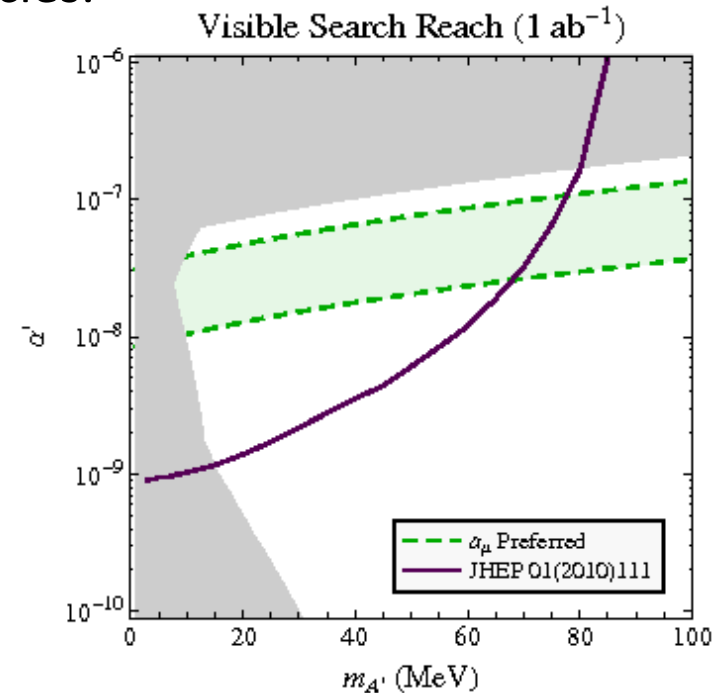
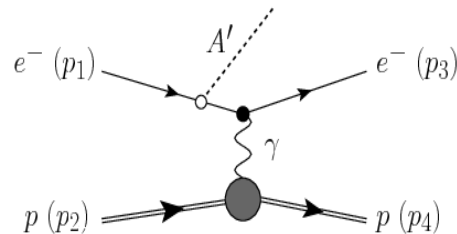


Motivation

- It is a possibility that Dark Matter could have its own sector of forces.
- There are some anomalies that Standard Model cannot explain such as Muon $g-2$ derivation from the SM.
- A heavy boson - A' – could explain these anomalies.

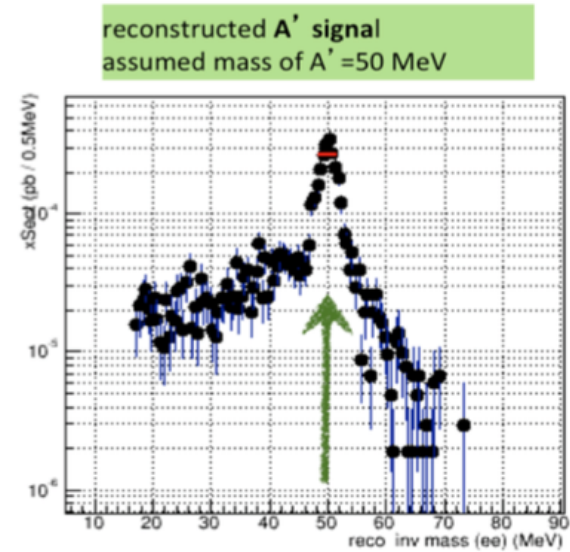
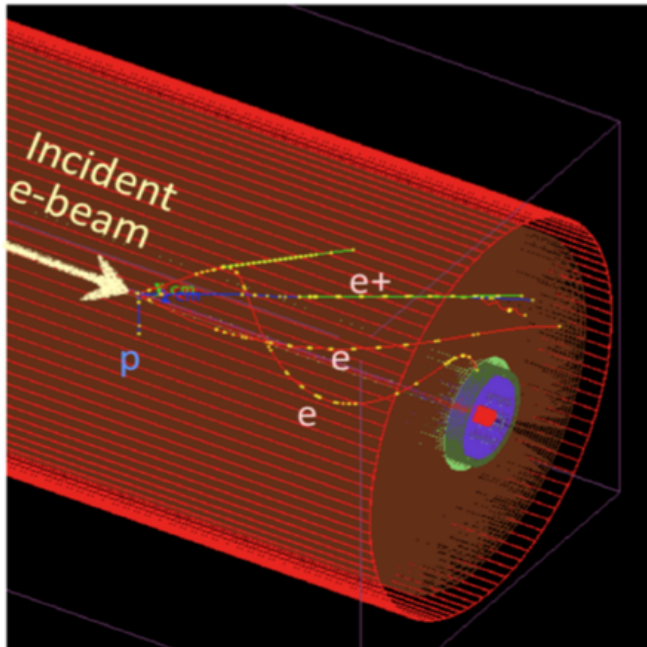
DarkLight Experiment Overview

