LIME Simulation

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Não é possível apresentar a imagem.

Outline

- Objective
- Present Status and Challenges
- LIME Simulation Results
- Future Work

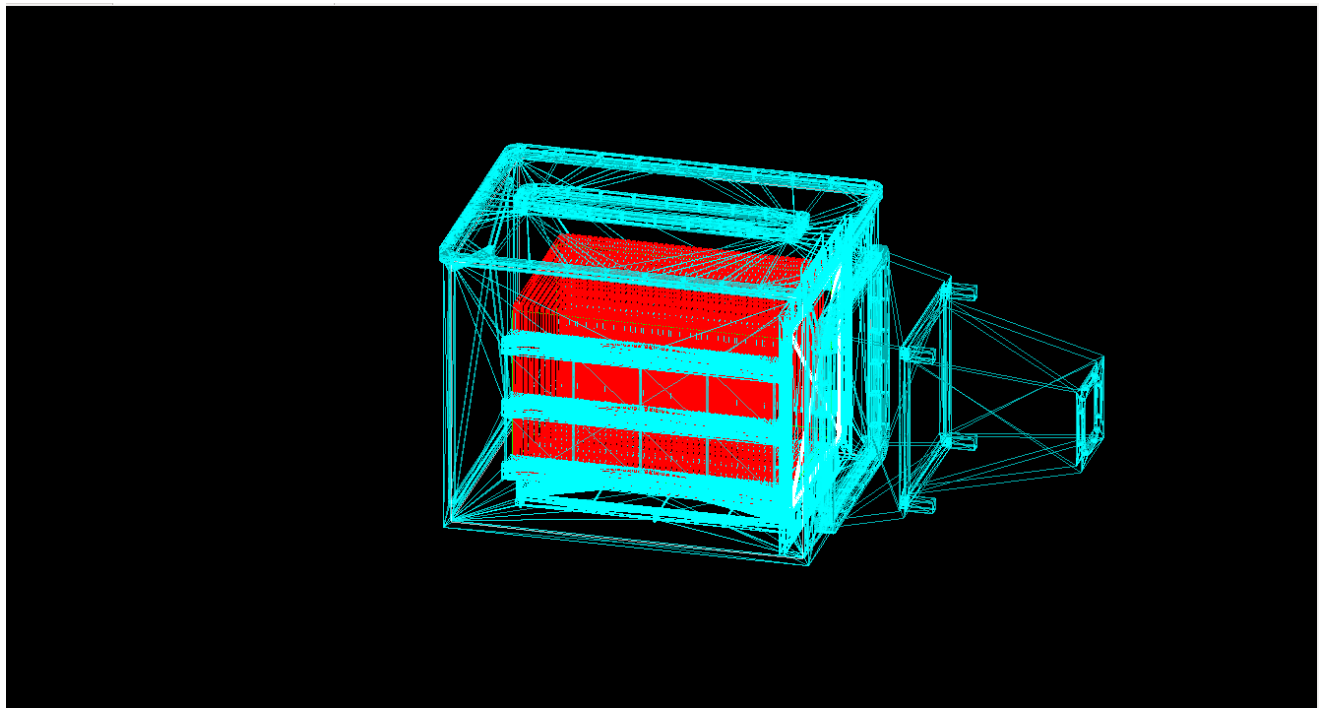
Objective

- Evaluate on smaller volume but similar dimensions in terms of “physics” the CYGNO’s detector
- Make precise and seasonal measurement of the neutron flux @LNGS

Present Status and Challenges

LIME geometry implemented in GEANT4

- Strangely, the LIME files, when I used the FreeCAD to convert them to mesh, were misplaced .
- Found out that when I try to reduce the airbox a similar problem appears, meaning that I couldn't reduce otherwise it wouldn't work big issue because the flux is directly related with that
- There are some discrepancies on the results to what I would expect initially (about tens of times smaller than CYGNO prototype)



First results for LIME with no shielding.

LIME Prototype

Active volume:

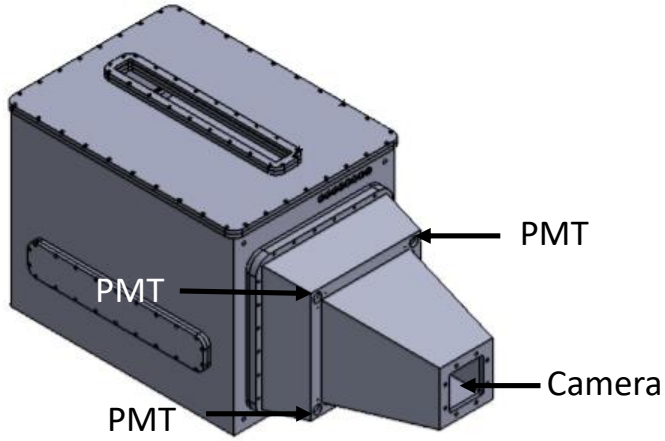
- 50 cm (xx)
- 33 cm (yy)
- 33 cm (zz)

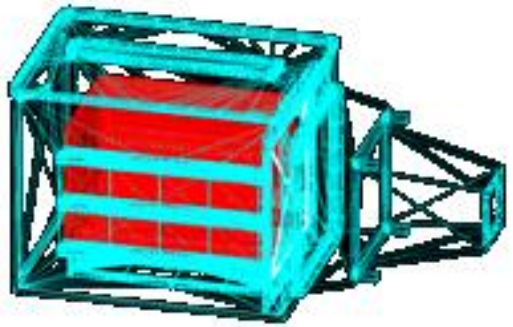
Using a camera and up to 4 PMTs

Materials:

- PMMA
- Cu
  - Field rings
  - GEMs

  (mylar not considered at the moment)



