Tracker Reconstruction Performance

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CM45 29/7/16

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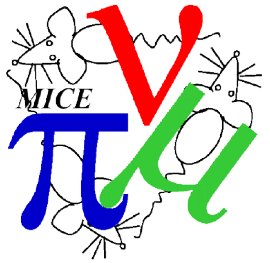
Tracker Operation

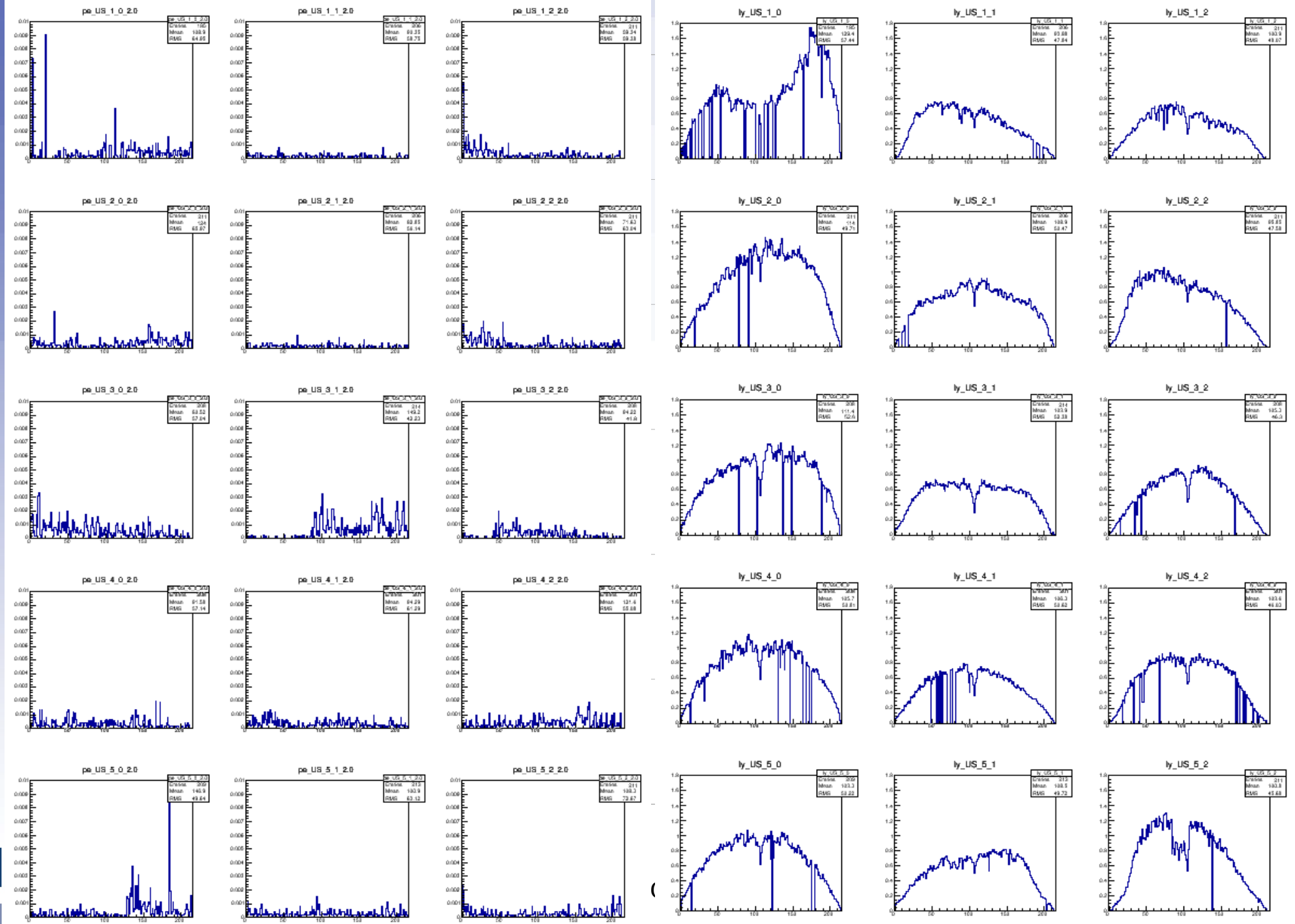


- Tracker systems have been stable since CM43.
  - No major changes to Hardware/Controls/DAQ, just minor improvements.
- Calibration Improvements have been operating well (master updates before each cycle and daily updates to account for small shifts).
- Helium in both trackers and working well, with no unacceptable leaks.
- Hall probes operating well,
  - Caveat: One was pulled out by the cable during commissioning works some time in May, this HP now sporadically fails and is being re-cabled.
- Data taking going very well with no interruptions from the Trackers.
- Online reconstruction and Reconstruction performing well.

NOISE

Tracker Calibration

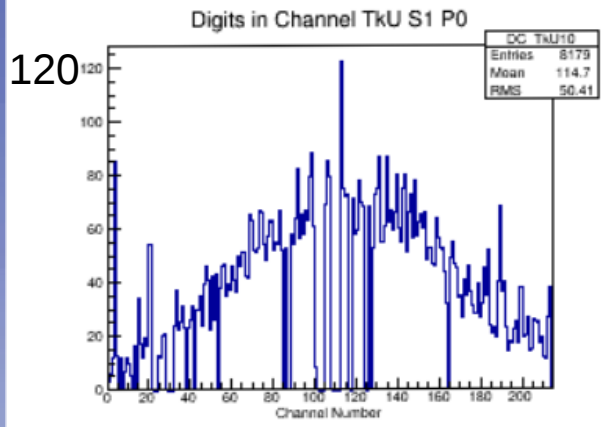
LED

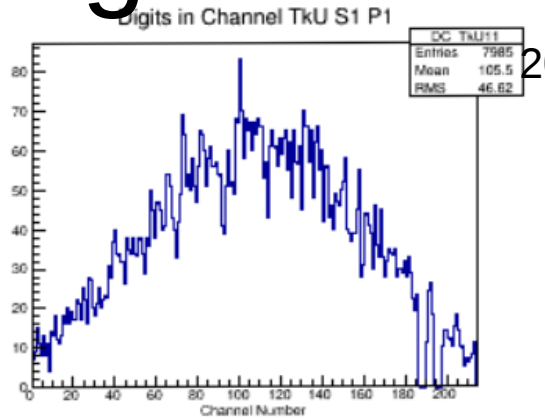


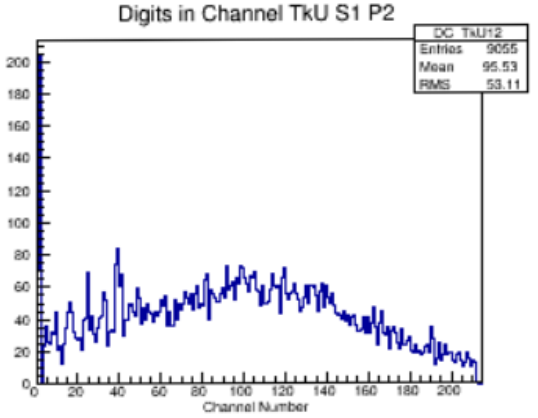
Tracker Reconstruction and Data Validation

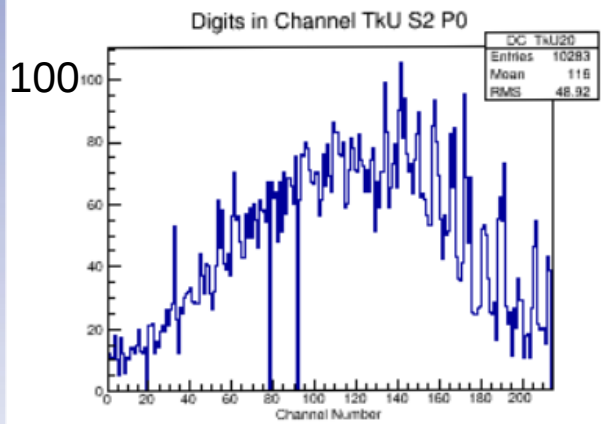
- Data is analysed for validity within ~24 hours turnaround.
- All reconstruction level plots and efficiency are available online through http://www.hep.ph.ic.ac.uk/~mgeorge/Files/2016MICEData/
- There are two scripts available through MAUS for validation and efficiency work and the full set and structure will be implemented soon.

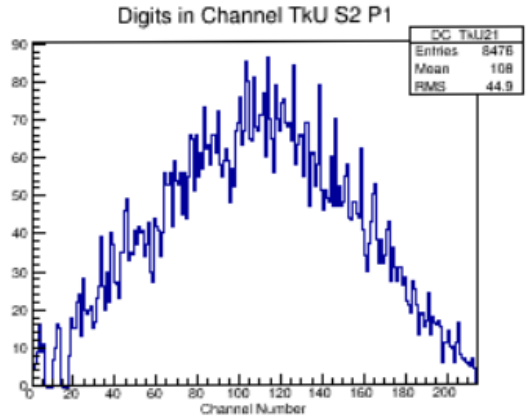
Digits, US, MAUS v2.5, Straight 7986

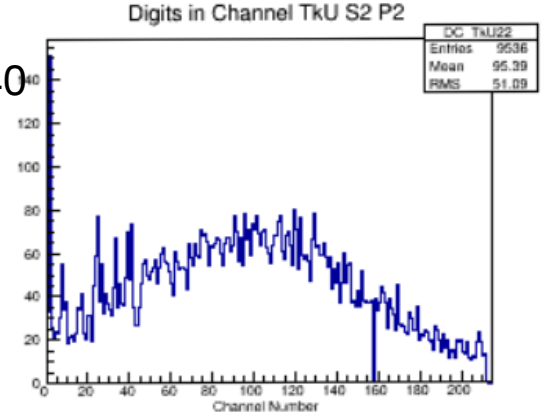


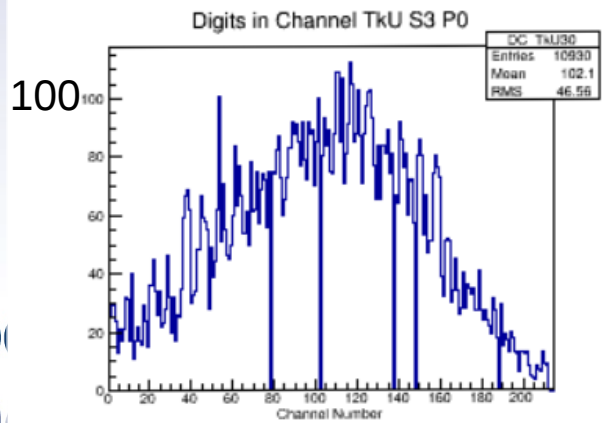


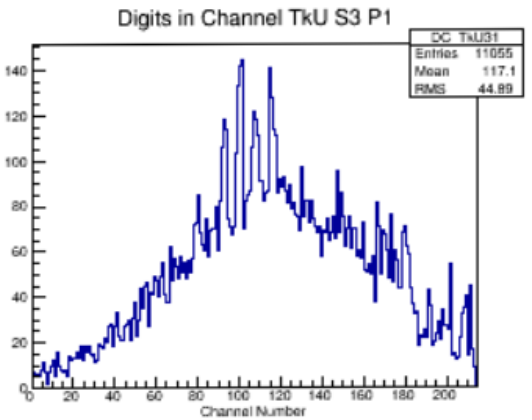


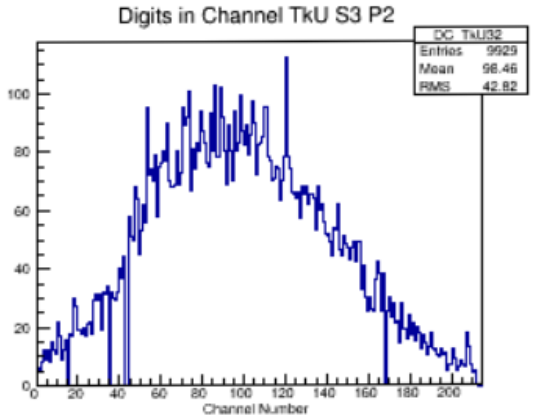




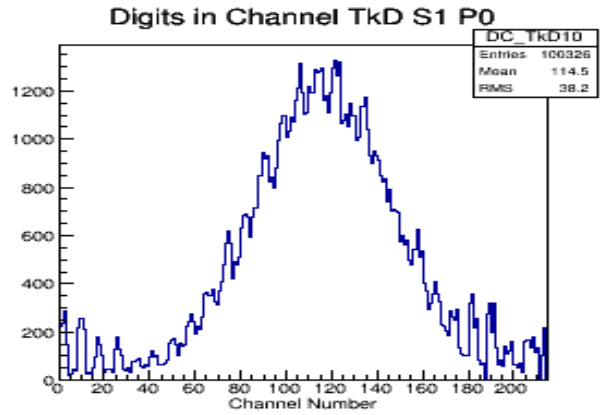


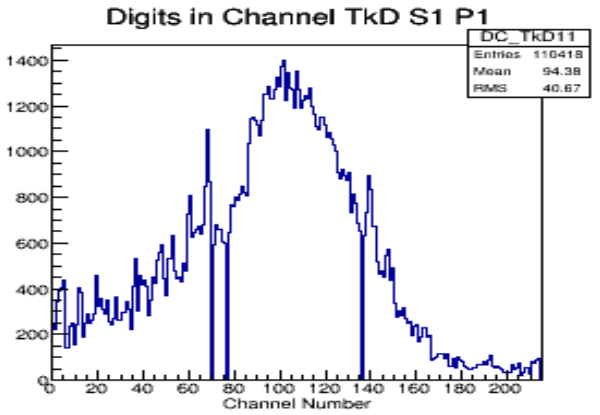


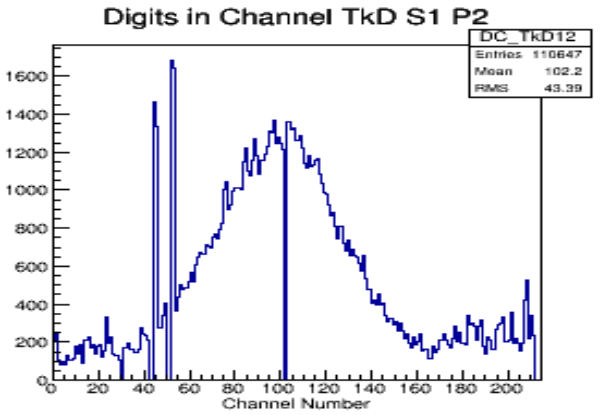


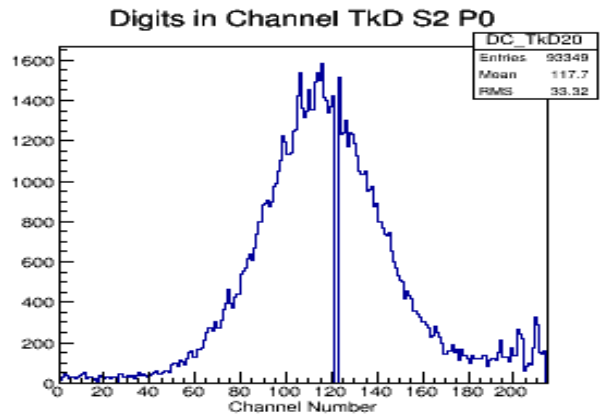


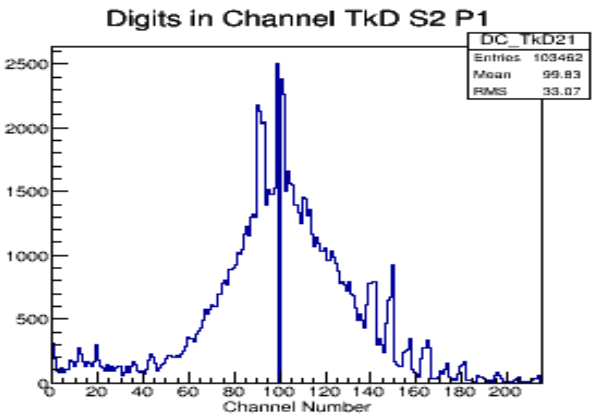
Digits, DS, MAUS v2.5, Helical ALL MAGNETS 8157

