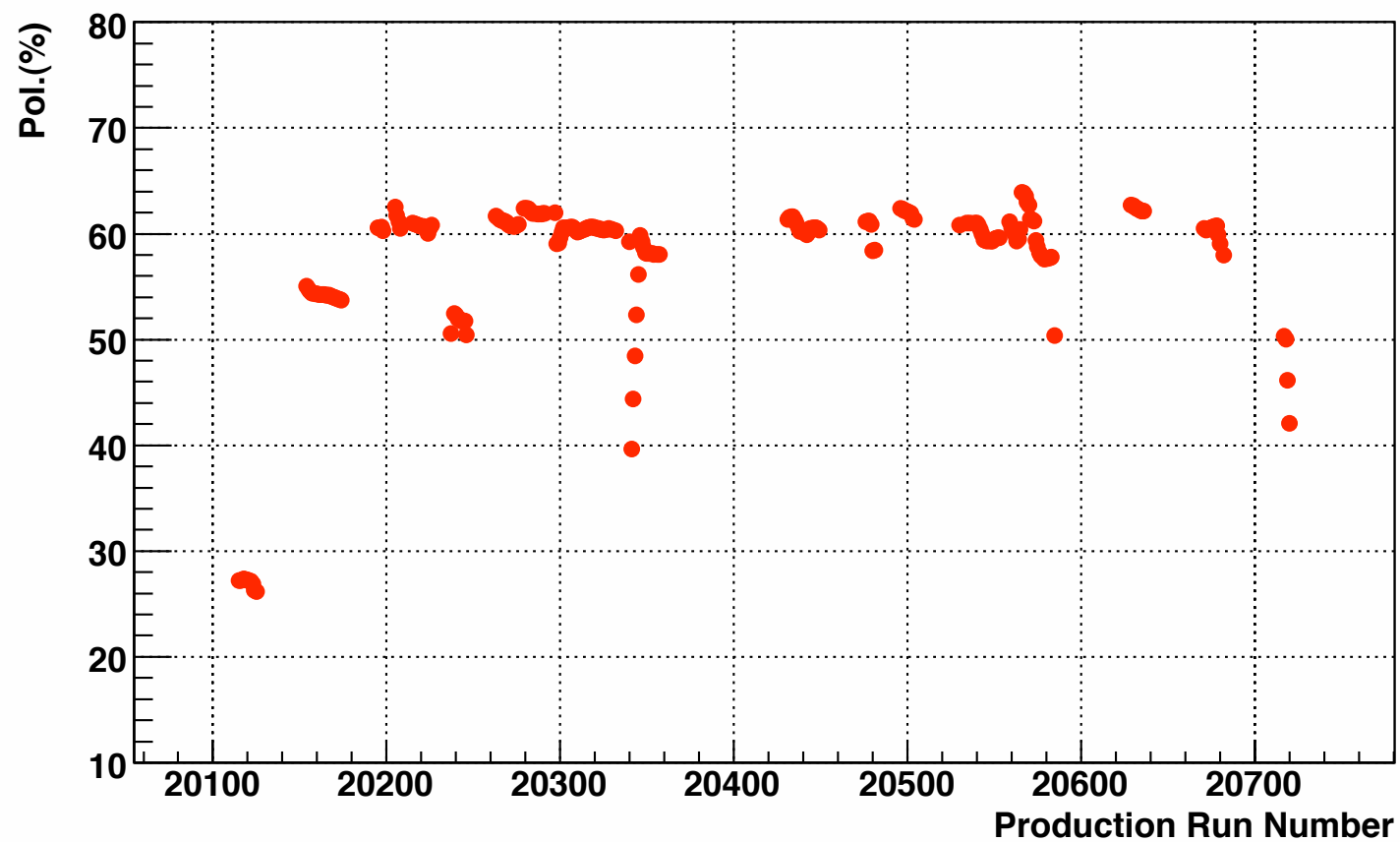


Target Polarization

EPR Polarization Summary for D2n



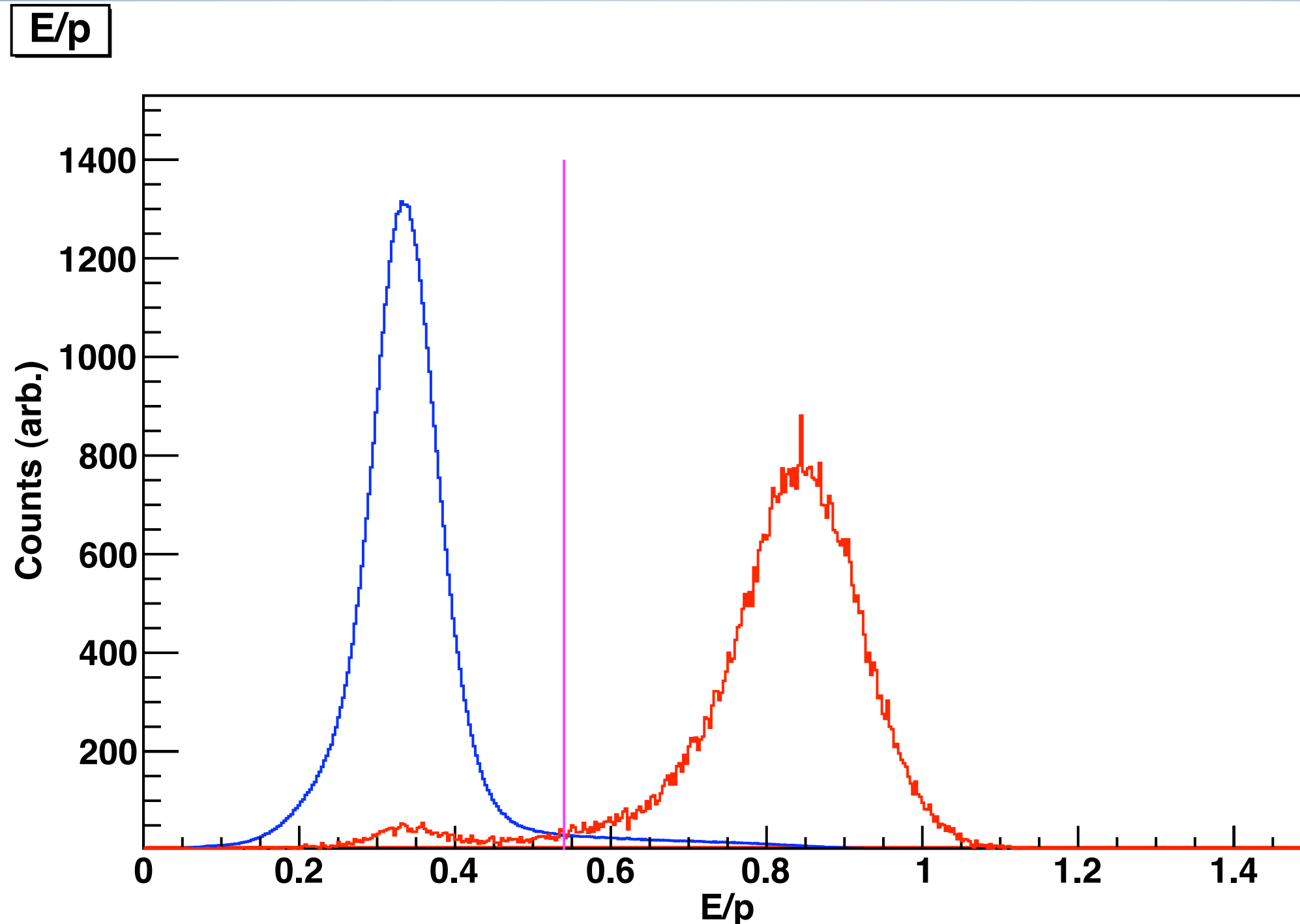
Samantha(Spread to Run by Run)



