

WP2: Analysis Summary

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Reco code

DONE

- For simulation: ROOT simulated files are not flipped vertically anymore (bug correction)
- Vignetting for QUEST with Xenon lens and EHD (PR soon to be accepted)

ONGOING

- Correct for lens geometrical distortion

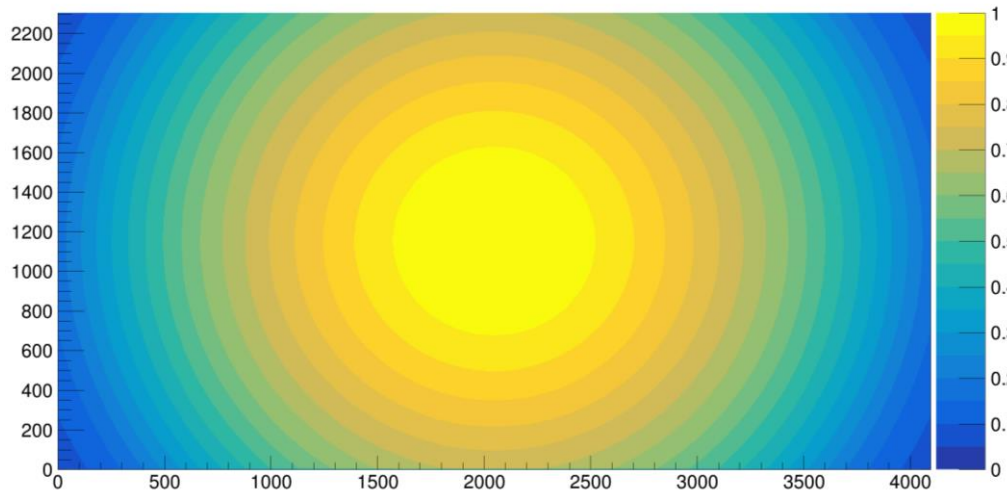
NEXT

- Update of autoreco to be run not only for LIME, but also for GIN and MANGO
- Standardise code to read refiles for analysis

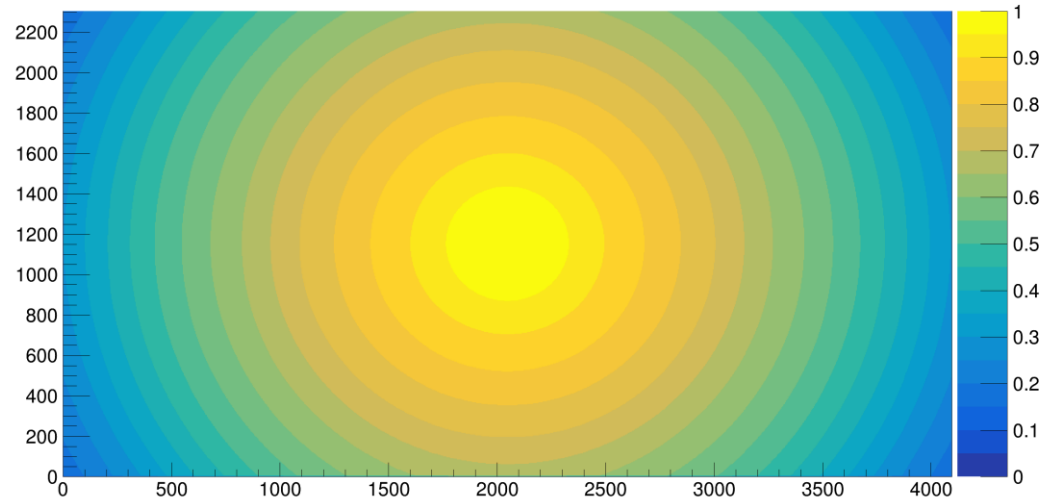
Vignetting

- Images taken with QUEST and Xenon Schneider and EHD lenses.
- Images of the flat wall with ambient illumination (for future, specific data taking may be required)

