Background and tracks simulation

CYGNO simulation meeting – 29/11/2021

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LIME internal background

- GEM – done and analysed
- Acrylic box – done and analysed
- Field cage – done and analysed
- Cathode – done and analysed
- Resistors – ongoing
- Camera body + lens – to do (new shielding geometry to be included in GEANT4)
- PMT, GEM supports, internal structure… – to do (?)

Measurement on resistors and copper rings is **done**, we are waiting for the results

Previous results on camera simulation:
35644 events/yr [0-20 keV]

Contribution	10^5 (ER+NR)/yr (0-20 keV)	10^5 (ER+NR)/yr (all)	NR/yr (0-20 keV)	NR/yr (all)
GEMs	0.69129±0.00002	3.83753±0.00004	311.62±0.09	17573.0±0.6
Acrylic Box	0.5245±0.0001	2.7054±0.0002	0	0
Field Rings*	0.049008±0.000005	0.32270±0.00001	2.665±0.004	121.84±0.03
Cathode*	0.033903±0.000001	0.081639±0.000002	0.4430±0.0006	69.400±0.008
TOTAL	**1.2987**	**6.9473**	**315**	**17764**

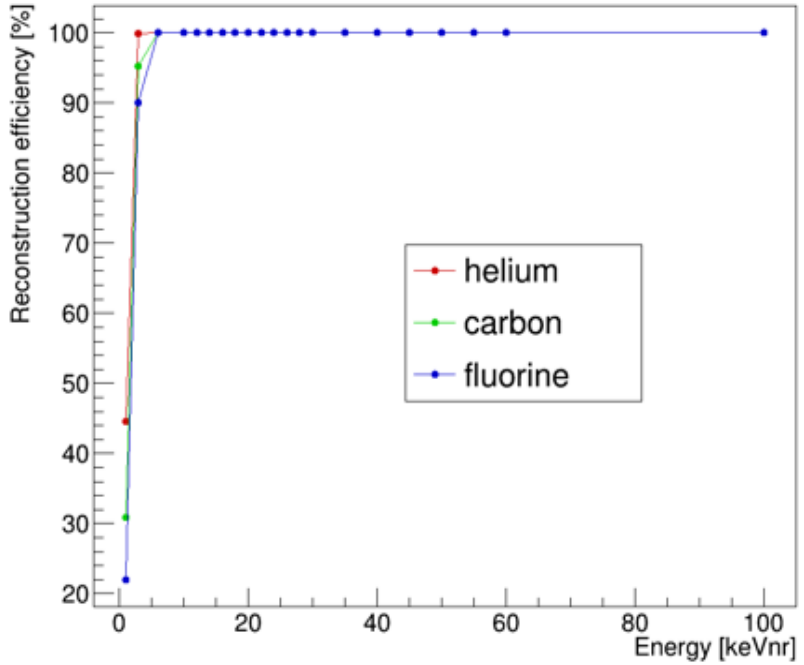
*Activity taken from TREX measurements multiplied by 10

Track simulation

- **SRIM ion simulation**
  - I produced a sample of 10^4 He recoils with random direction, random drift distance and **random energy between 1 and 50 keV**
  - The ionization profile files are uploaded on LNGS cluster (to be digitized)