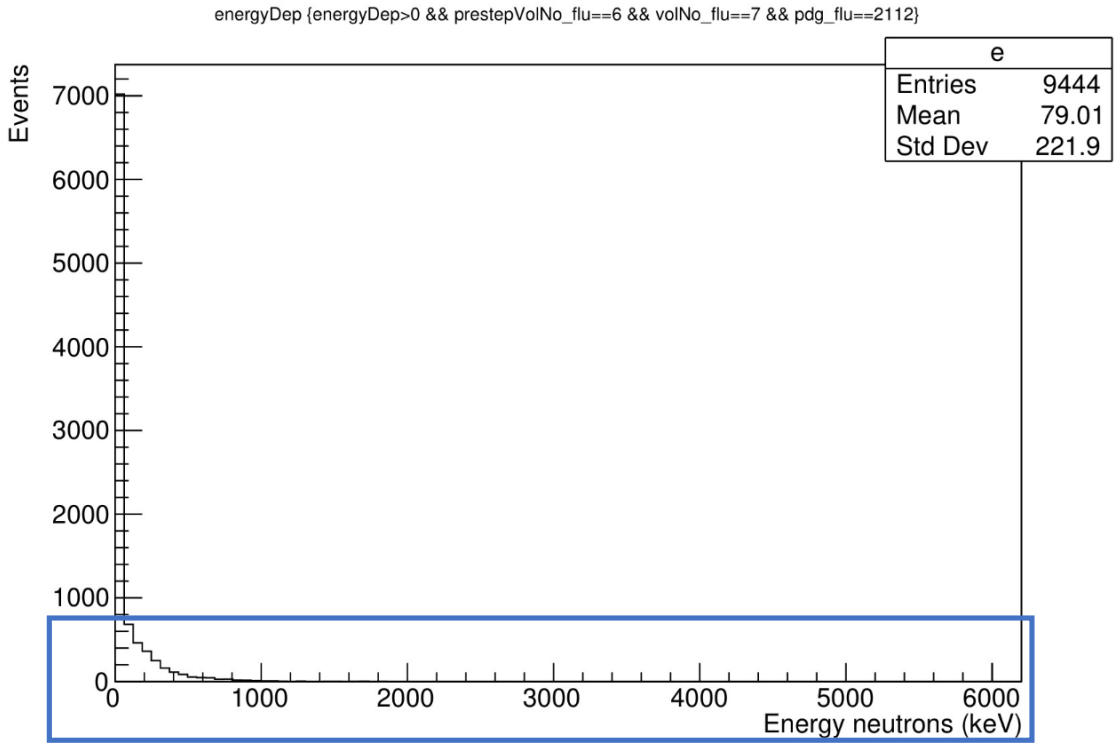


For the moment both the camera and PMTs are not included.

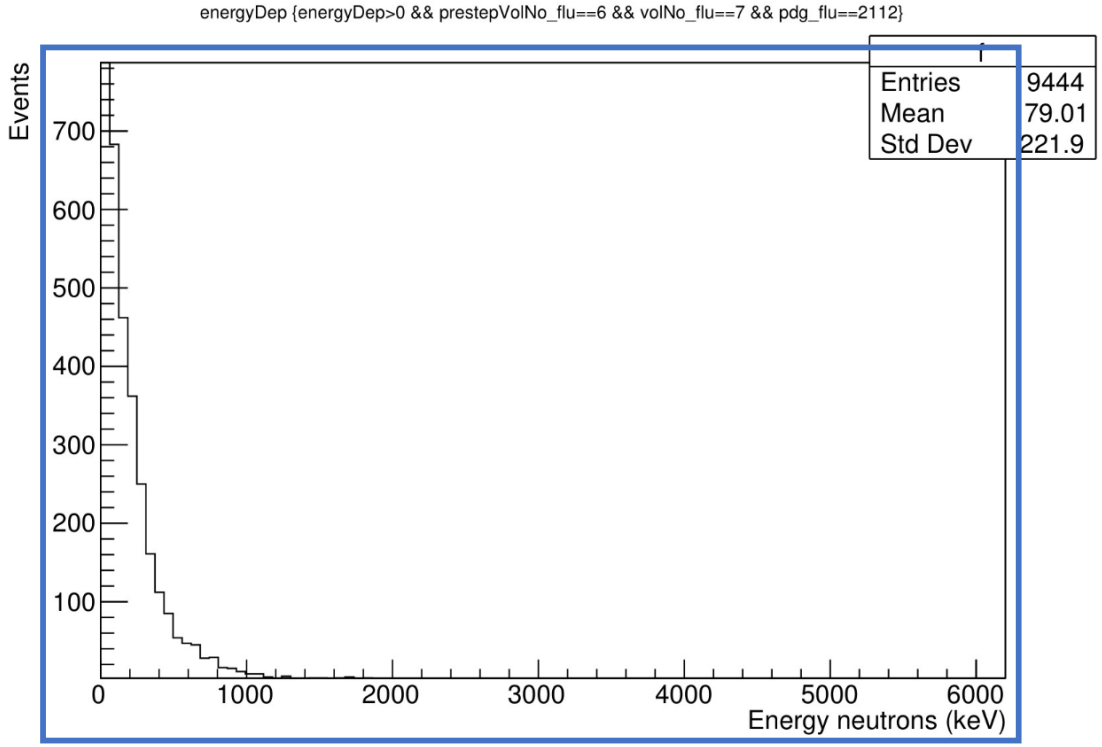
LIME Simulation Results – Neutron Background

Expected background (preliminar results for 30M events)