- Search for a dark photon A' in the mass range of 10-100 MeV/ c^2 which is possibly coupled to leptons.
- Reconstruct tracks of all four final Particles.
- Invariant mass of the e^+/e^- pair gives the mass of A'



Tracking and Reconstruction

$e p \rightarrow e-p \quad A' (50 \text{ MeV}) \rightarrow e^+ e^-$

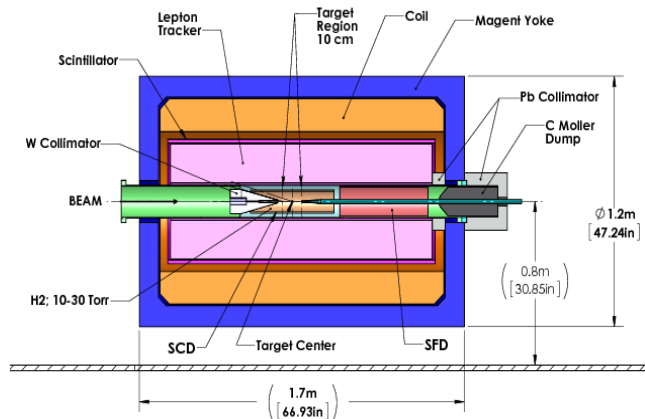


LERF at Jefferson Lab

- 5mA electron beam with 100 MeV energy is delivered to a windowless Hydrogen target in 0.5T solenoidal field.