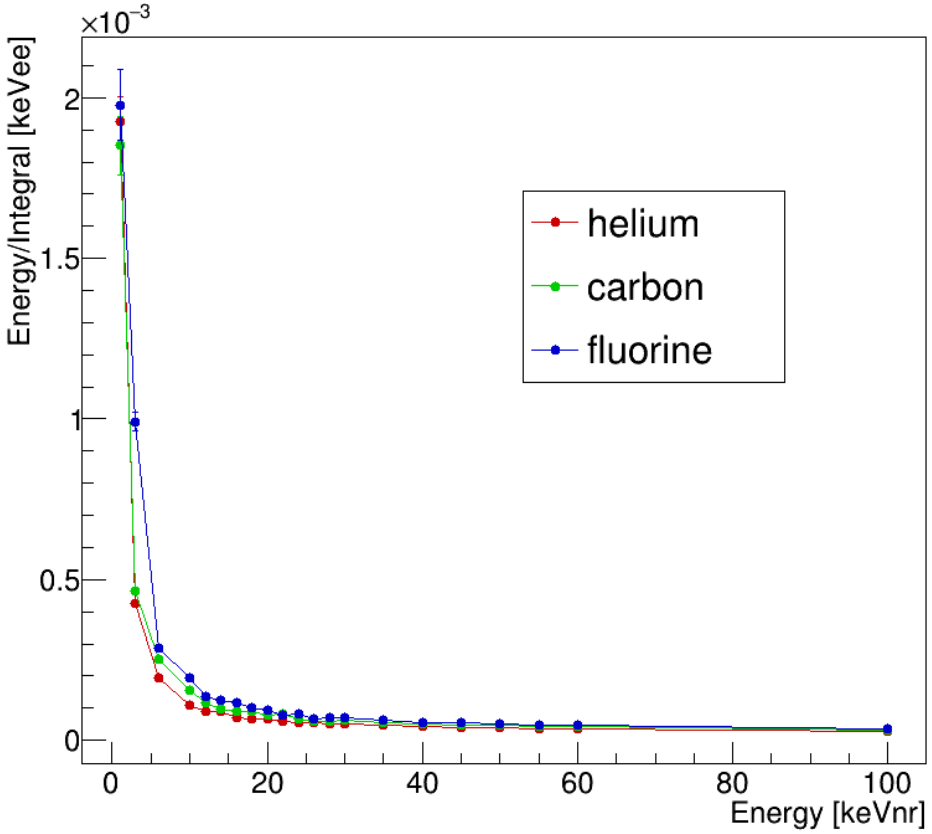
- Reconstruction of He, C and F sample (all energies, random drift, random direction) done with autumn21 branch
- Reconstruction efficiency 100% above 3keV

