E05-015 experiment (Ay) and the data quality

(For E05-015 collaboration)

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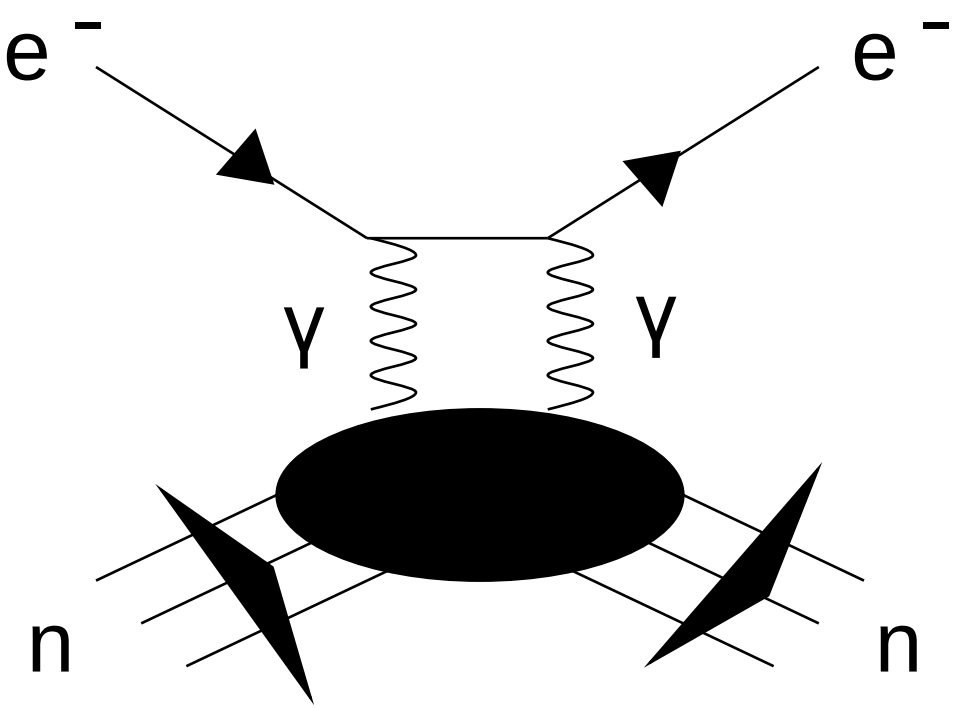
June 11th , 2009, JLab Hall A collaboration meeting

Physics motivation

- The study of nuclear structure relies on knowledge of form factors, previously measured using the Born Approximation (B.A.). This assumes one photon exchange, with multiple photon exchange neglected.

Physics motivation

- As new precision data becomes available, the contribution of two-photon exchange can no longer be ignored.



Physics motivation

- In one-photon exchange approximation, Ay is identically zero due to time-reversal invariance

