Radial TPC with curved GEMs for the detection of low energy alphas

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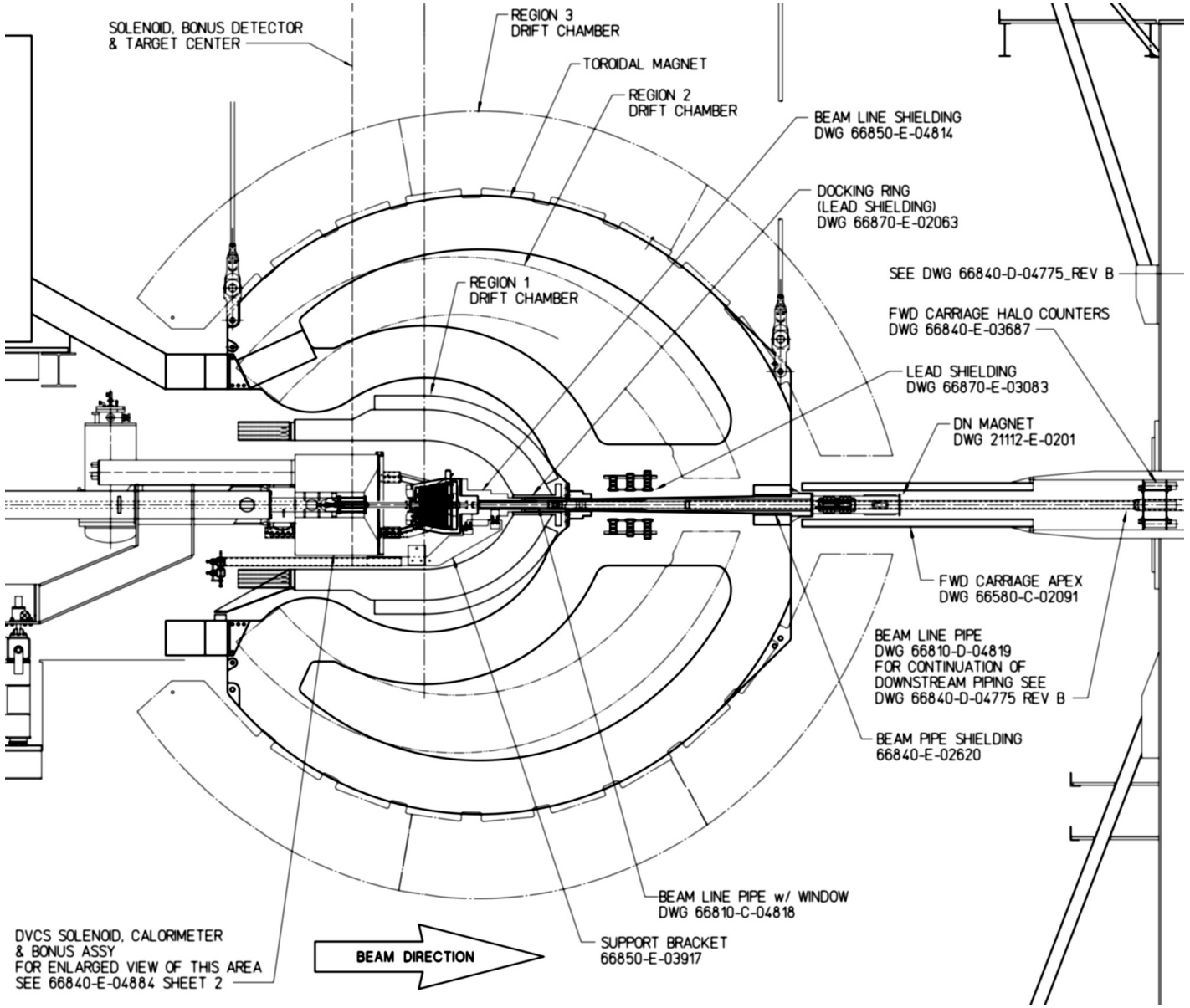
Physics Goals

- Two experiments running in parallel
  - Hadron spectroscopy (S. Stepanyan et al.)
  - DVCS on Helium 4 (K. Hafidi et al.)
    - Coherent and incoherent channels separately
- Need of a detector for low energy alphas
  - Energies of few MeVs
  - Need to run DAQ at high rate (2 KHz planned)

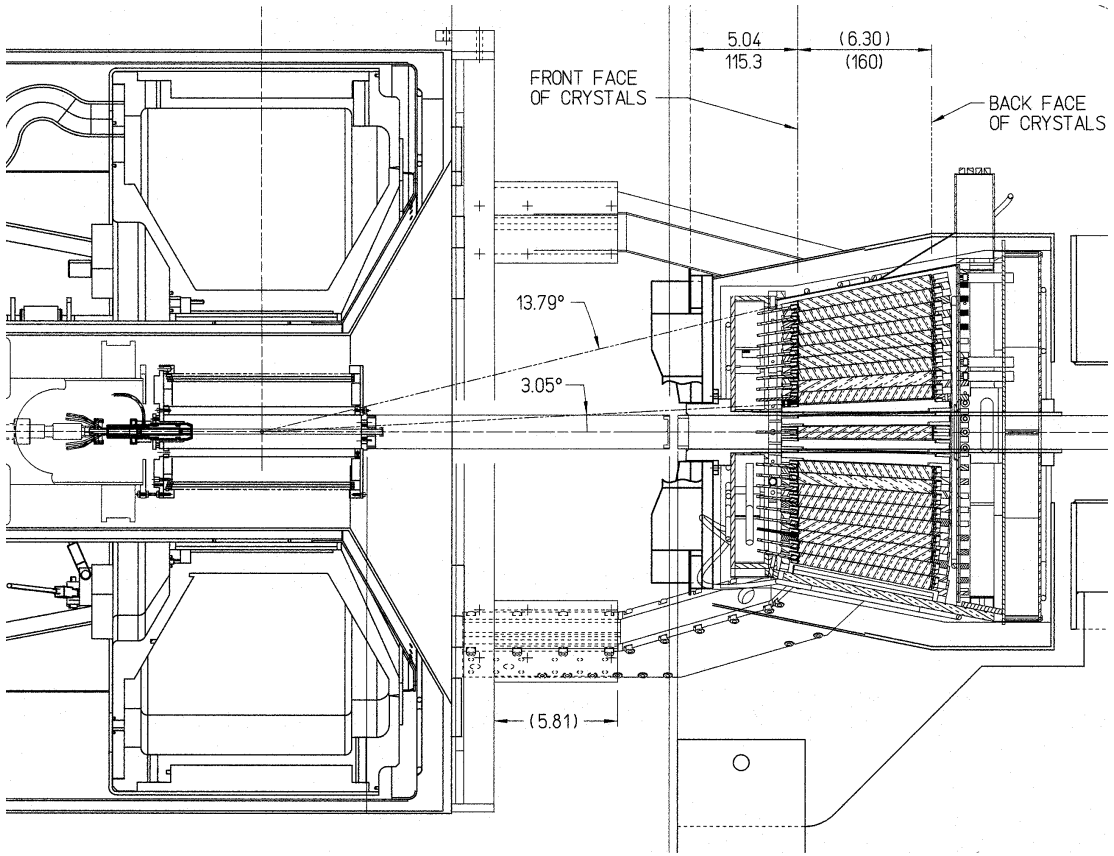
  → Solution: a Radial TPC similar to BoNuS