LHRS: Pion Rejector

● Pion Rejection: 680

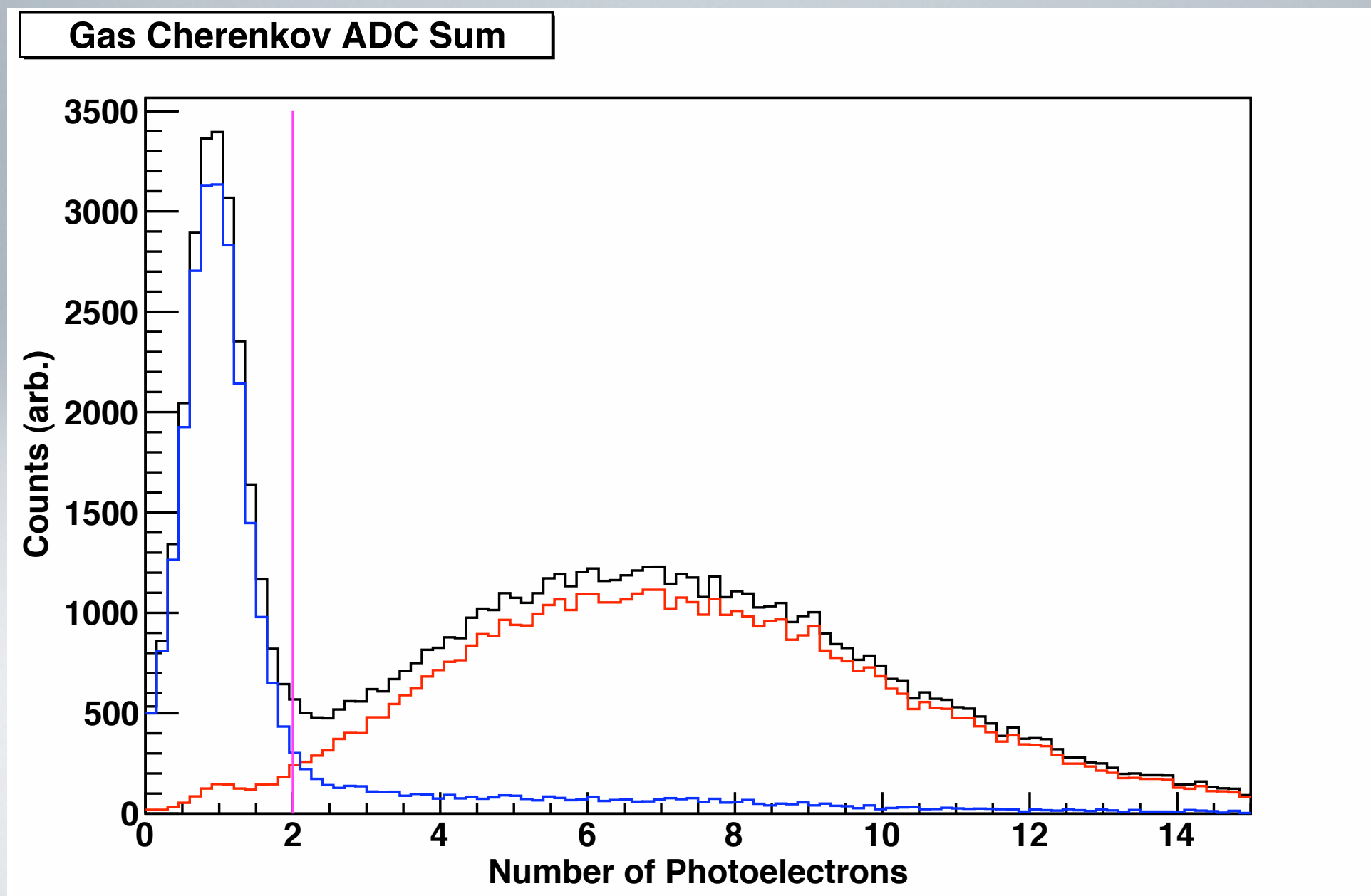
● Electron efficiency: 99%



LHRS: Cherenkov

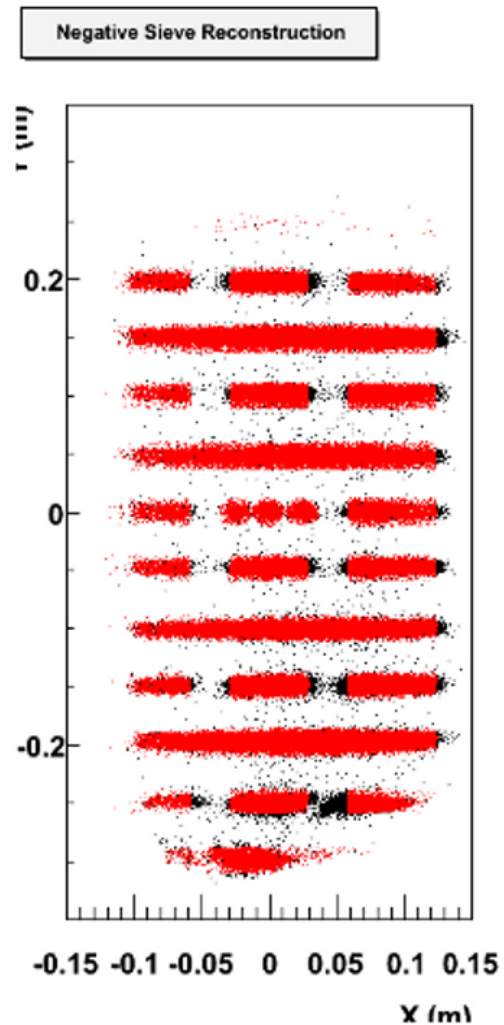
● Pion Rejection: 600

● Electron Efficiency: 96%

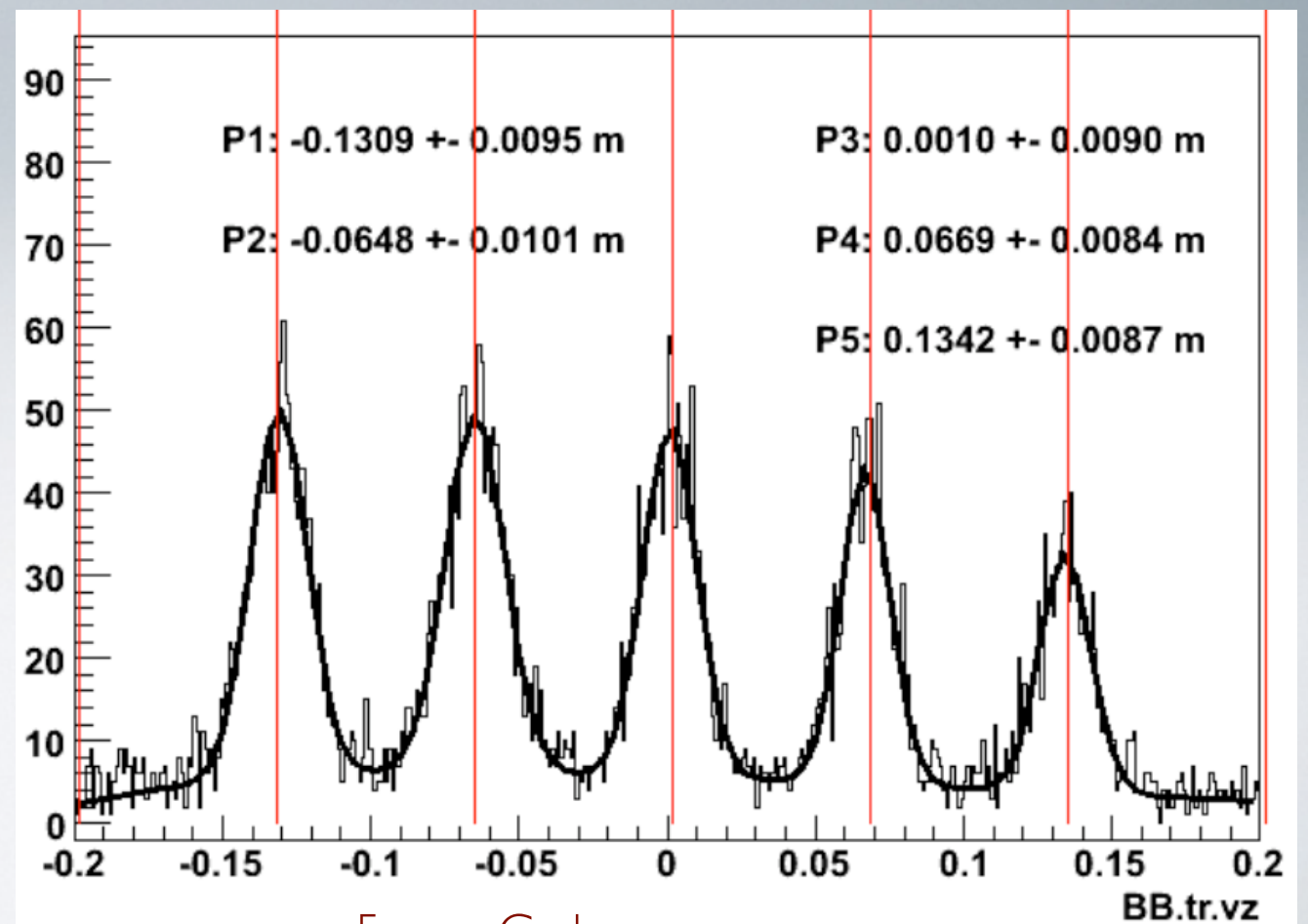


BigBite Negative Optics

- Majority of optics done by Xin during Transversity
- Vertex resolution at centimeter level



