WP2: Analysis Summary

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25/07/2024

Reco code

DONE

- Running Run3 PMT data
- Running Run4 PMT data before 29 Feb (all on cloud)
- Fixed issue for analysis of memory leak for ROOT files

ONGOING

NEXT

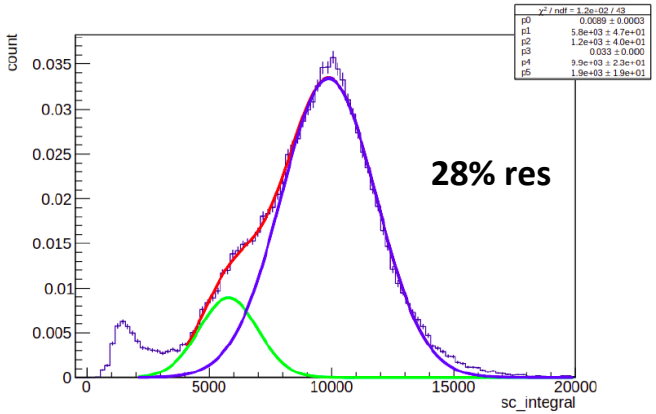
- Update of autoreco to be run not only for LIME, but also for GIN and MANGO
- Standardise code to read recofiles for analysis
- Correct for lens geometrical distorsion
- Vignetting for QUEST

LY30 Update (Antonietti)

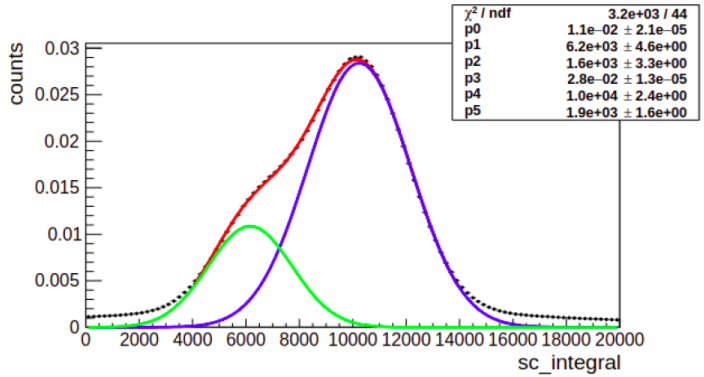
https://agenda.infn.it/event/41935/contributions/234767/attachments/120518/175360/Final%20results%20LY30.pdf

- Review of LY30 procedure to equalise data -> 13% resolution in correction for Run3
- Equalization in Run3 with ^{55}Fe from different distances allows to estimate a z-averaged signal, confirmed by simulation

Real data



Simulated data



- Potential Cu peak found in Run3 at 7.2 keV

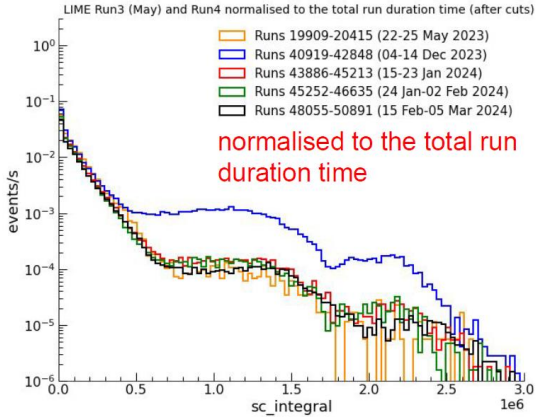
- Impossible to perform calibration in Run4. LY stable within 3%.
- Correction not needed

