Measurement of the Target Single-Spin Asymmetry in Quasi-elastic $^{3}\vec{He}(e, e')$

Bo Zhao

College of William and Mary

For the Hall-A Quasi-elastic collaboration at Jefferson Lab

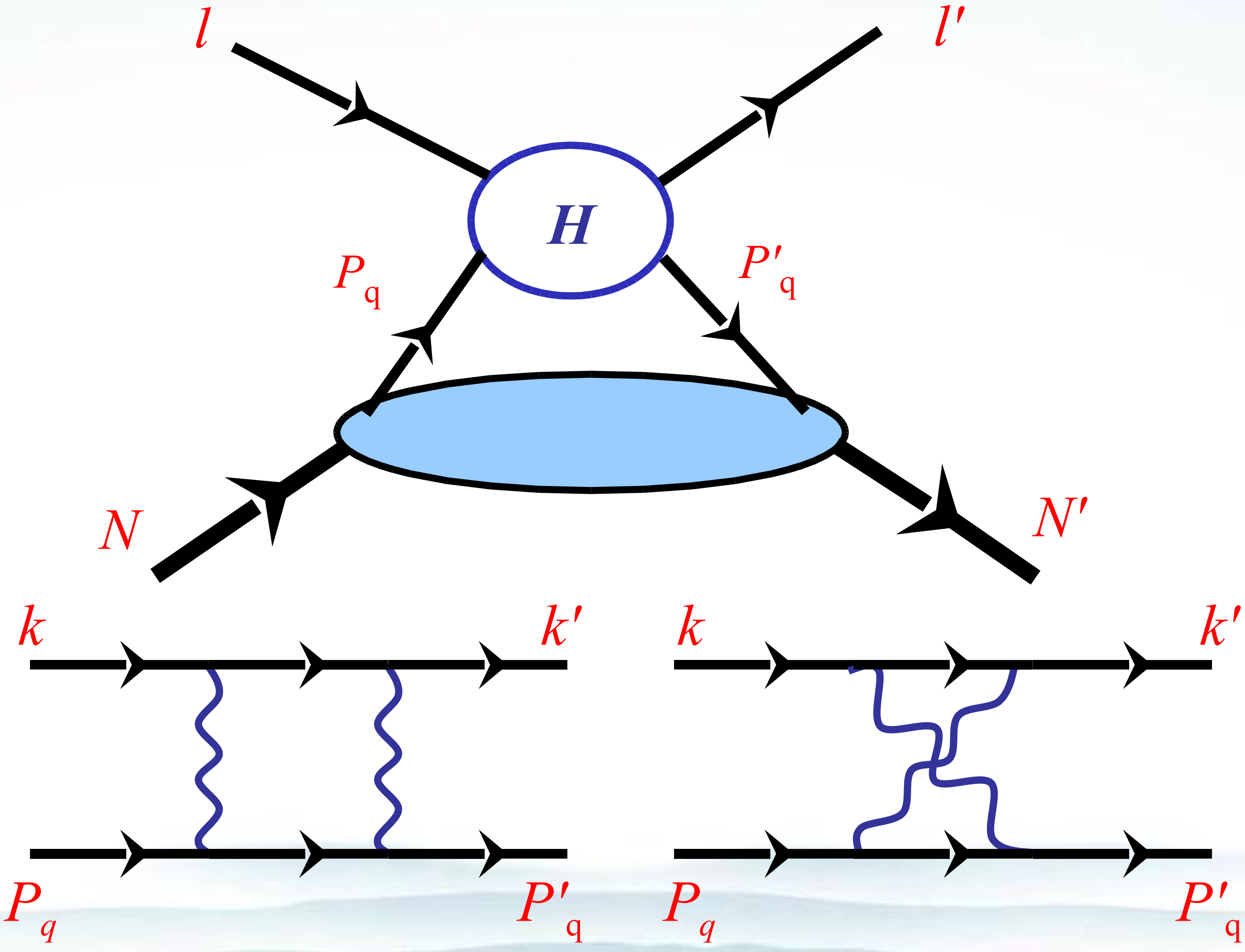
Thesis students: *Elena Long*, *Yawei Zhang*, *Ge Jin* and *Miha Mihovilovic*

DNP Meeting, Oct. 16, 2009

Outline

- Physics Motivation
- Experimental setups
- Data analysis
- Summary

Two-photon Exchange Process



Target Single-Spin Asymmetry (SSA)

