Nuclear recoil track reconstruction

CYGNO Reconstruction and Analysis meeting

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AmBe data selection

I'm analysing AmBe data taken with LEMON with an updated version of the reconstruction code, saving all the pixels, to study the direction of the tracks

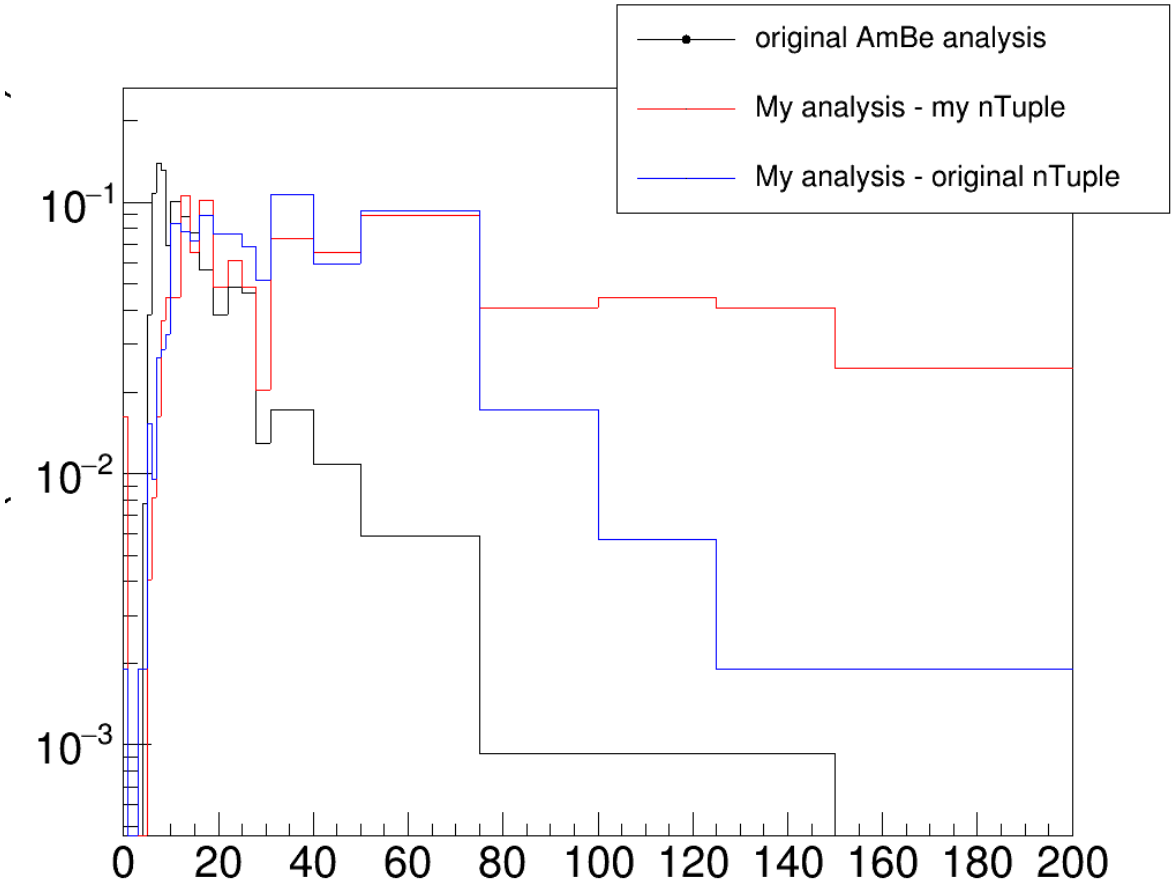
Selection cuts for NR:

- $0.4 < \text{width/length} < 1$
- length < 160 pixel (2cm)
- width < 53 pixel (6.54mm)
- density > 10

549 tracks selected out of **7826** superclusters (runs 2097, 2098) - **1477** entries

Applying the same cuts to the original nTuple (reconstruction used in the paper)
552 tracks selected out of **7433** superclusters (runs 2097, 2098) - **1467** entries