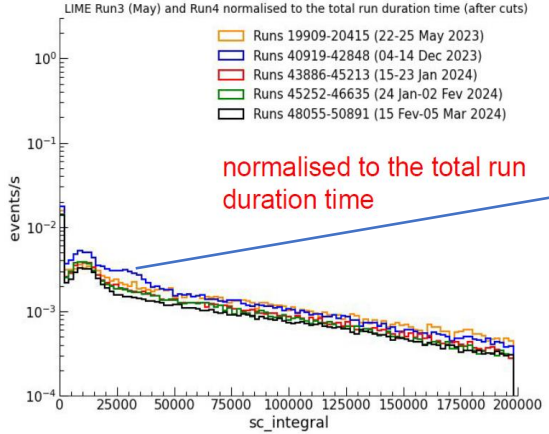
Run4 Time duration and correction (Mano)

https://agenda.infn.it/event/42256/contributions/236873/attachments/122058/178192/dead_time_correction_daniel.pdf

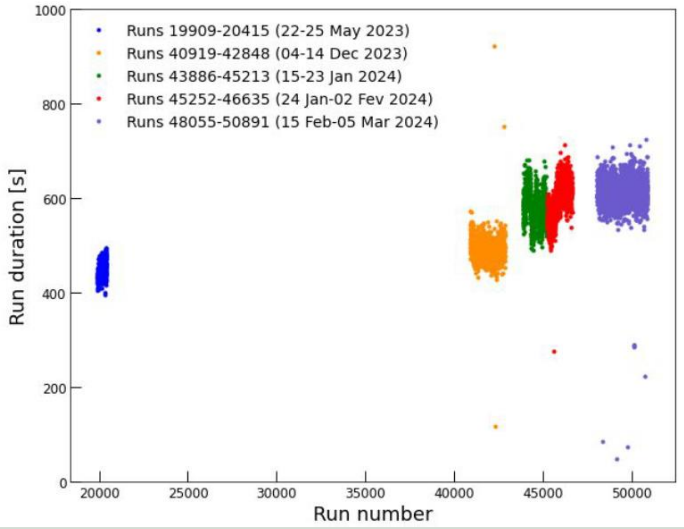
https://agenda.infn.it/event/42653/contributions/239859/attachments/123865/181832/rate_of_events.pdf

- DeadTime study with Flaminia's method lead to consistent results with Run4 data on correction for PMT inefficiency (~ 7%)
- Normalisation in time of different sets of Run4 data





Could this be a low energy excess due to Rn (76 keV and 79 keV line in Compton form??)



- Variation in the time duration of the runs with time.. Physics happening?
- To be tested with rate estimation technique from next slide

Deadtime and exposure (Piacentini, Dho)

https://agenda.infn.it/event/42653/contributions/239853/attachments/123866/181848/AM_240718.pdf

- Possibly golden presentation **for rate and deadtime estimation for LIME data and DAQ**
- Starting from number of waveforms and time duration of runs available in recofiles

$$T_{\text{run}}^{\text{acquired}} = \left(510\ \text{ms} \times N_{\text{pics}}^{\text{acquired}} + t_{\text{wf}} \times N_{\text{wfs}}^{\text{acquired}} + 510\ \text{ms} \times N_{\text{pics}}^{\text{empty}}\right)$$

Known run by run

Known run by run

Time to readout a single waveform, "unknown"

Measured to 9.9 ms from ^{55}Fe calibration runs

Known run by run

Number of empty pics, "unknown"

