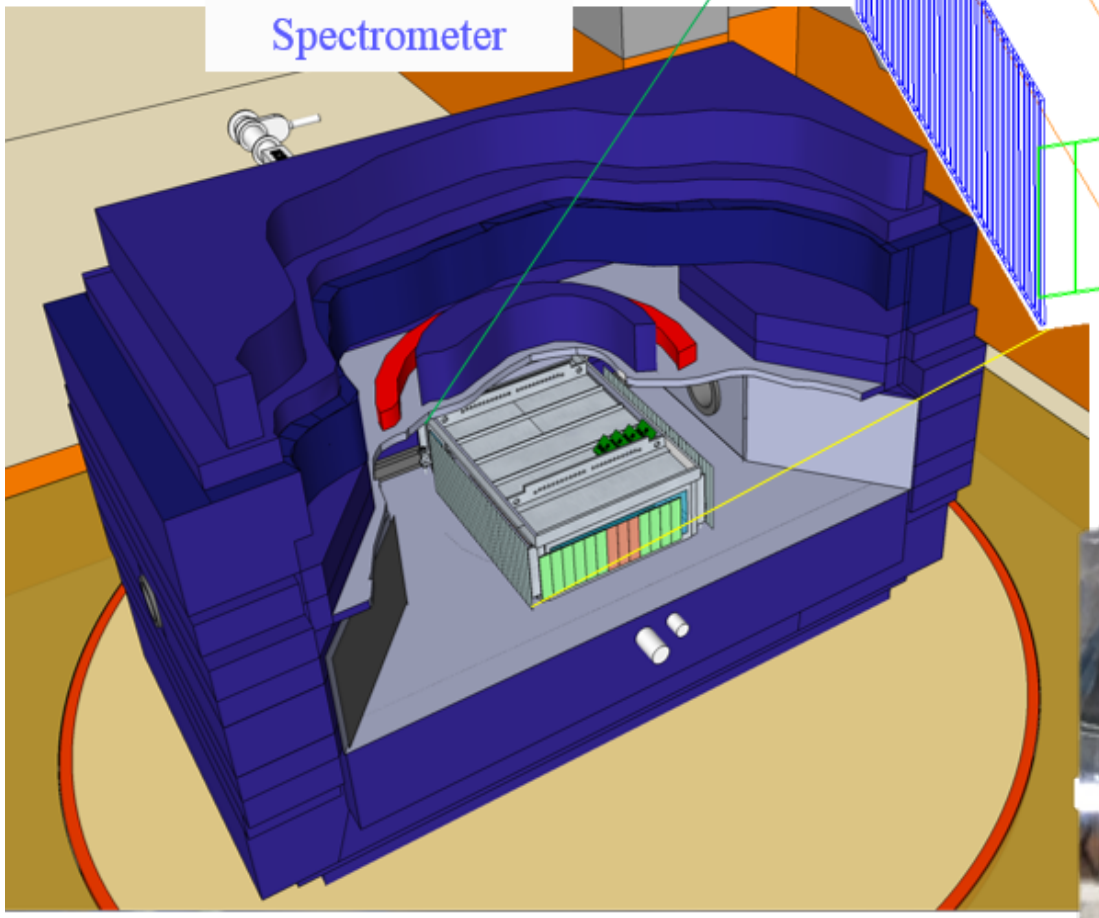
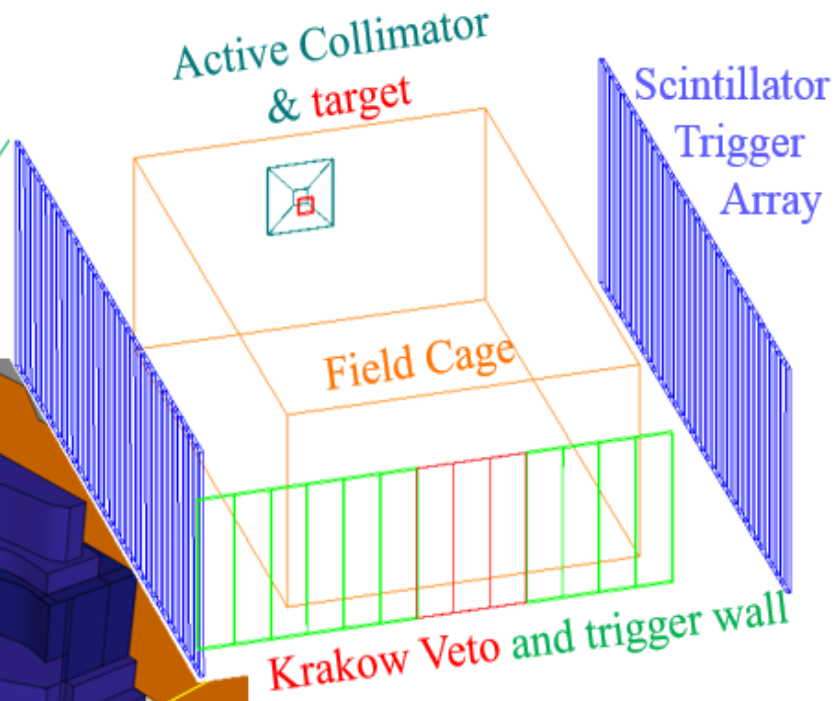
DAQ and Analysis needs for SπRIT experiments