For $l(k) + N(p) \longrightarrow l(k') + N(p')$

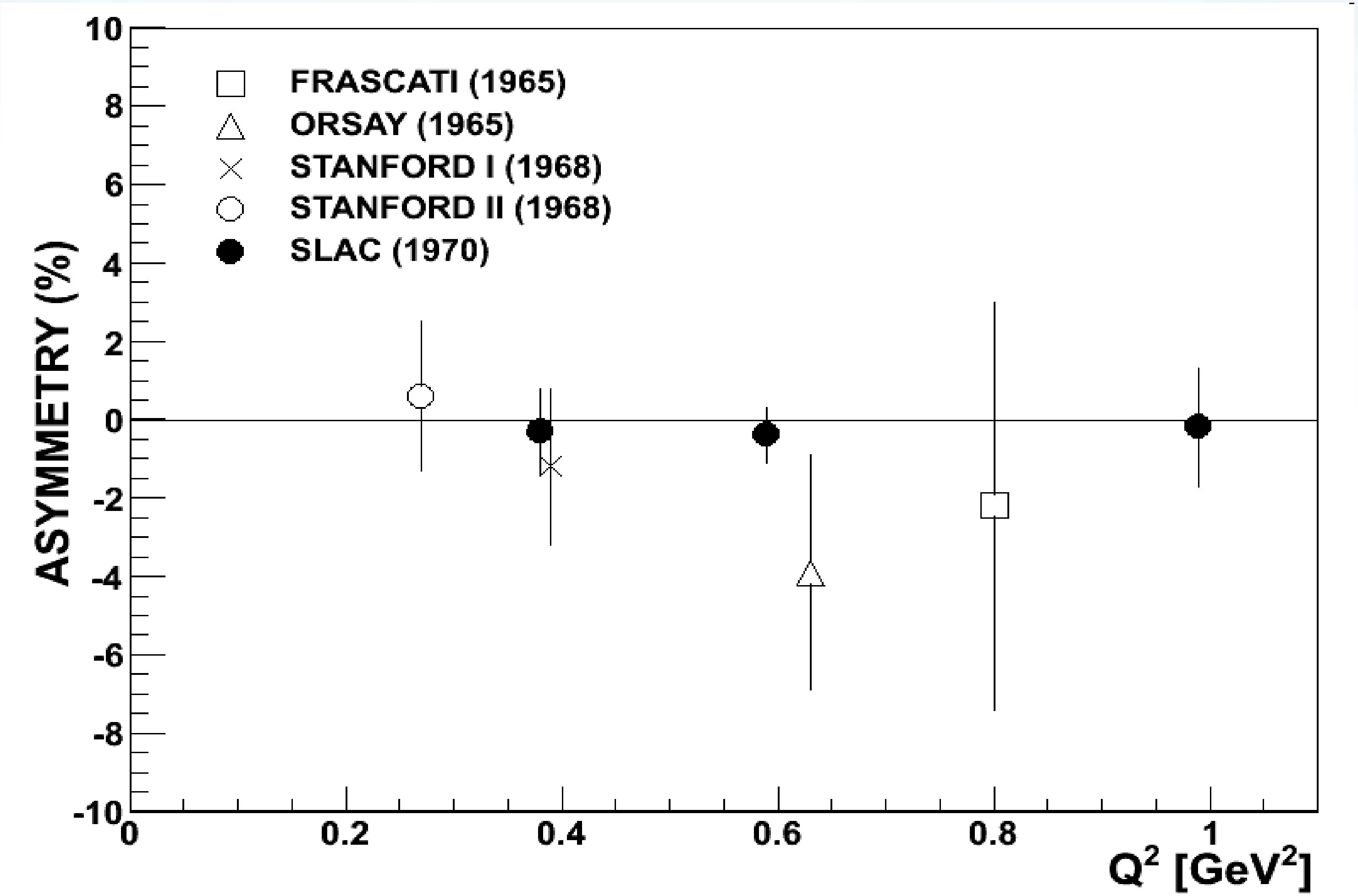
$$A_y = \frac{\sigma^\uparrow - \sigma^\downarrow}{\sigma^\uparrow + \sigma^\downarrow} = \sqrt{\frac{2\varepsilon(1+\varepsilon)}{\tau}} \frac{C_B(\varepsilon, Q^2)}{d\sigma} \times \left\{ -G_M \mathcal{I}\left(\delta\tilde{G}_E + \frac{\nu}{M^2}\tilde{F}_3\right) + G_E \mathcal{I}\left(\delta\tilde{G}_M + \left(\frac{2\varepsilon}{1+\varepsilon}\right)\frac{\nu}{M^2}\tilde{F}_3\right)\right\}$$

In terms of GPD moments

Y.C. Chen etc., PRL 93, 122301 (2004)

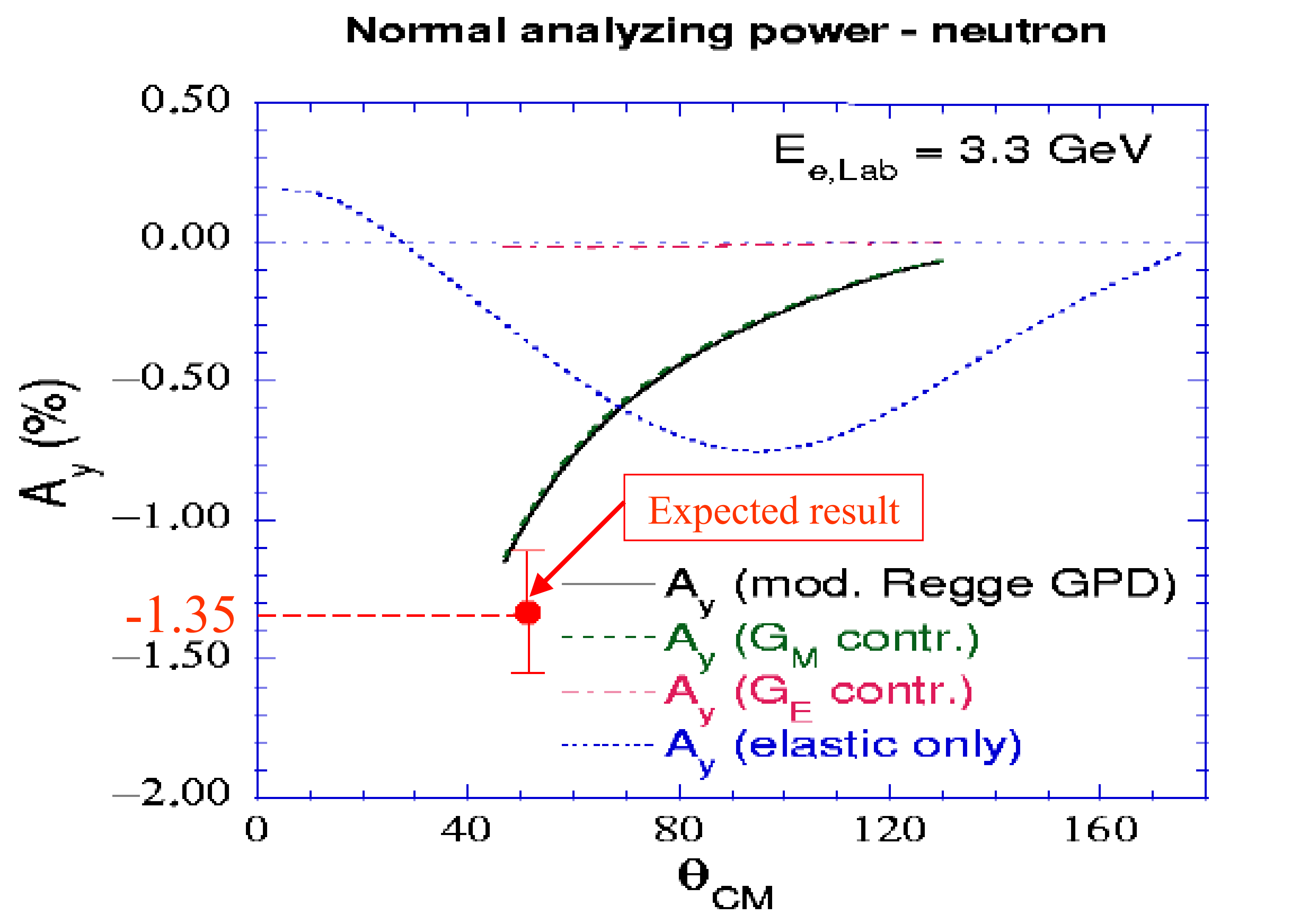
A measurement of Ay has sensitivity to GPD model input

