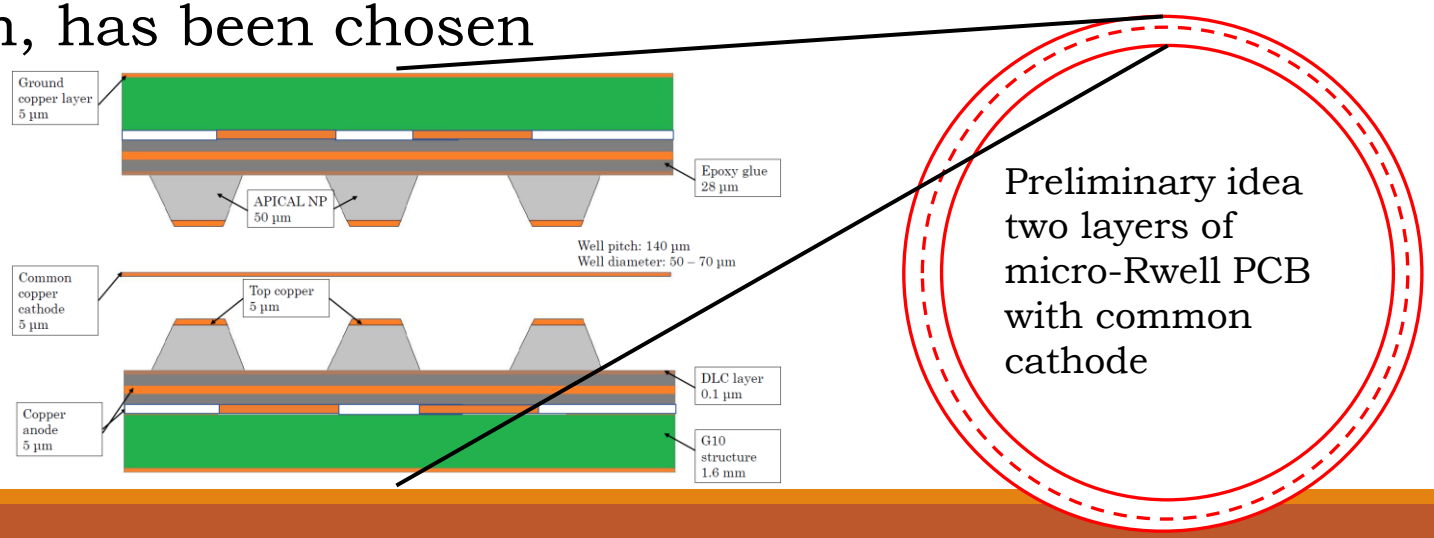
Status and Plan for PIONEER Tracker

JAYDEEP DATTA[1], KLAUS DEHMELT[2], ABHAY DESHPANDE[1], PRAKHAR GARG[3]

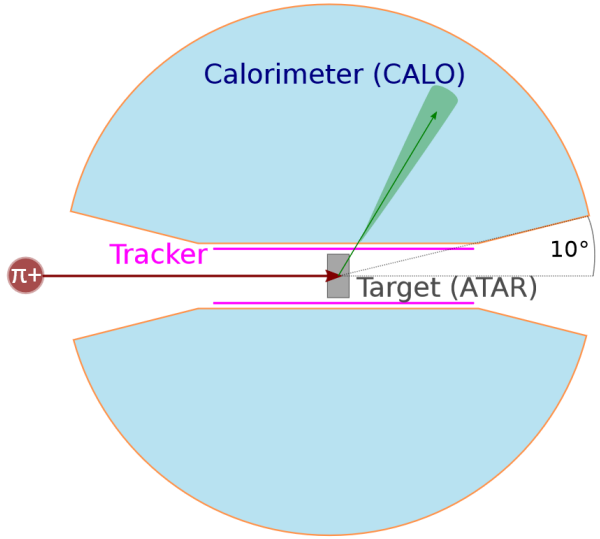
1. STONY BROOK UNIVERSITY, 2. MOVED TO TJNAF, 3. MOVED TO YALE UNIVERSITY

Motivation and Technology

- PIONEER tracker is motivated by the requirement of precise energy reconstruction
- The tracker hits will help to correlate the hits in ATAR with the Calorimeter
- For this good spatial and time resolution required
- Micro-Rwell, known for its good spatial and timing resolution, has been chosen

