Gamma Monitor using backscatters

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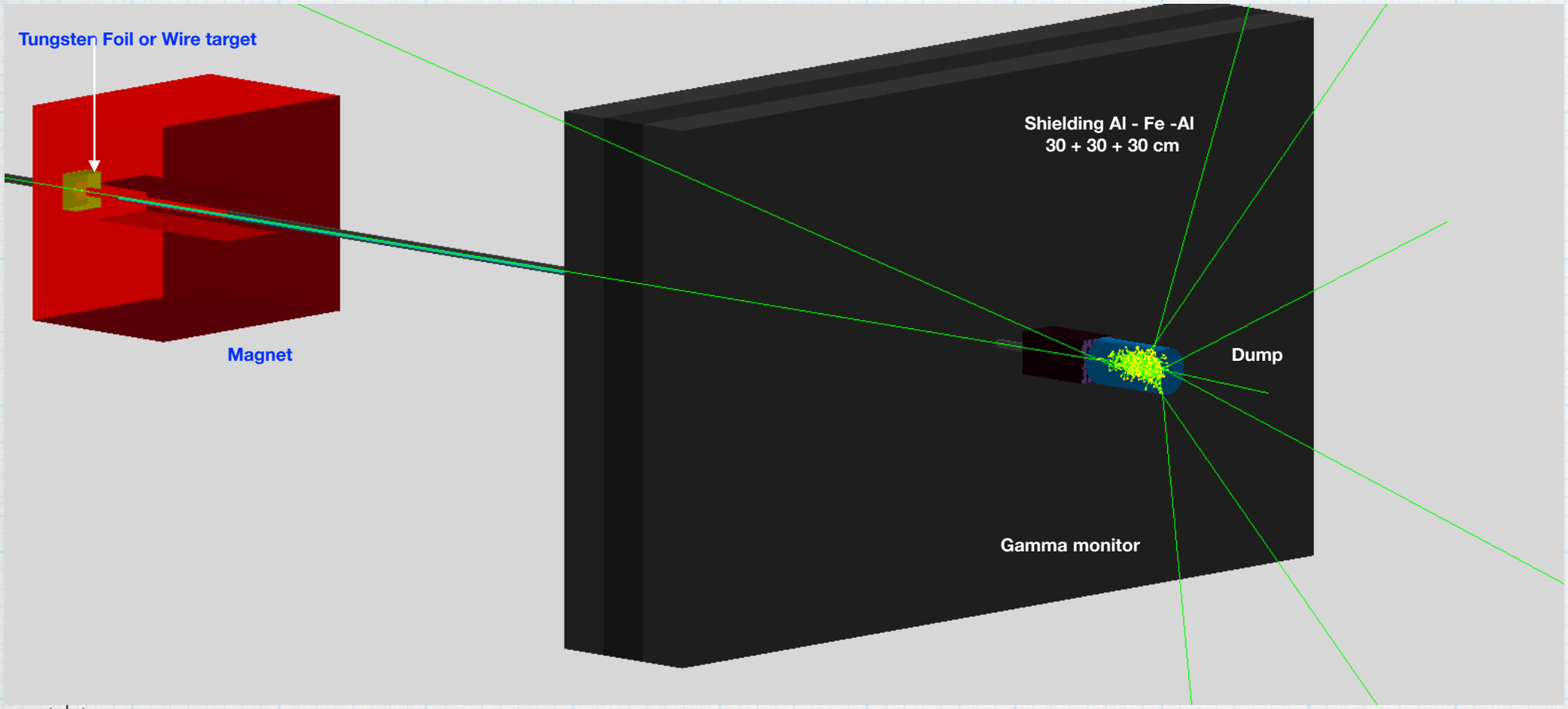
LUXE technical meeting