Earlier experimental results for SSA

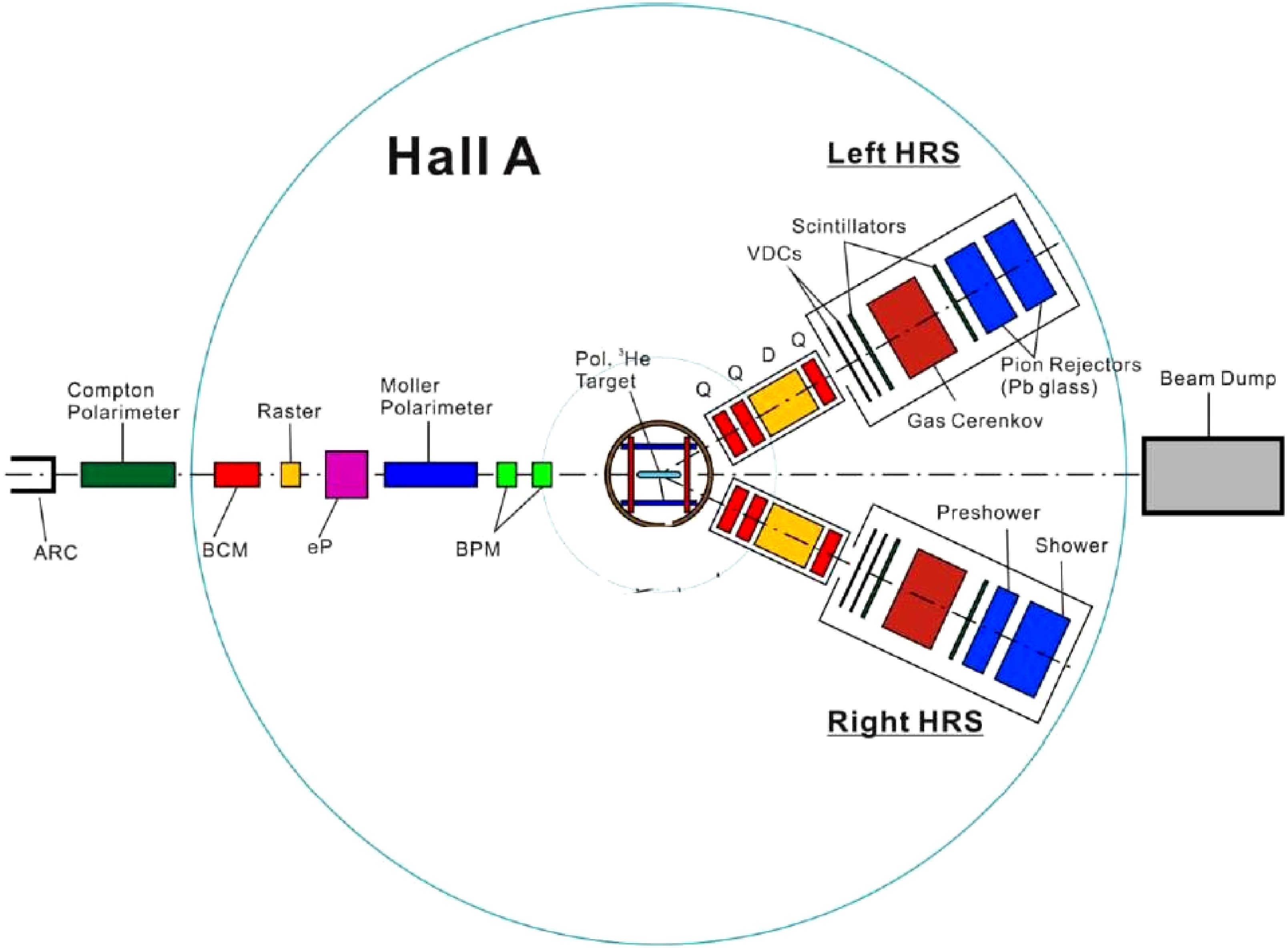


Earlier resutls were consistent with zero within large uncertainties

Expected result from our Ay experiment



Experimental facility