CYGNO Prototype – Energy deposit



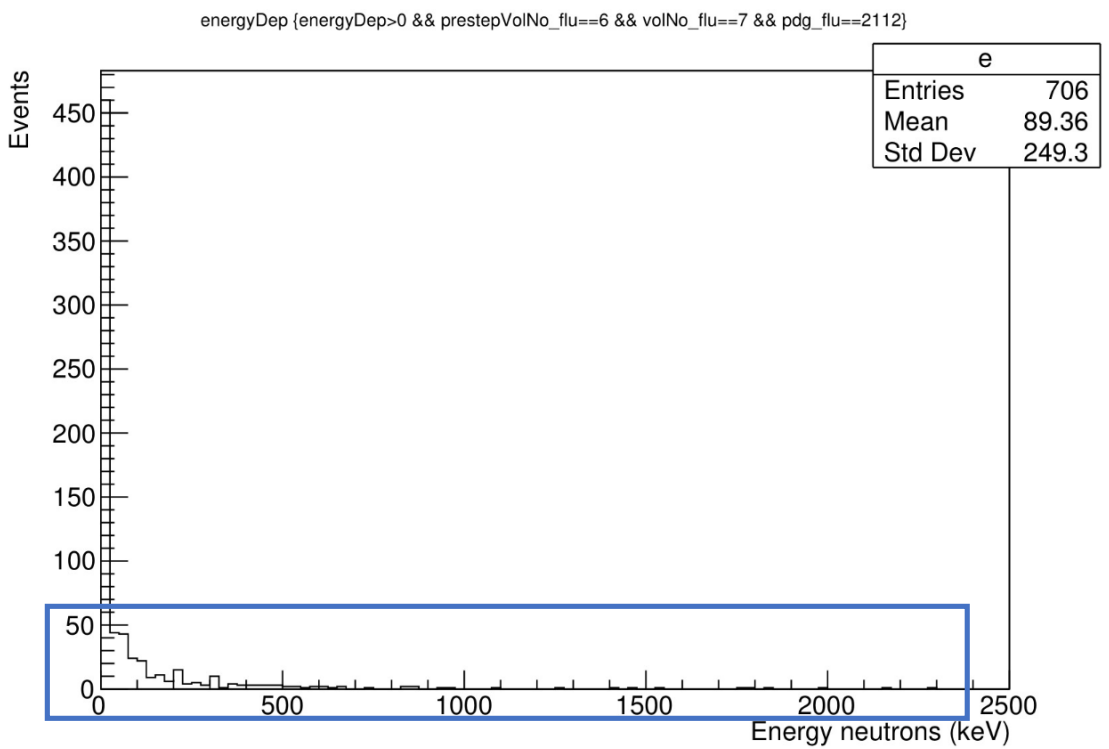
Zoom (0-700)



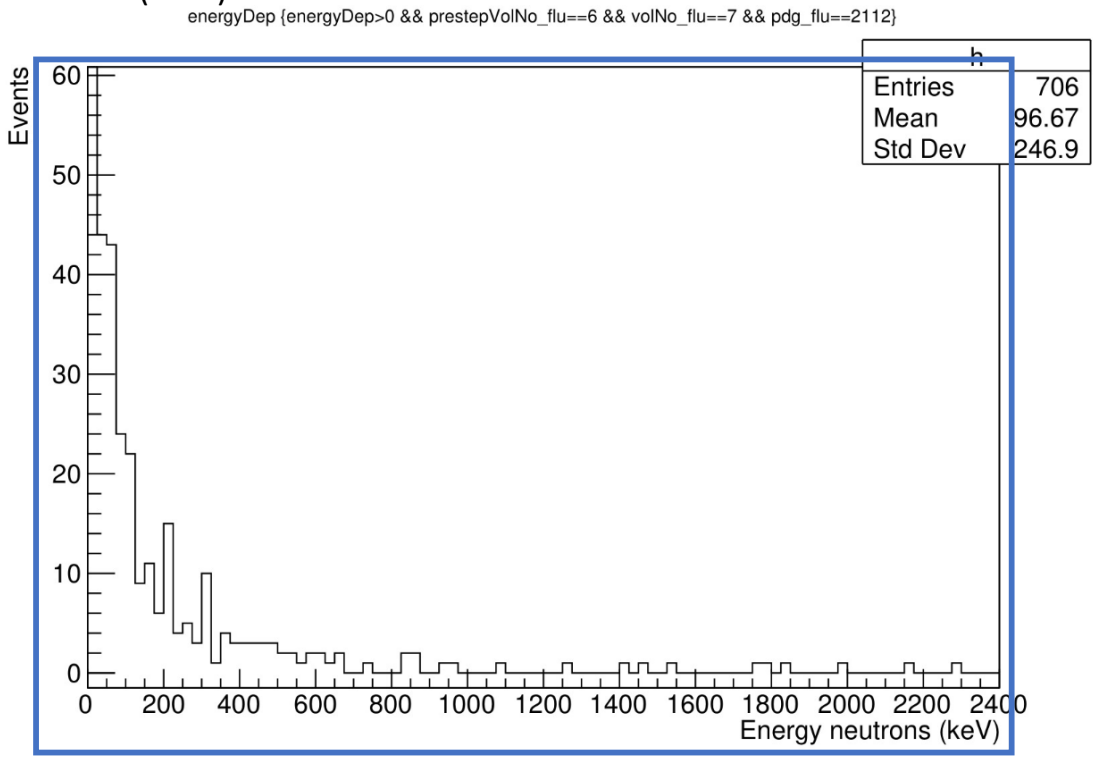
LIME Simulation Results – Neutron Background

Expected background (preliminar results for 30M events)

