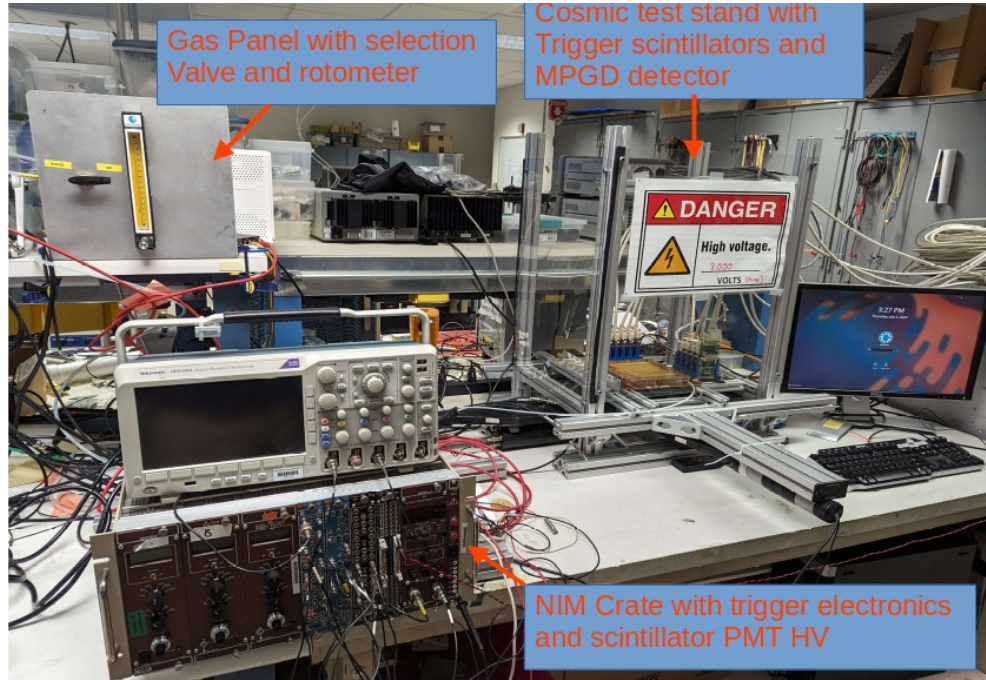# JLab RDIG MPGD Cosmic Test Stand