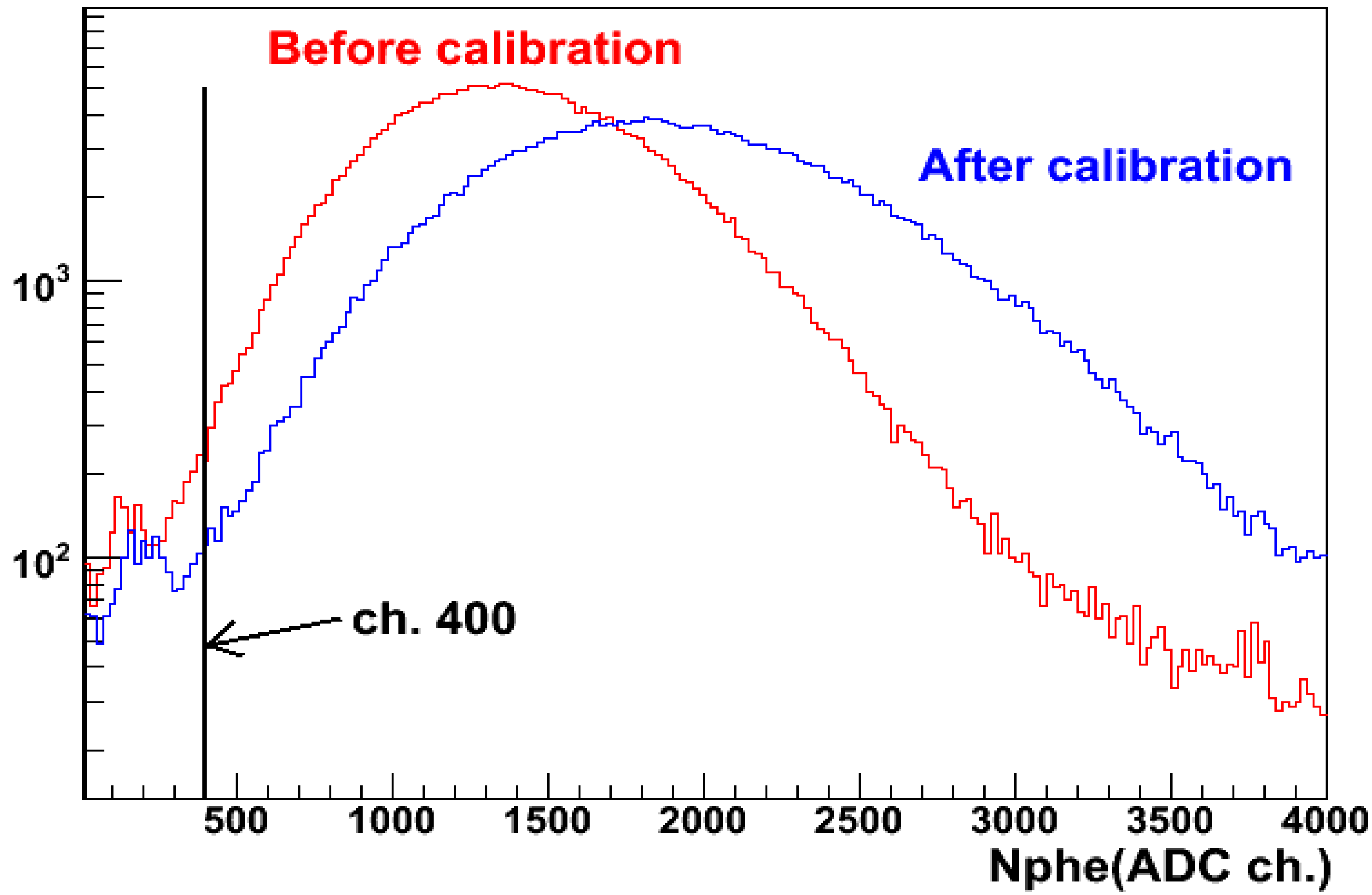


A_y Experiment Kinematics

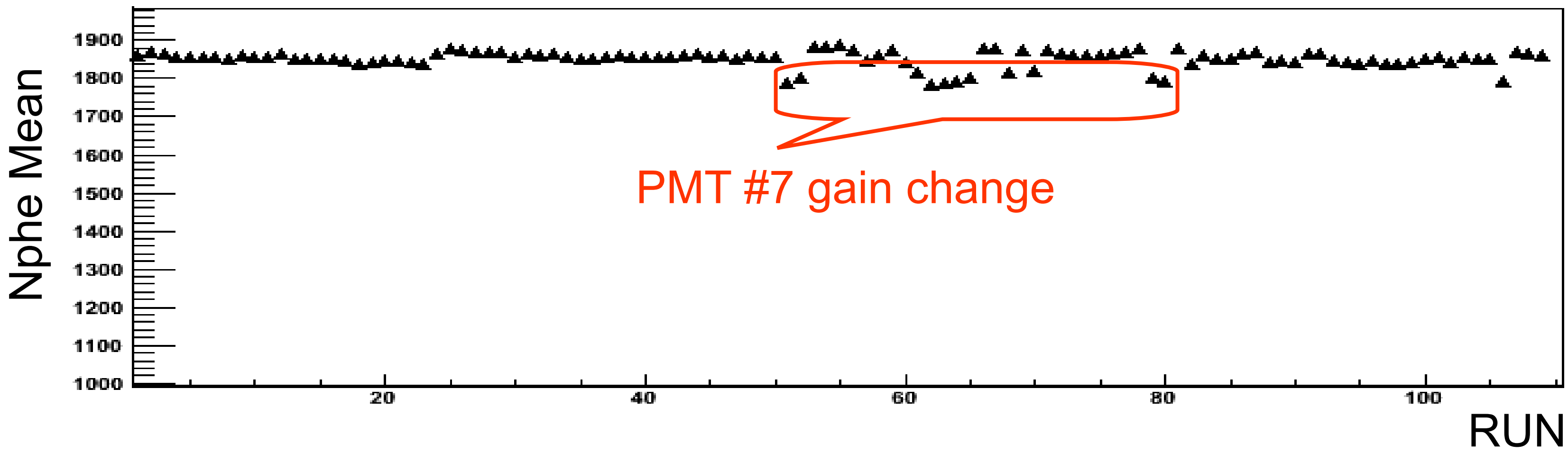
- This A_y experiment (E05-015) was run from April 26th to May 12th
- The Kinematics of this A_y experiment:

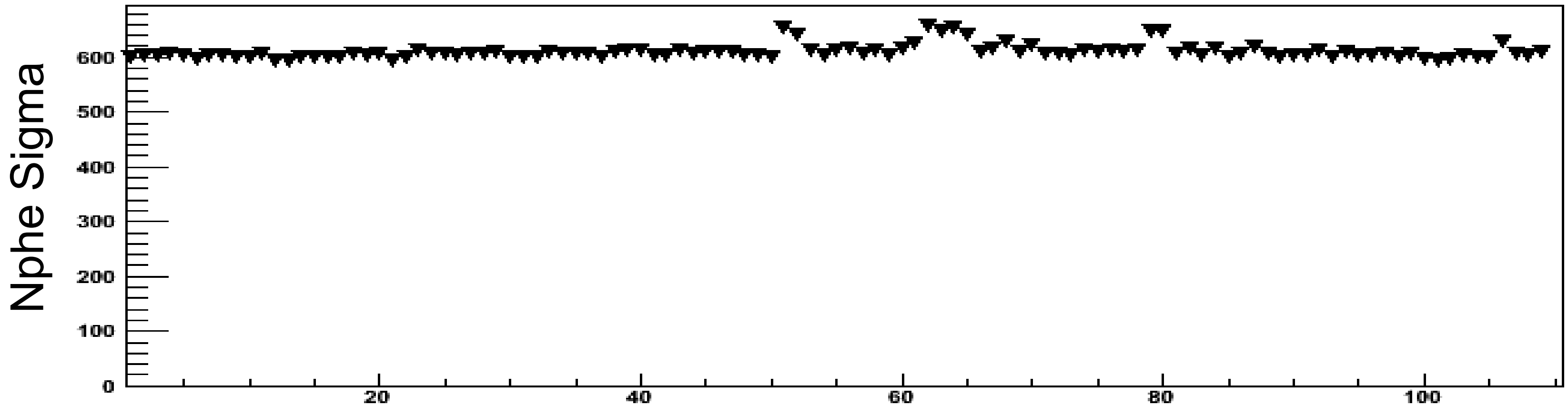
E_0 [GeV]	E' [GeV]	θ_{lab} [Deg]	Q^2 [GeV]^2	$\|q\|$ [GeV]	θ_q [Deg]
1.25	1.22	17	0.13	0.359	71
2.43	2.18	17	0.46	0.681	62
3.61	3.09	17	0.98	0.988	54

Cerenkov Counter Calibration (LHRS)



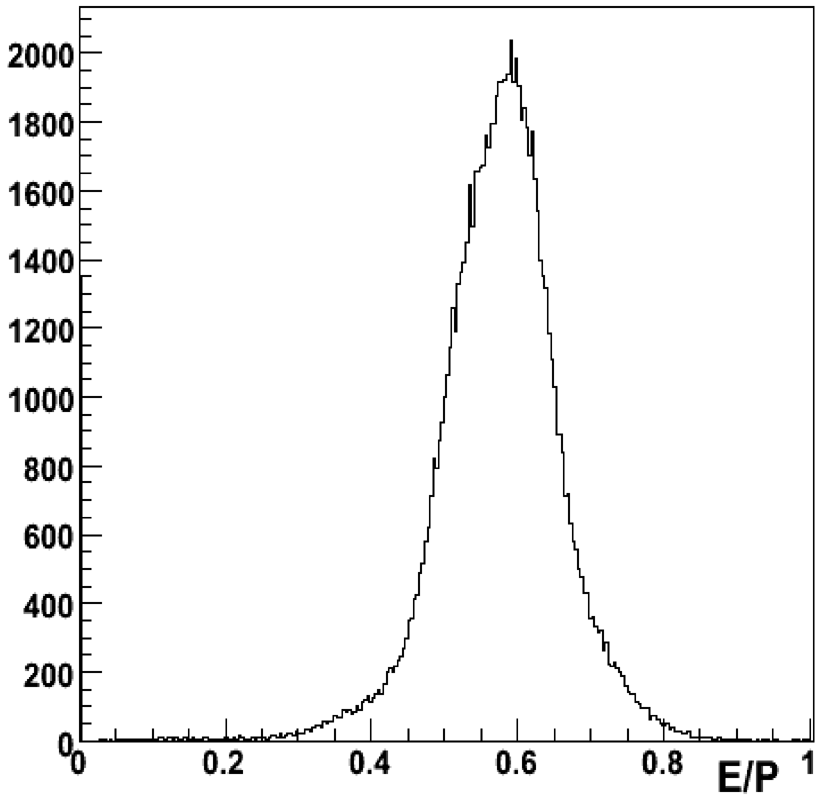
Data quality check (LHRS CC)