Quest Xenon lens 0.95 aperture

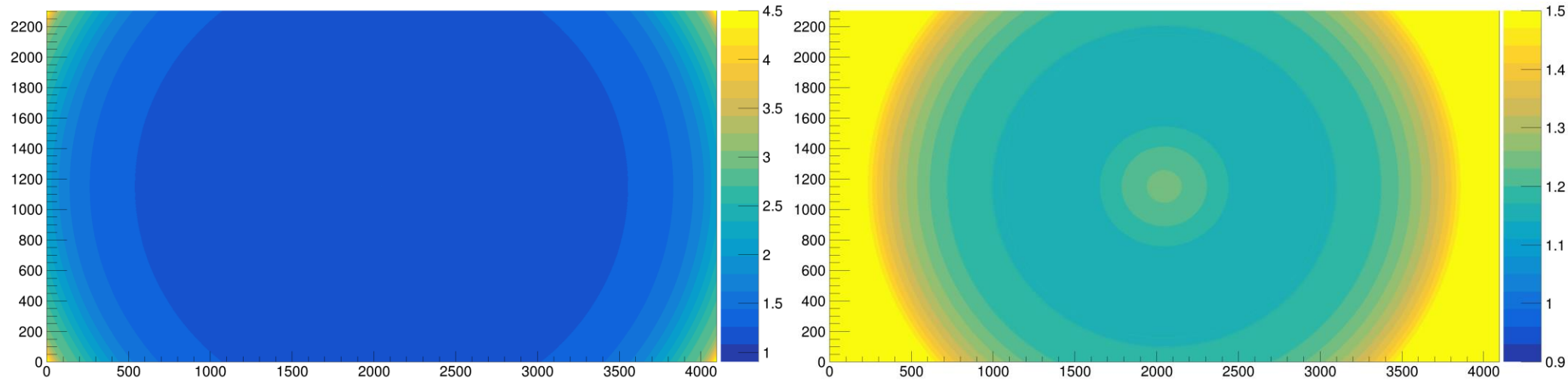


Quest EHD lens 0.85 aperture



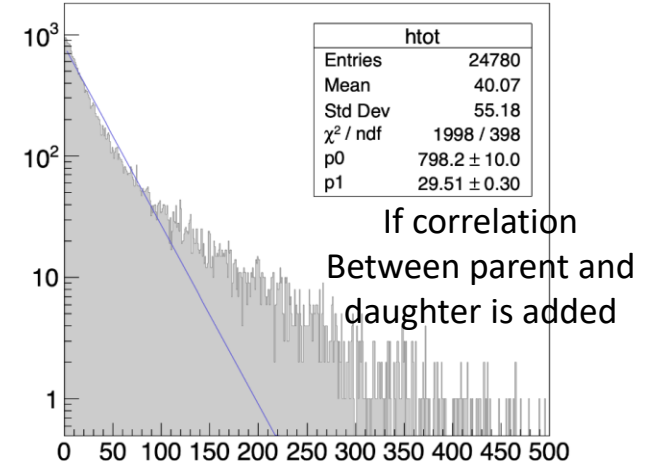
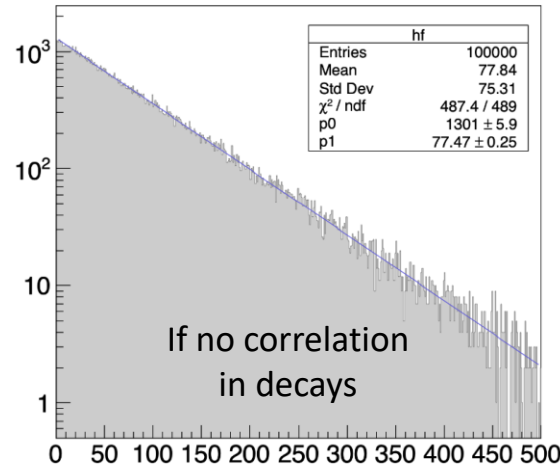
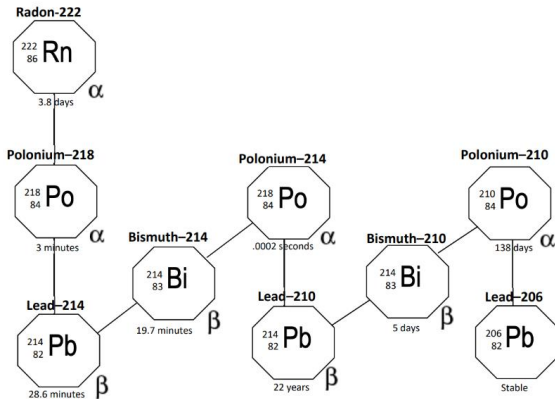
Vignetting

- The EHD with 0.85 aperture should grant 25% more light than Xenon lens (solid angle formula)
- Ratio of the two vignette maps (EHD 25% more light divided by Xenon)



EHD seems to improve light
on side bands by more than
factor 2

- In ^{222}Rn chain 4 alphas are expected, 3 possibly in secular equilibrium
- They have half lives comparable with our data taking
- By selecting alphas and measuring the time between two decays, the specific time decay constants should appear



