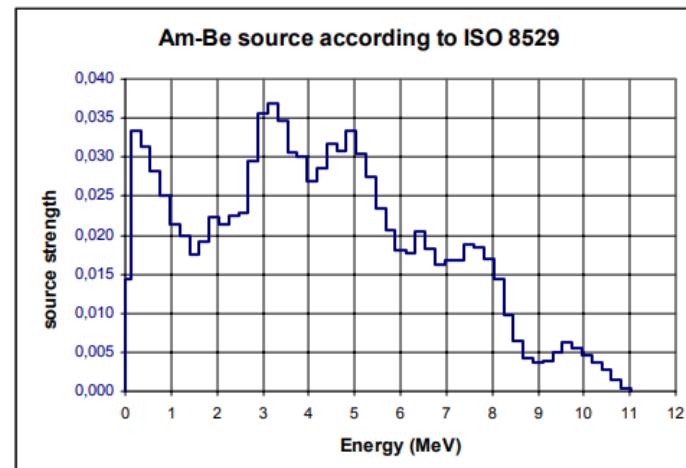
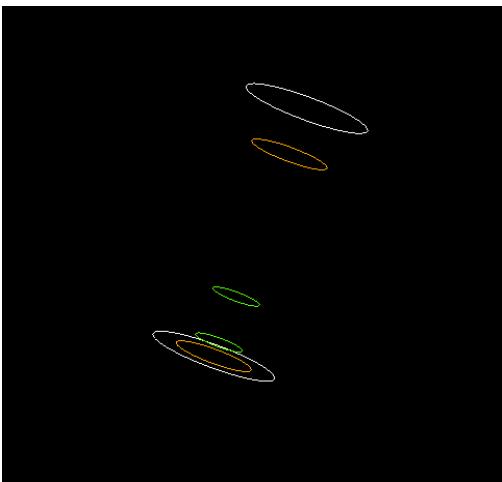
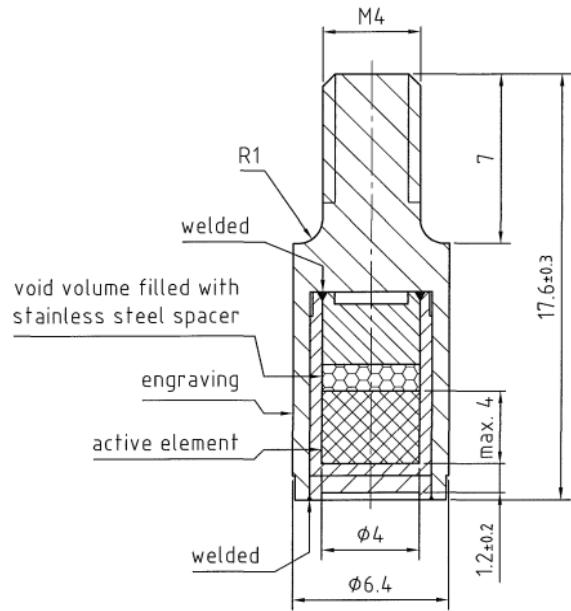


