NPOD simulation studies update

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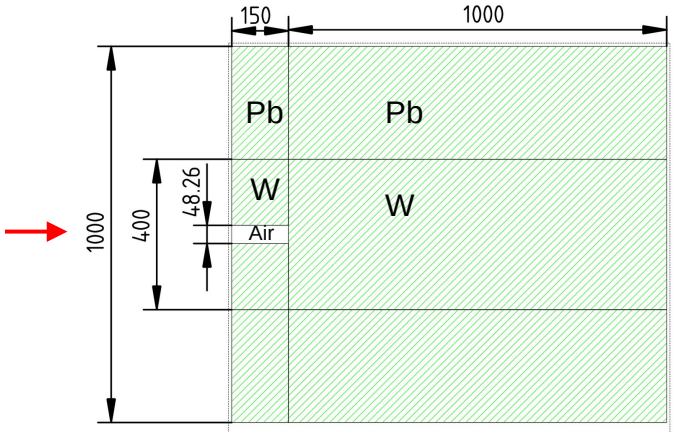
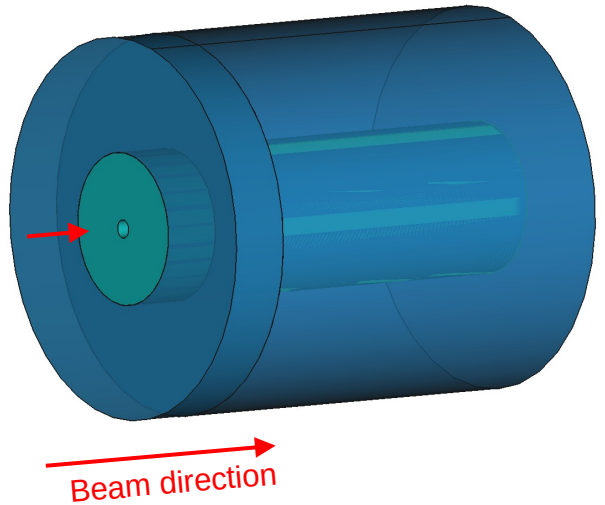
July 8th , 2024

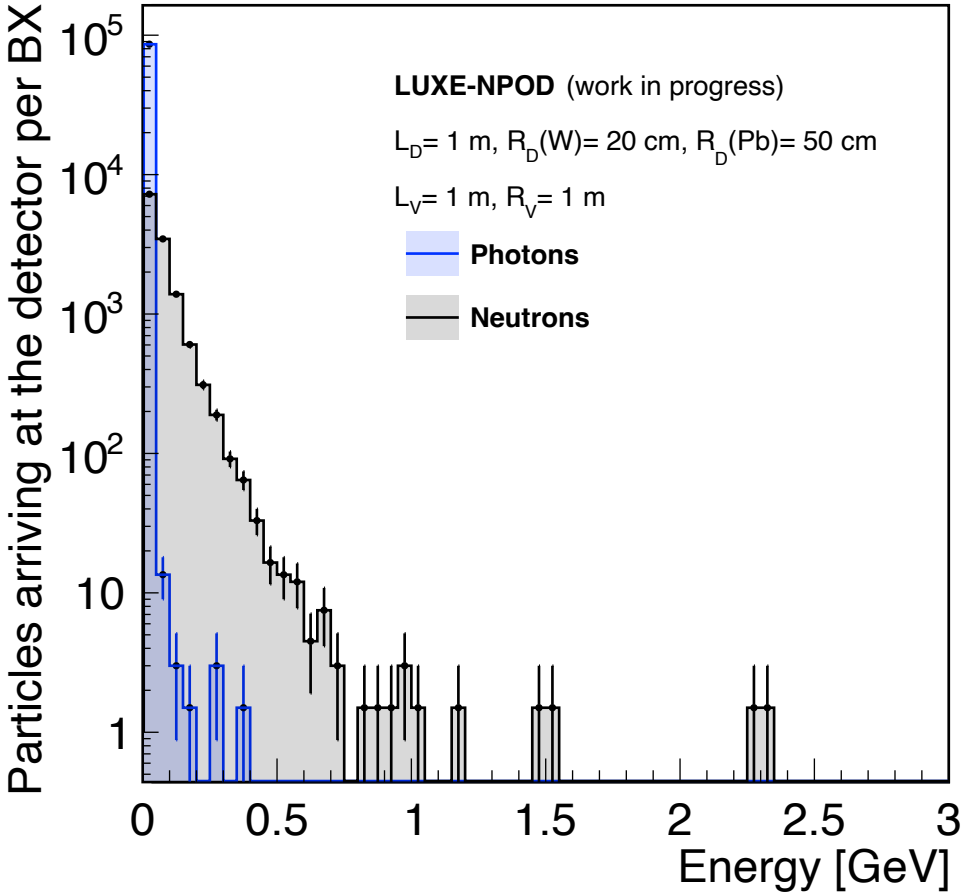
Double dump W+Pb configuration

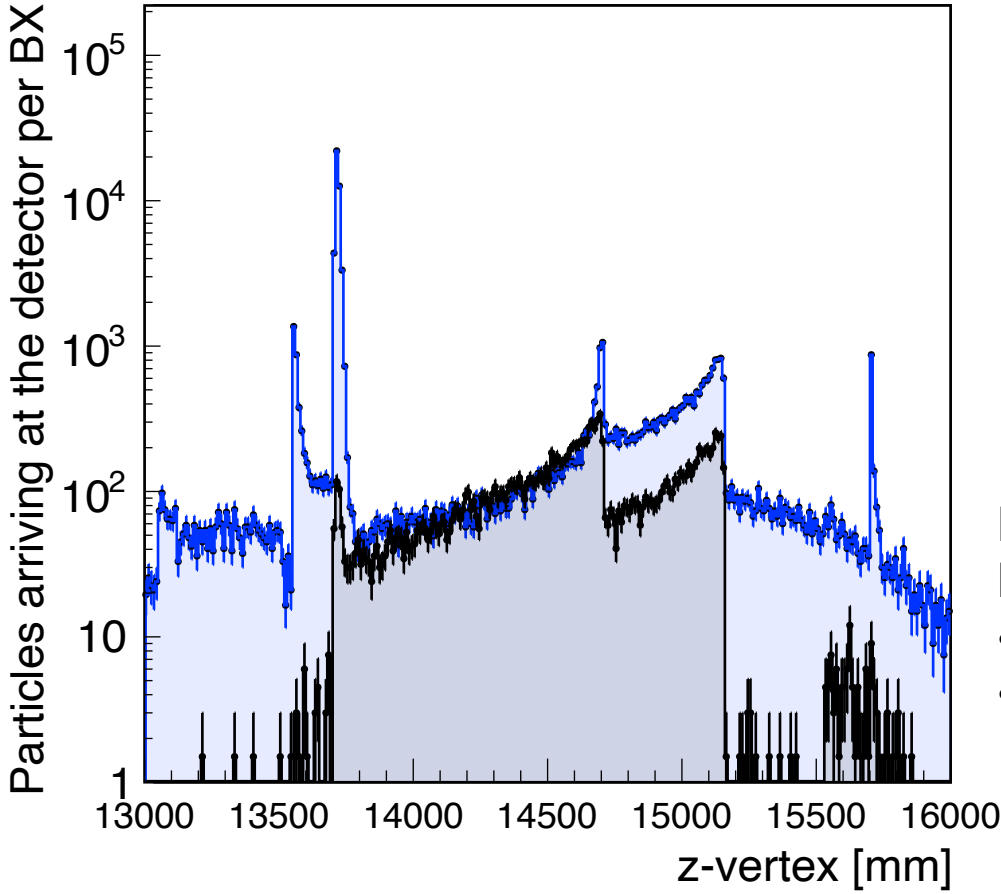
- Dump geometry:
  - Tungsten dump, radius 20 cm, length 1 m
  - Lead dump wrap, radius 50 cm, length 1m
  - Enclosing concrete wall
- G4 v10.06.p01
- Physics list: `QGSP_BERT_HP`
- Simulated a total of 10 BXs





Double dump W+Pb configuration
Background: neutrons and photons

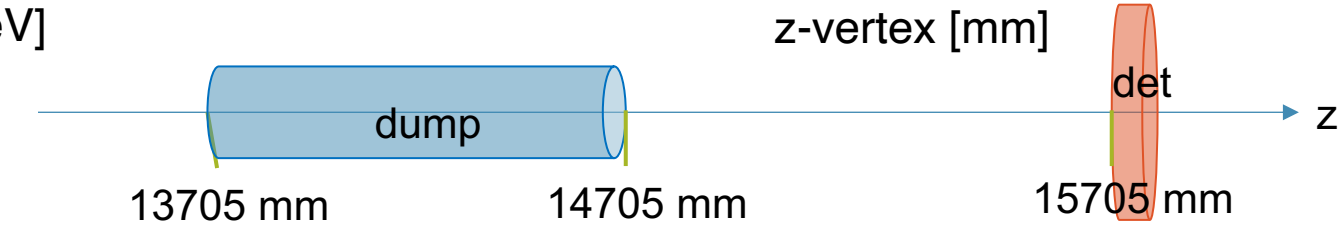




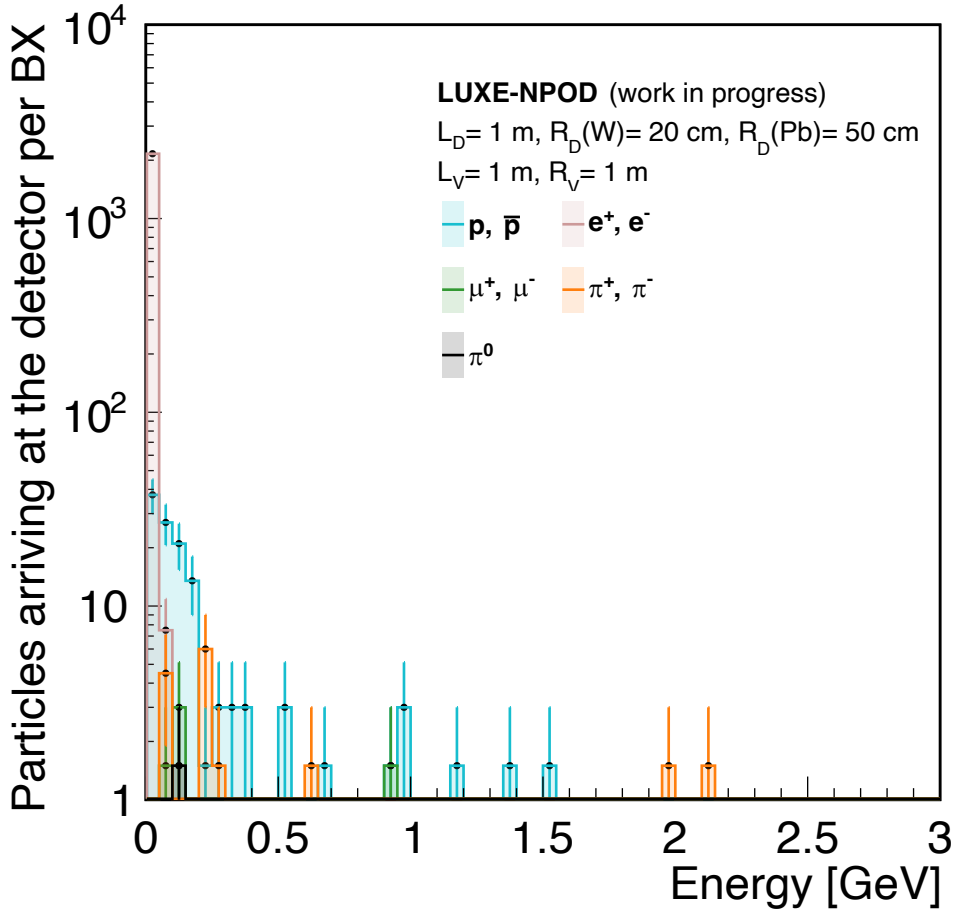
- L_D = 1m
- L_v = 1m
- $R_{detector}$ = 1m
- 10 BXs