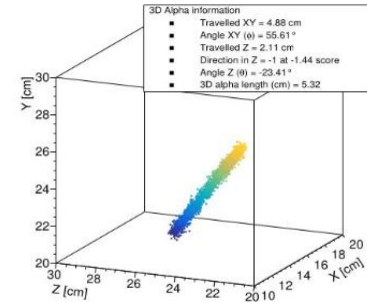
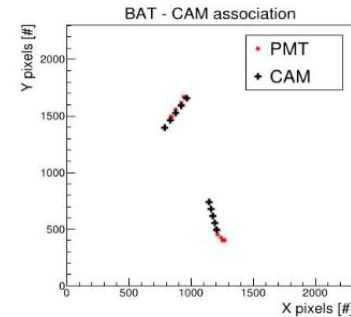
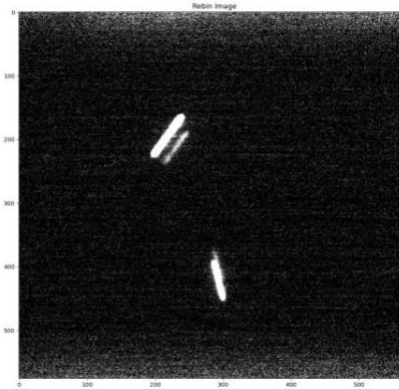
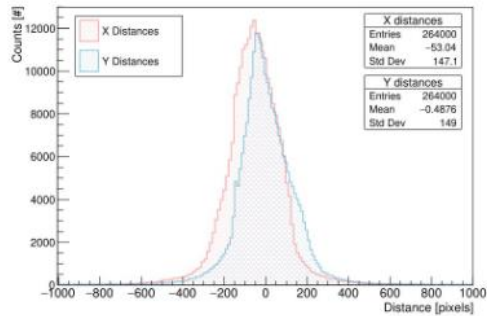
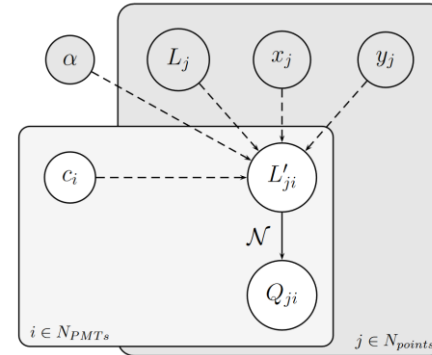
- Geometrical efficiency and of selection seems to have a relevant role
- Study in progress

3D (Borra, Marques)

<https://agenda.infn.it/event/43261/contributions/243495/attachments/125545/185129/PMTs%20fit%20update.pdf>

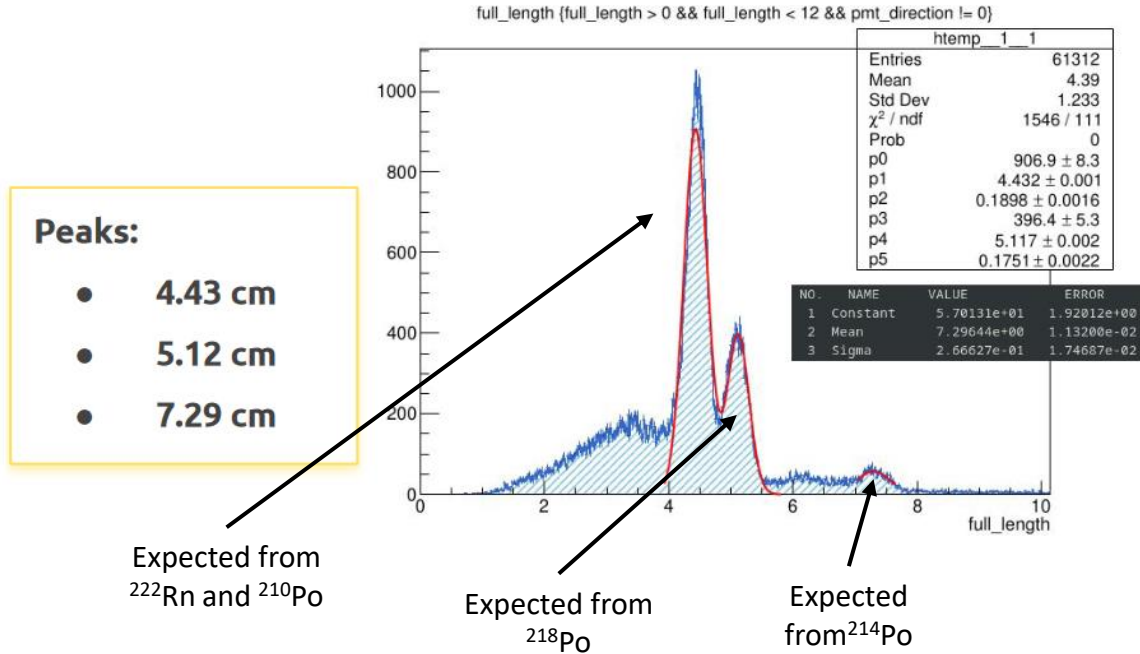
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- Borra and Folcarelli worked to improve the Bayesian association code exploiting images with 1 spot and 1 set of waveforms
- Code clear and ready to use with new calibration technique and data
- Alpha tracks used to test association by David.
- Tracks segmented in 5 slices, simulating spots and associated separately
- Slight horizontal bias but resolution on the order of cm found.