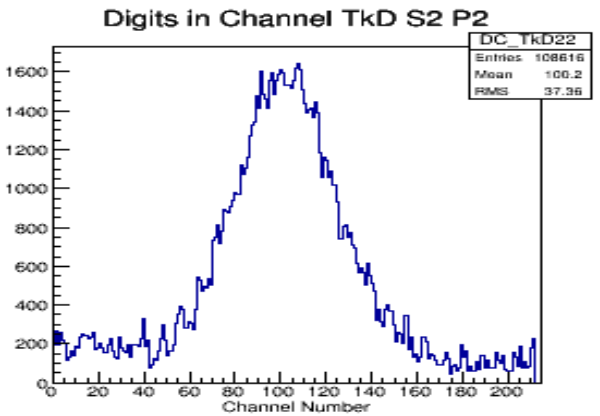


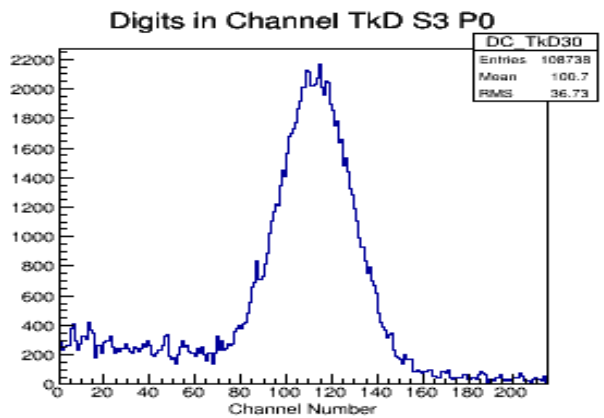


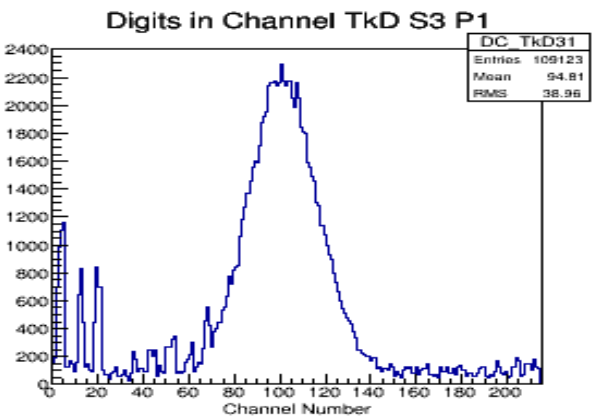


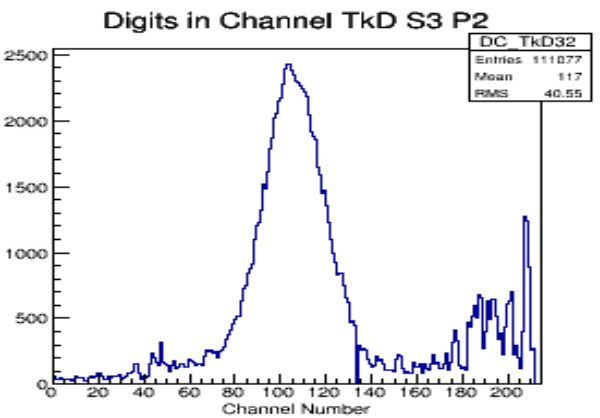




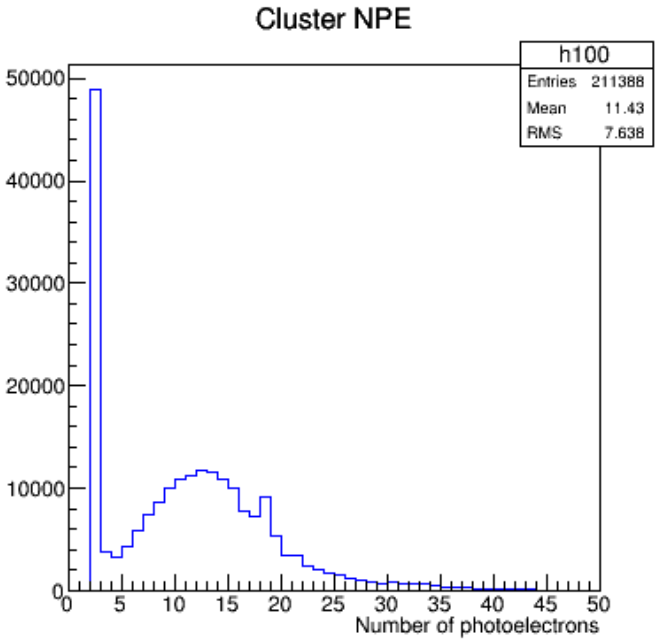


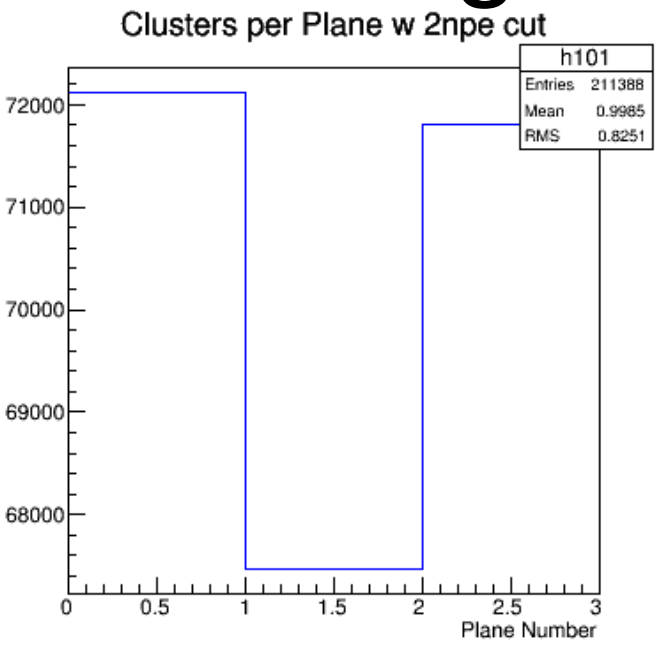


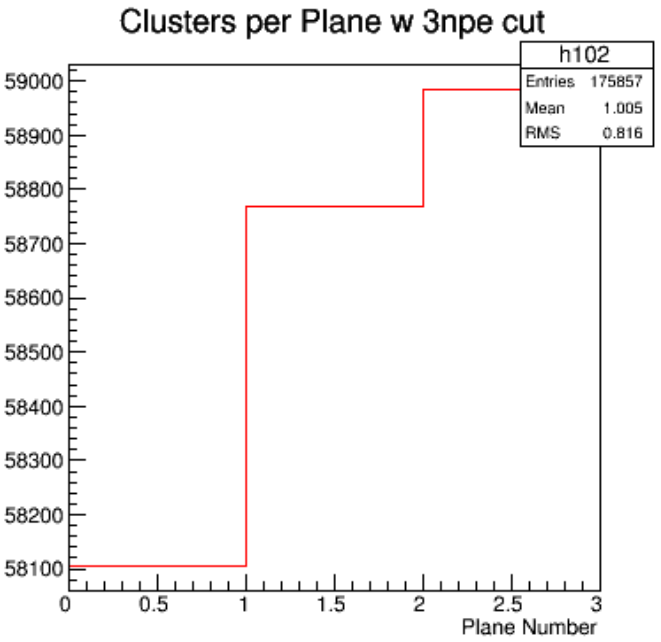


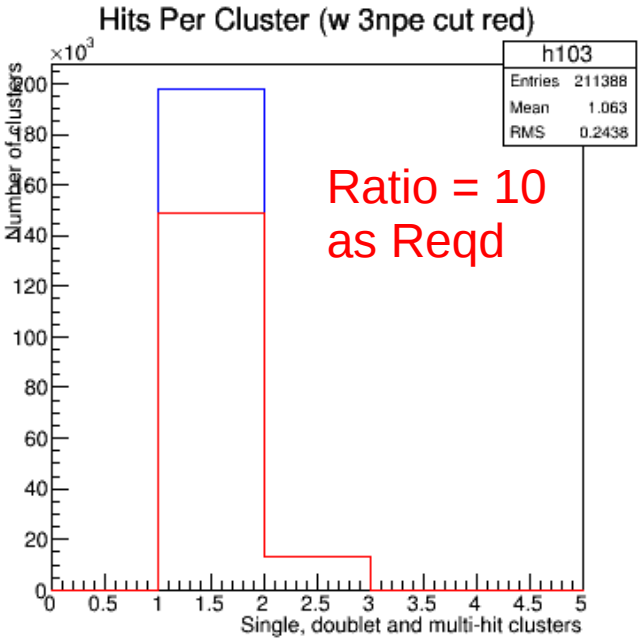


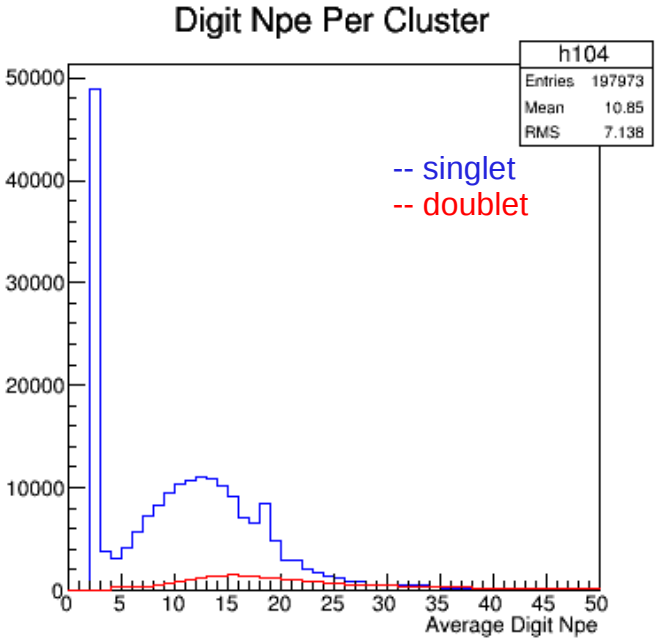
Clusters, Straight 8042

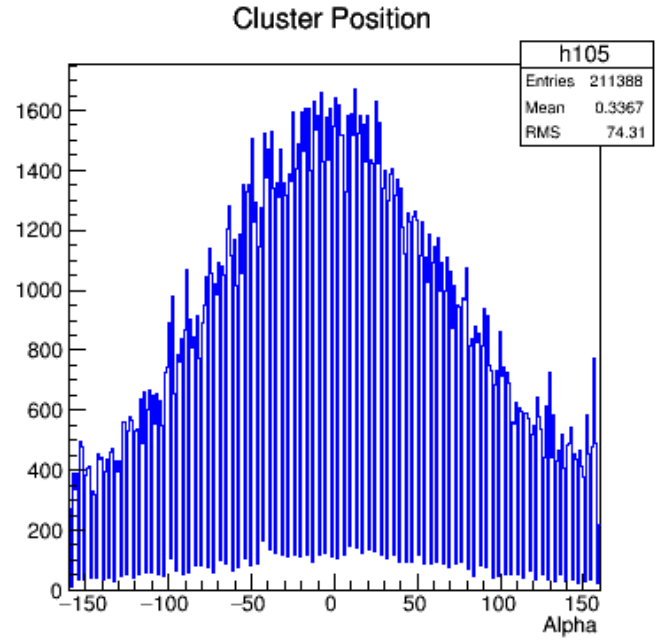