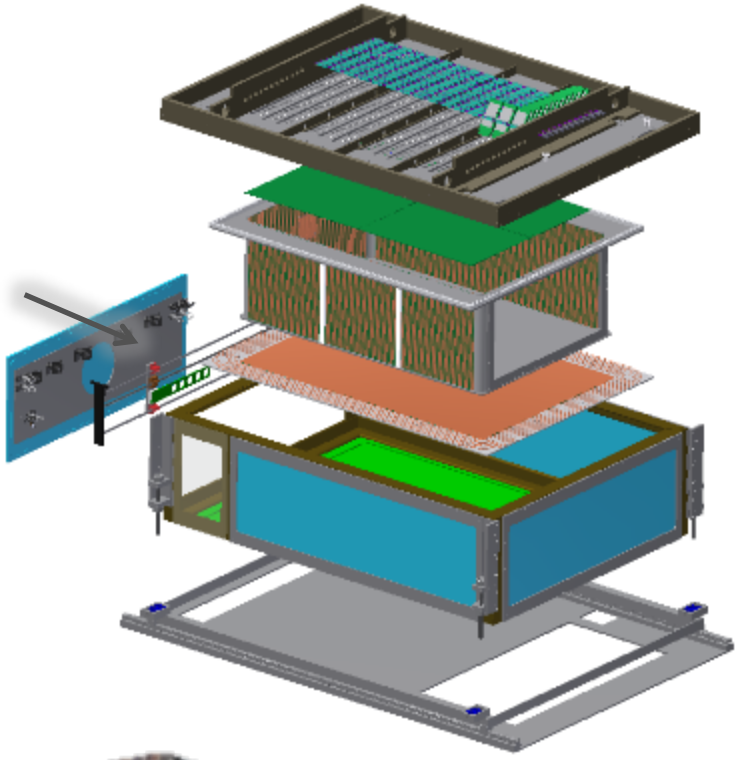
Implications for FRIB needs in 5 years

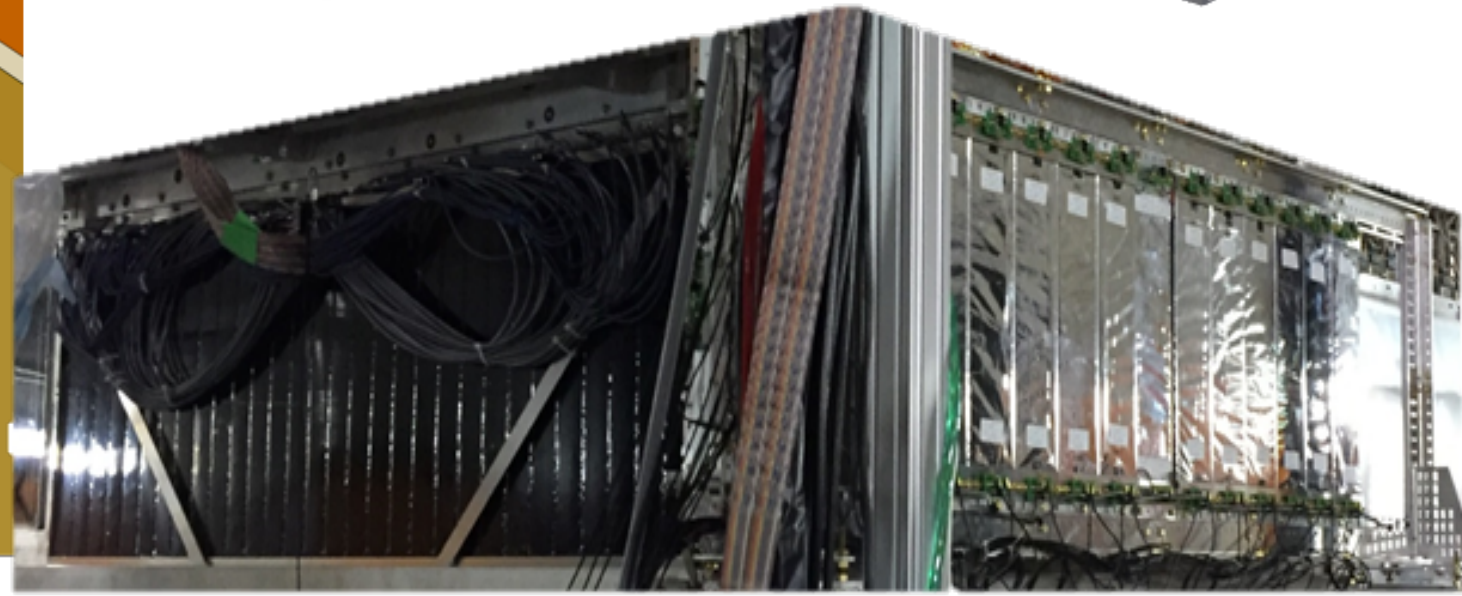
Betty Tsang

Determination of nuclear equation of state for asymmetric matter at high density







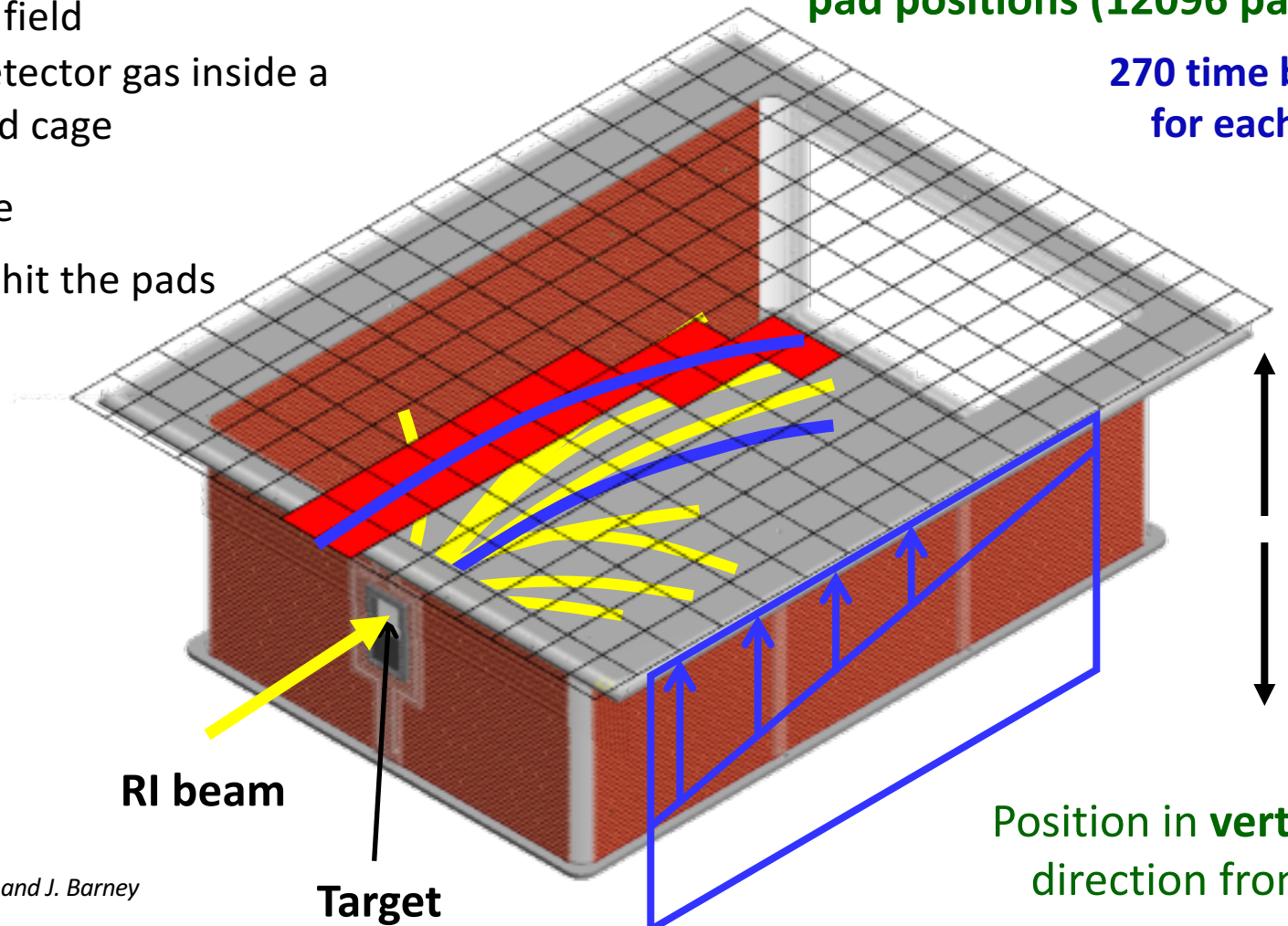


Time Projection Chamber – 3D camera for collisions