- Improvements will include new calibration by Borra and Folcarelli, barrel lens correction.
- Unavoidable: electronic saturation of waveforms for alphas

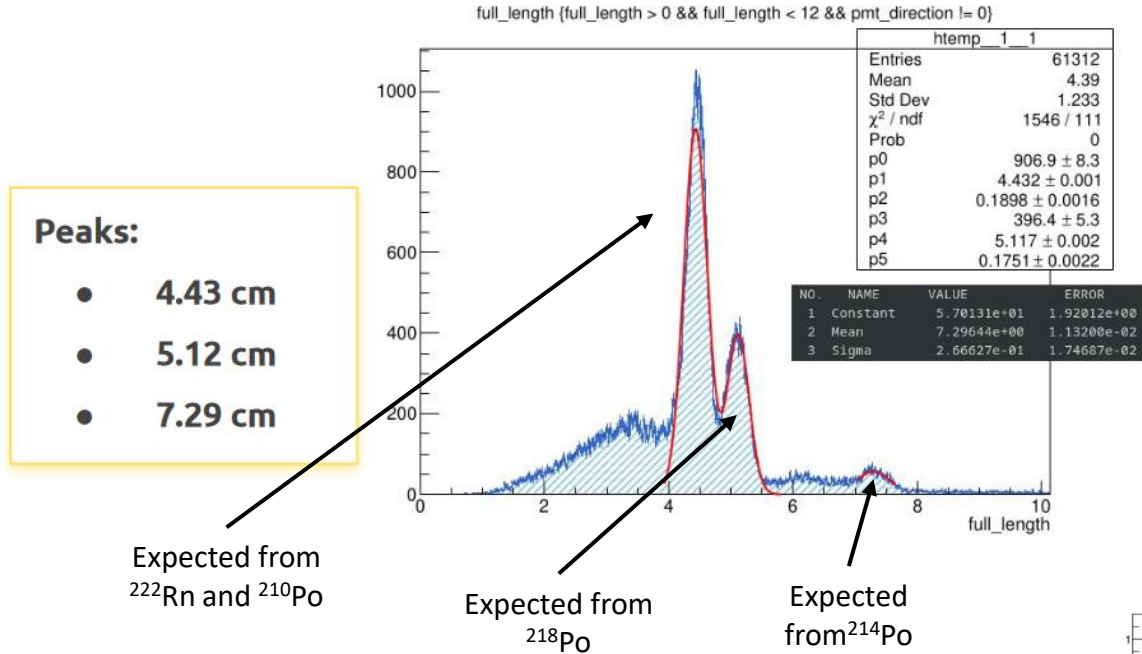
- 3D reconstruction allows to study full length of alpha tracks (exploiting camera, PMT and association)



Clear peaks in length.
Slight overestimation of the lengths we expect from Rn chain alphas

Intensity of peaks could be used to measure relative amount and check with expectations

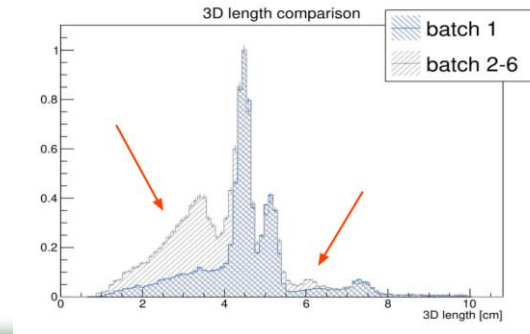
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Clear peaks in length.
Slight overestimation of the lengths we expect from Rn chain alphas

Intensity of peaks could be used to measure relative amount and check with expectations

- Study performed also comparing Dec Run4 (we know contamination happened) and after-Dec Run4.
- The peaks lose intensity, but keep ratio