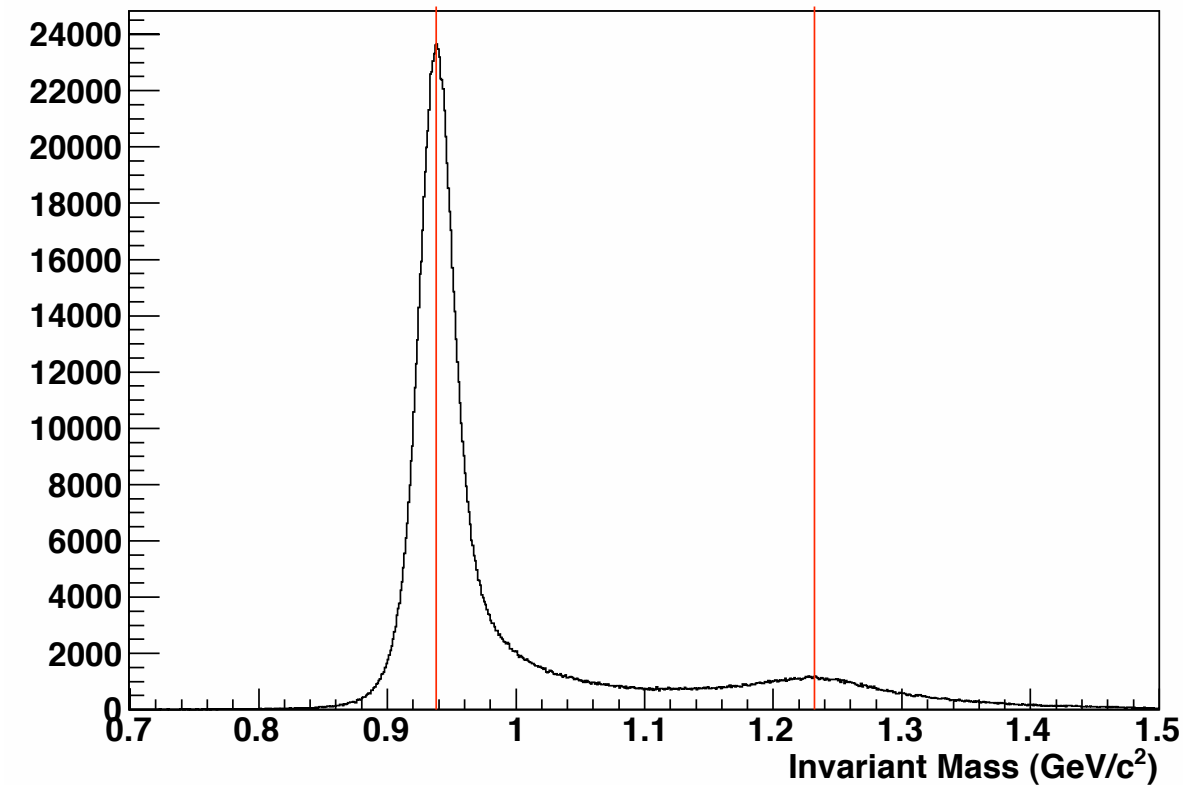
1-Pass Carbon



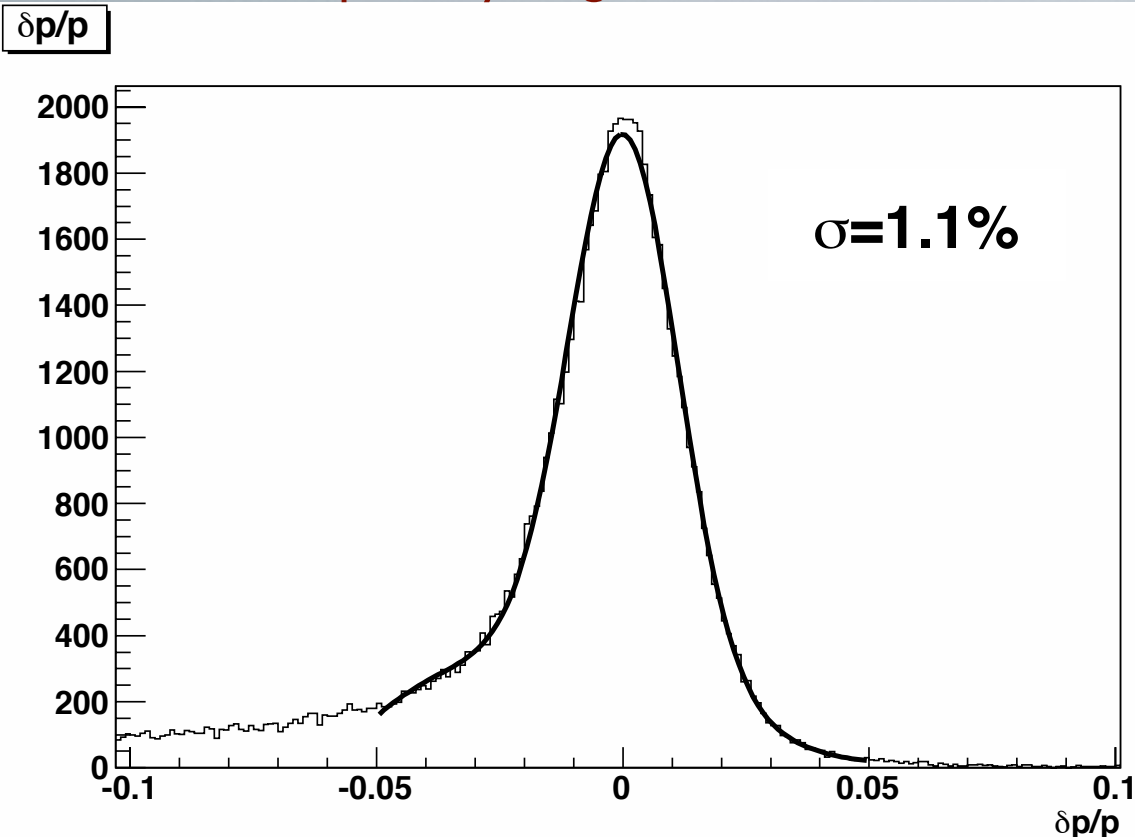
5-pass Carbon

BigBite Negative Optics

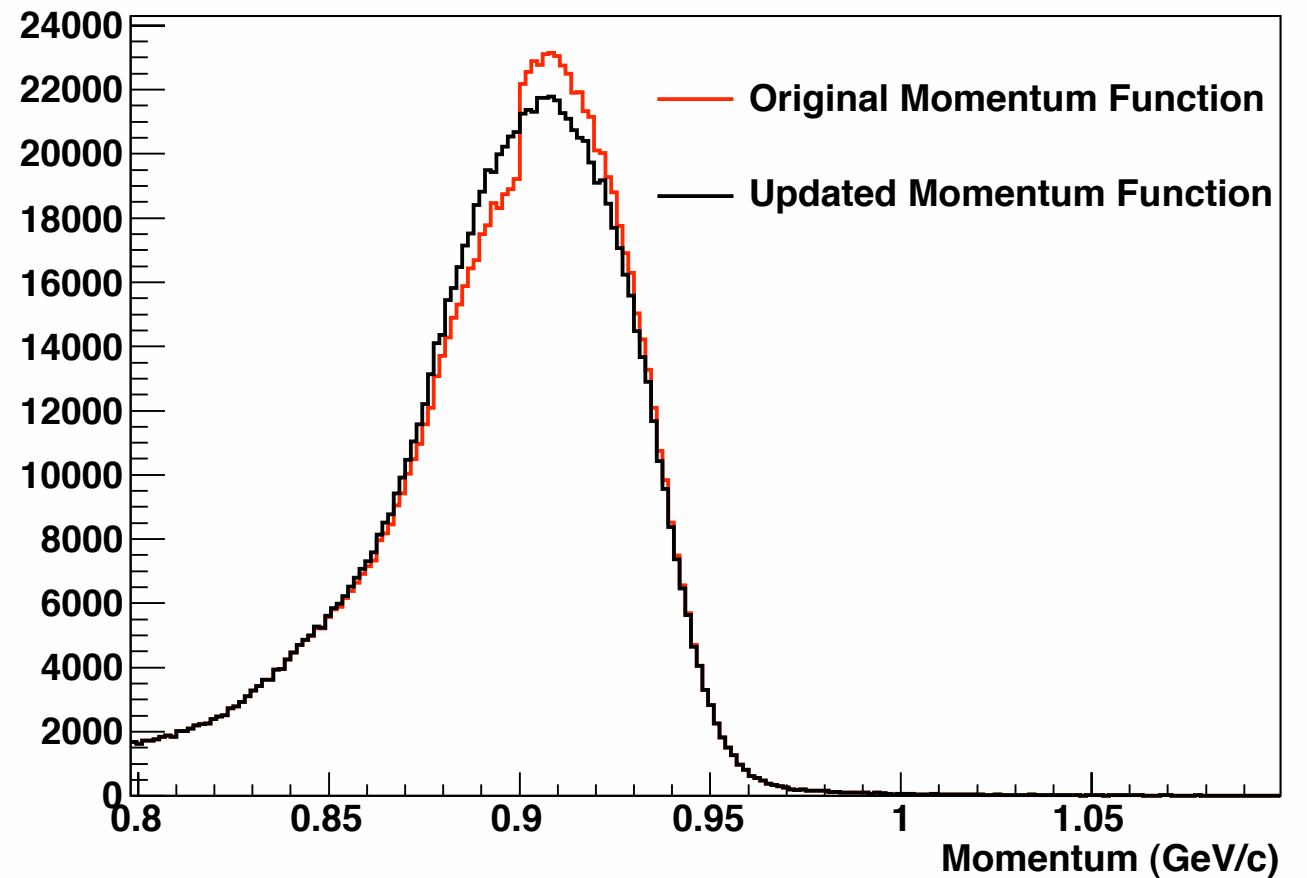
H₂ Elastic Scattering: Invariant Mass Spectrum



I-pass Hydrogen



Momentum Distribution



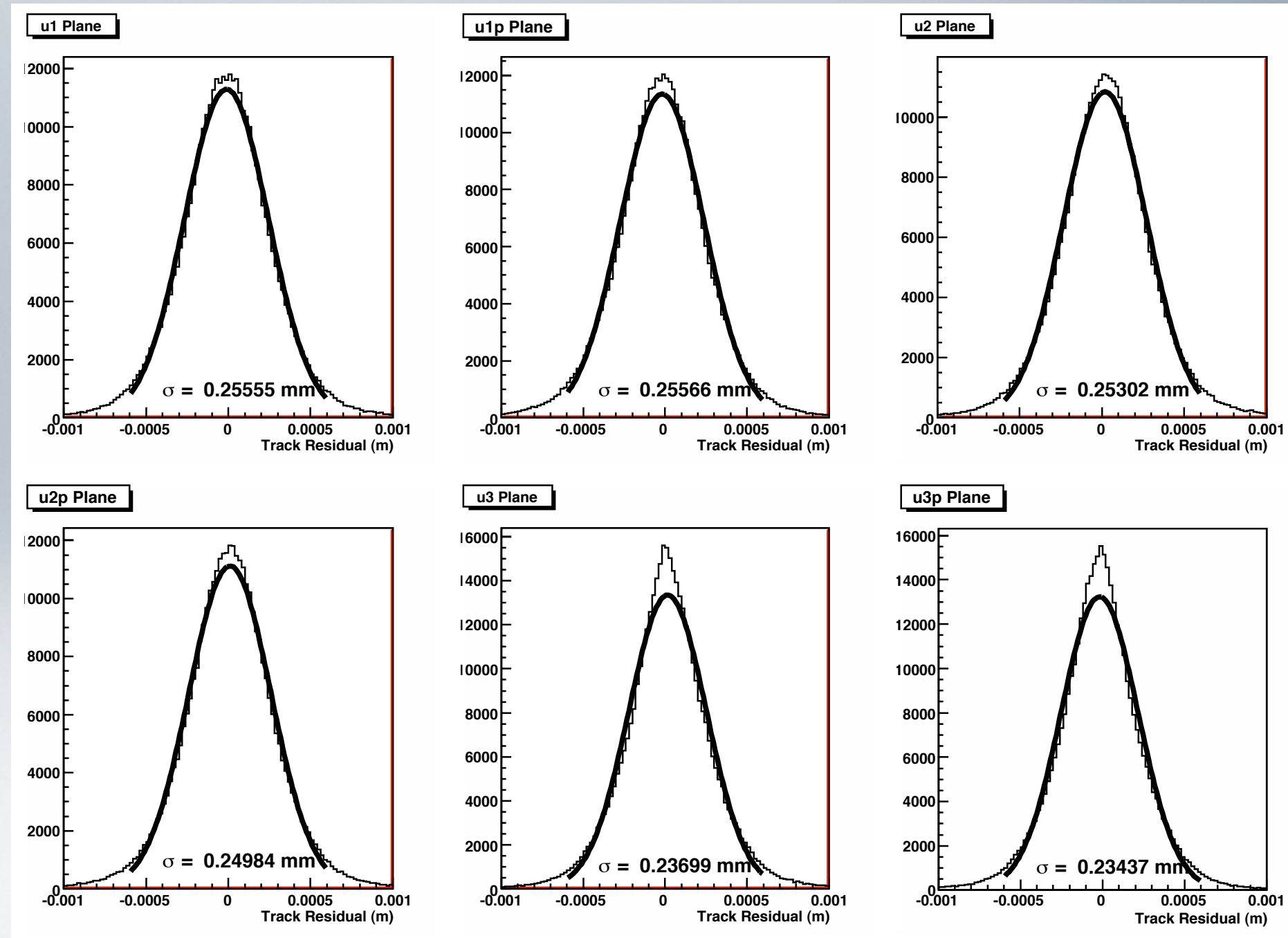
- Diana implemented a momentum correction to fix momentum discontinuity
- Momentum resolution of $\sim 1\%$