- Post reco analysis is ongoing

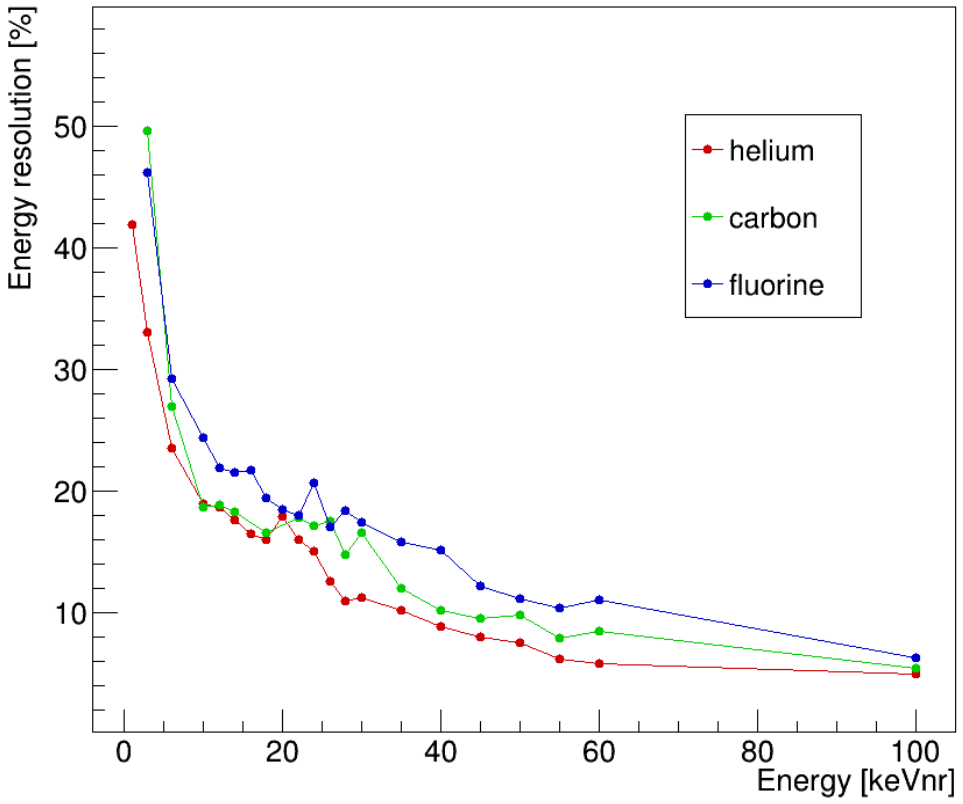


Track simulation

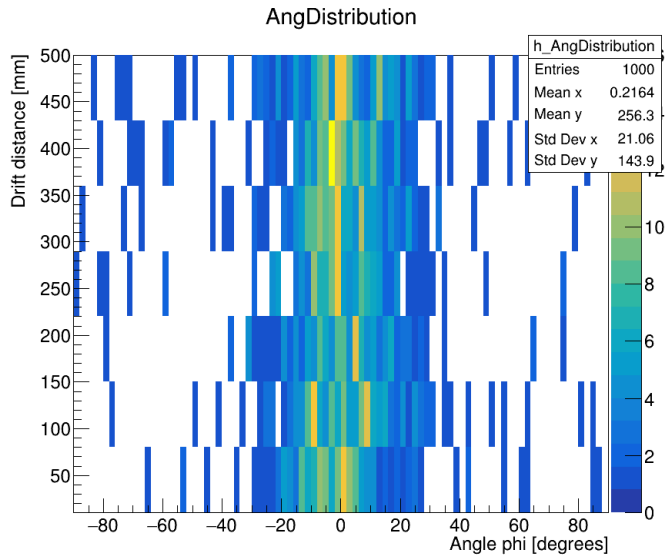
Calibration factor (averaged over drift distance)



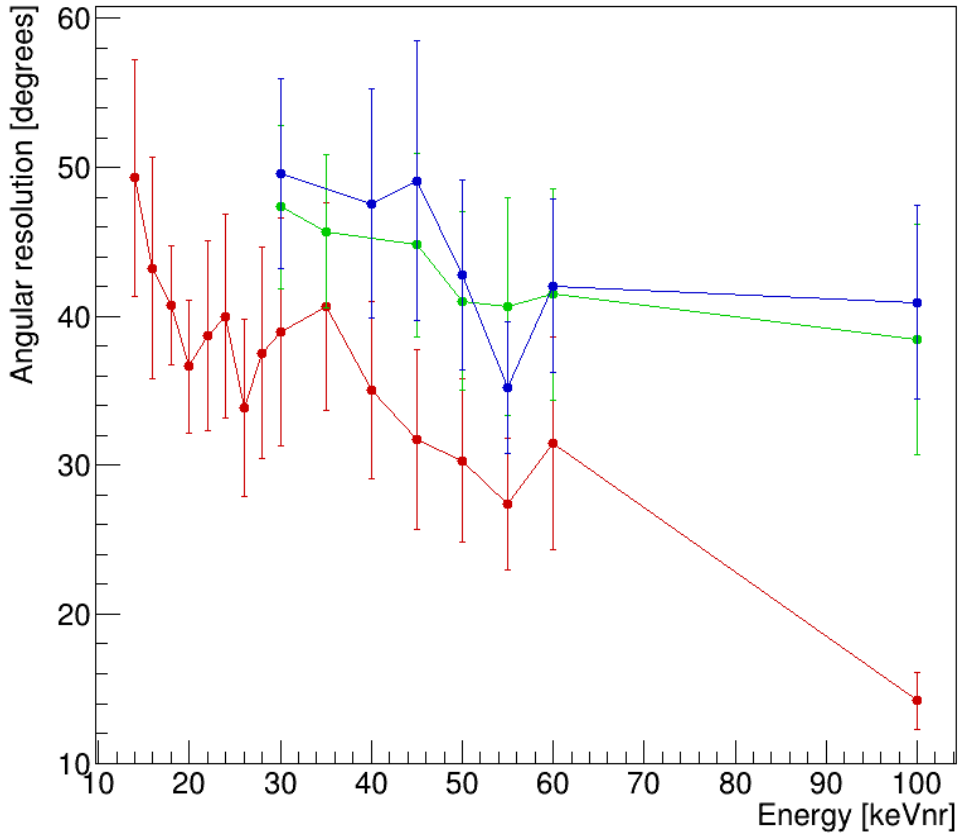
Energy resolution (averaged over drift distance)