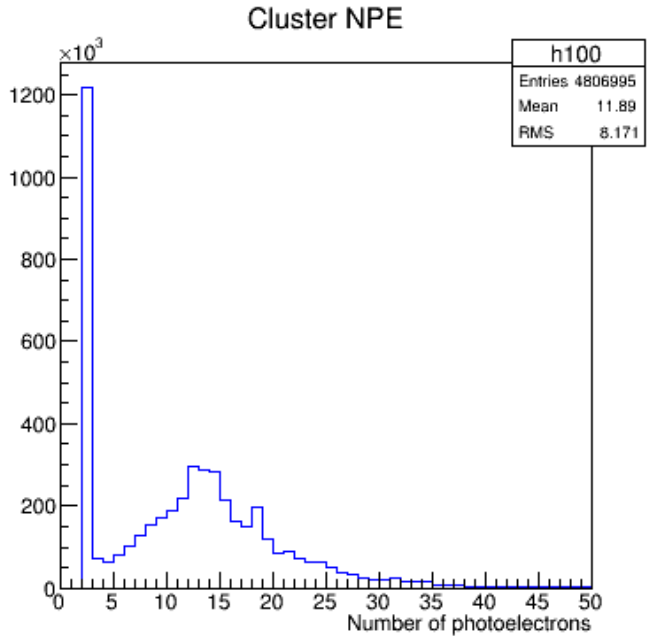


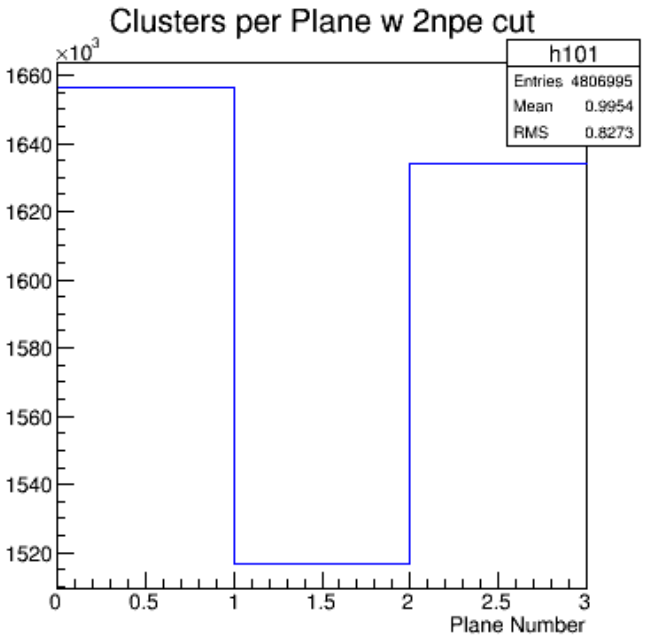


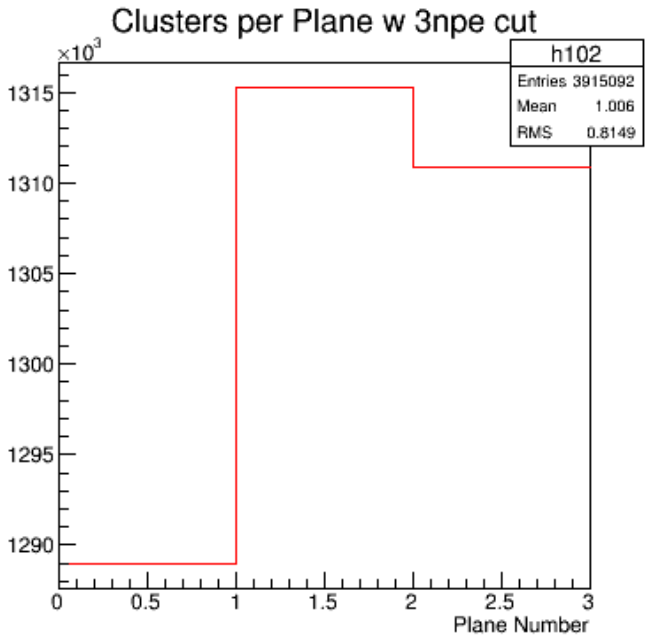


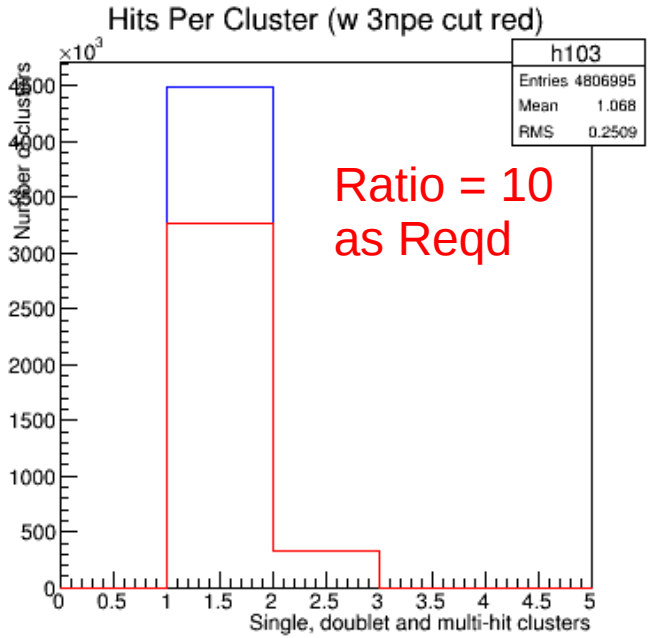


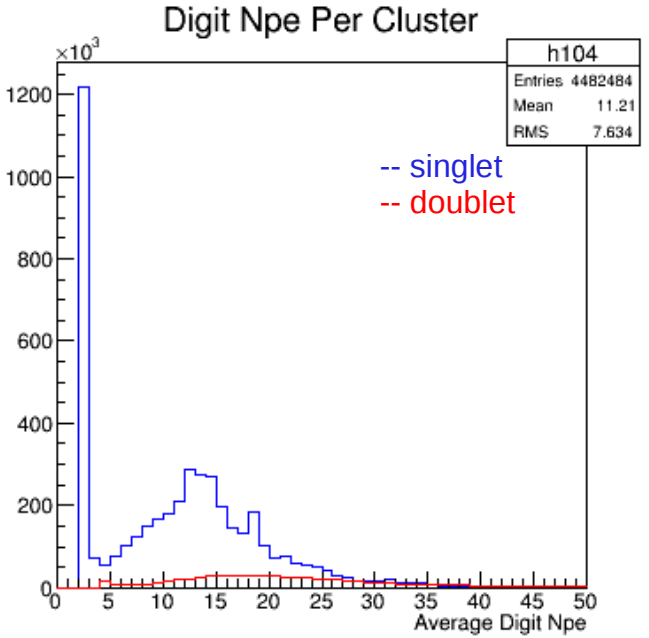
Clusters, helical 8155

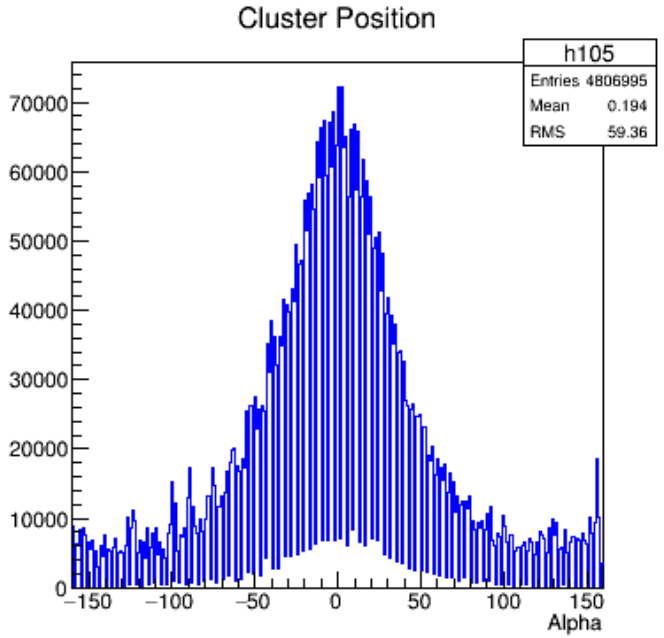




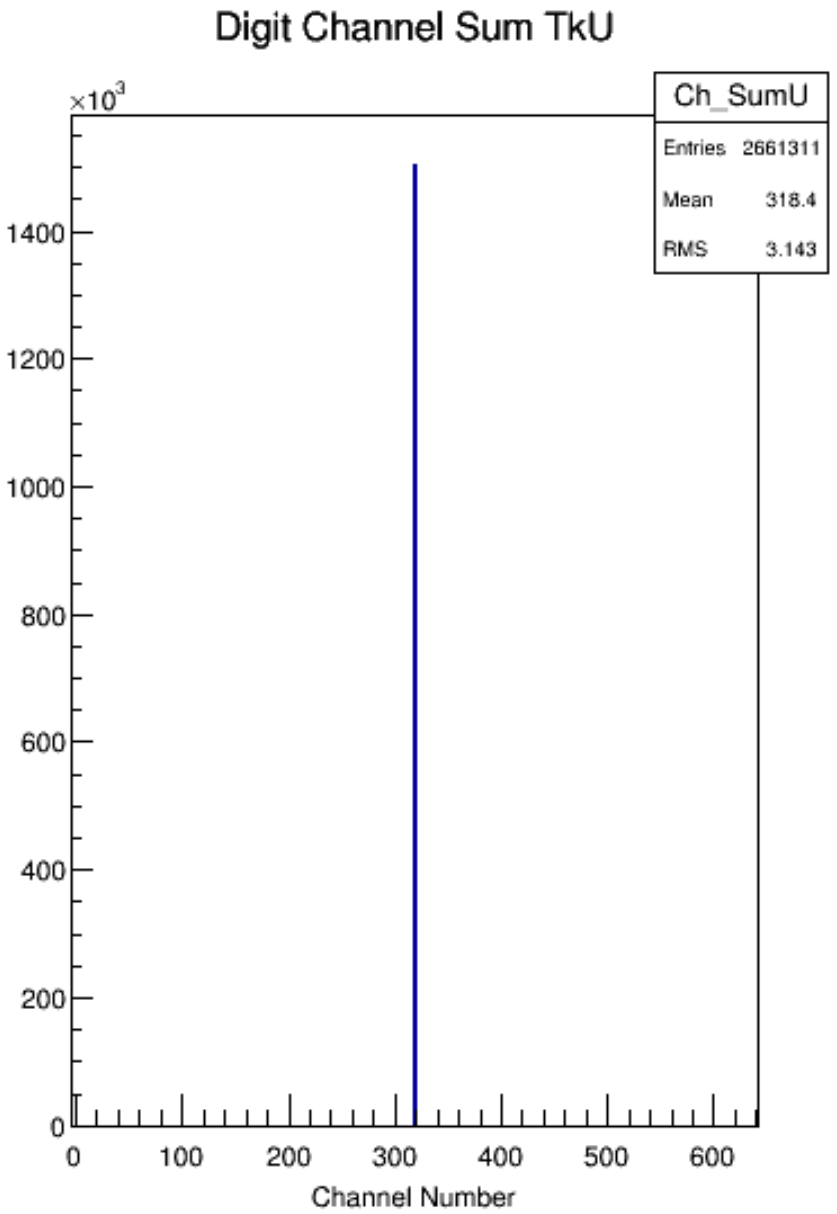


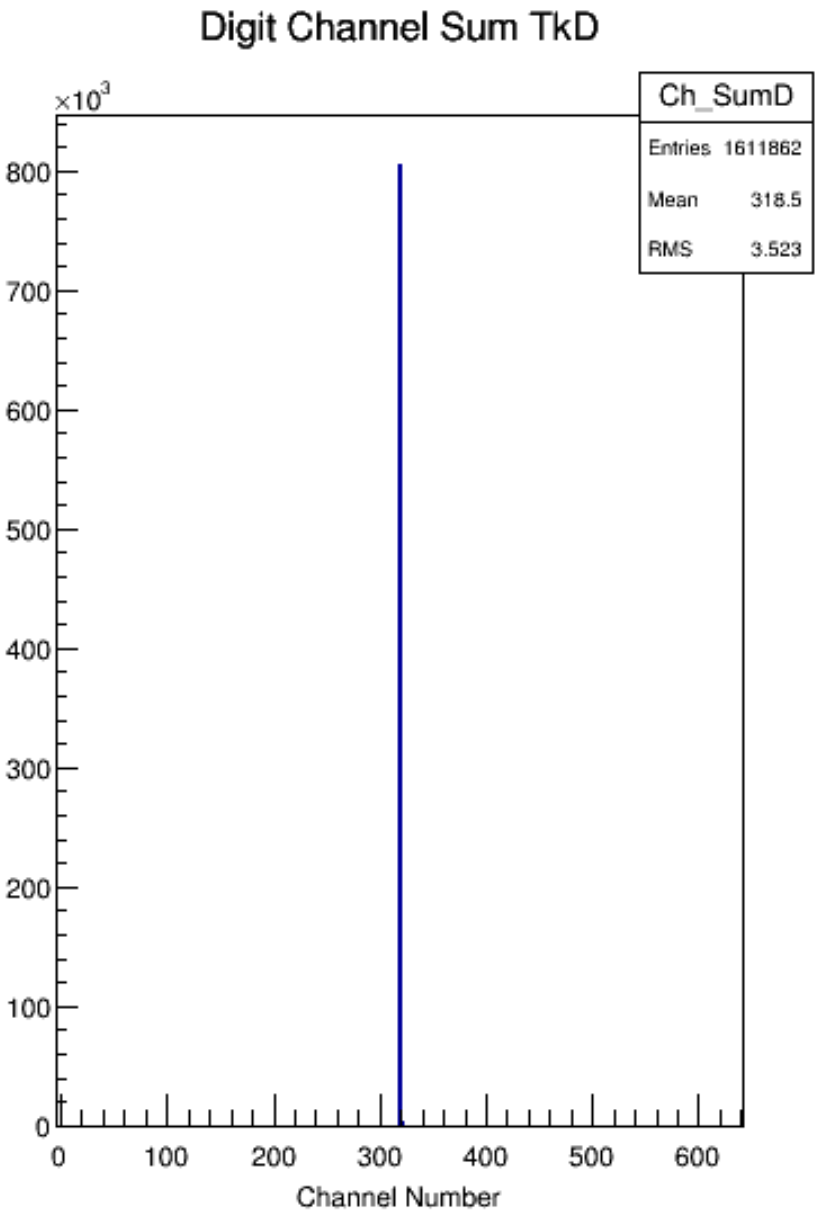




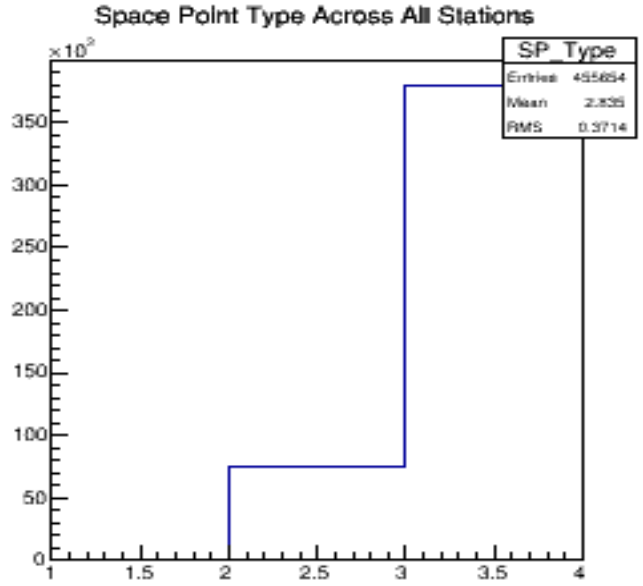


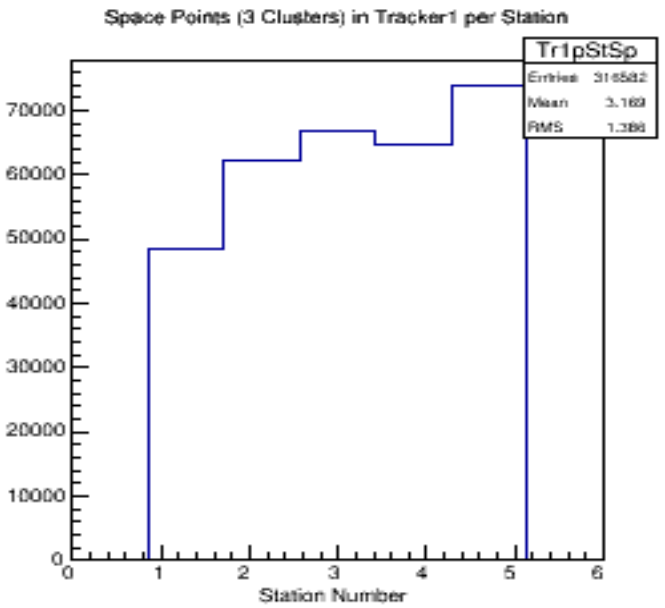