LIME Prototype – Energy deposit



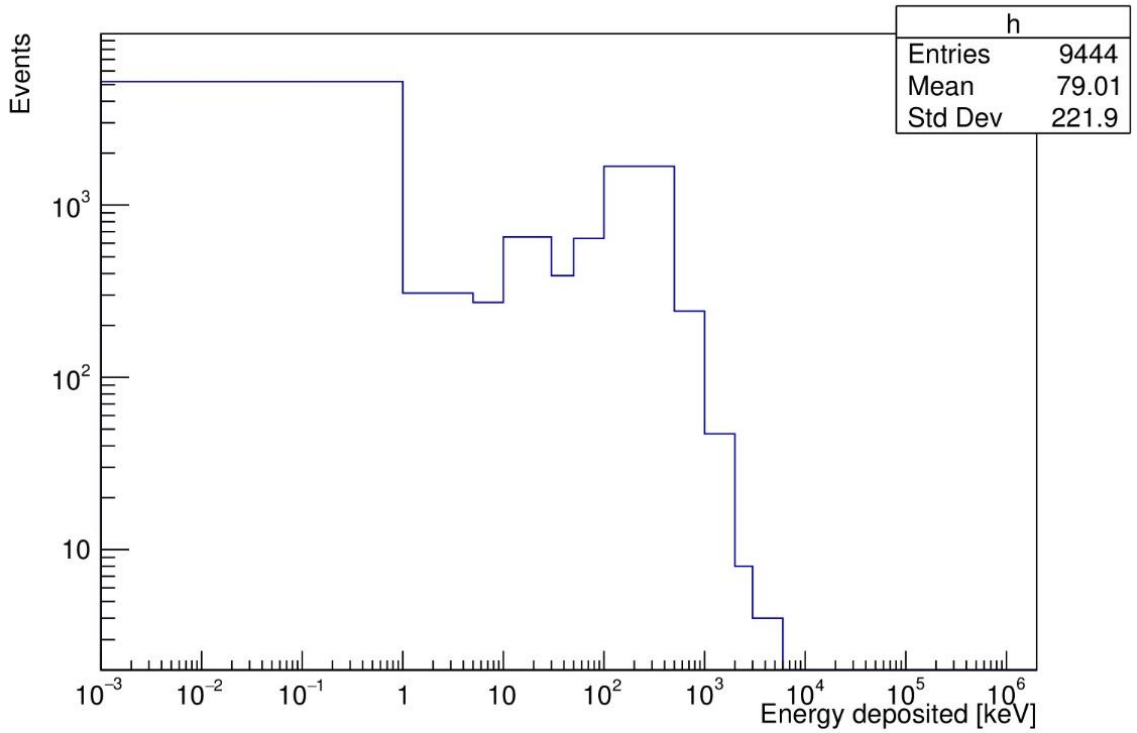
Zoom (0-60)



LIME Simulation Results – Neutron Background

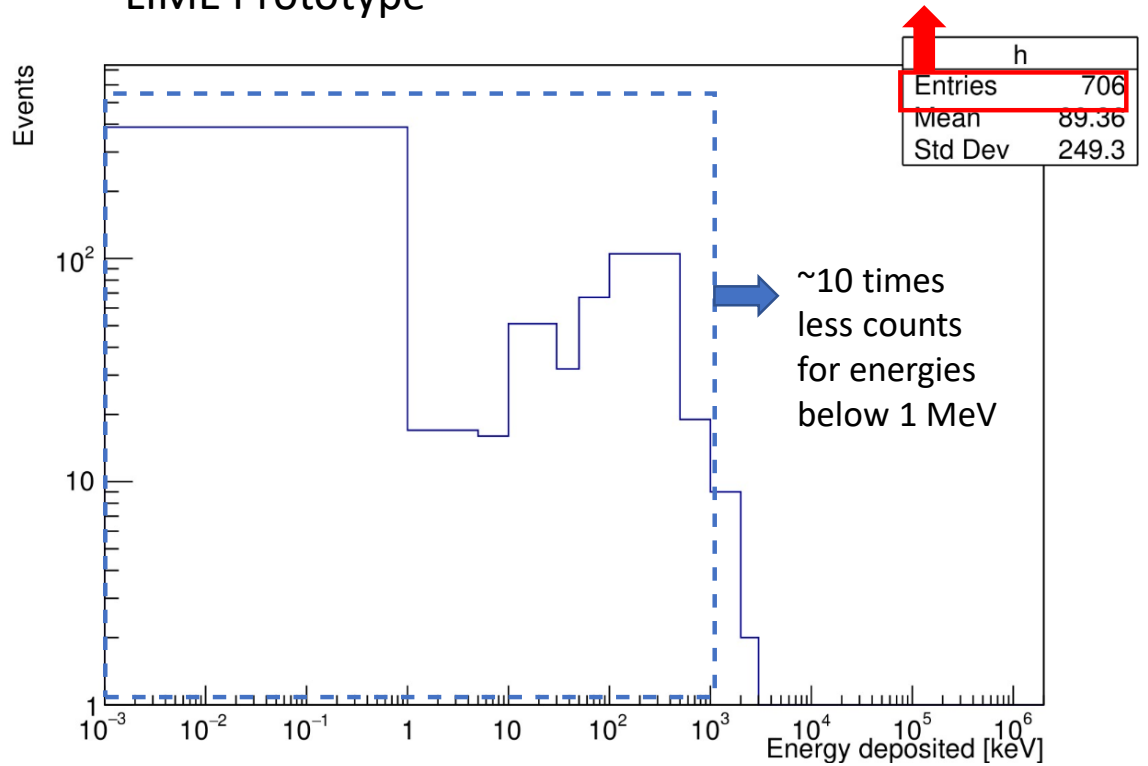
Expected background (preliminar results for 30M events)