DESY Hamburg

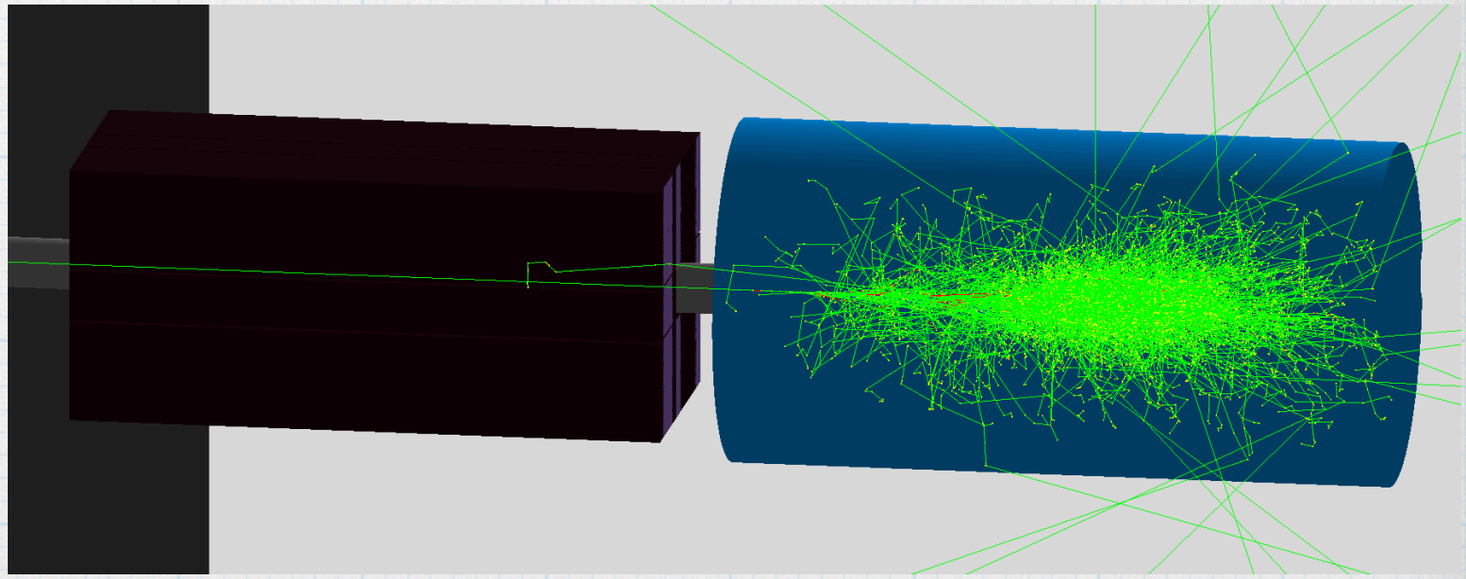
2/04/20

LUXE

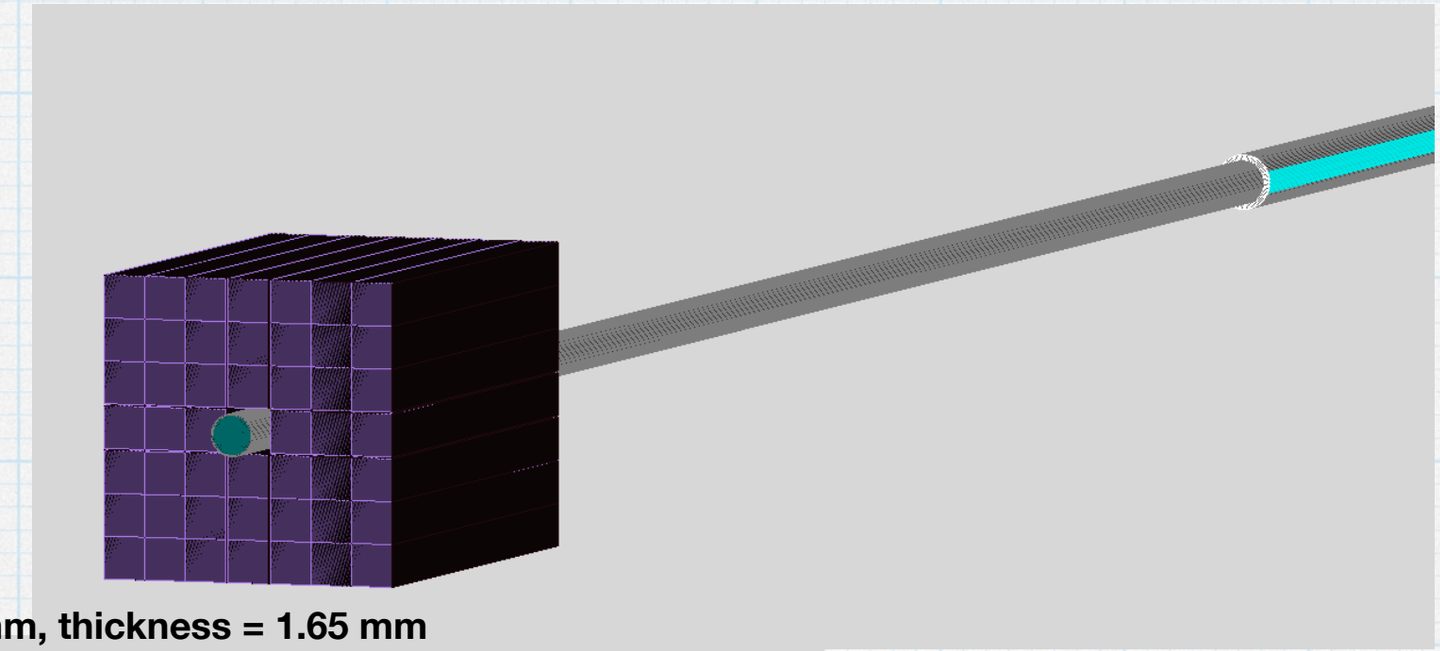
Gamma Monitor



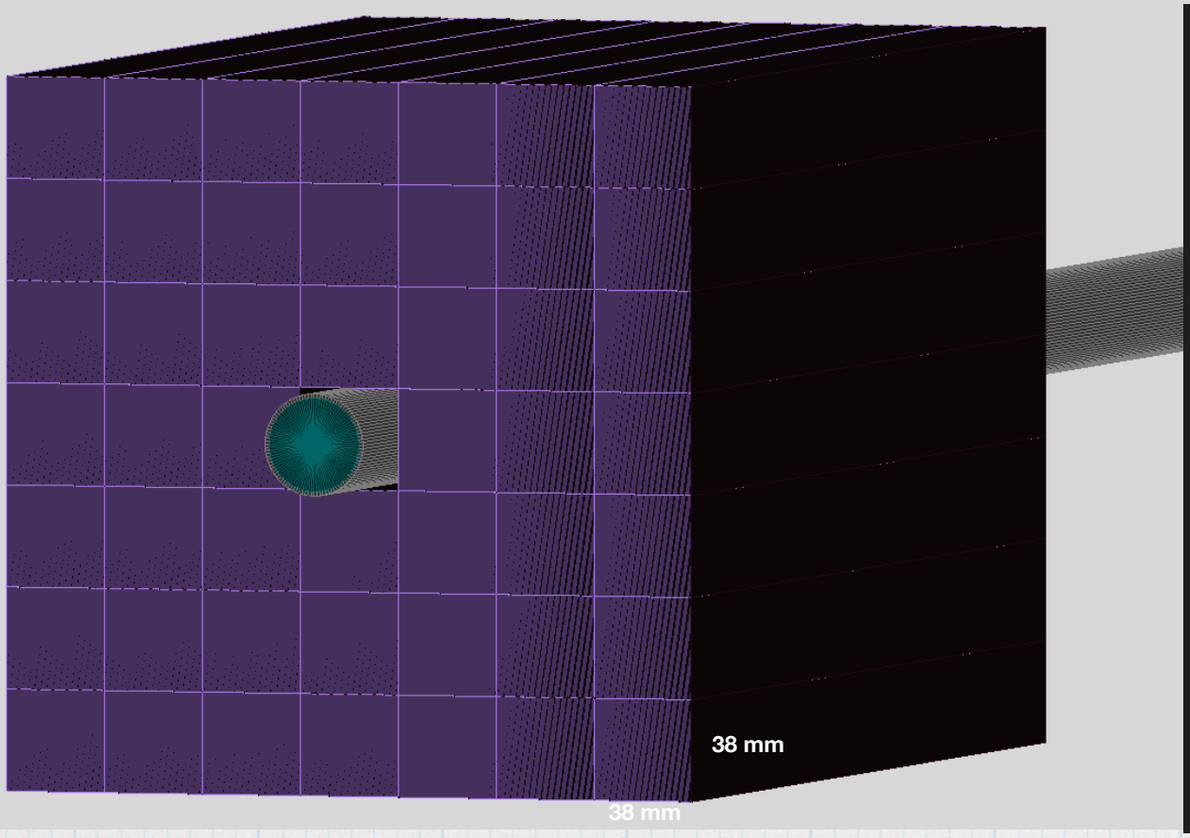
- The implementation of FDS in Luxe geometry with the LG Gamma Monitor made of new LG blocks in front of Al-Cu Dump,
- LG w/ measures 3.8 × 3.8 cm^2, length is 45 cm
- Wrapped with Aluminium foil of 0.016 mm (typical household foil; no account for air)



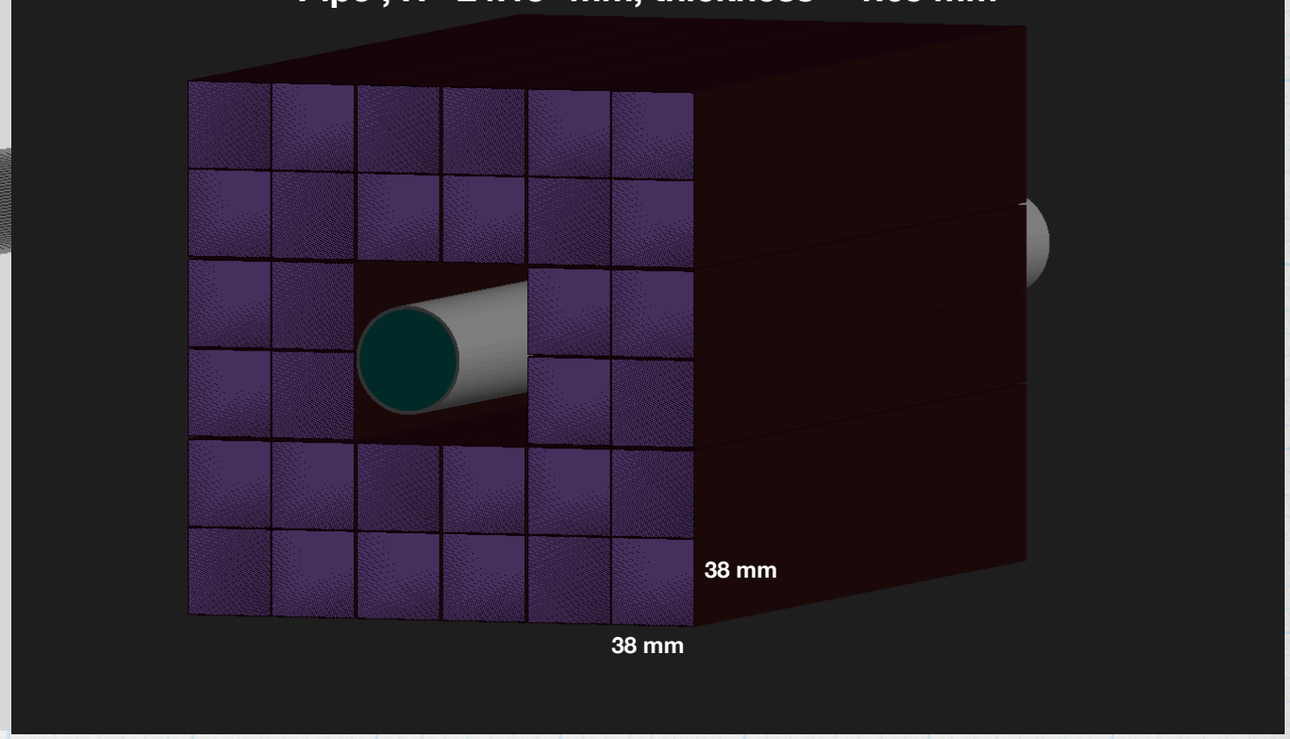
2 configurations: 48 vs 32 LG blocks



Beam Pipe , R =19.0 *mm, thickness = 1.65 mm



Pipe , R =24.13 *mm, thickness = 1.65 mm

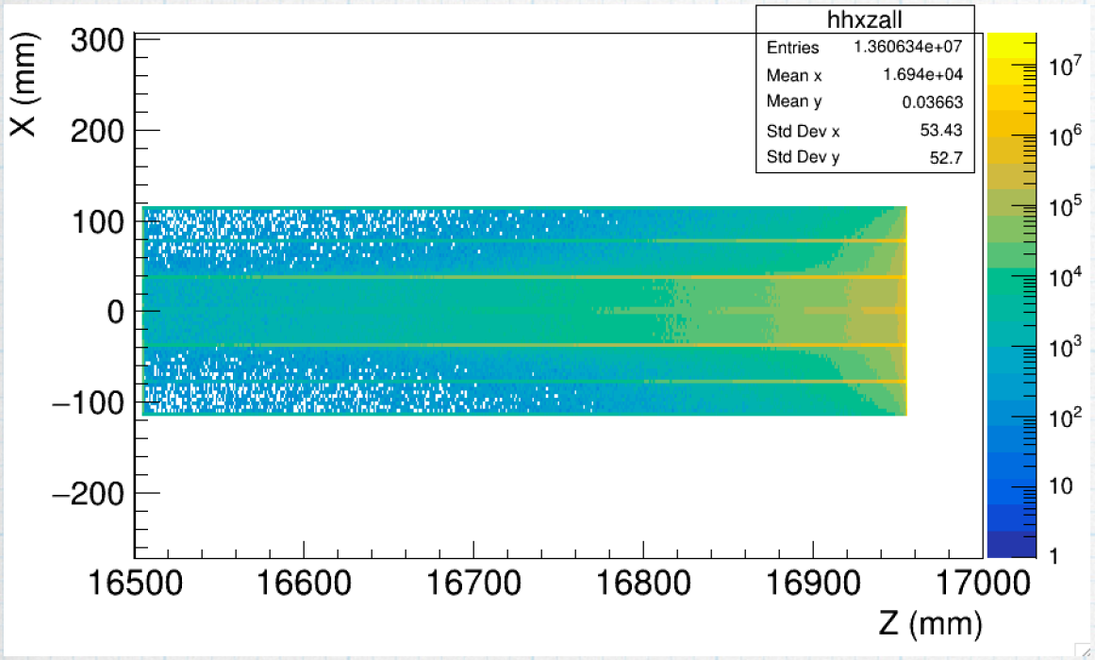


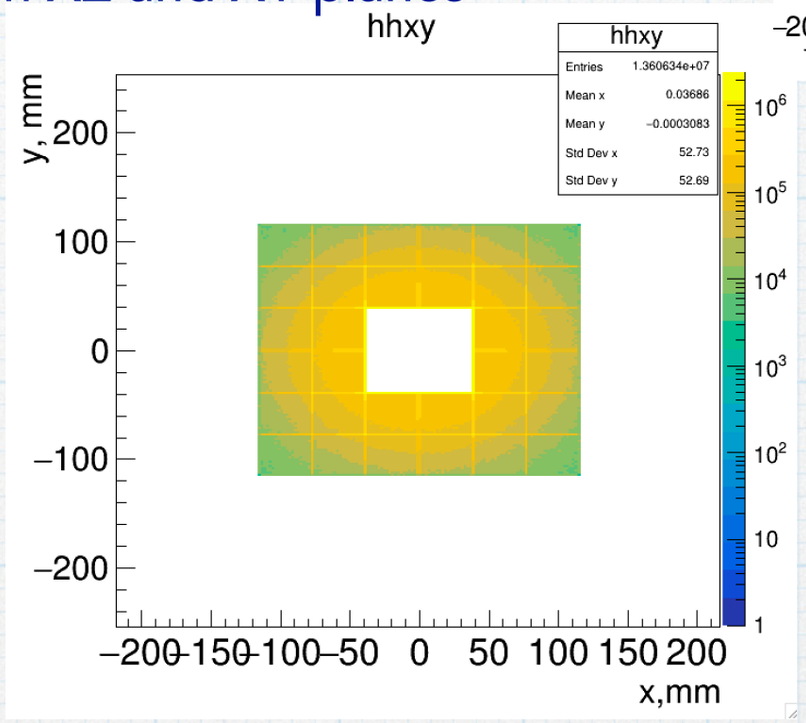
Reduced the size of the beam pipe to be consistent with the blocks size and to be able to monitor the area close to the beam pipe.