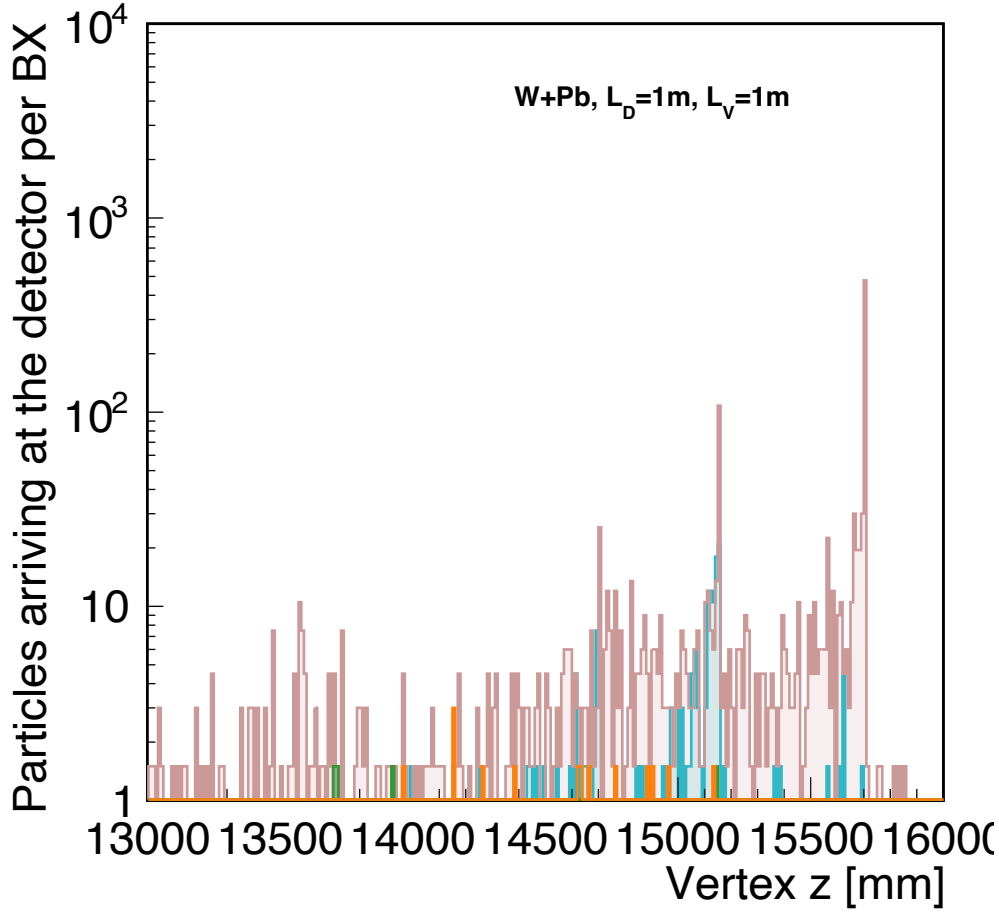
Number of particles per BX above 0.5GeV:

- Photons: 0.0
- Neutrons: 67.5



Double dump W+Pb configuration Background: other long lived particles





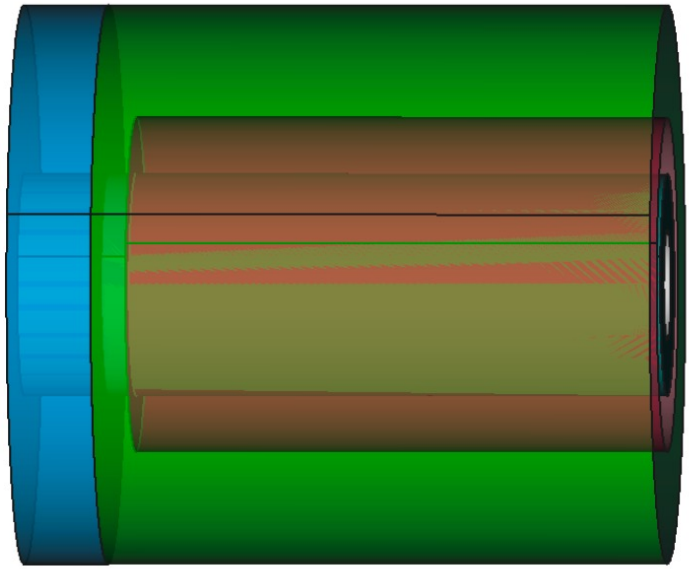
- L_D = 1m
- L_V = 1m
- $R_{detector}$ = 1m
- 10 BXs

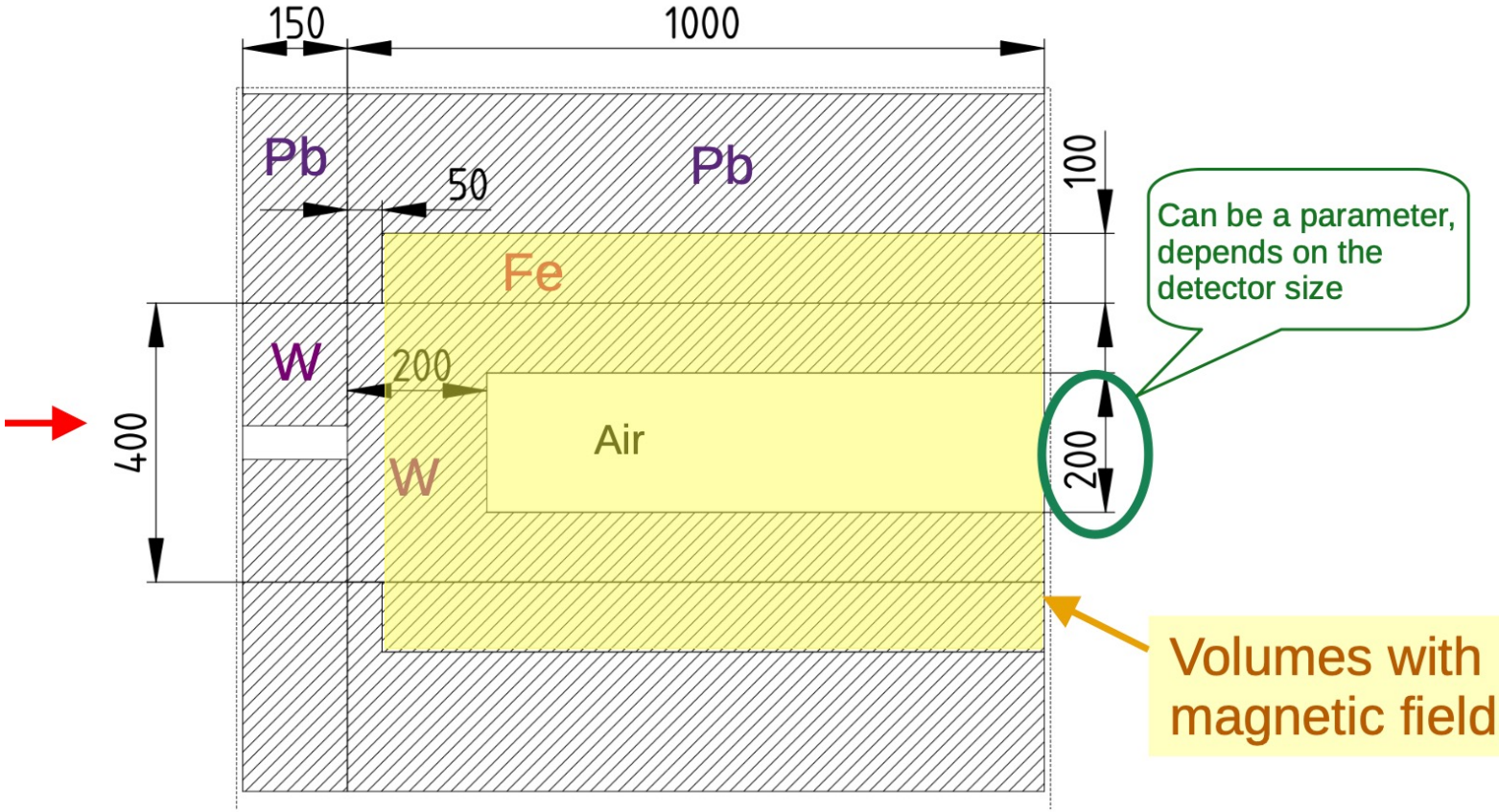
Number of particles per BX above 0.5GeV: 22.5

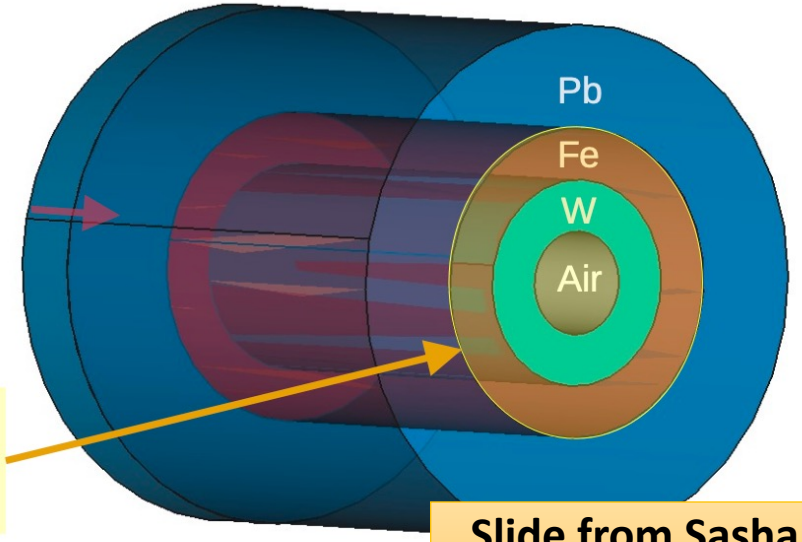
Charged particles can be handled with a magnet

Beam dump with magnetic field

- The Iron cylinder is supposed to be magnetized and serves as a source of the uniform dipole field, with By = 1.5T, cannot be more, probably should be less.
- Its thickness is not well clear, it should be small, but sufficient to create the field in the tungsten. So 100 mm here is just a guess.



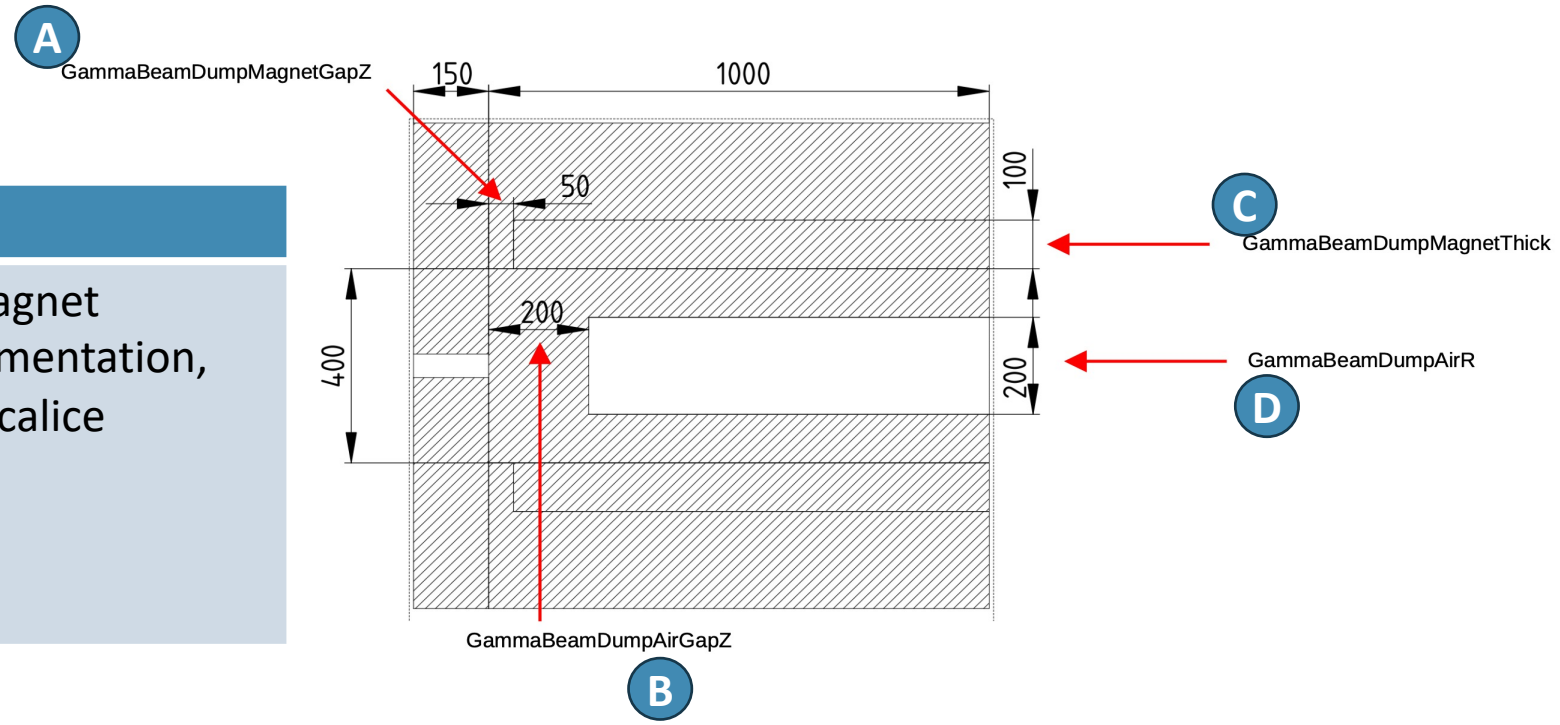




Slide from Sasha

Magnetised dump configuration

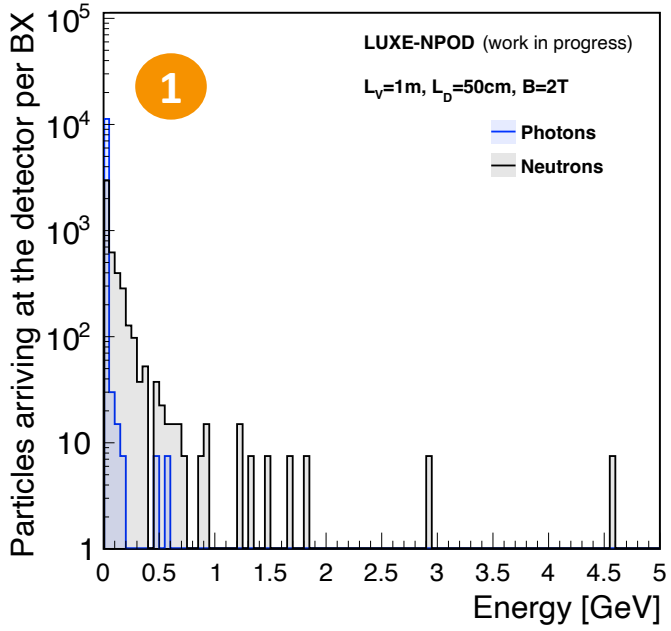
	1	2	3	4
A [mm]	50	0	50	No magnet implementation, BSM=calice
B [mm]	500	500	500	
C [mm]	100	100	100	
D [mm]	100	100	100	
Bfield [T]	2	2	0	