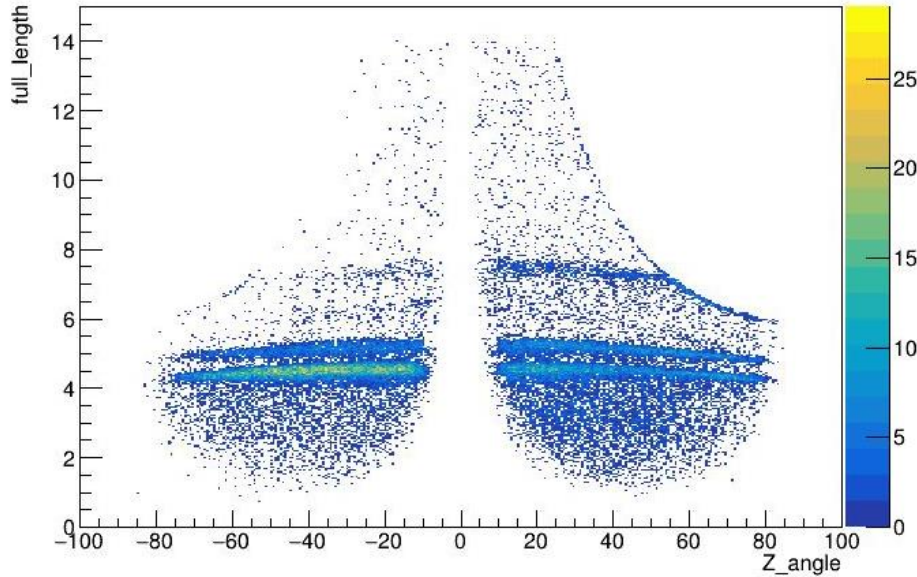


Batch1: Dec Run4

Batch2: After-Dec Run4

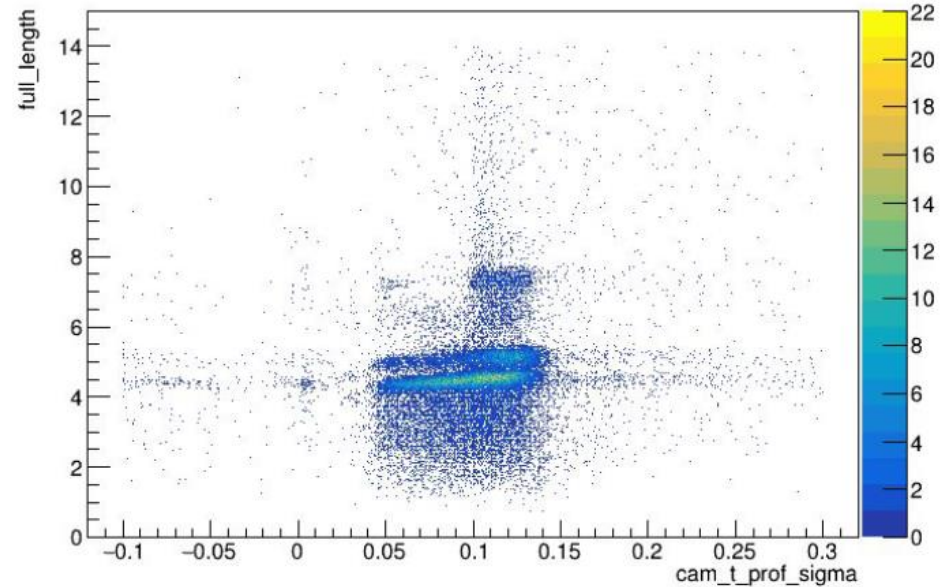
- 3D reconstruction allows to study angular directions
- A more complete version of tgausssigma can be exploited to estimate the absolute z of the track (cam_t_prof_sigma)

full_length_Z_angle (full_length > 0 && full_length < 14 && pmi_direction != 0 && cam_t_prof_sigma > -0.1 && cam_t_prof_sigma < 0.3)