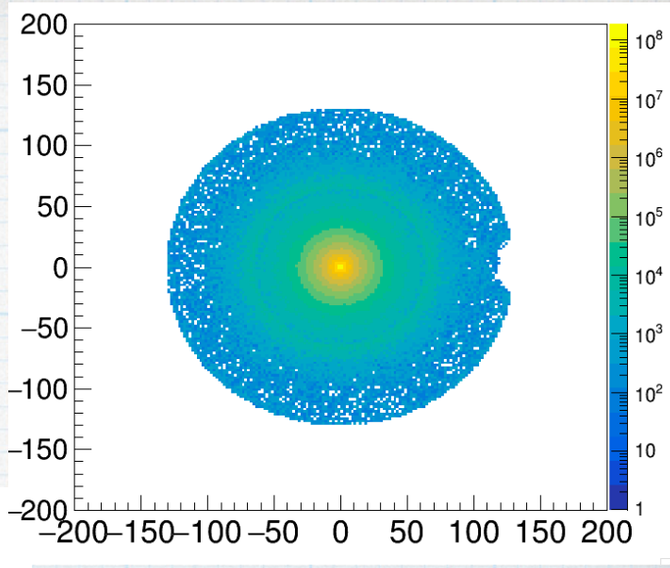
Simulation and Performance 32 LG vs 48 LG

- $\xi = 0.26$; 100 BX

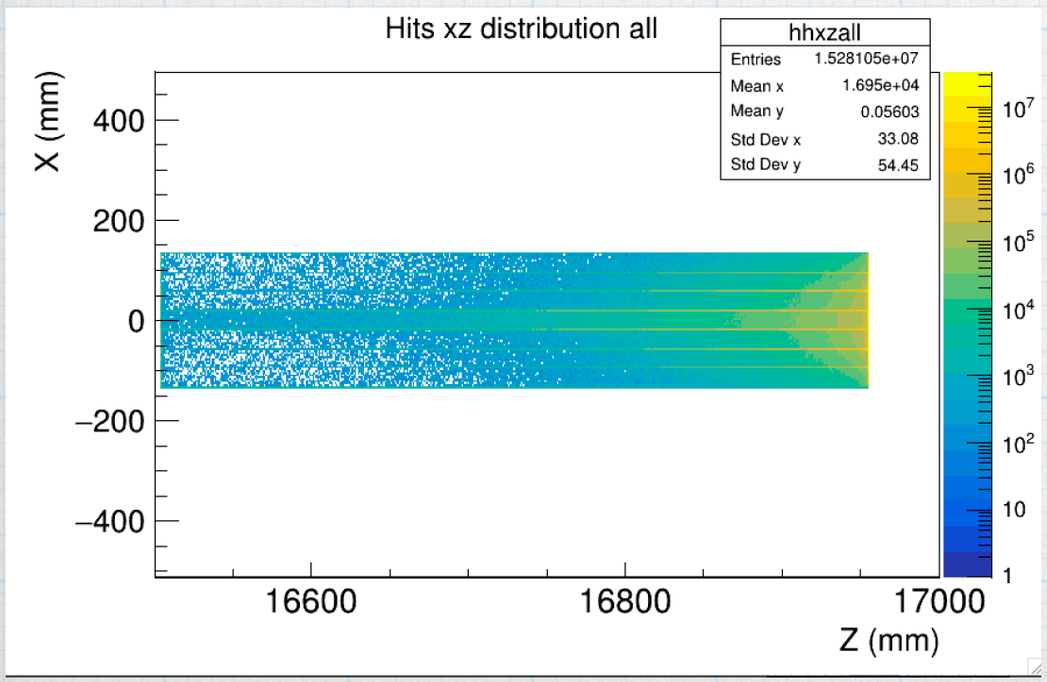
Track density on the surface of LG blocks in XZ and XY planes

