Brief summary of the reconstruction status/plans

IAC, EDM

What we have so far

- A software, which given the images taken with MIDAS, runs:
  - Pedestal-subtraction / zero-suppression
  - Clustering (iDBscan: 3 iterations of db-scan looking from the more concentrate clusters to the lowest concentrate ones)
    - Variation on the theme: 3D iDBscan. As before, but adding the z (intensity of the pixel) as a 3rd coordinate. The target is to give larger weight to brightest tracks
  - Compute cluster properties (a minimal set, that can be extended) like
    - Integral, length, width, “linearity”, Bragg peak finding and properties...
  - Saves these “reconstructed quantities” in a ROOT tree that can be used for statistical analysis
    - Vectorial tree (eg. “nTrack”, “track_width[nTrack]”,...)
- Alternatively this can be run on Fe55 (runs simple dbscan) or BTF tracks (it runs hough transform) and gives the same output
- Supplementary/debugging code to develop and debug single images, etc.
- Everything in github.

Clustering: hic sunt leones

We are currently using FNG data to develop / tune / debug reconstruction

DB scan does a lot (even more if iterative), but it is a *proximity* algorithm. I.e. it looks for clusters of pixels close in space, given a ~“gathering radius” ε and “sparsity”

1. If ε is too large, it joins pieces of different tracks
2. Otherwise it joins only pieces of a single track

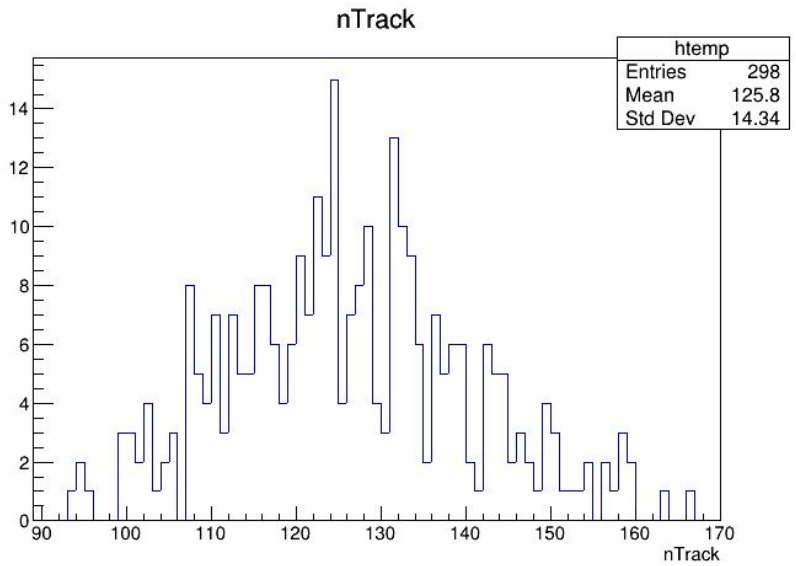
We choose 2. (with iteratively larger sparsity), and we have an algorithm which is stable, it doesn’t cluster random noise, and seems to get efficiently many of the pieces of the tracks that you can see “by eye”

“Fake-cluster rate”: it gets 0 clusters in runs with only camera and cap, few clusters with full detector, HV on and Beam OFF

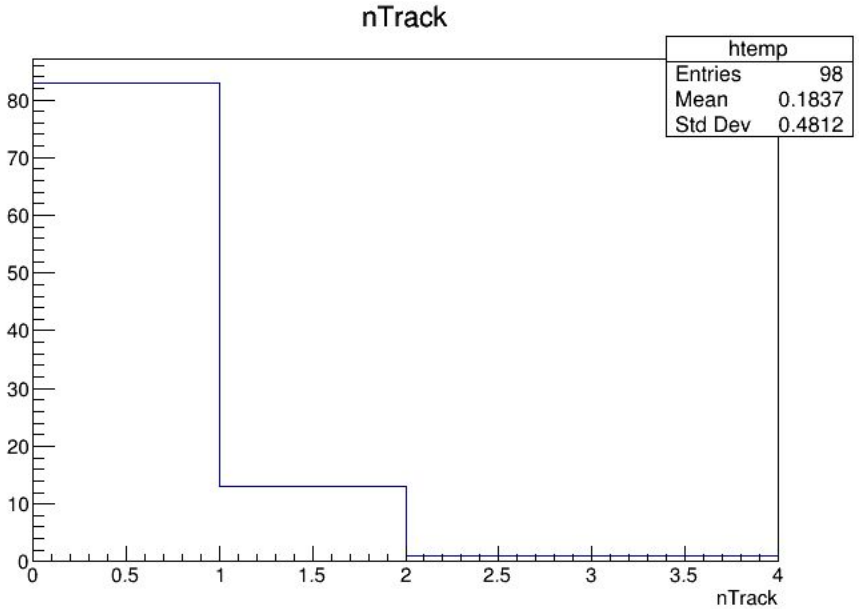
Number of reconstructed clusters

Same detector configuration (HV, exposure, etc.)