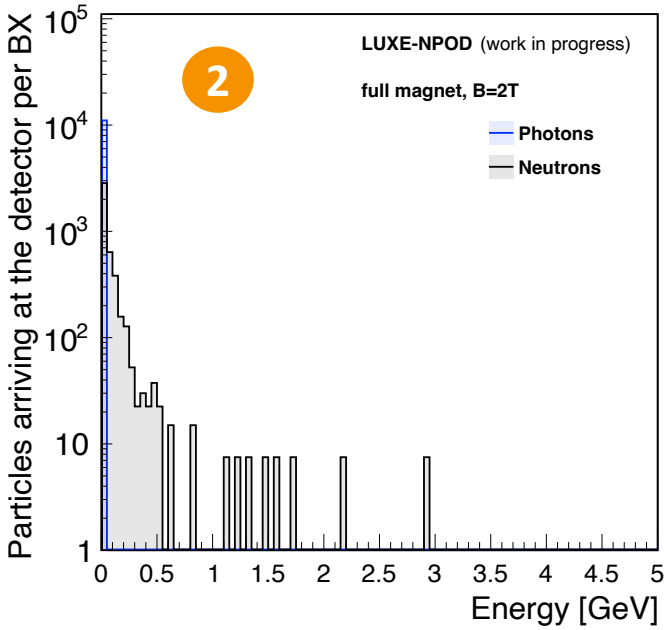


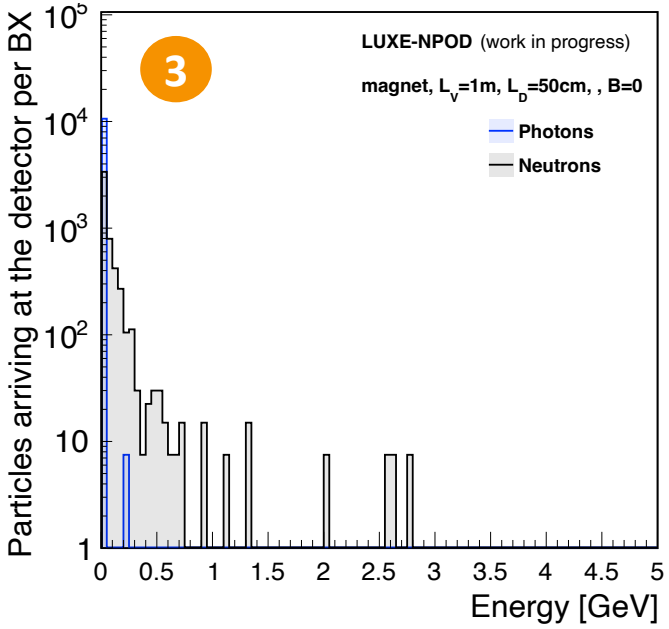
- Simulated **2BX** with W dump of radius 20cm wrapped in Pb of radius 50cm, and distance to BSM detector of 1m

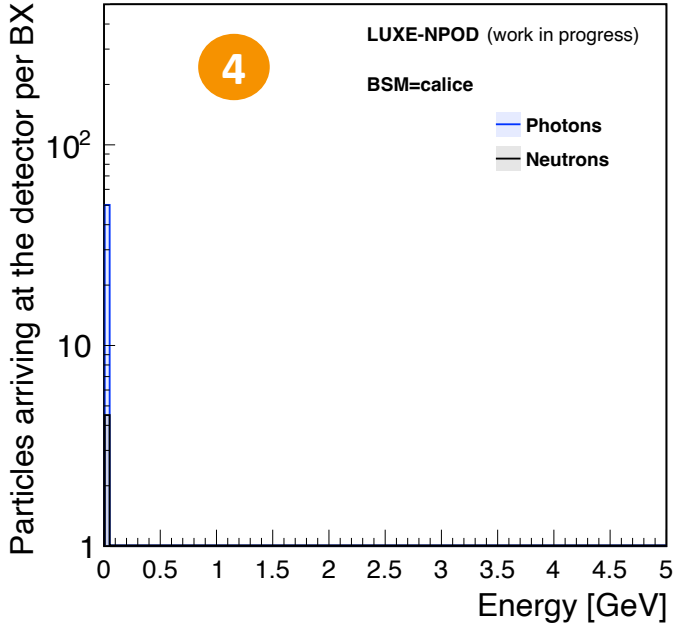
Photons and Neutrons

Energy

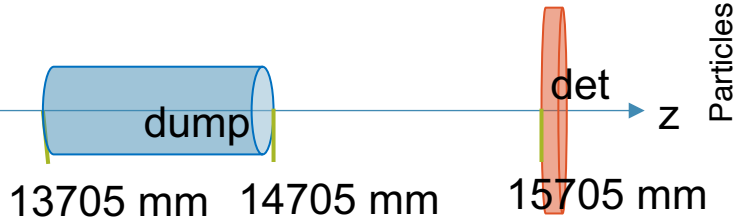

LUXE-NPOD (work in progress)
L_V=1m, L_D=50cm, B=2T
Photons
Neutrons
Particles arriving at the detector per BX
Energy [GeV]

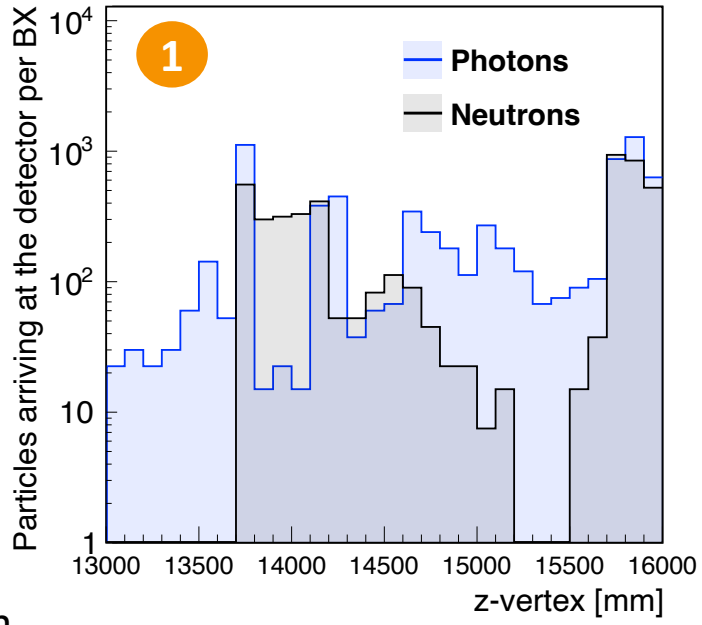

LUXE-NPOD (work in progress)
full magnet, B=2T
Photons
Neutrons
Particles arriving at the detector per BX
Energy [GeV]

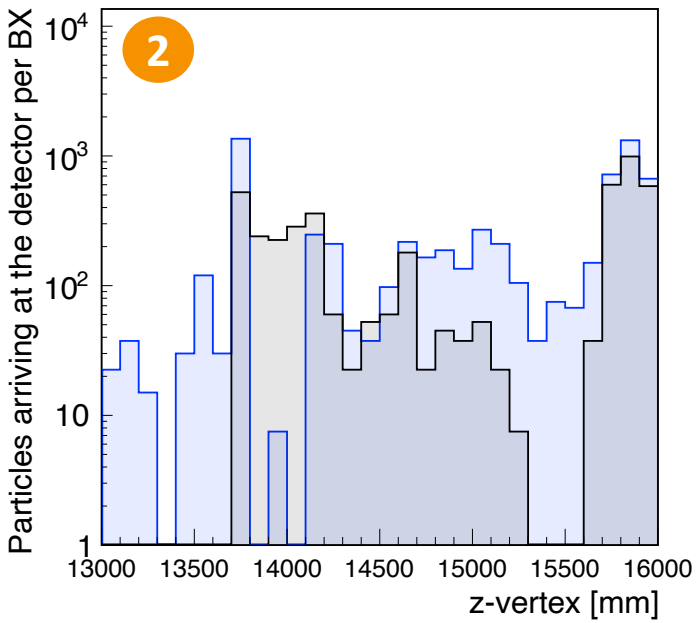

LUXE-NPOD (work in progress)
magnet, L_V=1m, L_D=50cm, , B=0
Photons
Neutrons
Particles arriving at the detector per BX
Energy [GeV]

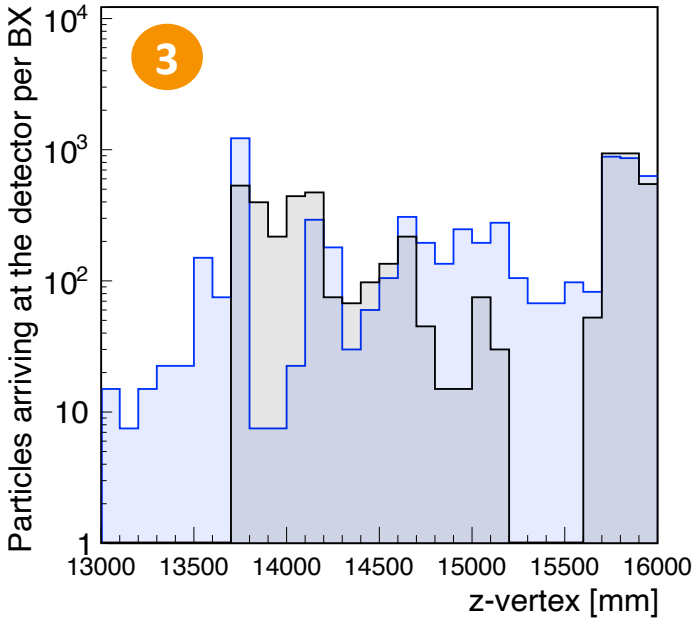

LUXE-NPOD (work in progress)
BSM=calice
Photons
Neutrons
Particles arriving at the detector per BX
Energy [GeV]