Simulation of AmBe measurements with LIME @LNGS

CYGNO Simulation Meeting – 13 February 2023

F. Di Giambattista

AmBe neutron source



<https://rifj.ifj.edu.pl/handle/item/217>

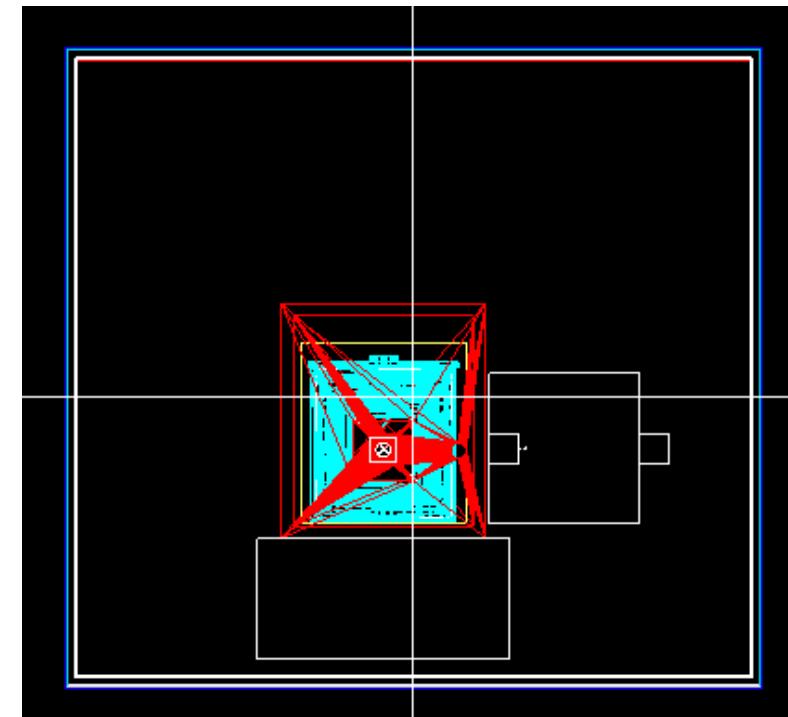
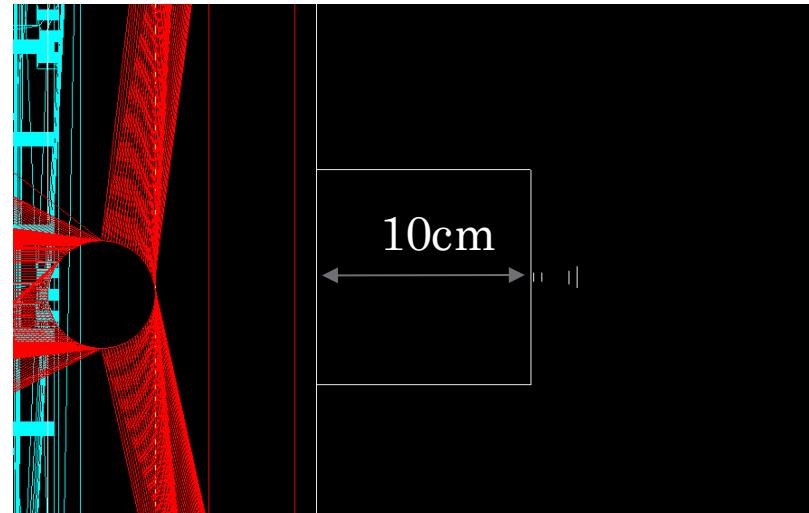
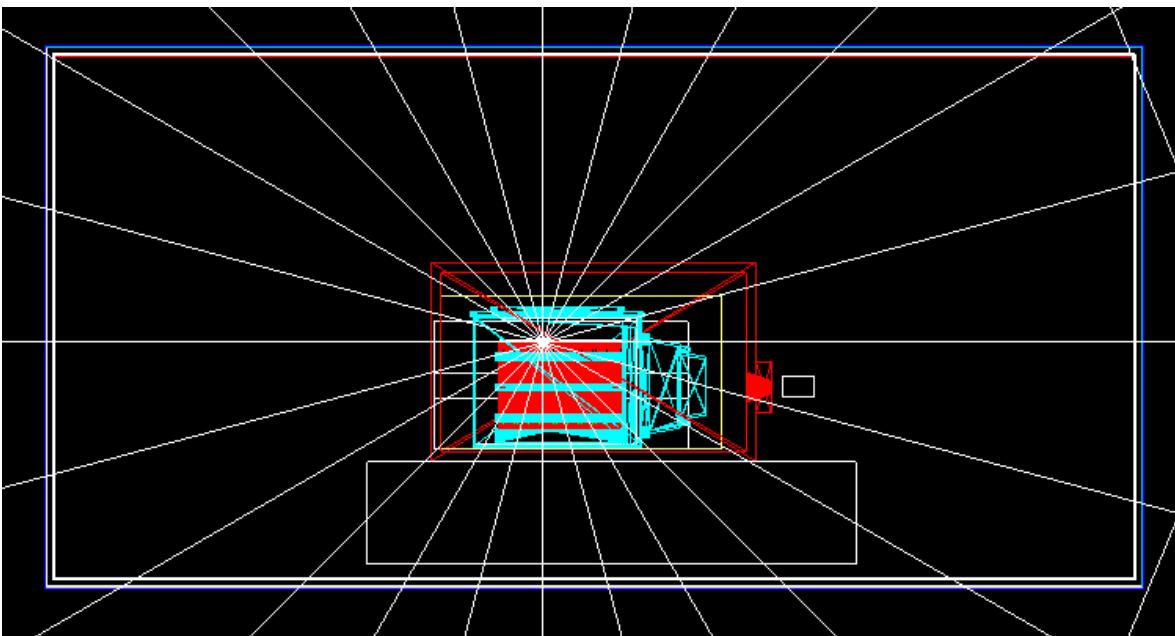
- Simplified geometry in GEANT4:
 - Capsule: stainless steel cylinder with 6.4mm diameter, 17.6mm height
 - AmBe source: cylinder made of homogeneous mix of AmO_2 and Be, 4mm diameter, 4mm height