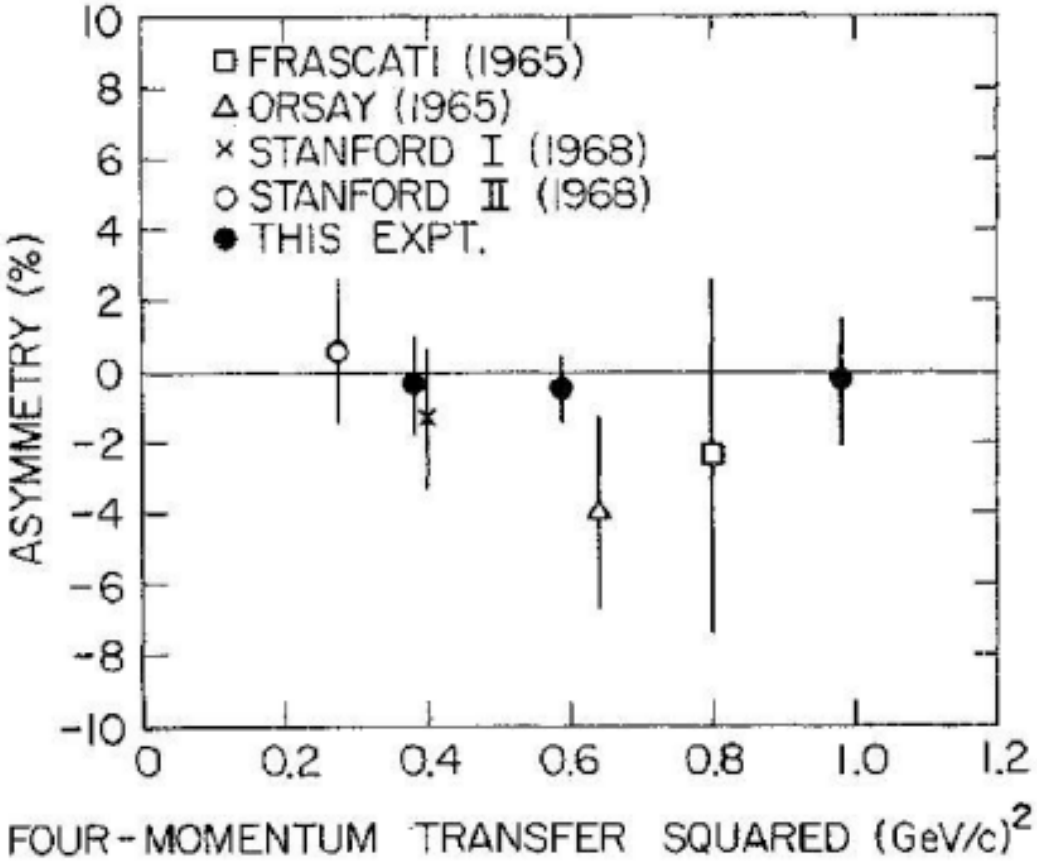
- Two-photon exchange amplitude enters non-zero Ay through the interference between the one- and two-photon amplitudes

The goals of E05-015

- Make a precise no-zero measurement of Ay
- Provide quantitative information about the imaginary part of the two-photon exchange process