- Time projection chamber is ideally suited for identifying particles in magnetic field
- Products from reaction ionize detector gas inside a detection volume, called the field cage
- 2-D path traced out on pad plane
- The time at which the electrons hit the pads provides the third dimension

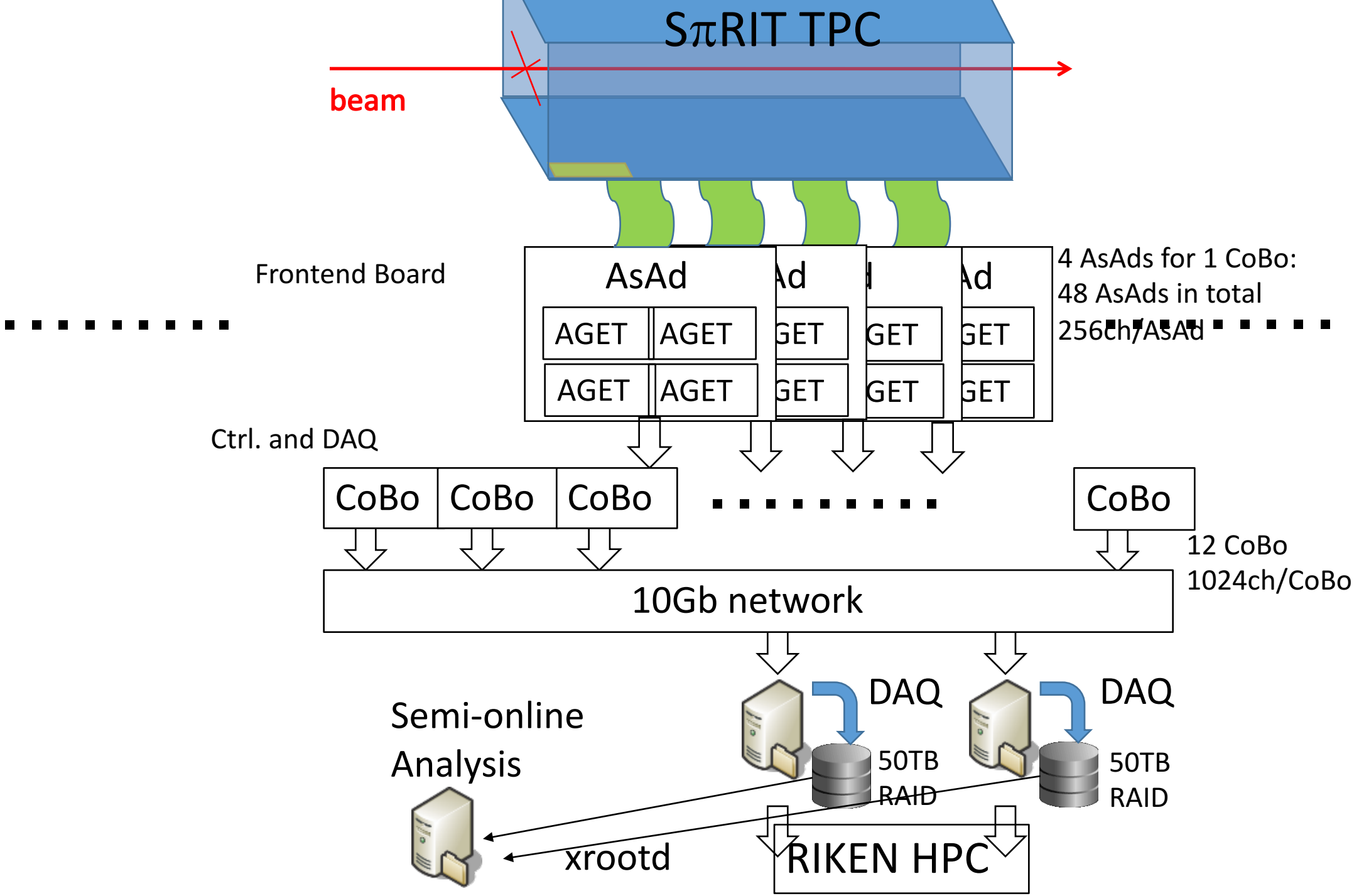
Path in **horizontal** plane form **pad positions (12096 pads) +**