Energy spectra



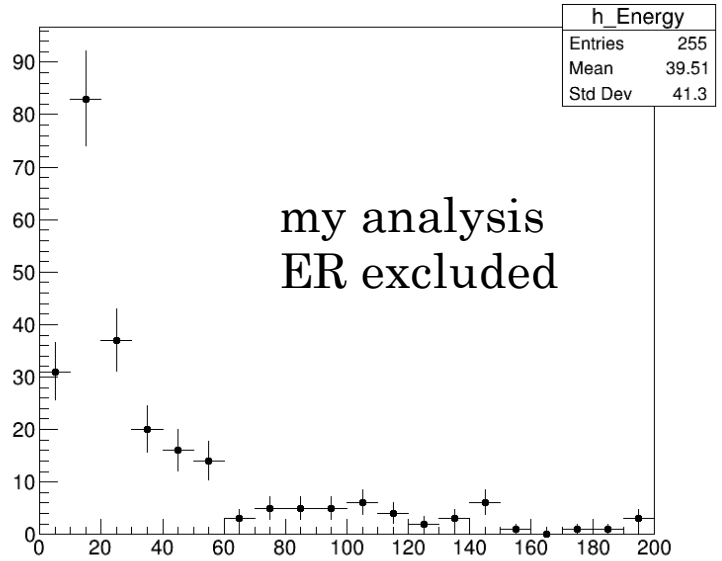
Superimposed spectra:

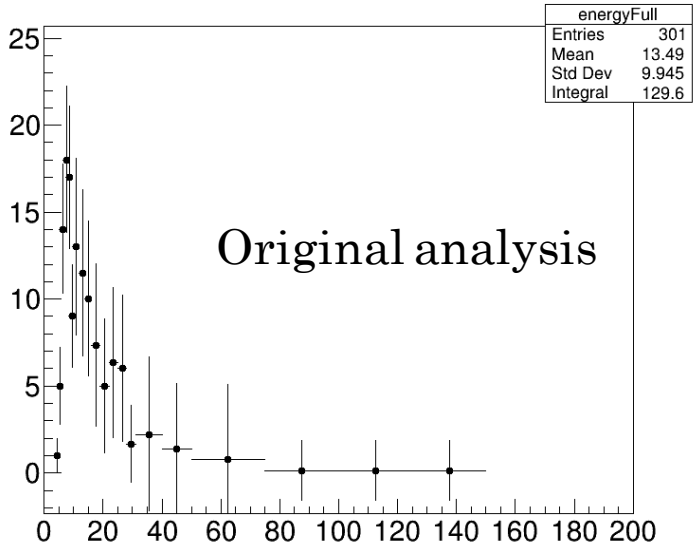
- Original analysed spectrum (preselection + cuts on delta for 50% efficiency on signal selection)
- My analysis on the ntuple produced with the new version of the code
- My analysis on the original ntuple