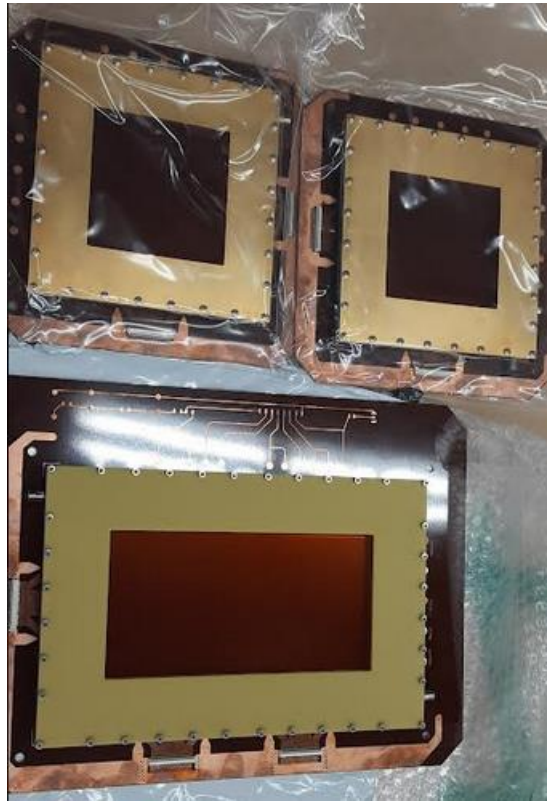


Preliminary idea two layers of micro-Rwell PCB with common cathode

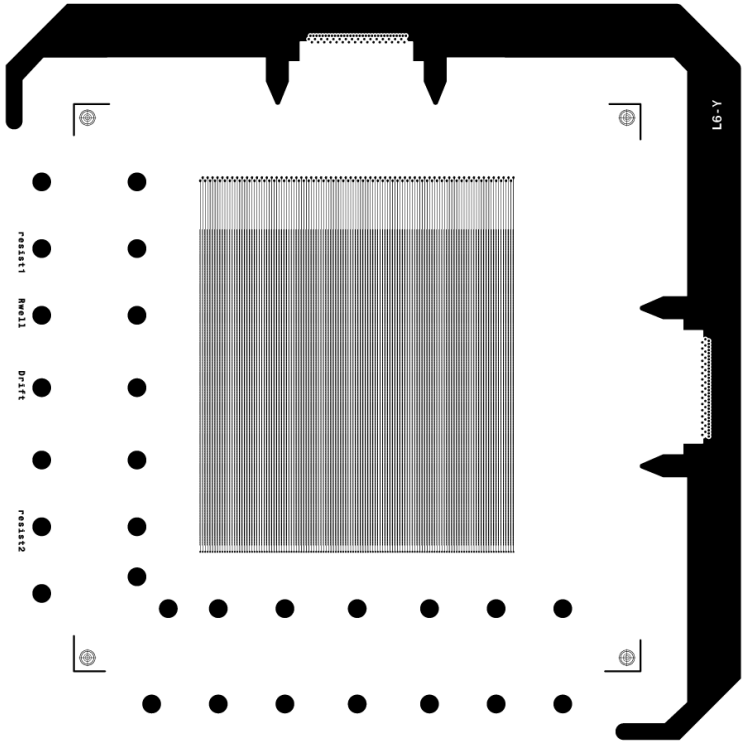


Simple schematic of the PIONEER experiment, with Liquid Xenon (LXe) calorimeter, Low Gain Avalanche Detector (LGAD) as Active TARget (ATAR) and cylindrical Tracker. (Ref: arXiv:2203.01981)