Beam ON

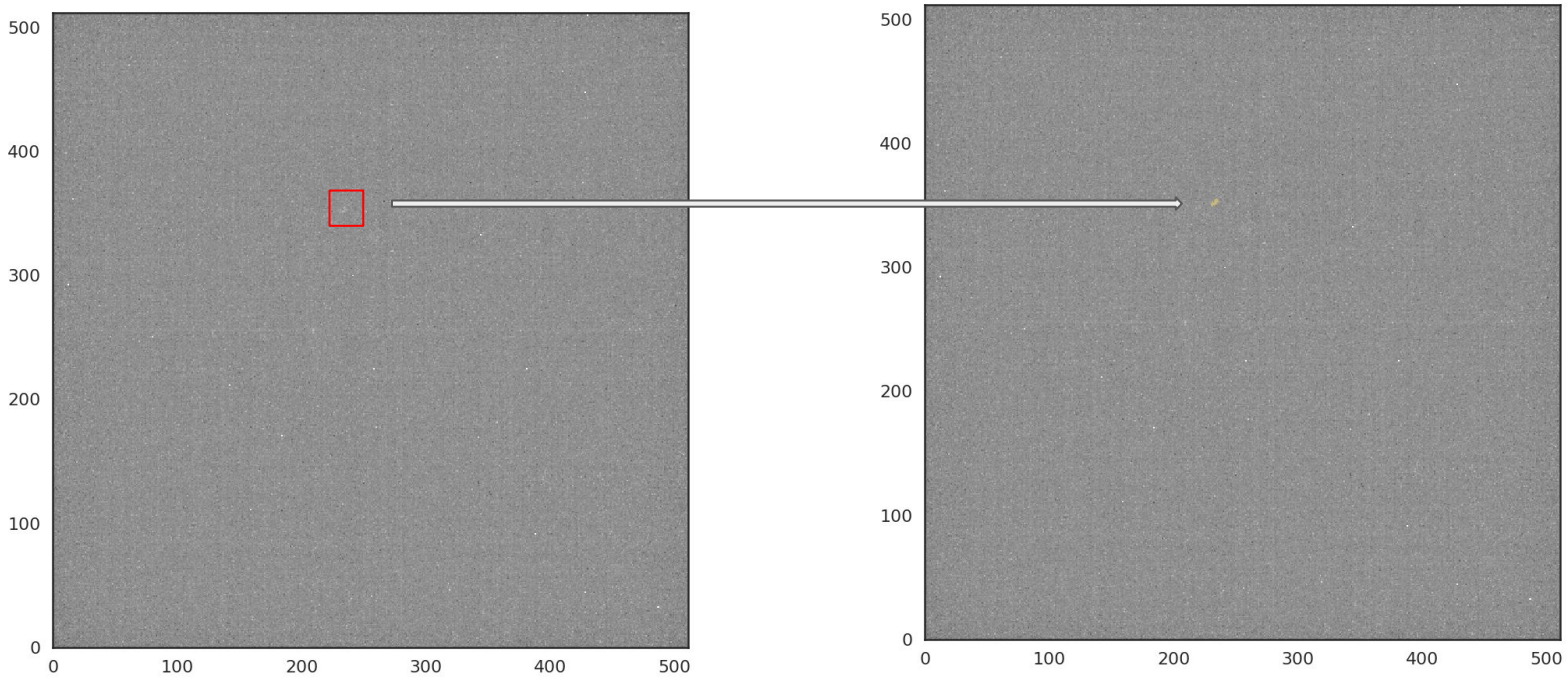


Beam OFF



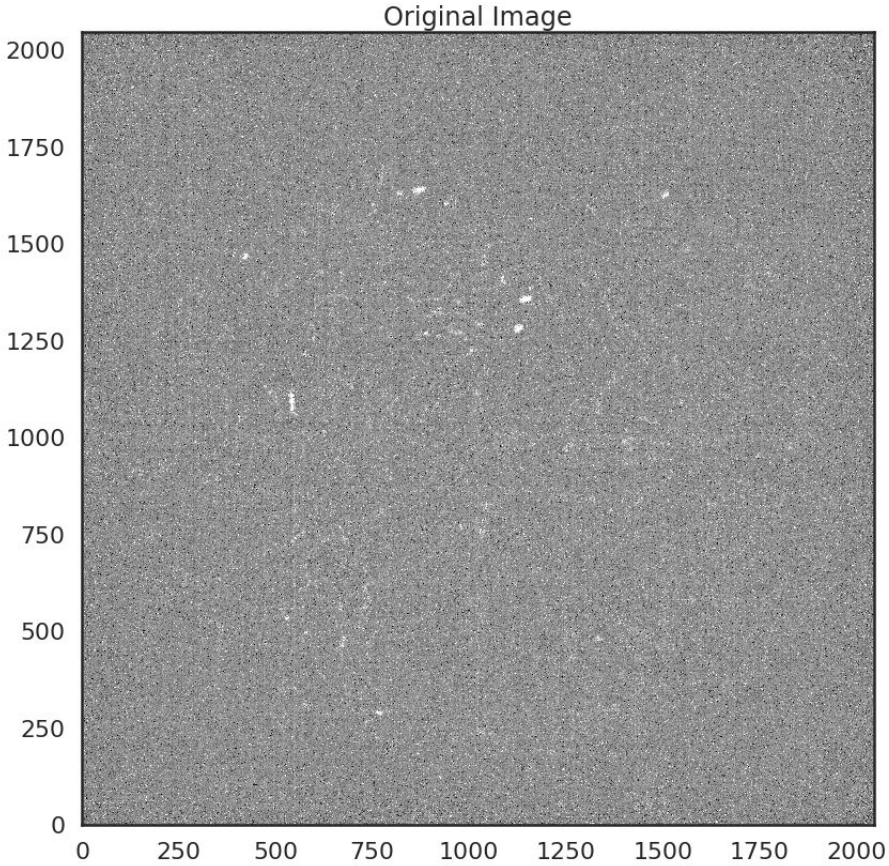