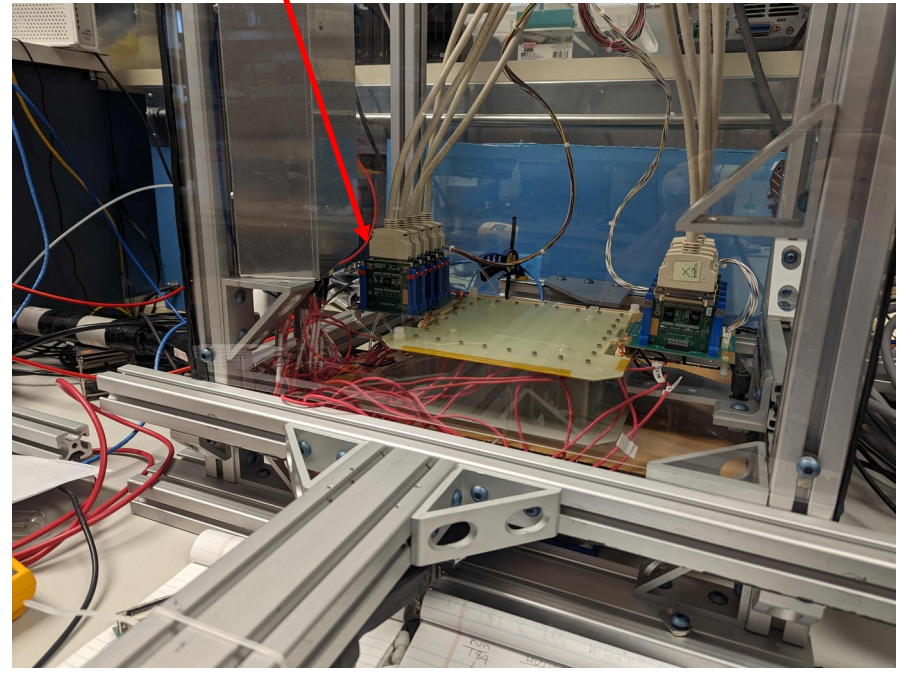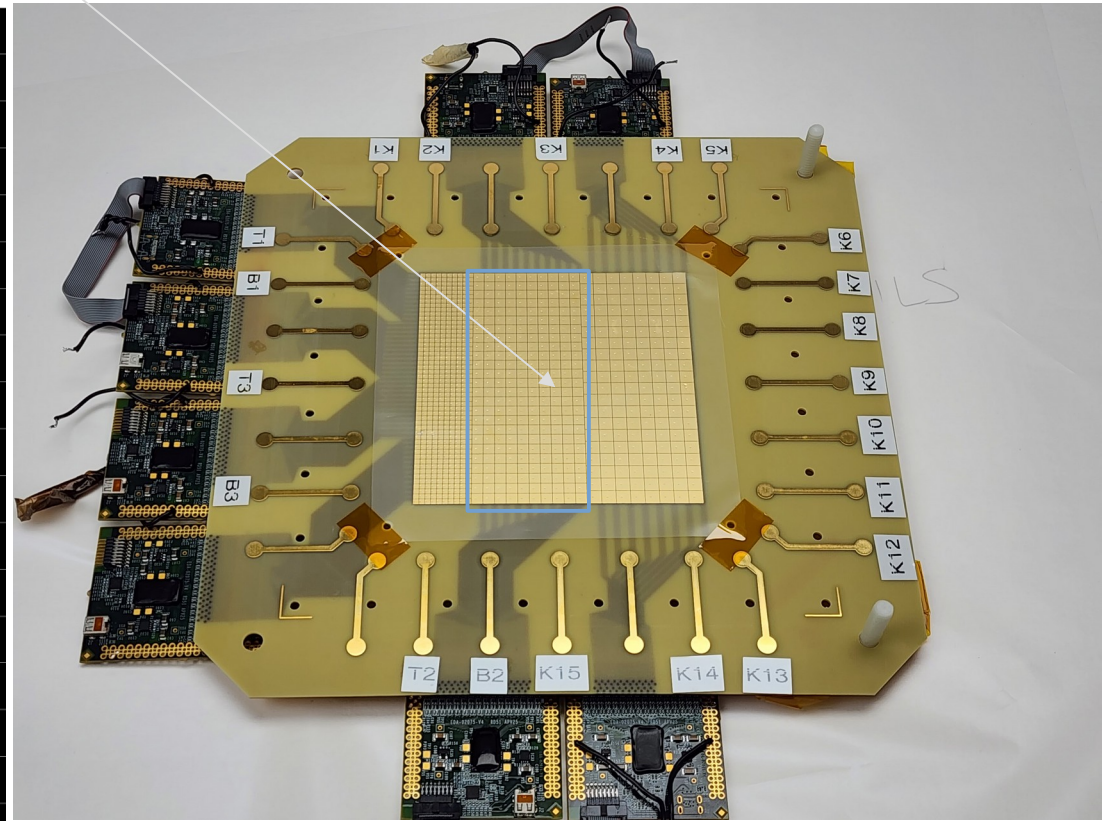