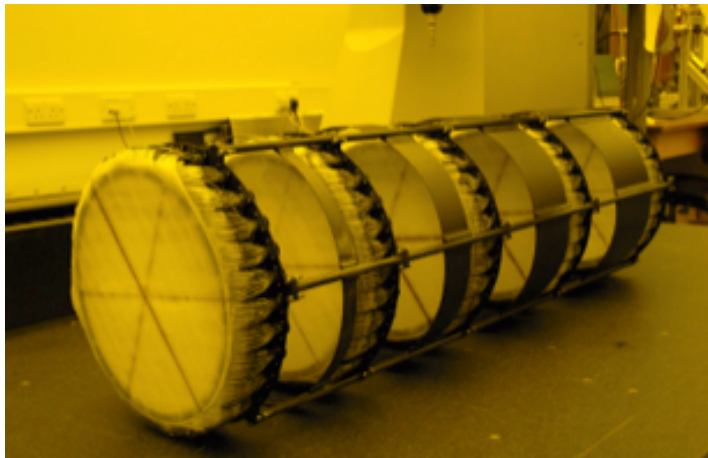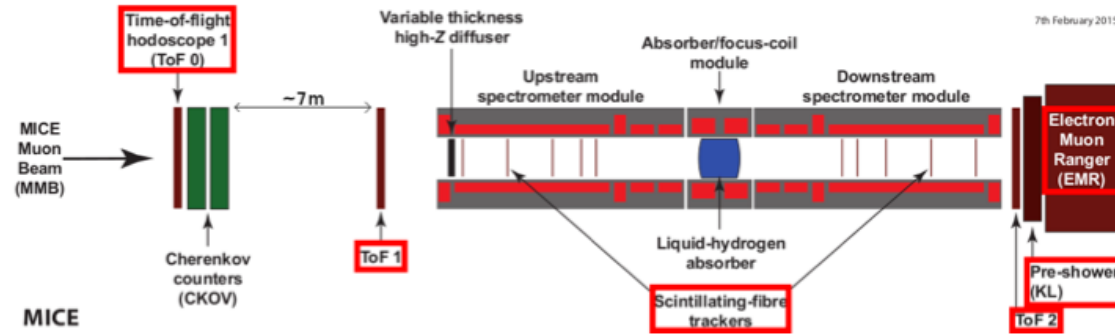# MICE Tracker Software

Durga Rajaram
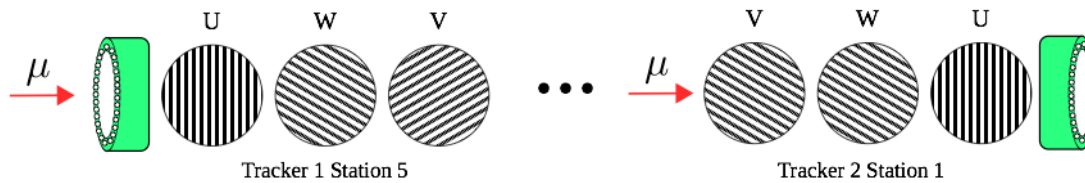
MAP Meeting
Feb 12, 2016

MICE TRACKERS

- 2 Trackers
- 5 stations each
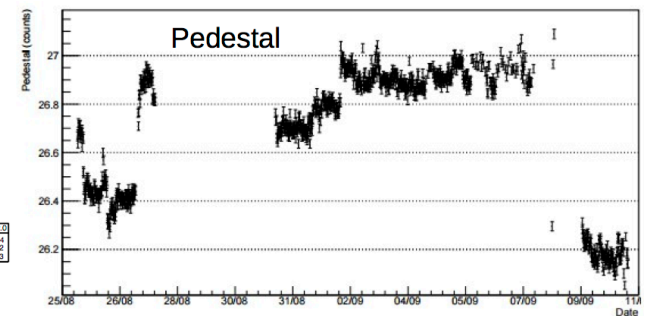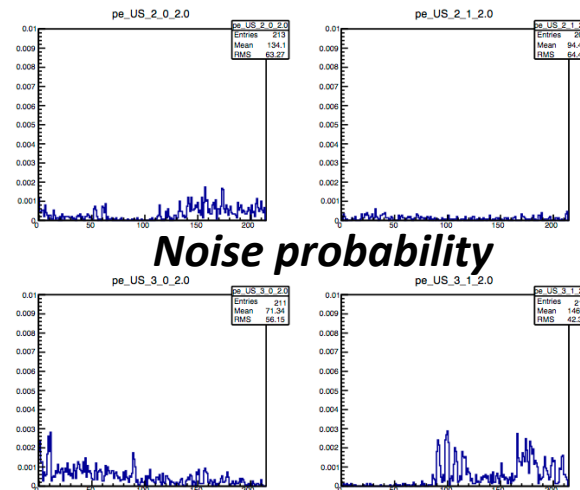- 3 views at 120°
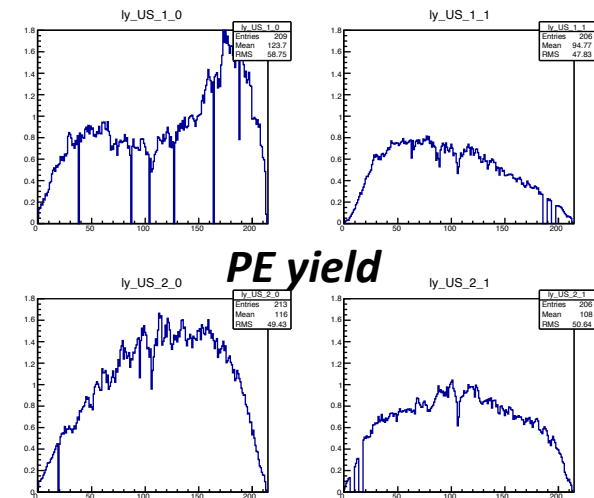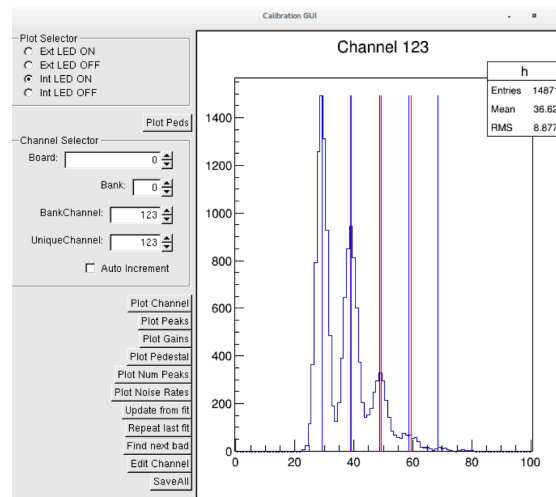
MICE TRACKERS - SOFTWARE