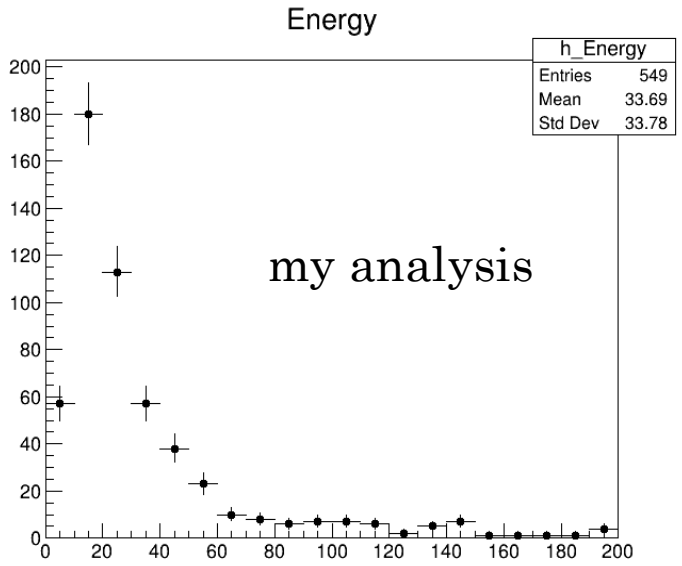
All spectra are normalized to 1

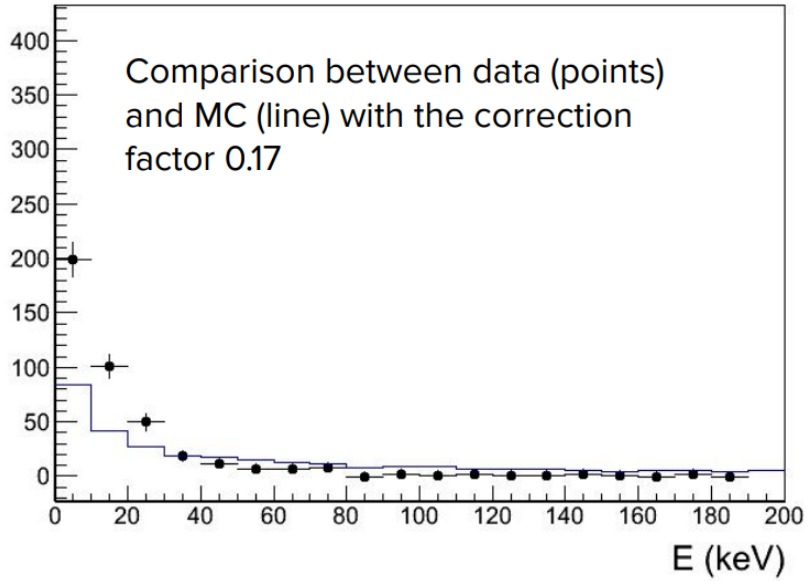
Energy spectra

Both the original spectrum and my spectrum are different from the one used to compare the data with MC simulation – how was this plot produced?