Positive Z_angle = track goes towards GEM

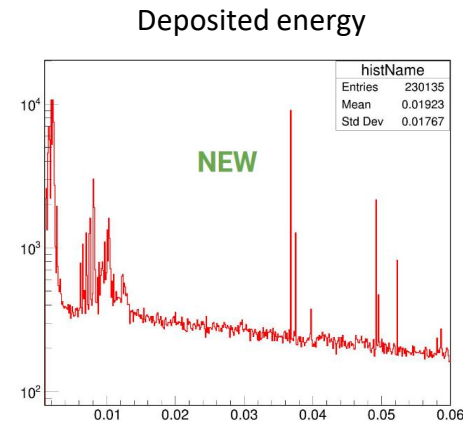
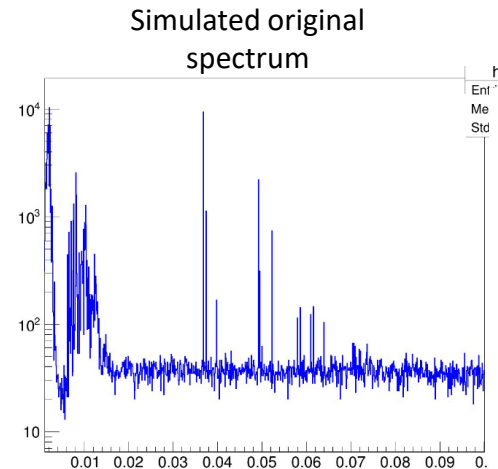
full_length_cam_t_prof_sigma (full_length > 0 && full_length < 14 && pmi_direction != 0 && cam_t_prof_sigma > -0.1 && cam_t_prof_sigma < 0.3)



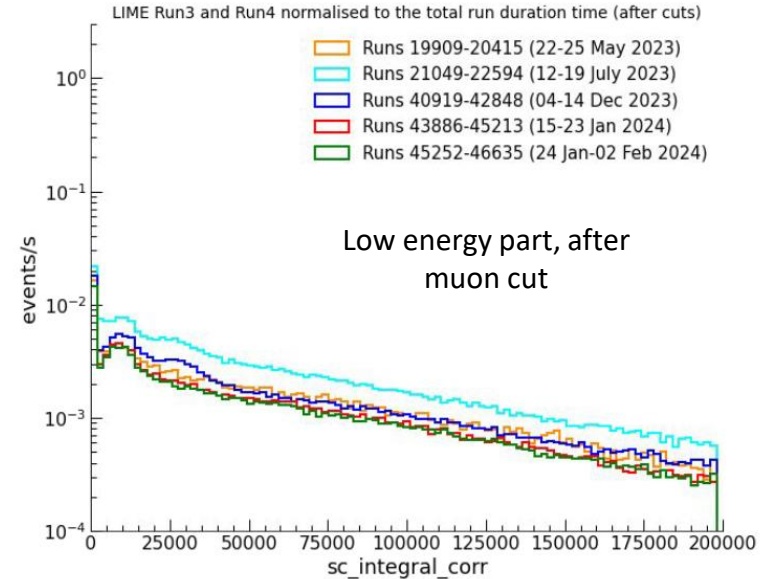
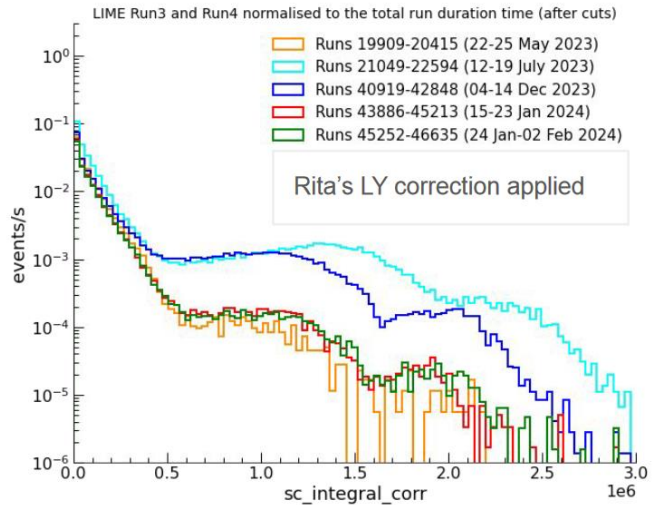
Large cam_t_prof_sigma = closer to cathode

- The 7 cm alpha seems to be mostly coming from the cathode

- ^{222}Rn chain simulated in Geant4 (randomly inside the gas volume, neglecting the motion of daughters)
- 4 alphas identified with 4 lengths and energies
 - measured range in mm:
 - 64.5
 - 44.5
 - 39.1
- Photons account for less than 1% of emission
- Considerable amount of beta emission and Auger electrons
- Bump at 8-10 keV_{ee} expected and lines at higher energies
- Spectrum digitized will provide more info
- Important to inspect which component of the chain is responsible for these low energy features