JLab - Hall B


SOLENOID, BONUS DETECTOR
& TARGET CENTER
REGION 3
DRIFT CHAMBER
TOROIDAL MAGNET
REGION 2
DRIFT CHAMBER
BEAM LINE SHIELDING
DWG 66850-E-04814
DOCKING RING
(LEAD SHIELDING)
DWG 66870-E-02063
REGION 1
DRIFT CHAMBER
SEE DWG 66840-D-04775_REV B
FWD CARRIAGE HALO COUNTERS
DWG 66840-E-03687
LEAD SHIELDING
DWG 66870-E-03083
DN MAGNET
DWG 21112-E-0201
FWD CARRIAGE APEX
DWG 66580-C-02091
BEAM LINE PIPE
DWG 66810-D-04819
FOR CONTINUATION OF
DOWNSTREAM PIPING SEE
DWG 66840-D-04775 REV B
BEAM PIPE SHIELDING
66840-E-02620
BEAM LINE PIPE w/ WINDOW
DWG 66810-C-04818
SUPPORT BRACKET
66850-E-03917
DVCS SOLENOID, CALORIMETER
& BONUS ASSY
FOR ENLARGED VIEW OF THIS AREA
SEE 66840-E-04884 SHEET 2
BEAM DIRECTION

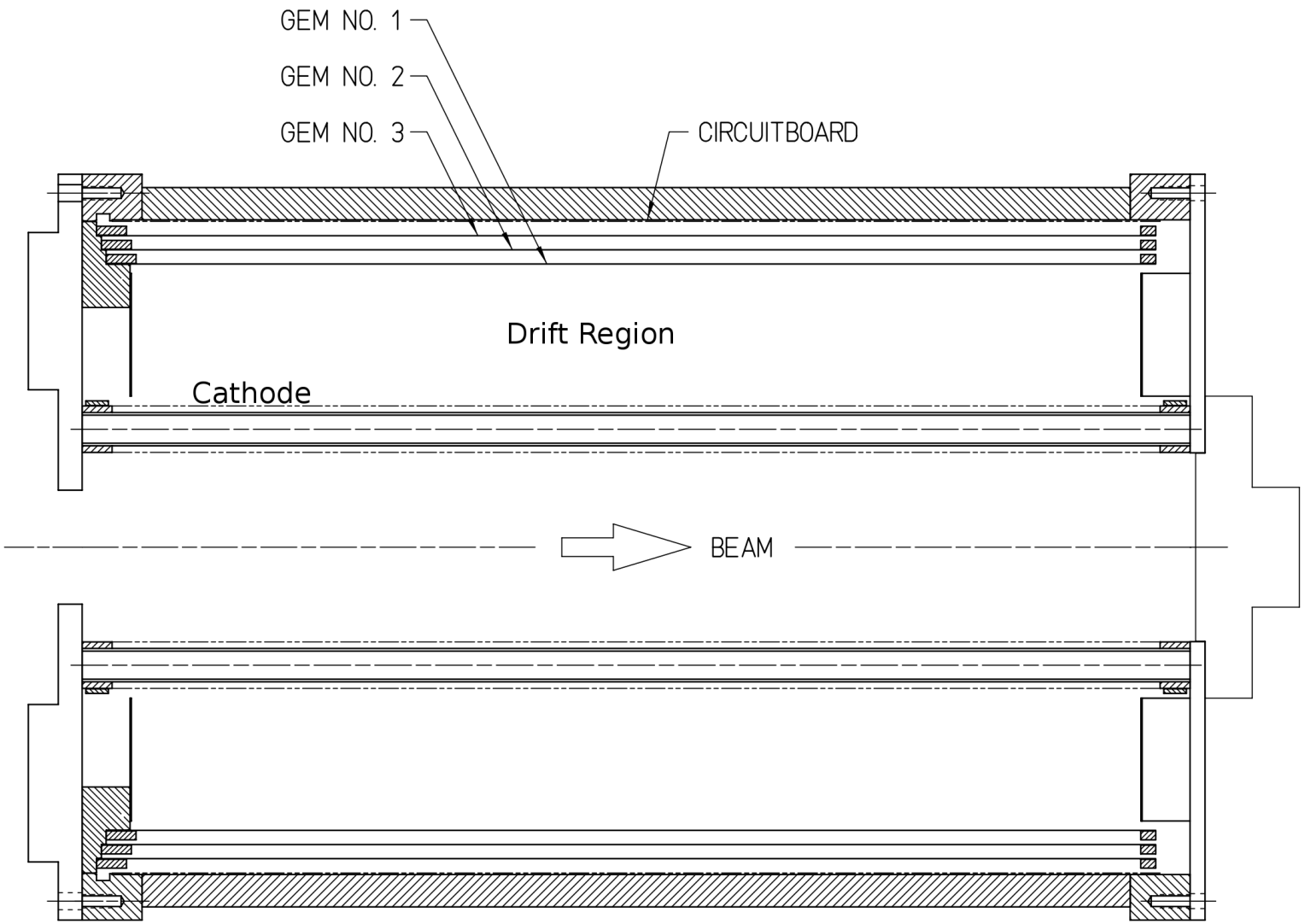
Apparatus

- Usual CLAS Detectors
- DVCS Solenoid
  - Protect the detectors from Möller electrons
- Radial Time Projection Chamber (RTPC)
  - Detect Helium 4 nuclei
- Inner Calorimeter (IC)
  - Detect photons at low angle
- Hodoscope
  - To differentiate electrons from photons in the IC