BigBite MWDC

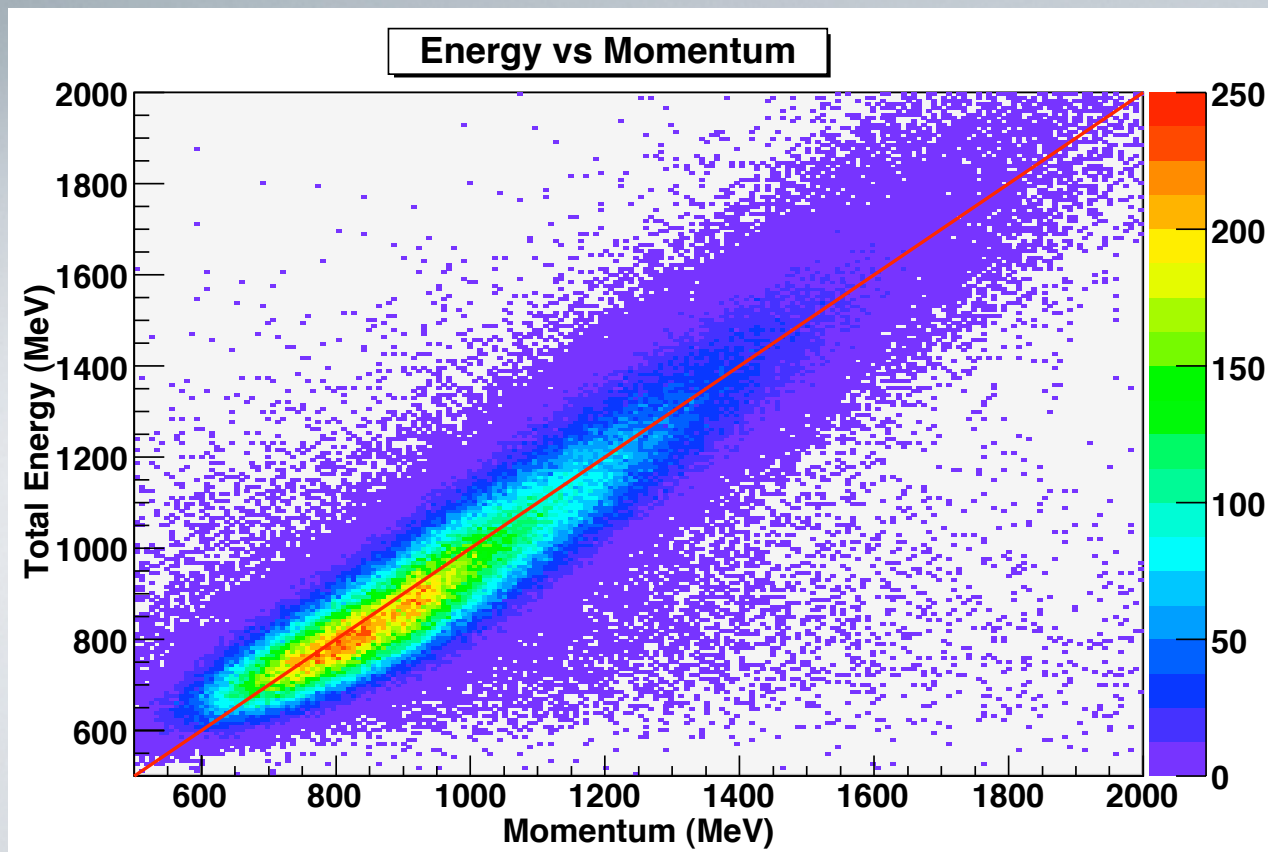
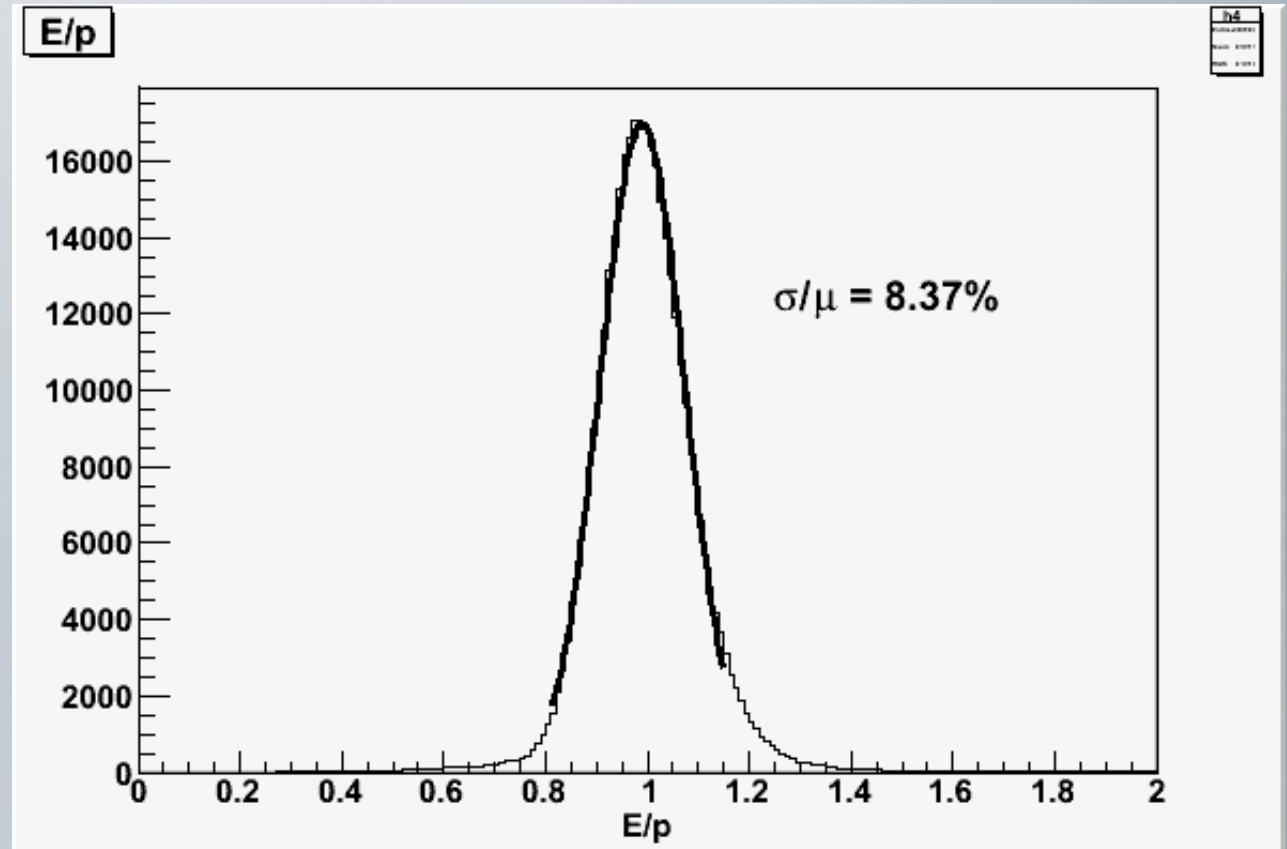
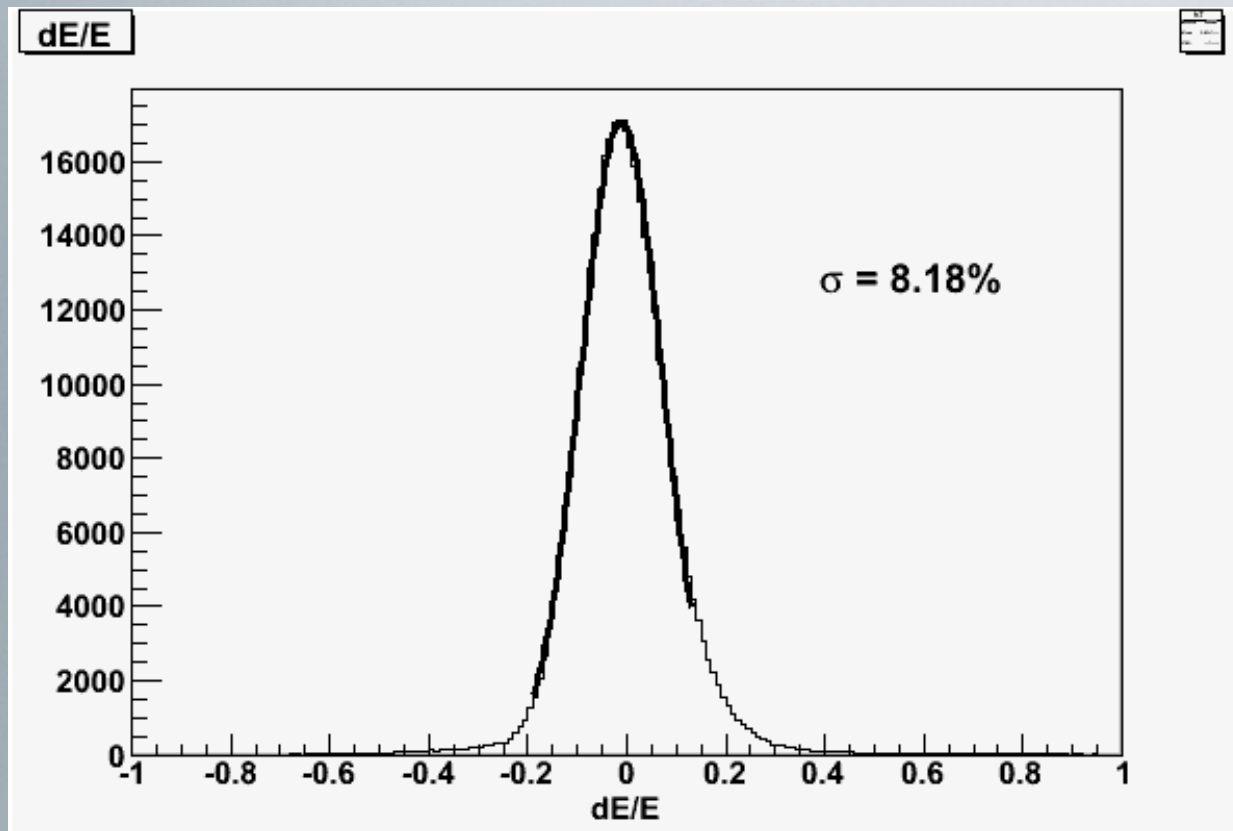
U plane track residuals