- Provide a new experimental constraint on GPD models

Yield important information about the structure of nucleon and the physics of the two-photon exchange process

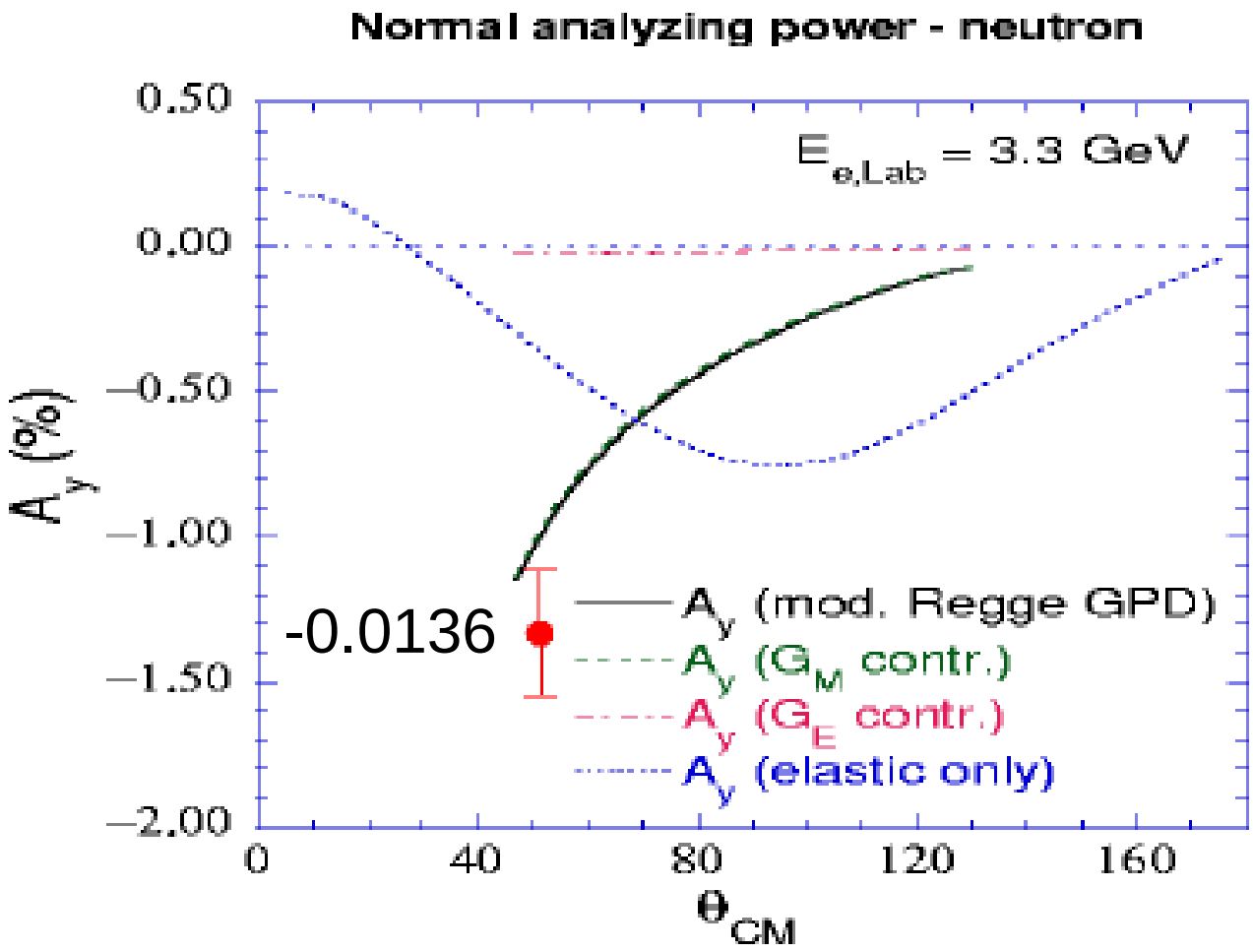
A non-vanishing A_y has never been observed