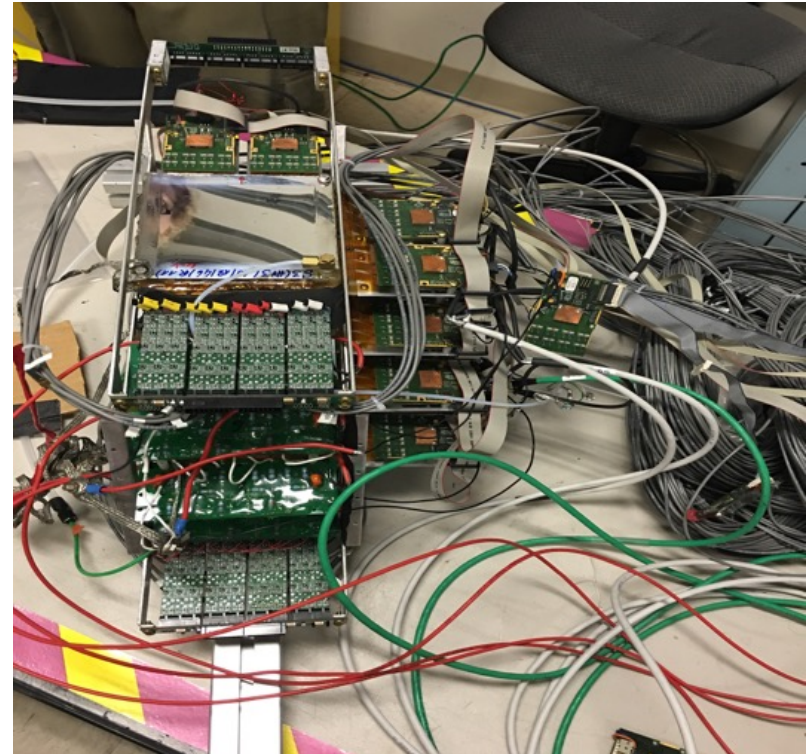
Design Overview



- 6 coil Toroidal Magnet field-free region along beam-target interaction region
- Target chamber
 10^{-19} H-atoms/cm² – Radius=2 mm, Length=30cm, Flow rate= 1.5×10^{18} s⁻¹, Target P= 100 torr
- Proton Detector
A radial TPC – made of Kapton - detect low energy recoil protons down to 1MeV
- Lepton Tracker - GEM detector
- Trigger scintillators
Trigger the scattered electrons

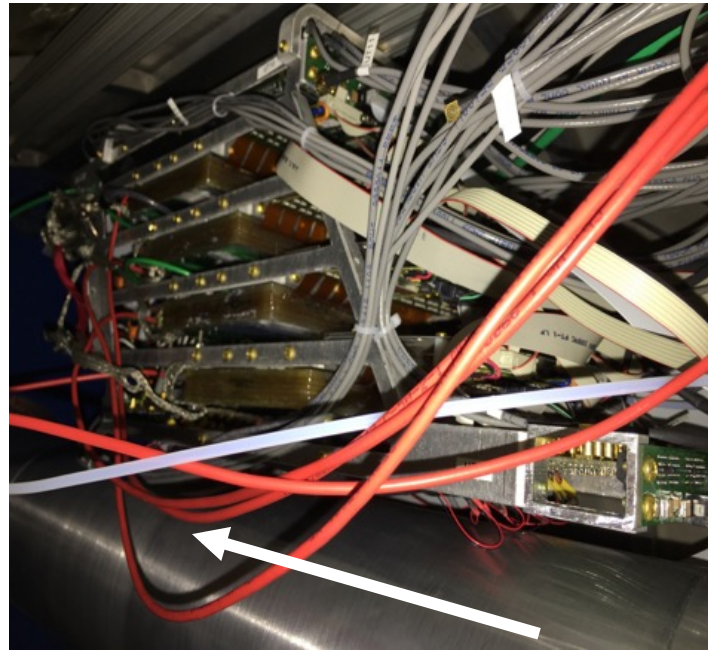
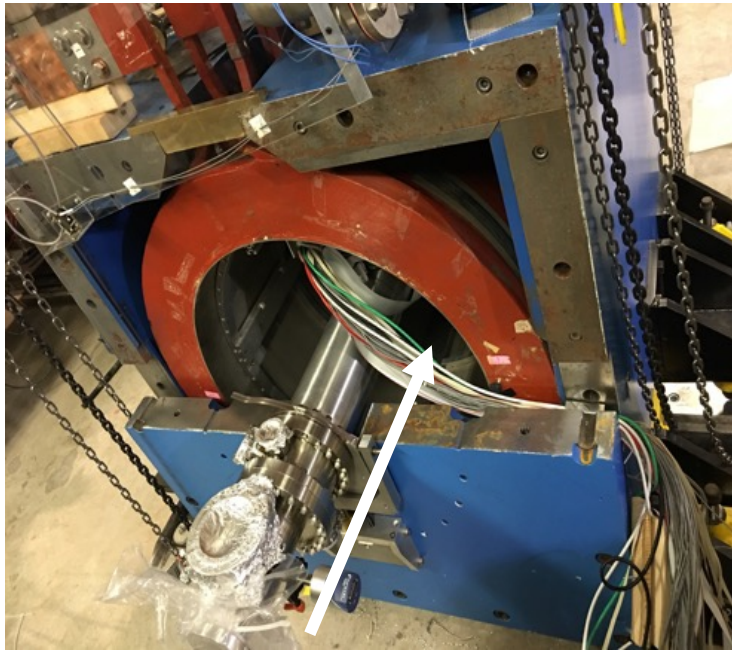
GEM Detectors

- GEM telescope Specifications-
- Consists of four 10x10 triple layer GEM chambers
- Each GEM has four APV-25 frontend chips connected to x and y axis.
- 2000 readout channels total.
- GEMs were supplied ArCO₂ gas mixture in 75:25 ratio



GEM Detectors

- The GEM stack was installed inside the solenoid above the beam pipe.