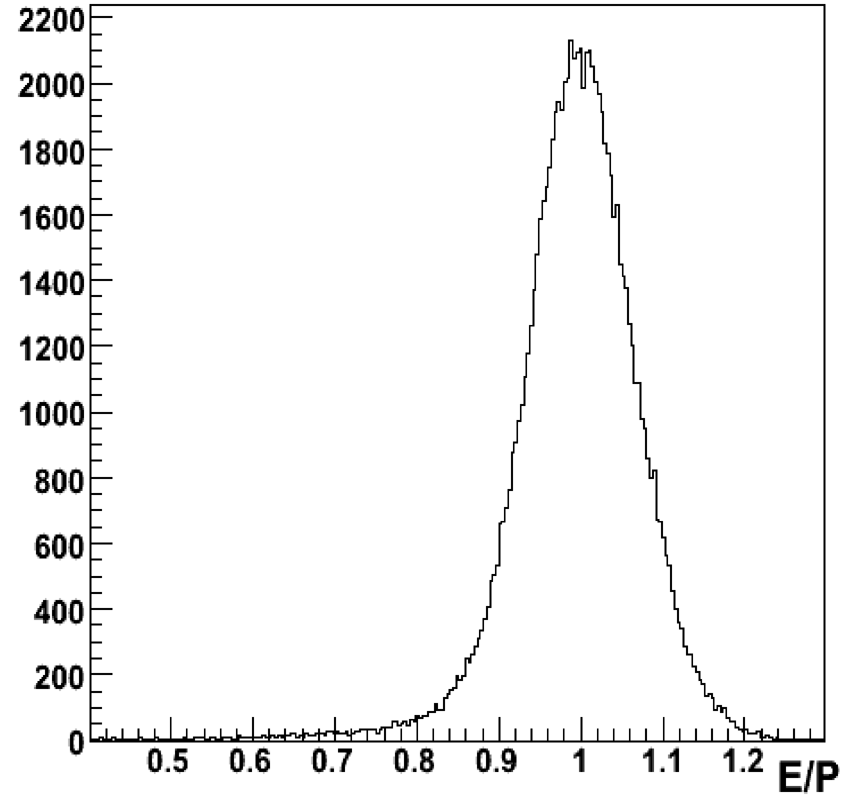


Pion rejecter calibration (LHRS)