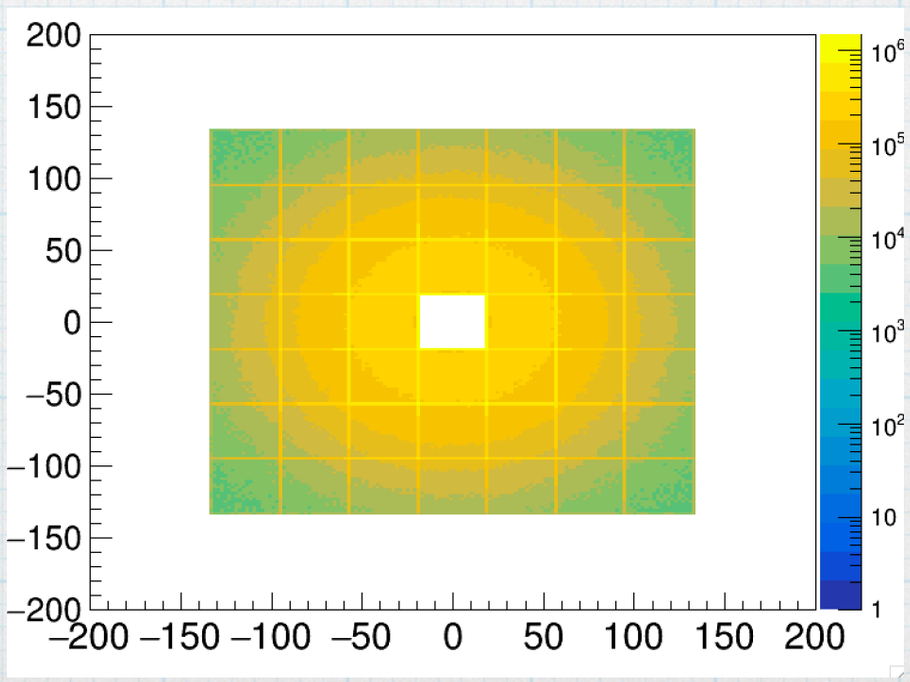




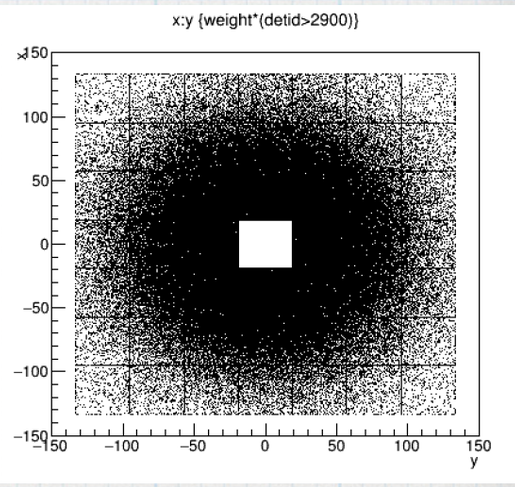


Required all the vertices to be from Beam Dump

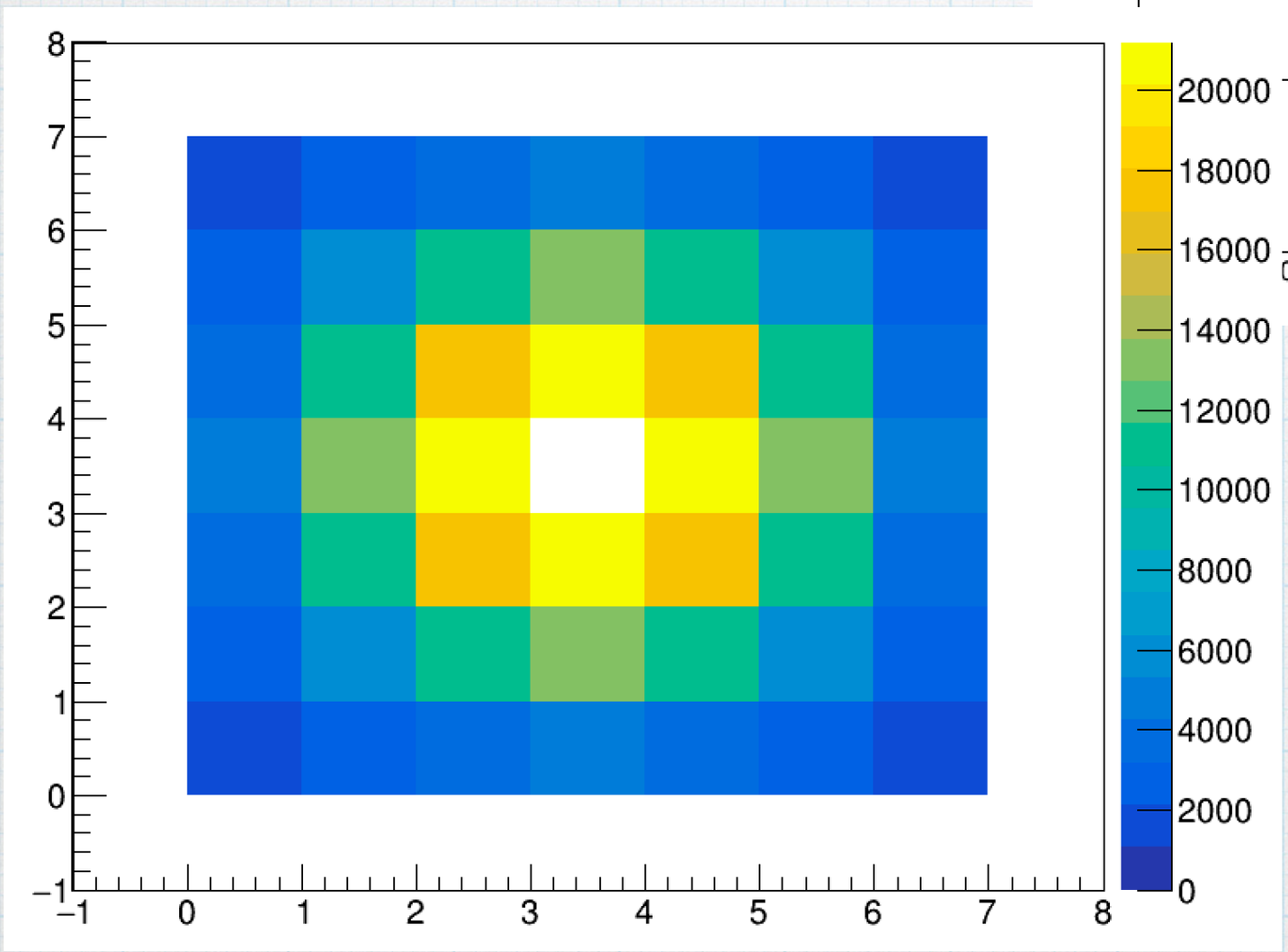


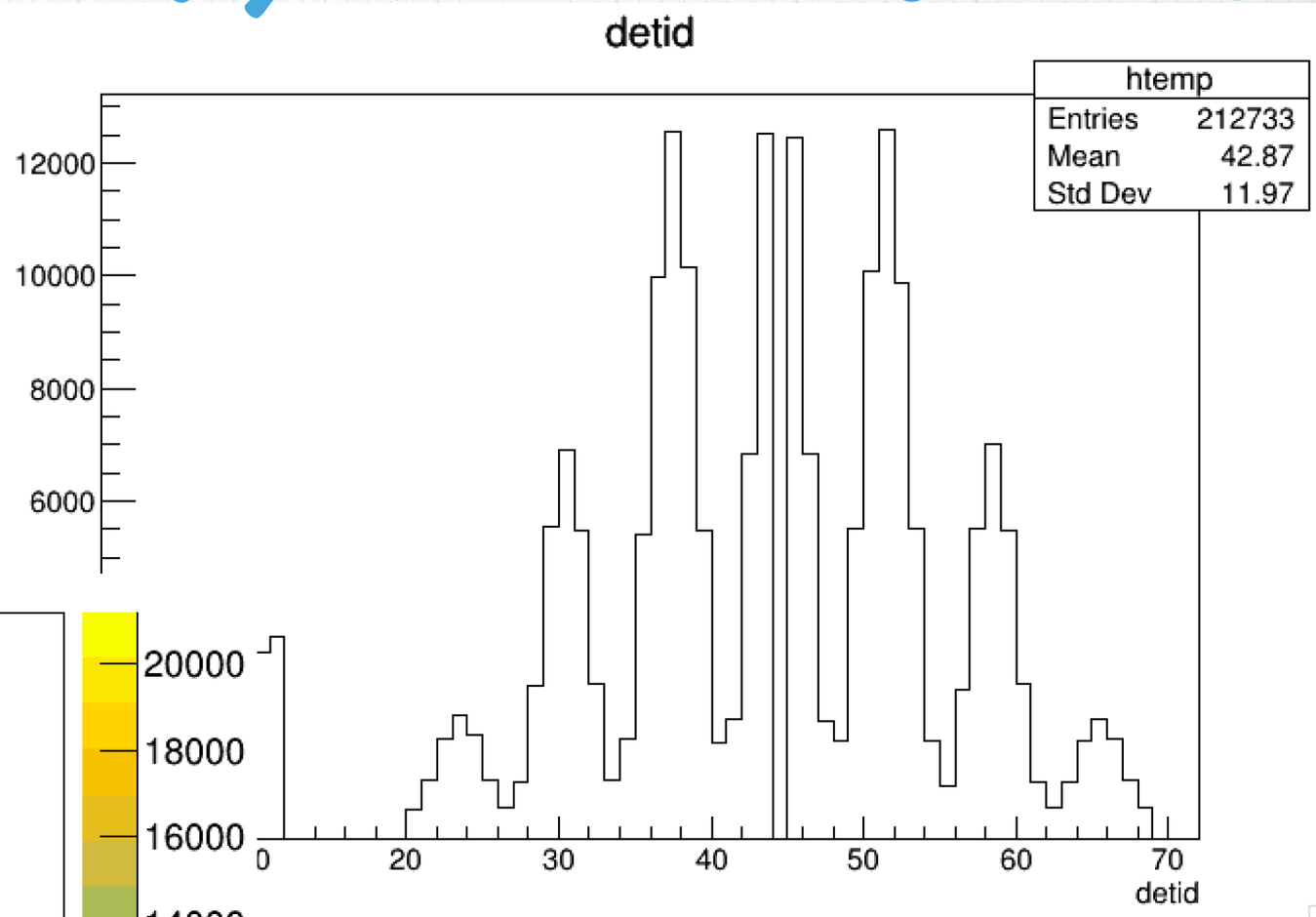


- $\xi = 0.26$; 1 BX



Energy deposition, 48 LG blocks





Row = detid / 7

Column = detid % 7

Outlook

- **Gamma monitor studies:**

✳New, irradiated LG block are found and could be wrapped and used for GM.
✳The implementation of two different configurations in Luxe geometry
✳run the simulation with new geometry implementation for ξ = 0.26; 100 BX
✳Running the simulation with new geometry implementation for ξ = 2.6; 100 BX

Further studies:
To implement optical physics in simulation

Back up

Lead glass blocks found in Hera West

- ✳ **New TF-1 LG blocks! Not irradiated, w/ measures 3.8 × 3.8 cm², length is 45 cm , ~50**
- ✳ **Will give the possibility to determine precisely coordinates and energies**

- ✳ **Spare modules for GAMS found in Hera West thanks to Sergey Schuwalow**
- ✳ **There is a preliminary agreement to move it to the LUXE Lab**

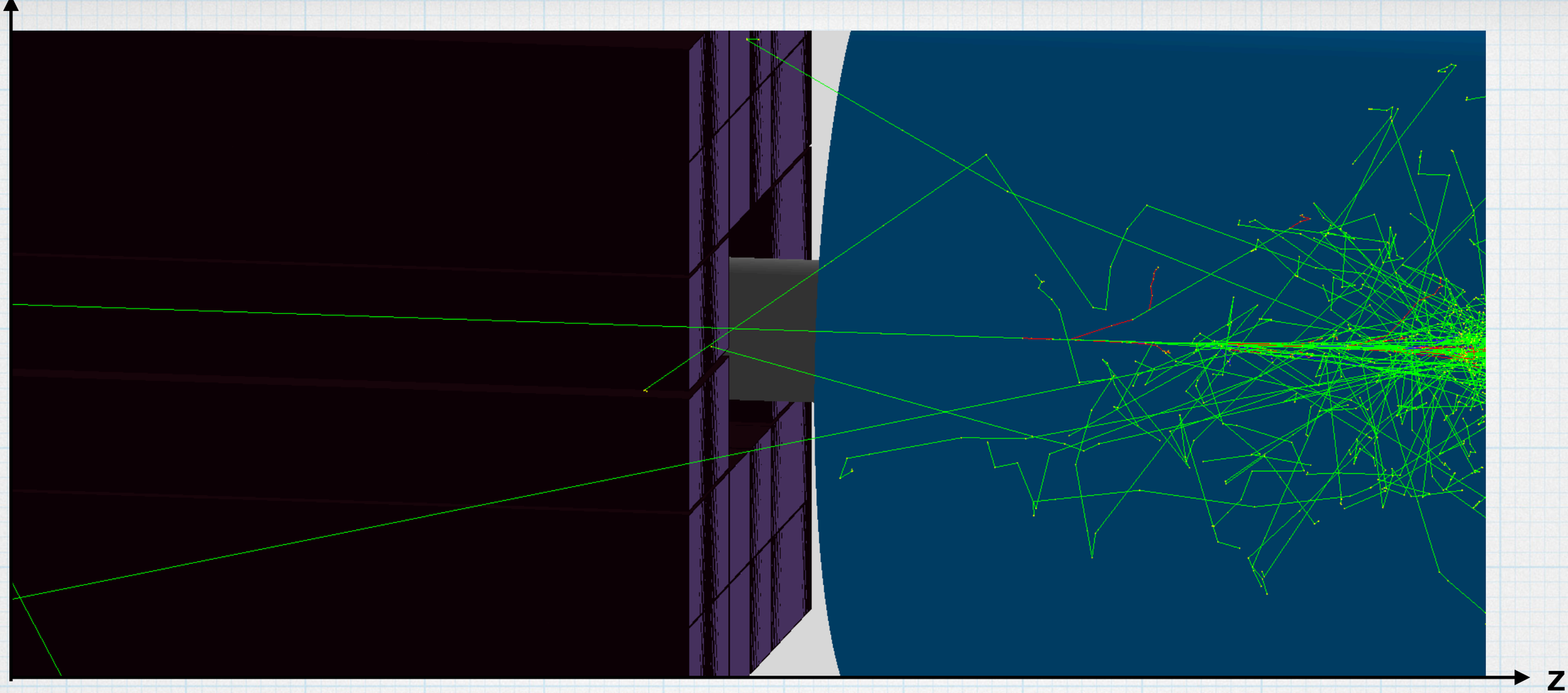
Chemical Composition of TF-1 LG

Table 1. Chemical composition and physical properties of the TF-1[10].

Chemical composition (weight %)		Fractions atomic units
PbO	51.2	Pb-0.082232
SiO_2	41.3	Si-0.246406
K_2O	3.5	0-0.608358
Na_2O	3.5	K-0.038057
As_2O_3	0.5	NA-0.023135
Radiation length (cm)	2.50	AS-0.001812
Density (g/cm^3)	3.86	
Critical energy (MeV)	15.57	
Refraction index	1.6476	