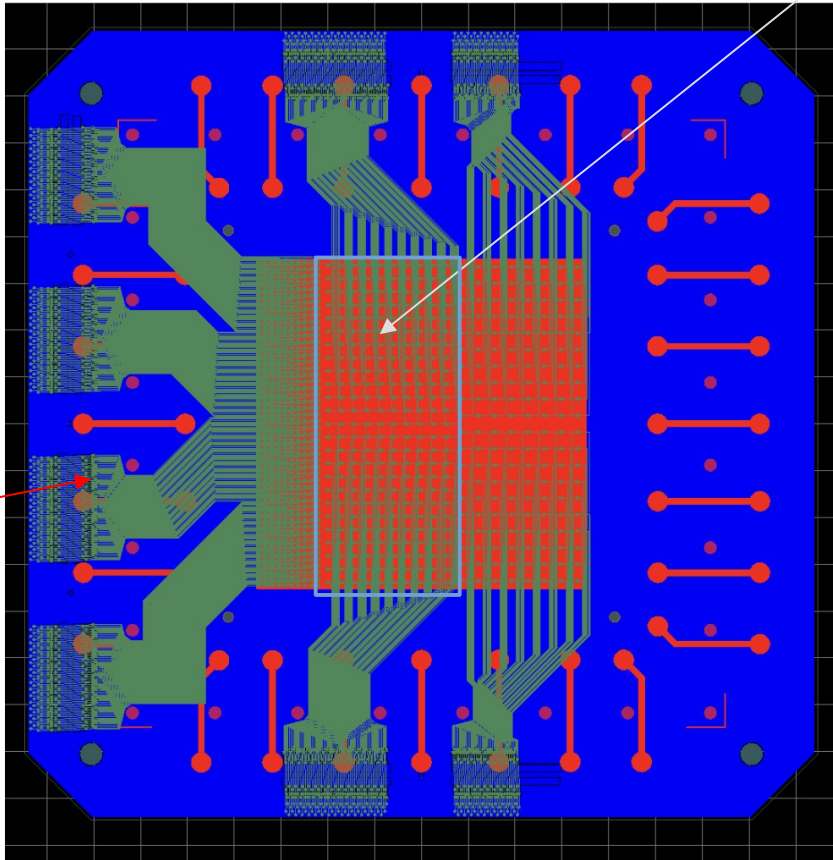
TDIS Prototype TPC installed