270 time buckets for each pad



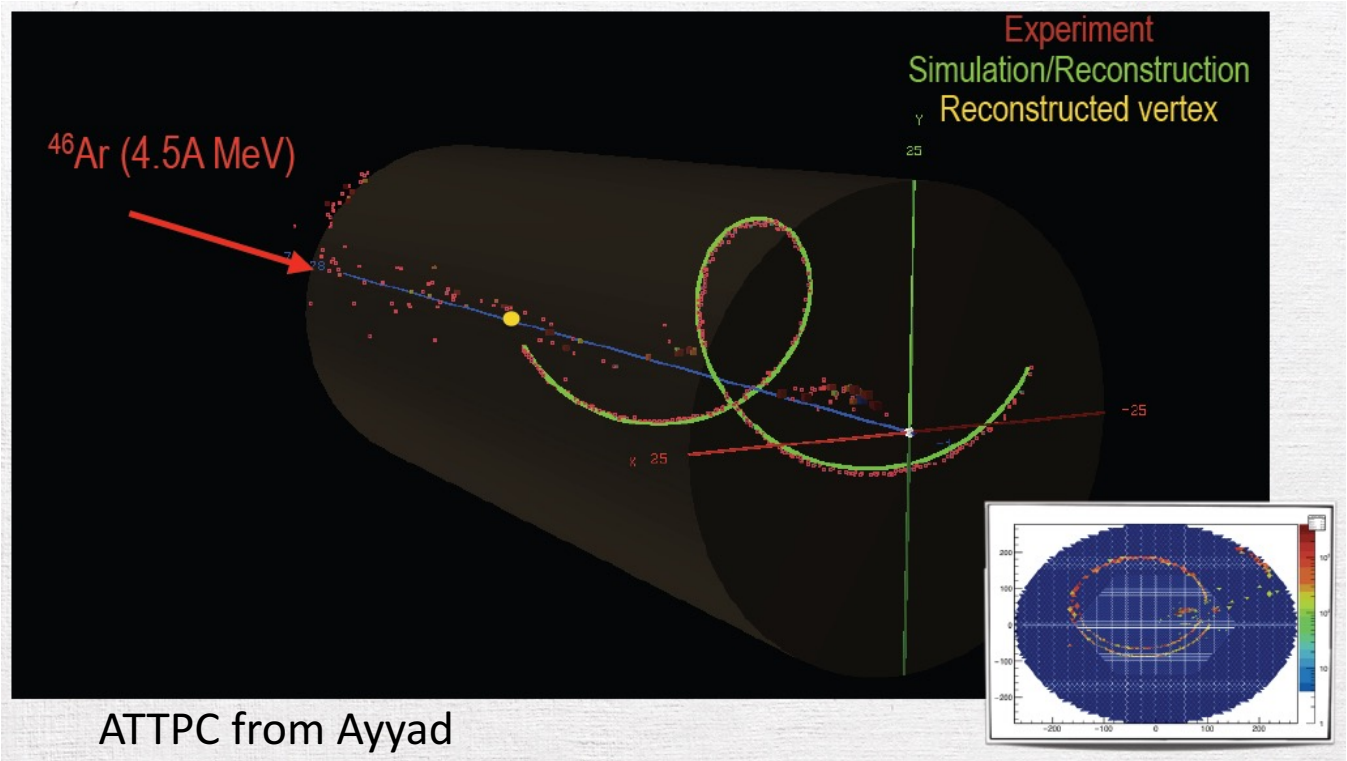
Position in **vertical drift** direction from **time**

Figure by J. Estee and J. Barney

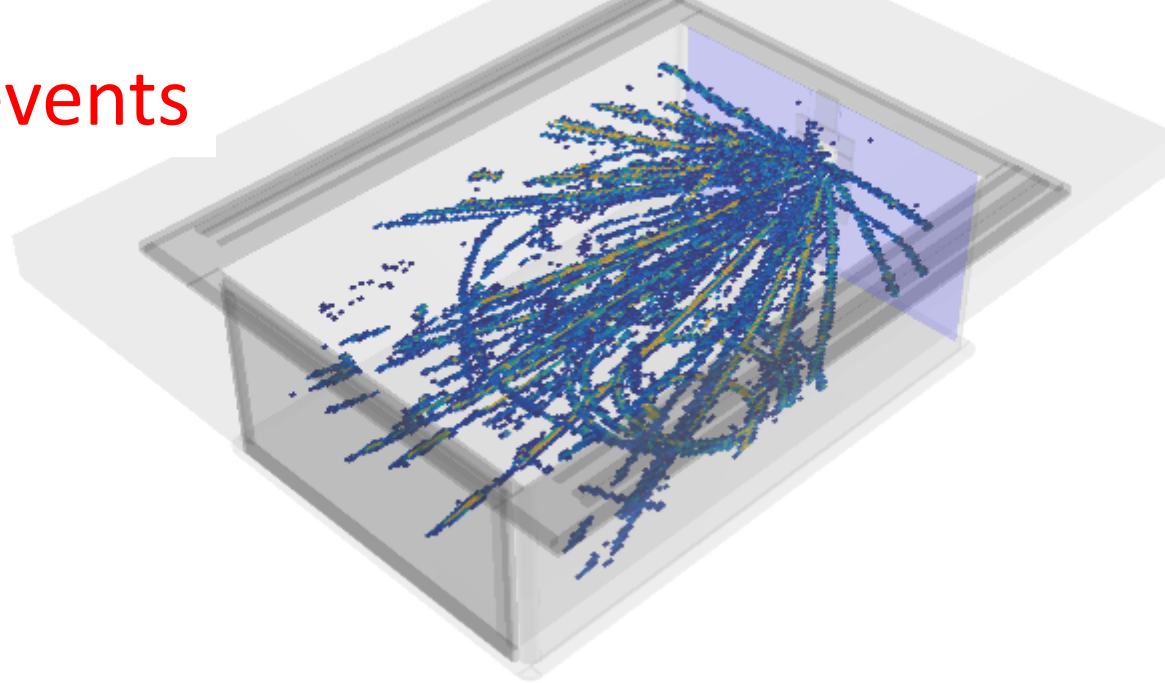

SπRIT TPC
beam
Frontend Board
AsAd
AGET
4 AsAds for 1 CoBo:
48 AsAds in total
256ch/AsAd
Ctrl. and DAQ
CoBo
12 CoBo
1024ch/CoBo
10Gb network
DAQ
50TB
RAID
Semi-online
Analysis
xrootd
RIKEN HPC