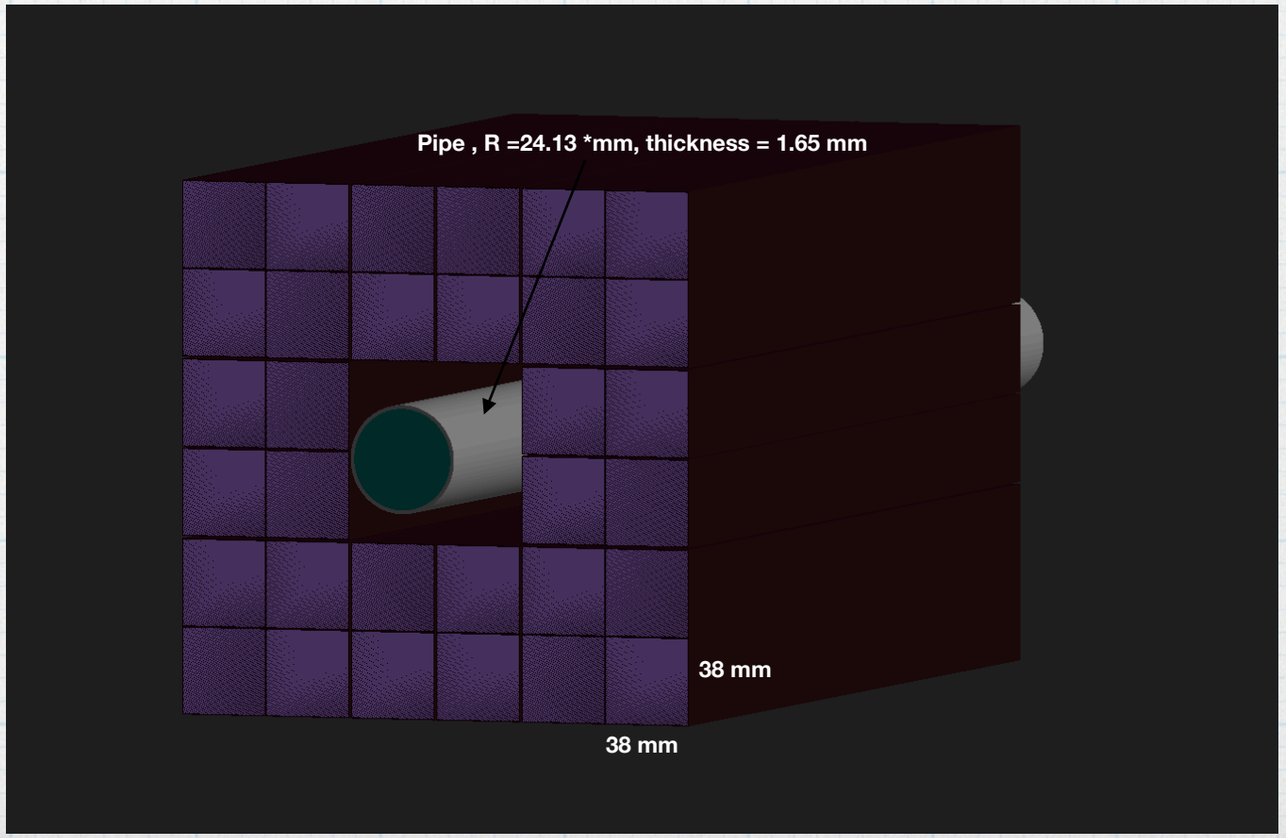
Used previously in
GAMS-2000 spectrometer (Serpuchov)
GAMS-4000 spectrometer (NA-12 experiment, CERN)

The measured energy resolution of the GAMS-4000 spectrometer for a single photon is $\sigma_E/E = 0.011 + 0.053 / \sqrt{E(GeV)}$.



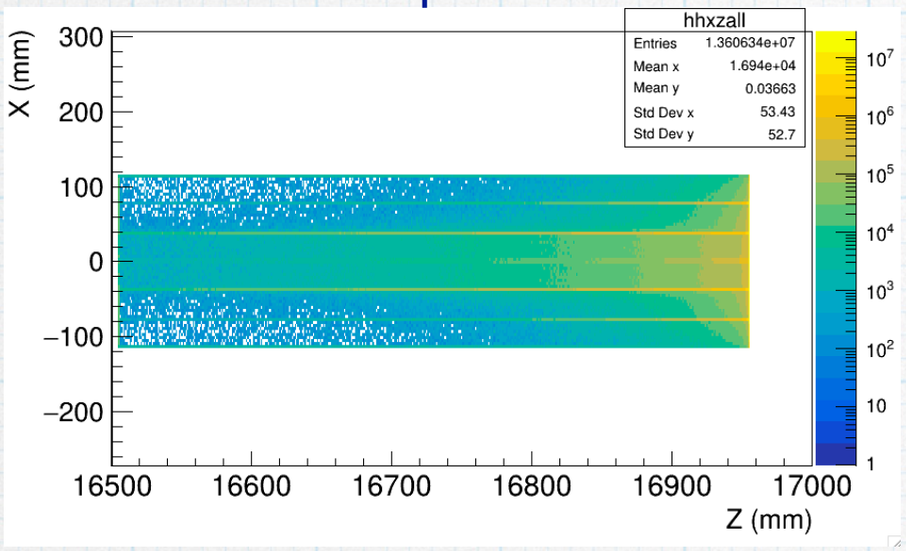
- The implementation in Luxe geometry of the LG Gamma Monitor made of 32 new LG blocks in front of Al-Cu Dump(R(Cu) = 13.0 *cm; R(Al) = 6.5 *cm & L(Al)= 20 *cm)

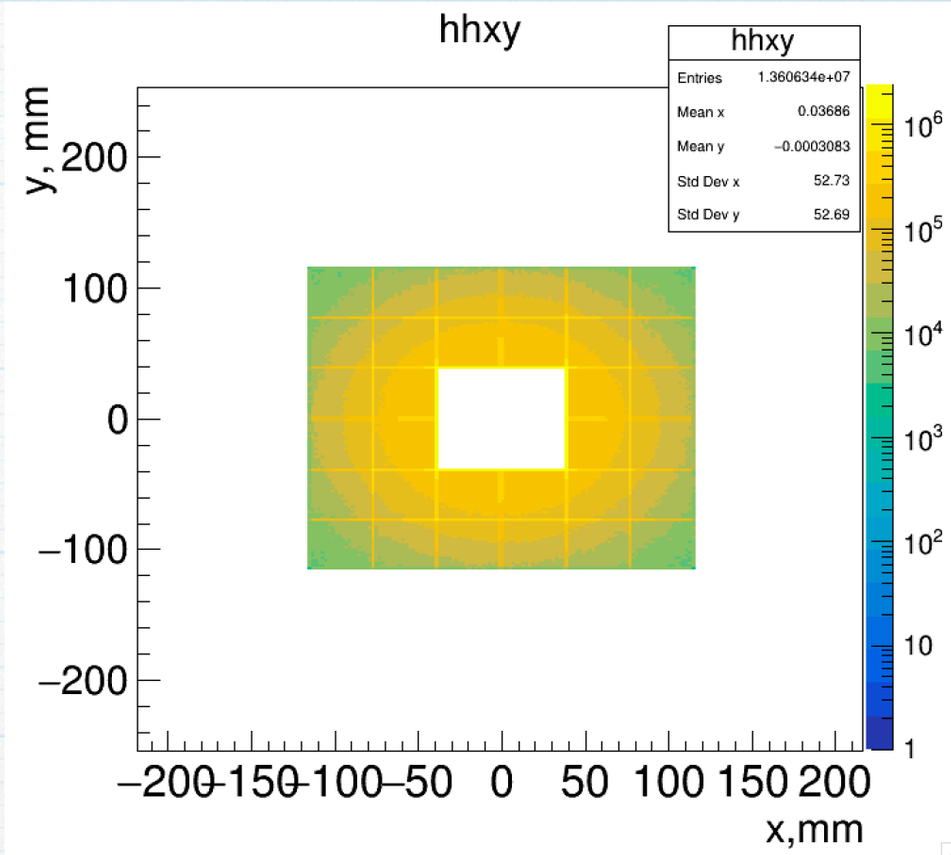
- 32 LG w/ measures 3.8 × 3.8 cm^2, length is 45 cm
- Each block is wrapped with Aluminium foil of 1 mm