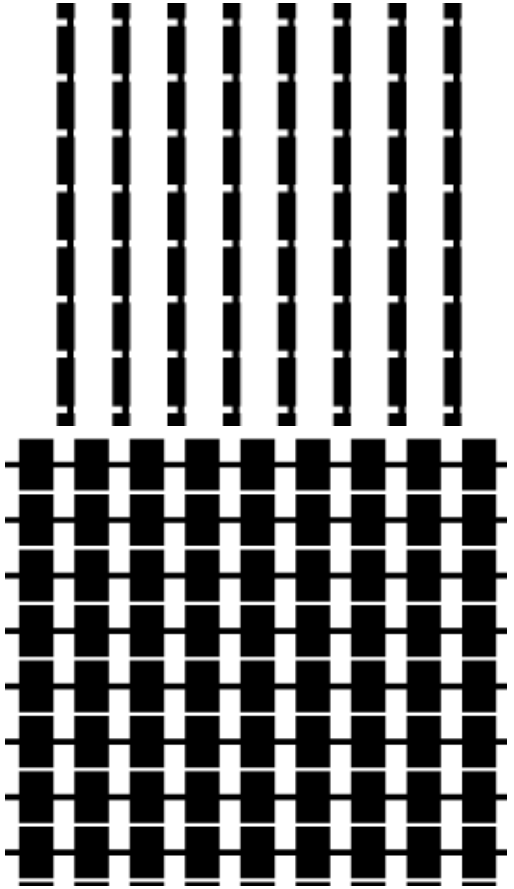
Micro-Rwell at SBU



Micro-Rwells



Y-side readout



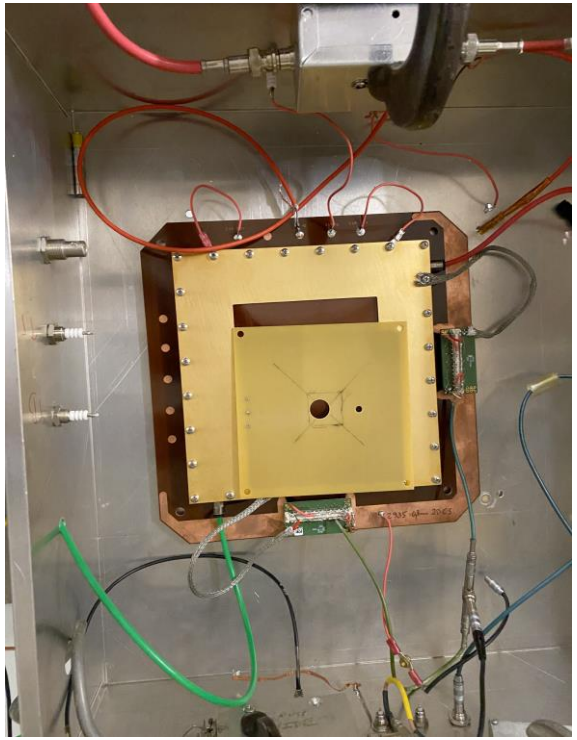
Zoomed view of Y-side readout

Zoomed view of X-side readout

Measurements with Radioactive Source

- Two 10 cm x 10 cm detectors are tested with Fe55 source
- All the channels of the micro-Rwell were shorted
- Fed to MCA after pre-amplifier and amplifier

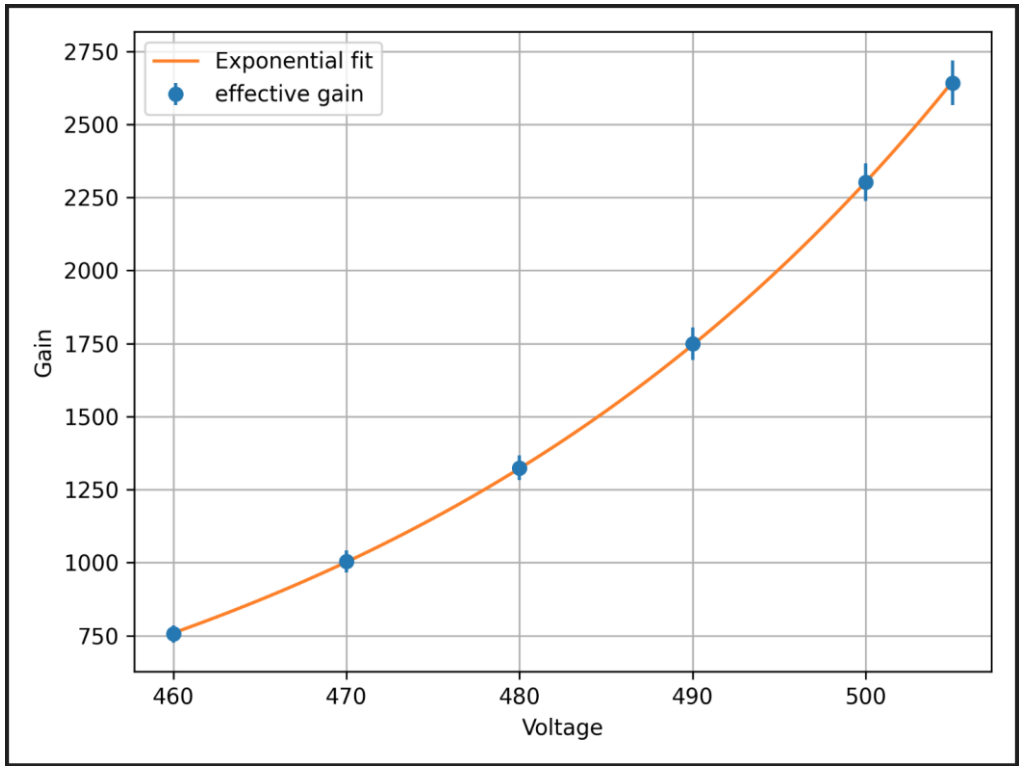
Detectors being baked at 50 degree Celsius