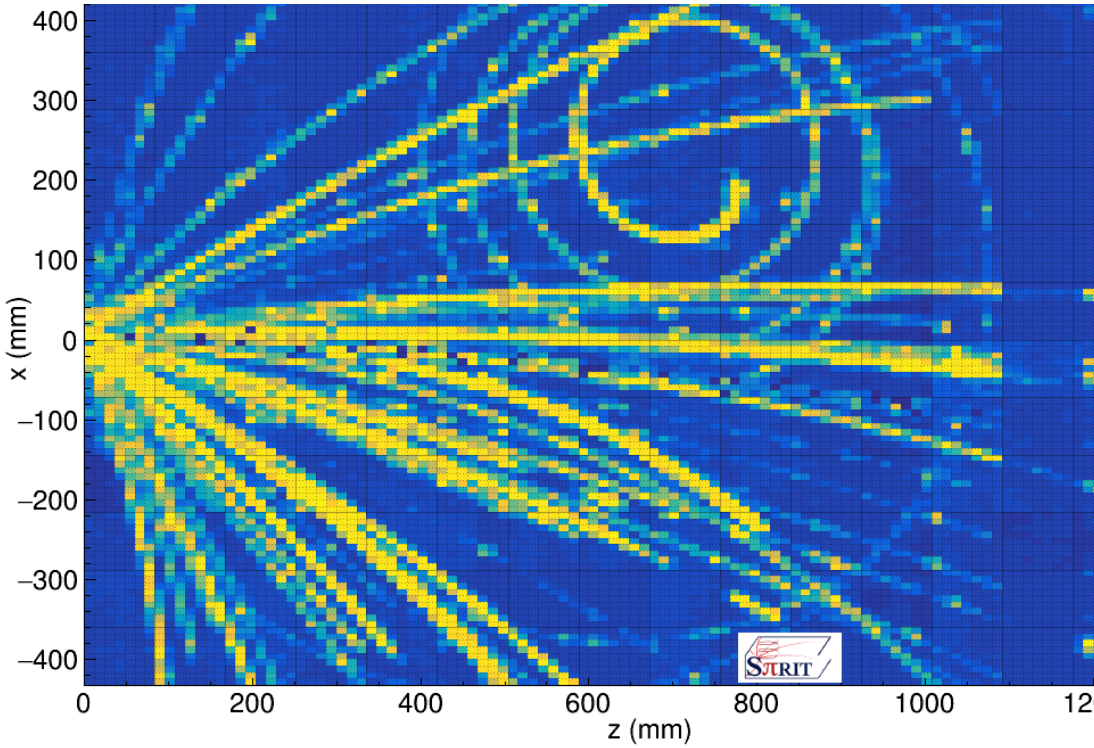
Isobe

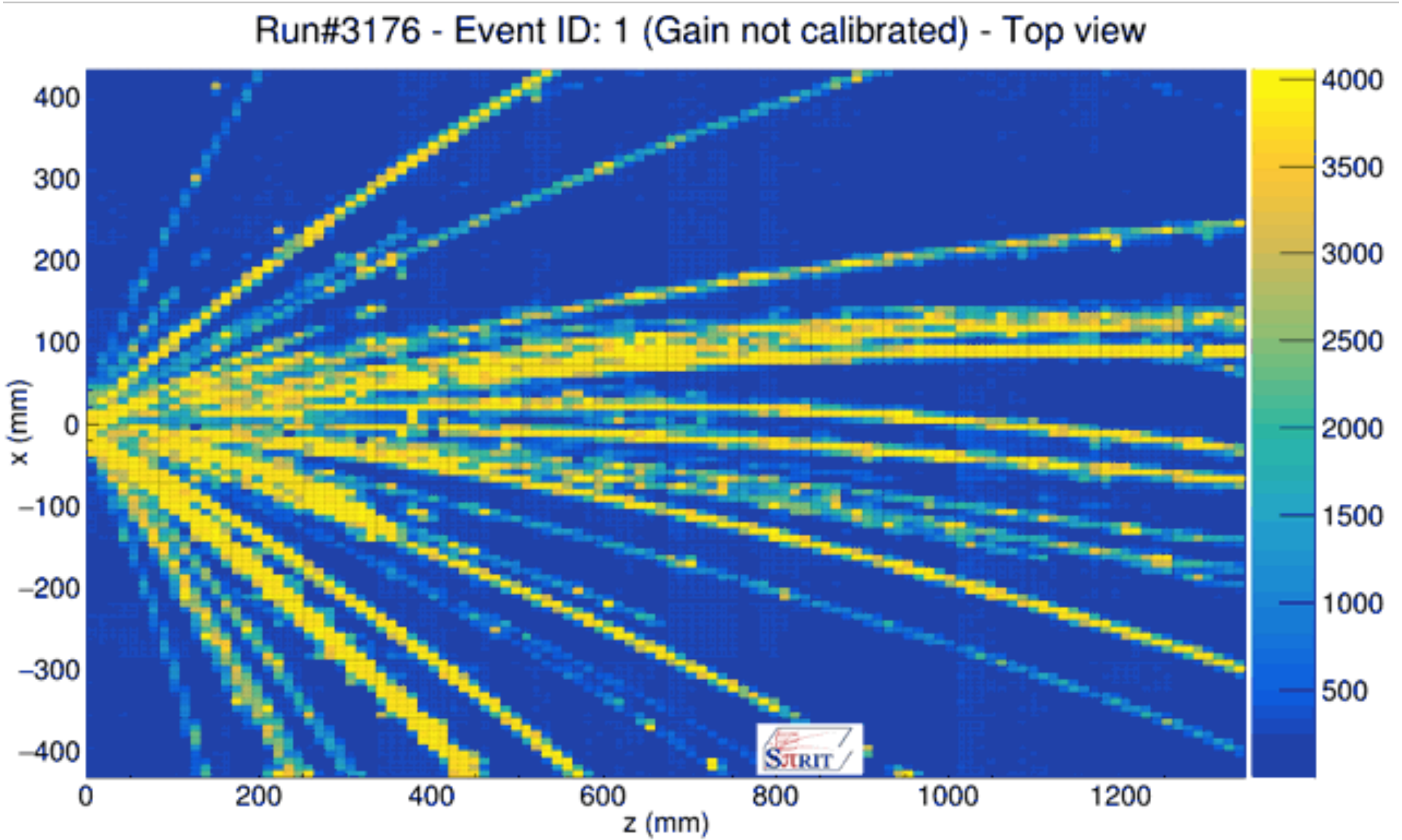
Comparisons of ATTPC and SpiRIT TPC events