- The last effort was made at Stanford in 1969, black dots. Set an upper limit: A_y<1% on proton.
- In Hall A, on a polarized neutron (^{3}He) target, our sensitivity allow us to determine A_y to 0.1% at several Q^2 points.

SLAC, T. Powell *et al*., PRL 24, 753(1970)

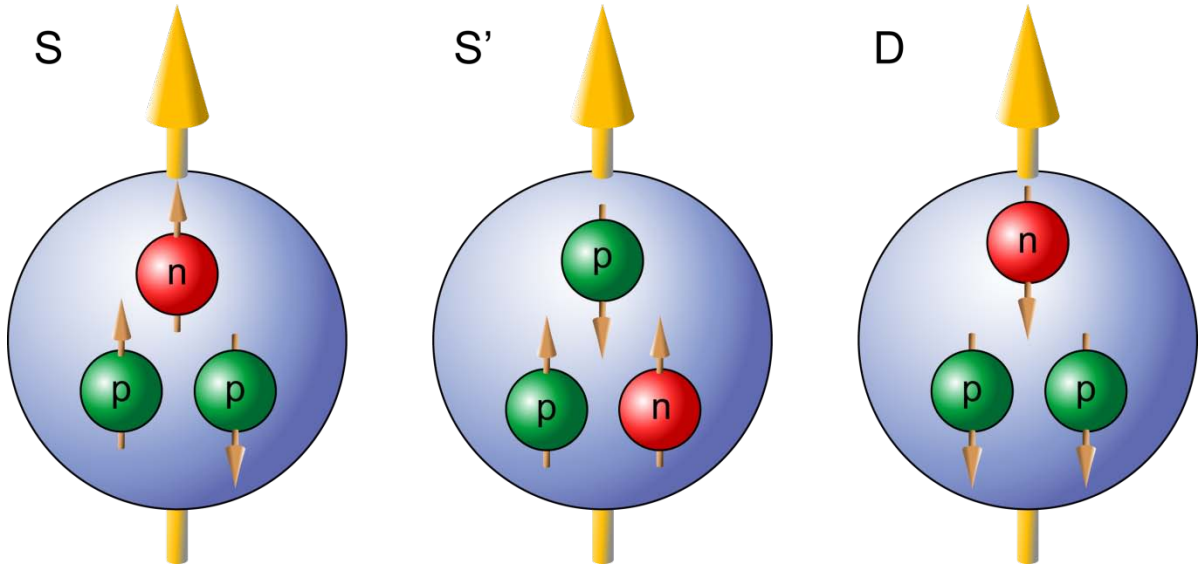
Expected results for Ay



$Q^2=1(GeV/c)^2$

A_y: Target SSA in Inclusive (e,e')