CYGNO Prototype



~13 times less number of events

LIME Prototype

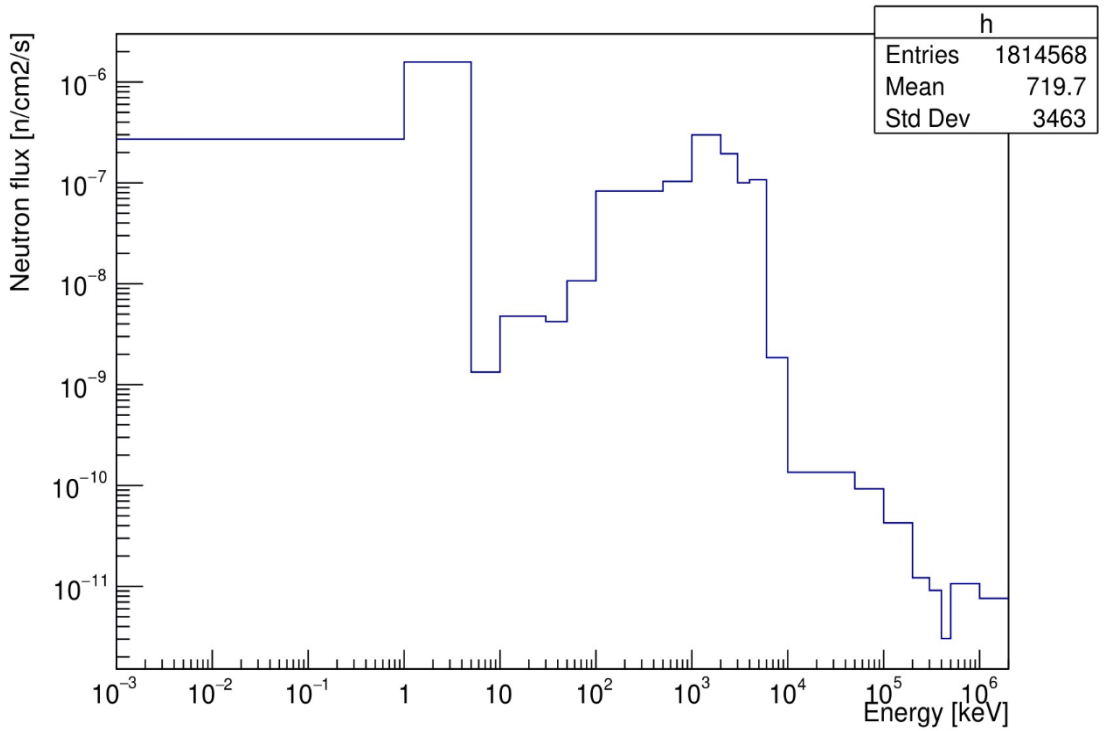


Note: Binning is variable (aprox. logarithmic scale)

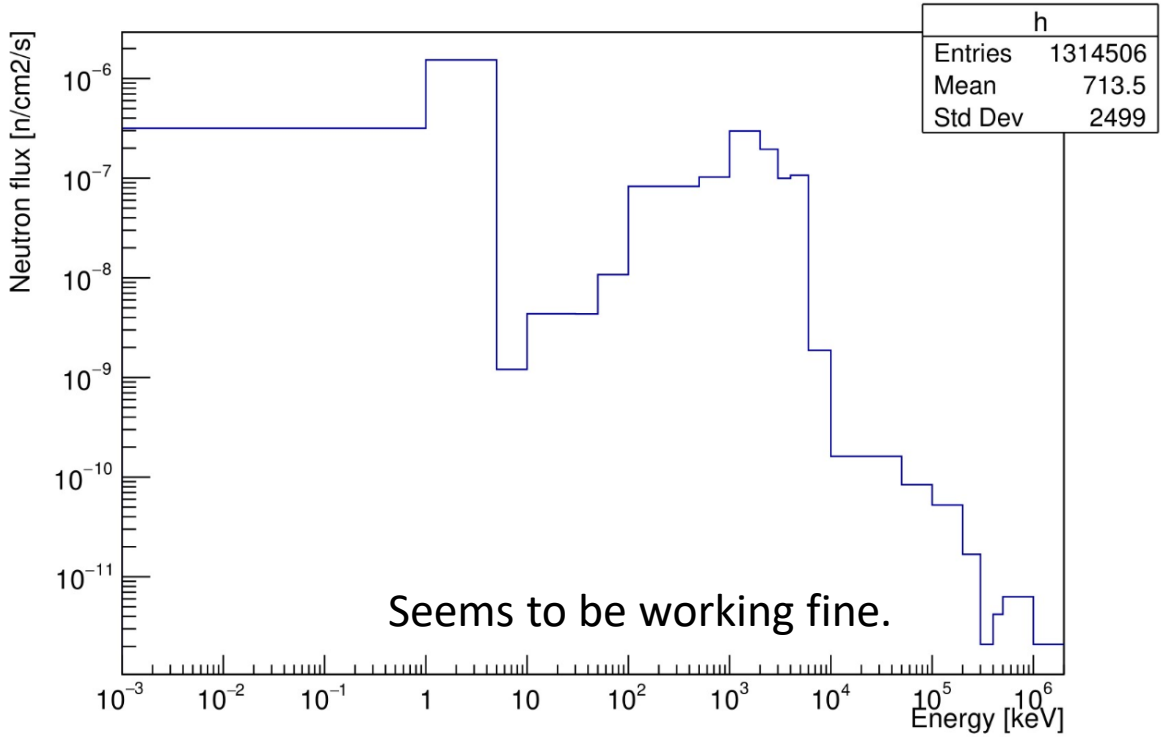
LIME Simulation Results – Neutron Background

Expected background (preliminar results for 30M events)