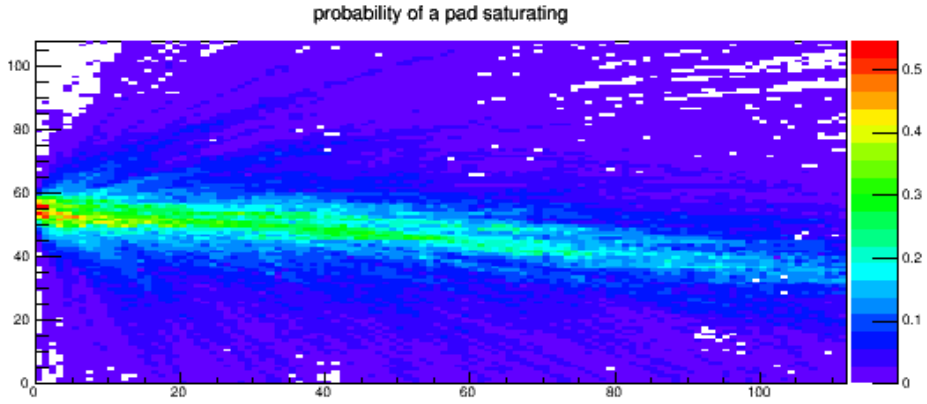


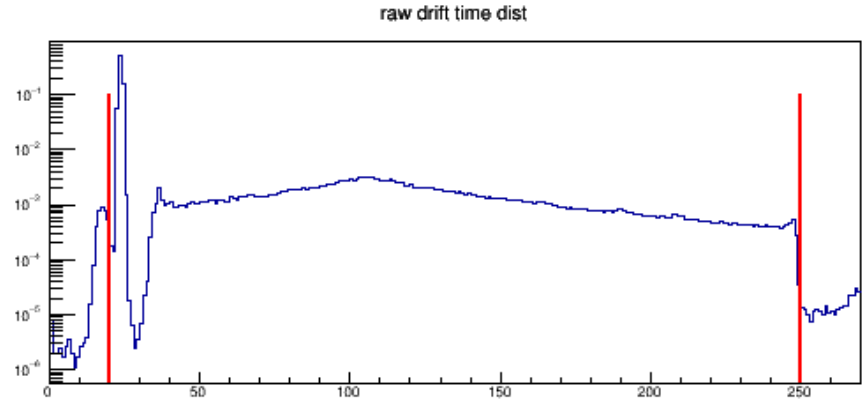
ATTPC from Ayyad

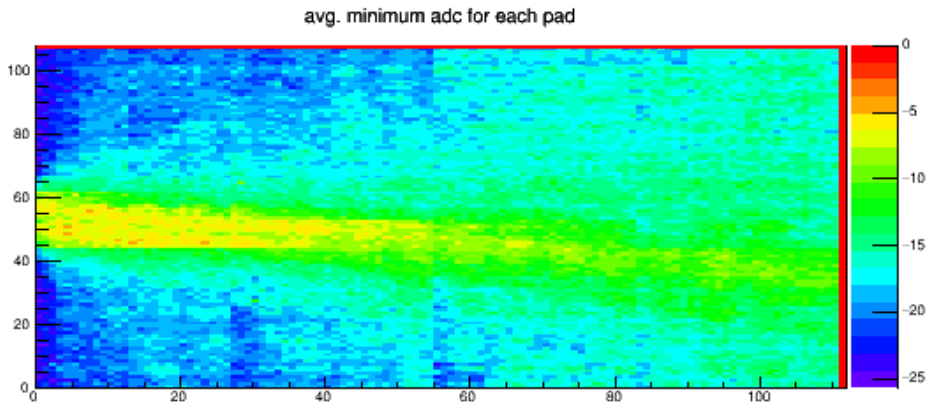


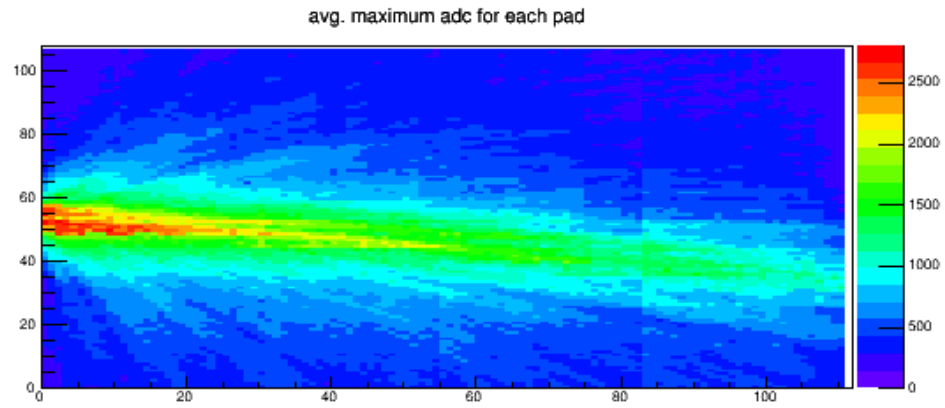


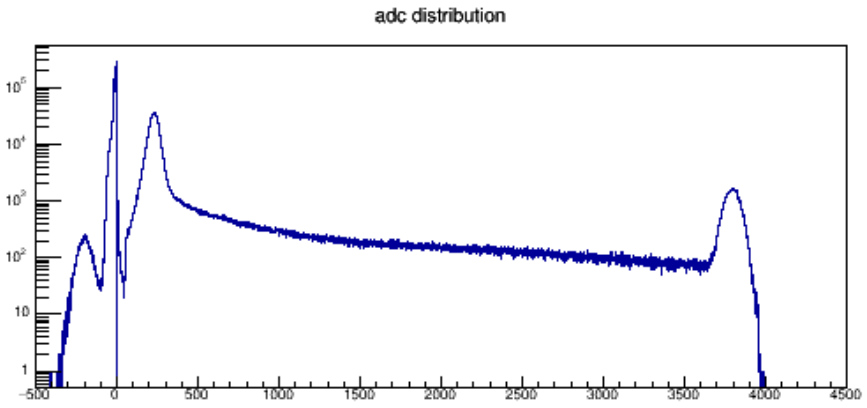

Run#3176 - Event ID: 1 (Gain not calibrated) - Top view
x (mm)
z (mm)
400
300
200
100
0
−100
−200
−300
−400
0
200
400
600
800
1000
1200
4000
3500
3000
2500
2000
1500
1000
500
SJTRIT