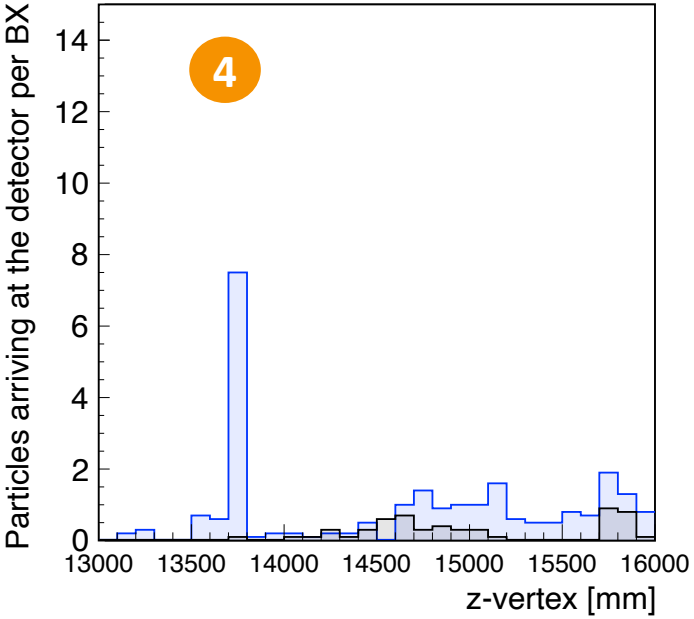
z-vertex


dump
det
z
13705 mm
14705 mm
15705 mm

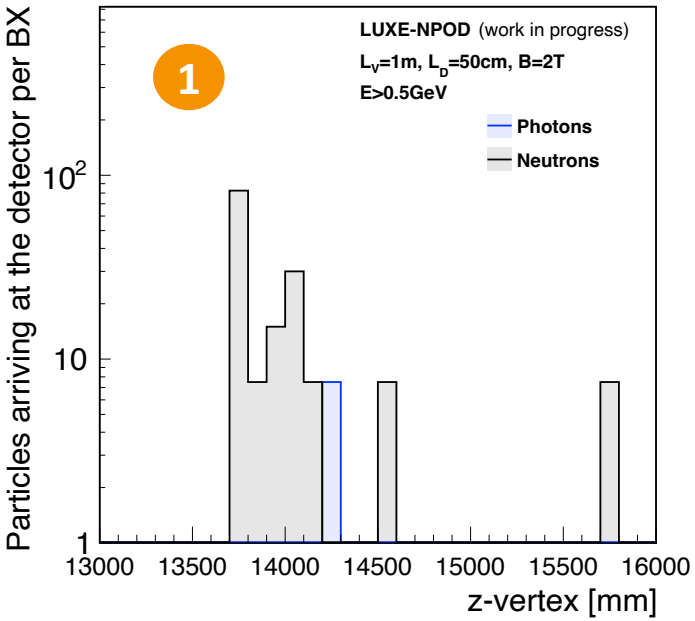

1
Photons
Neutrons
Particles arriving at the detector per BX
z-vertex [mm]

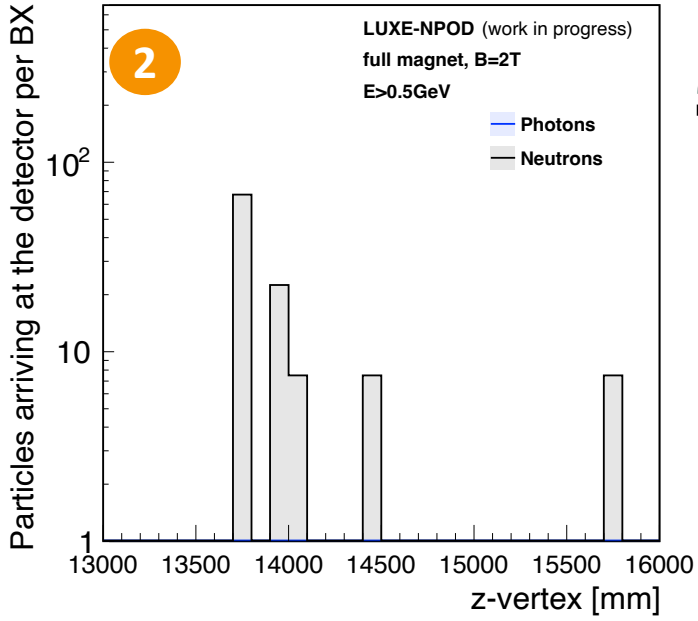

2
Particles arriving at the detector per BX
z-vertex [mm]

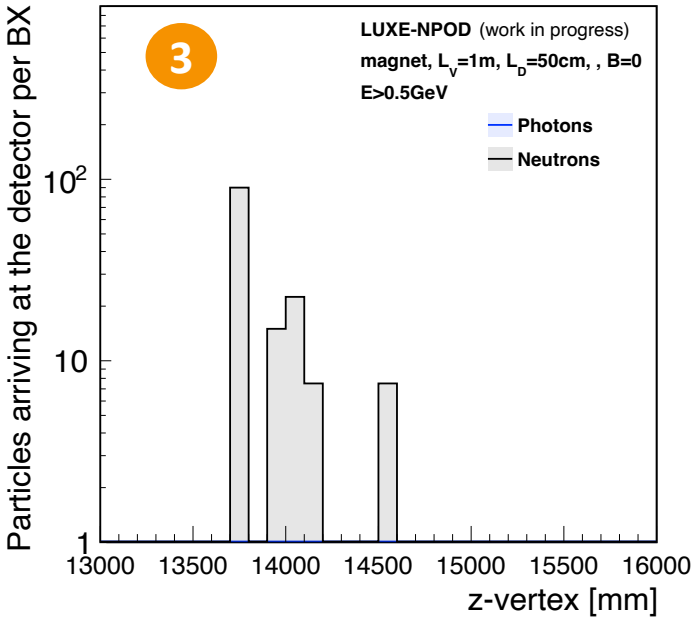

3
Particles arriving at the detector per BX
z-vertex [mm]

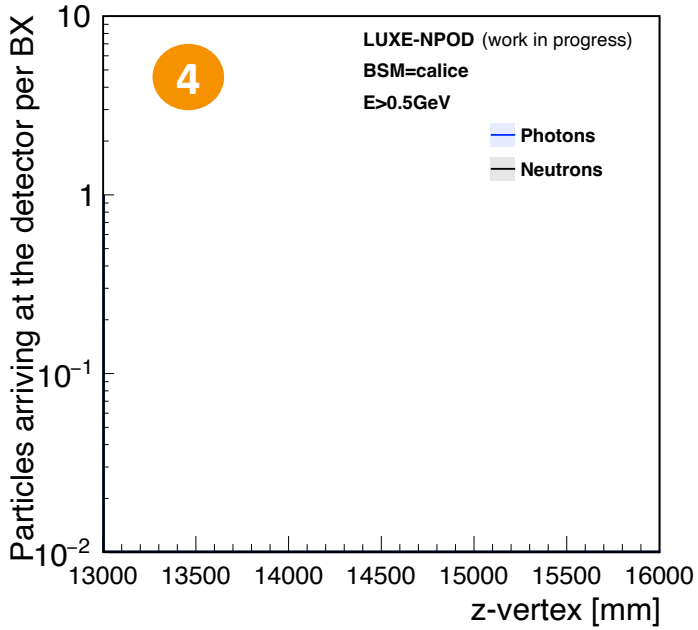

4
Particles arriving at the detector per BX
z-vertex [mm]

z-vertex (E>0.5 GeV)