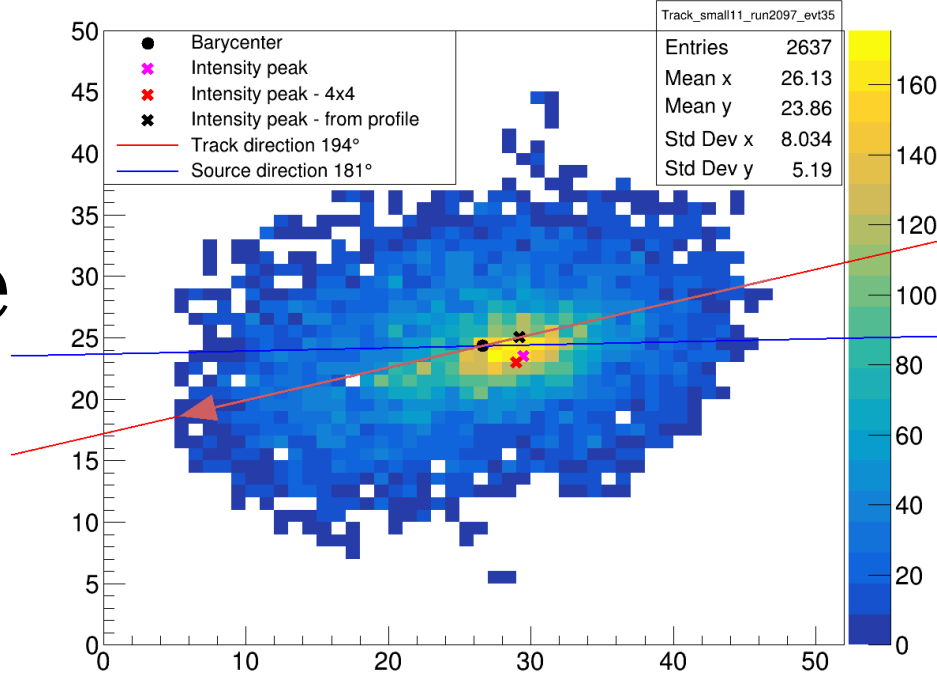


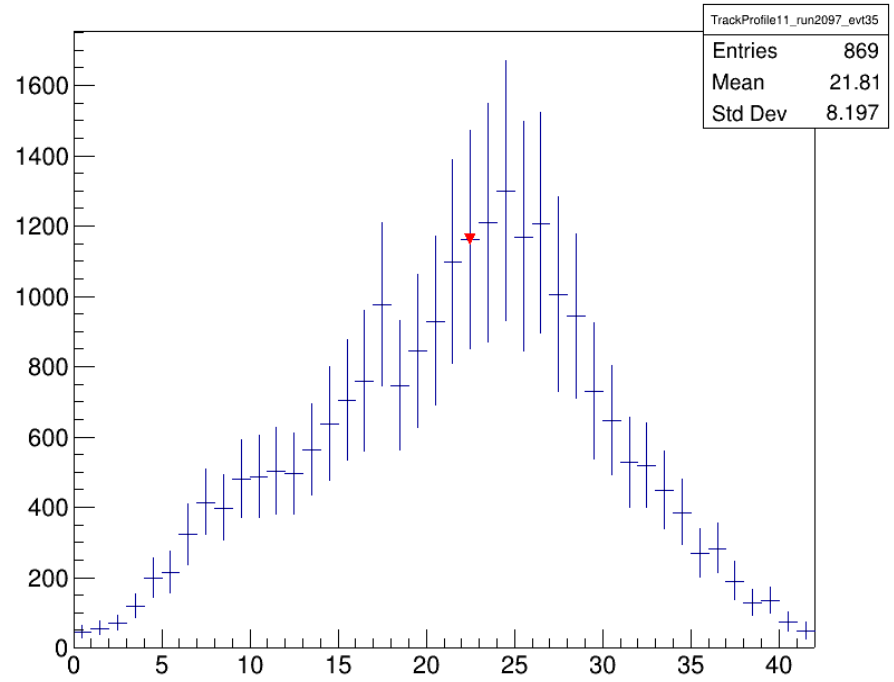




Track direction and sense

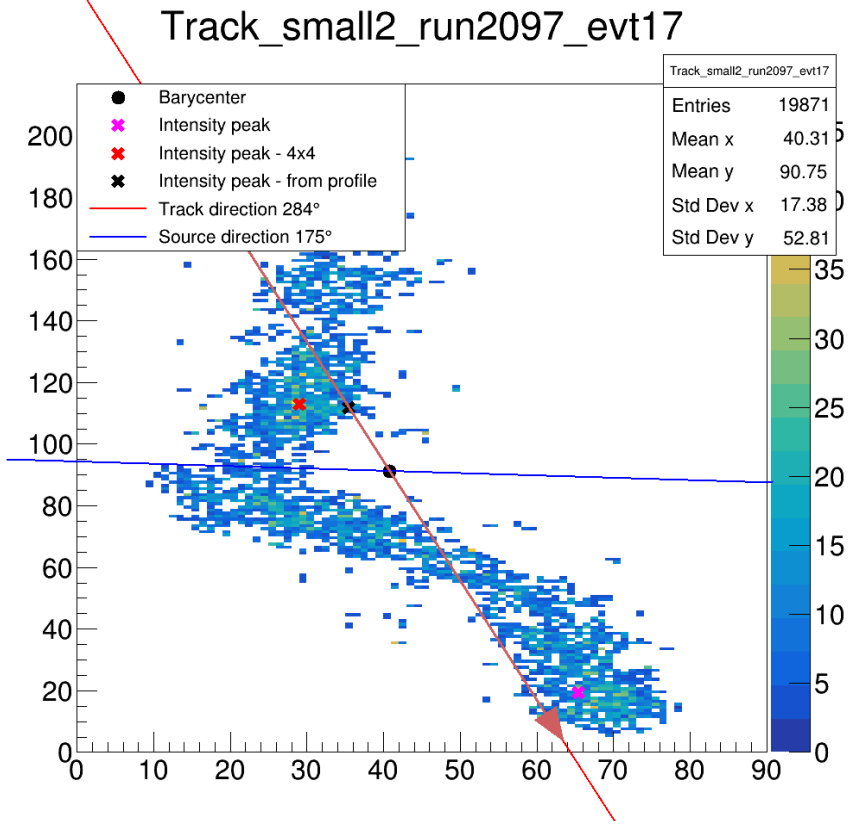
- Direction (red line) - found by maximizing RMS
  - Not optimized for NR, this is **preliminary**
- AmBe source direction (blue line) - 45cm distance along x, 10cm height in y
- The maximum energy release is expected to be at the *beginning* of the track
- Must define the intensity peak of the track – the sense is determined by its position along the line
- In the plot three points are shown: pixel of maximum intensity (pink), macro-pixel (2x2) of maximum intensity (red) and peak of intensity in the profile of the track along its direction (**black**)
- The arrow points in the opposite direction with respect to the projection of the macropixel peak (red) on the line
- Alternative: asymmetry of track profile (80.8% agreement with peak intensity approach)