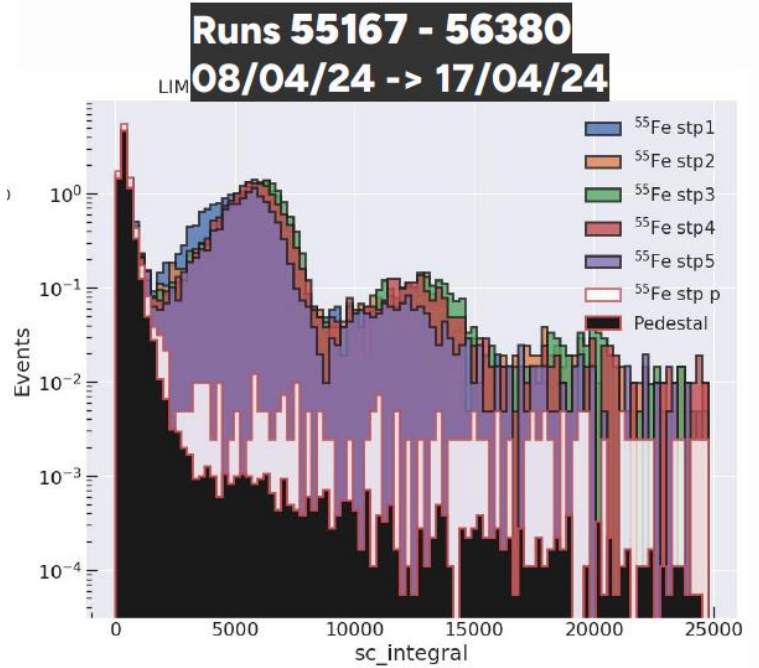
Can be evaluated by data

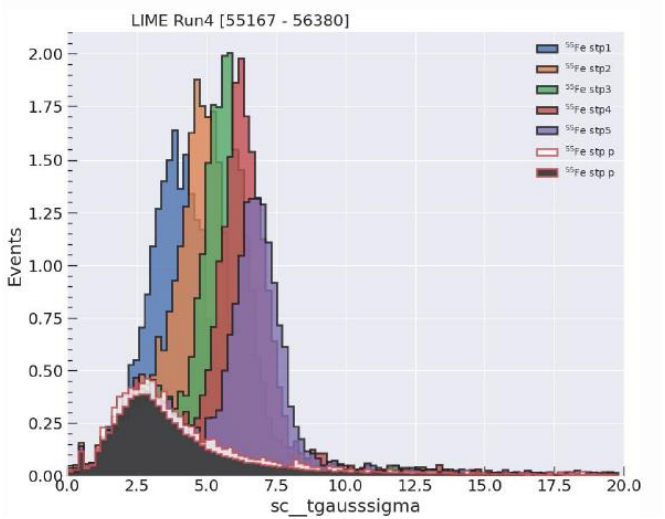
- Tested with trigger module rate and tracks in a run -> matches
- Livetime is different for camera and PMT (camera sits at 60% for spotlike events and can be estimated by counting the total pictures)

Run4 Lowgain (Silva)

https://agenda.infn.it/event/42148/contributions/236274/attachments/121547/177288/CYGNO_RUN4_LOW_GAIN_13_06_24_v2.pdf

- Run4 first look
- Distributions of sc_integral of ^{55}Fe calibration support a better stability of the detector response in z
- Work in progress to look at the background data normalised in light intensity
- Work in progress to check the efficiency at low energy and the cuts effects



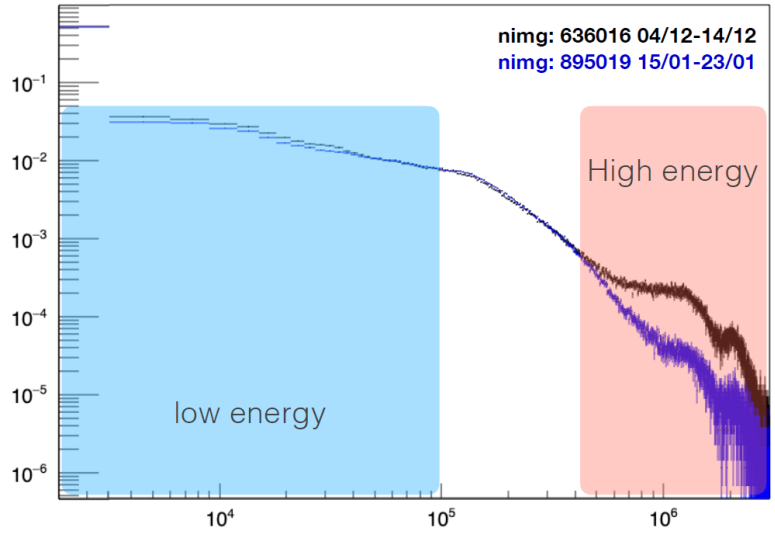


Alphas: camera (Pinci) and PMT length (Zappaterra)