Track simulation

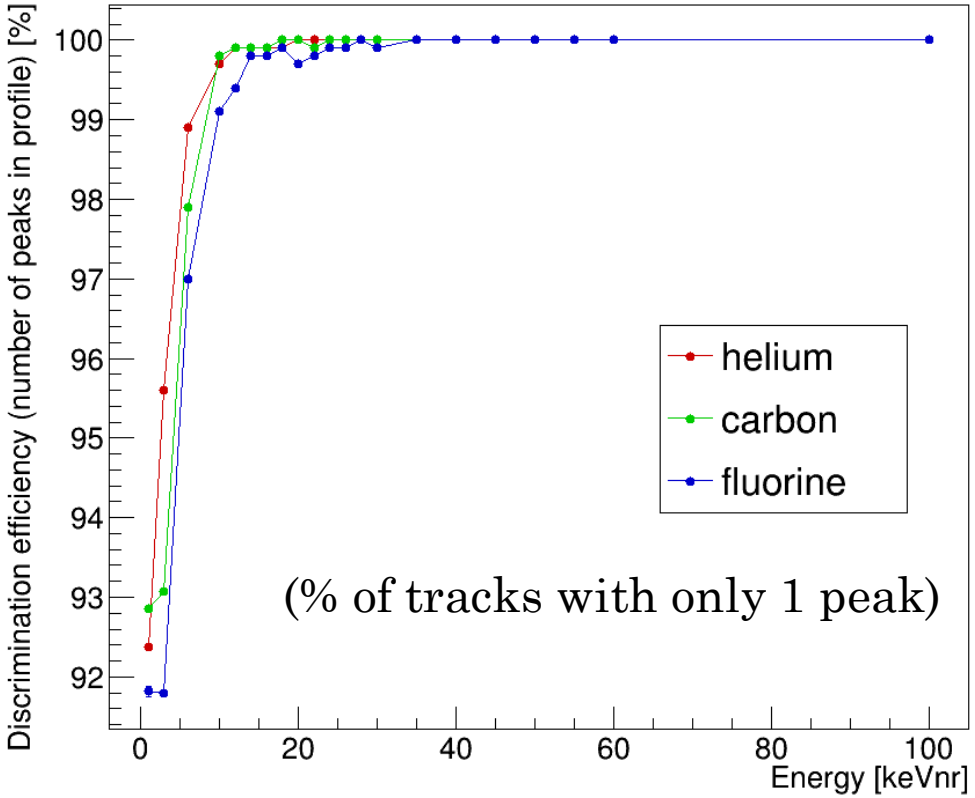


Angular resolution



- For each NR energy I construct the angular distribution as a function of the drift distance
- The angle is the difference between MC true angle in xy plane and the one found from the maximum RMS line method
- In each drift distance bin I fit the distribution and get the standard deviation
- Each point in the plot is the average resolution over all drift distances (7 bins between 1cm and 50cm)