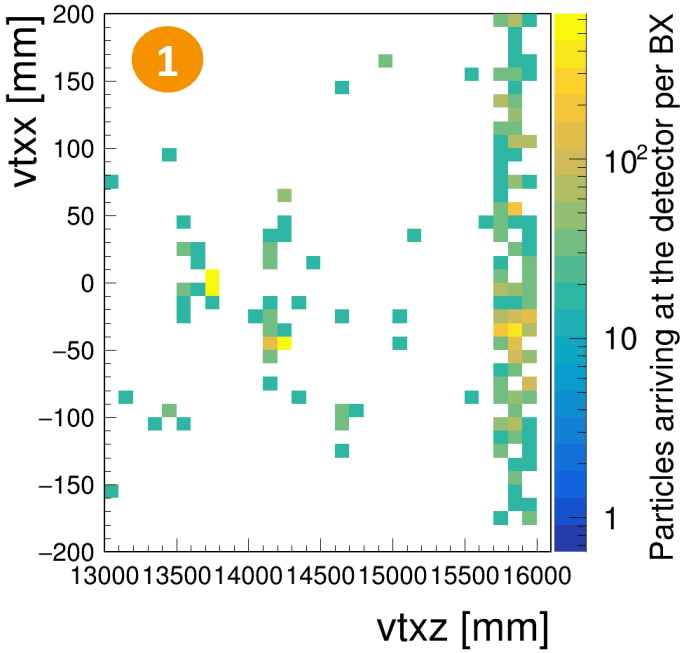


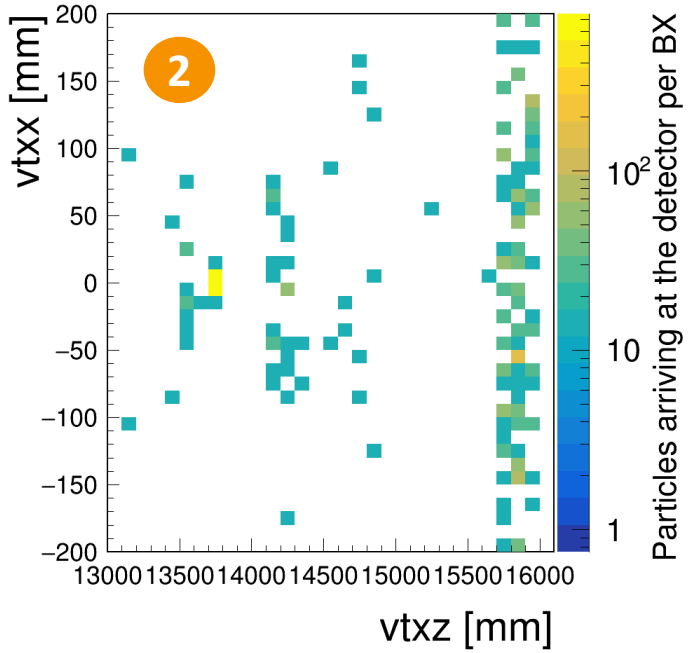


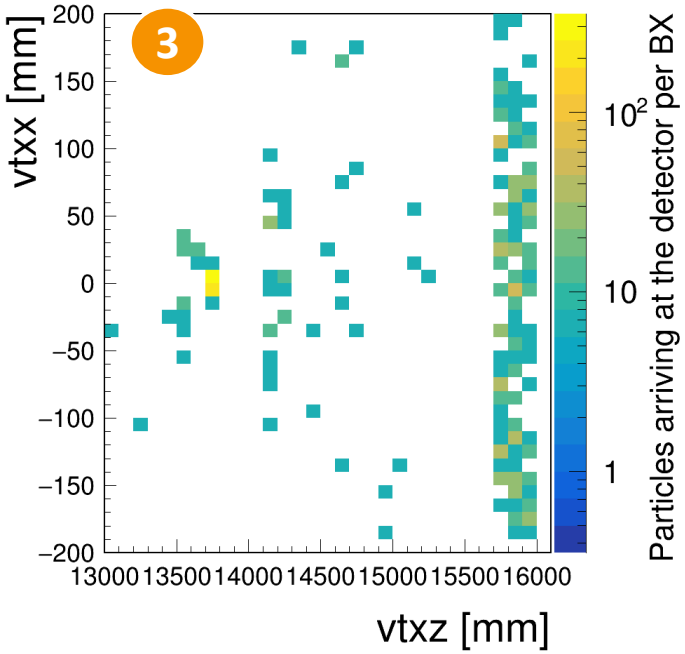


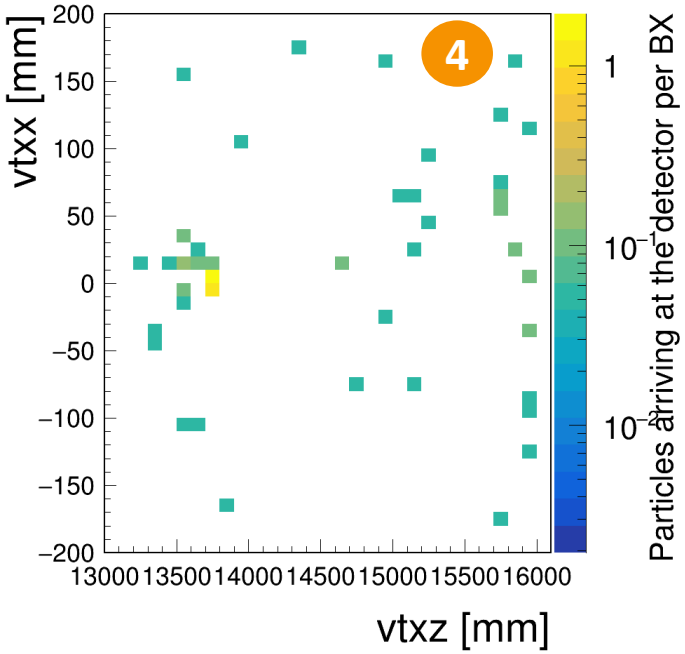


Photons: vtxx vs. vtxz

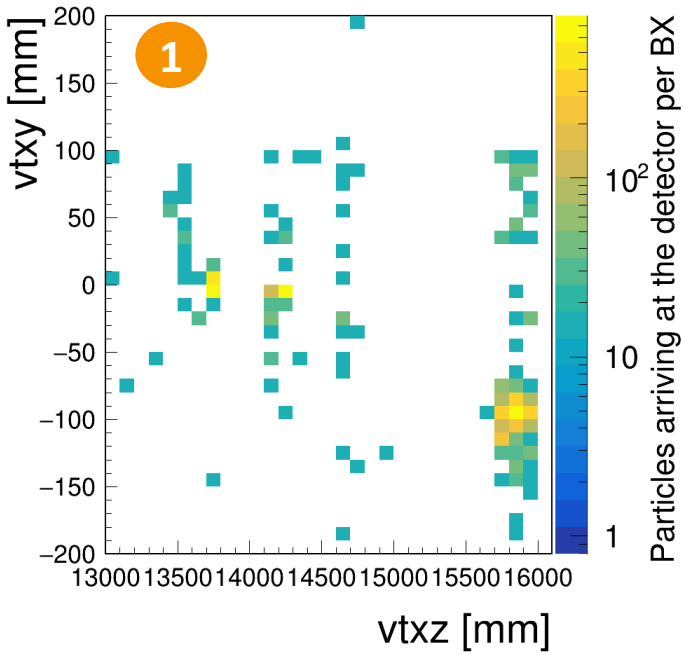


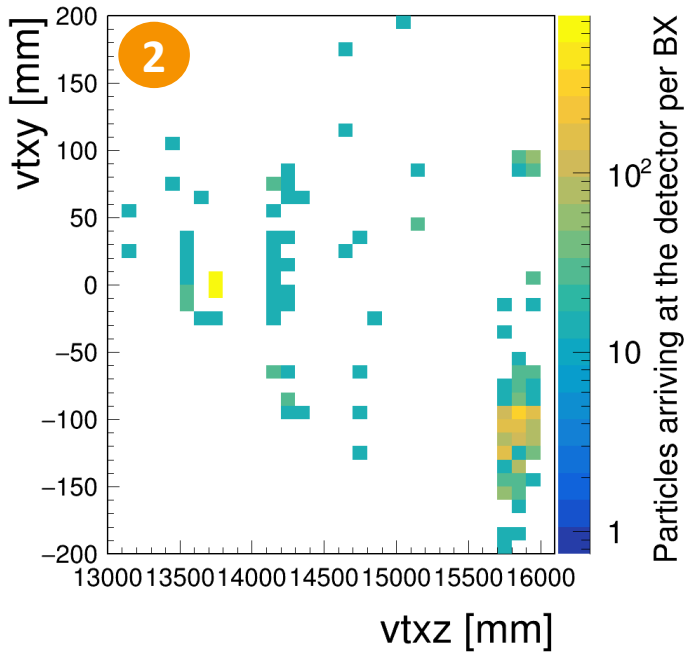


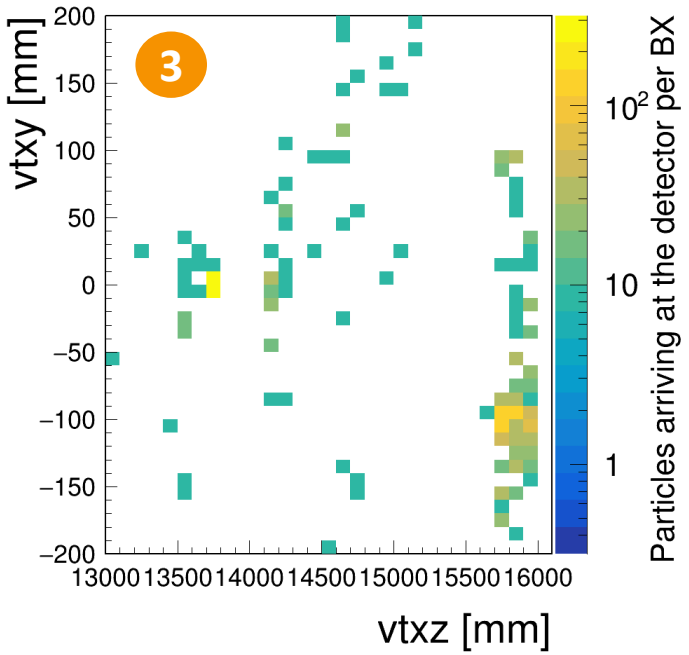


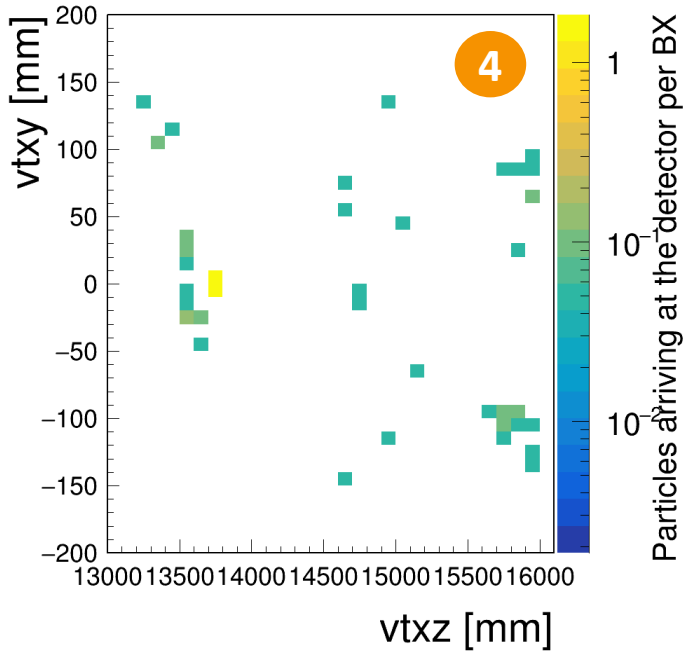


Photons: vtxy vs. vtxz

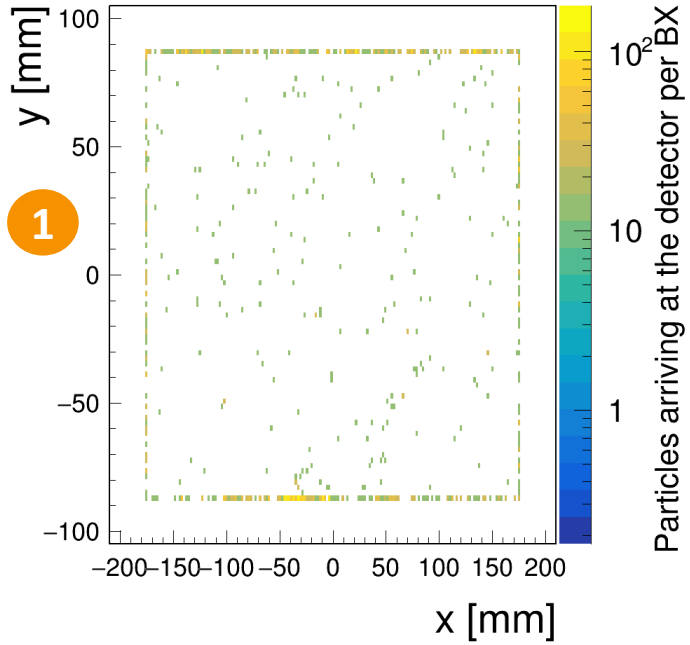


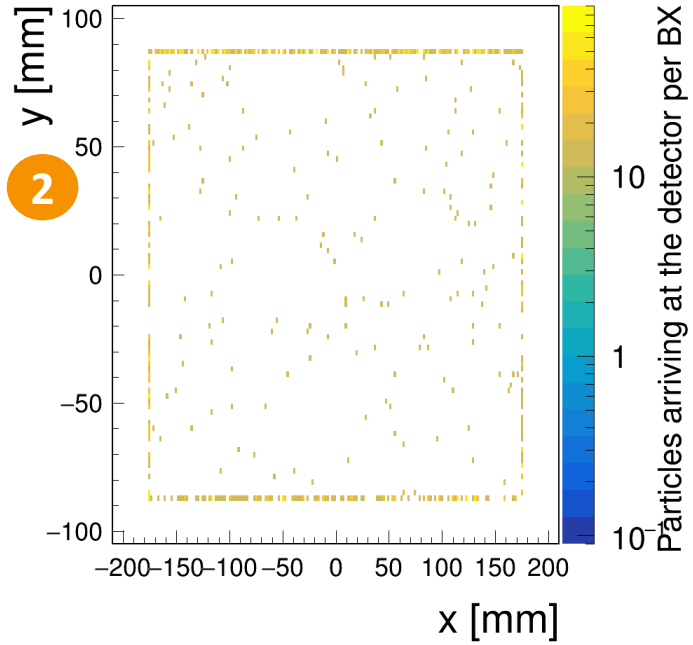


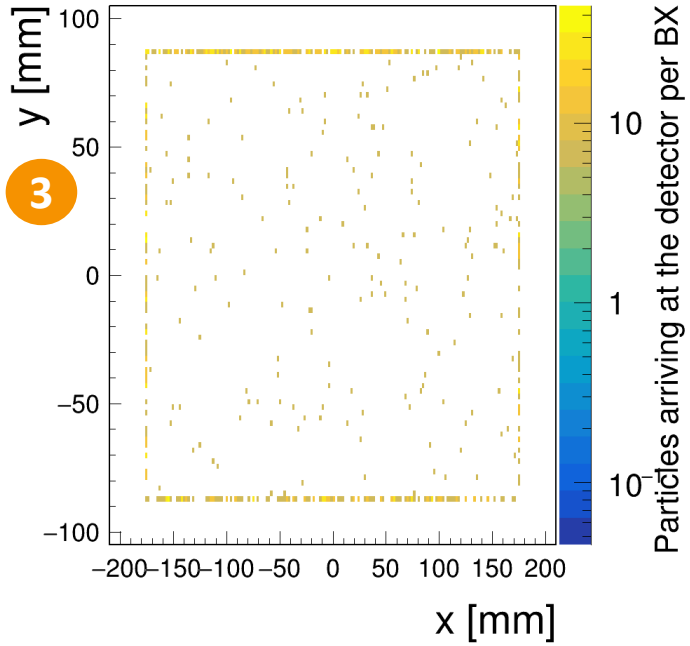


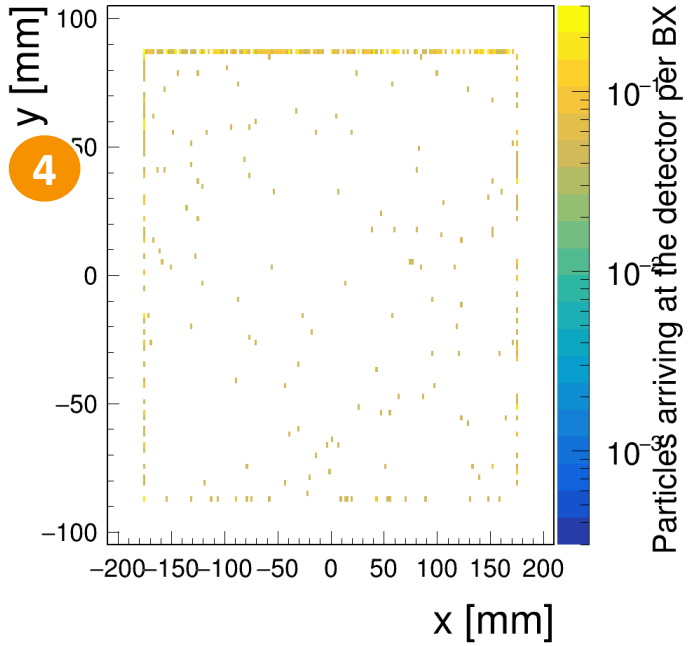


Photons (background) x vs. y