- After calibrating all MWDC planes the track residuals are checked

- Track residual resolutions varied from 190-265 μm



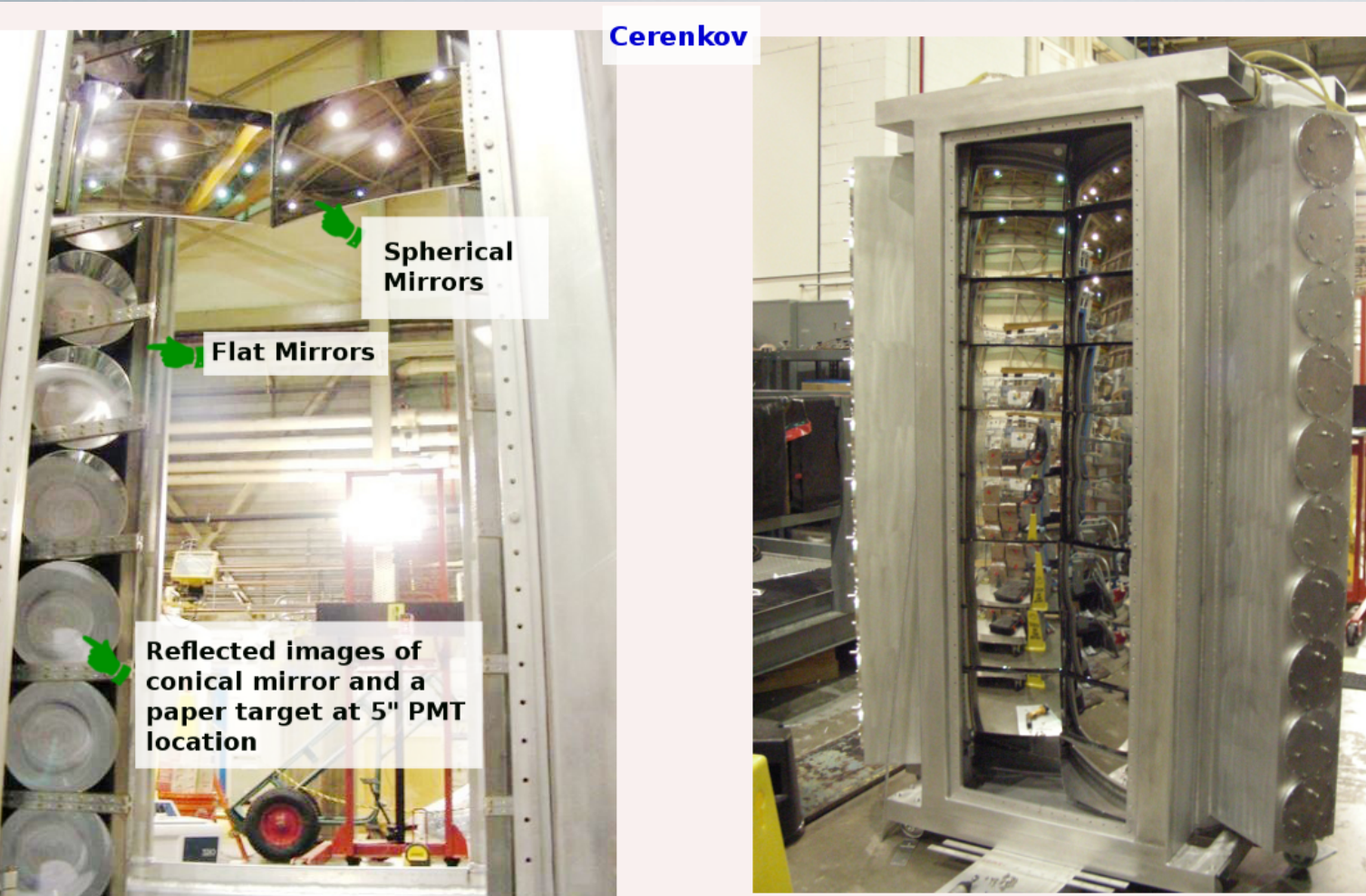
BigBite Shower



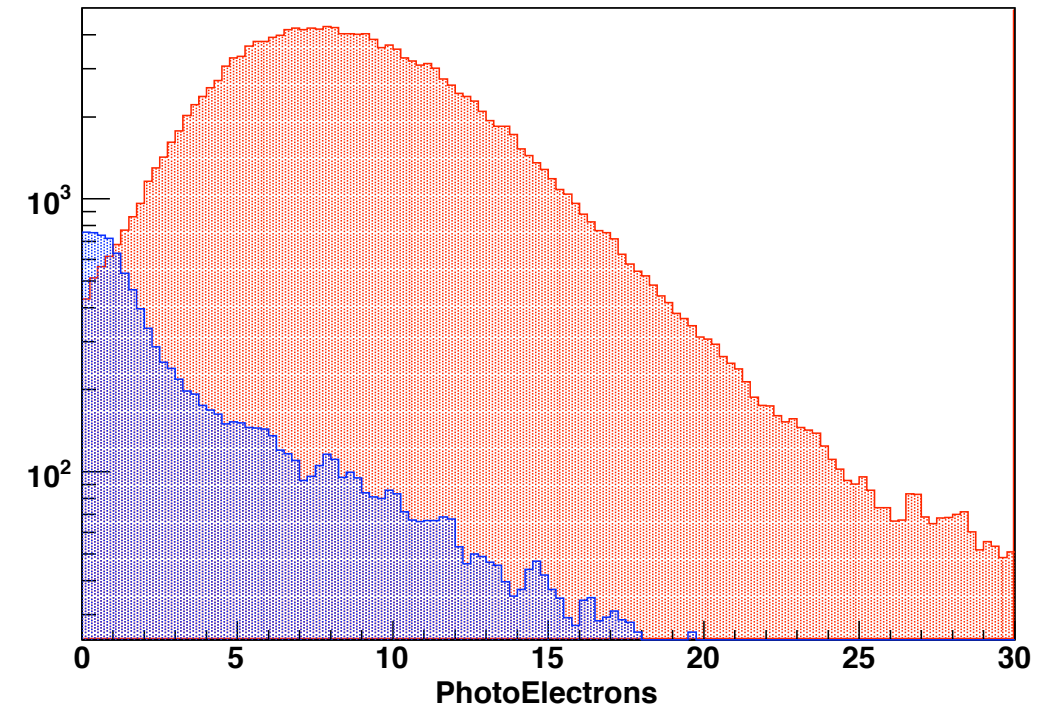
- Shower needs some fine tuning
- E/p resolution is 8.37%
- Energy resolution is 8.18%