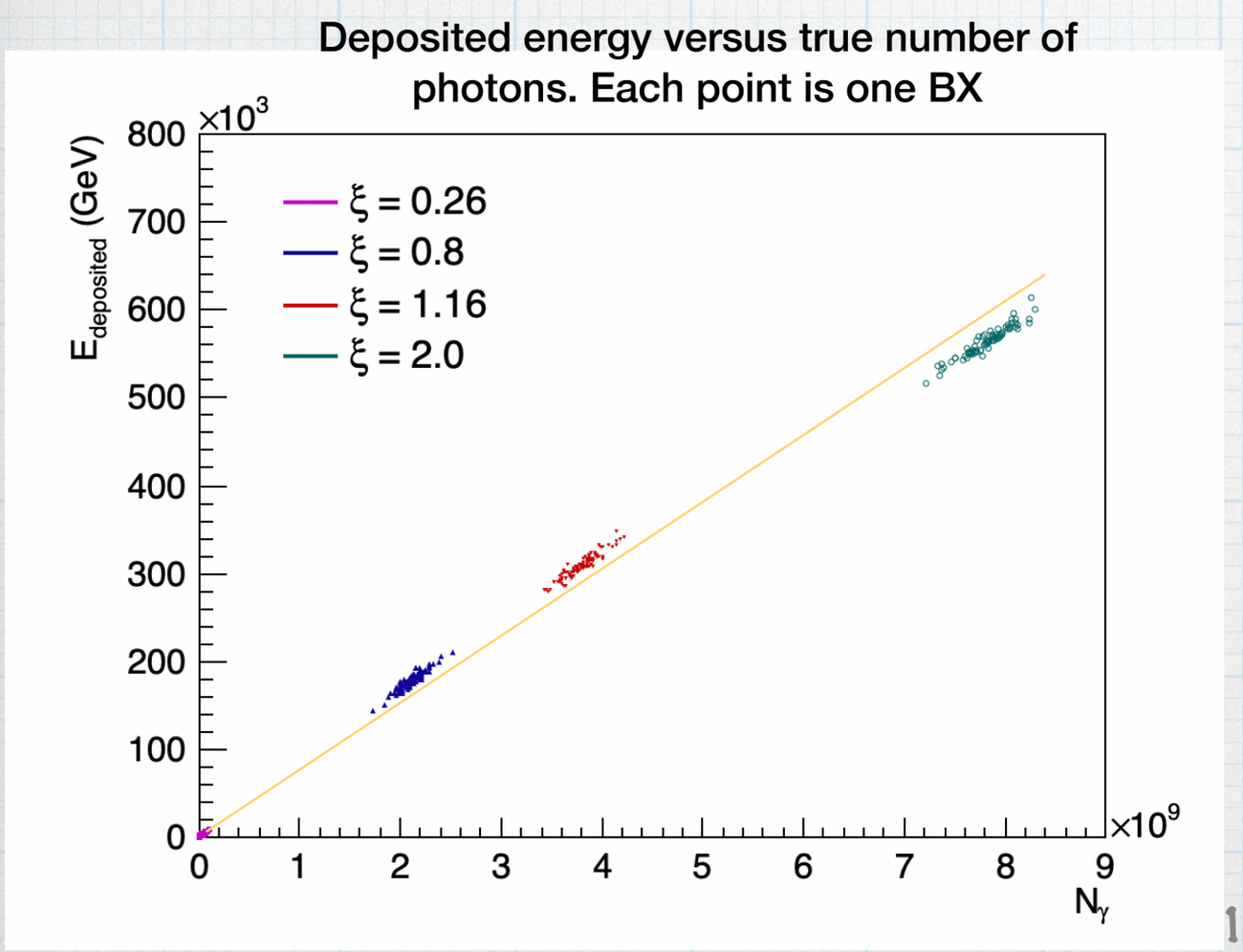


Simulation and Performance

Track density on the surface of LG blocks in XY and XZ planes

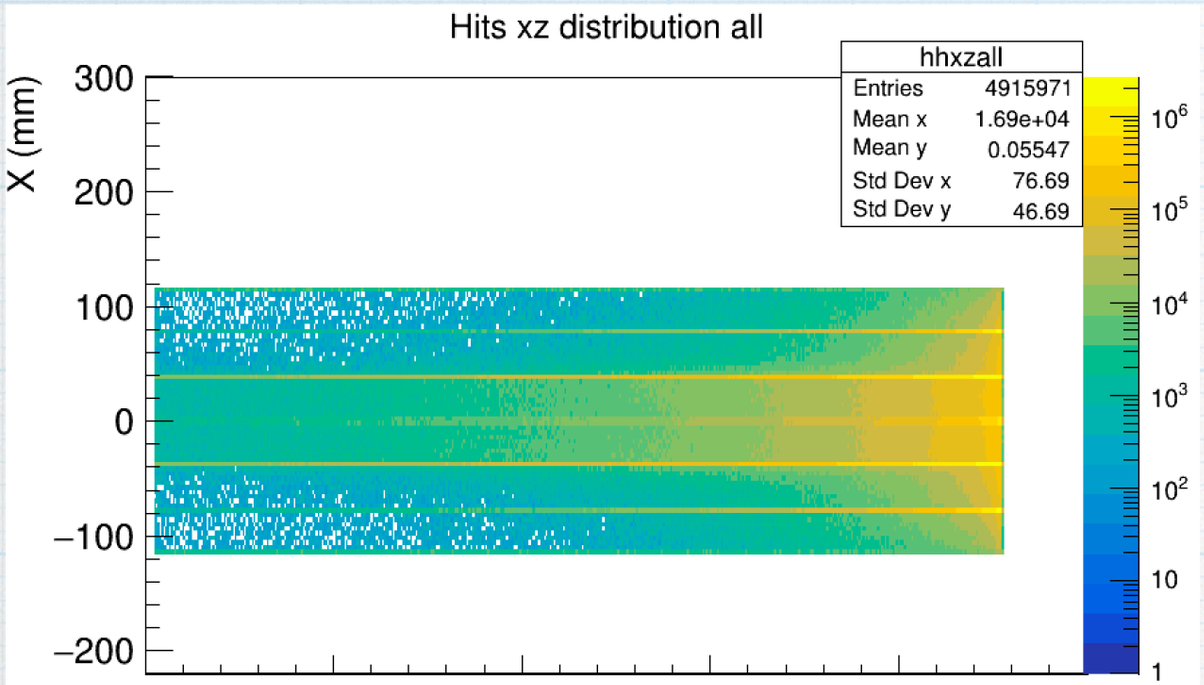


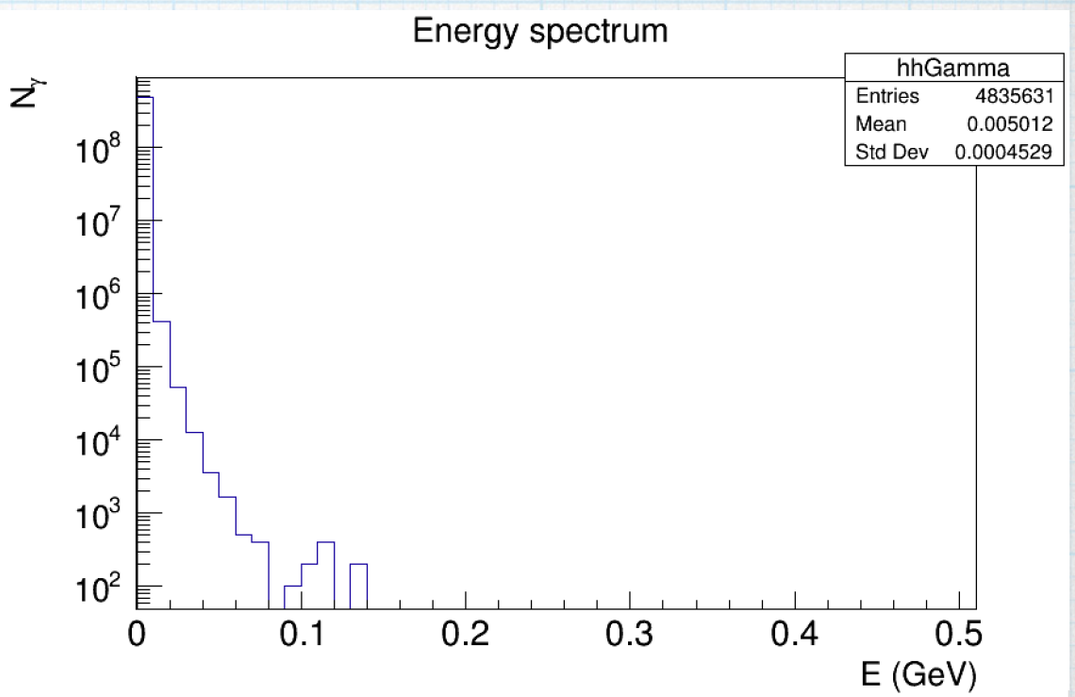


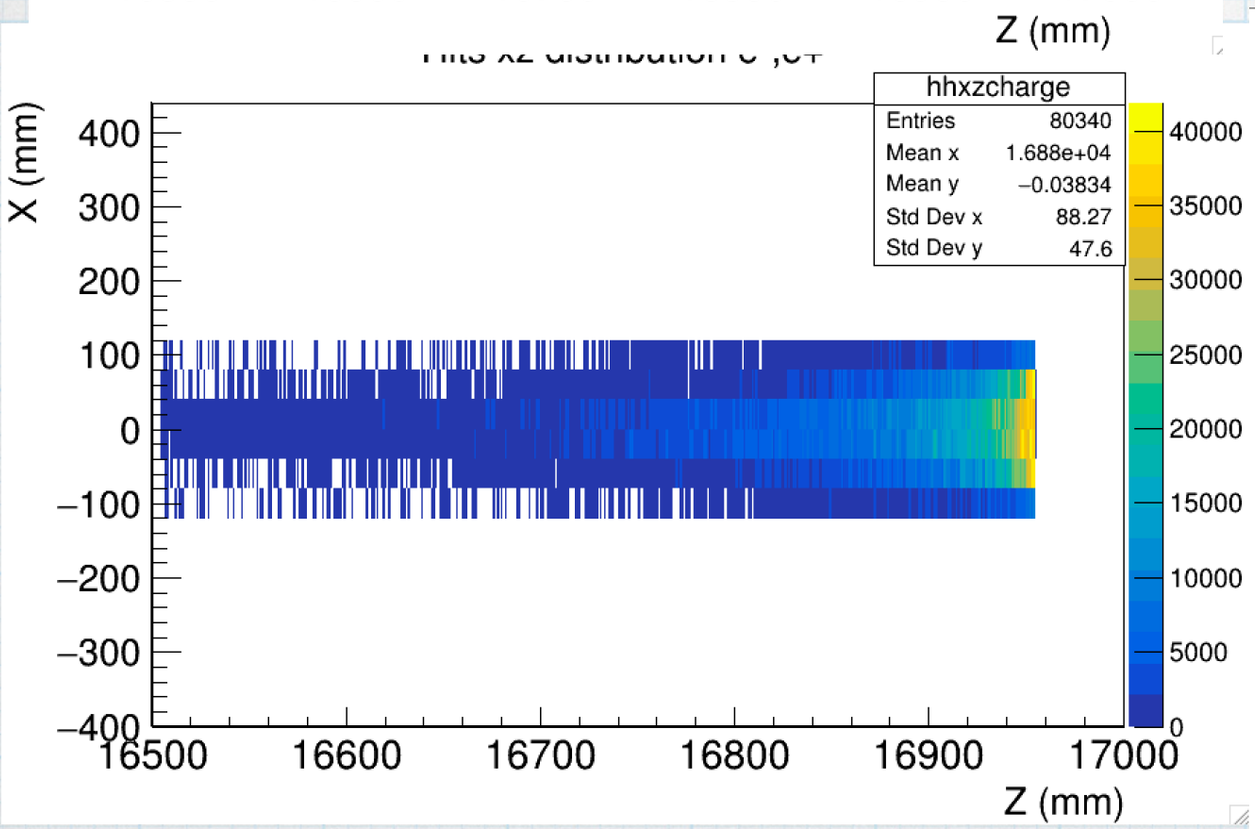


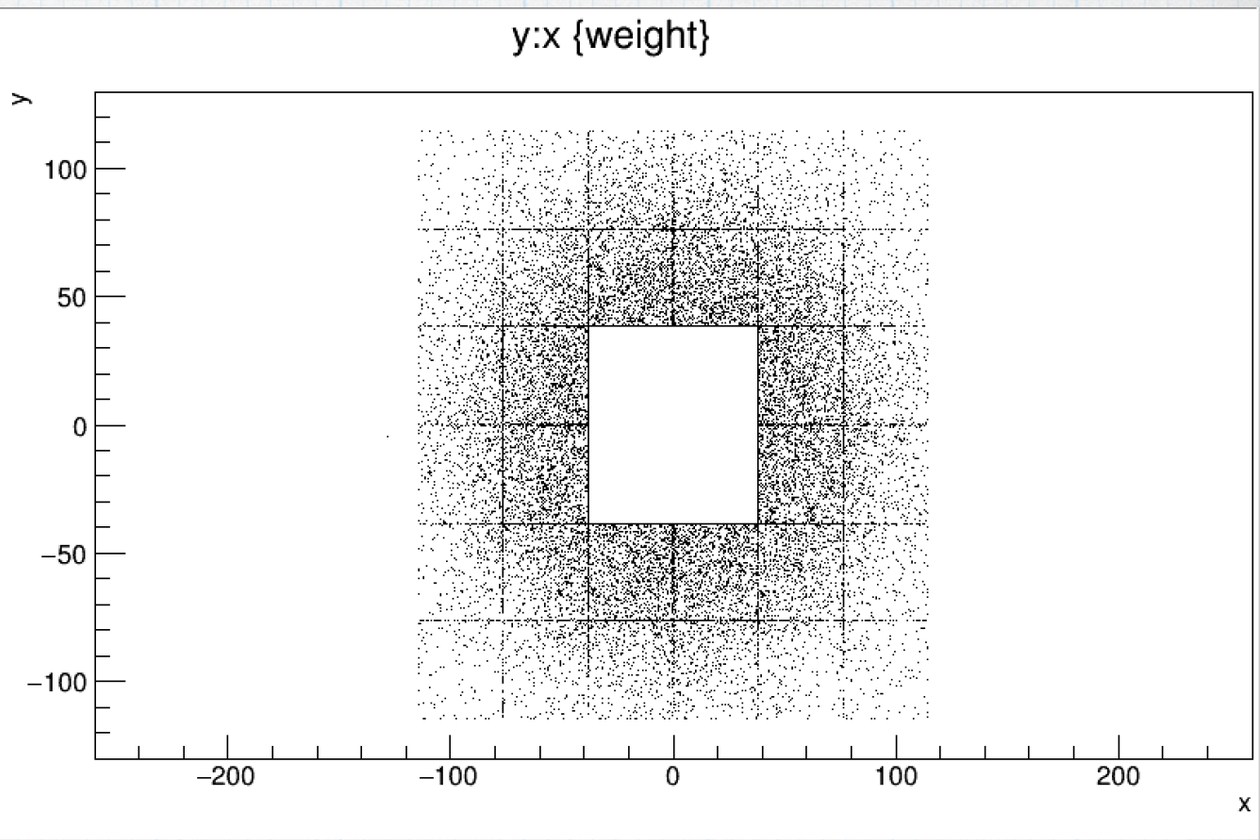
- The (almost) linear dependence of deposited energy on number of incoming photons in GM allows the usage of backscatters for monitoring the photon flux