CYGNO Prototype



LIME Prototype

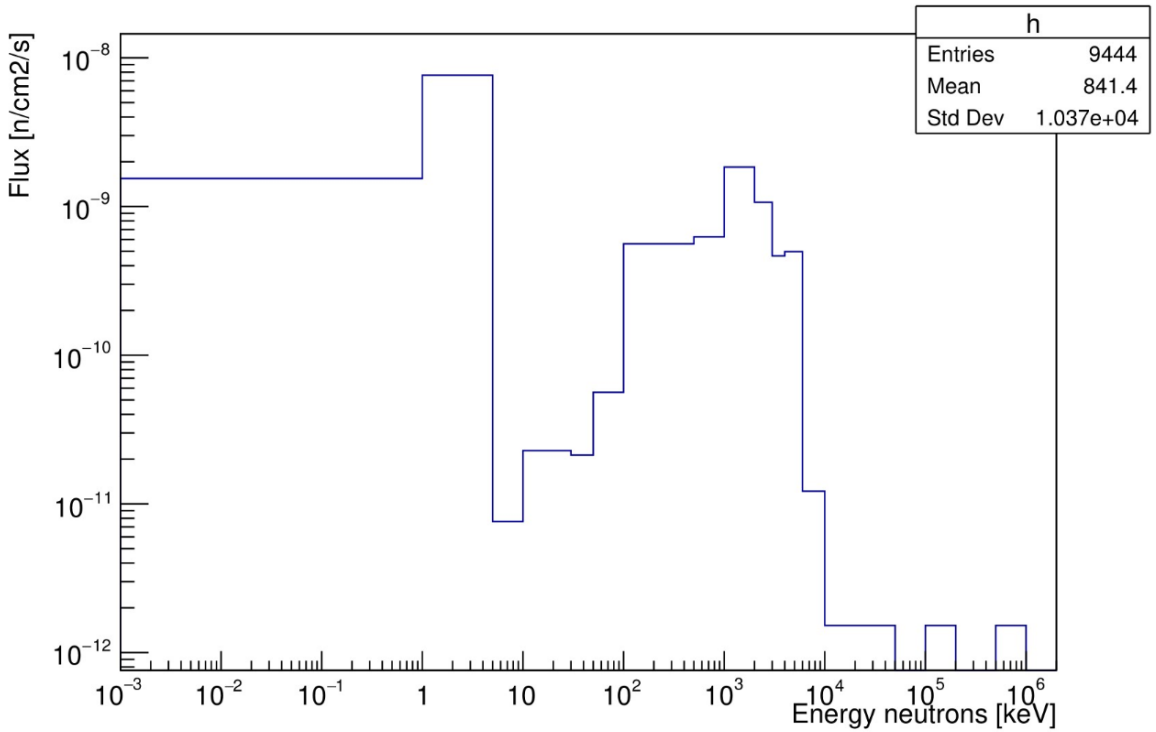


Note: Neutron flux across the airbox should be approximately the same.

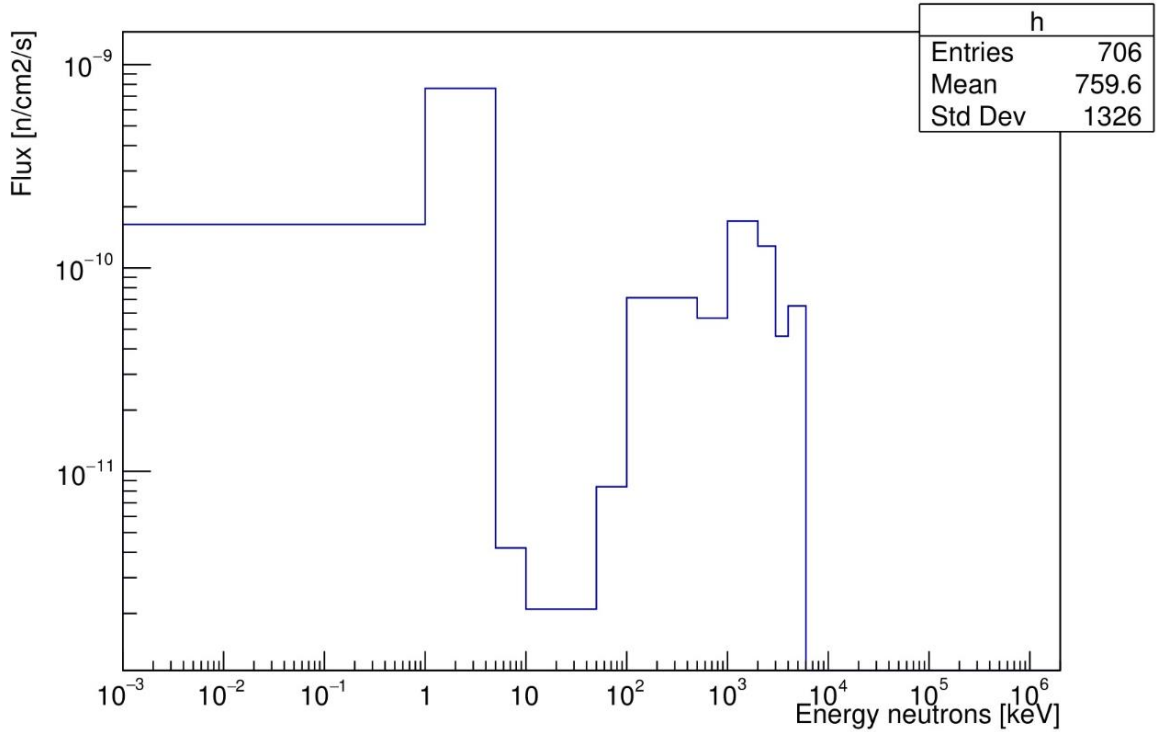
LIME Simulation Results – Neutron Background

Expected background (preliminar results for 30M events) – Neutron Flux in both CYGNO and LIME