11/8/16

Aug/Sep Run 2016

- Was an engineering run.
- Successfully acquired few hours of data.
- Data taking-
 - ✓ Took multiple latency scans to time in GEMs
 - ✓ Recorded large 'splash' samples without target gas.
 - ✓ Recorded 1k events with target at 300 mTorr

Problems and Issues

- Alignment:
 - Beam was never able to pass clearly through the target region.
 - Need to align to axis of magnet with precision of less than a millimeter.
 - Should have a test run where the laser is mounted and clearly through moller dump, i.e. sight down through target weeks in advance.
- Pumping
 - Pumping was less effective than predicted.
 - Turbo 1 broke, hypothesis is that this was due to shaking during valve closure.
 - Also, pumps were not vertically aligned well.

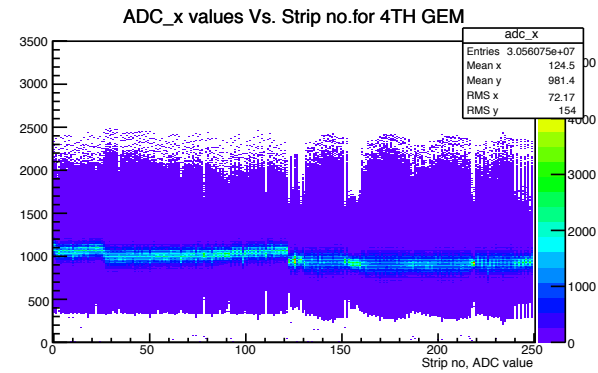
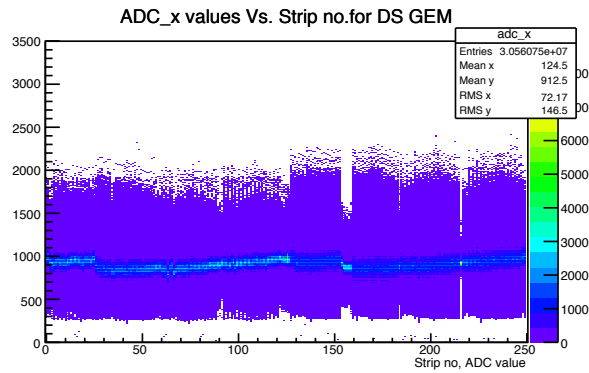
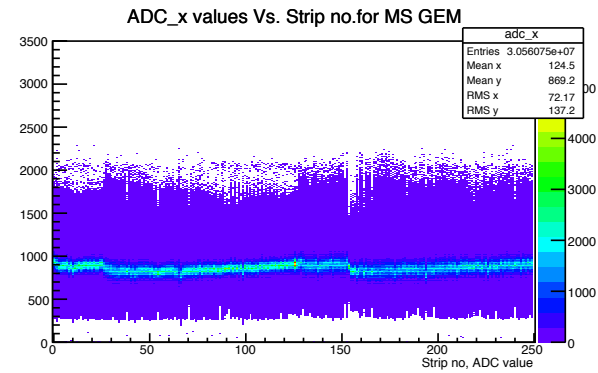
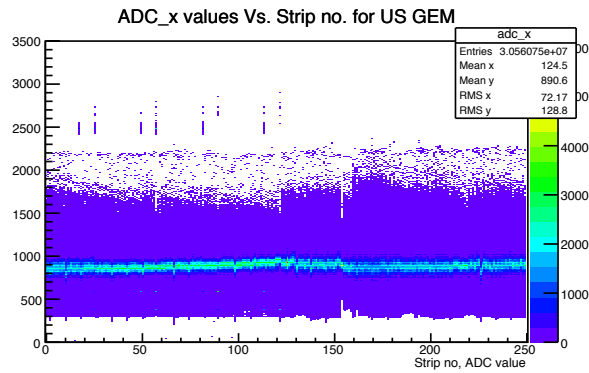
Problems and Issues