- Readout: DAQ: ADC for each channel
- Software:
  - Unpacking of raw DAQ readout
  - Digits from hits
  - Clusters from digits
  - Spacepoints from clusters
  - Tracks from spacepoints
    - Pattern recognition
    - Kalman filter optimization
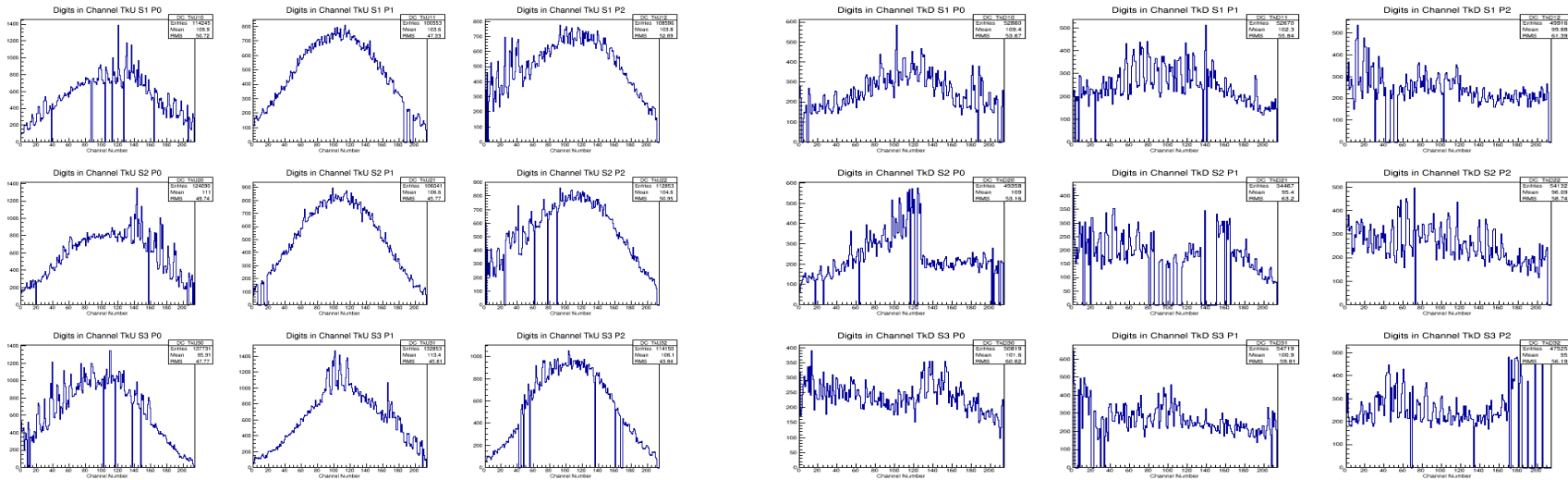
MICE TRACKERS - SOFTWARE

- Digits:
  - ADCs converted to #P.Es,DAQ channel# mapped to tracker/ station/plane/channel
  - For MC, digits produced from GEANT hits
- Clusters:
  - Digits from adjacent channels
- Spacepoints:
  - Crossing of clusters from different views in a station
  - Triplets formed, then search remaining clusters for duplets, singlets
- Tracks:
  - Pattern recognition: fit spacepoints (line, or circle)
  - Kalman filter: accounts for scattering and energy loss, find optimal track parameters