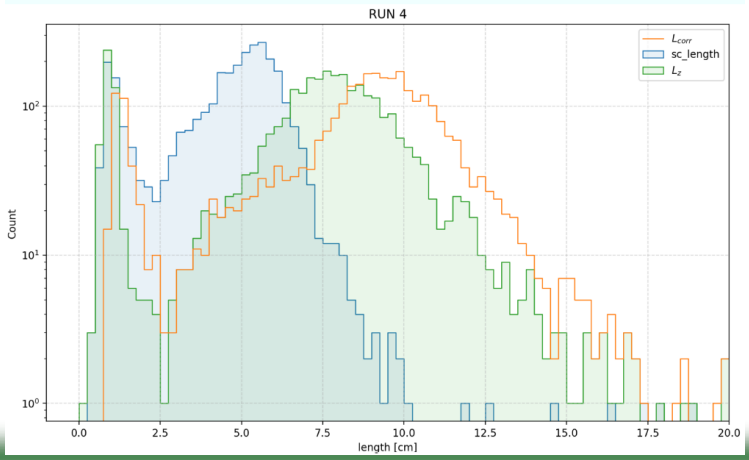
https://agenda.infn.it/event/42030/contributions/235553/attachments/120820/175986/240605-length_intercalibration.pdf

https://agenda.infn.it/event/42256/

- Study on alpha rich and poor runs to see the effect of Rn at low energy
- Work on going. Occupancy variable exploited to pick alphas with less ''shadow''



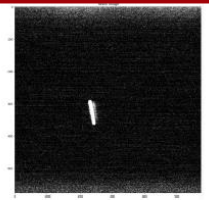
- Study on alpha with PMT waveforms to estimate and correlate the length
- Subtraction of a zero-length based on ^{55}Fe tracks.
- Unclear why length from camera and PMT are quite off
(blue: camera, green: PMT, orange: estimation of real length

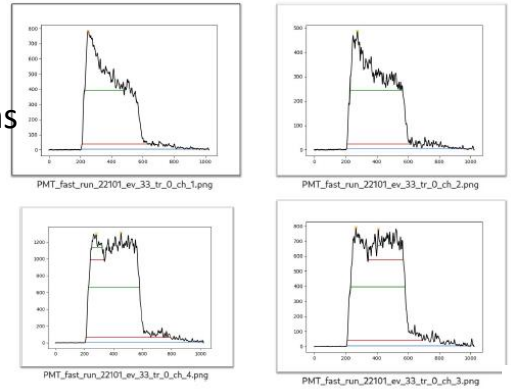


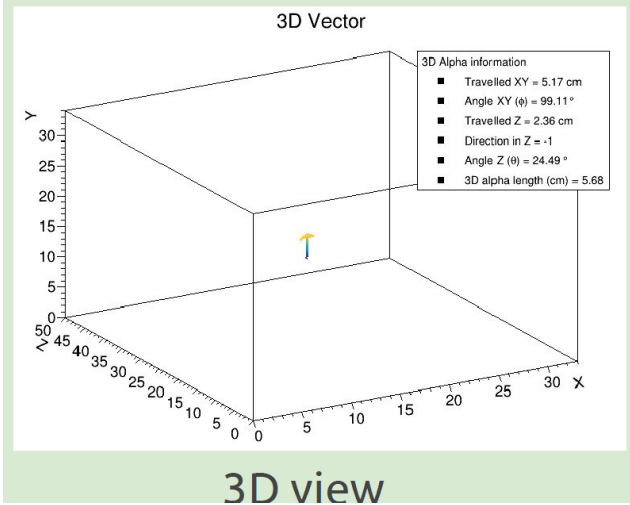
PMT 3D (Marques)

https://agenda.infn.it/event/42653/contributions/239860/attachments/123872/181850/PMT_Reco_Analysis_18-07-2024.pdf