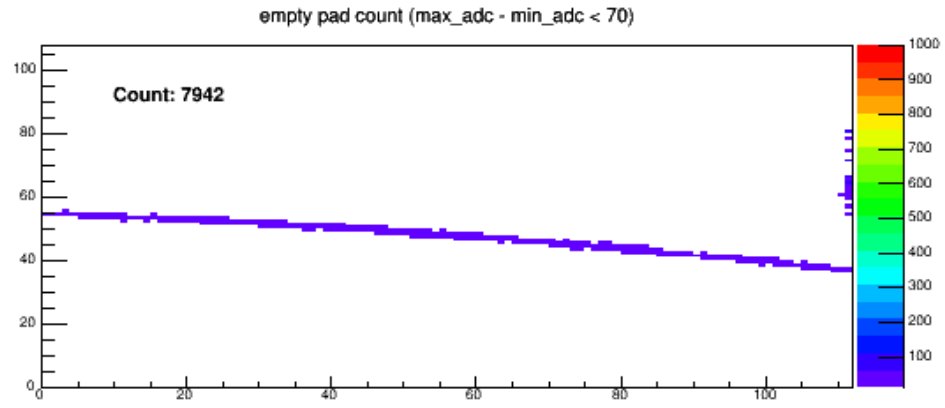

probability of a pad saturating


raw drift time dist


avg. minimum adc for each pad


avg. maximum adc for each pad


adc distribution


empty pad count (max_adc - min_adc < 70)
Count: 7942

Experiments with SpiRIT TPC

Oct, 2015: Beam test

April 2016: Commission

May 2016: 108Sn+112Sn

May 2016: 132Sn+124Sn

- 120MByte/sec/board → 1.4Gbyte/sec (max)
- 25MByte/sec/board → 300Mbyte/sec (prod. run)

- Data size/eve: 4(aget)x68(ch)x270(tb)x2x48(asad) = 7050240B ~ 7MB/eve
- ~260TB data were taken in two weeks beam time

- Raw data are located at RIKEN-HPC disk/tape.
- Accumulate ROOT-tree files which are produced for each subsystem.
- Analysis is being performed at RIKEN-HPC (may not be able to use the resource)

Workshop on "Software for Time Projection Chambers for Nuclear Physics Experiments" Aug 9-10, 2016, NSCL/FIRB

Data Analysis Requires intensive CPU & large storage

- CPU from iCER (MSU-HPC) but cannot handle storage >3Tb (rental: $175/TB/yr)
- Acquiring 394 TB storage space at NSCL – mid September?
- 24 (?) nodes of CPU to run jobs?
- Create a high speed connection to marry NSCL storage to HPCC@MSU (596 nodes ~ 15340 cores) for analysis

Data transfer via Globus (20-40 MB/s); 260 TB ~ 75-150 days

Implications for FRIB in 5 years

DAQ rate/CPU: GB/sec
DAQ network: 10s GB/sec
High Speed Data transfer: via Globus (20-40 MB/s) from the lab?

Data Analysis Requires intensive CPU & large storage

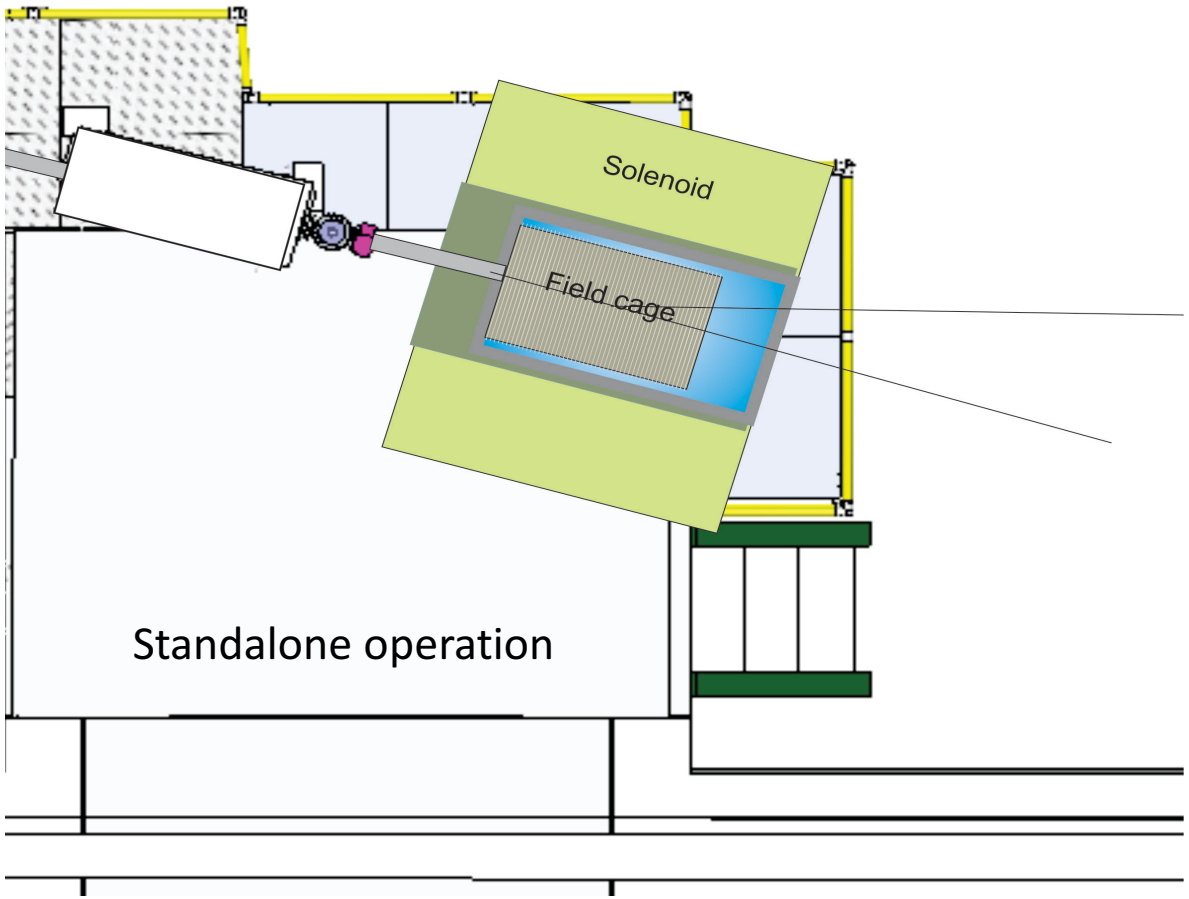
- Scalable storage space at NSCL (>1000 TB)
- CPU from HPC's or home clusters
- A high speed connection to connect NSCL storage to HPCC@MSU