CYGNO Prototype



LIME Prototype

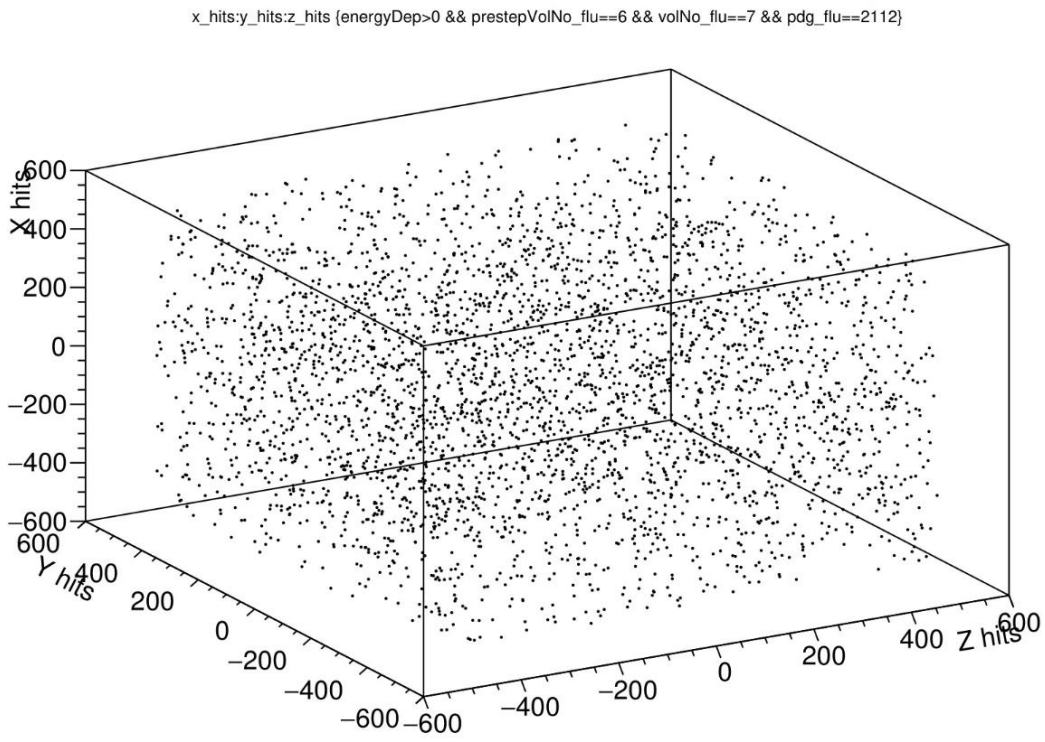


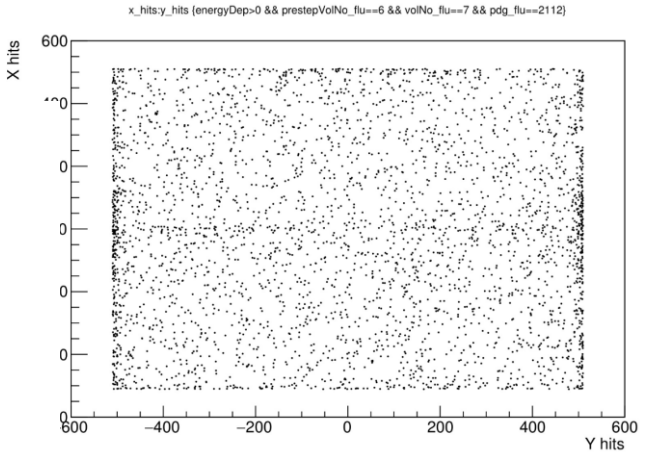
Note: Neutron flux considering the neutrons that interact inside the fiducialize gas (CYGNO gas).

LIME Simulation Results – Neutron Background

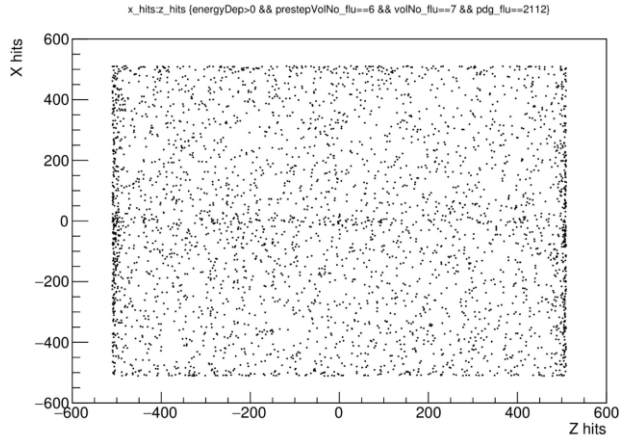
Spacial Distribution of Hits (preliminar results for 30M events)

CYGNO Prototype



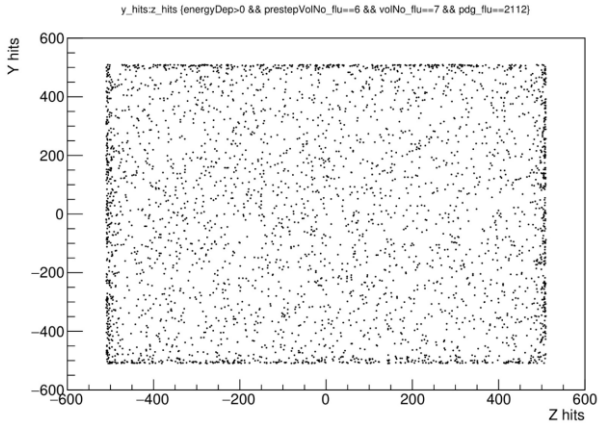


X/Y



X/Z

- Artifact originated by the central cathode is visible.
- Border effects clearly visible.