Detectors being prepared for test with radioactive sources

Results

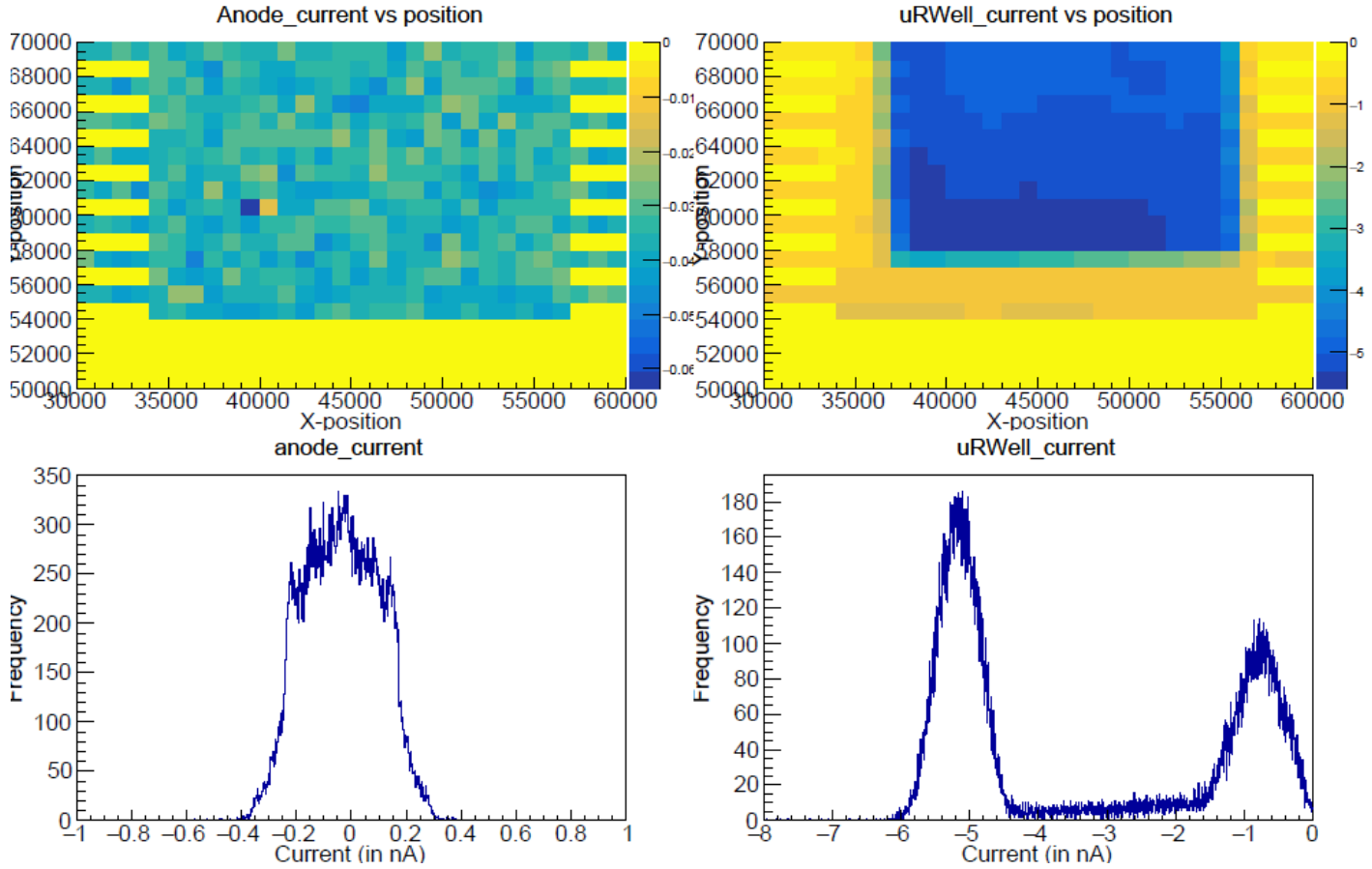
- MCA calibrated with known pulser
- Gas mixture used for the test Argon:CO2=80:20
- Number of primary for radioactive source calculated
- Using MCA, charge distribution for 1000 events measured
- The ratio gives the gain