~80% images w/o clusters reconstructed

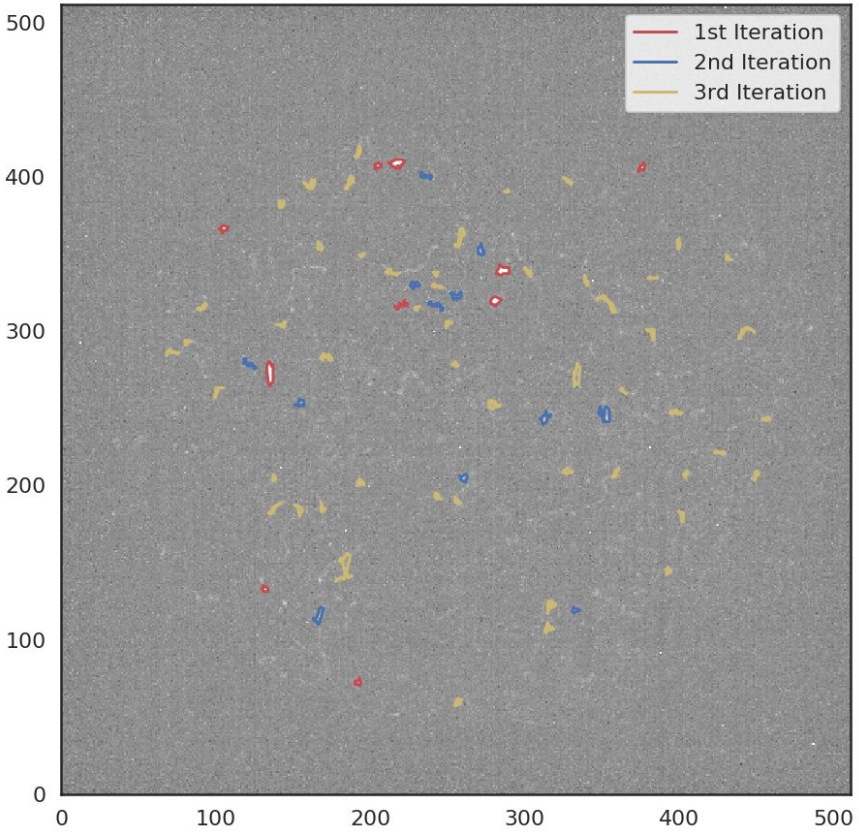
Who are these fake clusters ?