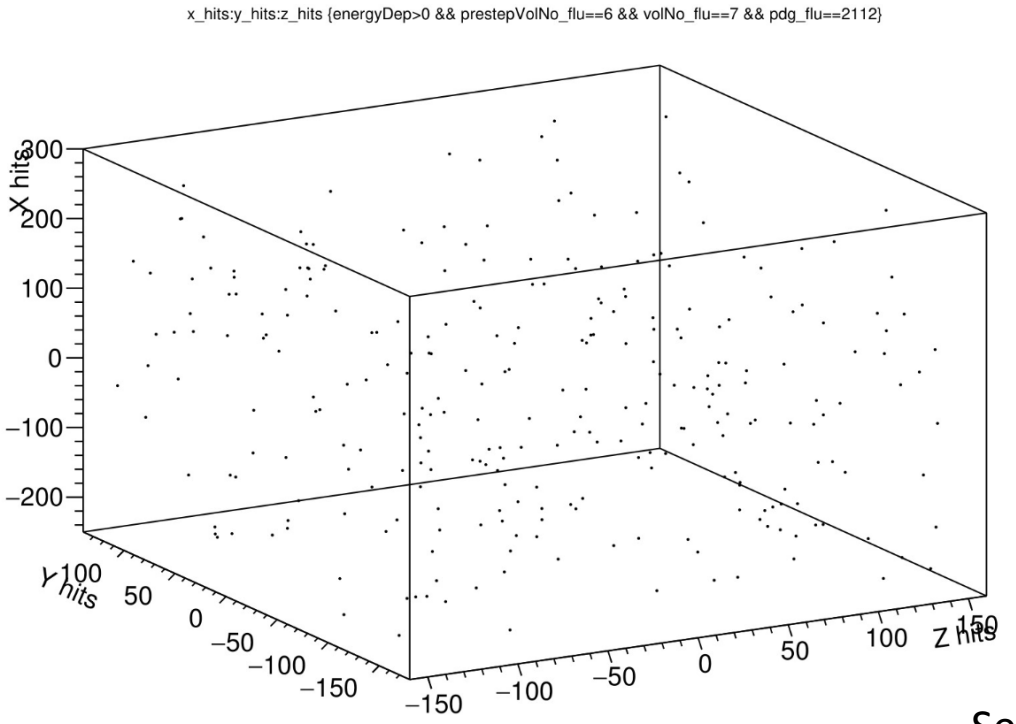


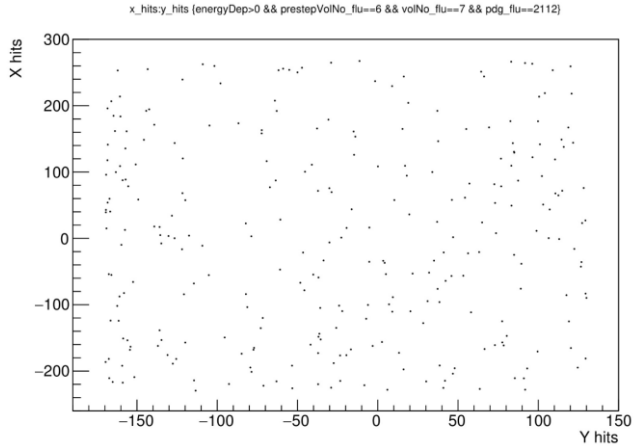
Y/Z

LIME Simulation Results – Neutron Background

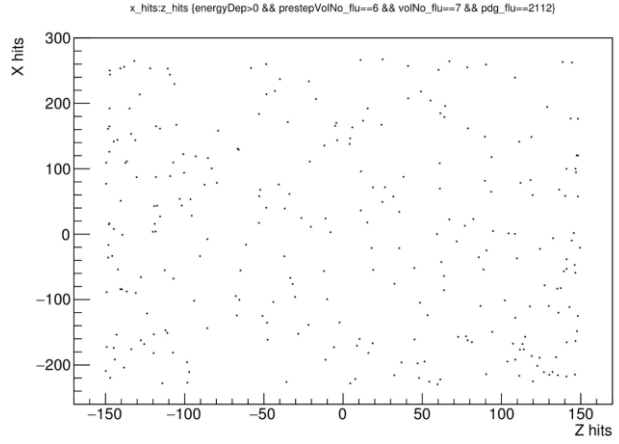
Spacial Distribution of Hits (preliminar results for 30M events)

LIME Prototype



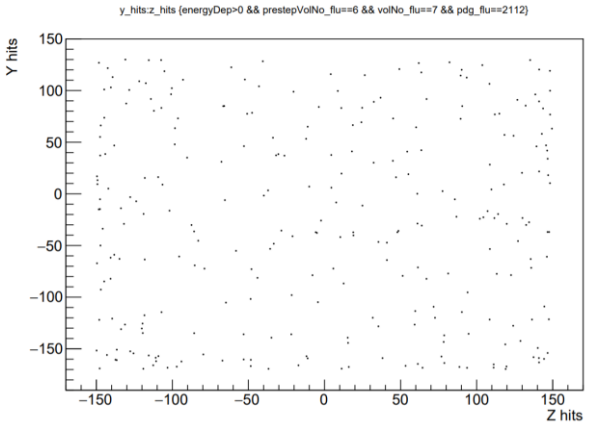


X/Y



X/Z

- No artifacts observed.
- Low statistics.

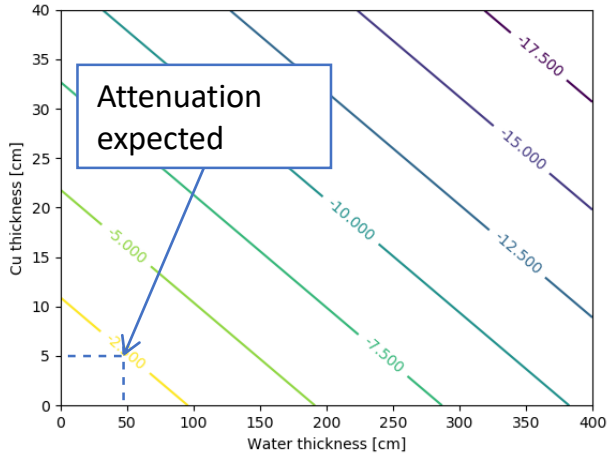


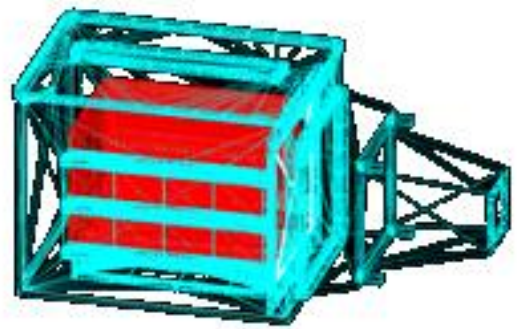
Y/Z

Seems to be working fine.

What's Next?

- Implement the option on Github so others can join the effort.
- Look at some options to reduce the computing time necessary for testing the different shielding configurations (~9 days ..using multiple cores..for 900 M events for 5 cm copper plus 50 cm water).
- Test different shielding options (Cu plus H_2O) to obtain a similar performance as expected in CYGNO.
- Implement the updated version LIME with the Kentaro field cage (although now it is functional).
- Simulate the radioactive background of the materials used in the prototype.





Summary

- LIME implemented successfully on GEANT4 (a special thank you to Giulia for helping me with the overlapping issues and by willingly sharing her expertise).
- First preliminary results with neutron background.
- We are starting to test the different shielding options (which may take some time).
- Implement the updated version LIME with the Kentaro field cage (although now it is functional).
- Simulate the radioactive background of the materials used in the prototype.

Thank you!