- Neutrons generated from AmBe disk with standard ISO spectrum
- 59 keV gammas from ^{241}Am decay to ^{237}Np ($\sim 10^5$ gammas per neutron)
- 4.38 MeV gammas from $\alpha + ^9\text{Be} \rightarrow ^{12}\text{C}^* + n$ ($\sim 58\%$)

<https://www.sciencedirect.com/science/article/abs/pii/S0969804307001200>

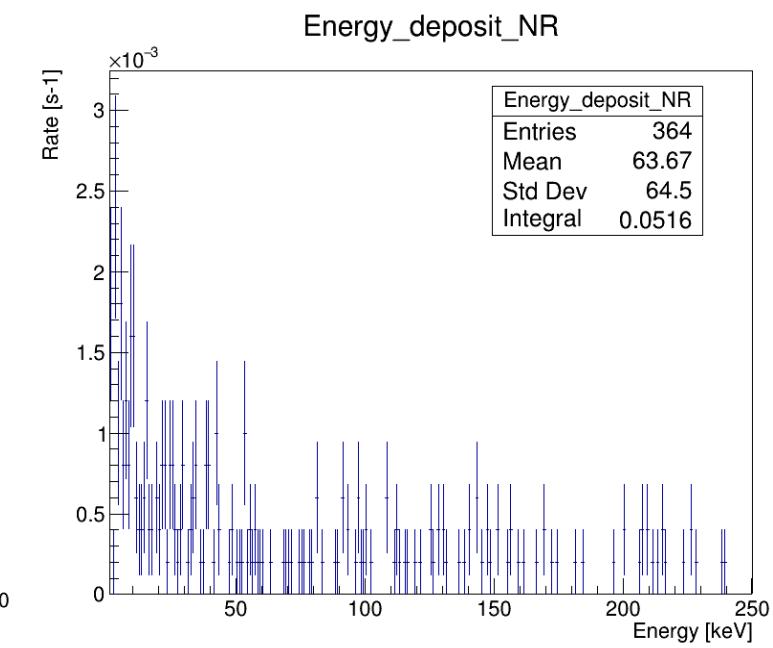
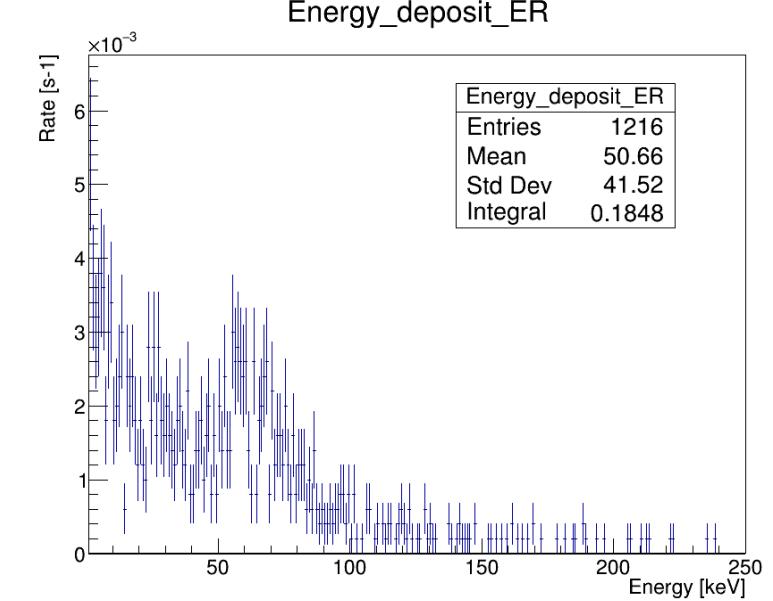
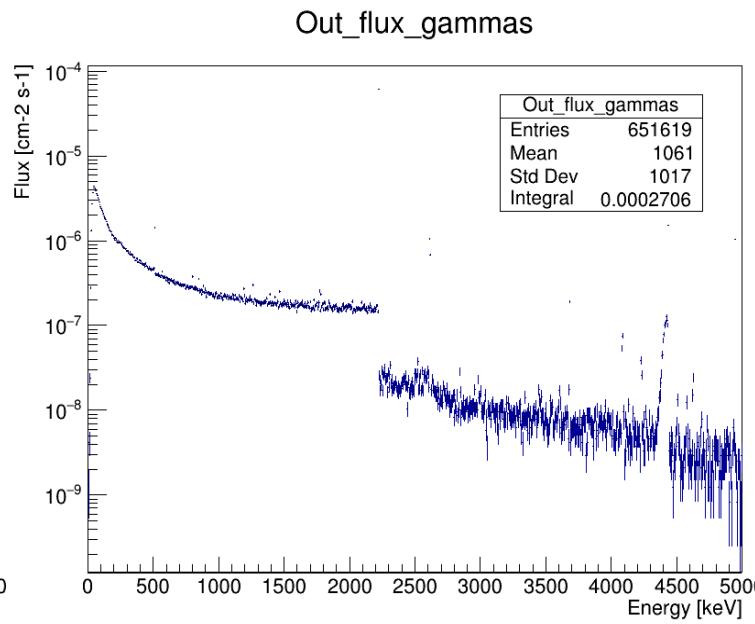
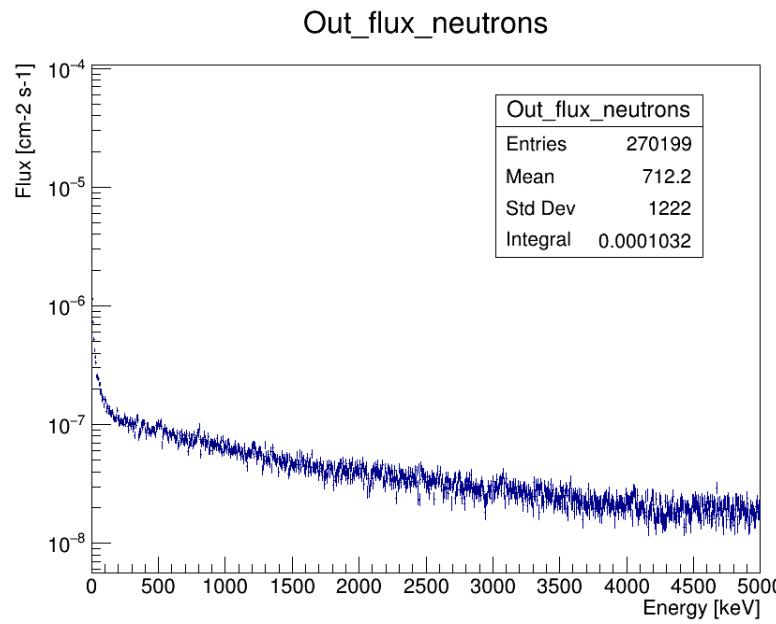
GEANT4 geometry setup