MICE TRACKERS - CALIBRATIONS

- Purpose: ADC->#pe conversion, find dead channels
- Calibration done with internal LEDs
  - Semi-automated, plan is do a calibration check at start of day
- Calibrations checked, posted, uploaded to DB
- Downstream tracker a little noisier, for some runs. Being investigated.
  - Important to monitor dead/noisy channels
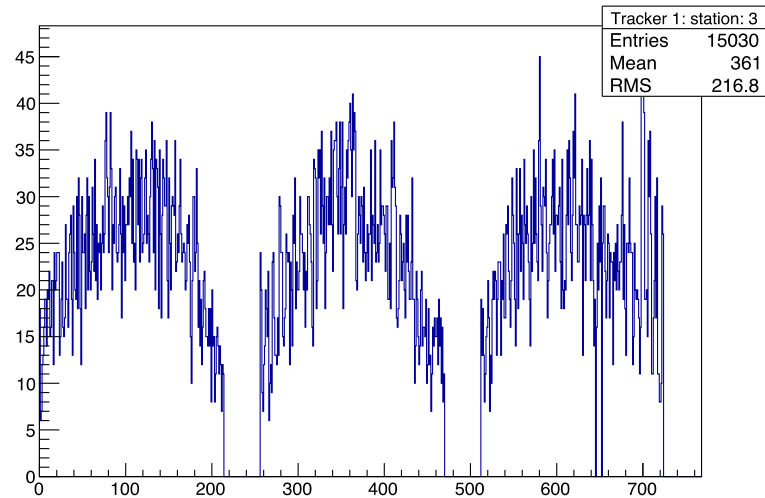

PE yield

Noise probability

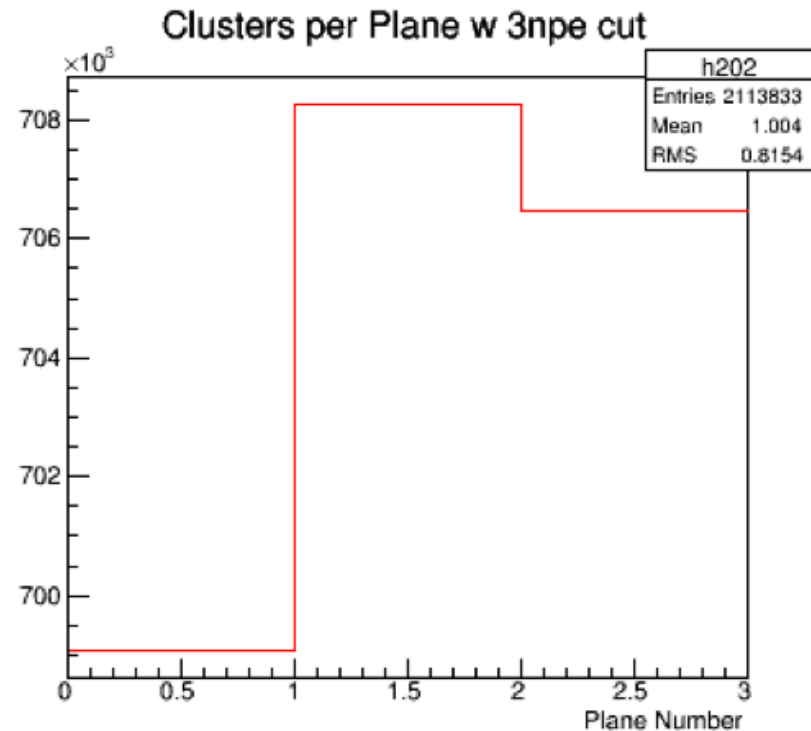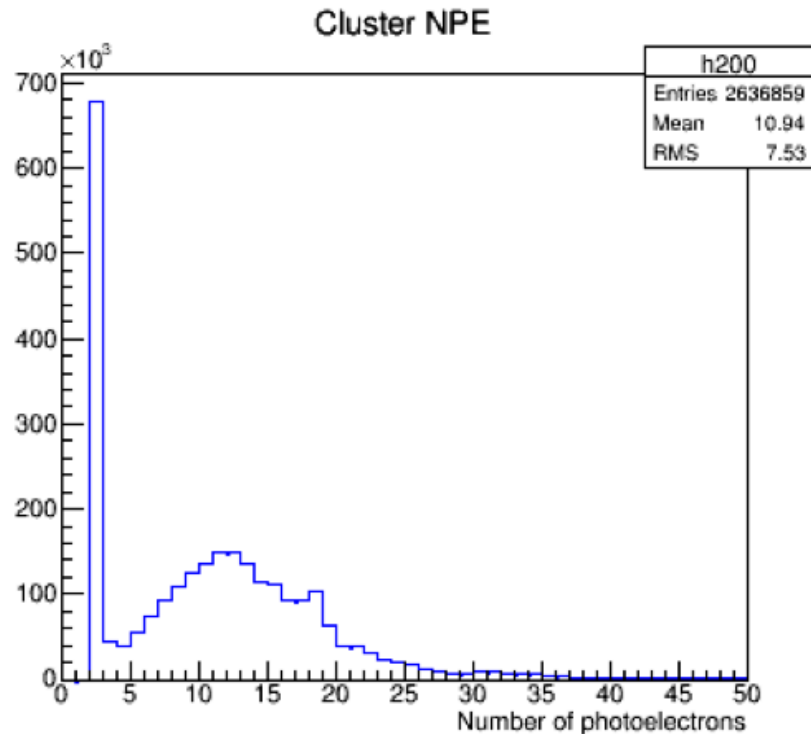Pedestal