- GEMs
 - Problems with I2C communication (i.e. couldn't program APVs)
 - APVs intermittently became non-responsive with no clear way to recover (4 APVs absent during data taking)
- Trigger Paddles
 - One v812 malfunctioned after installation.
 - Slow controls incident damaged more channels, not clear what happened.
- Slow Controls
 - Slow controls webserver occasionally froze
 - Various bugs

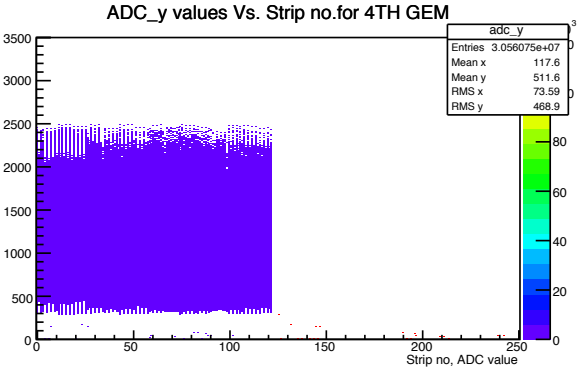
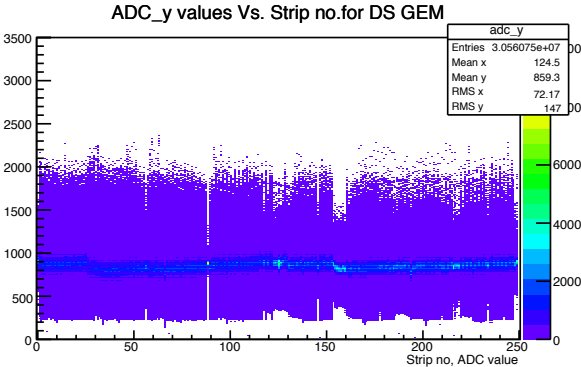
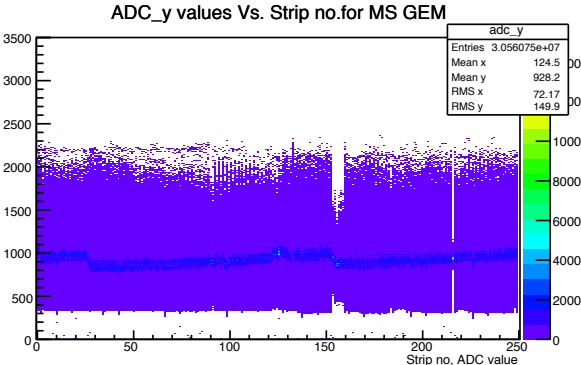
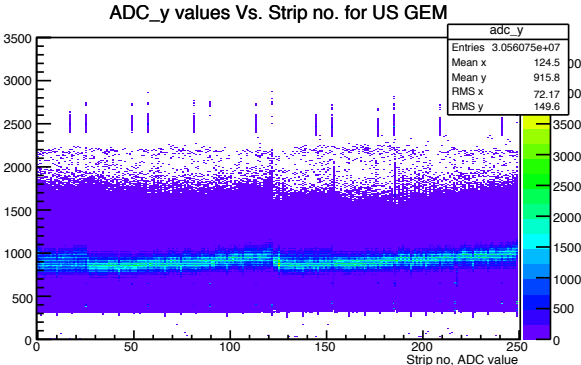
Data Analysis

- The DAQ system is almost different than what we used before for the MUSE experiment.
- So the DAQ code has been adjusted by Anusha to read new data type.
- Still the Data Analysis is in the beginner's phase.