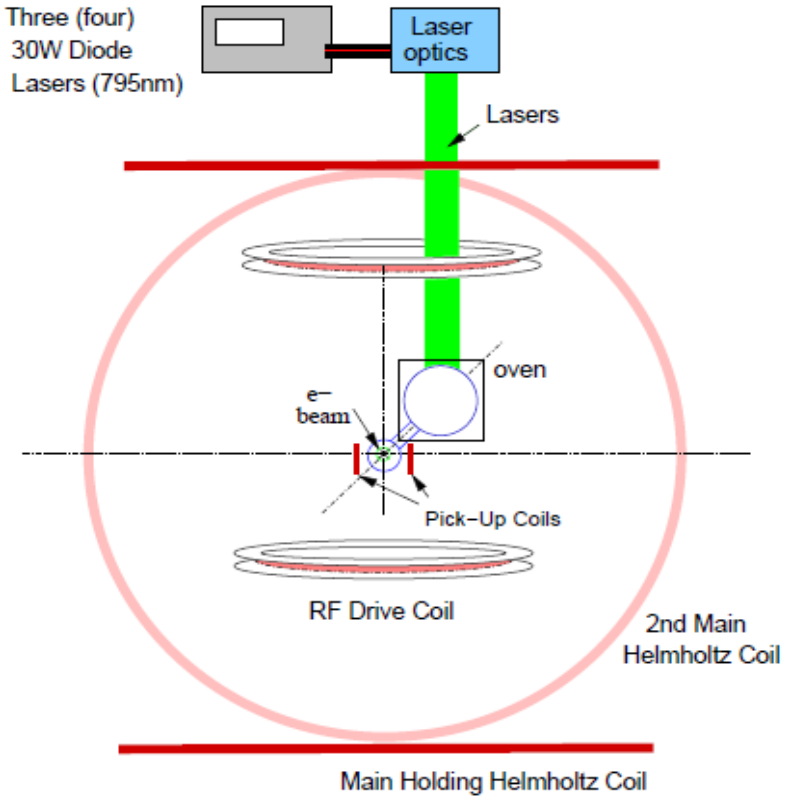
- Unpolarized electron beam, polarized target.



S 90% of averaged wave function, " neutron target"
S' 1.5% mixed symmetry
D 8.5% generated by tensor force of N-N force

A_y: Target SSA in Inclusive (e,e')

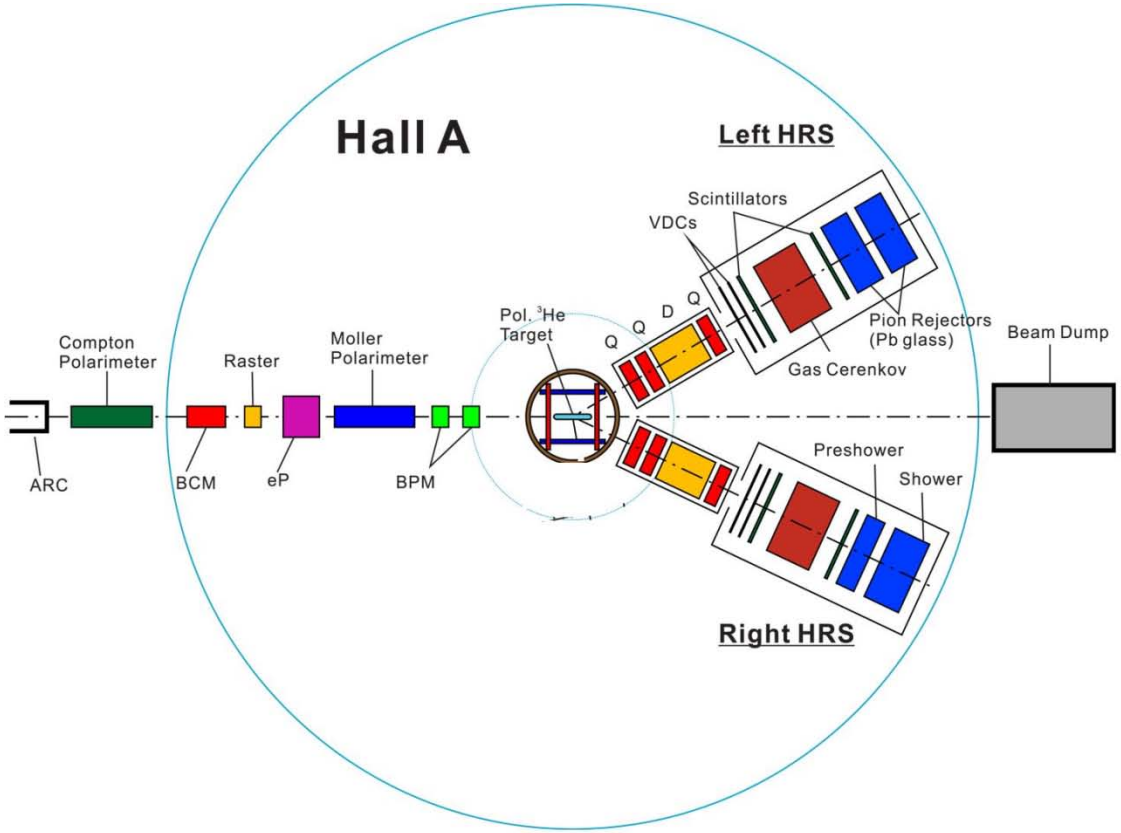
- Unpolarized electron beam, polarized target.