MICE TRACKERS – SOFTWARE: DIGITS

Tracker 1: station: 3

- Calibrations are applied to unpacked data and each hit is stored with its plane channel# and #npe
- Downstream noisier for some runs.
  - Some recalibration done, being checked
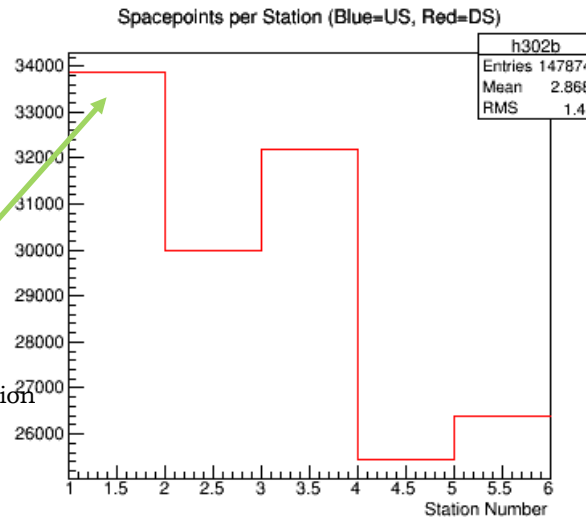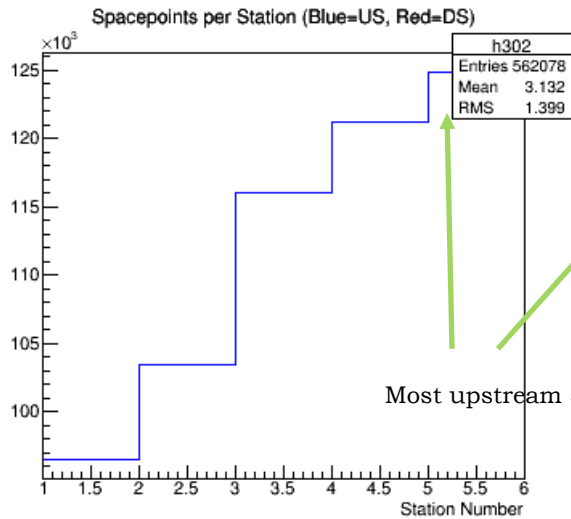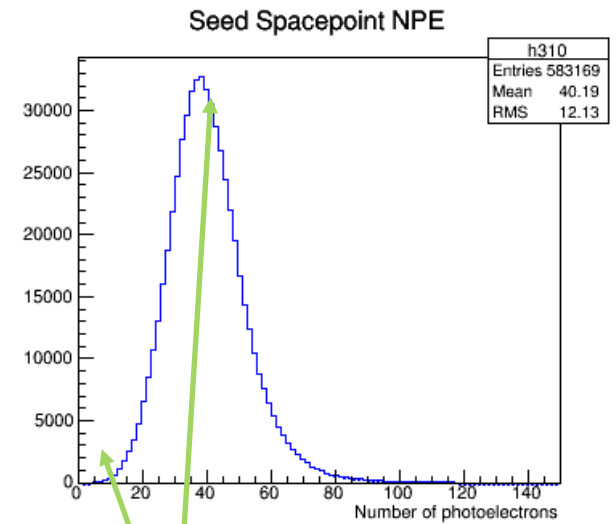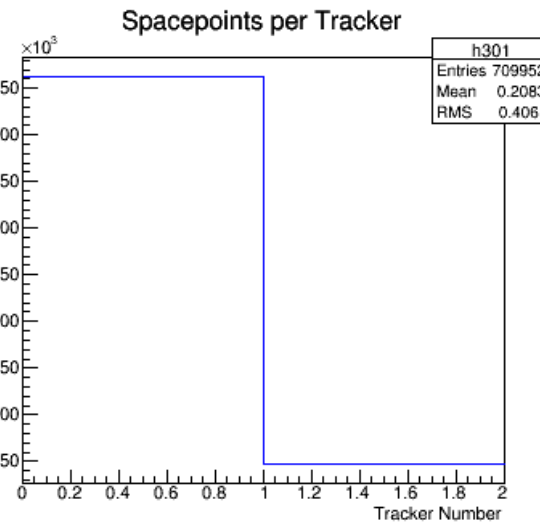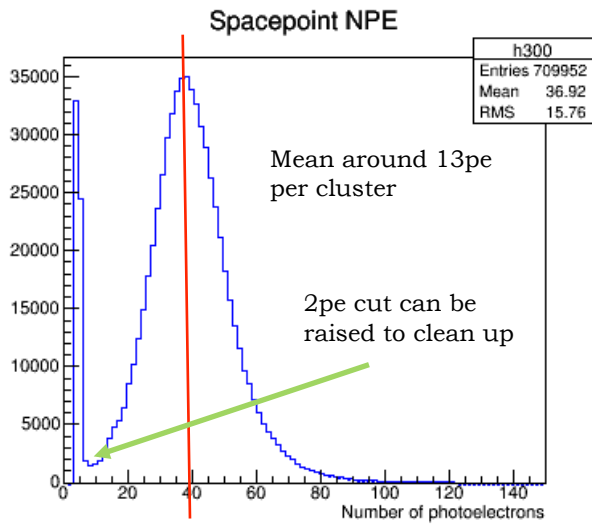 - Regardless, requiring 1 hit/plane cleans up