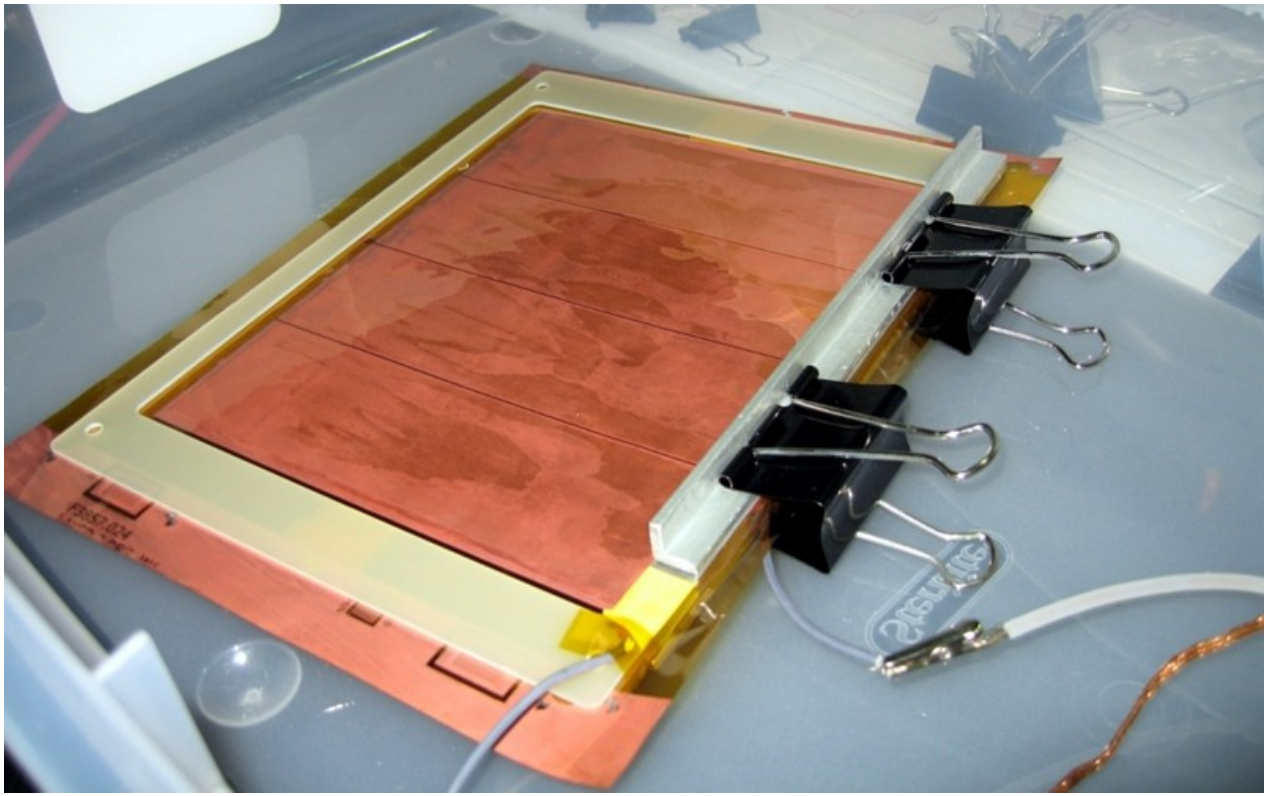
EG6 RTPC

Inspired by the BoNuS detector



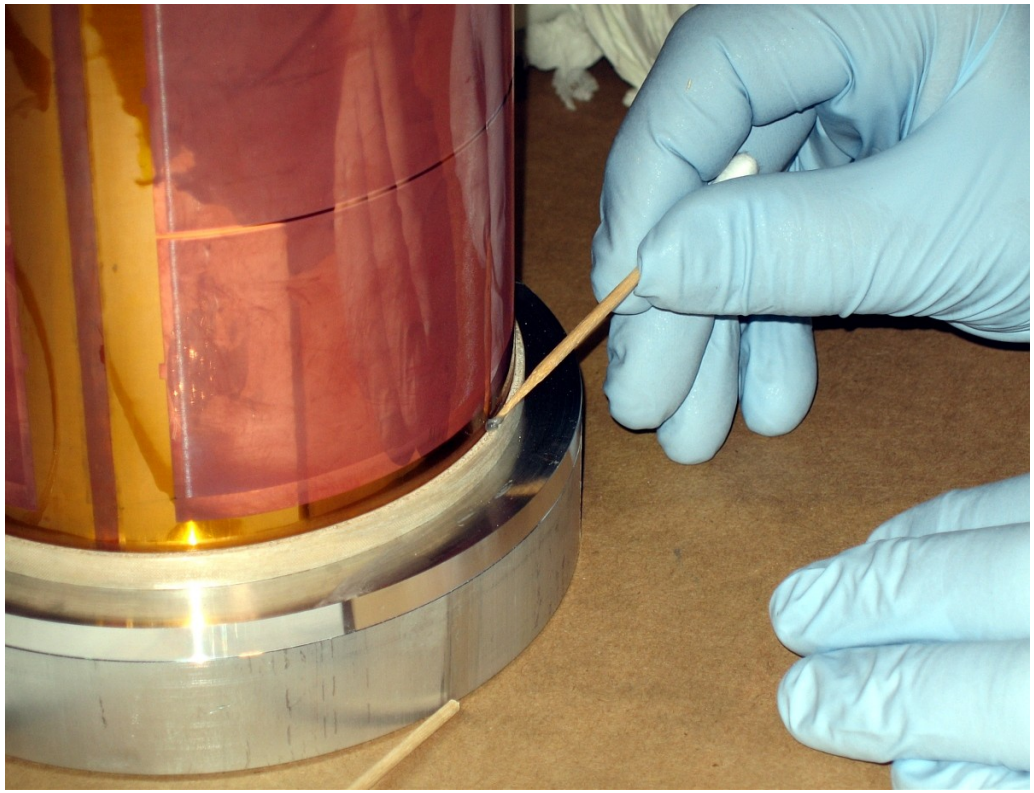
Construction of the RTPC (1)