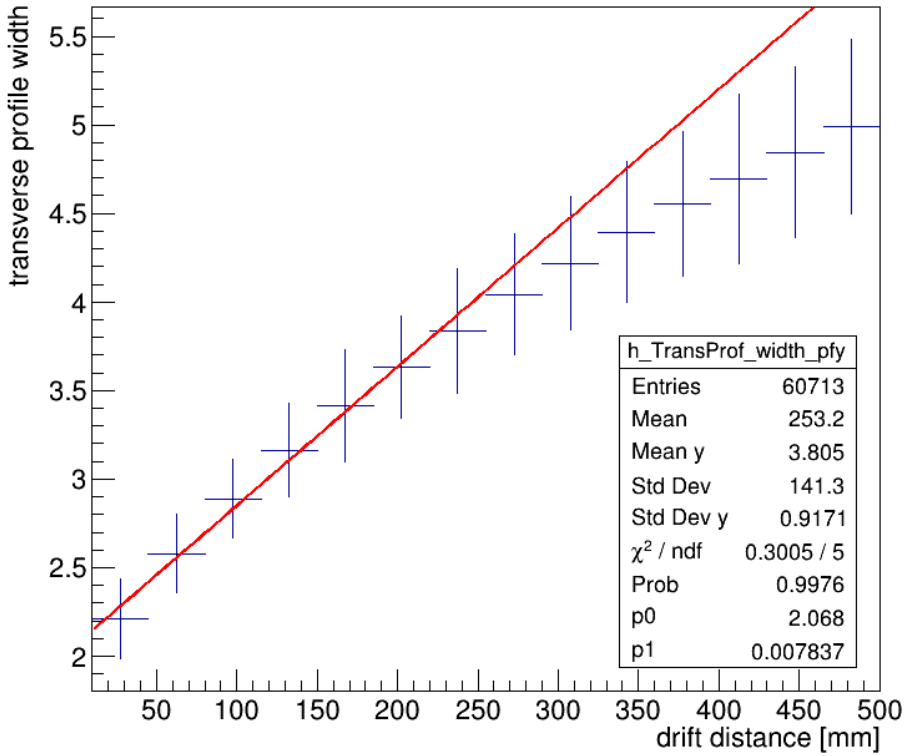
Track simulation

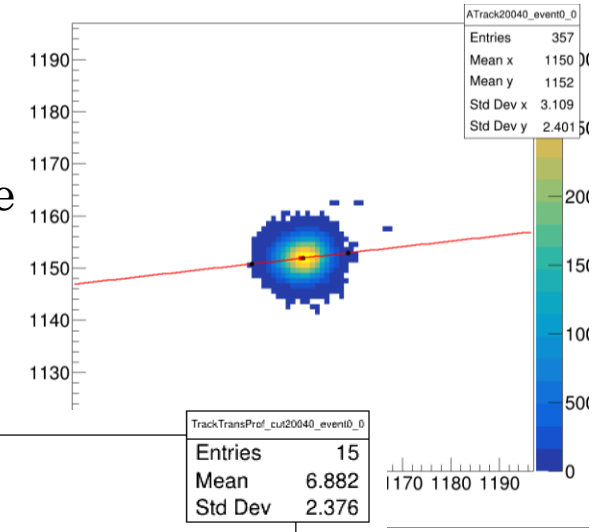


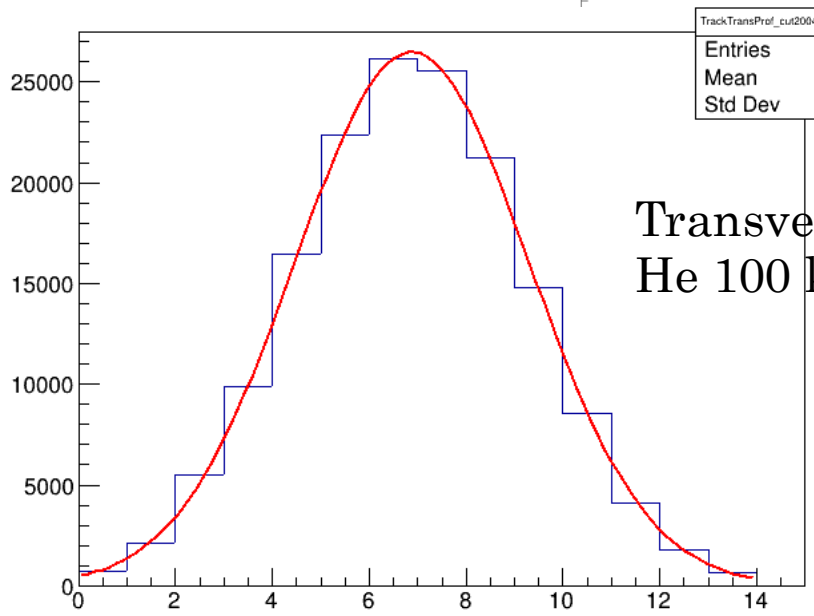
- I find the number of peaks in the longitudinal profile of the tracks – only one peak expected for NR
- Efficiency of recognition of NR from the study of the profile is always above 90%
- Need to compare with ER efficiency (already tested on AmBe data, 100% efficiency in recognition of ER using 59keV Am photon cuts)

Track simulation

- Many features strongly depend on the drift distance
- This can be improved by optimising the reconstruction parameters (the track borders may be cut), and/or by estimating the drift distance







Transverse profile
He 100 keV

Conclusions

- Internal background simulation of LIME underground is ongoing; simulation of resistors and camera to be done
- Preliminary results on post-reco analysis of digitized NR tracks
- Random energy sample to be digitized
- I'm working on the assessment of the radiogenic and cosmogenic neutron contribution to the background