MICE TRACKERS – SOFTWARE: CLUSTERS

- Cut in software during cluster formation is very loose. Can be tightened during later reconstruction
- Both 2-digit and 1-digit clusters are saved
- Verified that the ration of #2-digit-clusters to #1-digit-clusters is what is expected from geometry
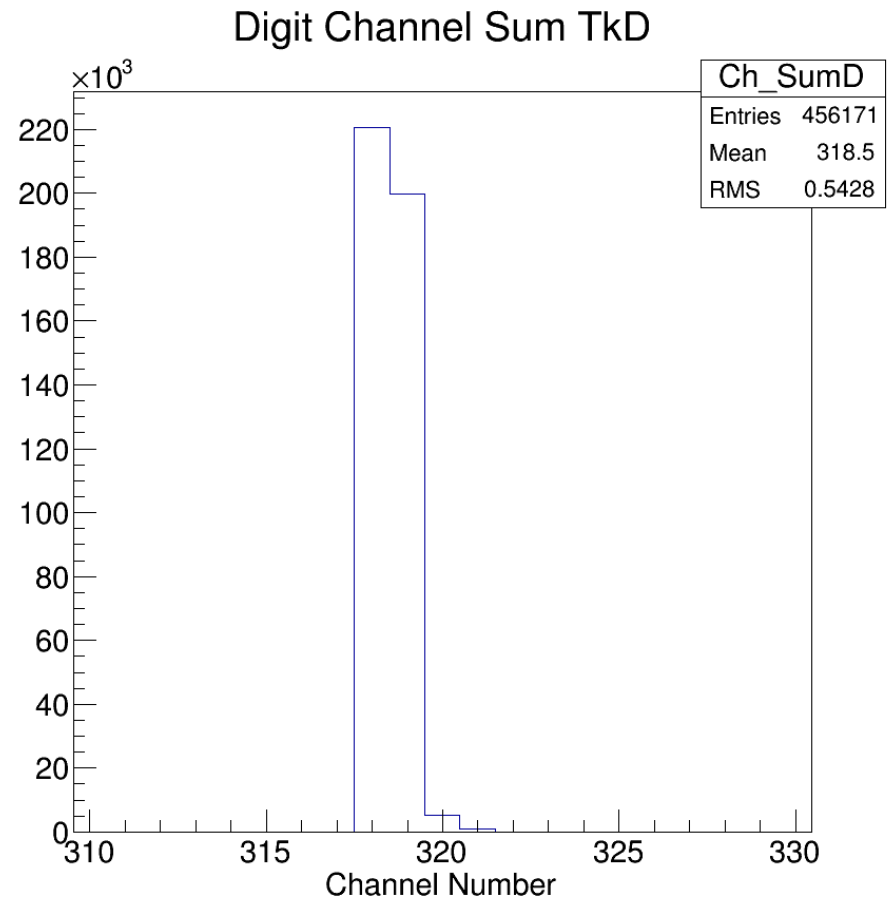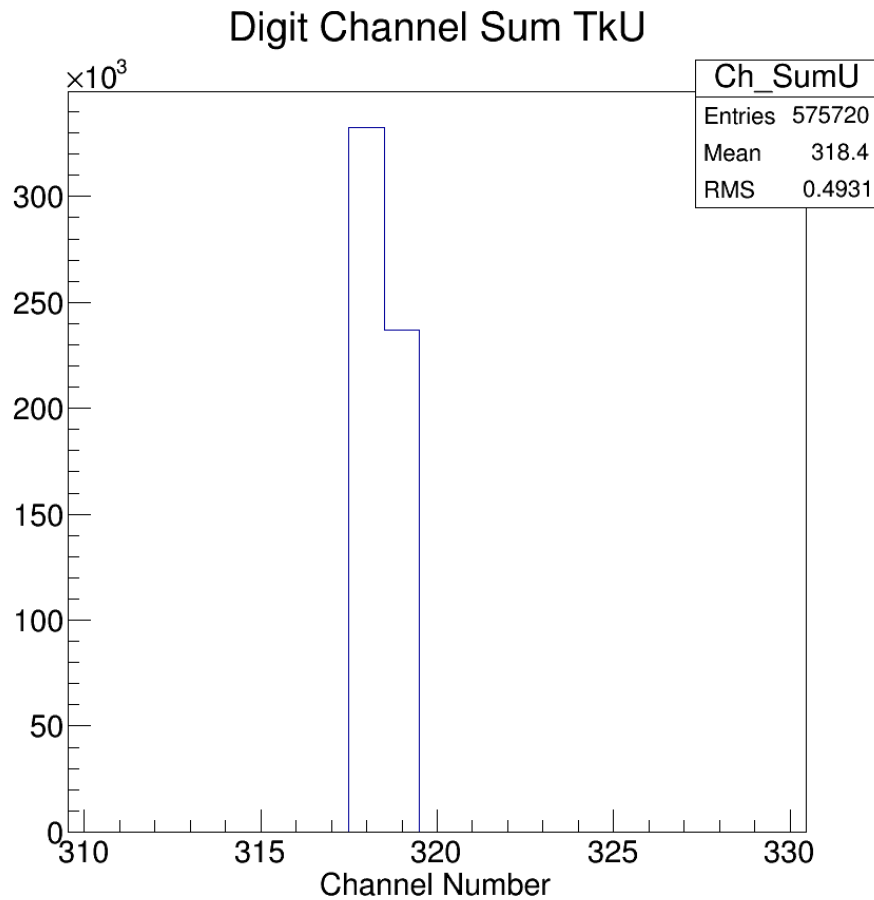
MICE Trackers – Software: Spacepoints

Spacepoint NPE

Mean around 13pe per cluster

2pe cut can be raised to clean up

Spacepoints per Tracker

Seed Spacepoint NPE

Spacepoints used in tracks.
Noise has gone.
Peak the same

Spacepoints per Station (Blue=US, Red=DS)