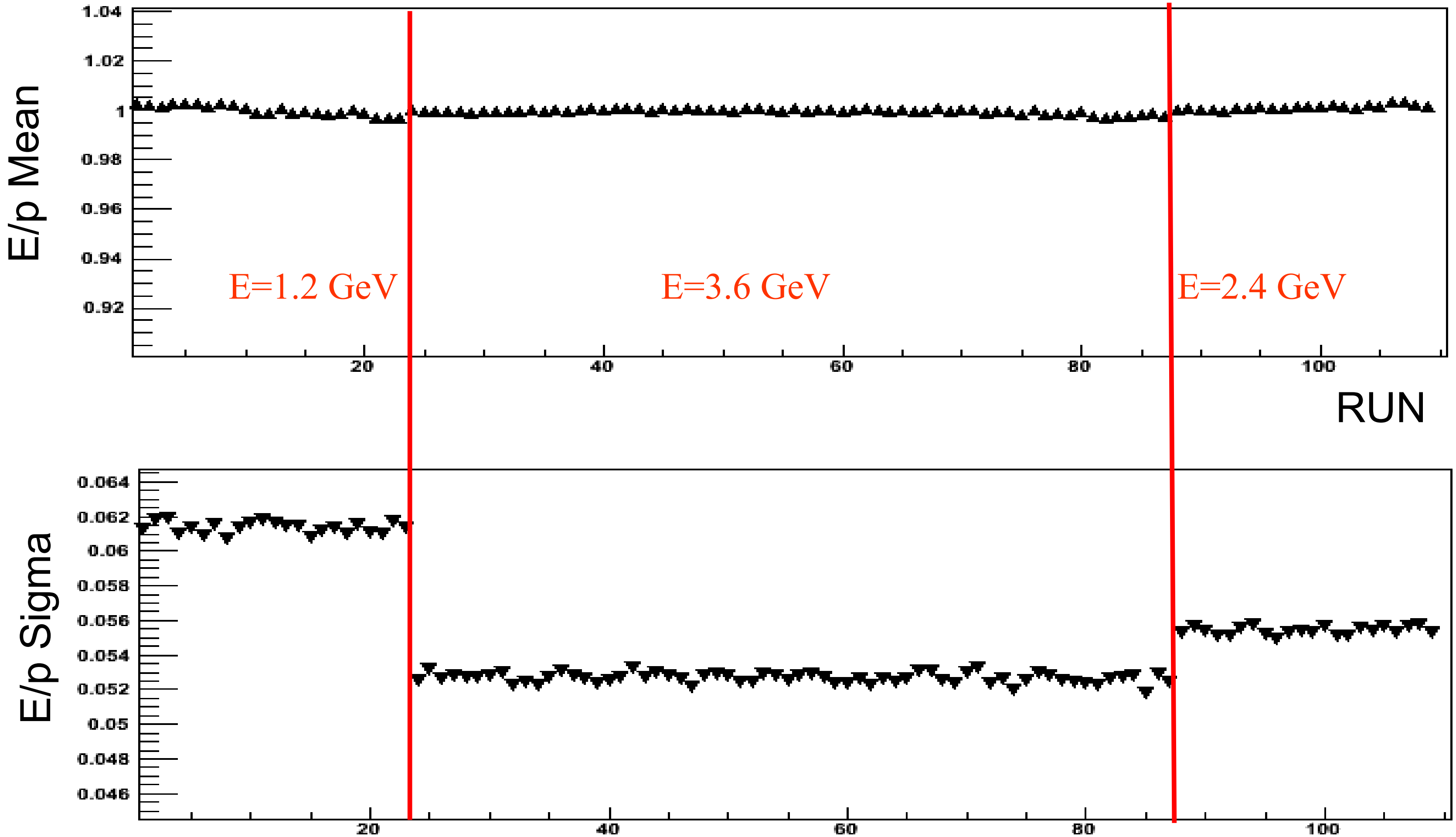
Before calibration



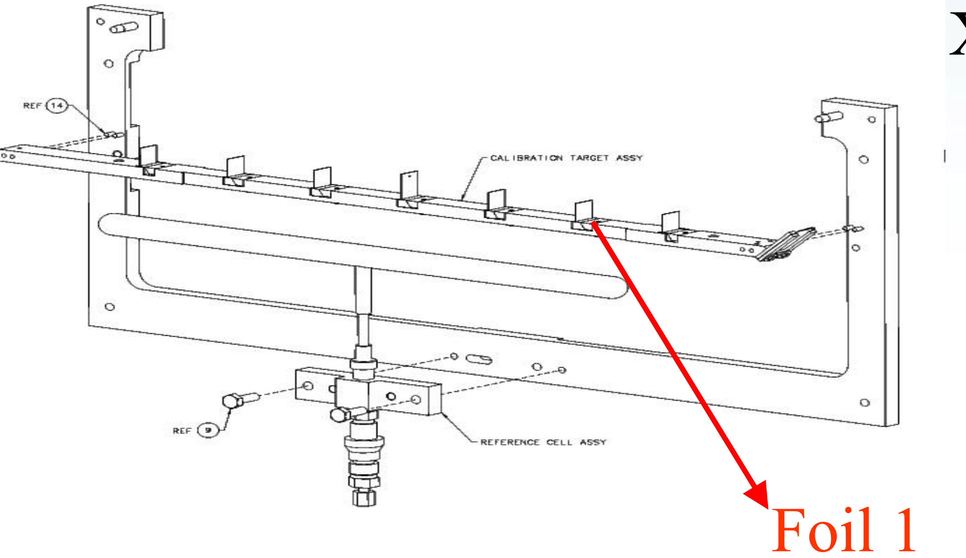
After calibration

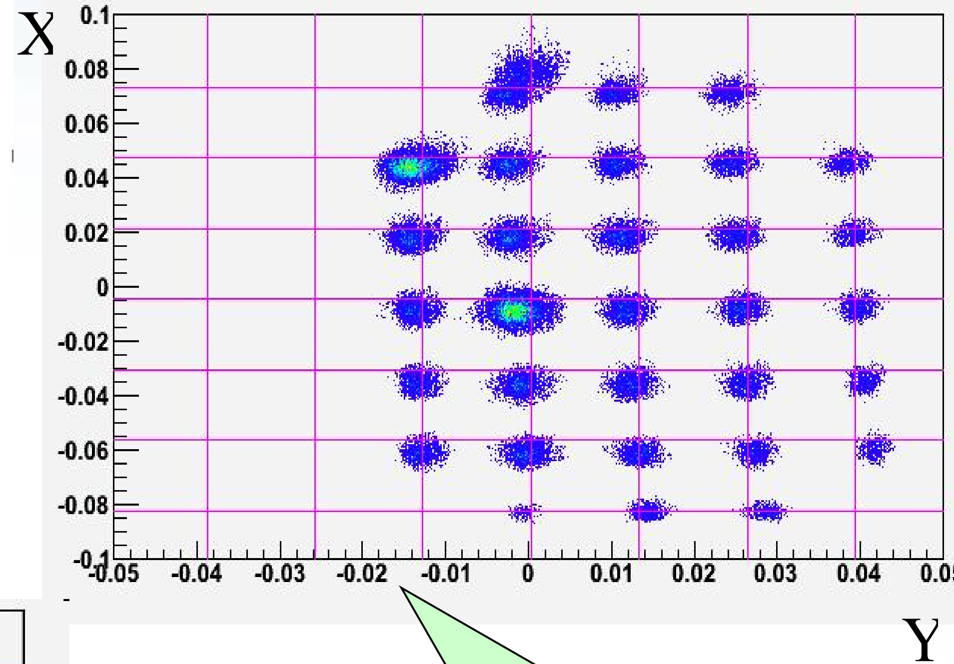


Data quality check (LHRS Pion rejecter)