- GEM tests and assembly

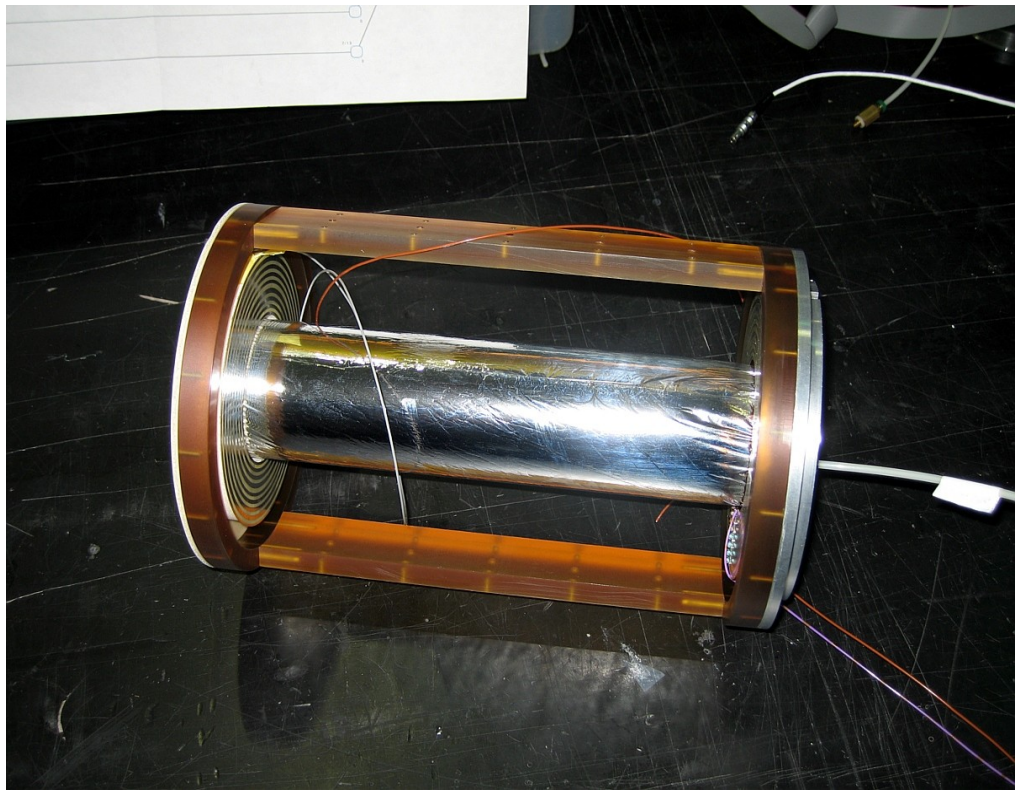


Construction of the RTPC (2)