Gain measured as a function of voltage

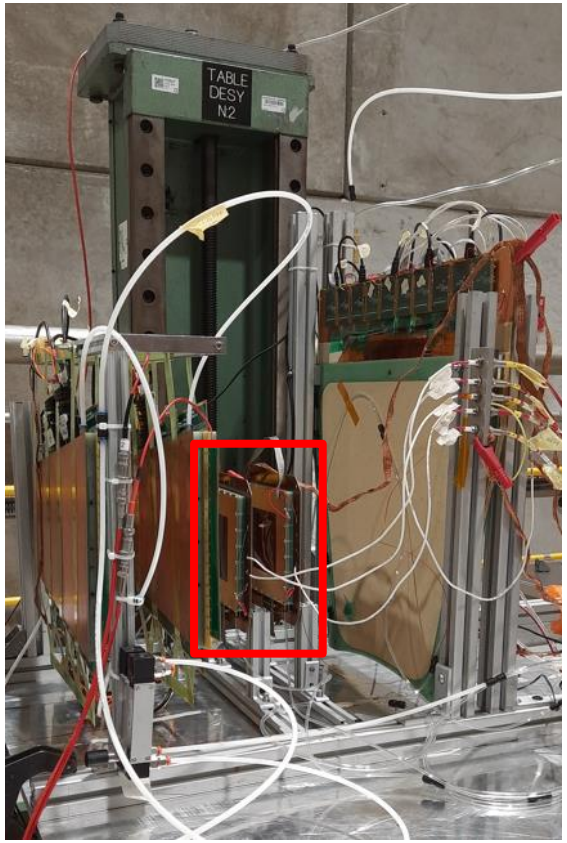
Gain uniformity test

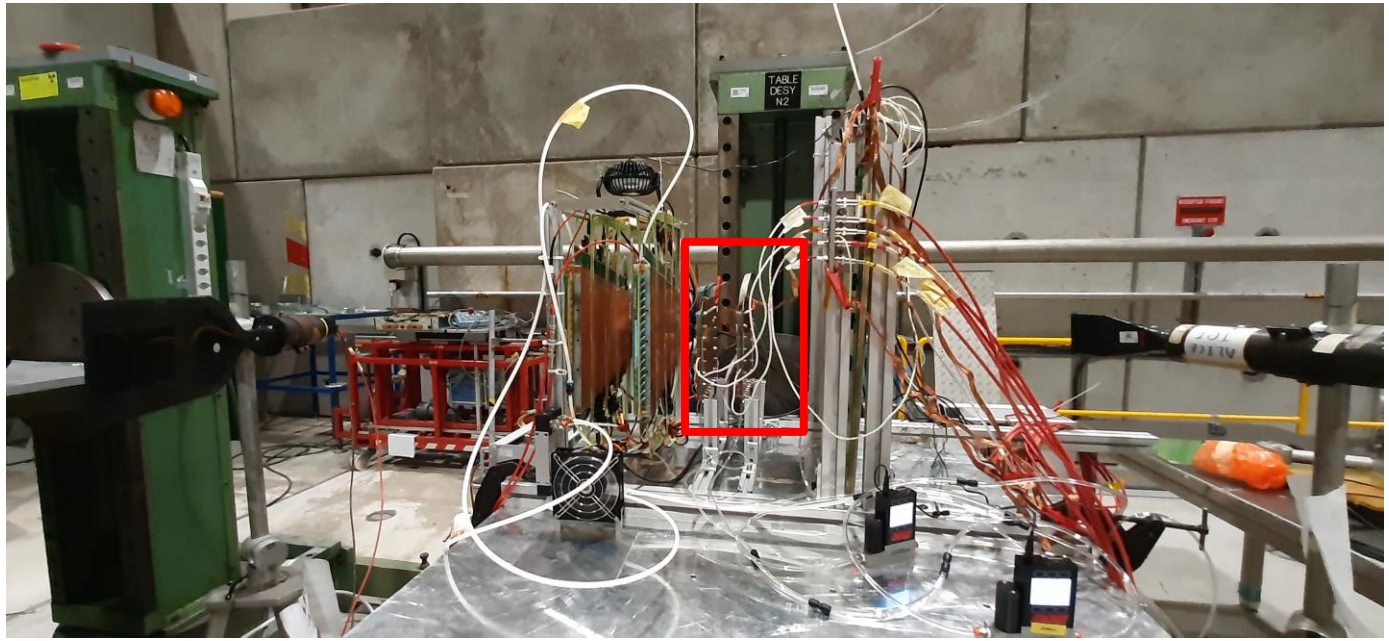
- For gain uniformity test the detector was tested using x-ray generated from Cu.
- The current from the anode and from the Copper layer of the micro-Rwell was read using pico-ammeter
- Anode current is induced charge, no pre-amp or amplifier present
- Micro-Rwell current is, ion for each event directly collected.