- For small ξ the HICS spectrum is softer and soft photons produce less back-scatters. This is the reason of small deviation from linearity in Edep on Eγ dependence

The distribution of particles tracks entering LG Gamma monitor in XY and XZ planes









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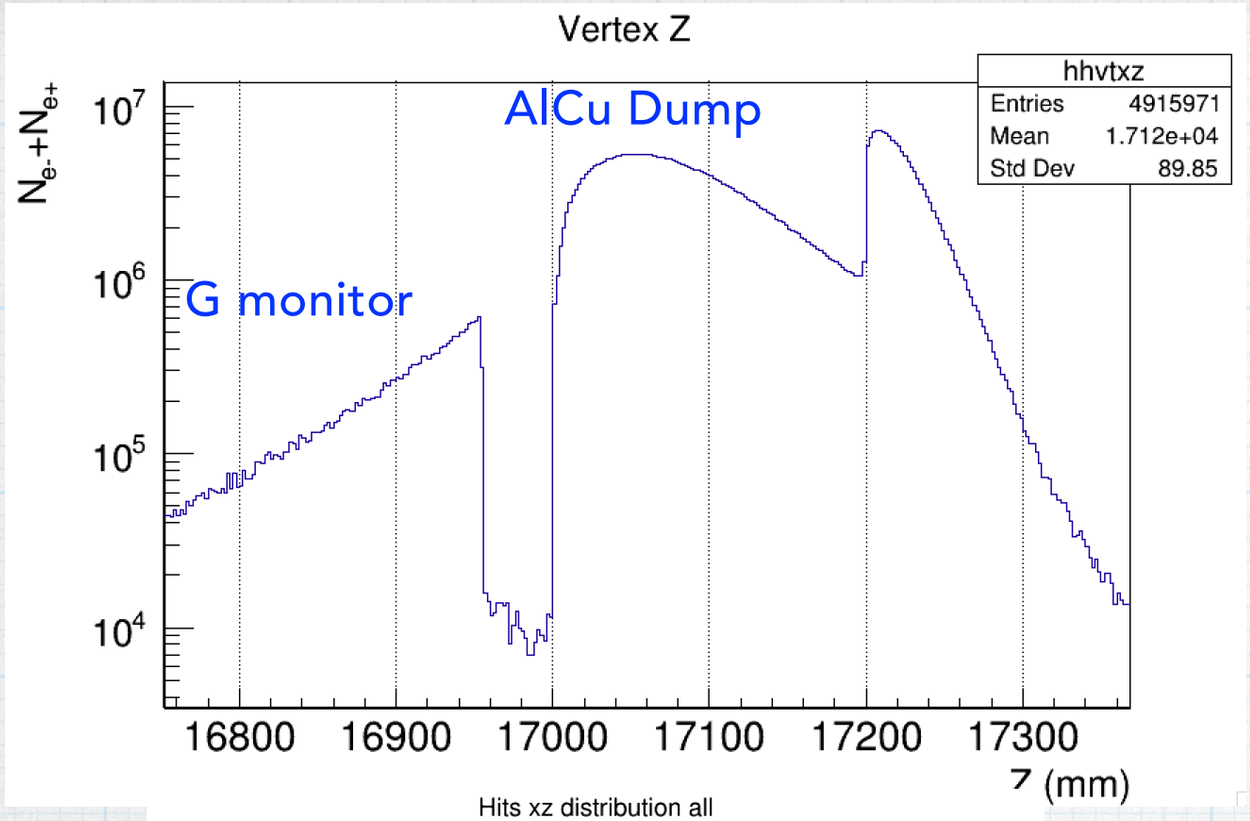
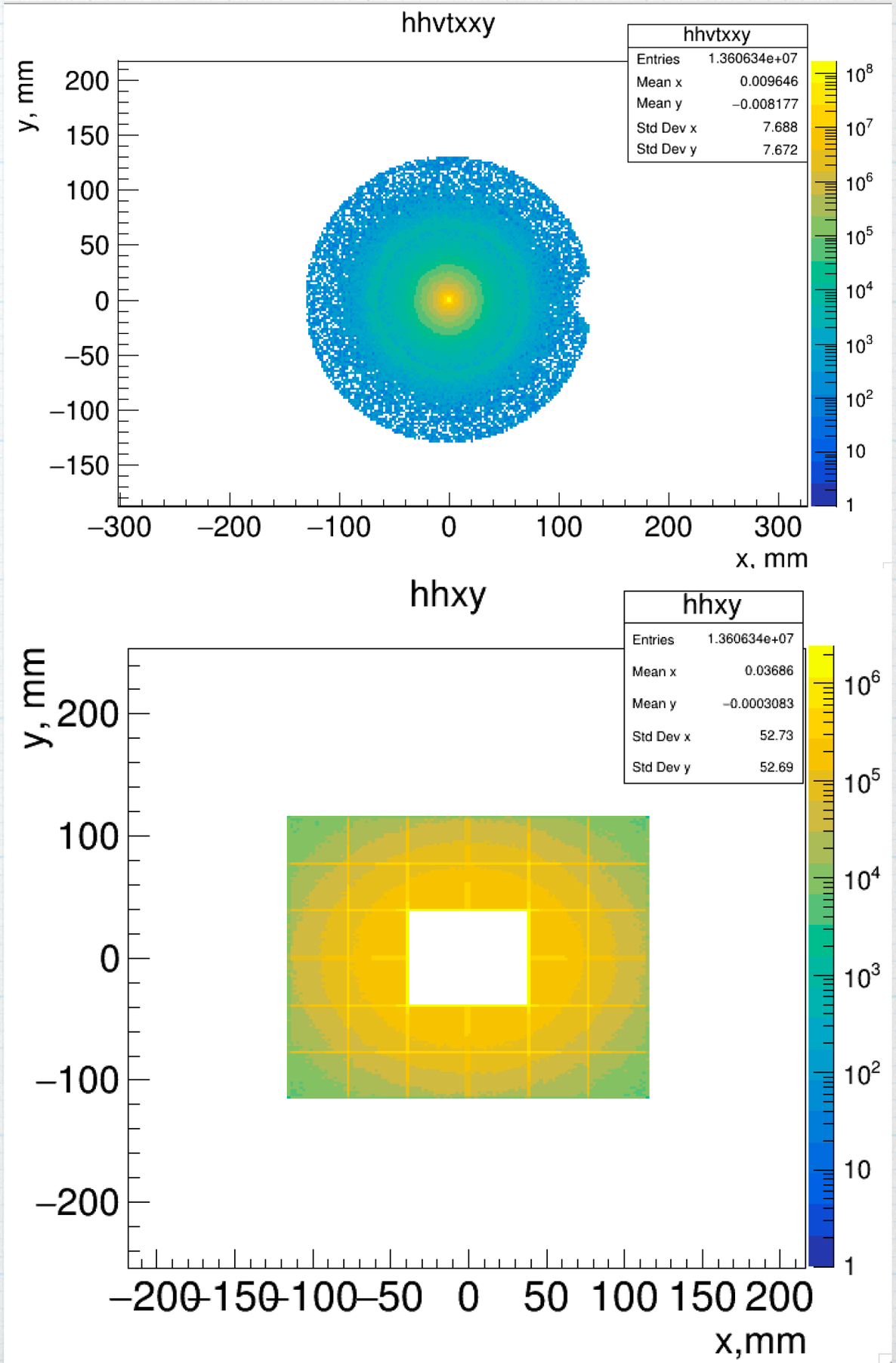
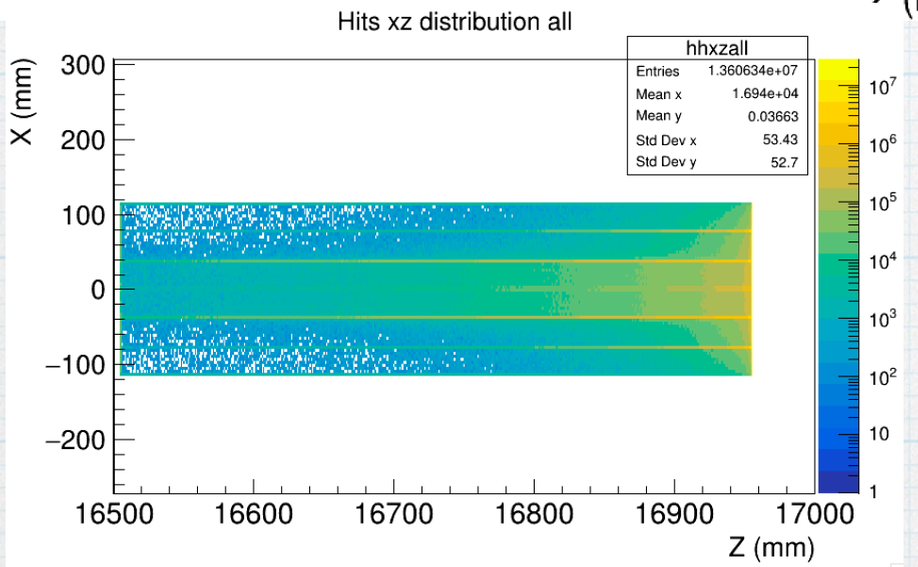
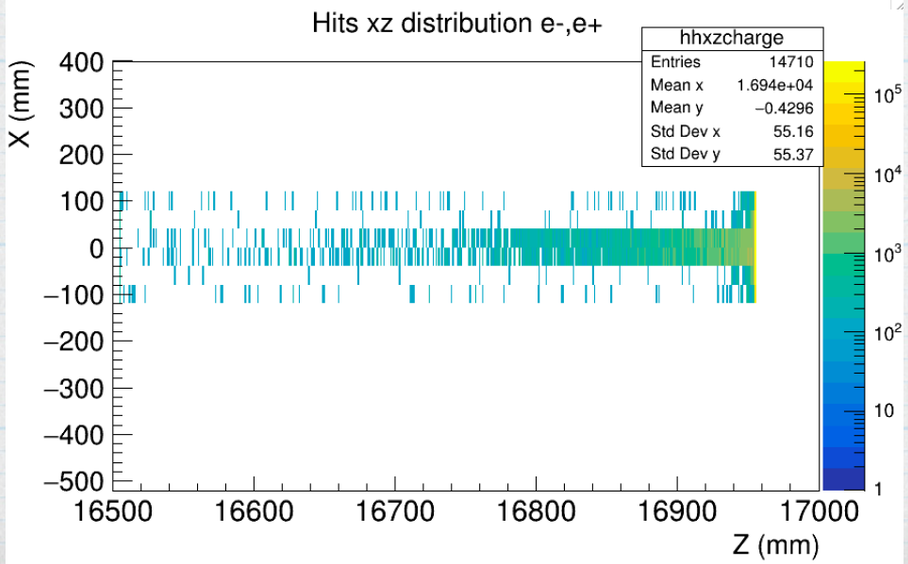
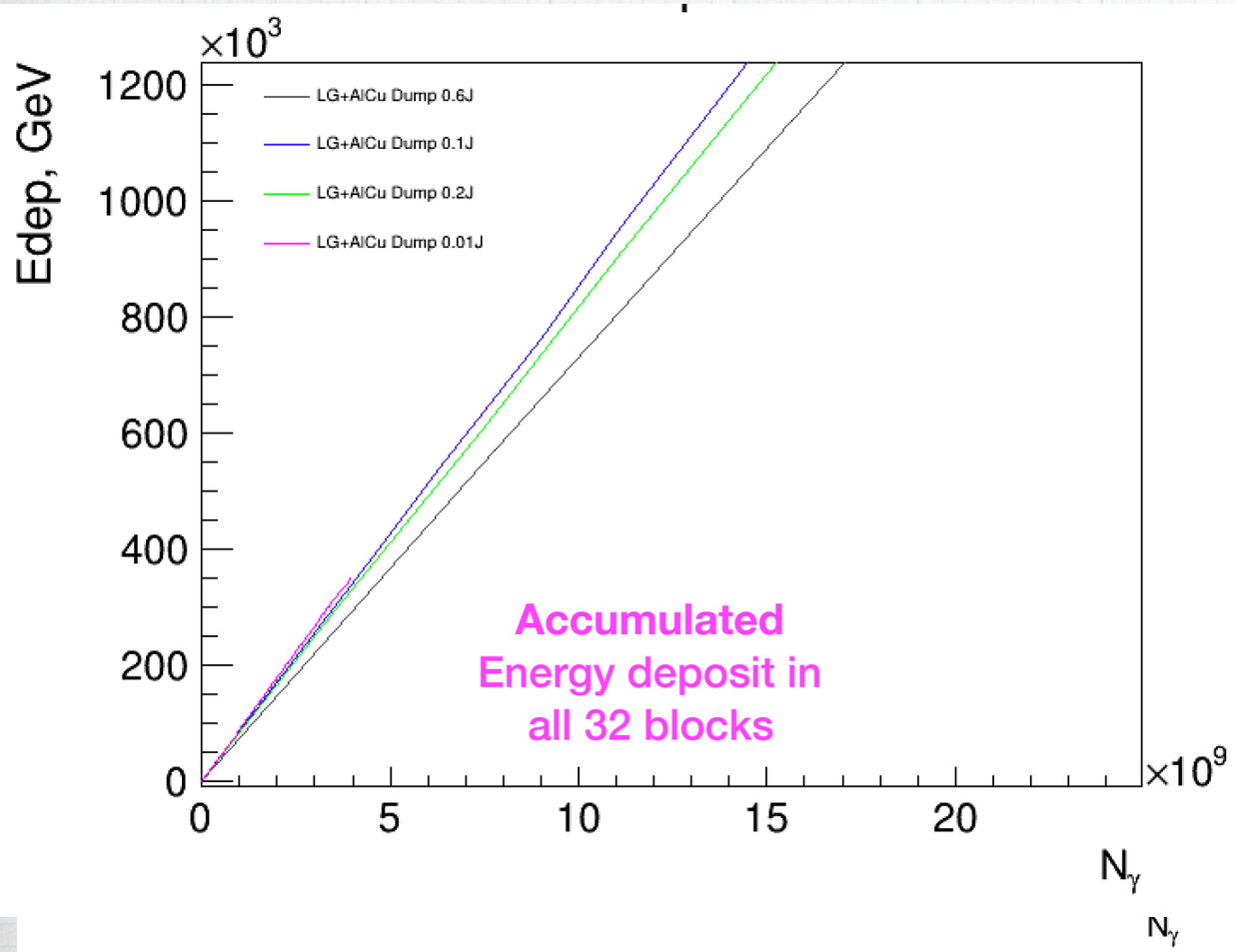