Vertical polarized target, polarization in Ay ~60%

Two identical measurements at the same time

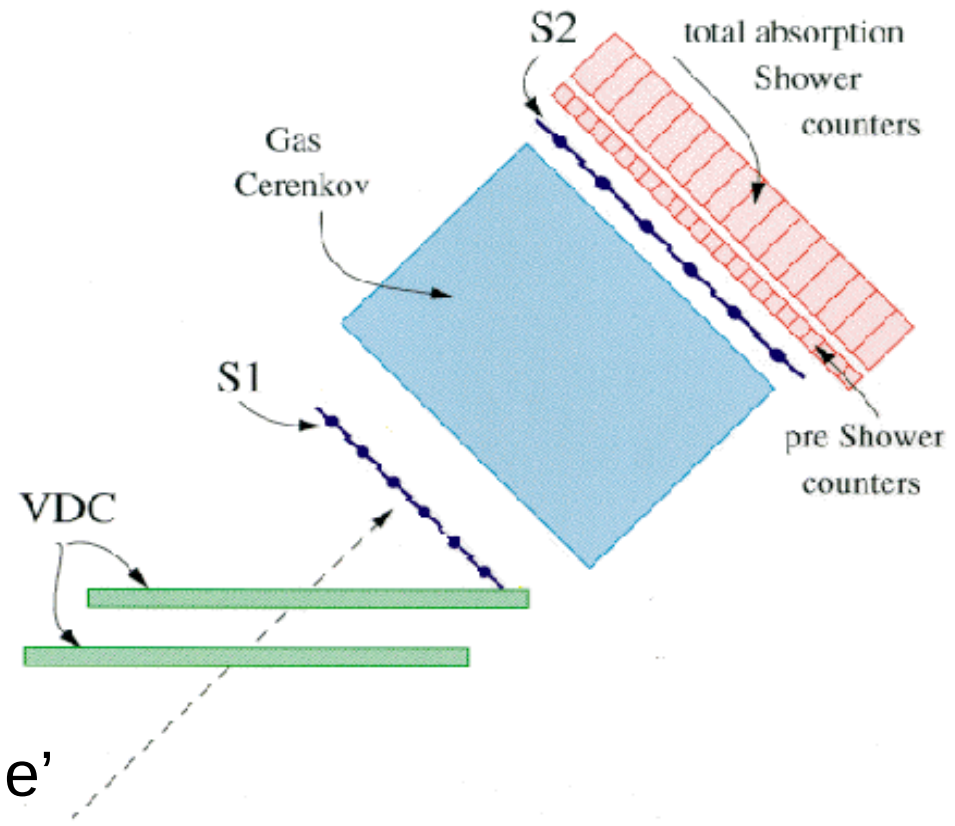
- Identical spectrometers and detectors



Both arms were fixed at 17°

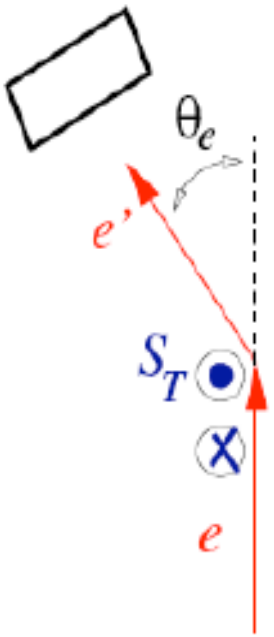
Two identical measurements at the same time

- Identical spectrometers and detectors

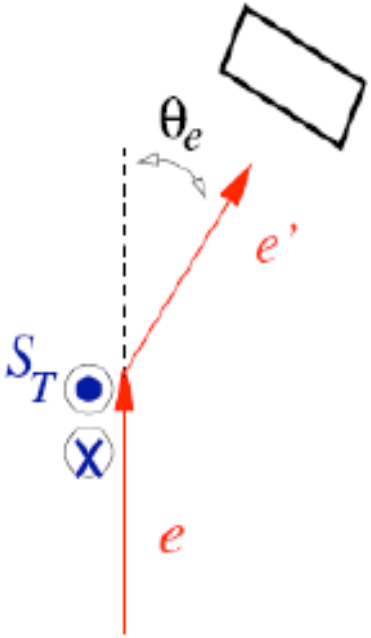


Two identical measurements at the same time

- Independent DAQs, start/stop at the same time. Same beam charge, same luminosity.
- Scalars cross-read between two DAQs as a redundancy.

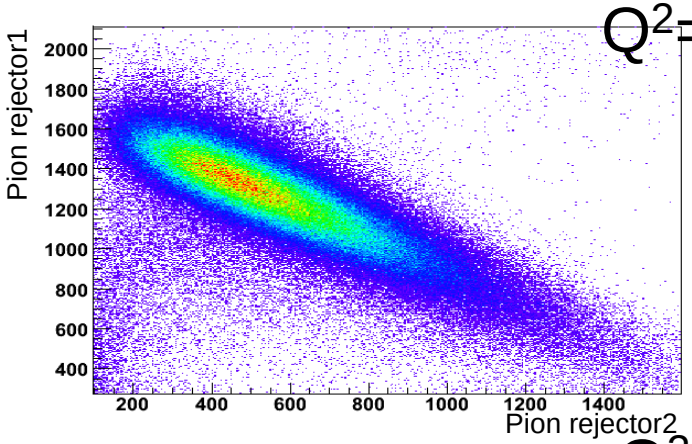


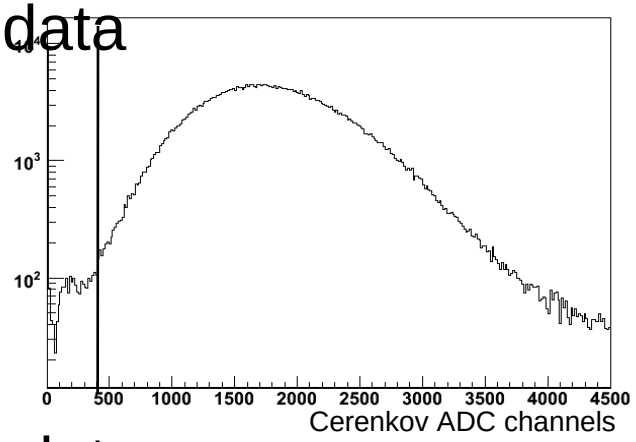
$$A_y = \frac{N_\uparrow - N_\downarrow \cdot \frac{\mathcal{L}_\uparrow}{\mathcal{L}_\downarrow}}{N_\uparrow + N_\downarrow \cdot \frac{\mathcal{L}_\uparrow}{\mathcal{L}_\downarrow}}$$