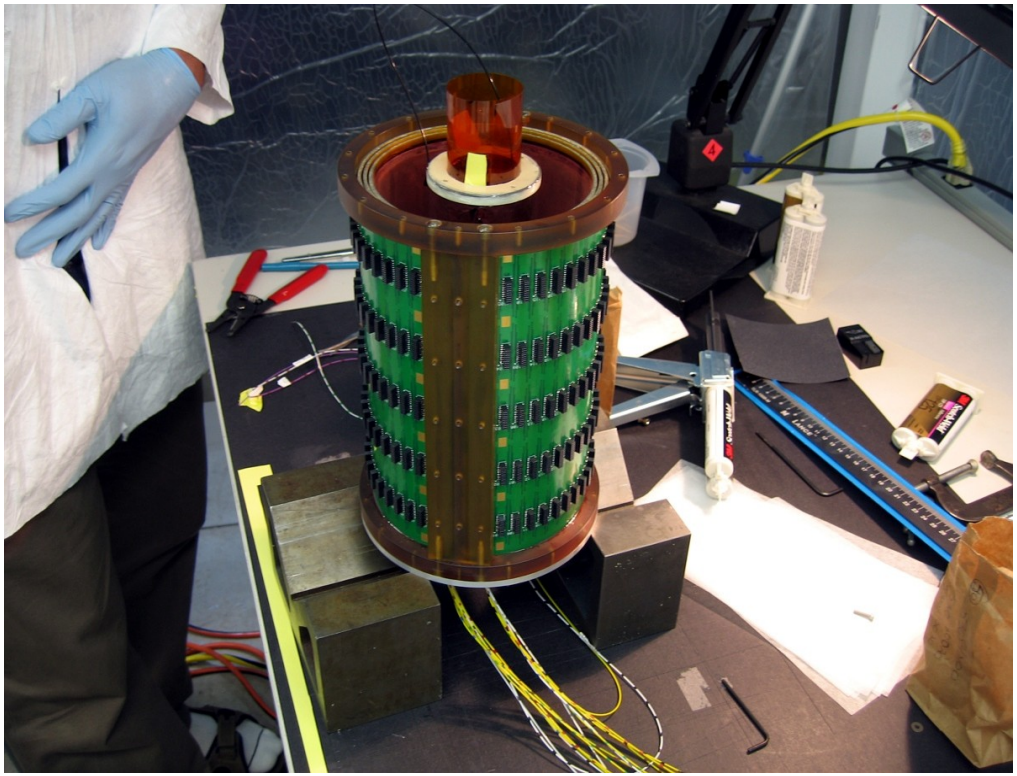
GEM structure

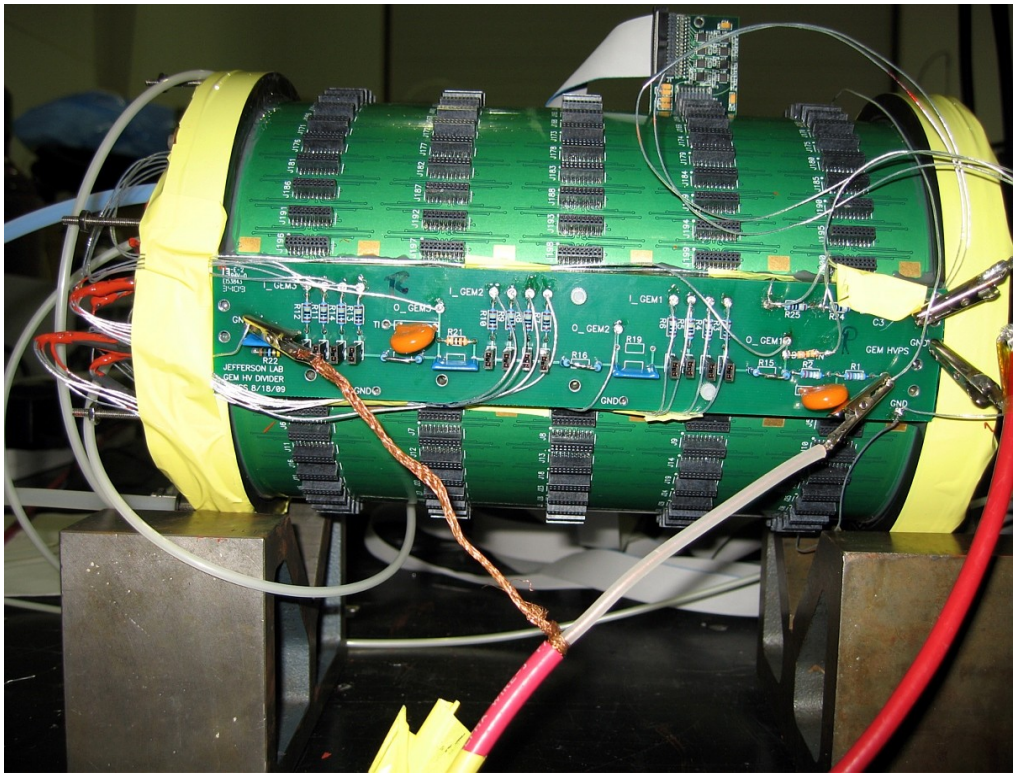


Detector structures with cathode and field cages



Construction of the RTPC (3)