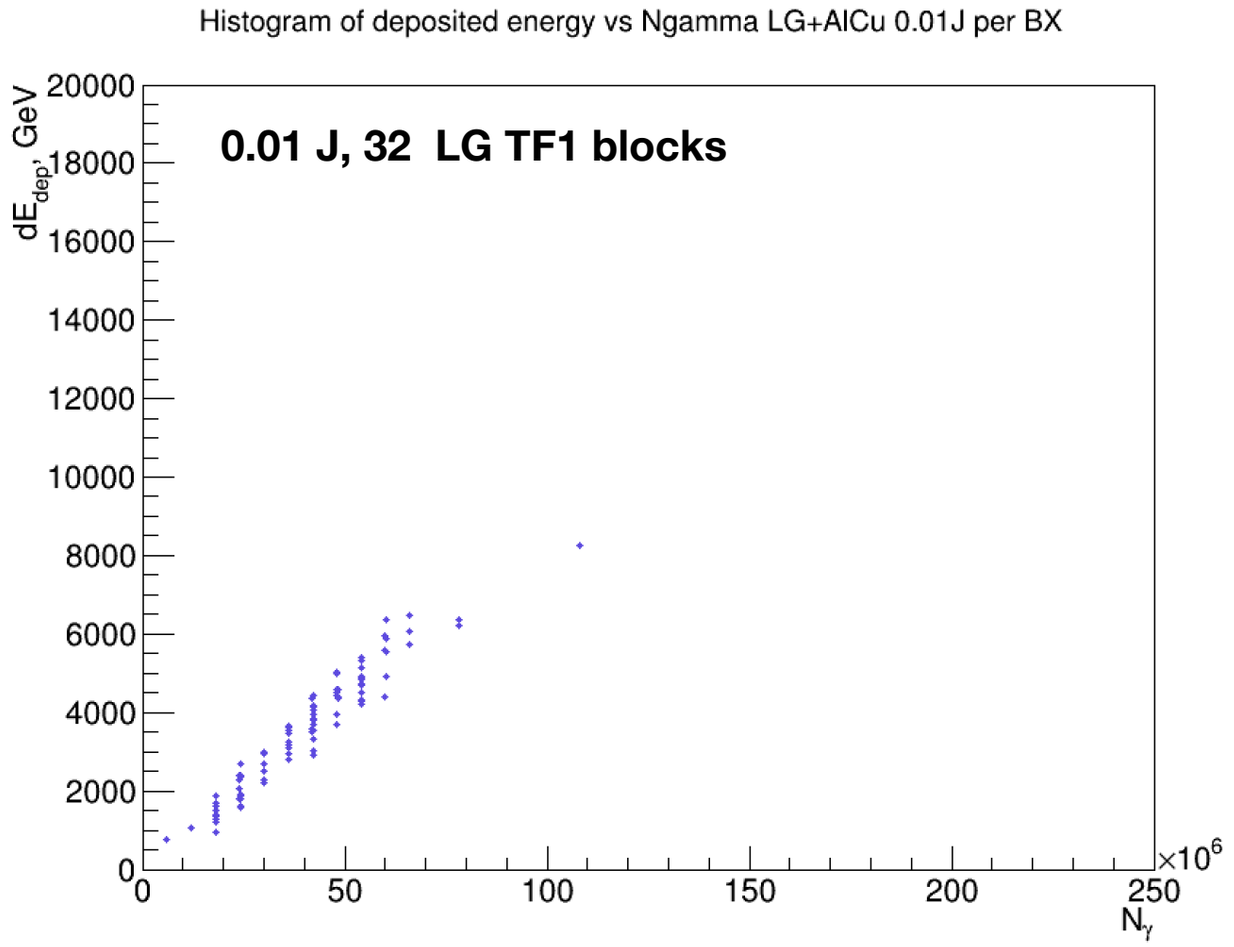






The dependence of deposited energy on number of incoming photons per BX for LG Gamma monitor and AlCu dump





Energy deposit on Ngamma
Each point is one BX, xi=0.26