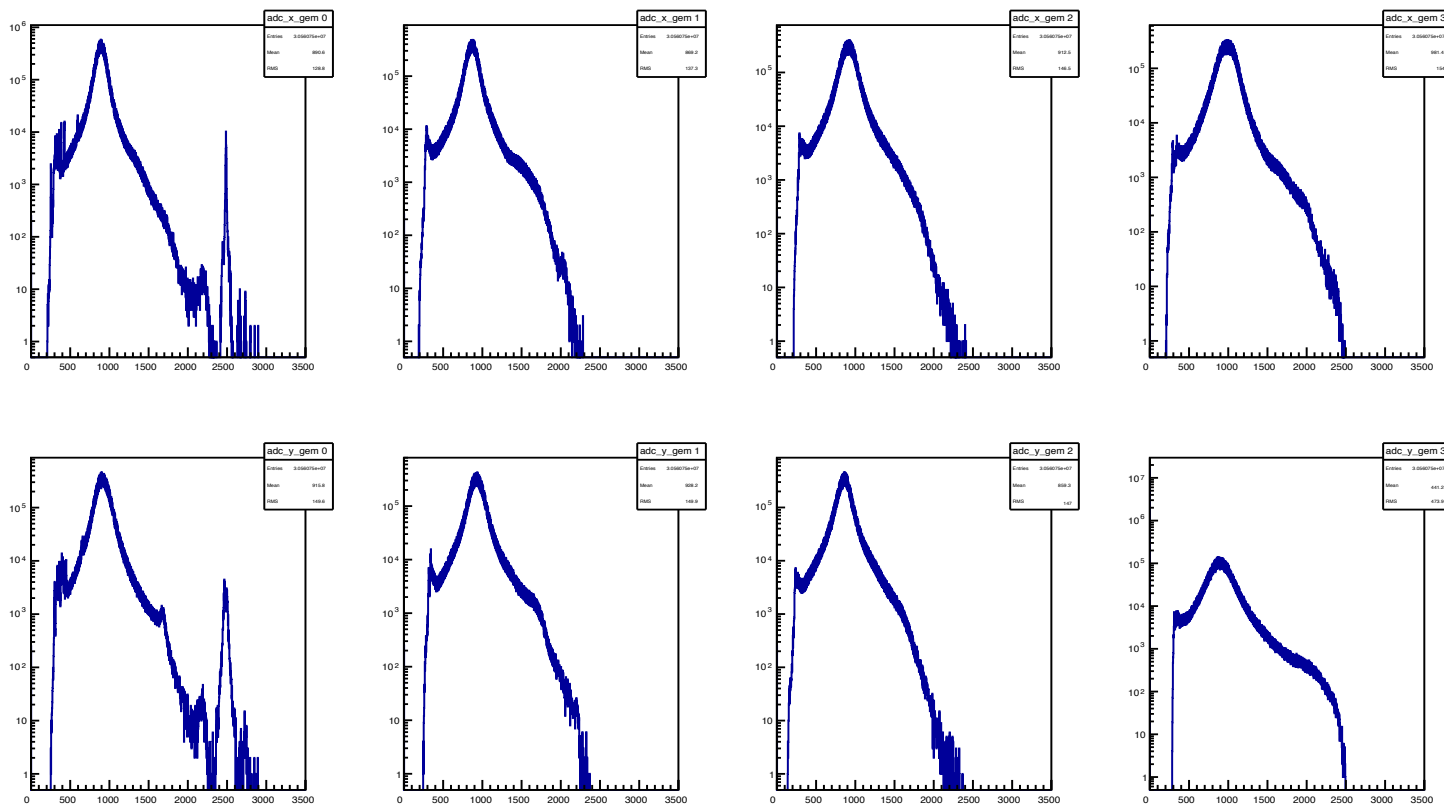
Raw ADC spectra – x axis



Raw ADC Spectra – y axis



1D Raw ADC spectra



Continue..

- Mapping has to be corrected accordingly, since we changed some of the APV cards from v3.1 to v3.0 at LERF.
- More analysis has to be done to see clean clusters..

Goals for coming weeks

- Data Analysis:
 - Adjust mapping
 - Pedestal subtraction from the raw ADC spectra for each strip
 - Common mode noise correction for each event
- Hardware
 - Replace broken APVs in the DL GEM stack.

THANK YOU!