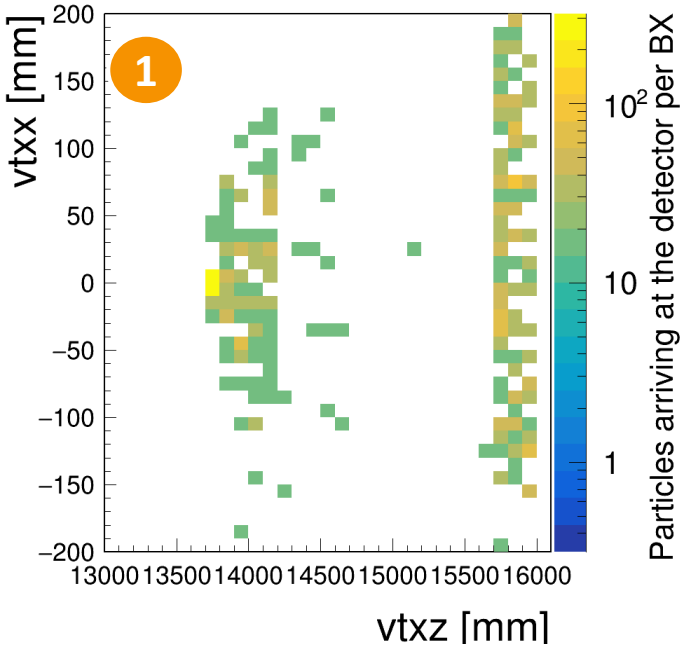


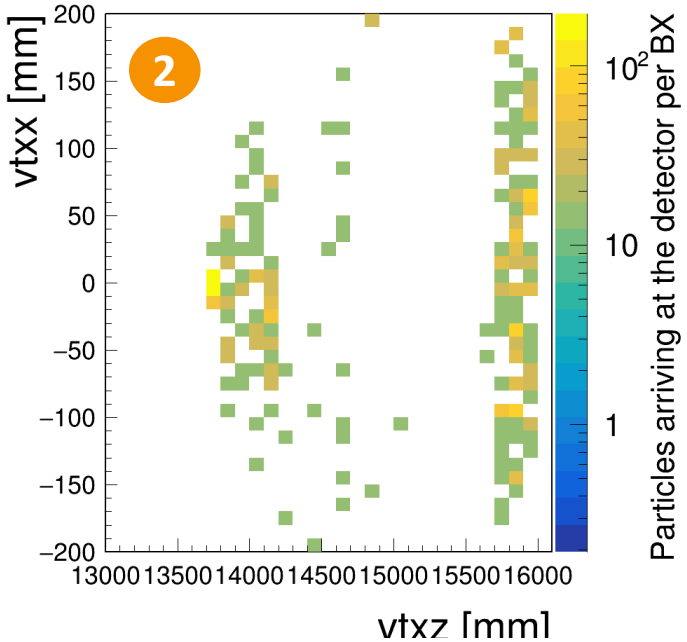


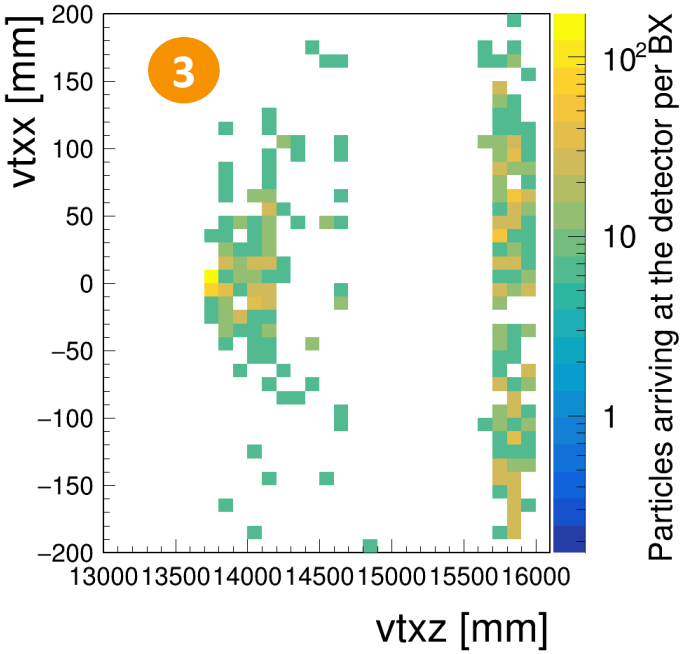


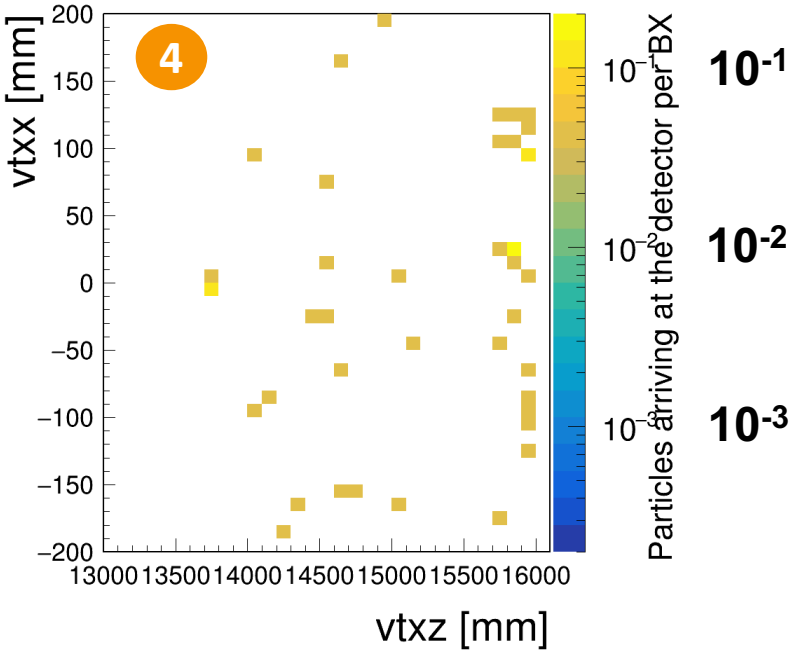


Neutrons: vtxx vs. vtxz

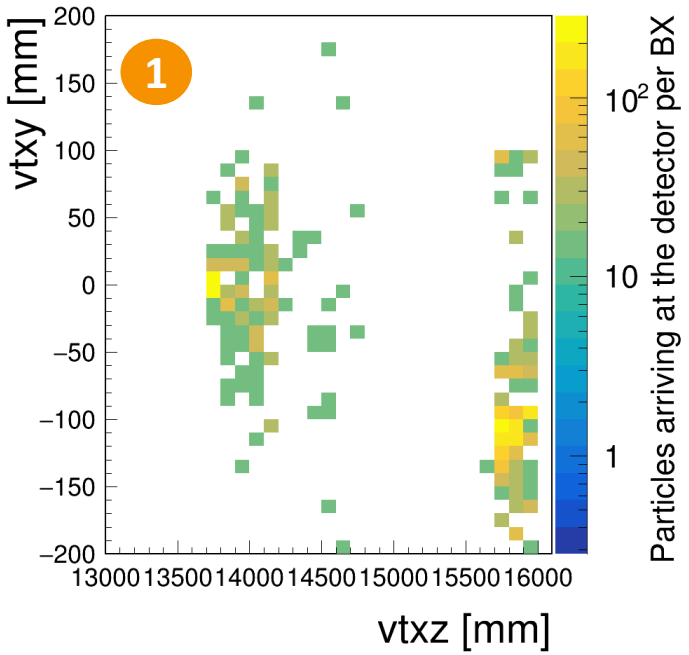


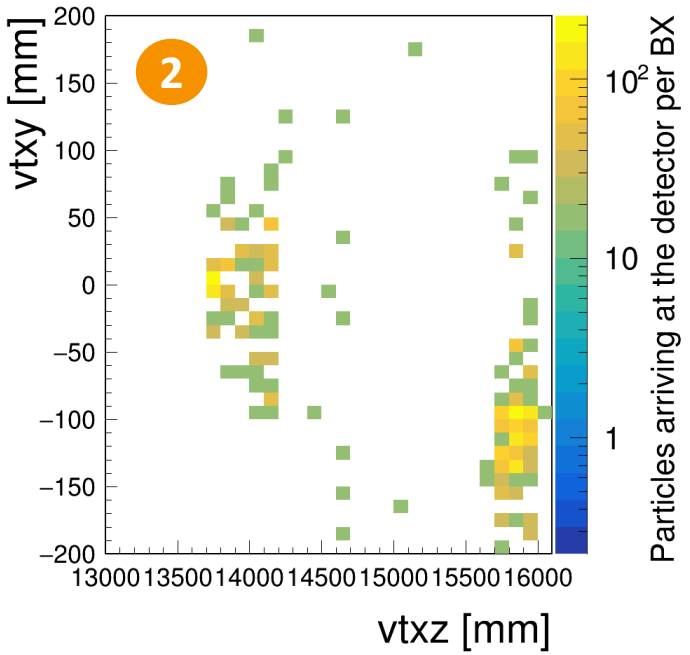


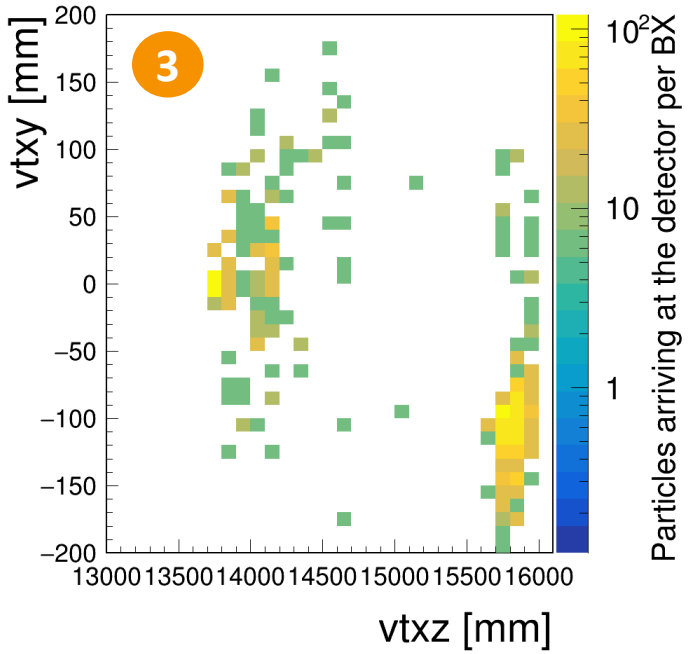


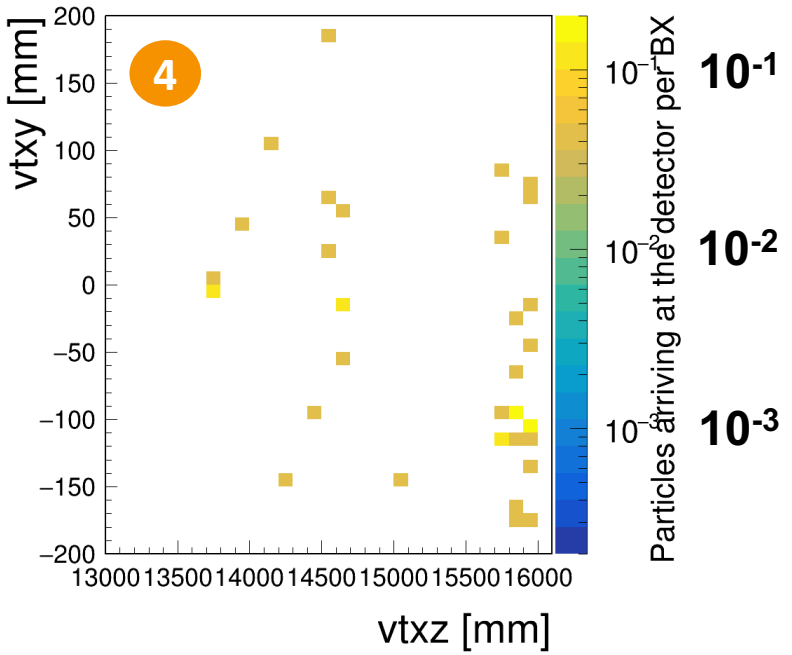


Neutrons: vtxy vs. vtxz

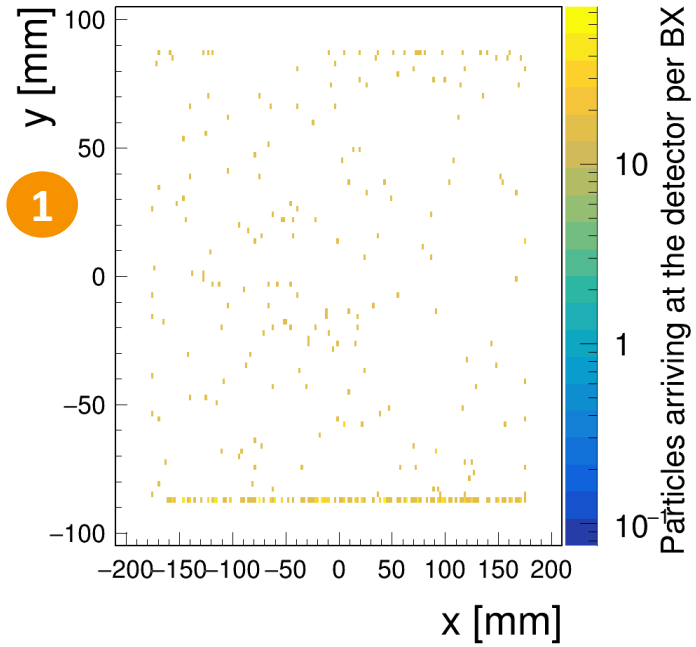


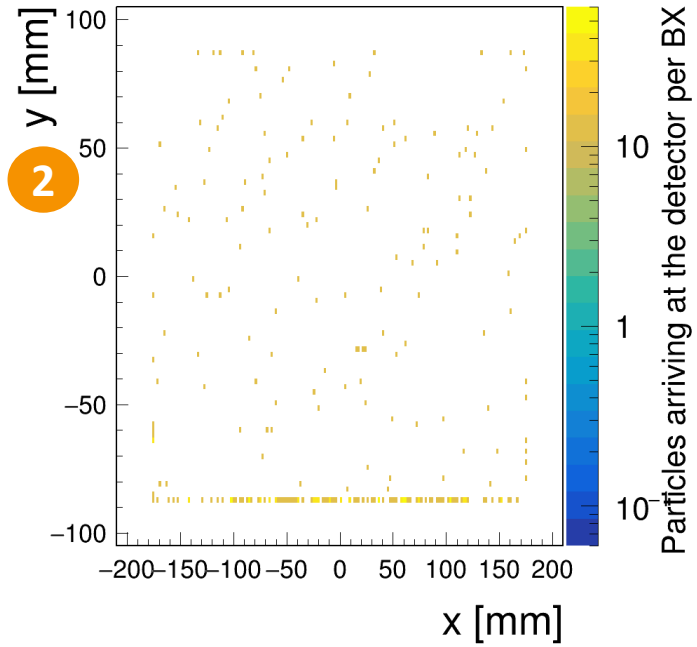


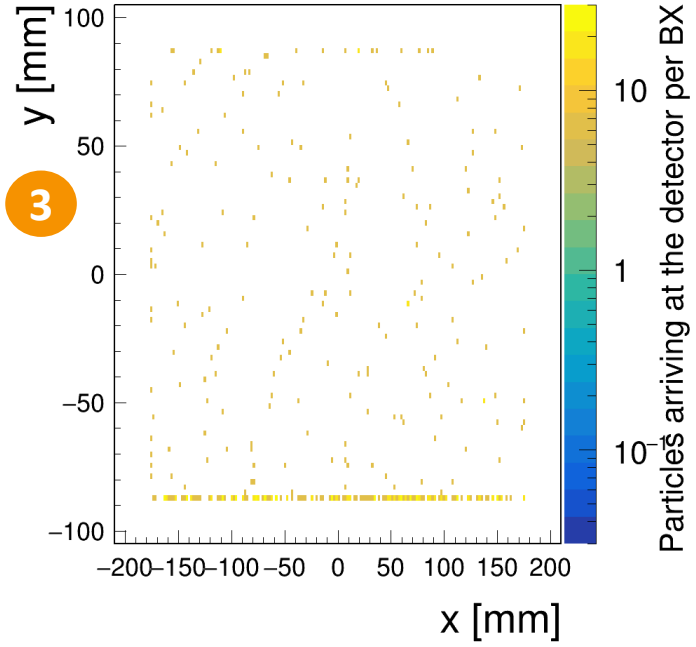


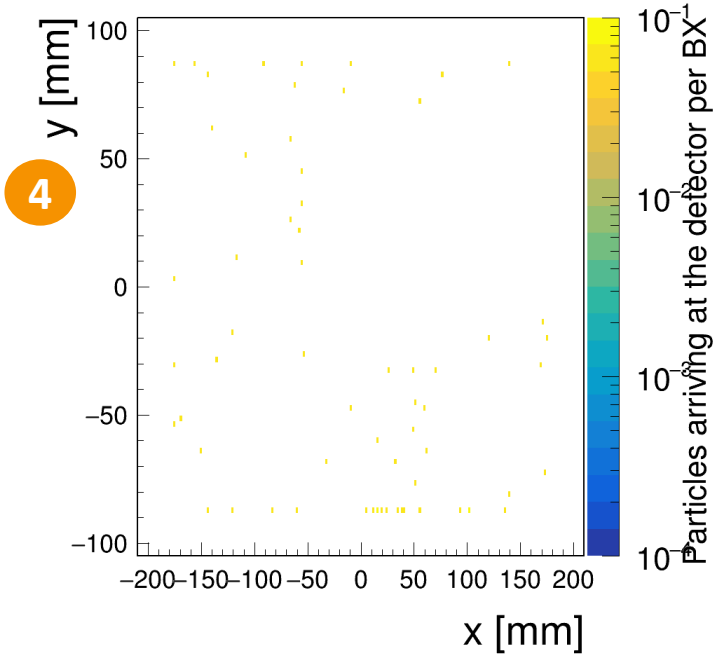


Neutrons: x vs. y









10^{-1}

10^{-2}