Kuno Plots Helical 8156

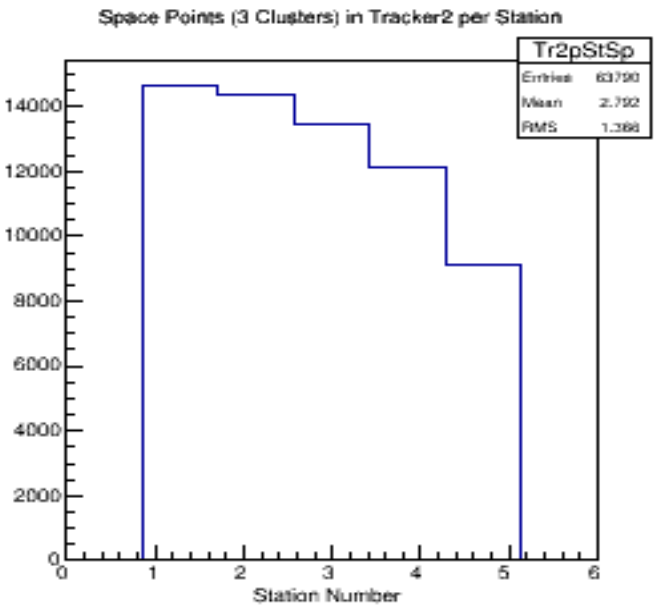


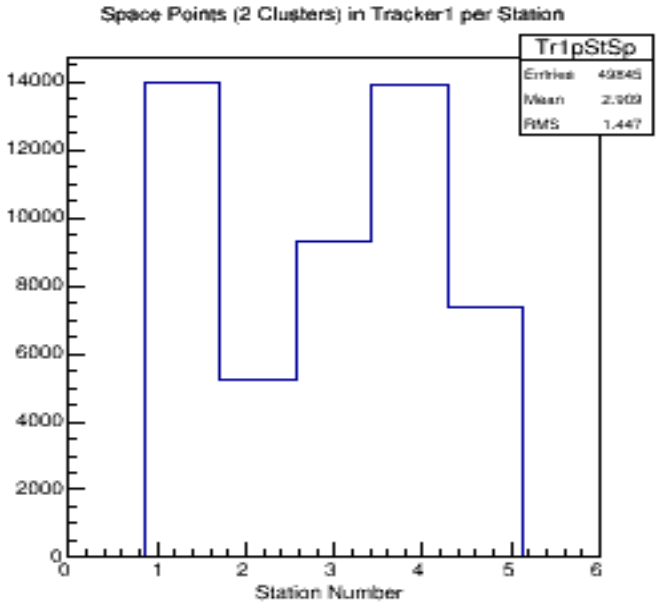


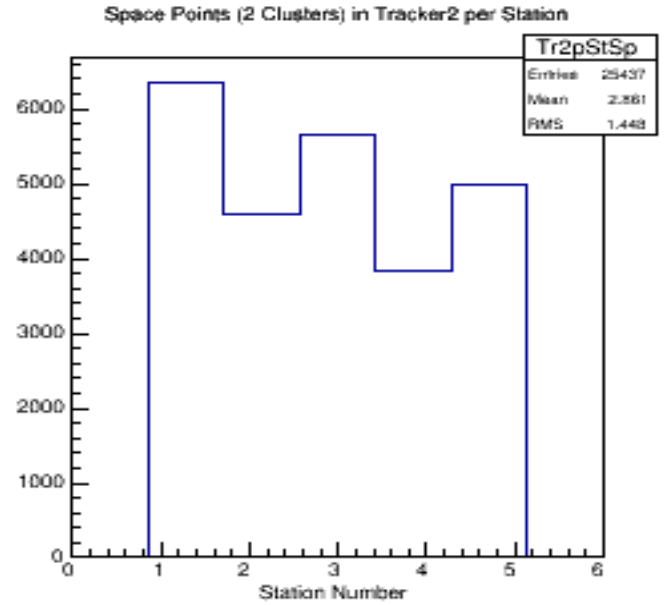
Spacepoints, Straight 8031











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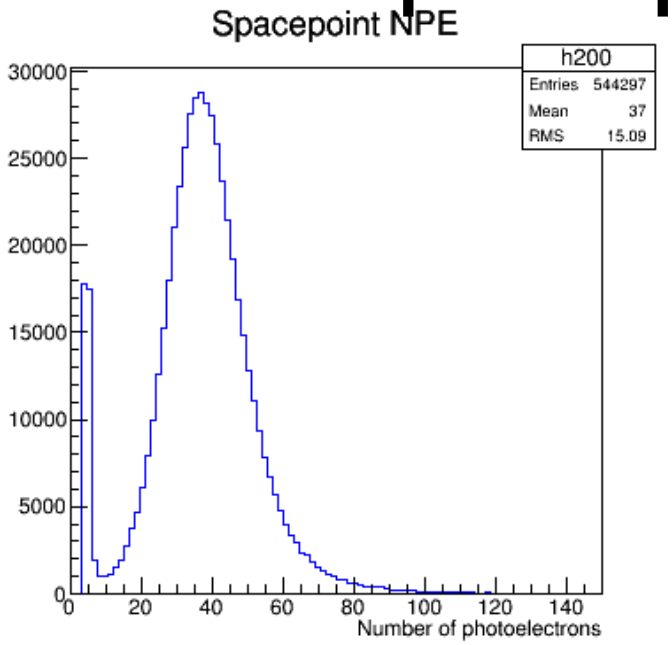
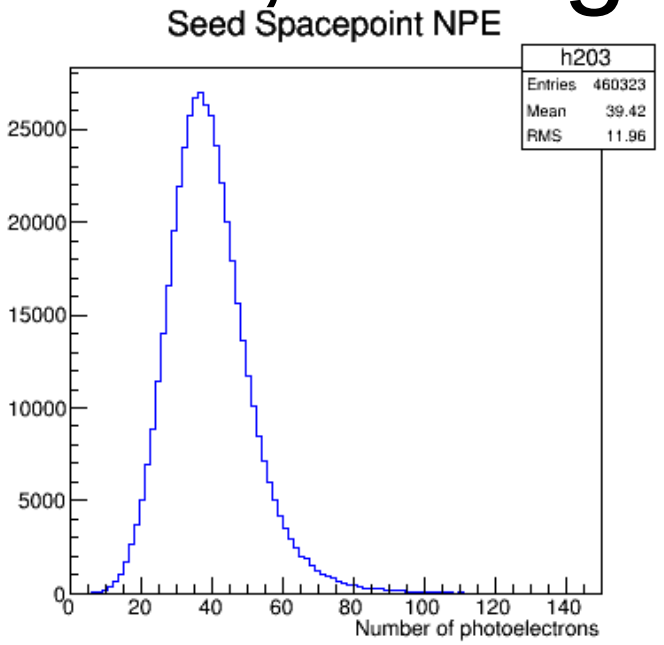
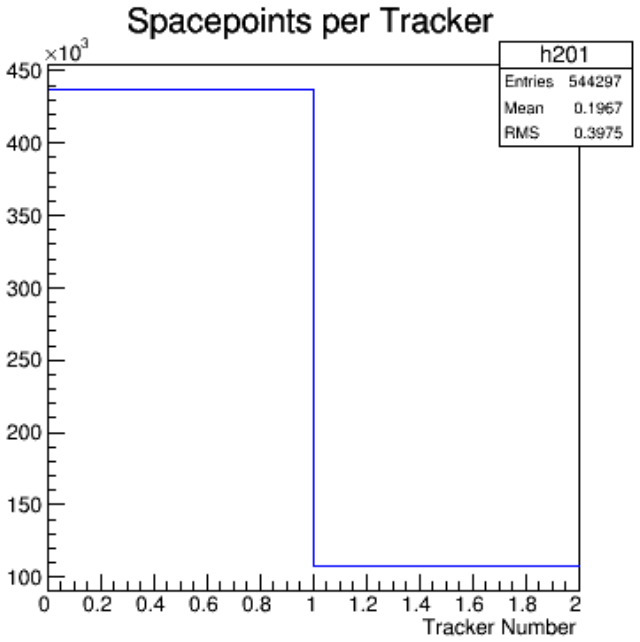
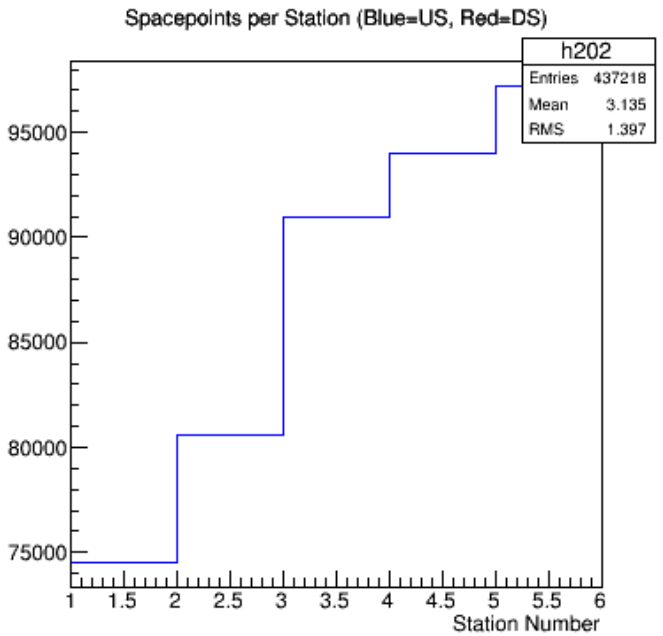
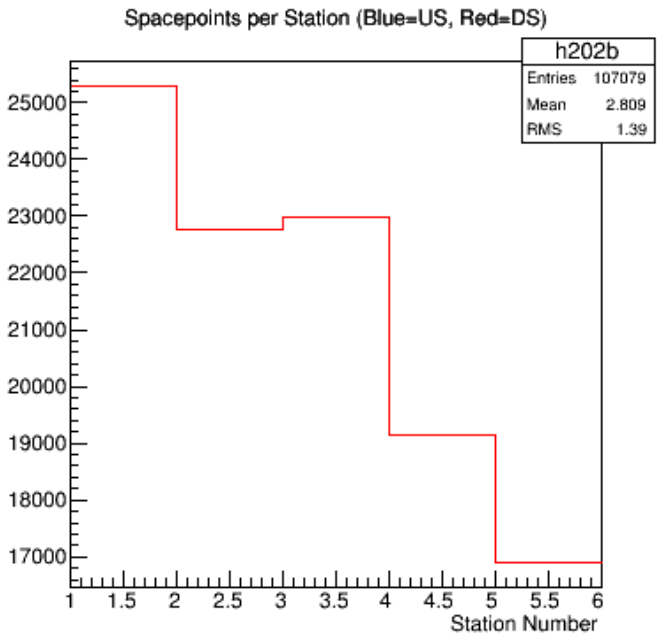