They seem to be some real light, so the clustering is doing its job

Example on FNG with beam ON

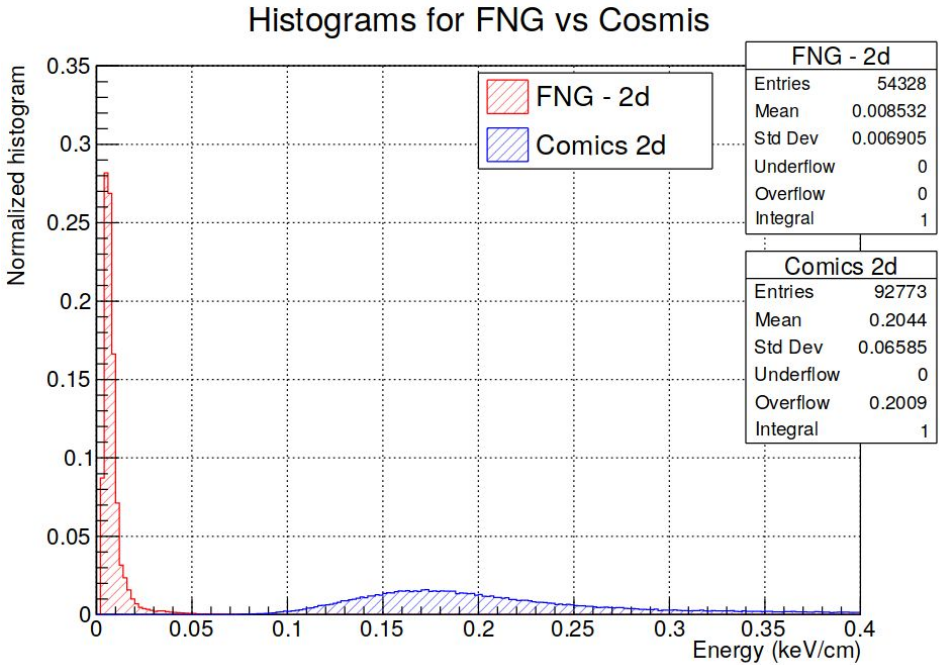


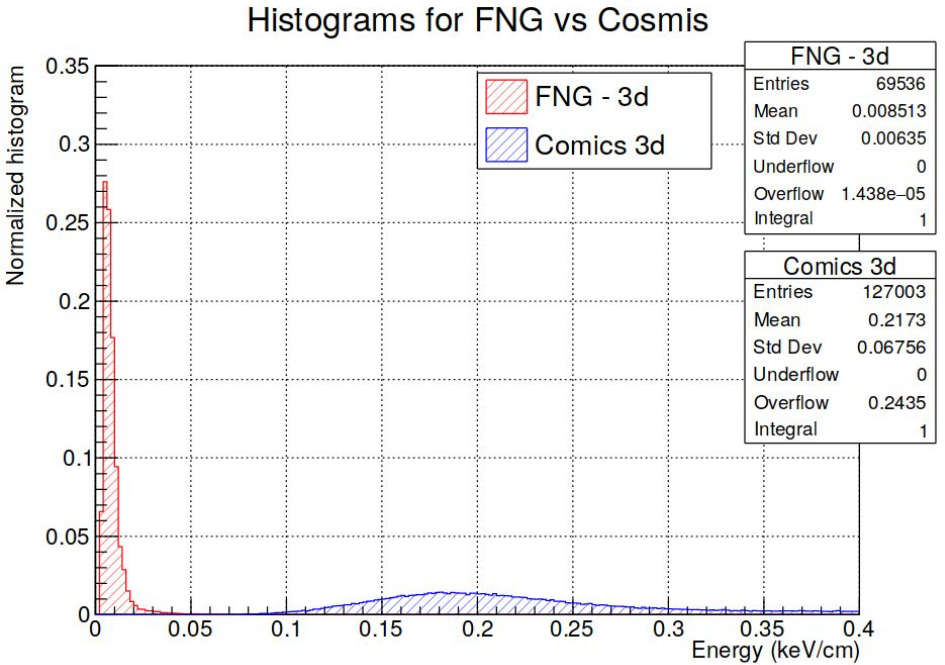


Next developments: join the clusters with a tracking

- By construction the clustering is gathering together only **pieces** of the track
  - We will increase the radius to get them a little longer, on FNG runs with ~1/10 the occupancy (more realistic for DM/underground), where tracks don't overlap much
- But we don't want the clustering to make the full track. Idea for next future (~month)
  - Use iDBscan as a **first step** of the reconstruction to get seeds
  - Run tracking using clusters as seeds, l**ooking for the pattern that we expect**
    - E.g. a short track with some kinks
    - It may be something like a generalized Hough transform, a Kalman Filter, etc.
- Sparse ideas to be tested soon:
  - Variable threshold around the seeds to recover the unclustered pixels around the seeds and include them (not to have disjoint clusters - this is a typical pattern from clusters in the gas) in the second step
  - Add a pre-processing in the 2nd, 3rd iteration of iDBscan (the most difficult ones)
  - Use either full resolution or weighted clusters as seeds for the tracking
  - Your suggestions !

An example of out-of the box plots from the ntuple: FNG vs Cosmics - Energy/Length (**don't take it quantitatively**)





E.g of comparison of dE/dx in FNG and runs with cosmics. We don't understand the scales/calibrations, but at least everything technically is working in two very different cases