Gain uniformity result using x-ray

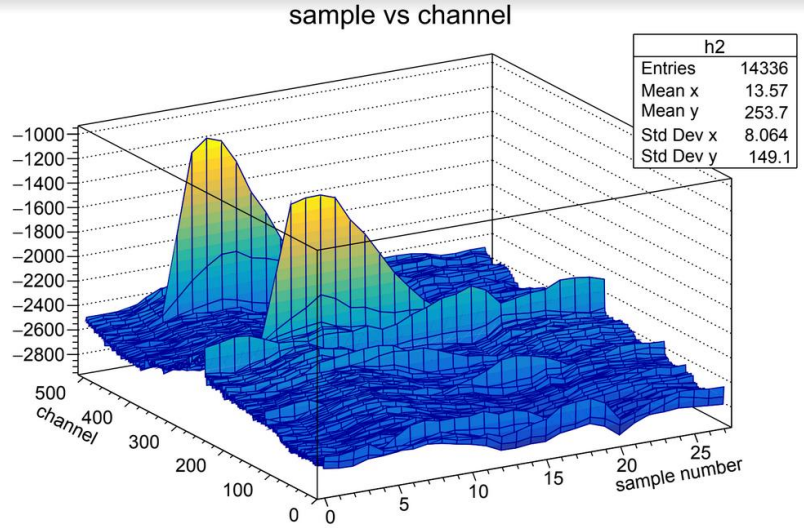
Test beam at CERN

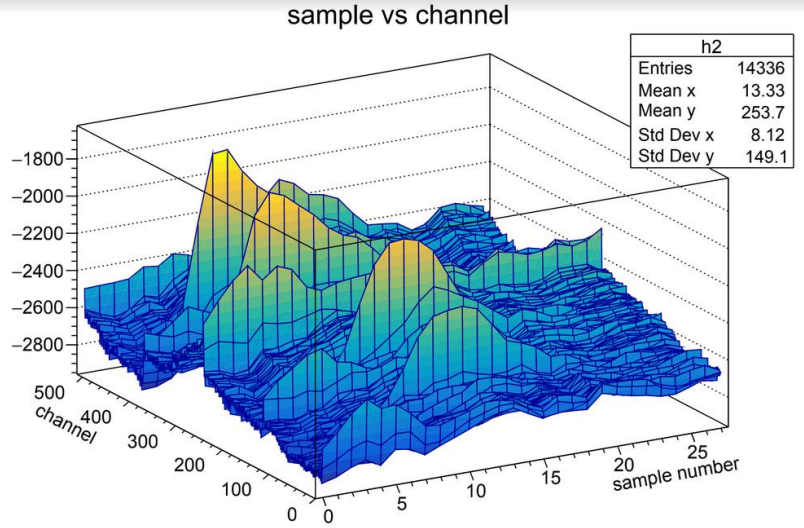


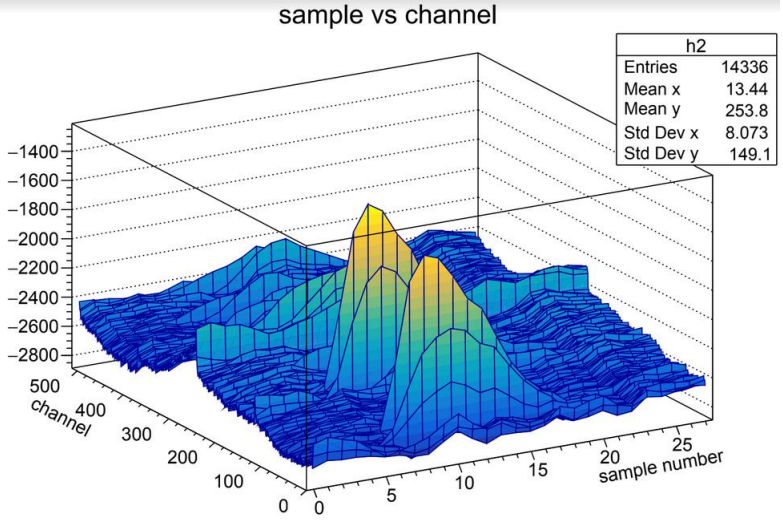


- SPS H8 area
- 150 GeV per nucleon Pb beam on fixed Pb target
- DAQ triggered using coincidence of two scintillators