BigBite Cherenkov

small angle side

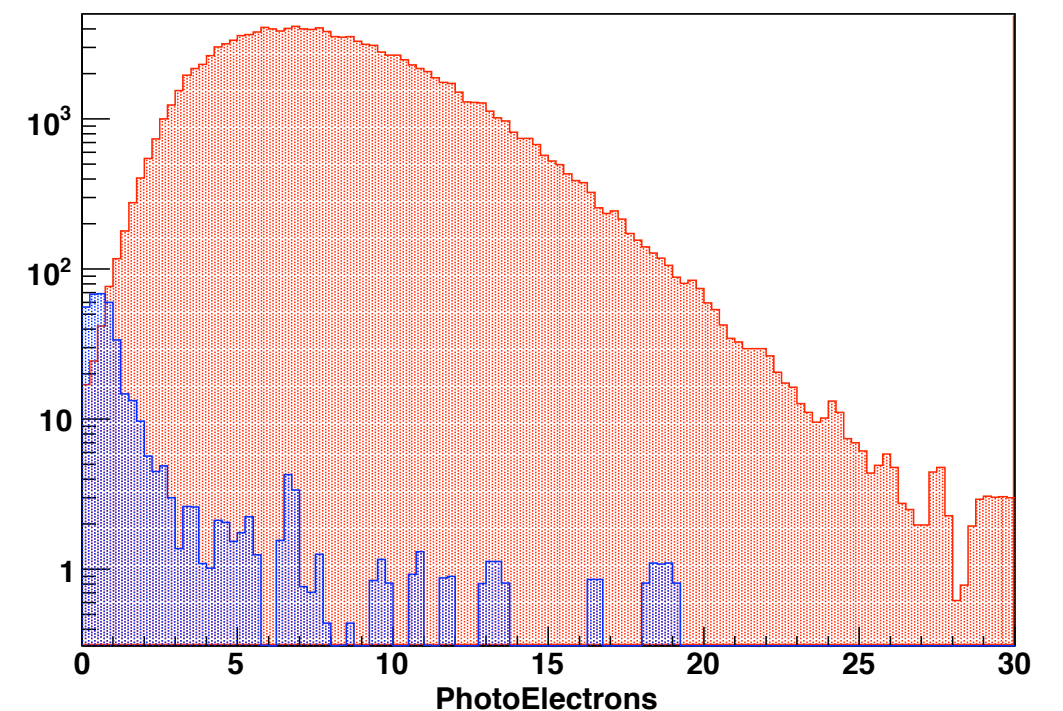


ADC 04 ~1.0 MHz



large angle side

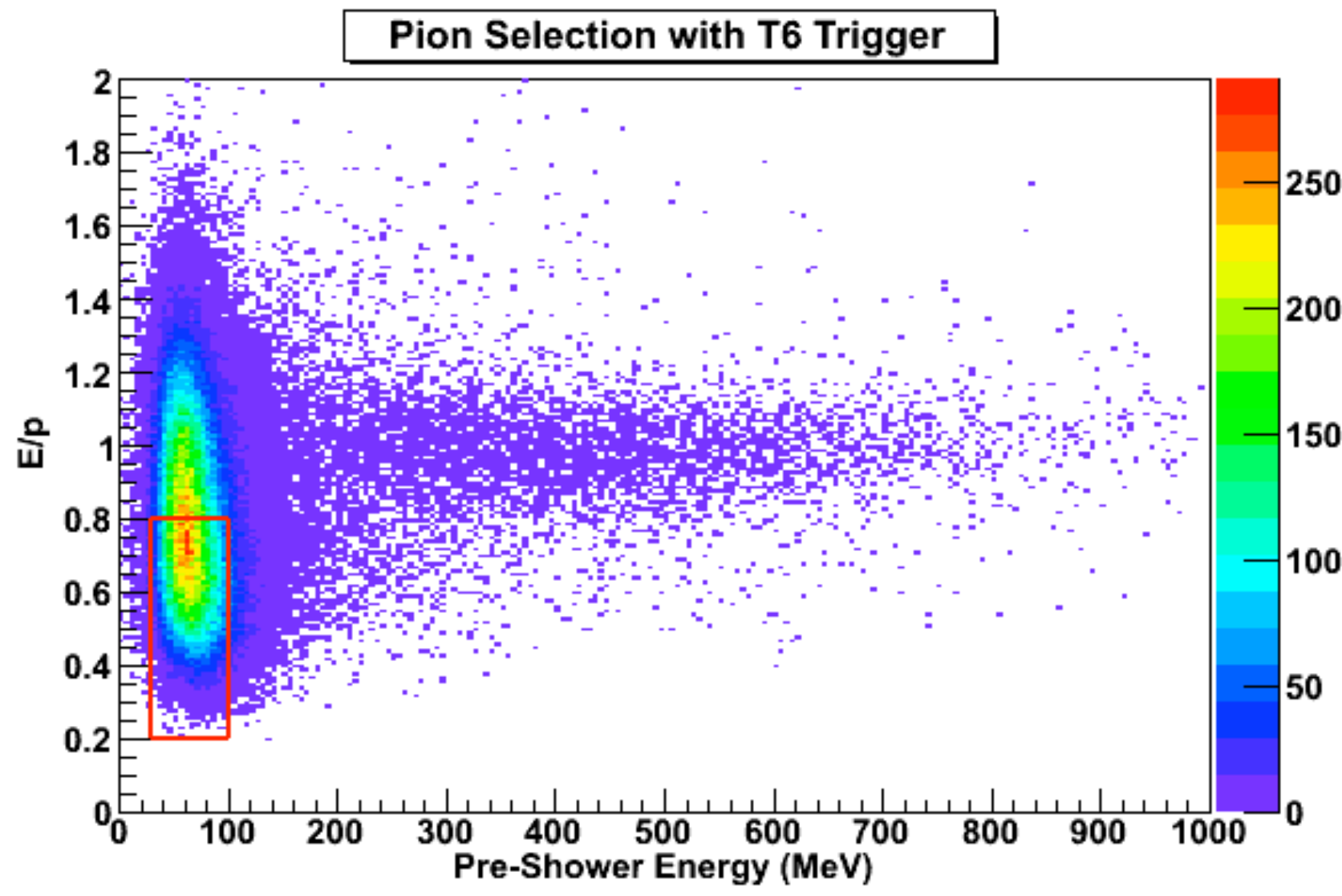
ADC 14 ~0.1 MHz



● Rate ~10 times larger on small angle side

● Resulted in larger background on small angle side

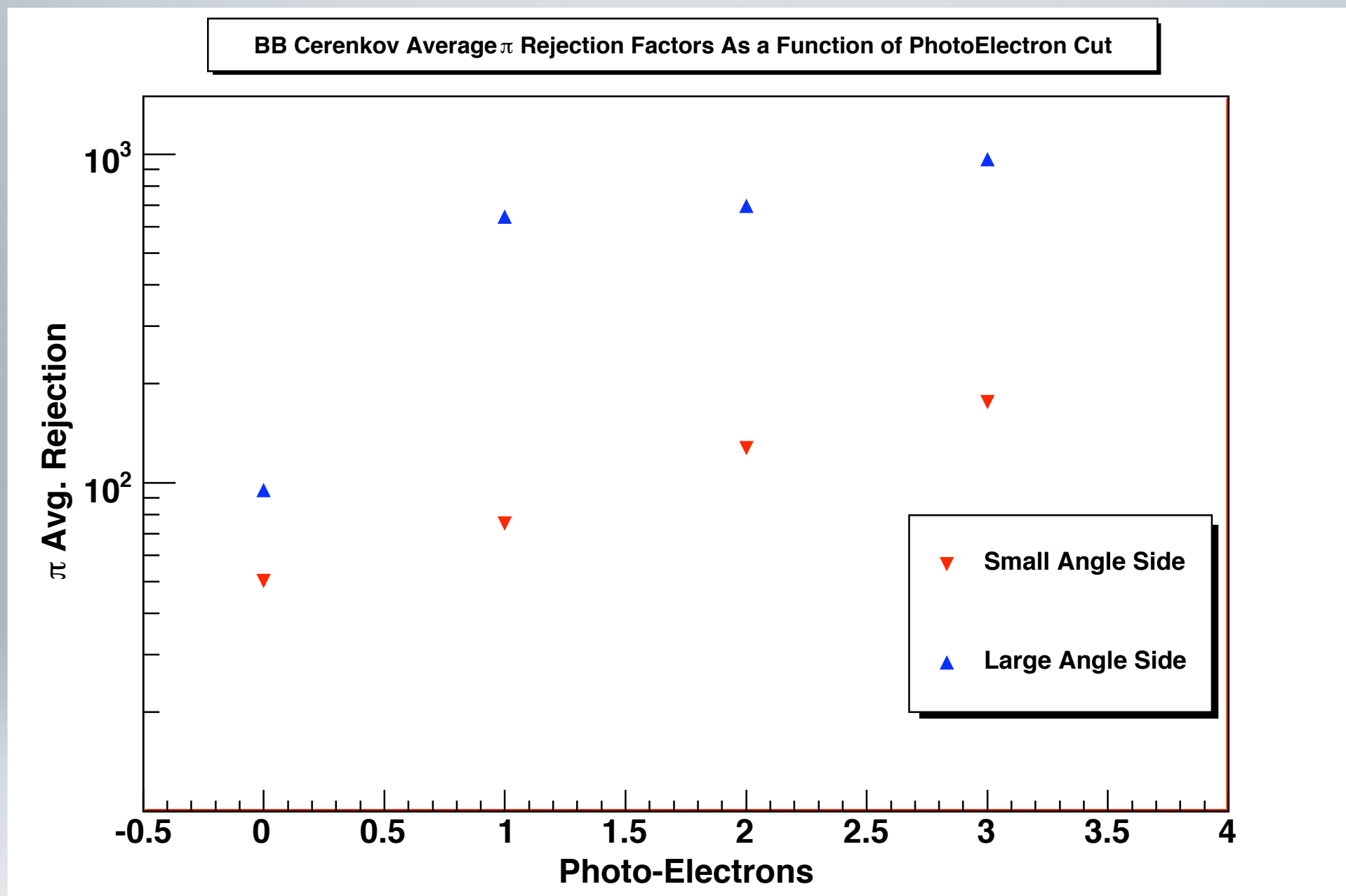
BigBite Cherenkov: Pion Rejection



● $\epsilon_{\pi} = \frac{N_{\pi}}{N_{cer}}$

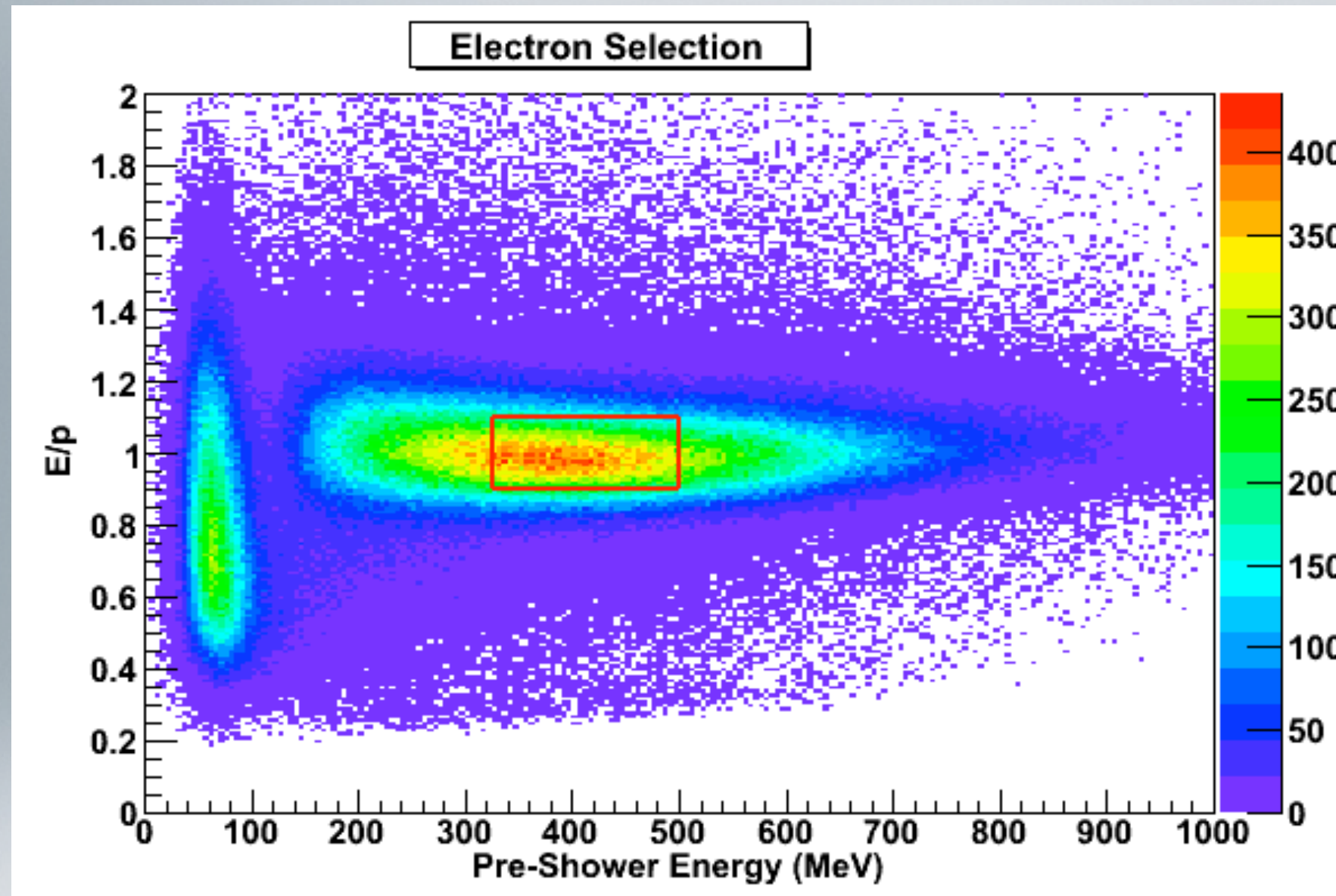
- N_{cer} = Number of pions left after Cherenkov cut
- N_{π} = Number of events in pion sample

BigBite Cherenkov: Pion Rejection



- Small angle side pion rejection factor at 3 photo-electron cut ~ 200
- Large angle side pion rejection factor at 3 photo-electron cut ~ 900