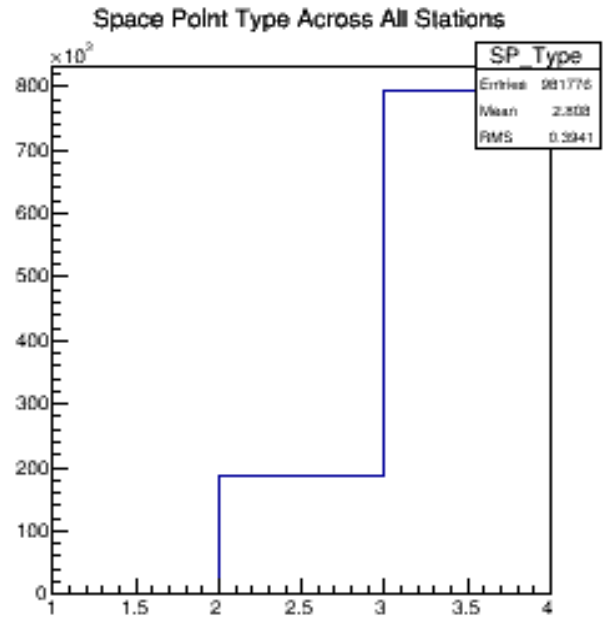


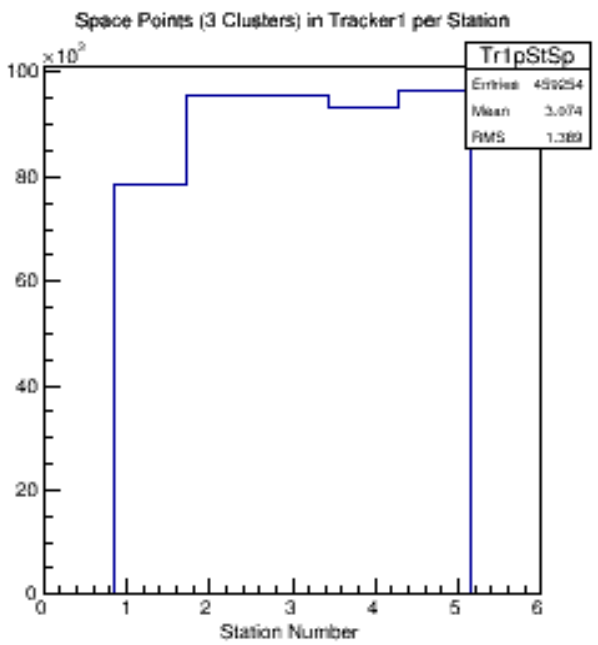


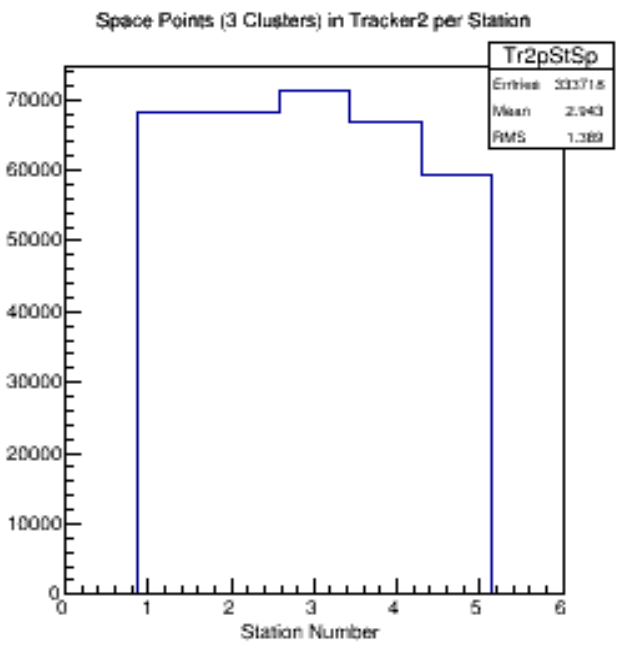


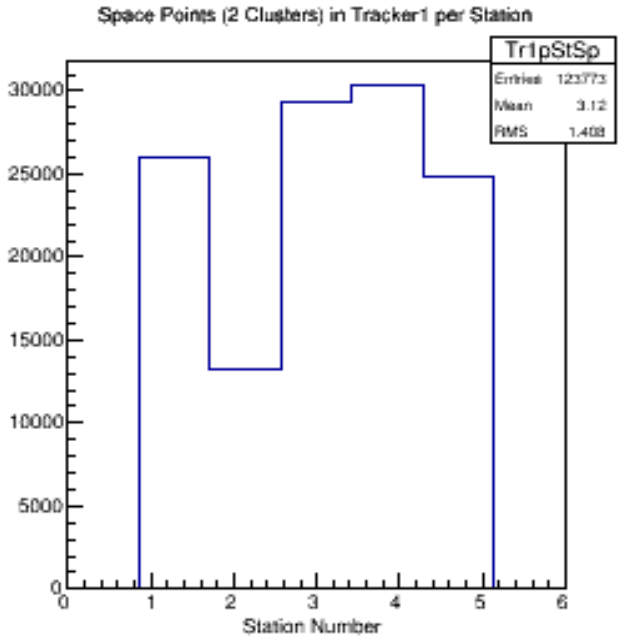


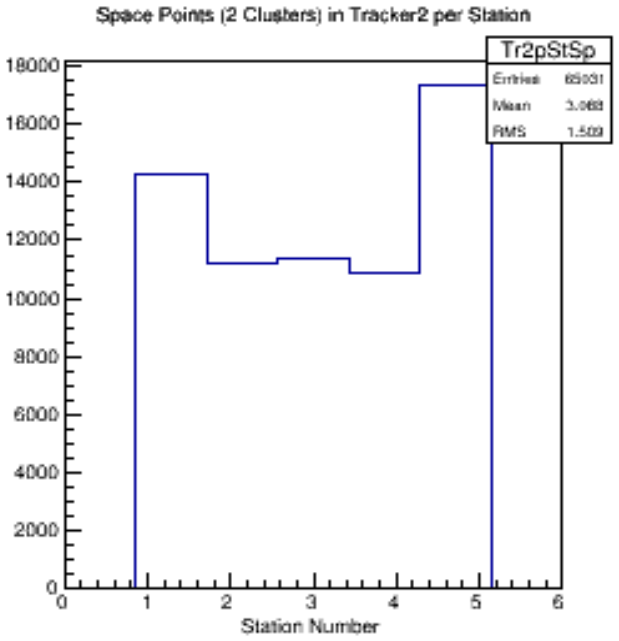
Spacepoints, Helical 8157



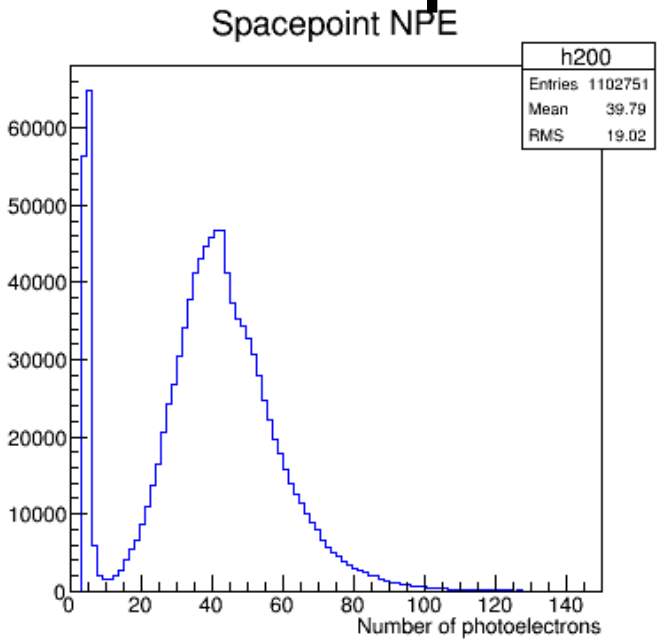


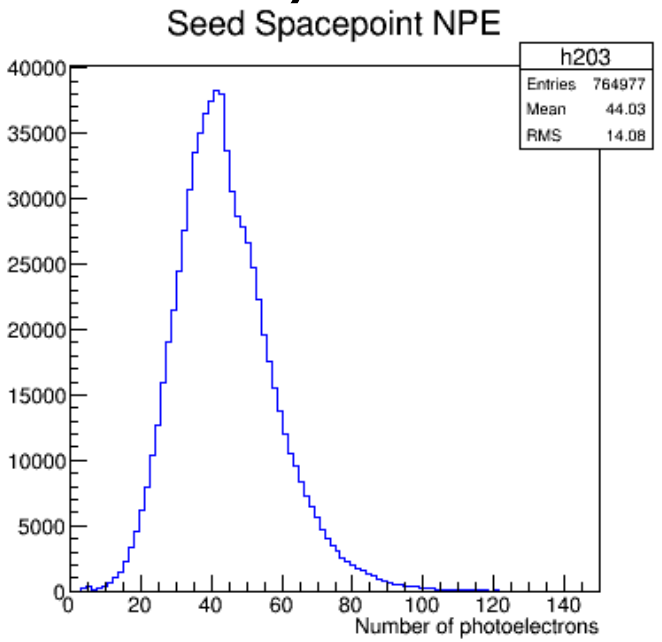


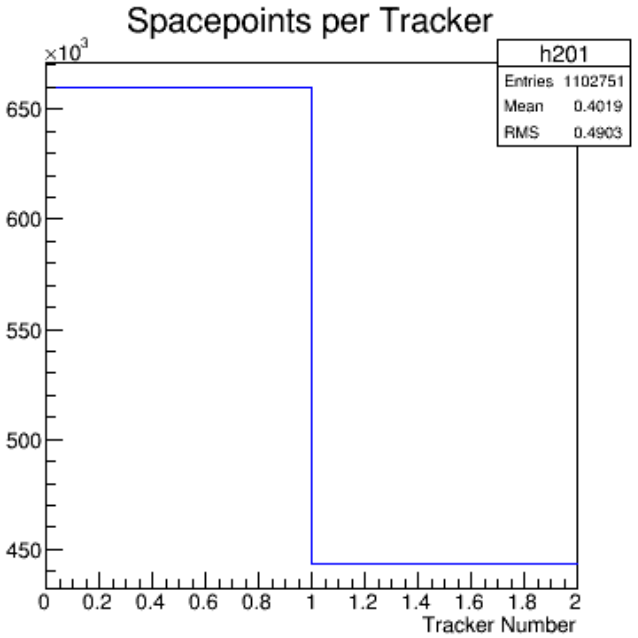


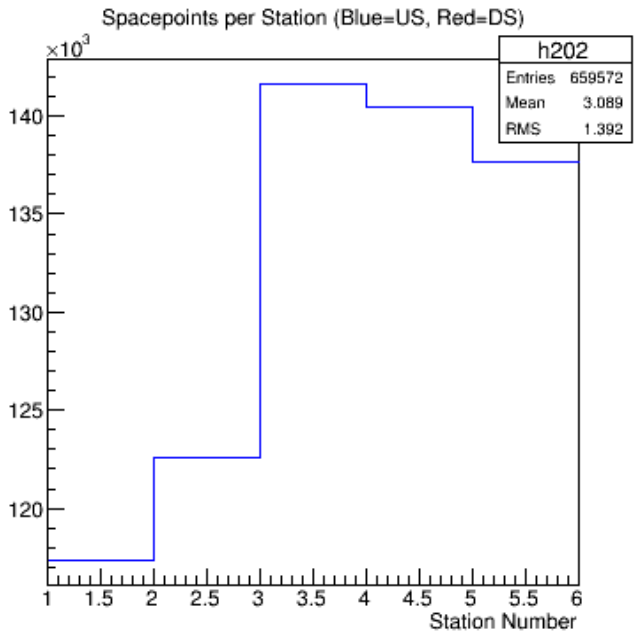


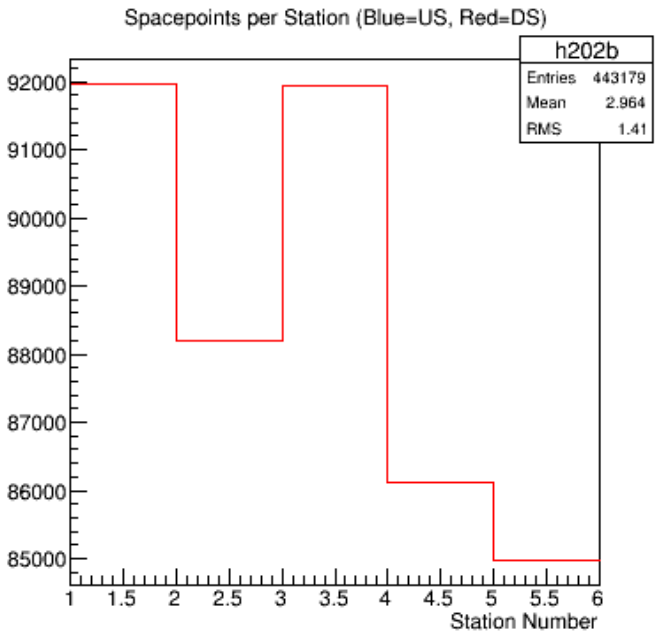
Spacepoints, Helical 8157

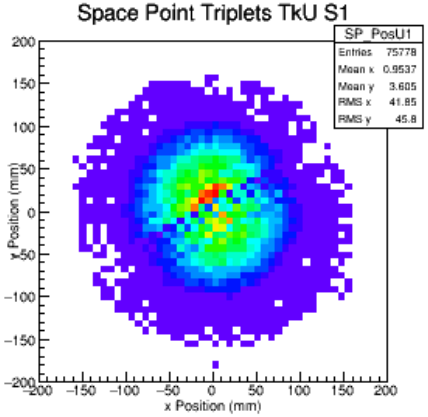


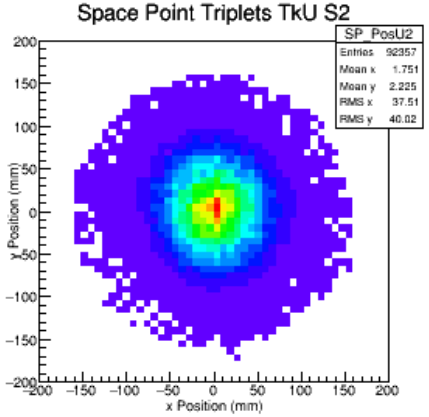


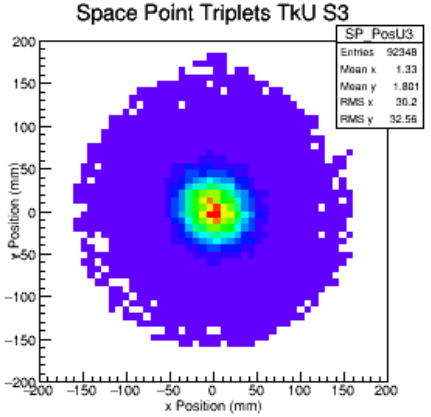


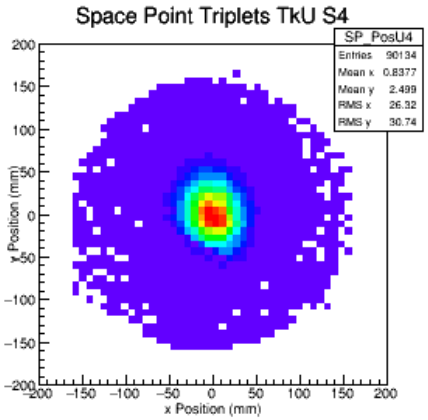


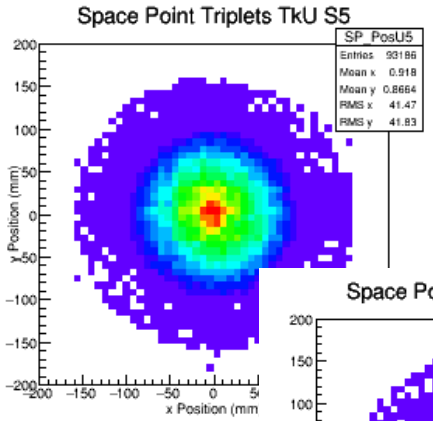




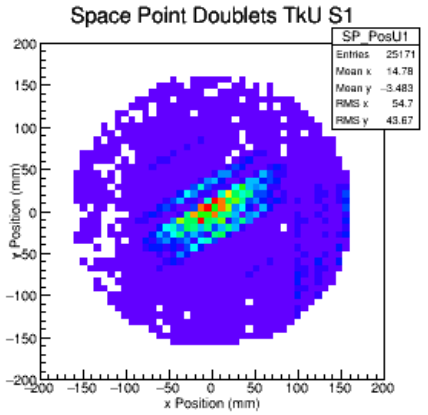


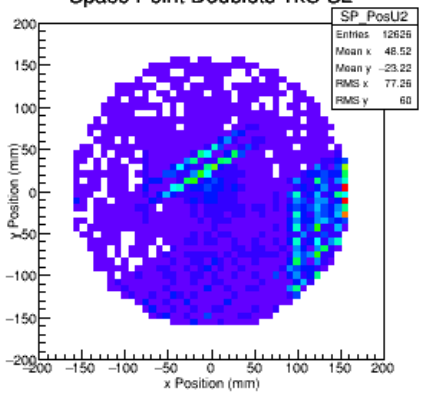


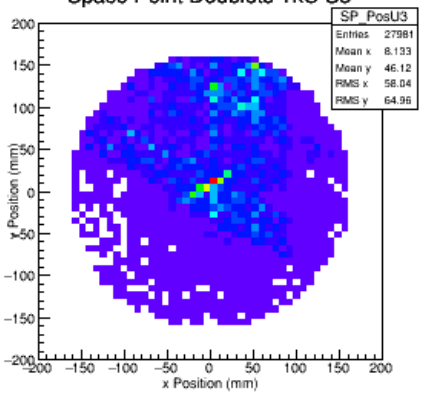


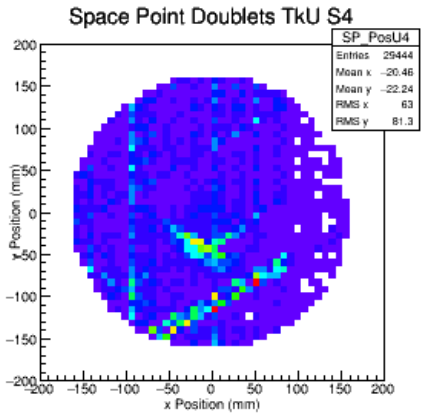


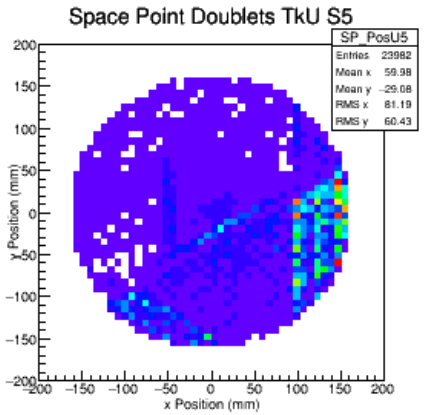
Beam Profiles US Helical 8156











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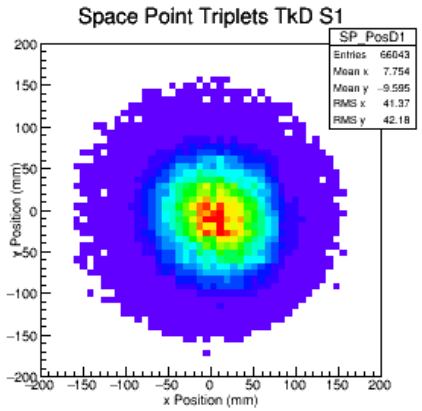
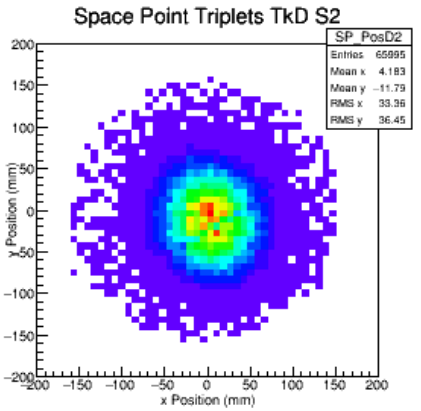
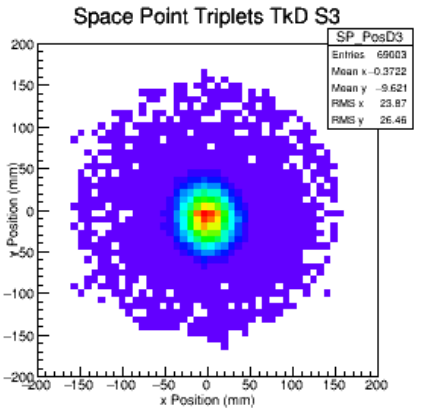
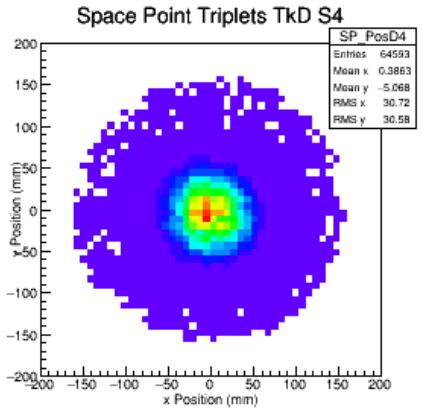
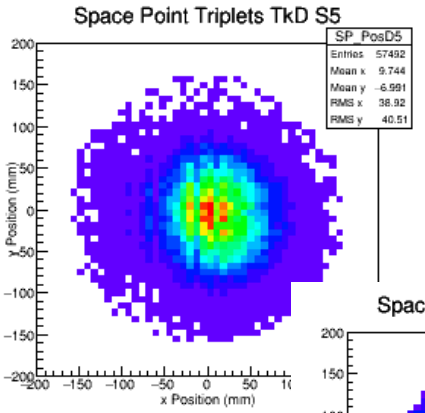