- 3D reconstruction of alphas with head-tail recognition
- Introduction of a score to more reliably associate waveforms to camera image
- Still work needed to nicely match PMT and waveforms
- Lens distorsions are possibly affecting the results

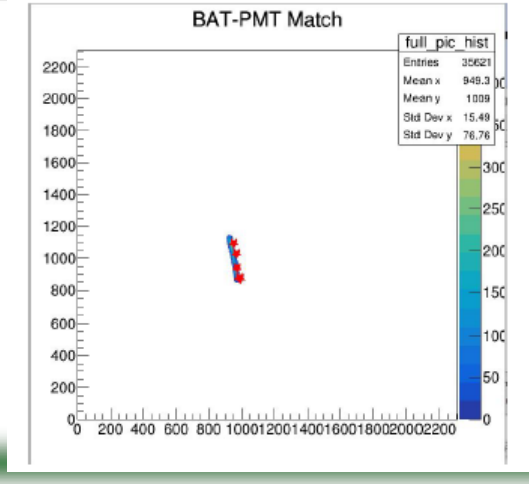






3D view

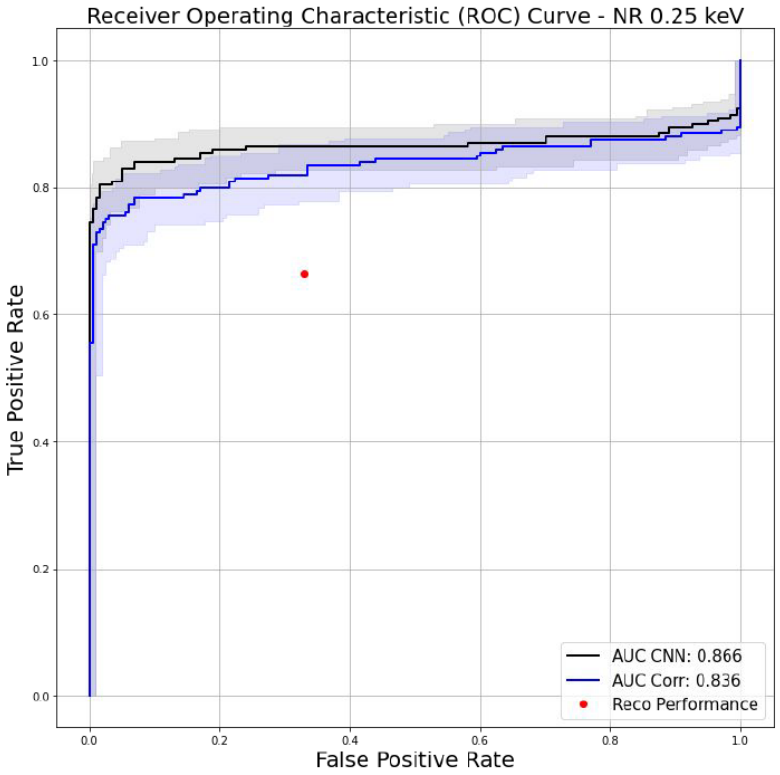
- Bayesian fit to associate waveforms to track is under study. Optimisation undergoing



Update trigger (Pains)

https://agenda.infn.it/event/42653/contributions/239874/attachments/123871/181849/Trigger%20Proposal%20Status%20-%20CNN.pdf