Most upstream station

Spacepoints per Station (Blue=US, Red=DS)
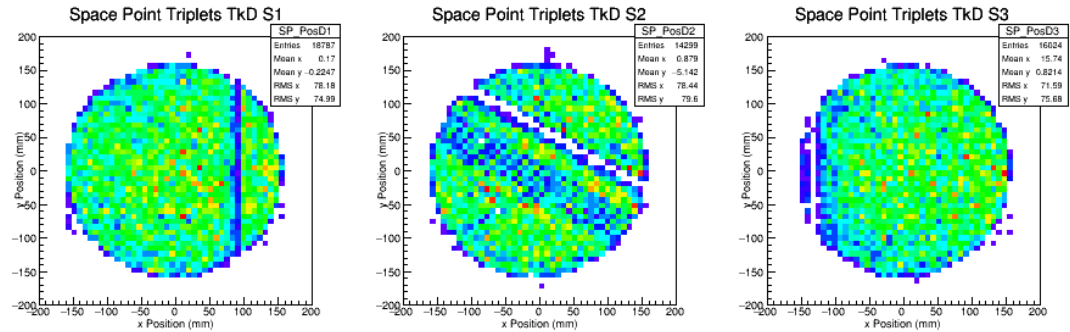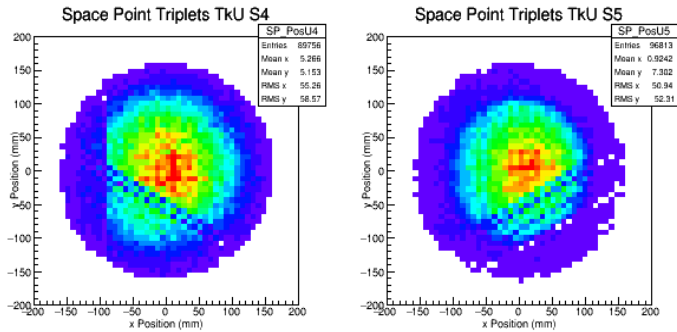
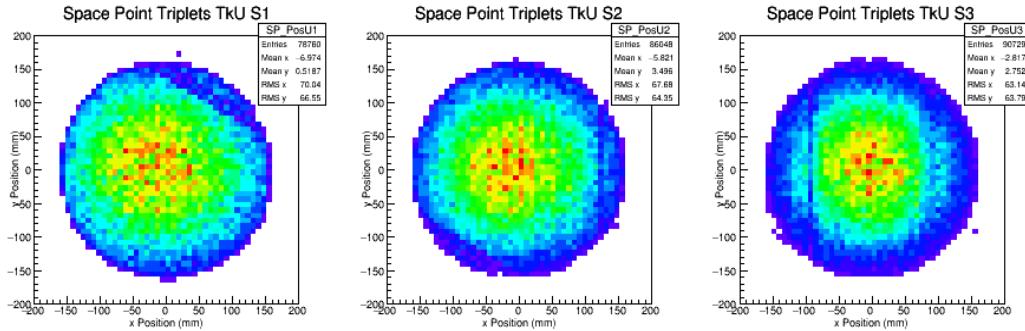SP efficiency >99% for both trackers

MICE TRACKERS – SOFTWARE: SPACEPOINTS

- Kuno's conjecture: for a triplet spacepoint, sum of cluster channel #s = constant
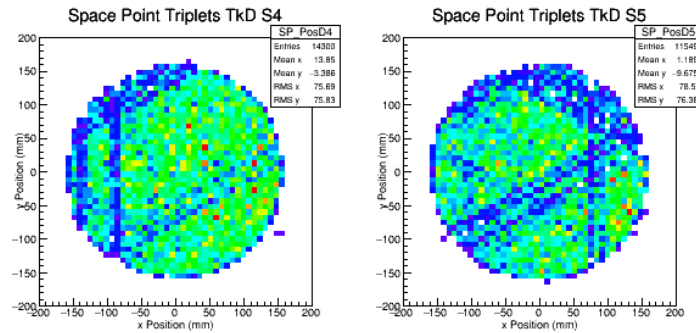 - Verifies that the mapping is correct