Preamp cards with shaper
24 channels per card / 5 cards per baseboard

Gas Panel with selection Valve and rotometer

Cosmic test stand with Trigger scintillators and MPGD detector

NIM Crate with trigger electronics and scintillator PMT HV

Instrumented pads

Status

→ Started with Ar/CO2 75/25, but moved to 90/10 for faster v_d

→ Prototype powered to 8 kV / 3.2 kV (Cathode / GEMs)

→ Time window on FA125 set to ~2.0 us width.

→ Rough adjustment of FA125 baselines performed

=> observed saturation of some large signals so turned down the GEM HV.

→ Event observed with expected multiple signals throughout maximum drift time.

=> measured drift velocity from the time distribution width.

Example cosmic events

- GEM HV @ ~3100 V

- Waveforms (Q vs time bin) for events

- 8 ns / bin, 12 bit ADC - 4096 max bin in Q

- multiple channels (pads) contributing

→ Some channels saturating – lower GEM HV?

ADC125 raw data

ADC125 raw data
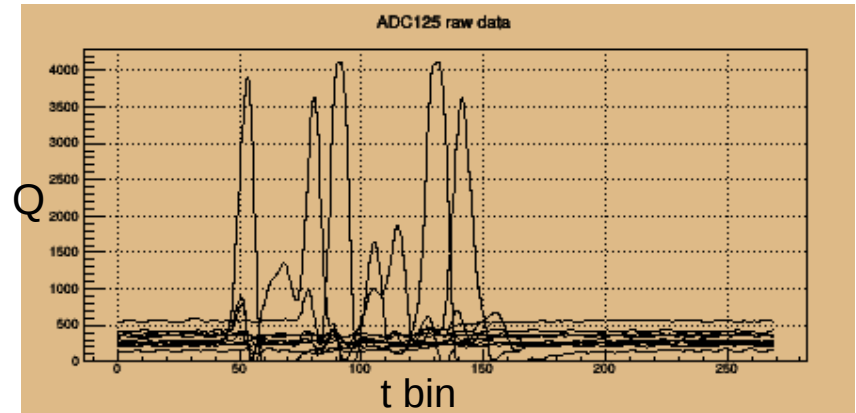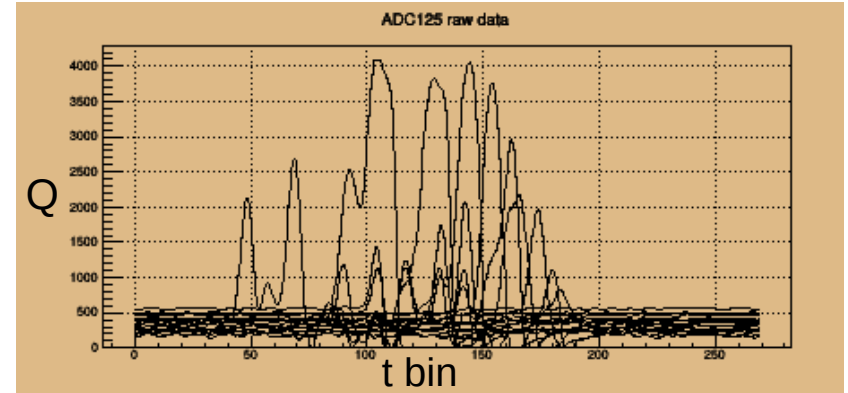
Notes

→ Some issues with small increases in current draw which produce ringing in FA125s and can kill the DAQ.

=> Need to move Cathode / FC electrodes as far from GEM and ground as possible to reach highest HV required.

→ Very inconvenient to have Panasonic connectors on bottom of Readout board, as the preamp cards then hang upside down.

→ We now have a frame (Seung Joon Lee) to mount the prototype at a 10 degree tilt (often only a few pads are seeing signals from vertical tracks).

Drift velocity measurements

(Rachael Hall, Duquesne U. SULI student)

Runs with range of E_{drift} for Ar/CO2 90/10

Expect hits along tracks to be uniformly populated in position and, therefore, in drift time.
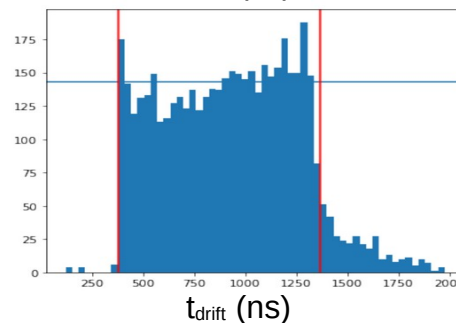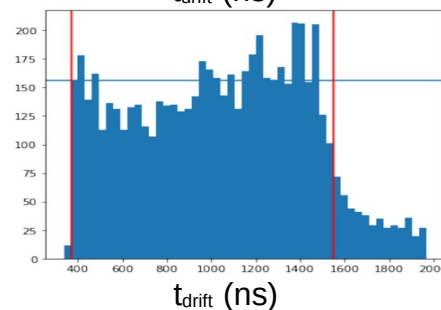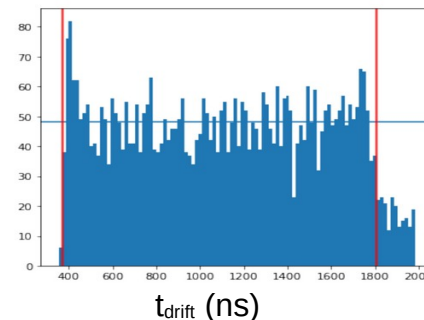
=> Range of drift time distribution dt = t_{max} - t_{min} corresponds to time for full 5 cm drift and removes amplification and signal propagation time.