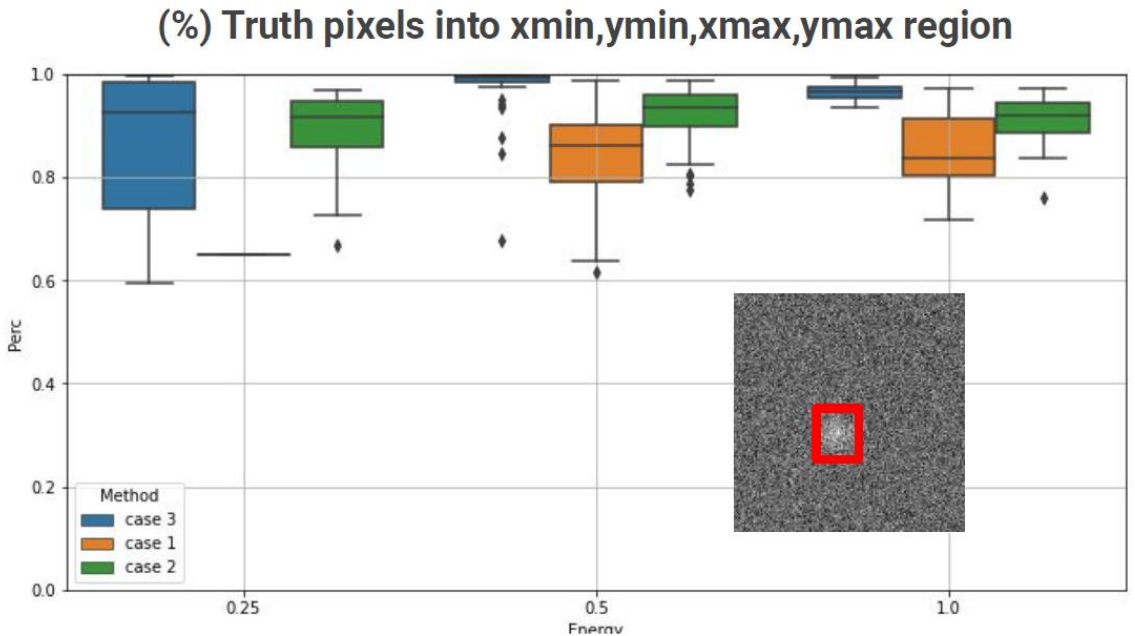
- Selection of the image to decide whether there is signal or not
- CNN structure used in comparison with AUC corr filter-based selection
- Similar results on 0.25 keV and 0.5 keV (strongly outperforms current reco code
- 0.4 s of run time of the codeper image. Can be improved by GPU
- While AUC corralready reached its ceiling, CNN can be improved



U-Net Update (Lopes)

https://agenda.infn.it/event/42148/contributions/236190/attachments/122502/179332/U-Net%E2%80%99s%20performance%20for%20low%20energy%20events.pdf

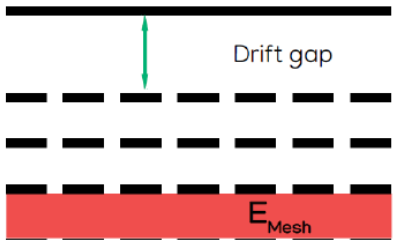
- U-Net for pixel classification: what is signal what is noise
- U-Net tested directly on images or on preprocessed images (like our reco)
- U-Net performed better alone with more than 50% efficiency in finding the pixels of 0.25 keV events
- Comparison with not optimised reco-code is promising (20 times better)
- Always better at finding which pixels belong to the actual cluster