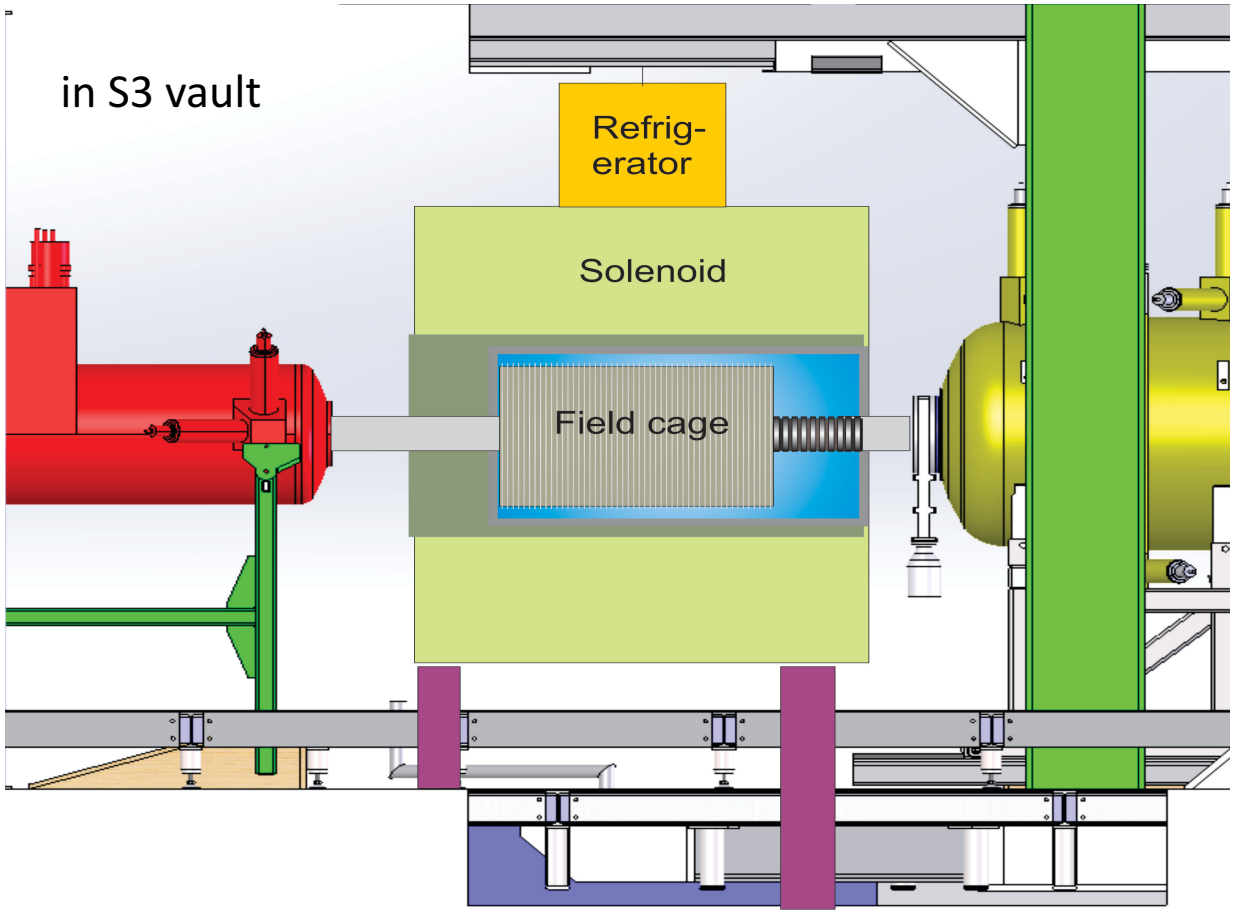
Questions: Giordano Cerizza

DAQ dead time: 2~3msec

- TPC: 0.8 msec
  - Much longer in the case of more than 100Hz trigger rate because of multi-event buffer in CoBo.
  - Data size/eve: 4(aget)x68(ch)x270(tb)x2x48(asad) = 7050240B ~ 7MB/eve
  - 256MByte RAM on CoBo : buffer for 36 events
- Spvme(scaler, input register): 120 μsec
- **Katana: 2~3msec**
- b3f-vme(BigRIPS plastic): ~300 μsec
- Sva03(BigRIPS): ~100 μsec
- Sva01(F7-IC) 100 μsec
- BDC: ~120 μsec
- NeuLAND: ~100 μsec

For NSCL/FRIB: Western Michigan Active Target





- Adopts much of the design of the AT-TPC
  - Solenoidal magnetic field (using portable MRI magnet).
  - MICROMEGAS gas amplification

Differences:

Beam enters through MICROMEGAS

Cathode allows passage of charged particle ancillary detectors downstream.