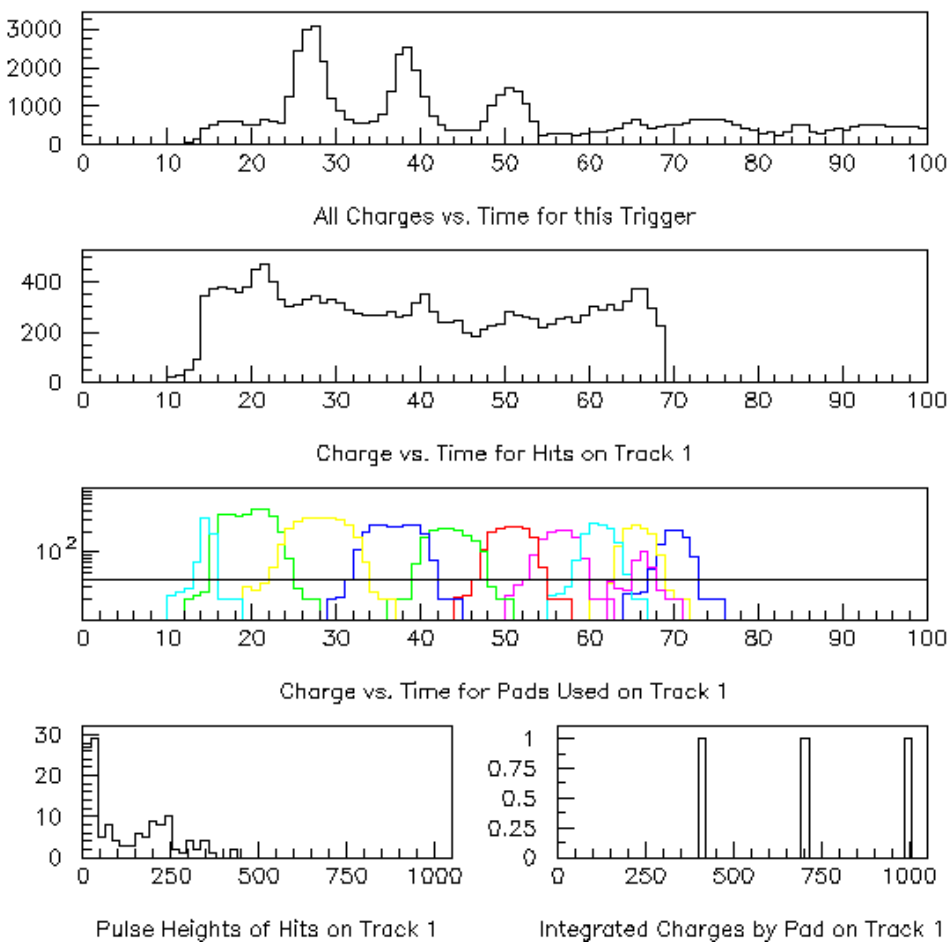


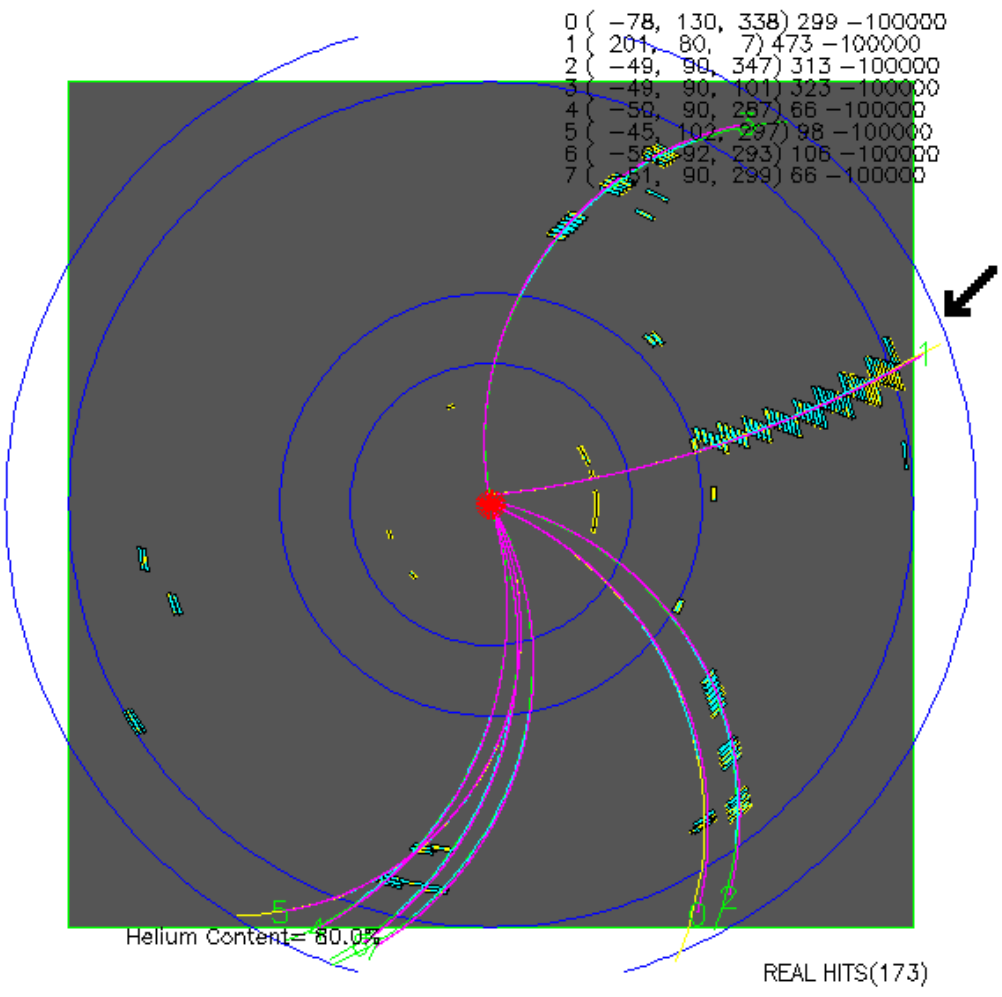
Readout and HV connections

Running the Experiments

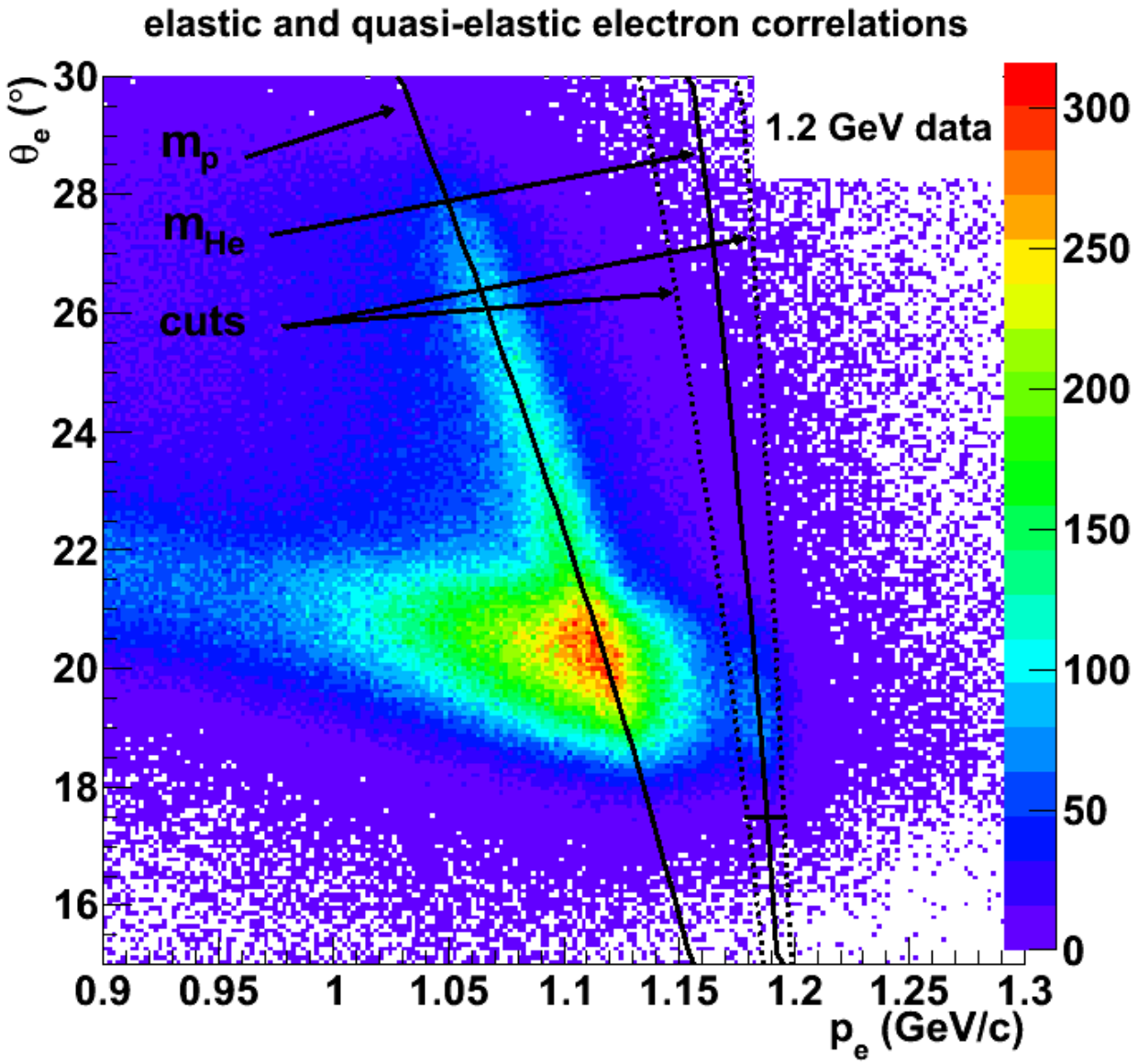
- Tracks easily reconstructed using MAGBOLTZ to estimate the drift paths
- Electronic was very noisy (not a problem for the physics)
- But data taking at 3 kHz (beyond our goal)
- Usual production with 6 GeV beam
- Runs at 1.2 GeV for calibration using elastic scattering