Present status

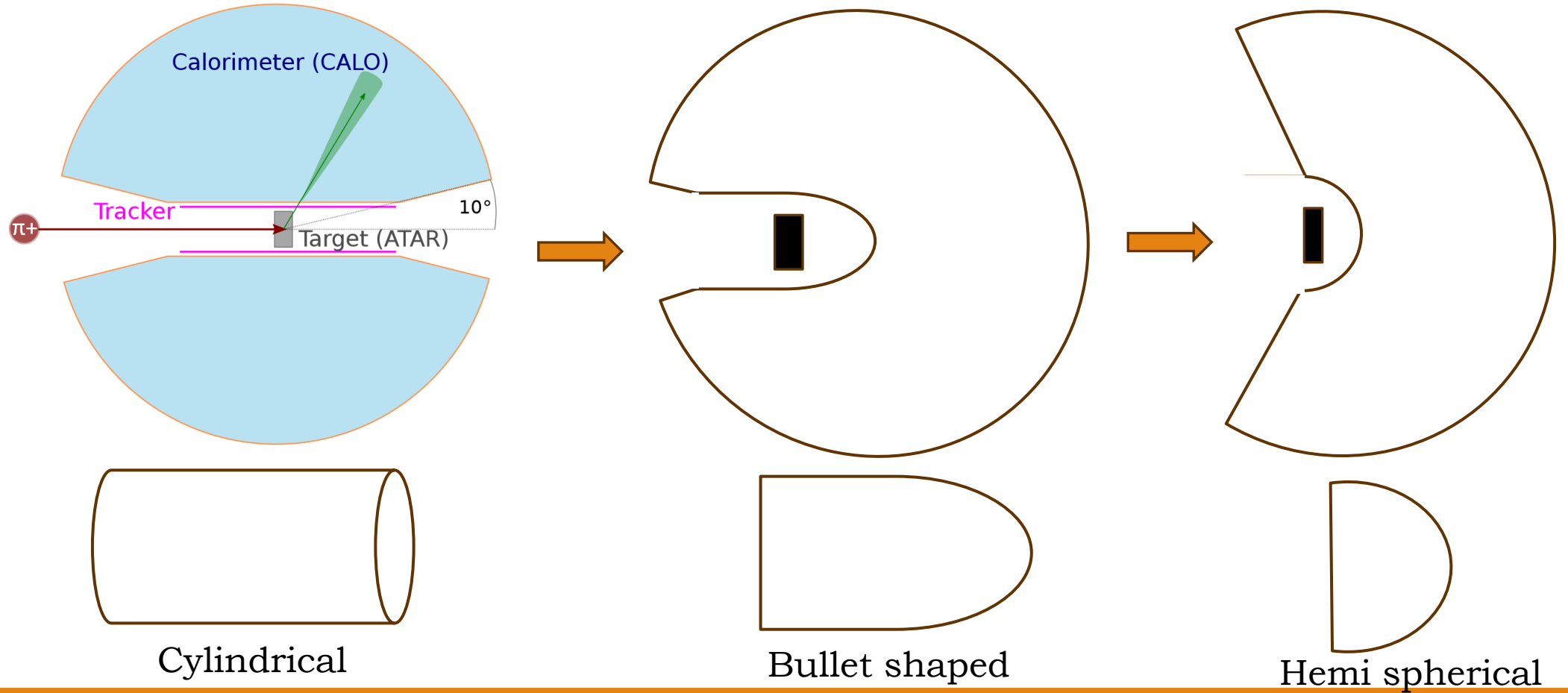






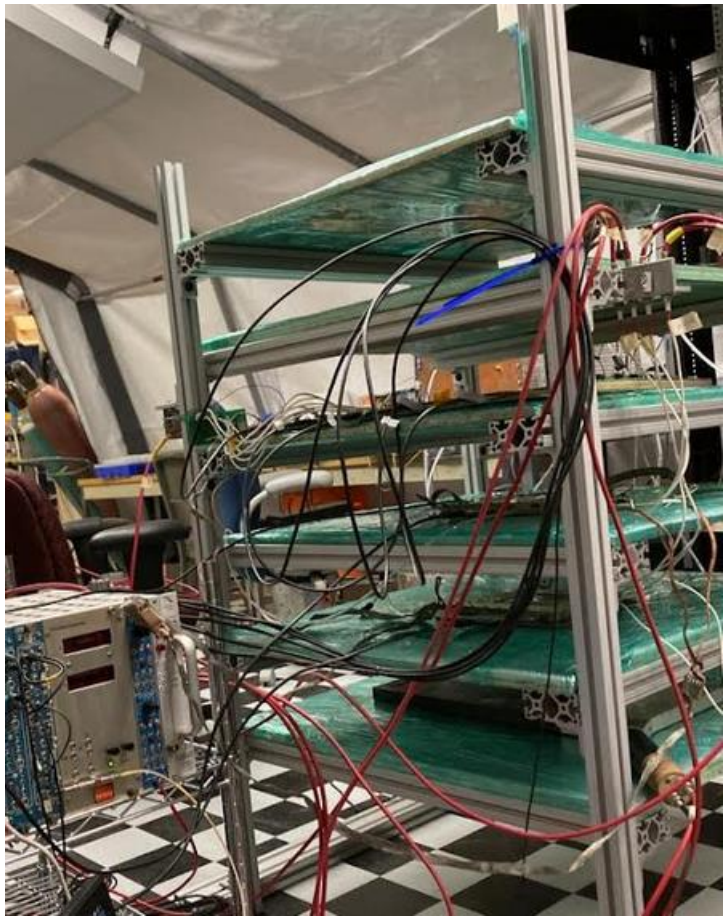
- Data acquisition going on
- APV25 cards being used along with SRS
- Channel indicates strips of the detectors, sample is time window of constant 25 ns width
- Z-axis is ADC counts

Evolution of Tracker Geometry



Future Plans

- More rigorous tests are planned for next few months to understand the detector
- Cosmic ray test set up is ready
- Schedule has been made to meet the expert of micro-Rwell at CERN



Cosmic Ray test set-up

Acknowledgement

I would like to thank our colleagues at Yale university and Jefferson lab for their contributions and help.

CERN GDD lab, to helping us out for the test beam

NA60+ colleagues for their help

James Shirk, Brynna Moran and Allen Pierre Louis, students of Stony Brook University, for helping with the experiments.

Thank you