$$v_{drift} = 5 \text{ cm / dt}$$

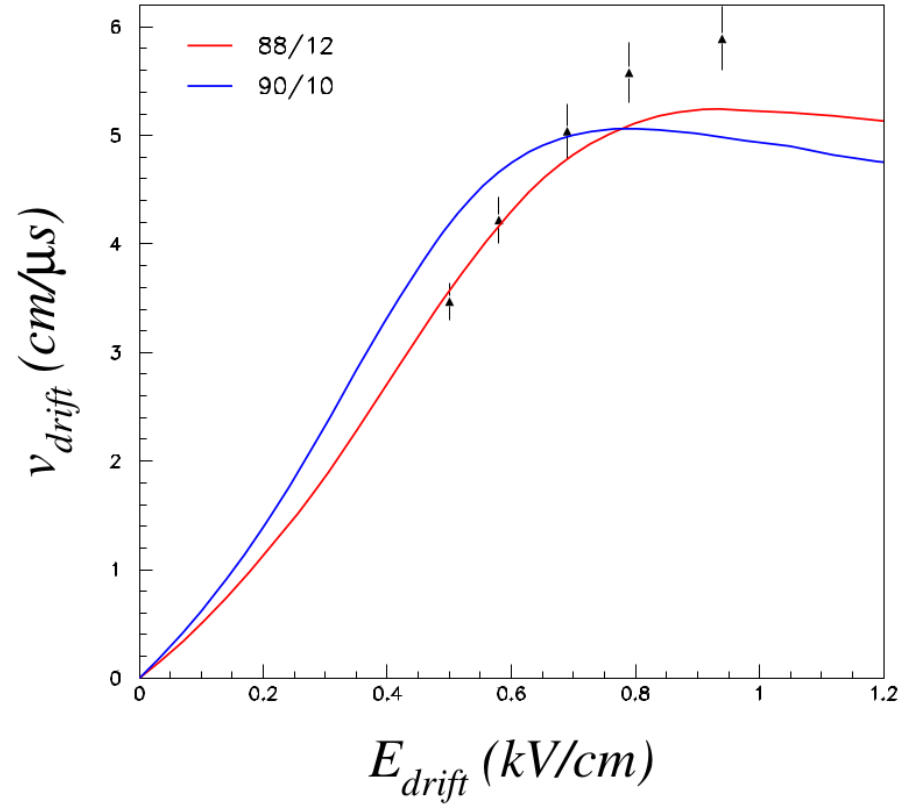The measured v_{drift} are *close* to those expected (~10-15%).

Note: the gas percentage uncertainty is +/- 2%.

t_{drift} (ns)

Run: 254
E_{drift} : 0.50 V/cm
t_{max} - t_{min}: 1440 ns
v_{drift} = 3.47 cm/µs

t_{drift} (ns)

Run: 257
E_{drift} : 0.58 V/cm
t_{max} - t_{min}: 1184 ns
v_{drift} = 4.22 cm/µs

t_{drift} (ns)