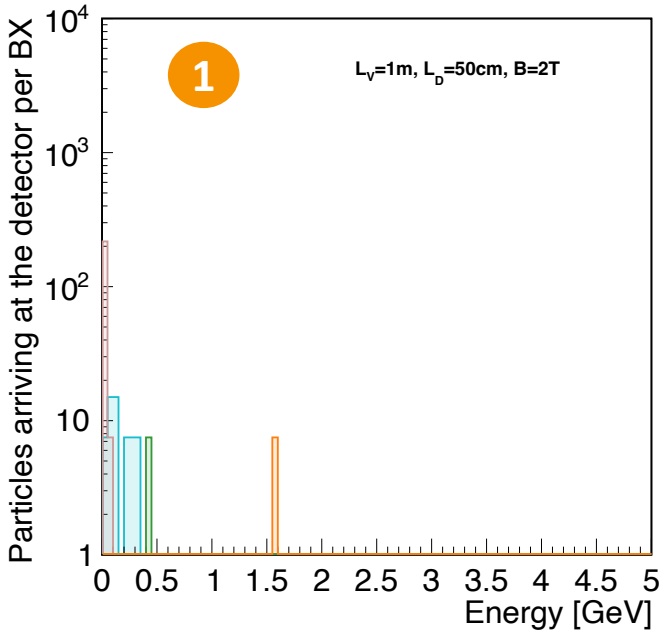
10^{-3}

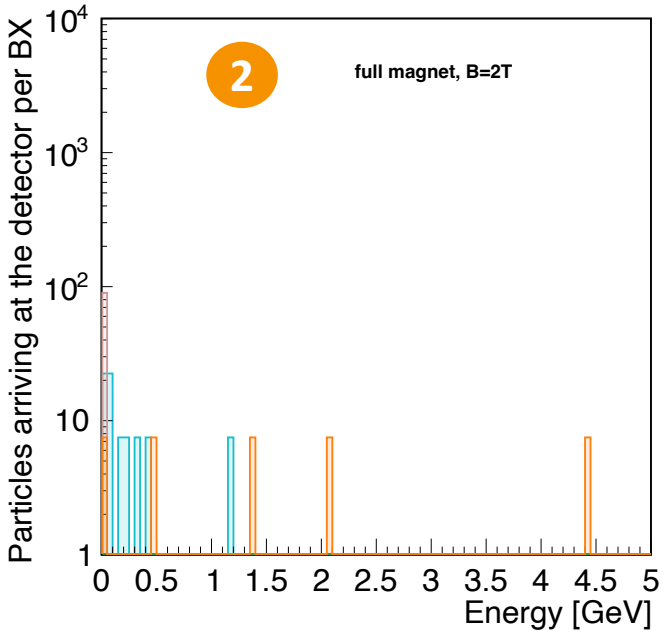
Other particles

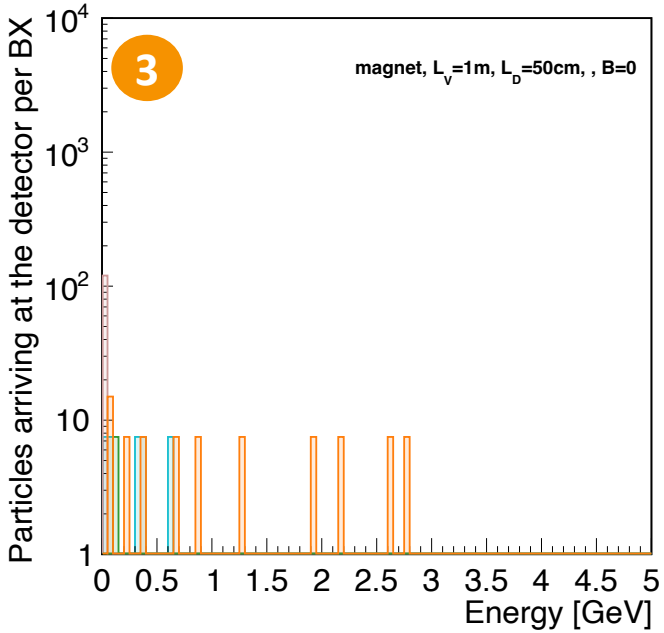
Energy

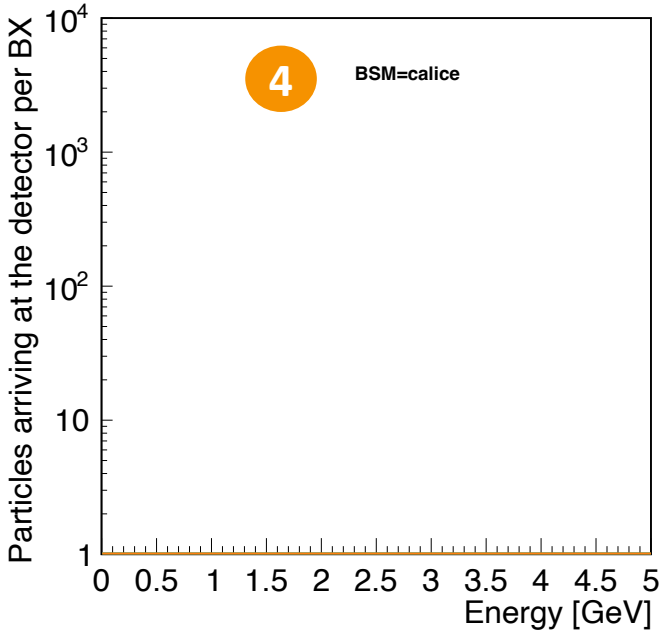
p, $\bar{p}$ e^+, e^-

μ^+, μ^- π^+, π^-





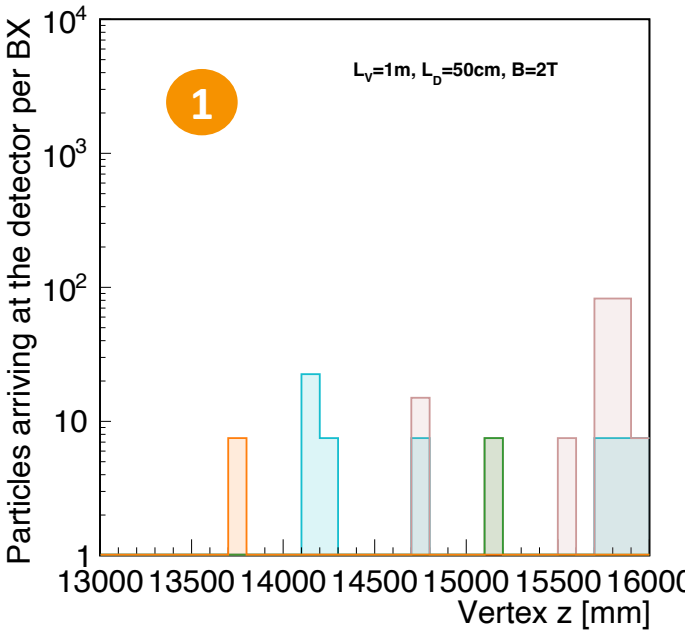


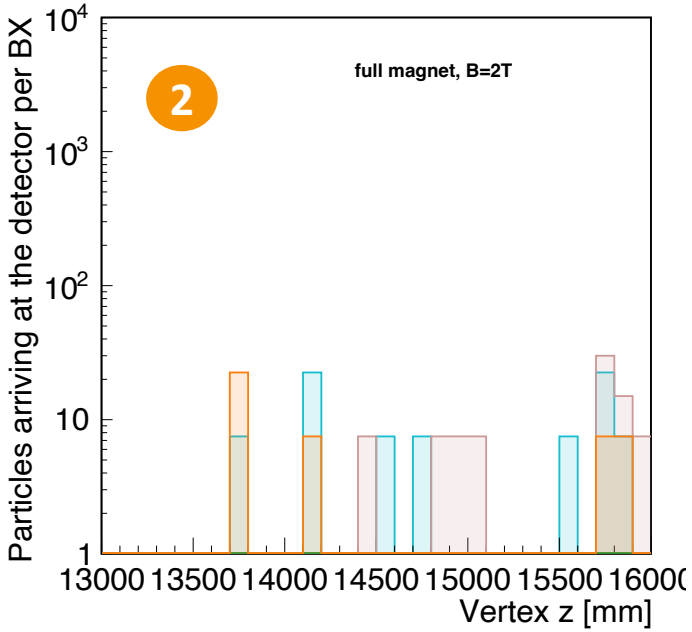


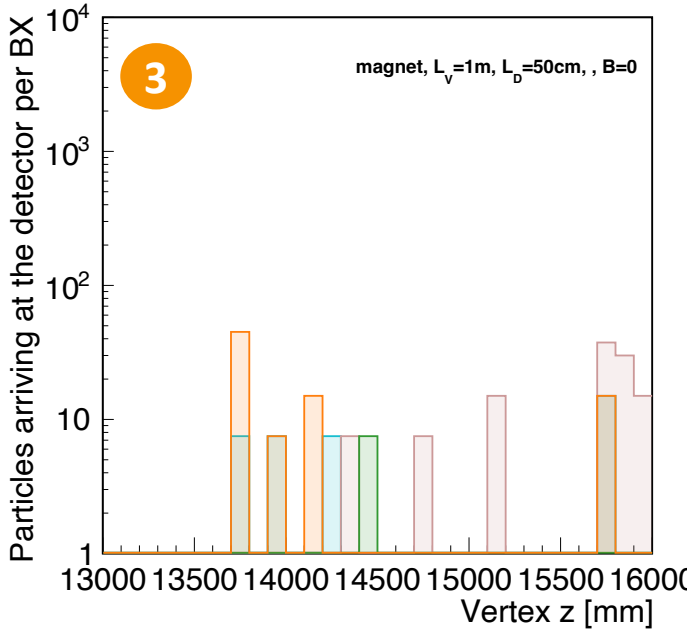
z-vertex

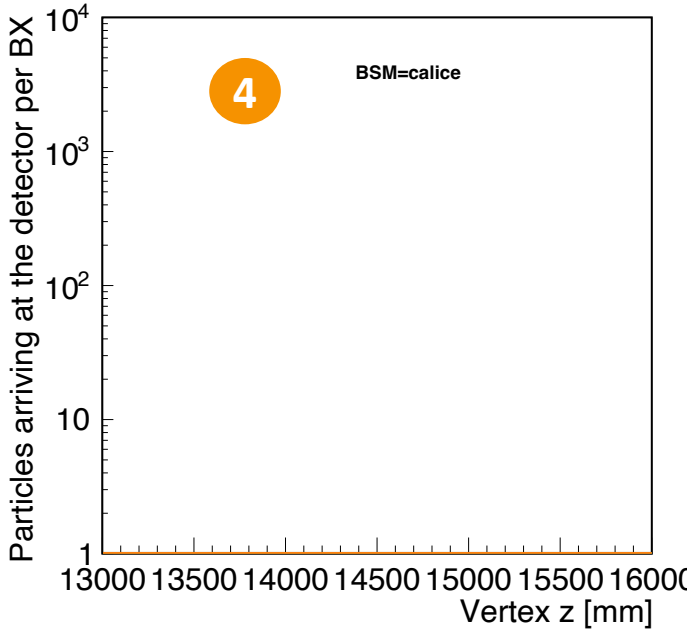
p, $\bar{p}$ e^+, e^-

μ^+, μ^- π^+, π^-









Number of particles above 0.5 GeV

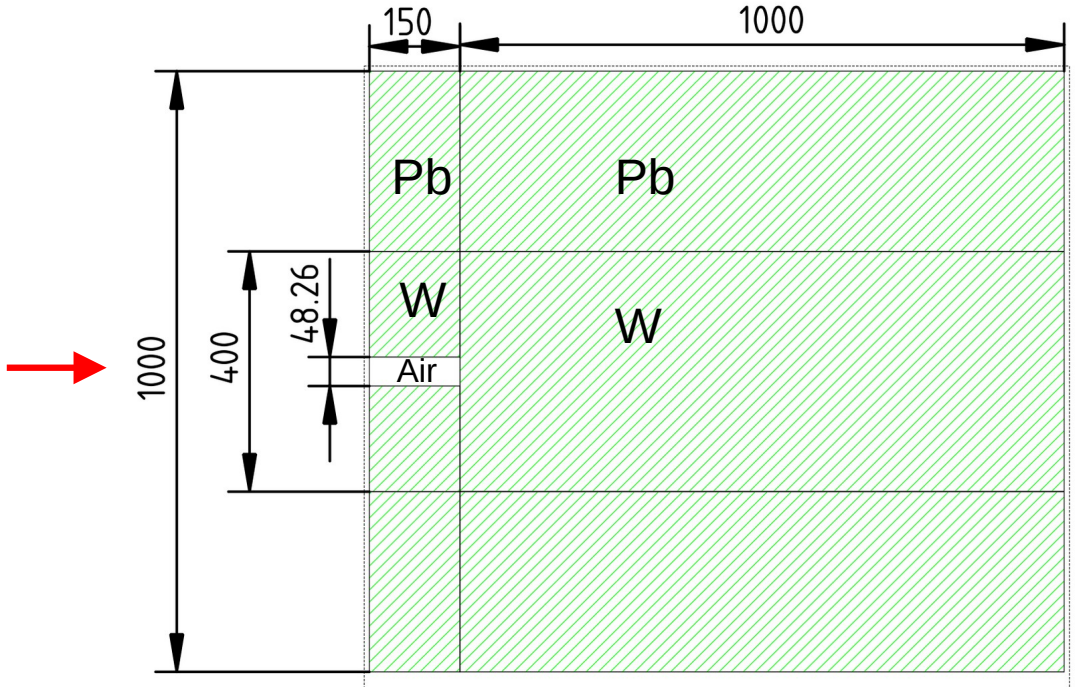
	1	2	3	4
Neutrons	157.5	112.5	142.5	0
Photons	7.5	0	0	0
Charged	7.5	30	60	0