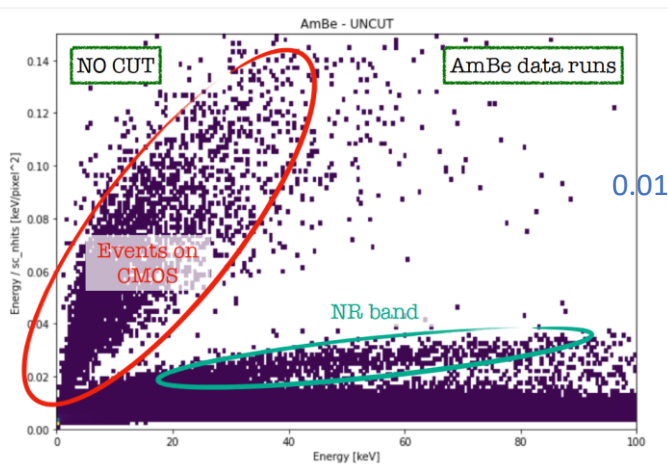
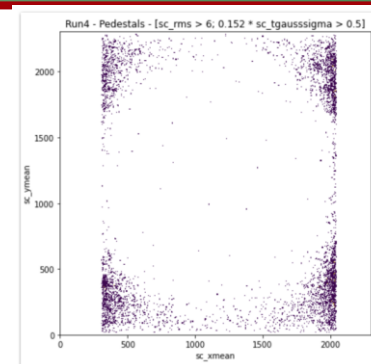
- Run4 high gain normalised and compared to May and July of Run3



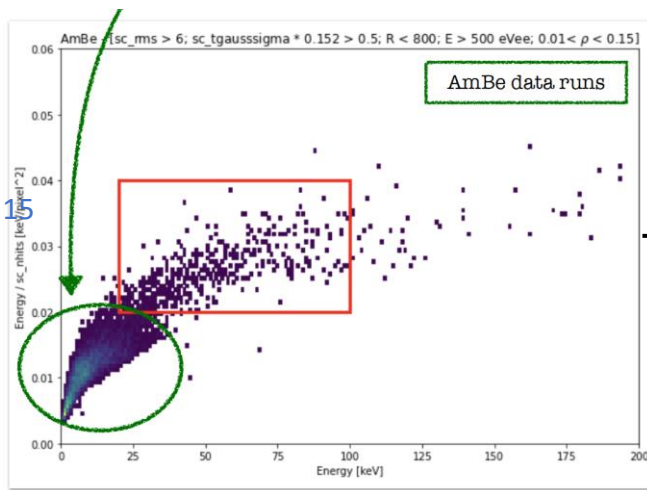
- When a lot of alphas are present two peaks at low energy appear
- Study on going:
 - using alphas and ^{55}Fe to calibrate in energy along the whole spectrum;
 - learn more about these two peaks
 - Exploit new variables (Stefano)

- Fake cluster are mostly in the external part of the image (vignetting correction)
 - If cut out (fiducialisation) threshold $0.5 eV_{ee}$
 - Else threshold $1.5 eV_{ee}$
- Introduction of new variables to remove background (from events in CMOS to MIP)

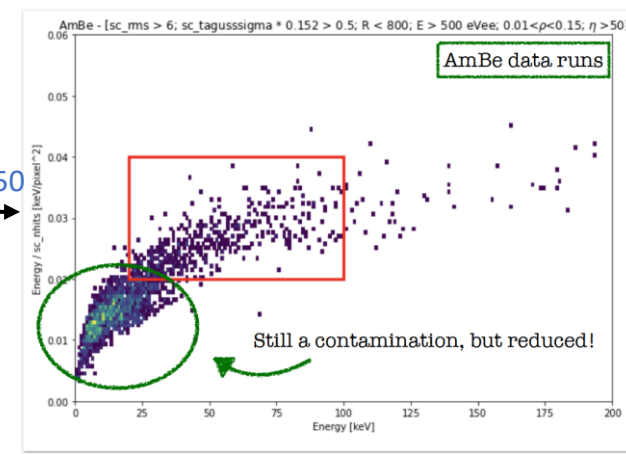
$$\rho \equiv \frac{sc_rms}{sc_nhits} \quad \eta \equiv sc_width * sc_length * \rho$$