Run: 259
E_{drift} : 0.69 V/cm
t_{max} - t_{min}: 992 ns
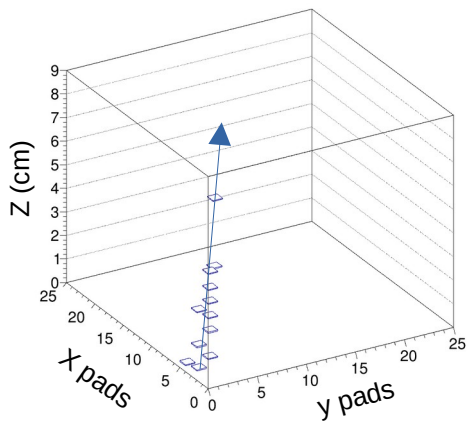v_{drift} = 5.04 cm/µs
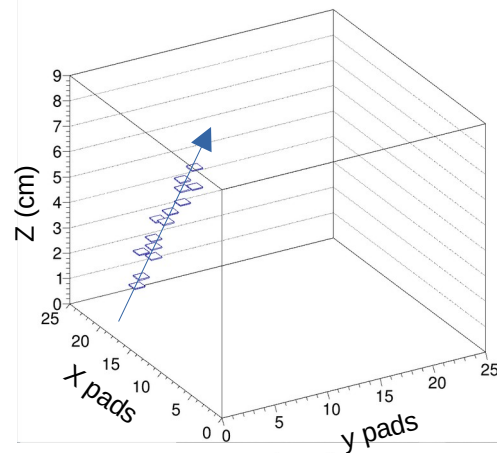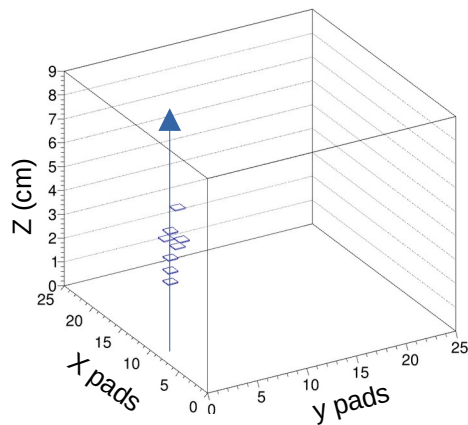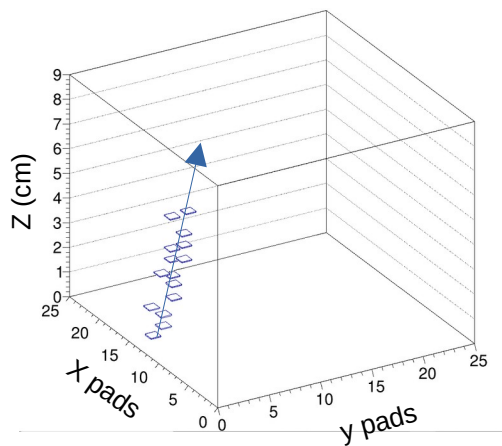
Drift velocity results

(Rachael Hall, Duquesne U. SULI student)

Examples of reconstructed 3-D track hits

(Sudipta Saha, JLab)

- Tracks not fitted. Lines just to guide the eye
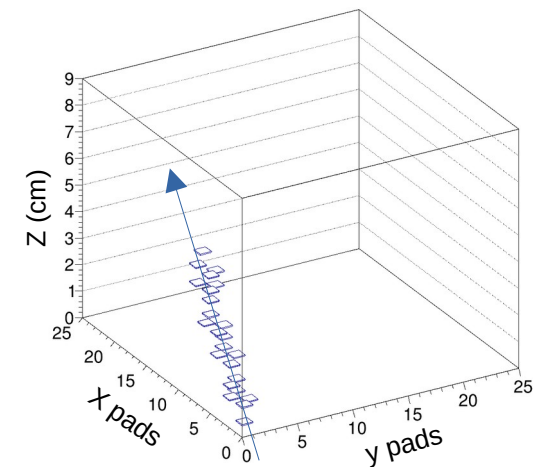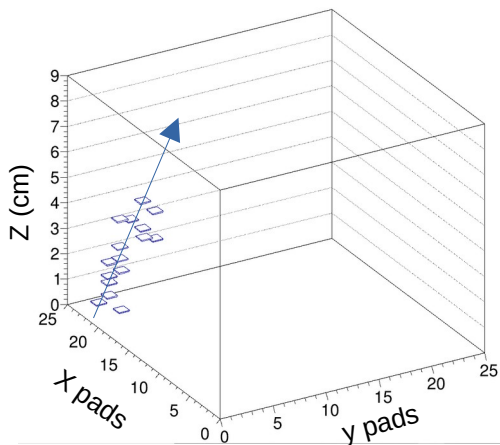
Status and plans

→ Waveforms and measured drift velocity look reasonable.

=> Detector generally operating nominally
   (sans discharge events previously noted)

→ cosmic tracks with GEM HV @ 3050 V are close to
   saturating on some channels

=> optimize GEM HV / gain in future.

→ Good progress on channel → pad map.
   Top connector looks good. Bottom connector still in progress.

=> See good tracks in active area!

Need to:
1. finalize mapping
2. optimize fadc baseline (pedestal) and GEM gain.
3. improve time –> distance map to account for longitudinal dispersion and shaping bias.