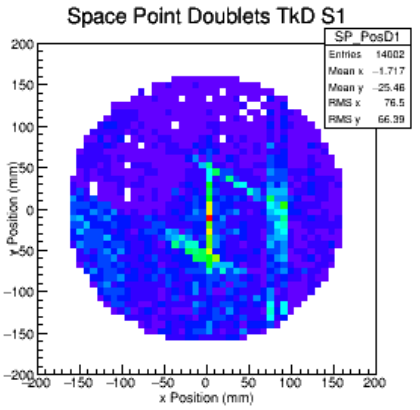


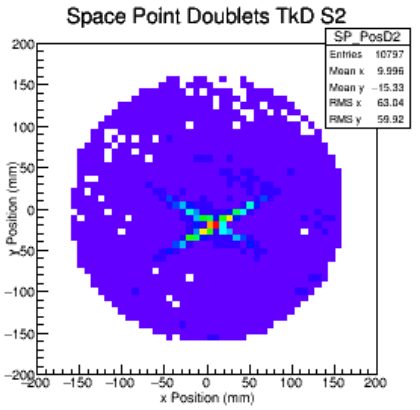


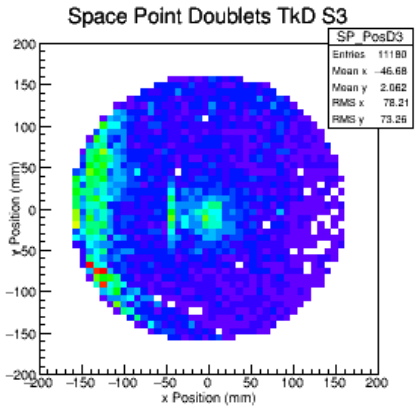


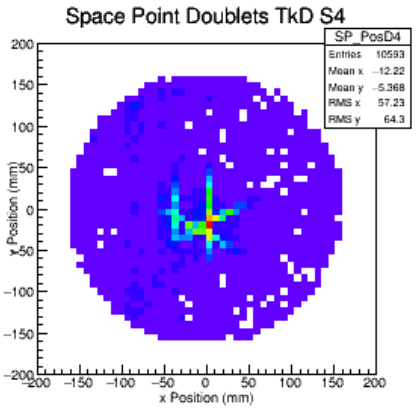


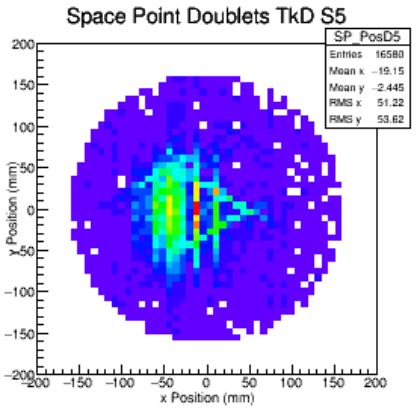
Beam Profiles DS Helical 8156











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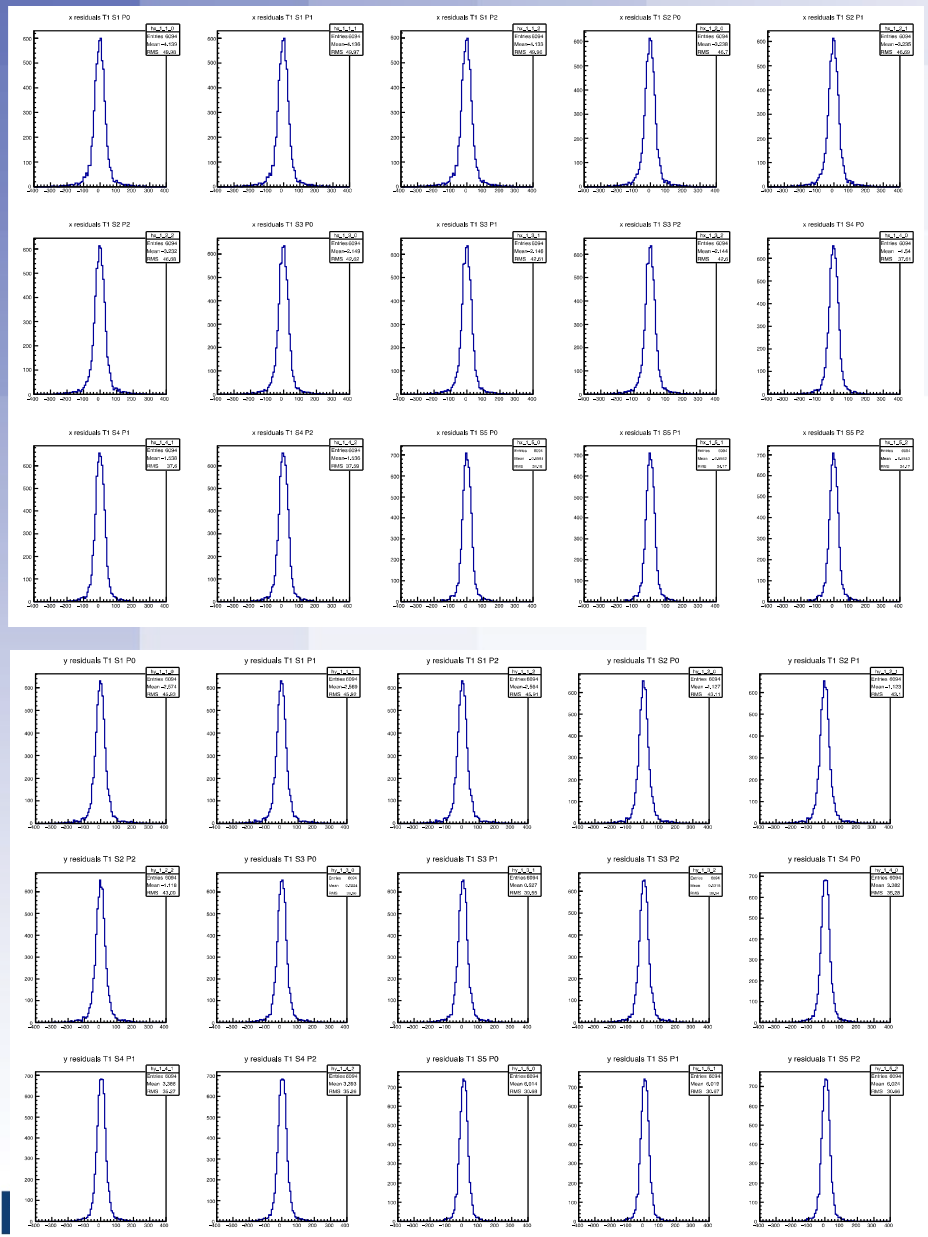
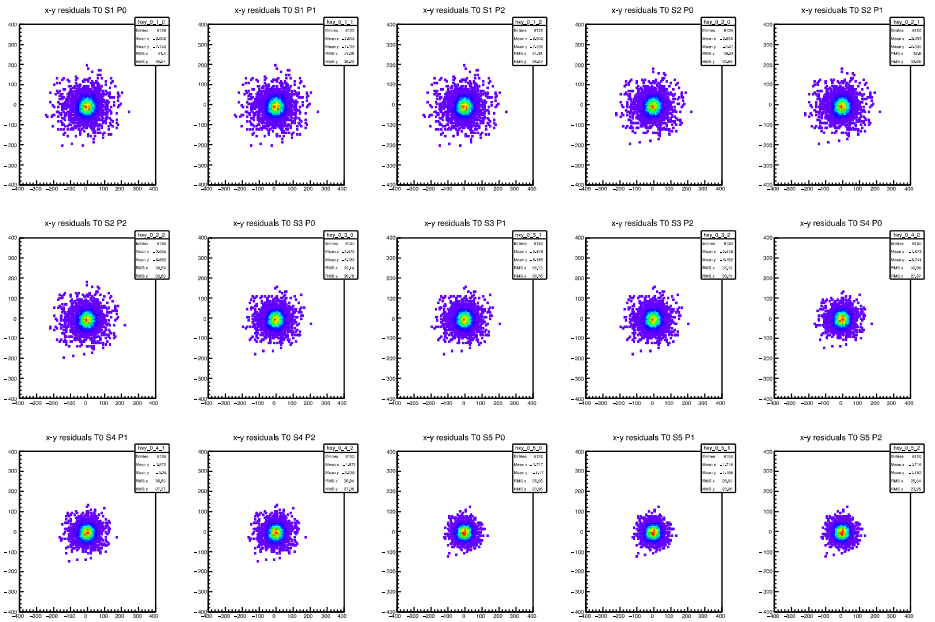
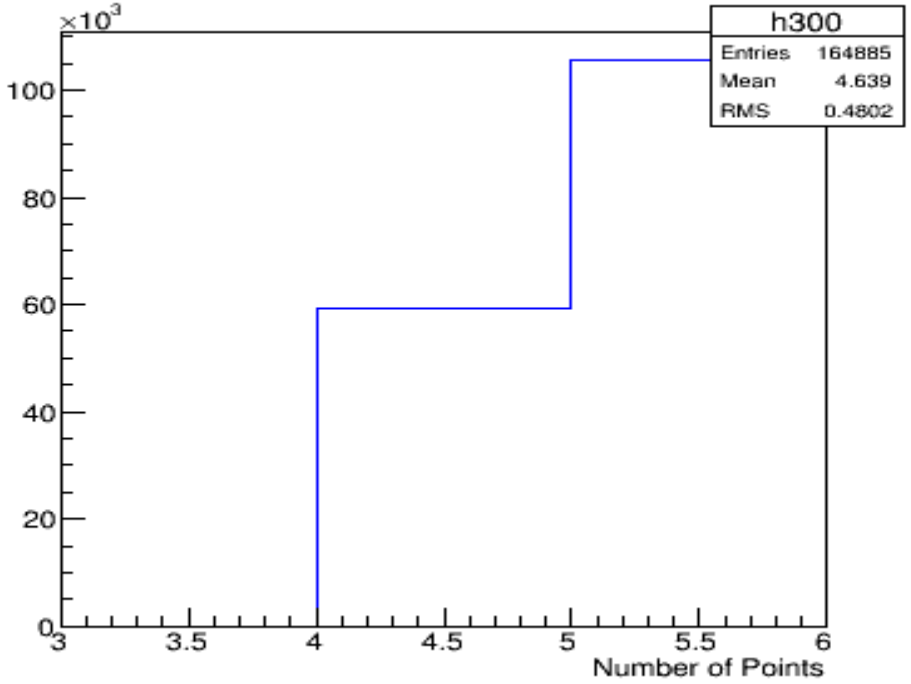
Track Finding Efficiency (Straights)

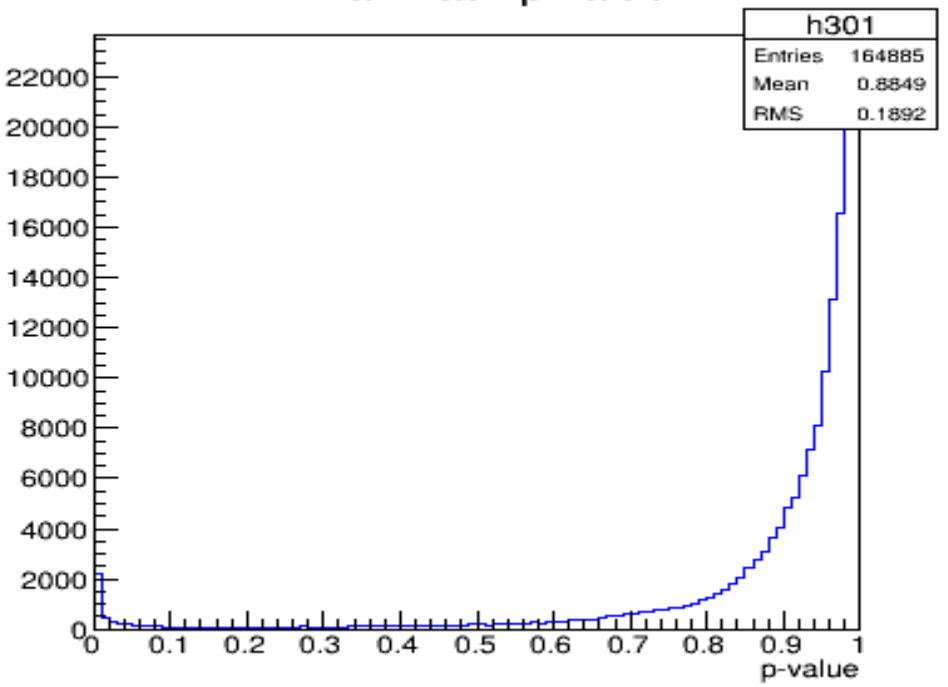


Upstream x residuals, Downstream y residuals.
Comparison with projected hit position from joining a hit in TOF1 and TOF2