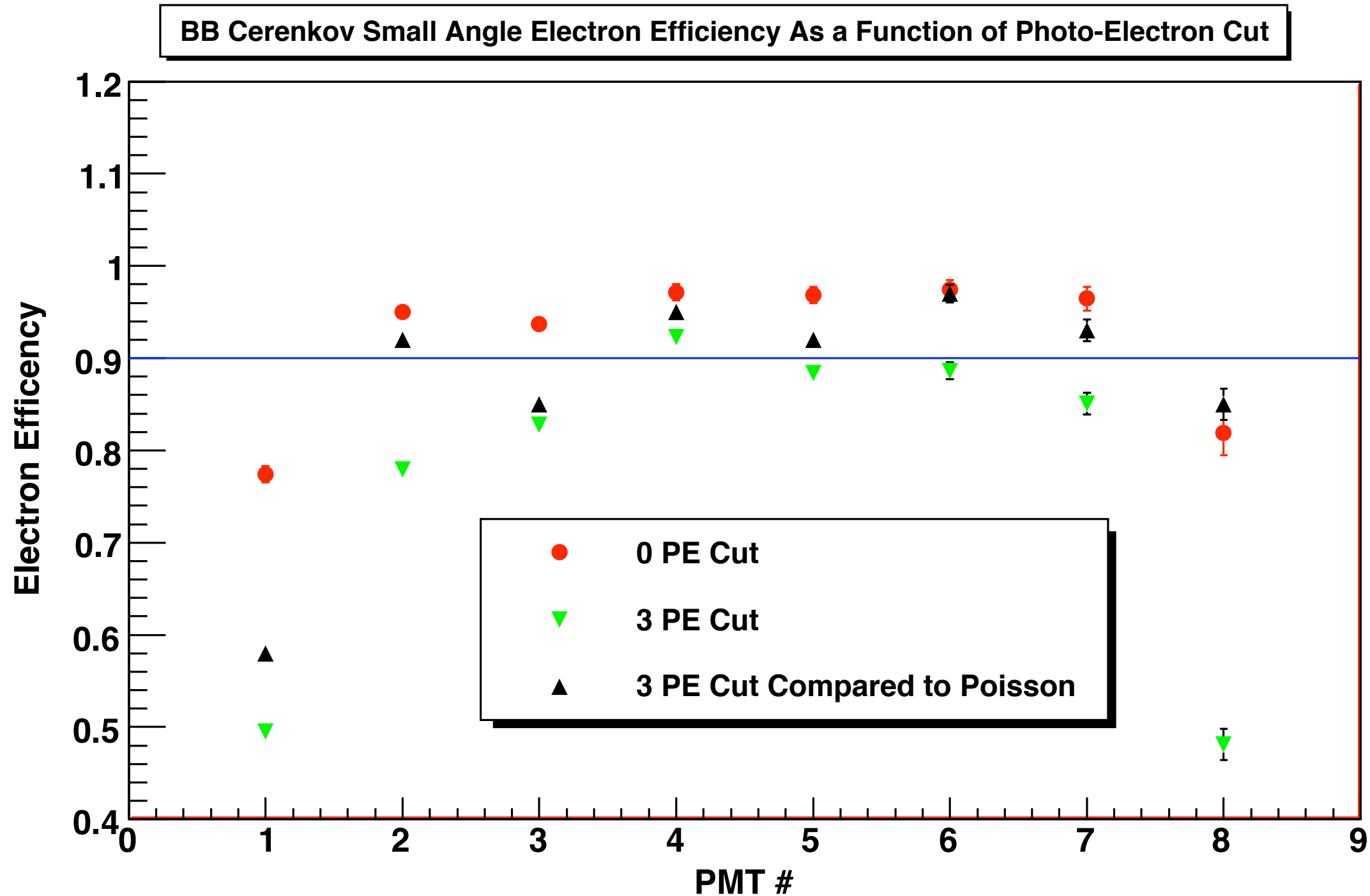
BigBite Cherenkov: Electron Efficiency



● $\epsilon_e = \frac{N_{cer}}{N_e}$

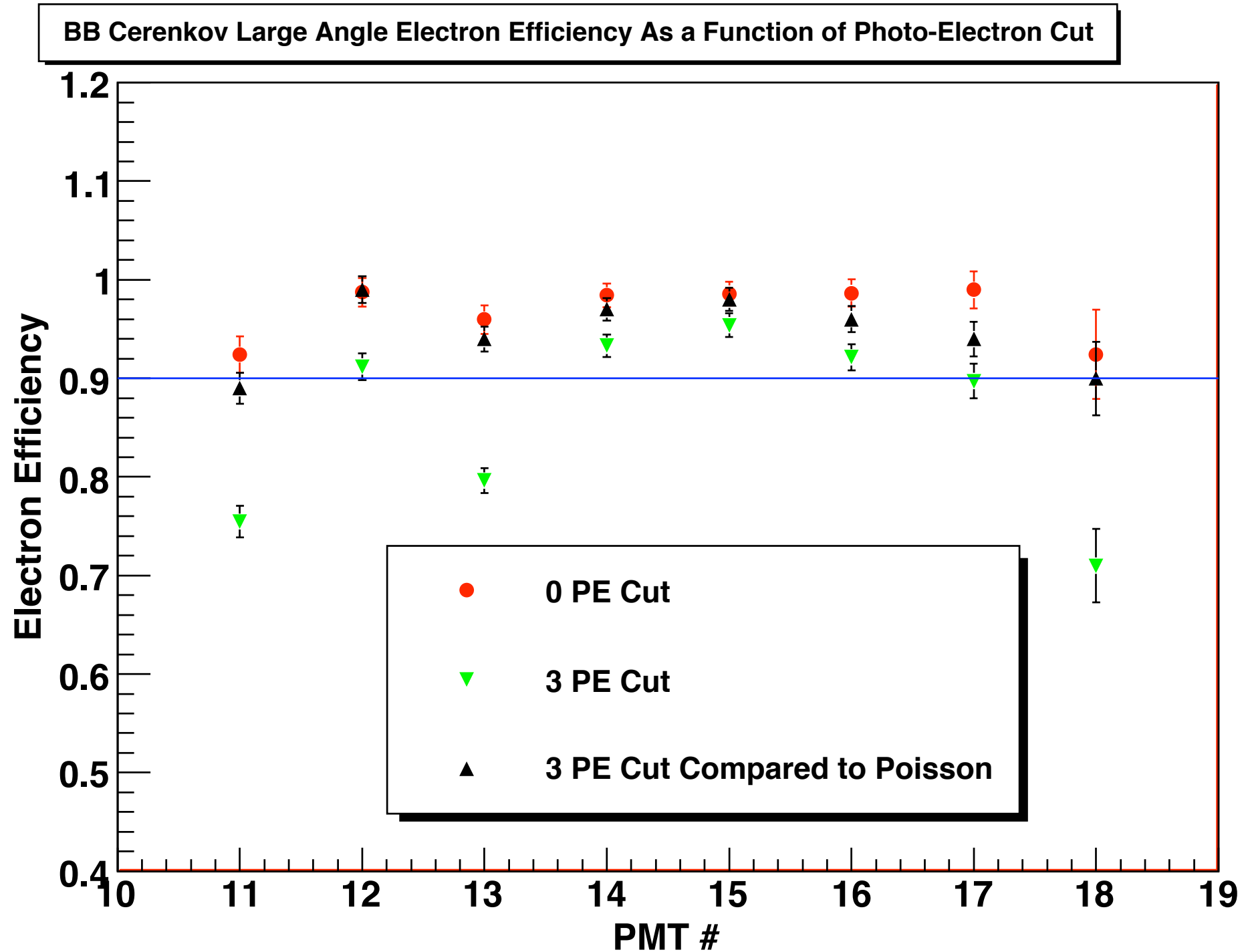
- N_e = number of events in electron sample
- N_{cer} = number of events in electron sample after Cherenkov cut

BigBite Cherenkov: Electron Efficiency



- Small angle average electron efficiency >85%

BigBite Cherenkov: Electron Efficiency



- Large angle average electron efficiency $>90\%$

What's Next...

- Studying LHRS acceptance
- Finalize Cherenkov pion rejection factors and electron efficiencies
- Fine tune shower calibrations
- Data quality checks
- Begin extracting asymmetries

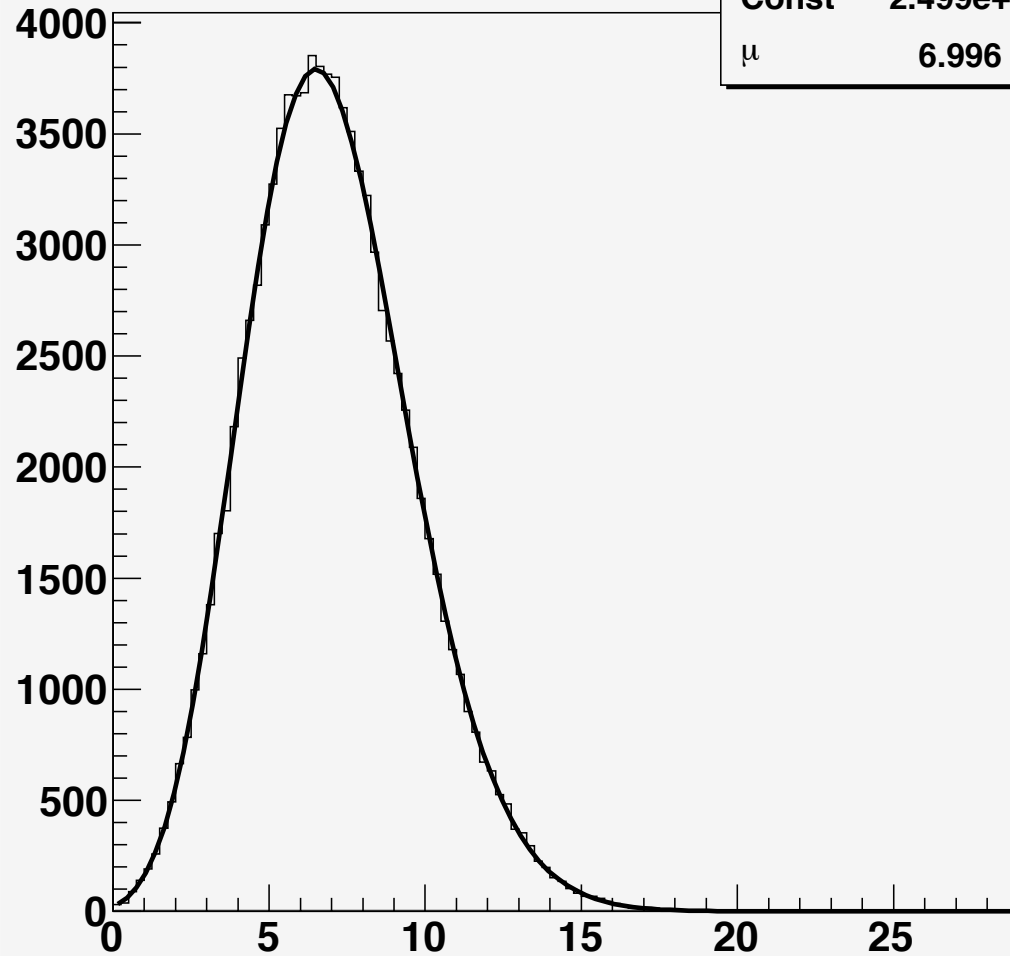
Thank You

- B. Sawatzky, Z.-E. Meziani, G. Franklin, L. El Fassi
- P. H. Solvignon, V. Sulkosky, S. Riordan, Yi Zhang
- X. Qian, J. Huang, K. Allada, C. Dutta, Yawei Zhang
- D. Flay, D. Parno
- The E06014 Collaboration