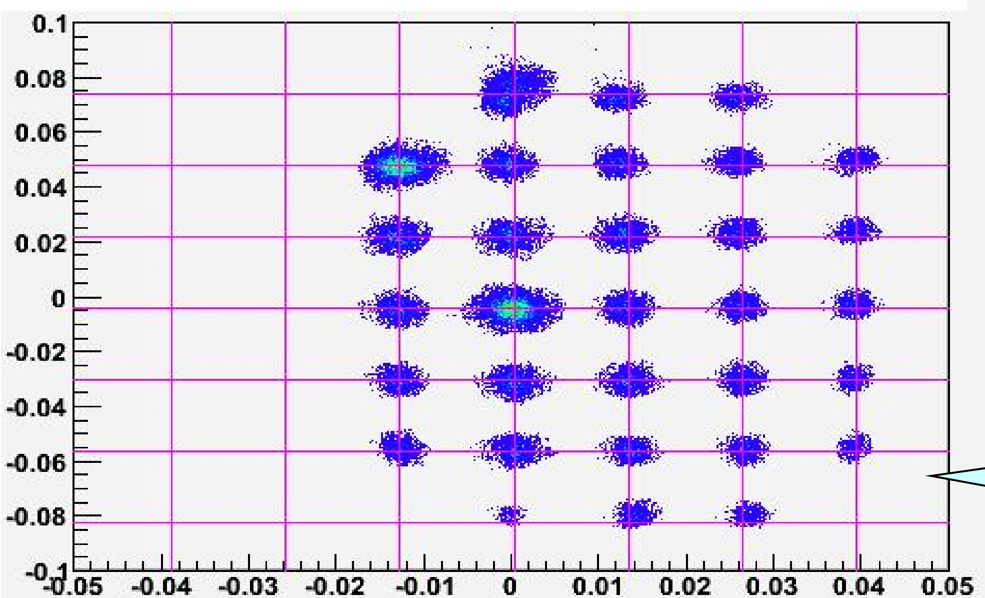


Optics calibration （LHRS）





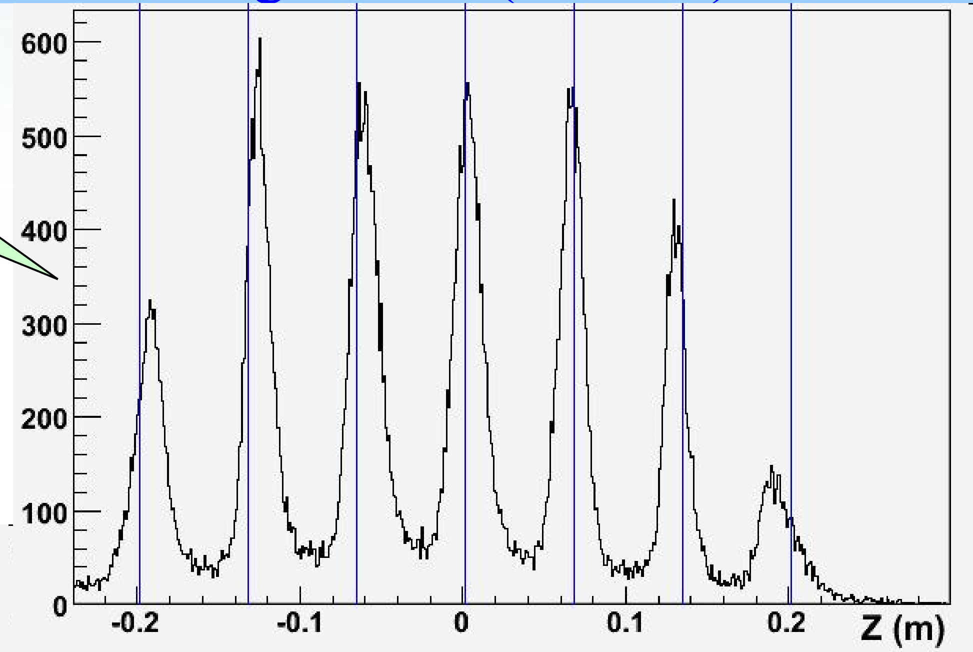
Before calibration

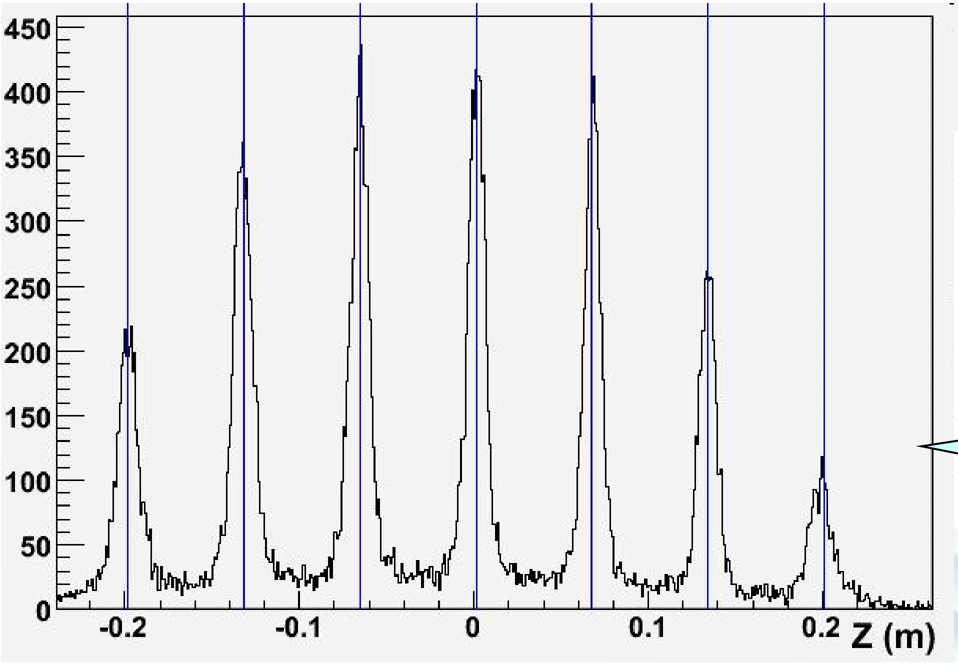


After calibration

Carbon target foils （LHRS）

Before calibration





After calibration

Summary and future plan

- Detectors calibration were completed for LHRS.
- Some data quality checks were done for LHRS production runs.
- More data quality checks (live time, scalars etc.)
- The same procedure for RHRS data

Back up slides

$$\delta\tilde{G}_M = C$$

$$\delta\tilde{G}_E = -\left(\frac{1+\varepsilon}{2\varepsilon}\right)(A-C) + \sqrt{\frac{1+\varepsilon}{2\varepsilon}}B$$

$$\tilde{F}_3 = \frac{M^2}{\nu}\left(\frac{1+\varepsilon}{2\varepsilon}\right)(A-C)$$

$$A = \int_{-1}^{1}\frac{dx}{x}K\sum_q e_q^2\left(H^q(x,0,t) + E^q(x,0,t)\right)$$

$$B = \int_{-1}^{1}\frac{dx}{x}K\sum_q e_q^2\left(H^q(x,0,t) - \tau E^q(x,0,t)\right)$$

$$C = \int_{-1}^{1}\frac{dx}{x}K'\sum_q e_q^2\tilde{H}^q(x,0,t)$$

Normal analyzing power - proton