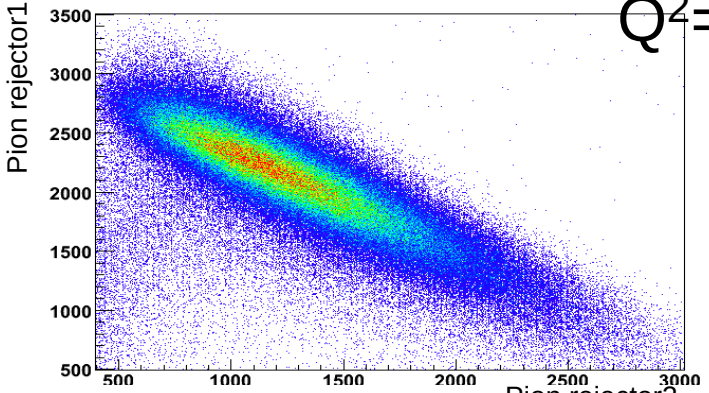
Data quality

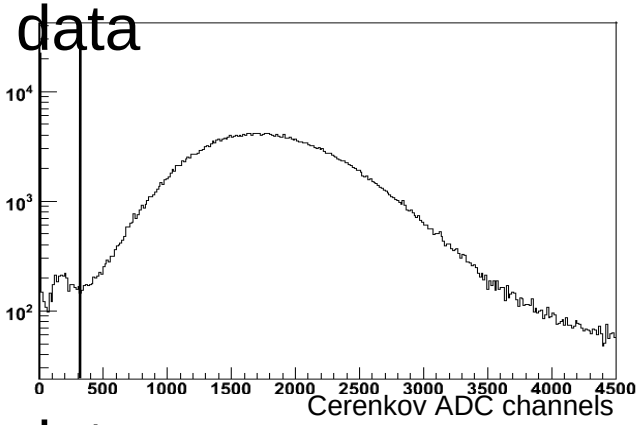
Q^2=0.13 data



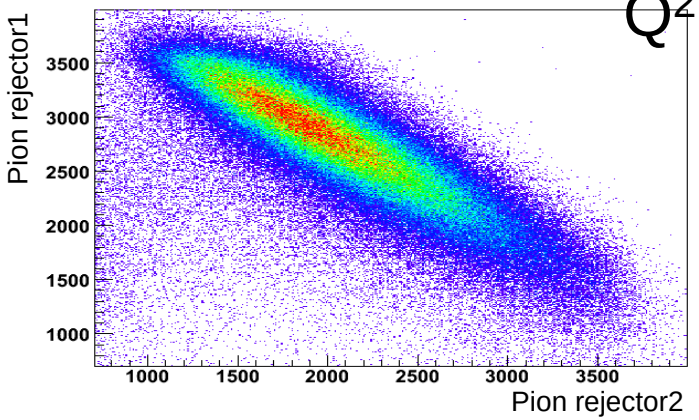


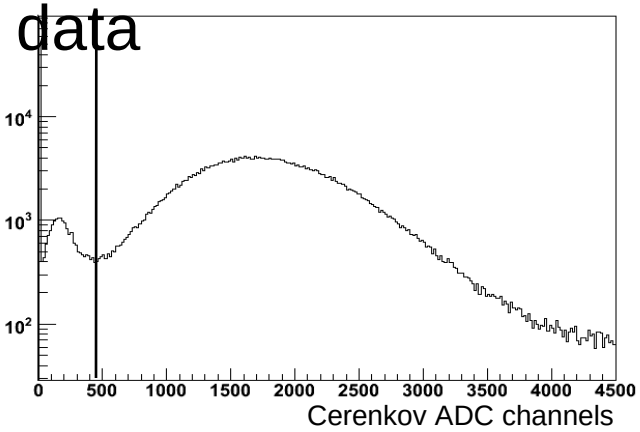
Q^2=0.46 data





Q^2=0.97 data





Kinematics and number of useful events

E_0	E’	Q^2 (GeV/c)2	Left Arm	Right Arm	Total
1.247	1.176	0.13	110 M	108 M	218 M
2.427	2.181	0.46	100 M	108 M	208 M
3.608	3.086	0.97	90 M	83 M	173 M

Future Work

- Calibration
  - Optics
  - Acceptance
- Analyze target polarization
- Radioactive corrections
- Dilution factor
- Calculate Asymmetry

Thanks for your attention!