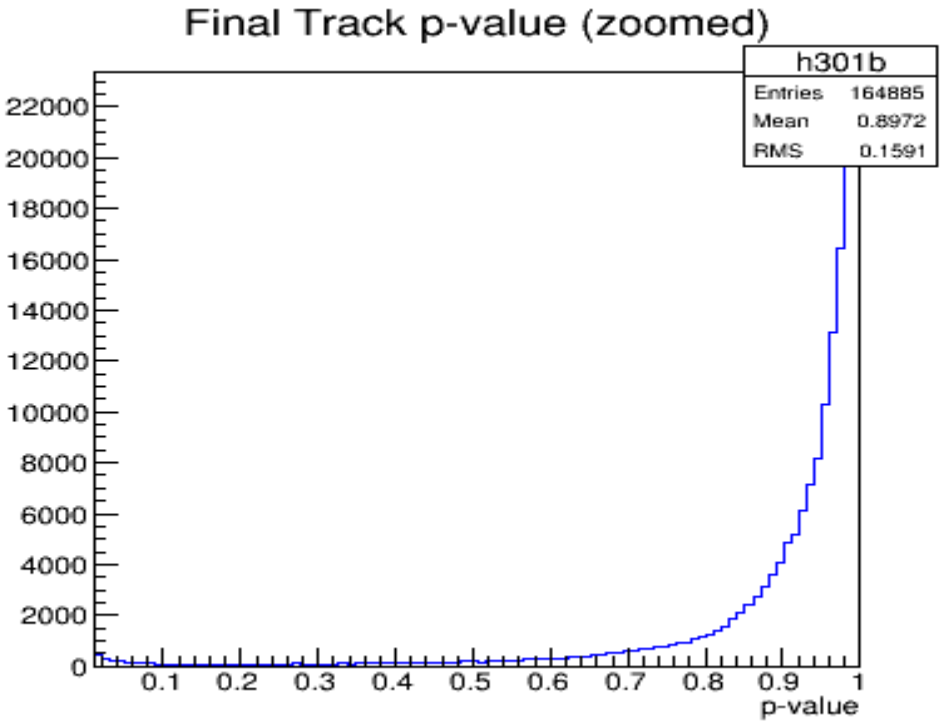


Upstream x-y residuals

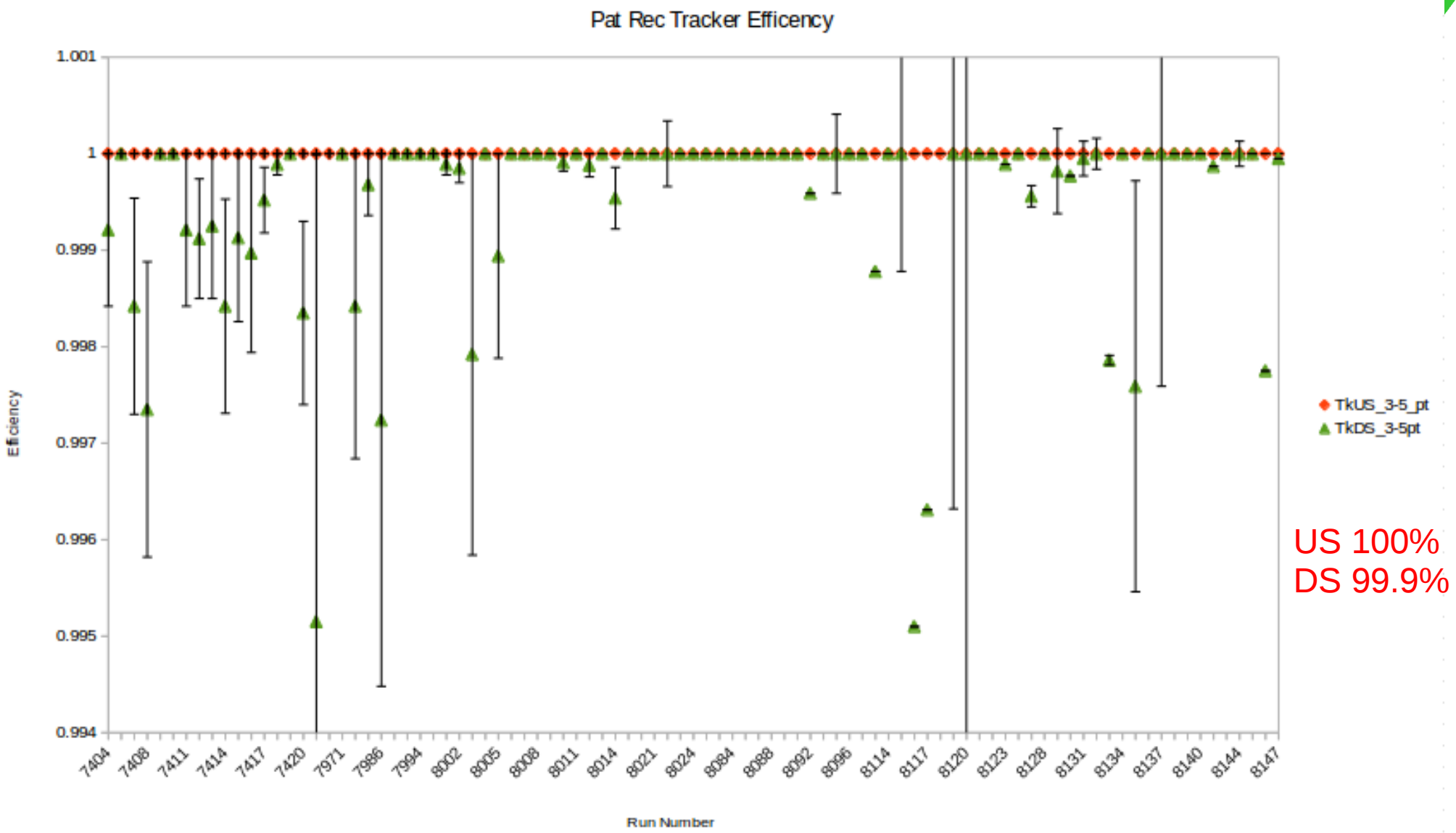




Kalman Track Finding Efficiency (Helicals)



Pat Rec Track Finding Efficiency

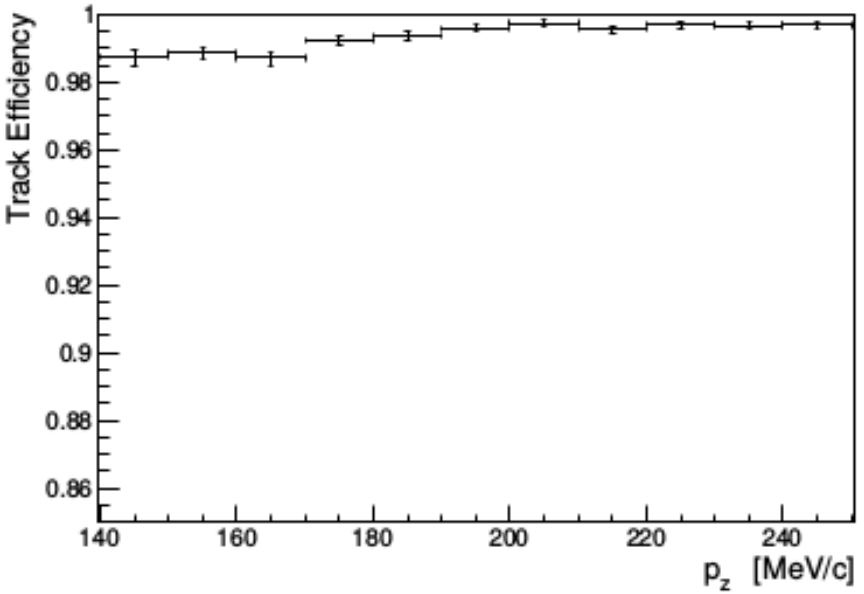


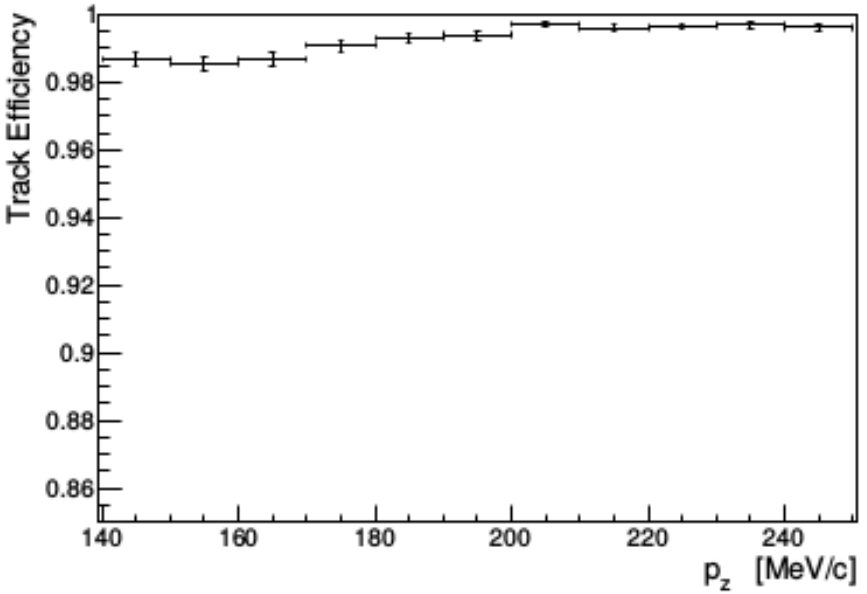
US 100%
DS 99.9%

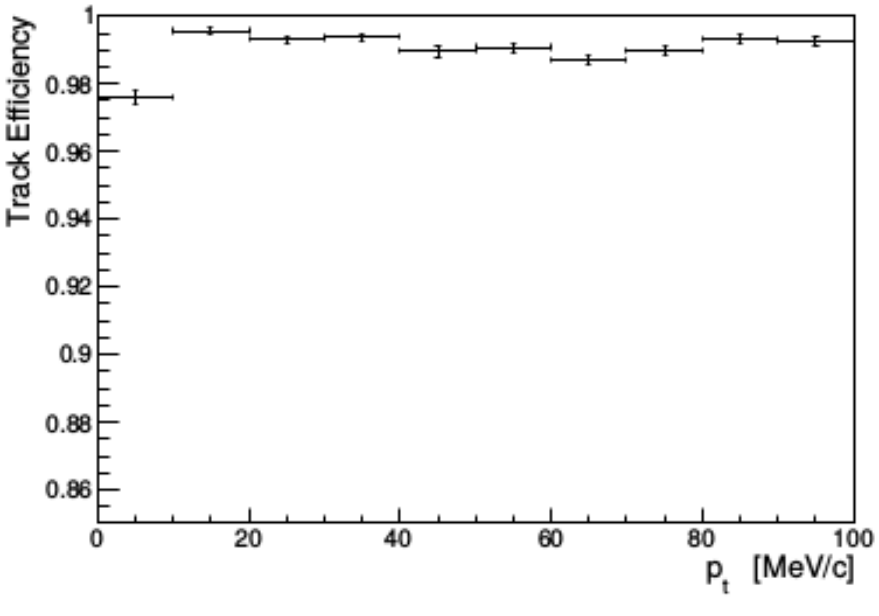
If you have 5 spacepoints in tracker what is the efficiency of finding a 3-5 sp track, req a sp in TOF 1 and 2

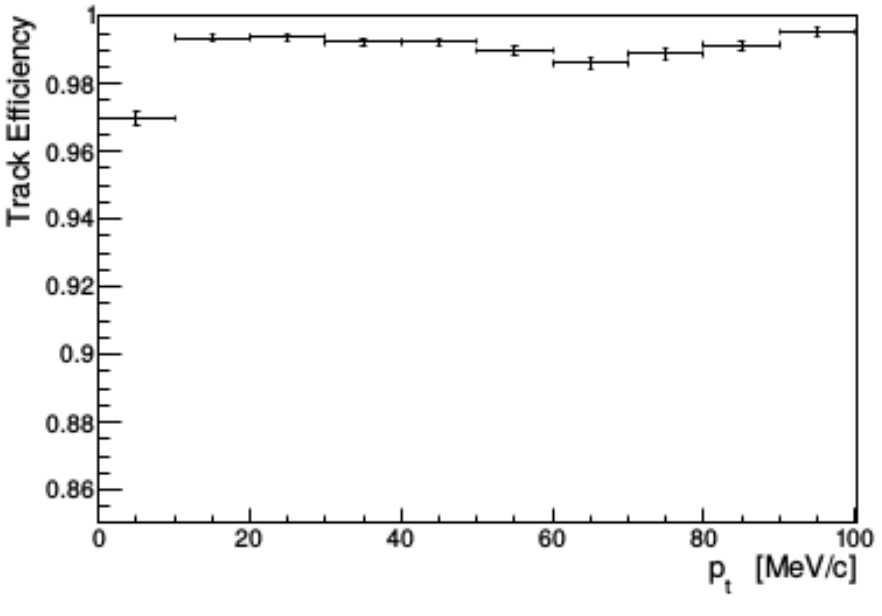
Binomial error

Efficiency of reconstructing tracks US (left)DS (right) as a function of the simulated longitudinal (top) and transverse (bottom) momentum.