BigBite Cherenkov: Electron Efficiency

Poisson distribution

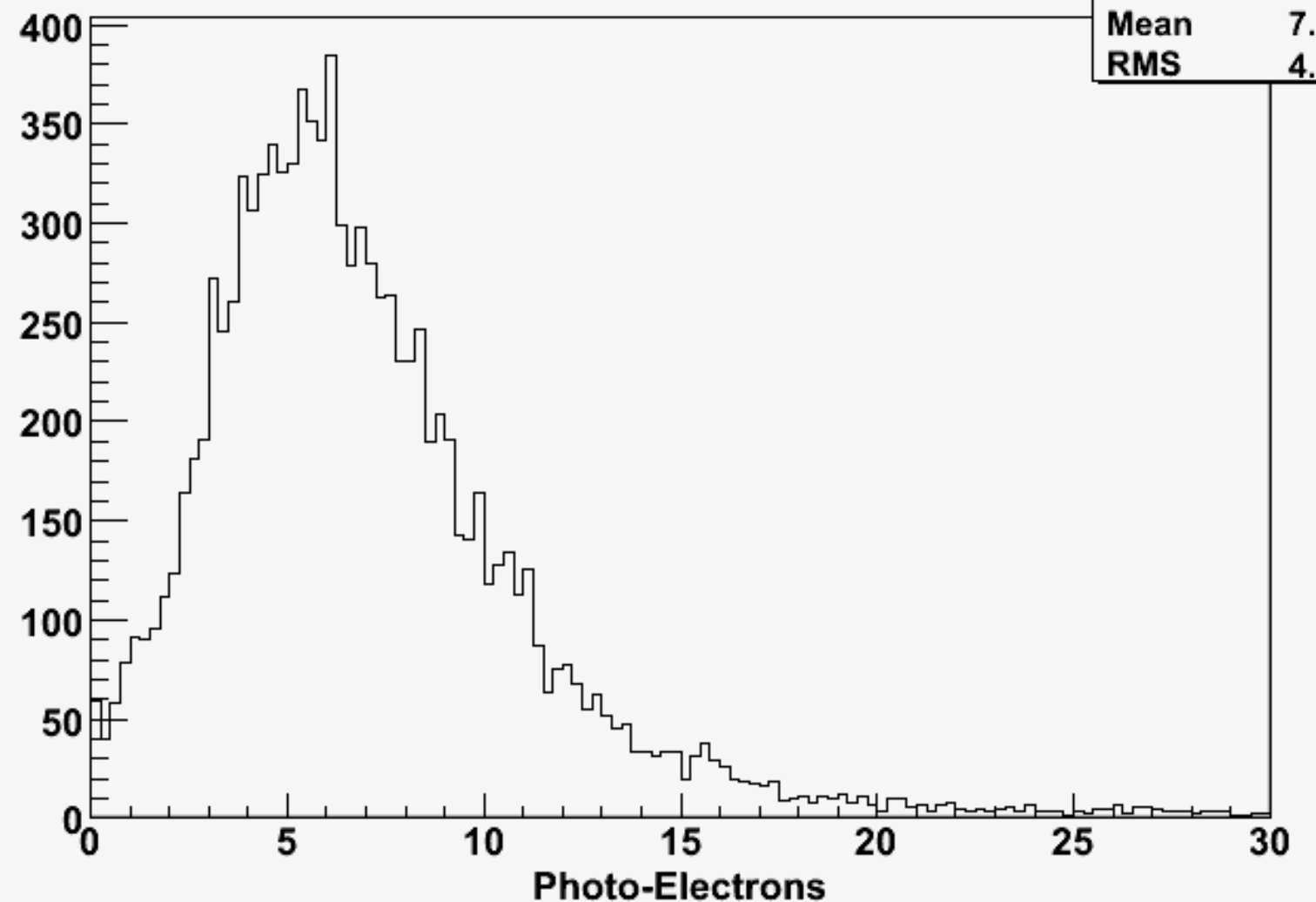
χ^2 / ndf 66.91 / 78
Const 2.499e+04 $\pm$ 79
 μ 6.996 $\pm$ 0.008



- Plot electrons in Cerenkov
- Find the mean photo-electrons
- Compare to Predicted distribution with same mean

BB Cerenkov ADC 07 with 0.0 Photo-Electron Cut

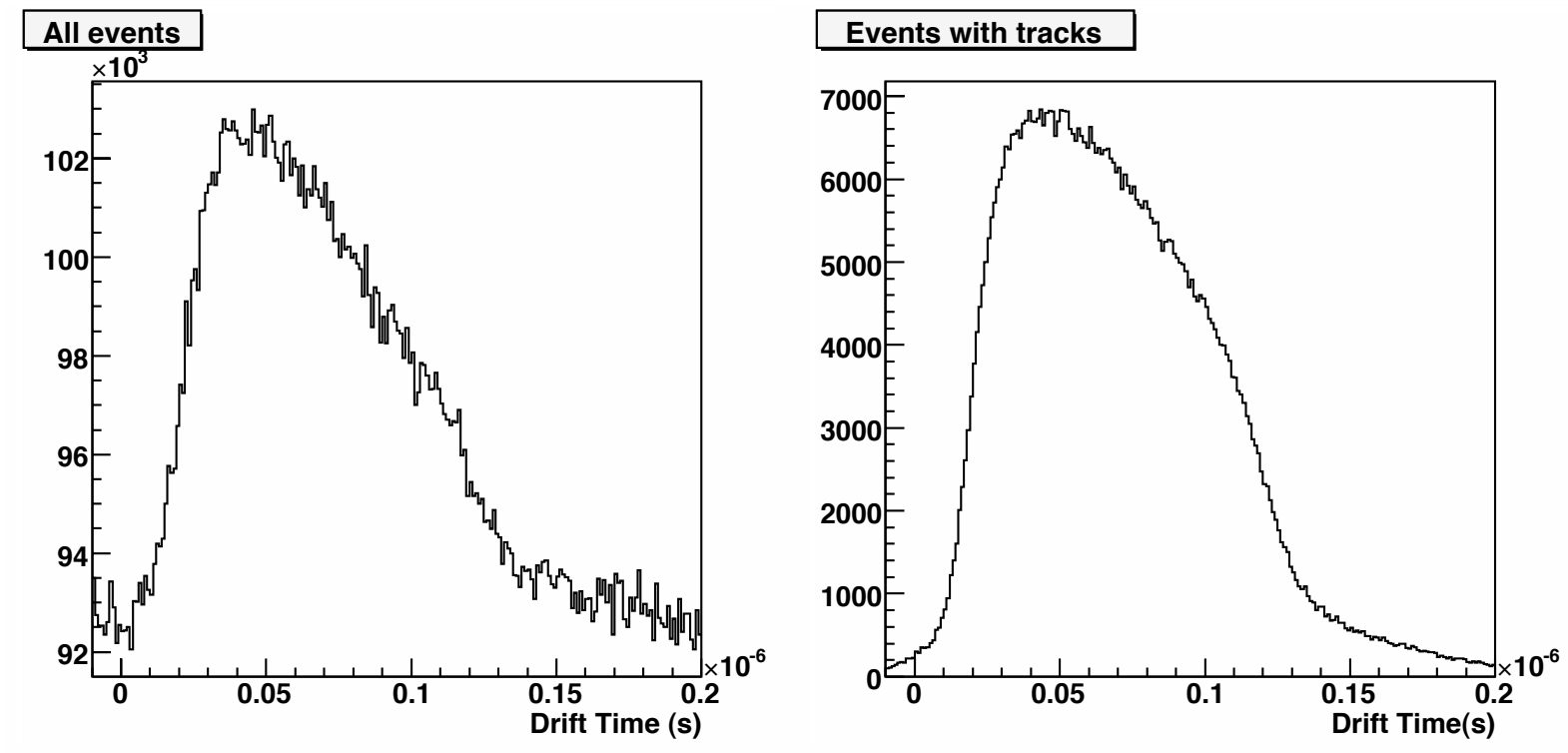
hcer
Entries 11021
Mean 7.004
RMS 4.172



- Predicted 3 photo-electron cut probability ~91%
- Empirical 3 photo-electron cut efficiency ~85%

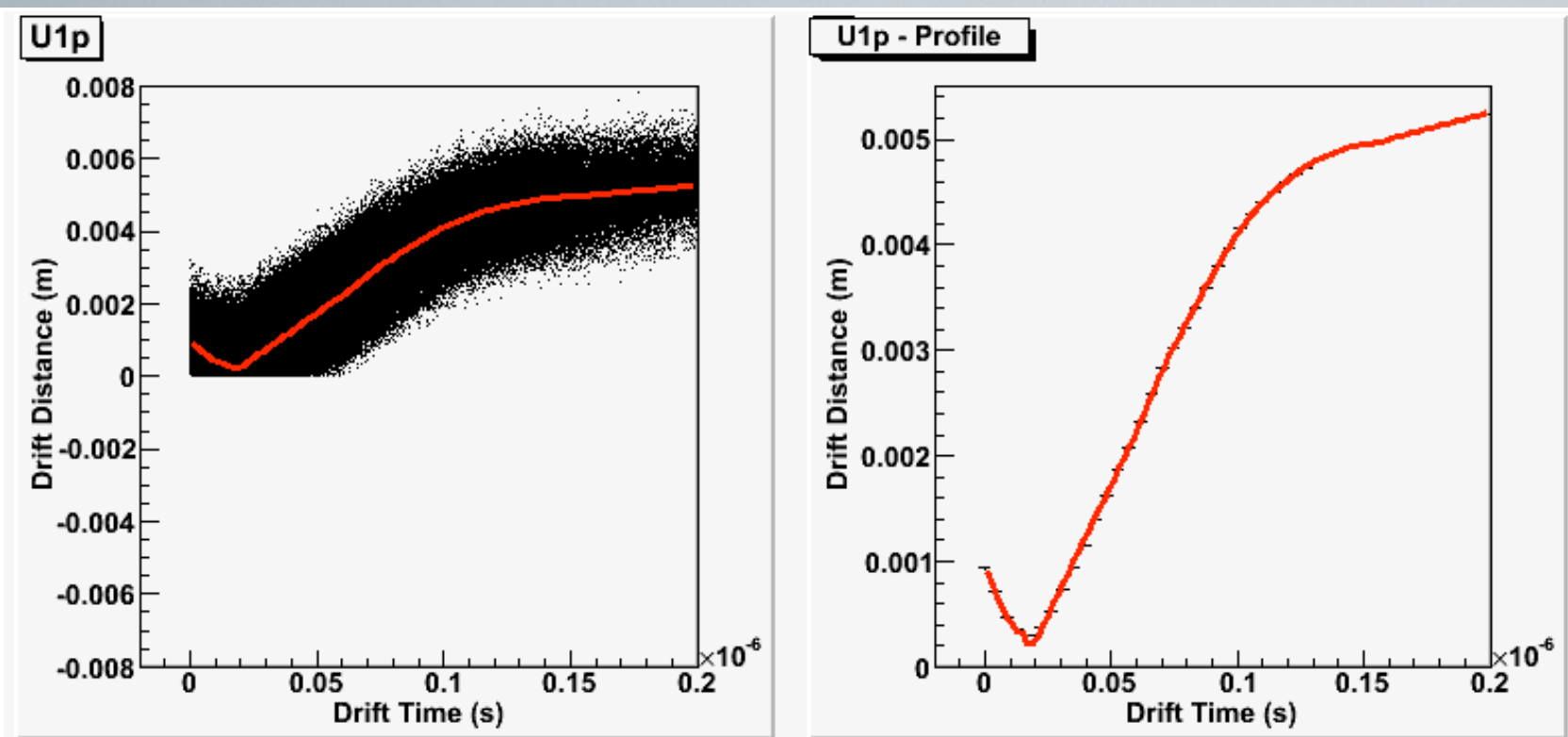
BigBite MWDC

t0 calibration



- t0 calibration was done for each plane
- t0 calibrated to within 10 ns

drift distance to drift time



- Drift distance to drift time was parameterized for each plane

T2 Trigger