- Copper shielding, 4cm thickness on all sides
- 100x50x50 cm³ polyethylene box, 2 lead blocks 20x10x5 cm³
- PE blocks below LIME
- Container made of concentric boxes: 1cm PC + 1mm Al + 5cm PU foam + 1mm Al (inner to outer layer)



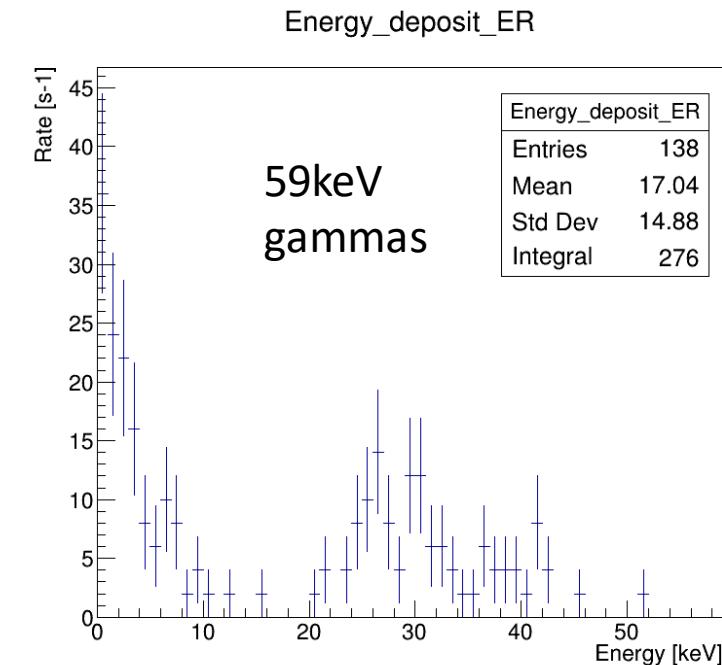
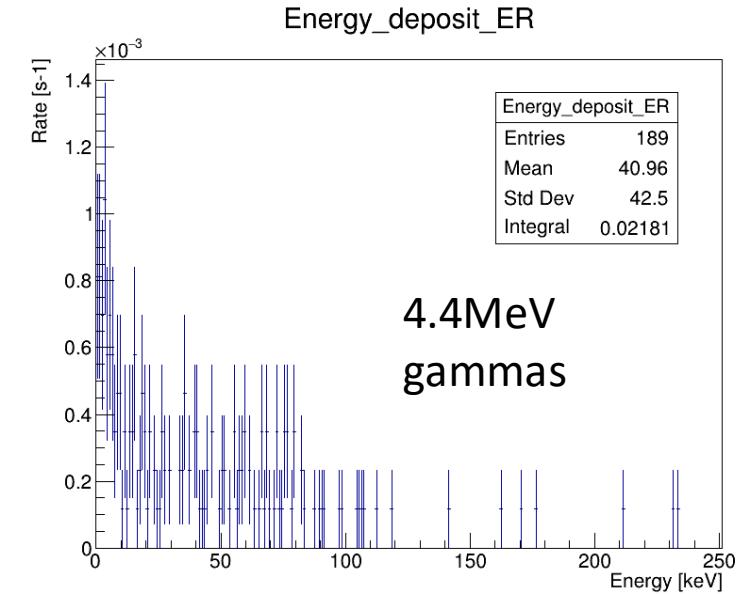
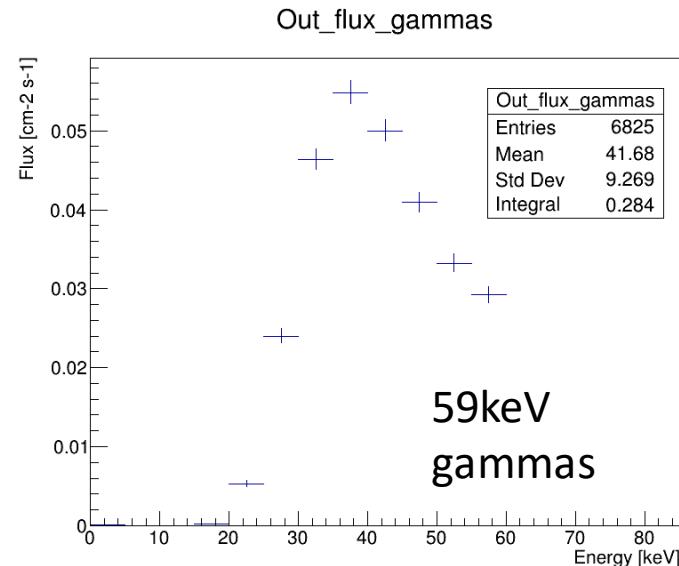
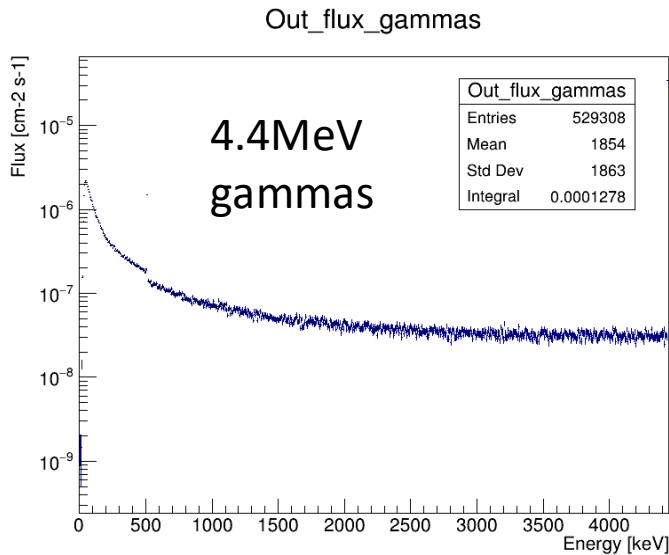
Neutron simulation

- Simulated neutrons following standard ISO AmBe spectrum
- Neutron rate: 200 n/s (assumed isotropically emitted)



Gammas simulation

- About 10^5 59keV gammas per neutron emitted \rightarrow 59 keV gamma rate: 2×10^7 gammas/s
- 0.58 gammas per neutron emitted \rightarrow 4.4 MeV gamma rate: 116 gammas/s



Summary

- Outgoing gamma flux: 0.284 gamma/cm²/s (environmental flux 0.56 gamma/cm²/s)
- Outgoing neutron flux: 1.e-4 neutrons/cm²/s (environmental flux 2.7e-6 neutrons/cm²/s)

Event rates in the detector above 1 keV:

- 240 ER/s (from 59keV gamma) + 1 ER/s (from radioactivity of LIME components and environment)
 - 134 ER/s above 20 keV (from 59keV gamma)
- 0.066 NR/s (from AmBe source)
 - 0.048 NR/s above 20 keV (from AmBe source)