Digit Channel Sum TkU

Digit Channel Sum TkD

MICE TRACKERS – SOFTWARE: SPACEPOINTS

UPSTREAM

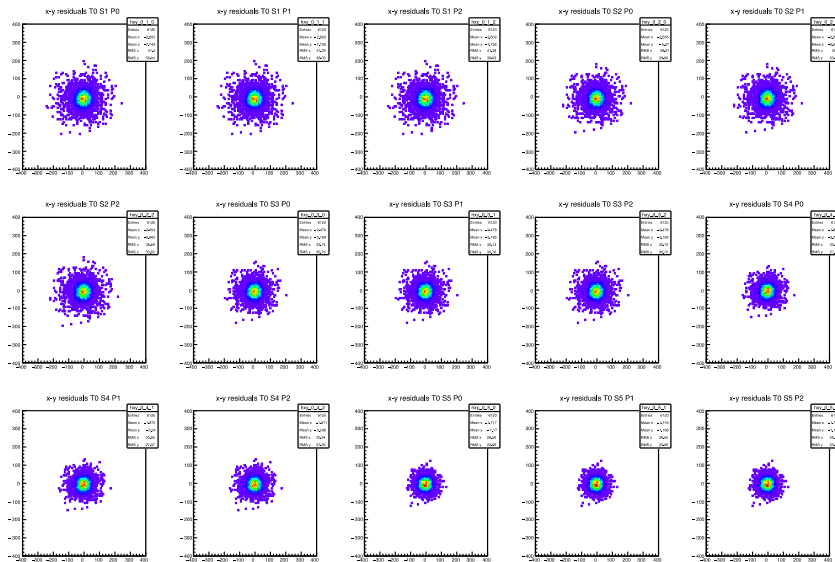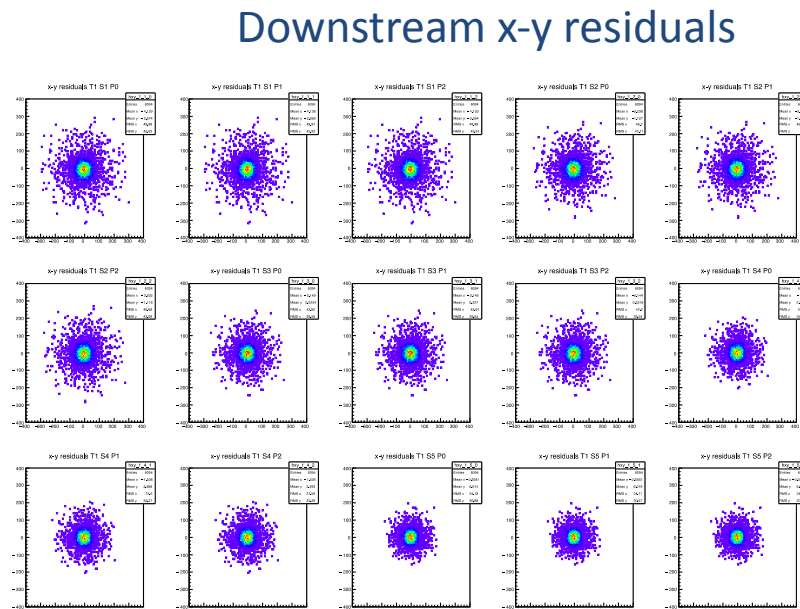**DOWNSTREAM**

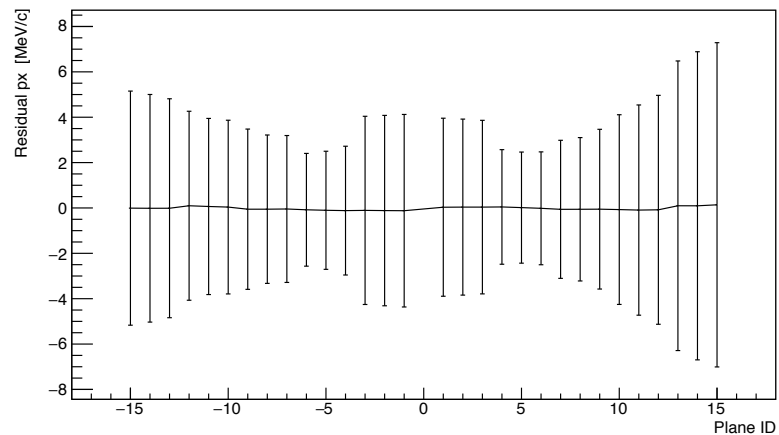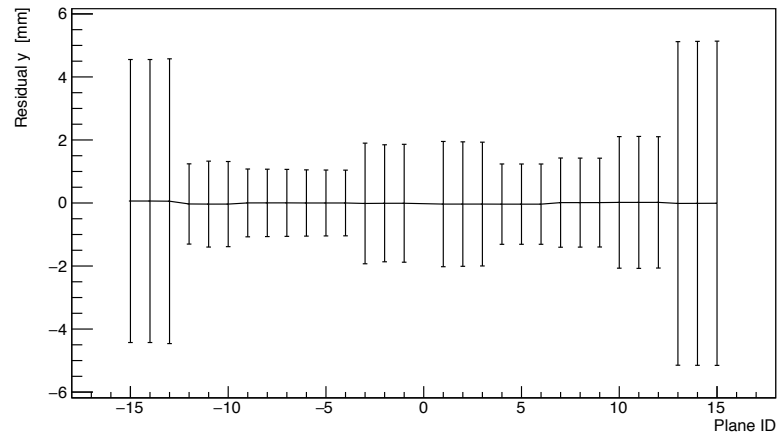# MICE Trackers – Software: PR Tracks