$0.01 < \rho < 0.15$



$\eta > 50$

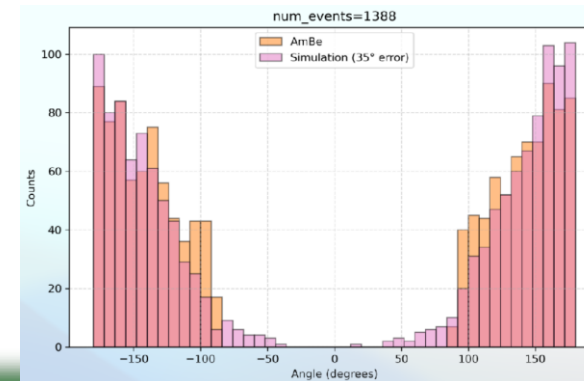
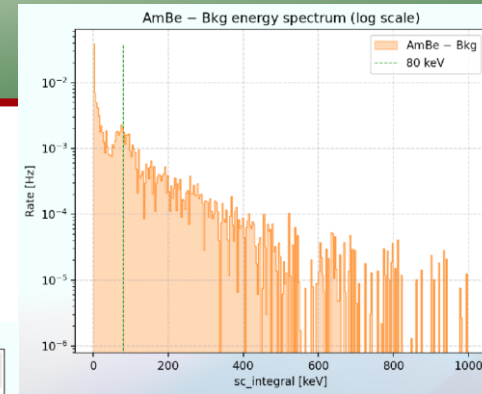
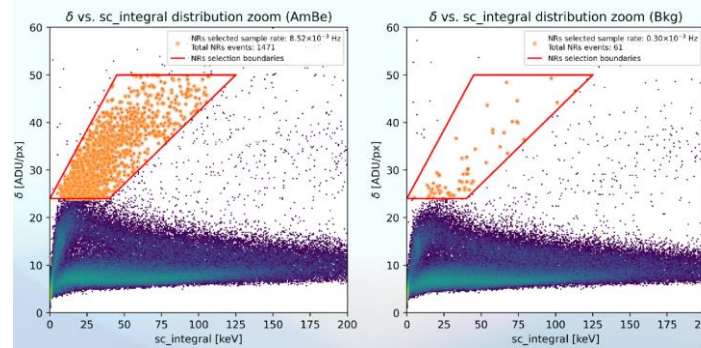


- Optimisation on AmBe data with lots of NR. Study ongoing to apply these cuts to Run4.

AmBe analysis (Zappaterra)

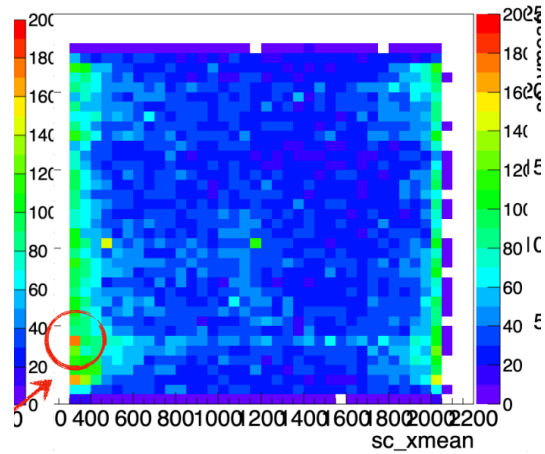
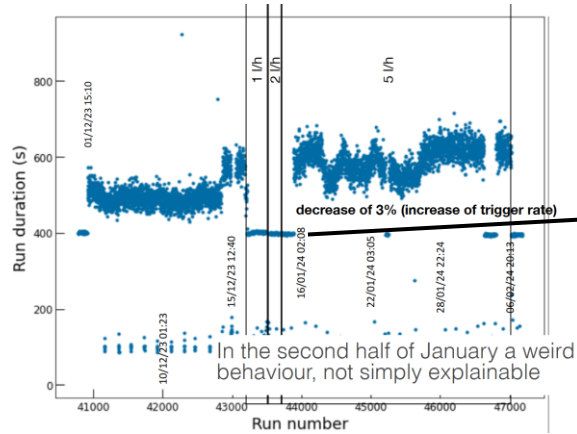
https://agenda.infn.it/event/43261/contributions/243488/attachments/125540/185122/240919-thesis-work_summary.pdf

- AmBe analysis searching for NR
- Calibration in energy using Pinci's uniformity map and correction for humidity (sort of worked)
- A peak at 80 keV appears in ER spectrum
- Selection of NR made by hand in high density region
- Estimation of directionality estimated forcing HT knowing the source position (can be improved by Samuele's code)
- Comparing with simulation, it gives the idea of a possible 30-40 angular resolution (energies >15 keV_{ee})



Run Duration, GEM (Pinci, Fiorina)

- Run duration variable seems a very sensitive variable for detector condition and physics
- Dependence on pressure which affects gain (Study will be improved by Zahoor)
runs: 44604-44704



Possibly hot spot reducing the time duration

Run duration variable added to Grafana monitor

GEM Signal (Fiorina)

- GEM waveform analysis led to realise only GEM3 is visible and is coupled to signals in GEM2 and GEM1
- Specific circuit to read out the GEM would be required