Exemple of a track

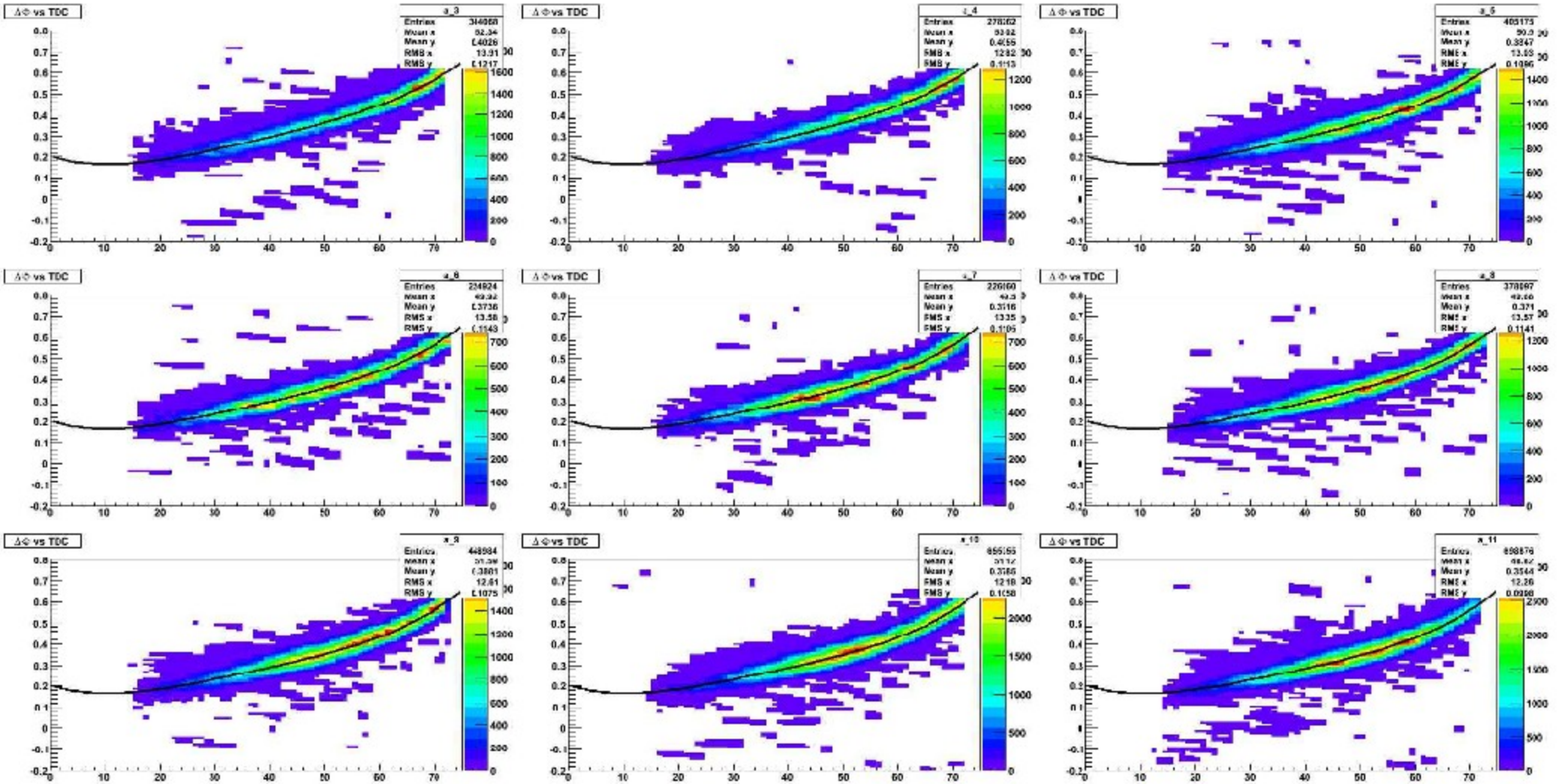




Elastic Scattering on ^{4}He at 1.2 GeV

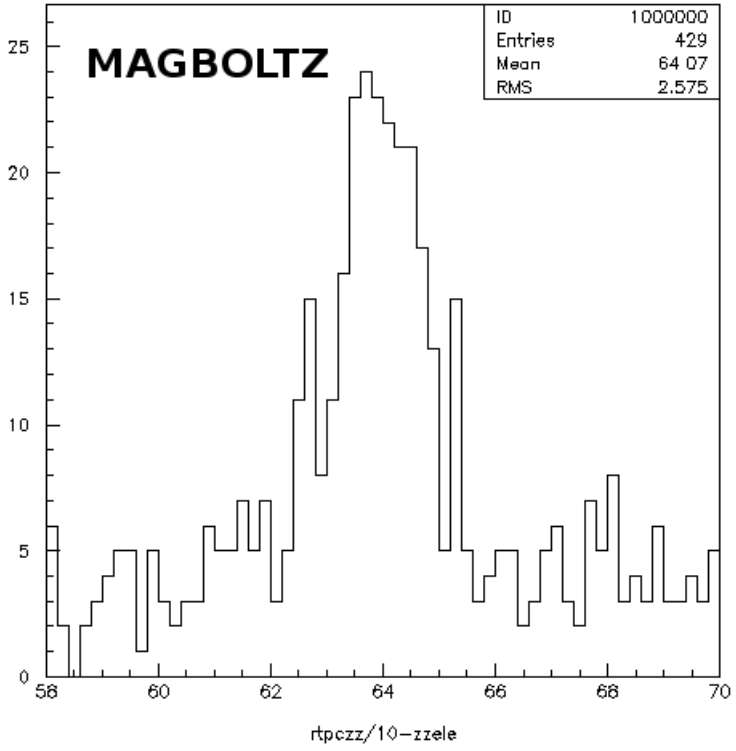


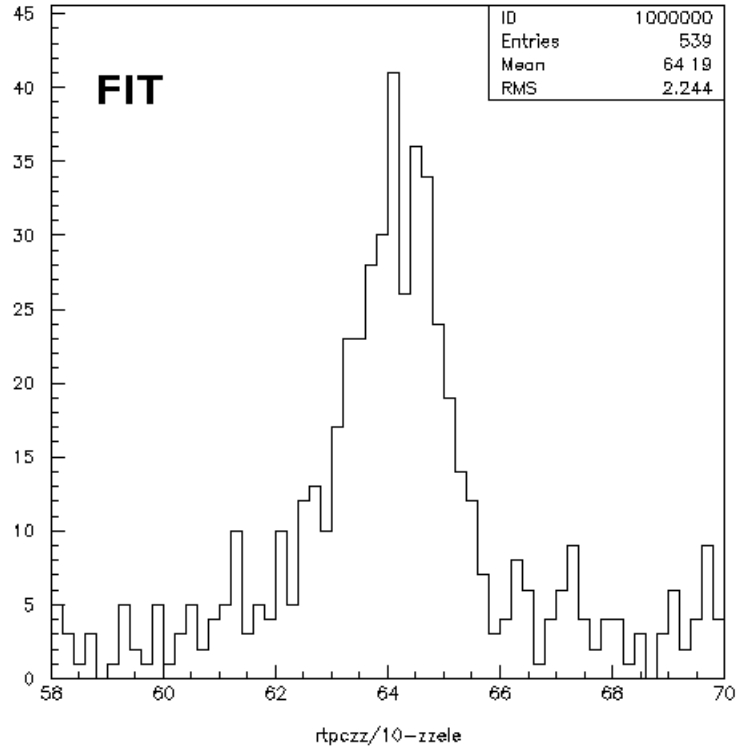
Fit of the Drift Paths



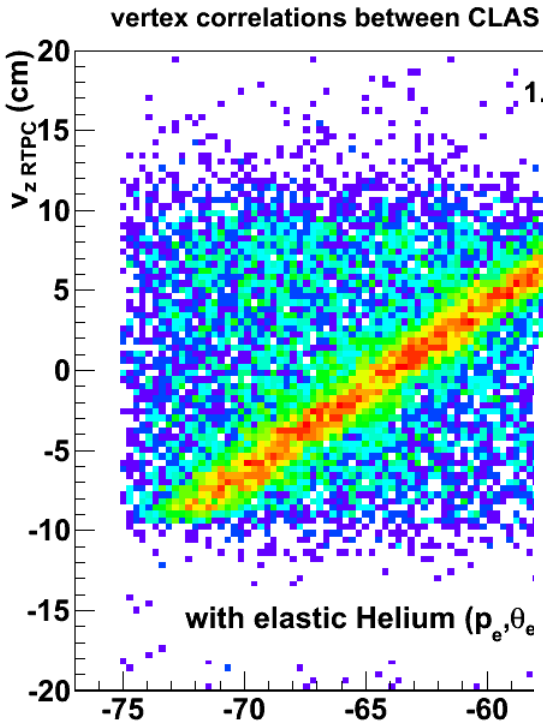
Results for Drift Paths Fit

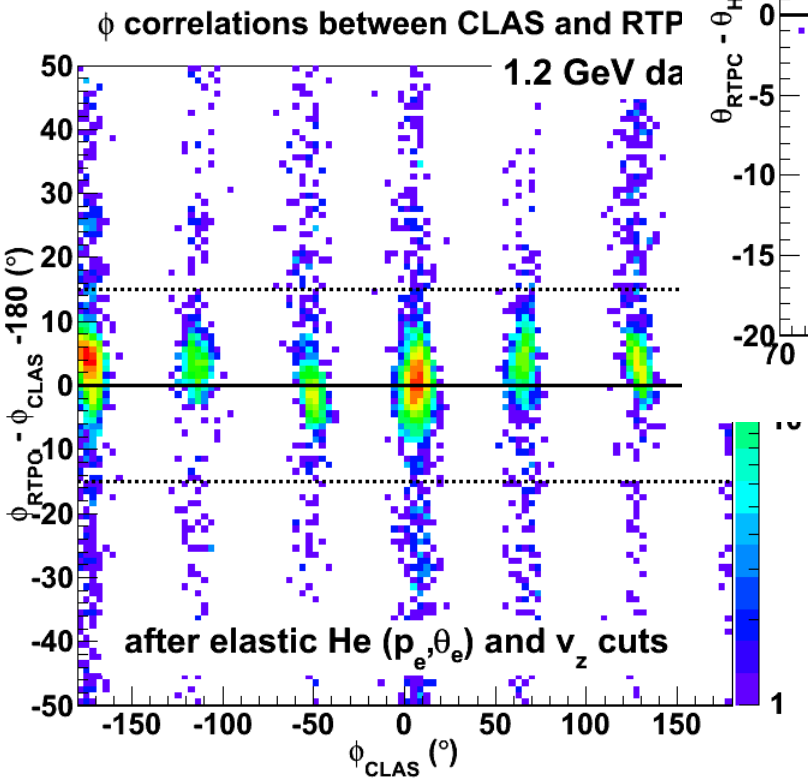
- Compared to parameters computed with MAGBOLTZ
  - less background
  - gain of 30% in number of tracks