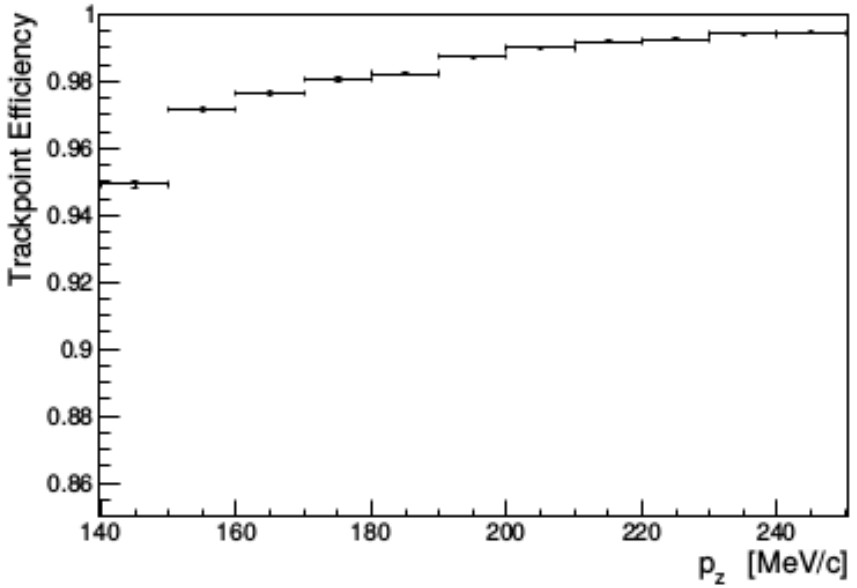


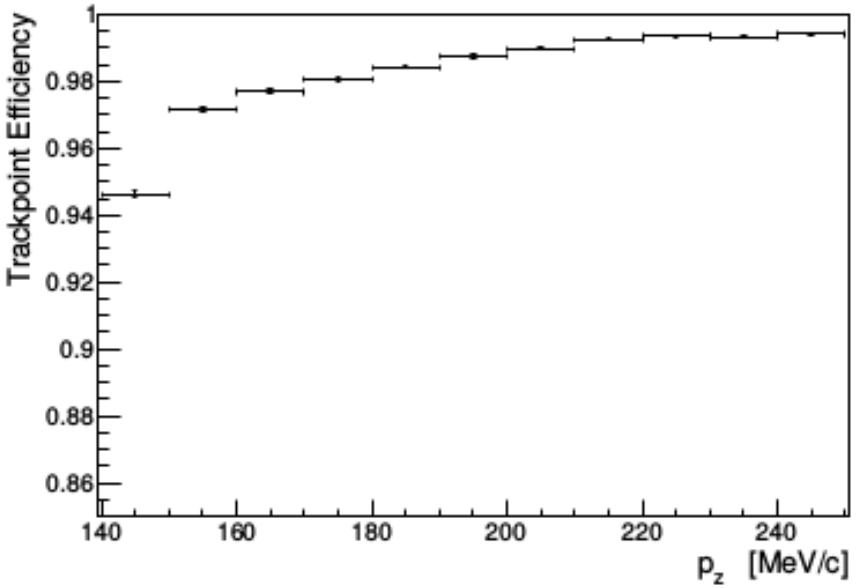


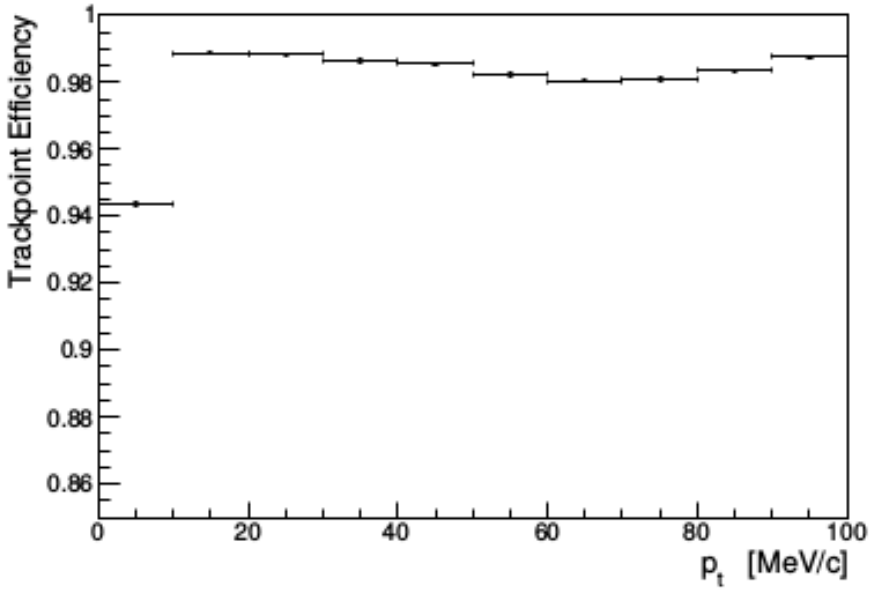


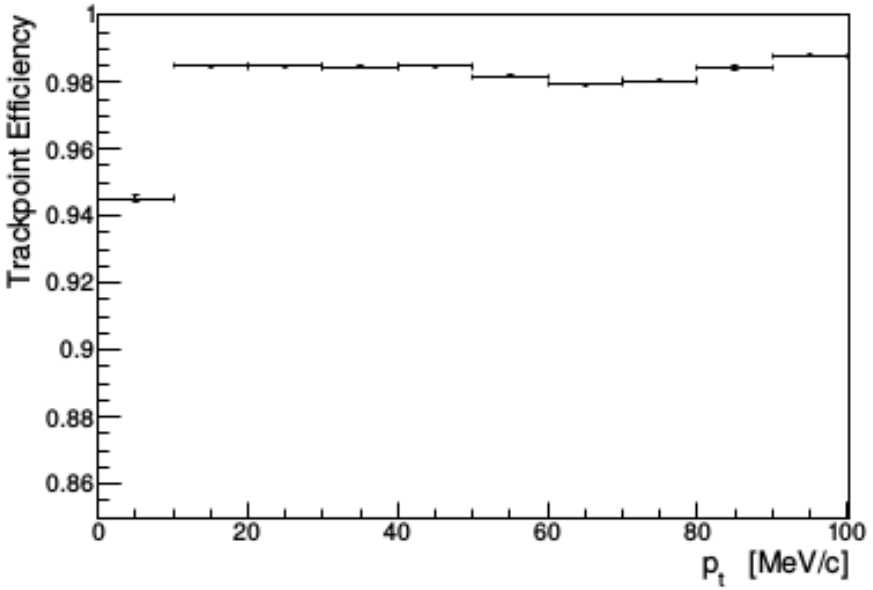


Efficiency of trackpoint reconstruction US (left) DS (right) as a function of the simulated longitudinal (top) and transverse (bottom) momentum.

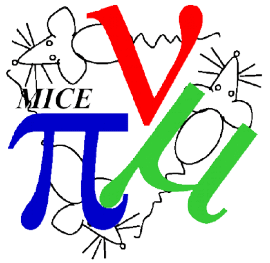






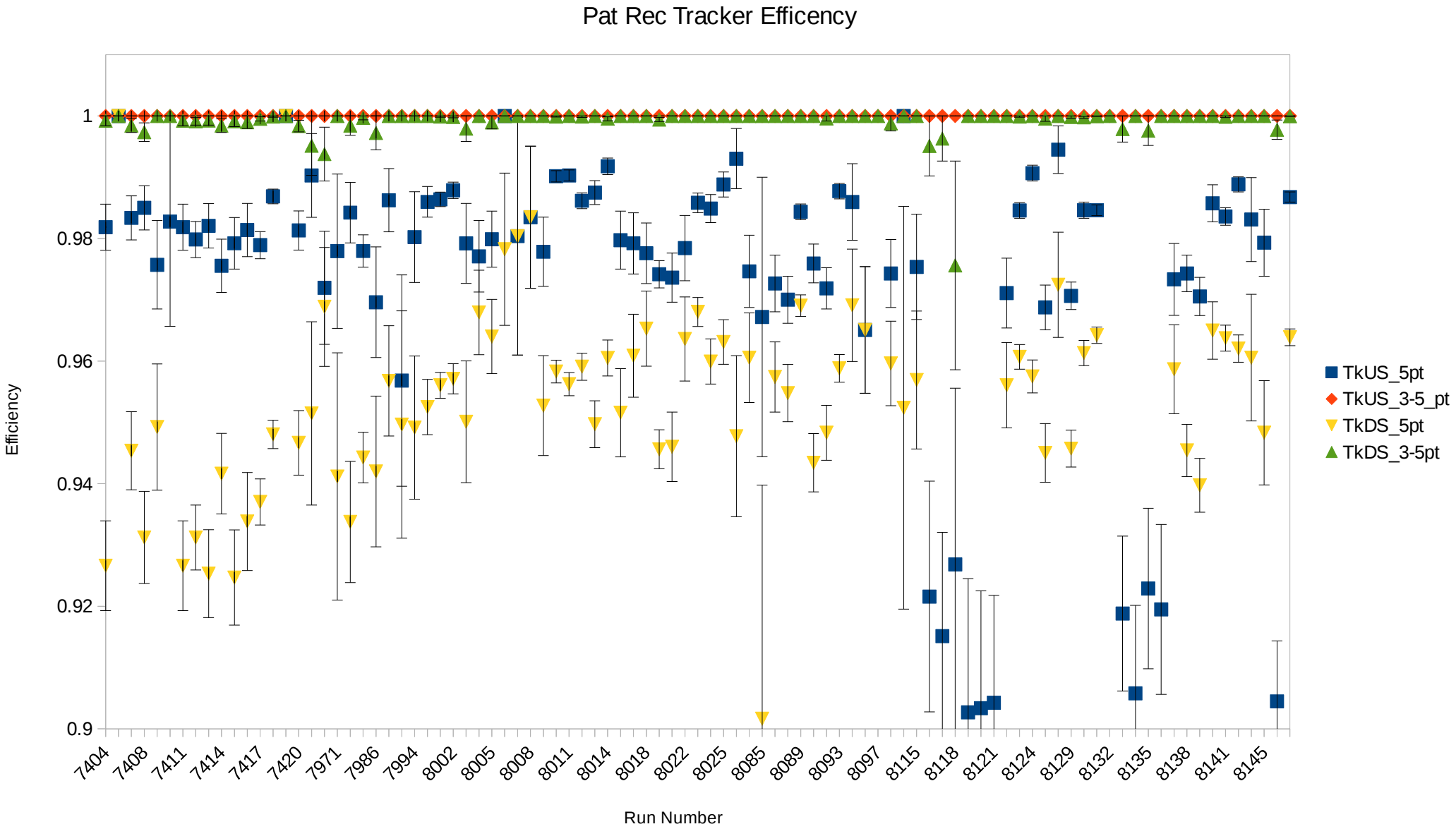


Final Summary



- Tracker Hardware is performing well.
- Calibration data is taken daily and analysed almost immediately, new calibrations are produced with fast turnaround.
- OnMon and OnRec are working well.
- Data taking has gone well and data is analysed for validity/problems etc within 24 hours.
- Reconstruction efficiency is ~99.5% using four methods, note in preparation.
- MC-Data comparison work has begun.

Pat Rec Track Finding Efficiency



If you have 5 spacepoints in tracker what is the efficiency of finding a 3-5 or 5 sp track, req a sp in TOF 1 and 2

Binomial error

Tracker Efficiency from npe

- Unbiased by noise and does not require track finding.
  - Uses cluster light yield to determine # noisy hits which contaminate SP doublets.
- Coincidence (20-50ns) between TOF1&2 trigger SP (within 2ns of particle trigger) and removing multiple events per trigger.
- SP grouped into doublets and triplets and light yield of clusters forming the SPs are stored.
- These are combined to find efficiency:

$$E = (T + D - N_D)/C$$

where T= triplets, D = doublets, ND = doublets from noise and C = # TOF coincidence.

- T, D and C taken from event selection

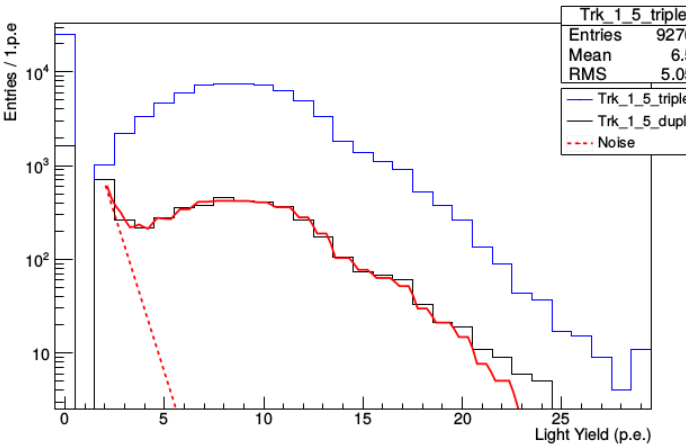
Tracker Efficiency

- Prob of doublet sp from noise, $P_D \approx 3.6 \times 10^{-2}$
- N_D determined from doublet light yield histogram fitted with triplet light yield and expon decay (noise)

  $L_D(x) = f_1 L_T(x) + f_2 \exp(ax)$

  x = pe, $L_D(x)$ = doublet light yield, $L_T(x)$= triplet light yield, f_1 and f_2 fits triplet histo and noise height respectively

$$N_D = \frac{1}{2}\int_2^\infty f_2 \exp(ax)\mathrm{d}x$$



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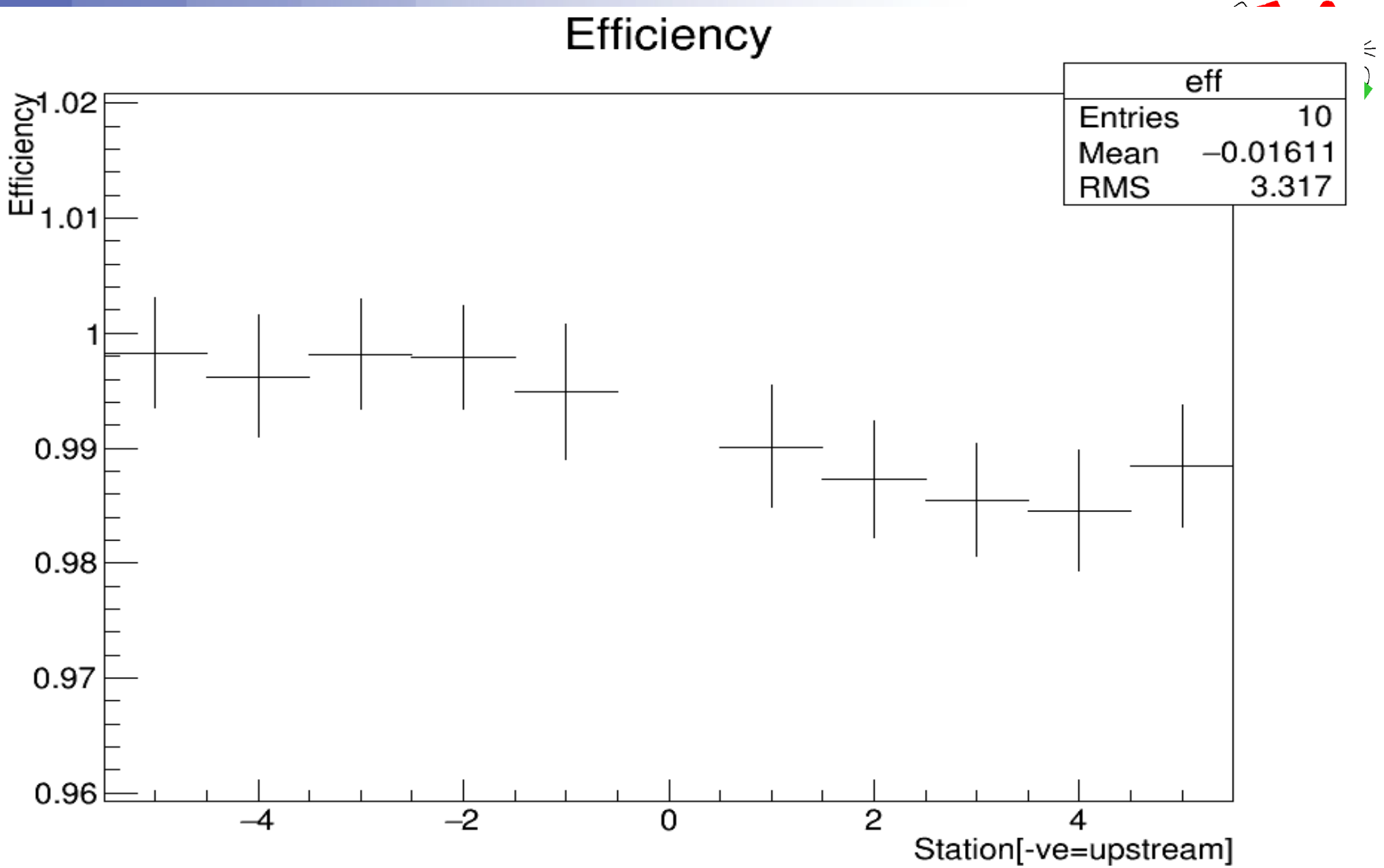

- Requires: TOF1-2: 0-100ns, TOF1 slabs 2,3,4, TOF2 slabs 4,5,6
- US eff: a track from the DS tracked to the active area of station 1 in the US.
- DS eff a stack from US tracked to the active area of station 1 in the DS