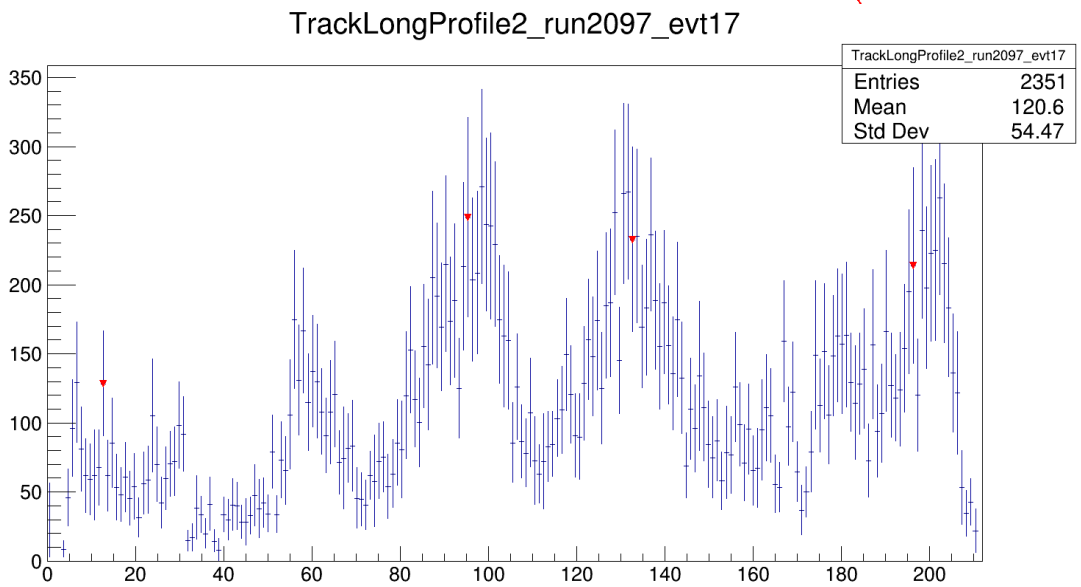




ER/NR discrimination

- To discard the selected ER, I look for **multi-peak** structure in the track profile
- 294 ER were found out of 549 tracks with the NR selection cuts (53.6%)
- I am now working on the optimization of this method with simulated tracks
- To check this method I selected the tracks in the photon region that should correspond to the **59keV Am photons**