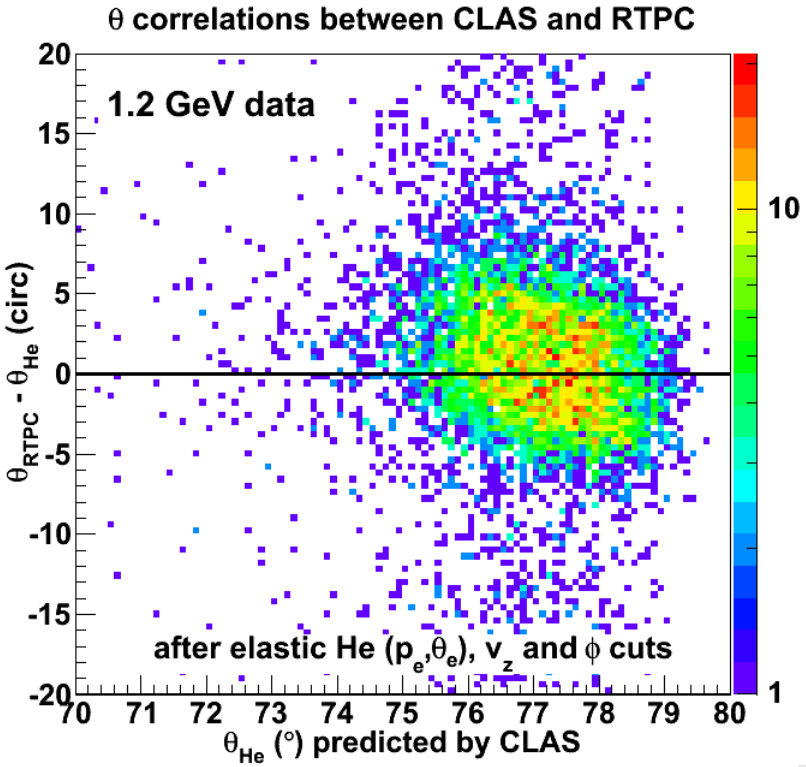




Correlation between CLAS and RTPC







Summary

- Radial TPC using GEMs worked successfully
  - Parallelism was much improved compared to BoNuS
  - Acceptance was also improved using self supported structure
- Method for drift paths calibration was developed
- Issues with electronics lead to noisy data
  - Treated off line
- More iterations needed to finalize calibration
- Physics results to come!