Upstream x-y residuals

Downstream x-y residuals

- Keep 3,4, 5 point tracks
- Spacepoints not part of track are marked
- Good reconstruction even in the presence of noisy channels
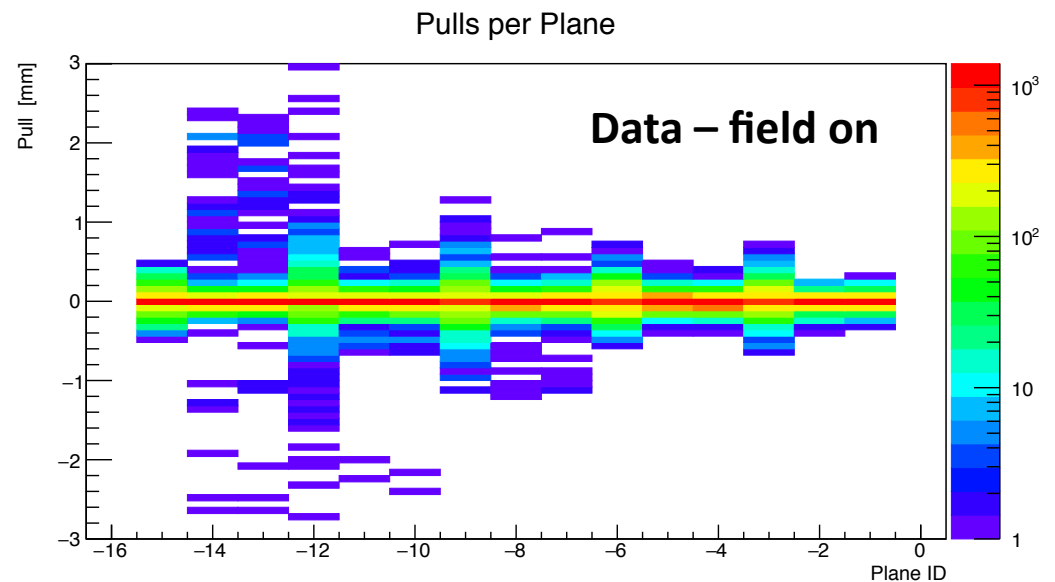
MICE Trackers – Software: Helicals

- Some bugs fixed. Resolutions check out in MC

- For data, # purely 5-point tracks a little low, fits being investigated

MICE Trackers – Software
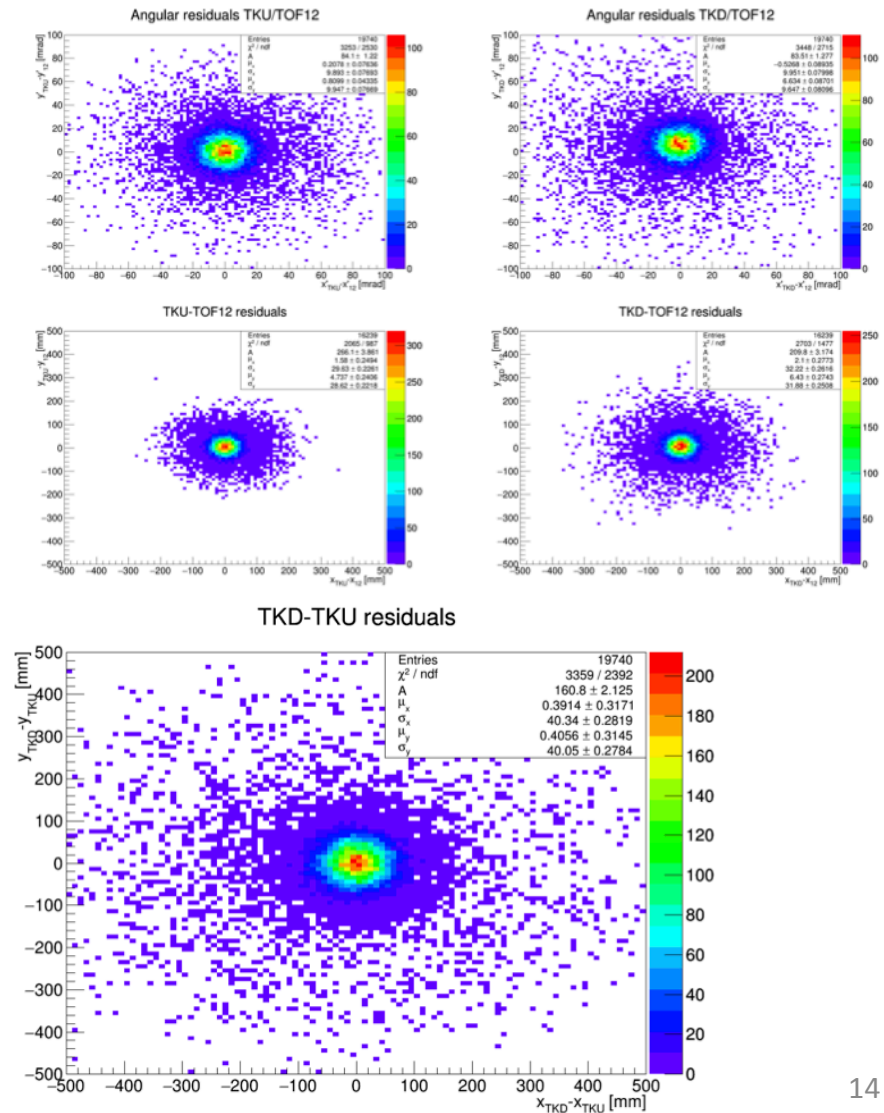
- Improvements to Kalman addresses issues with resolutions and pulls

- MC being validated

MICE TRACKERS - SOFTWARE

- Making sure the geometry representations and global transformations and alignments are correct by looking at trackers wrt other detectors

- Alignment corrects being applied to survey-geometry and reprocessed data being checked

Alignment results provided by 07417

MICE TRACKERS - SOFTWARE

- Systematic validation of tracker software all the way from calibrations to track finding
- Several issues found and fixed (coordinate transformations, mapping, geometry description, fits)
- Efficiencies high for spacepoints & PR tracks
- Some inefficiency for helical tracks being addressed
- Geometry-handling issues in MC being validated
- Several layers of monitoring have been put in place to catch failures (readout, calibration, reconstruction)
- Improvements down the road (e.g non-constant field)