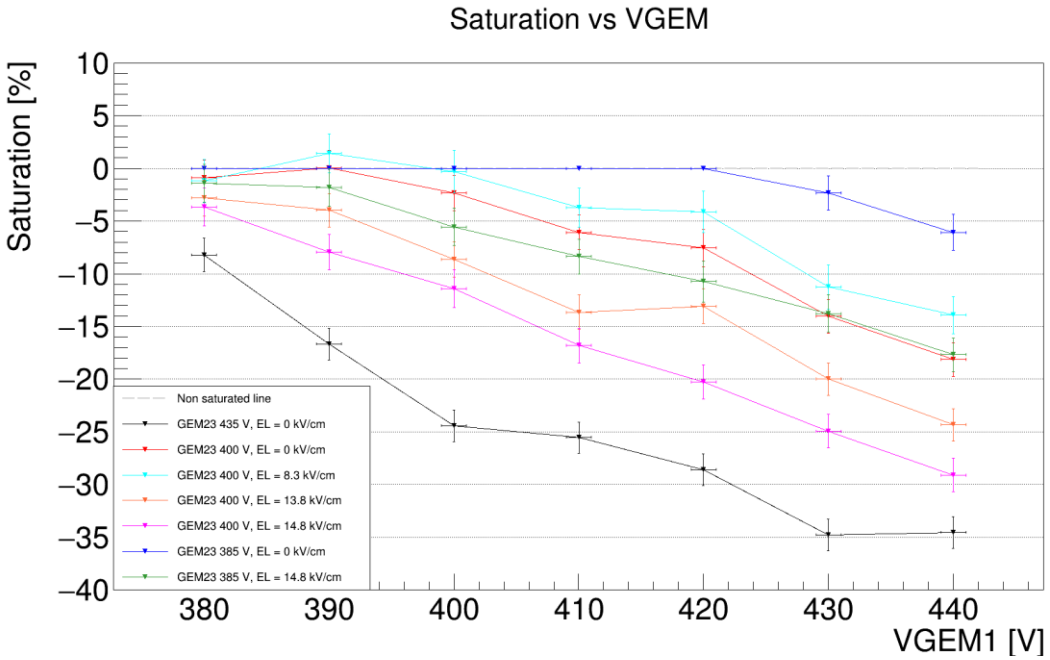


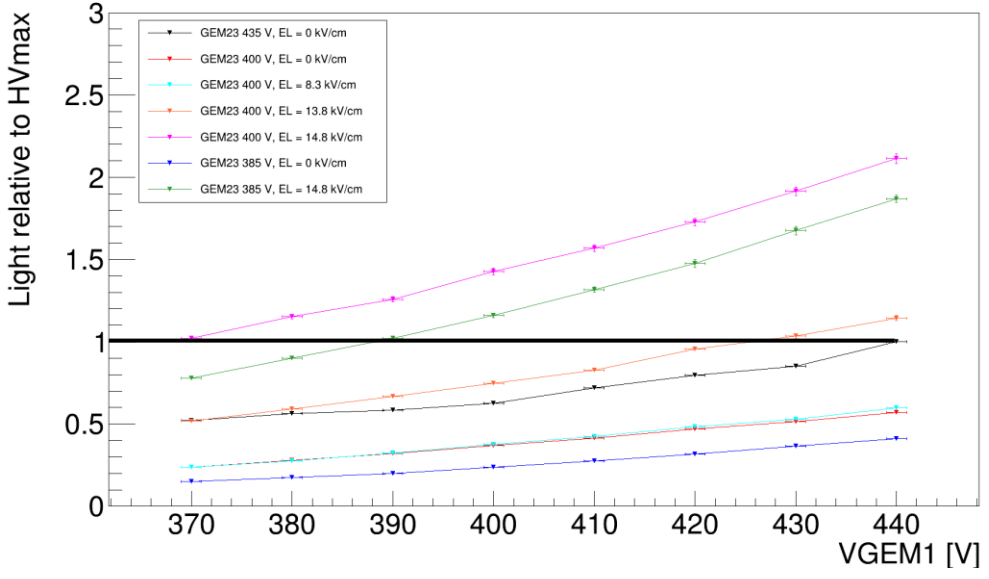
ITO low saturation (Dho)

https://agenda.infn.it/event/42148/contributions/236275/attachments/121565/177328/ELSat_Slide5_6_24.pdf

- Exploit data on VGEM scan with MANGO with ^{55}Fe source within 1 cm from the GEMs
- Data taken in non-saturated regime, saturated regime and test regime with ITO fields
- Saturation estimations might point at a condition with similar light with less saturation







ITO low saturation (Dho)

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