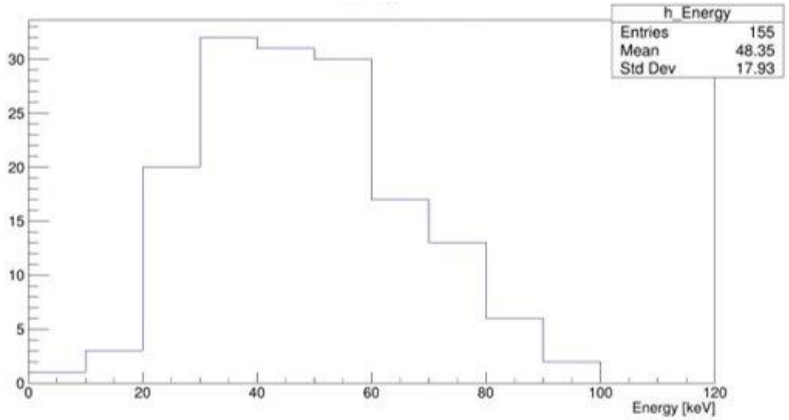




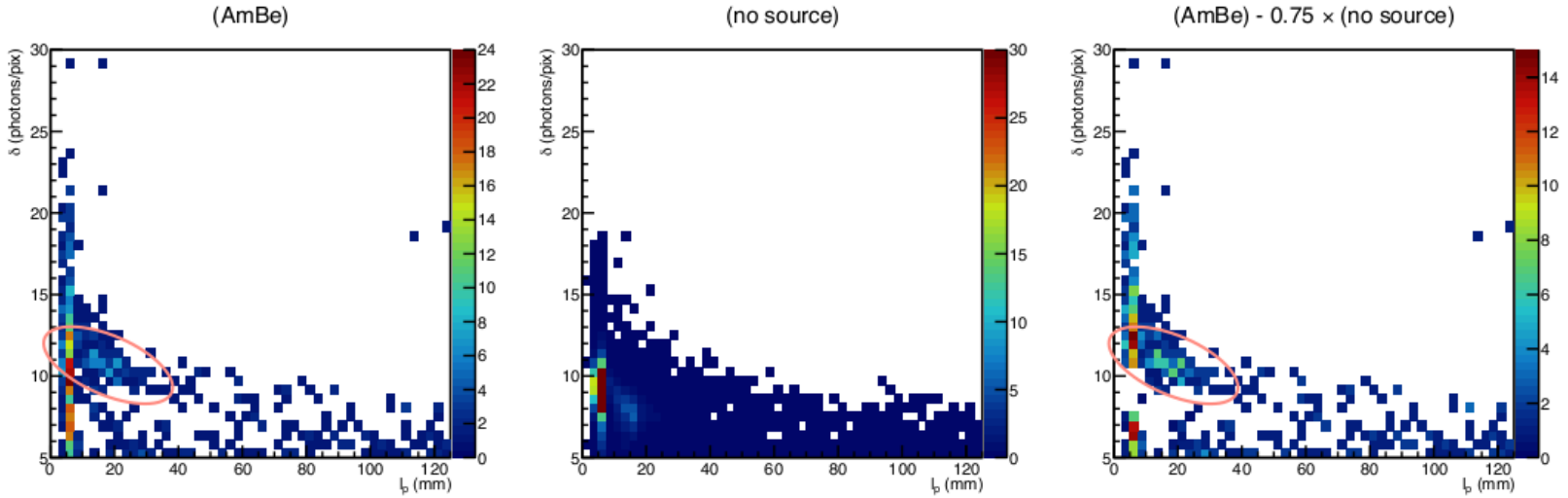
ER/NR discrimination

Applied cuts:

- width/length >= 0.3
- 120 < length < 250
- 9 < density < 12
- |density-y| < 2 (y = 14 – length/50)



With PR selection **155 out of 155** tracks were recognised as ER (100%)



Conclusions

- I can not reproduce the right energy spectrum – wrong cuts? Ideas?
- NR appear as straight tracks – preliminary approach with maximising RMS line, not optimized for NR
- The sense of the track can be identified by finding the maximum energy deposit point or from the asymmetry – but can not compare to the real direction; tests with alpha source with MANGO could be helpful (also for energy calibration)
- ER can be distinguished from NR by the structure of the profile – more tests needed
- Tests of the algorithms on simulated tracks from SRIM are ongoing