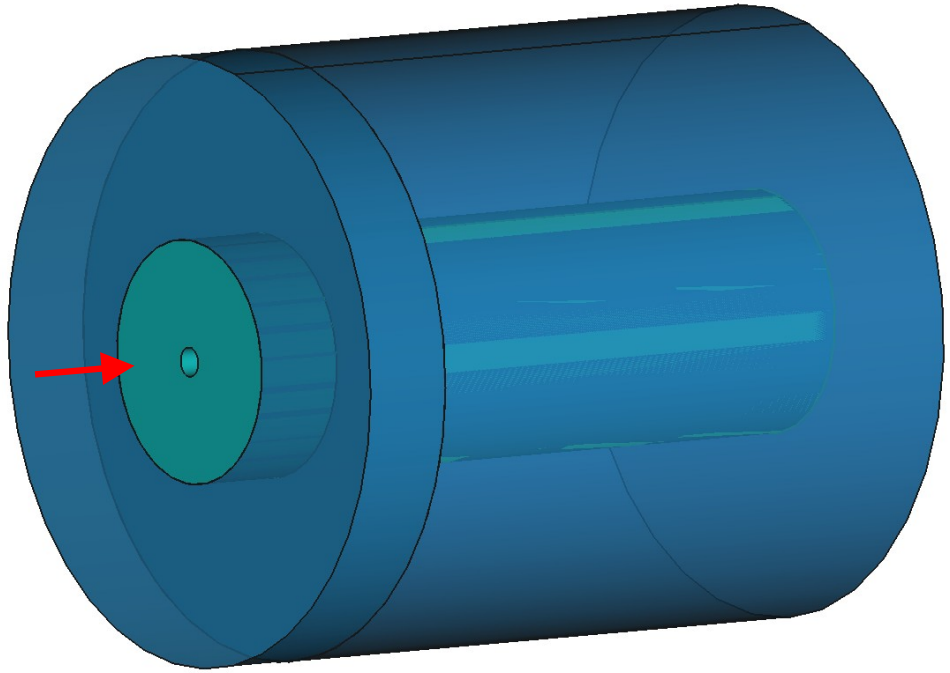
Comments

- The double dump design (W+Pb) supresses more the background coming from neutrons and photons
- No significant background coming from charged particles. It can be handled with a magnet
- In the magnetised dump configuration, there is a significant difference on the number of photons on (1) vs (3) above 0.5 GeV. The photons seen in (1) are barely above 0.5 GeV, and originate before the magnetic field begins. Could be verified with more statistics

Backup

Present implementation of the beam dump

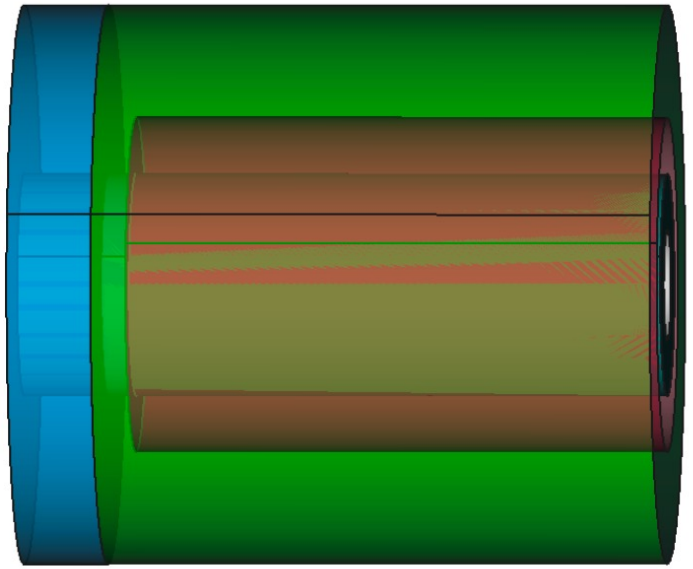


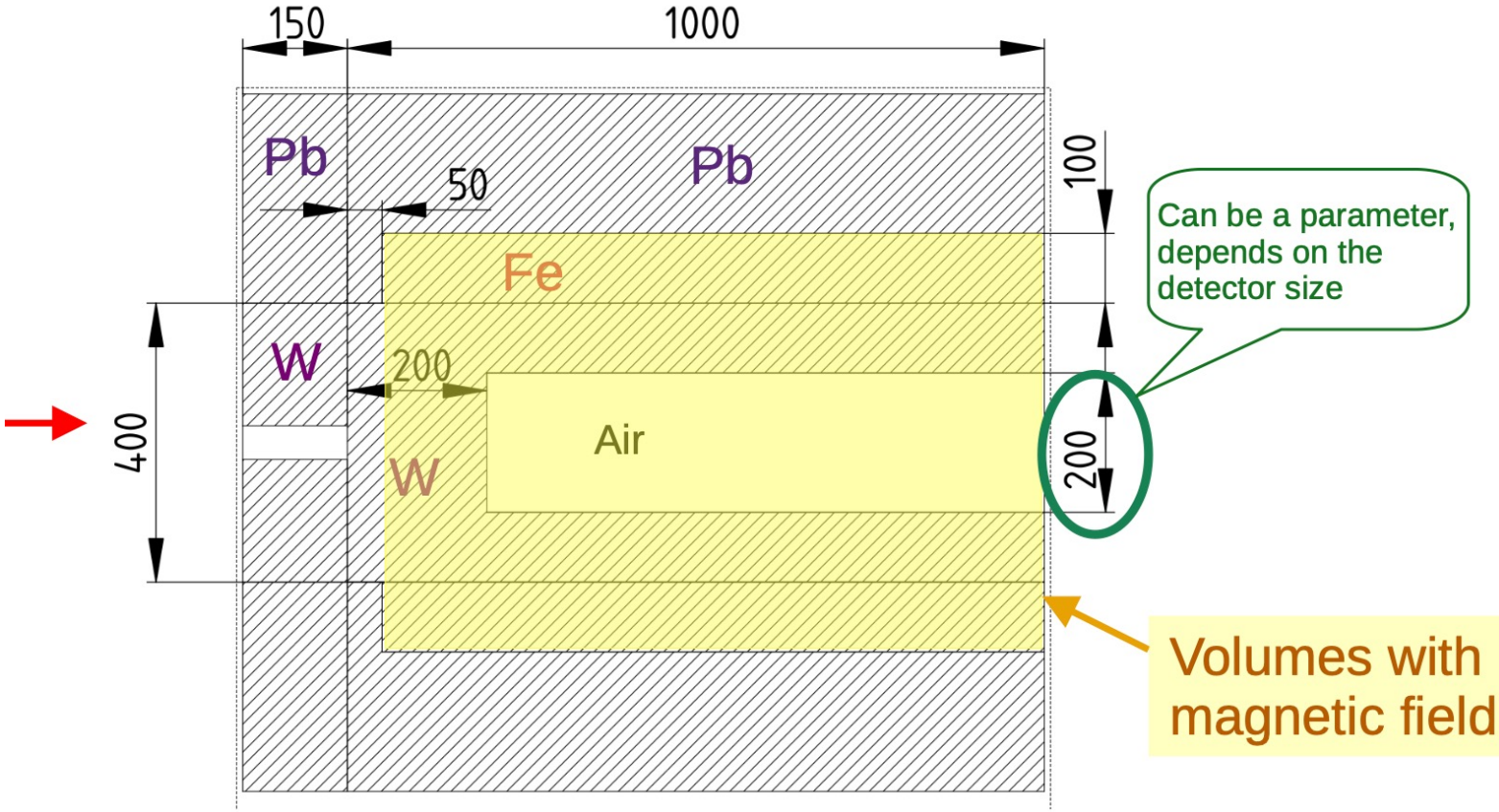


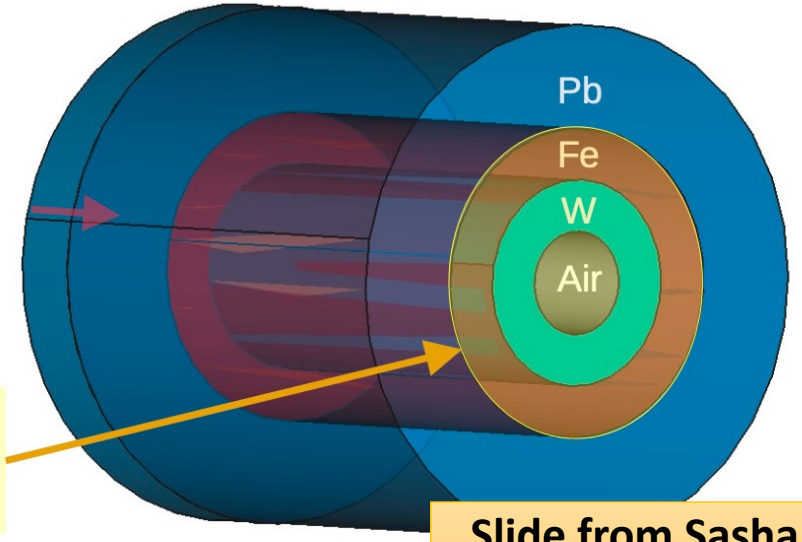
Slide from Sasha

Beam dump with magnetic field

- The Iron cylinder is supposed to be magnetized and serves as a source of the uniform dipole field, with By = 1.5T, cannot be more, probably should be less.
- Its thickness is not well clear, it should be small, but sufficient to create the field in the tungsten. So 100 mm here is just a guess.



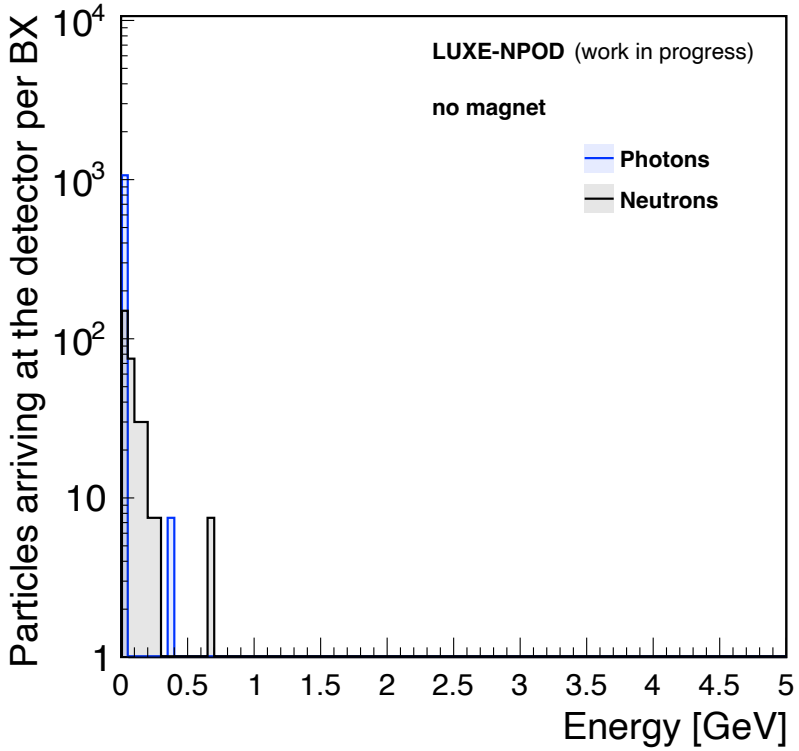


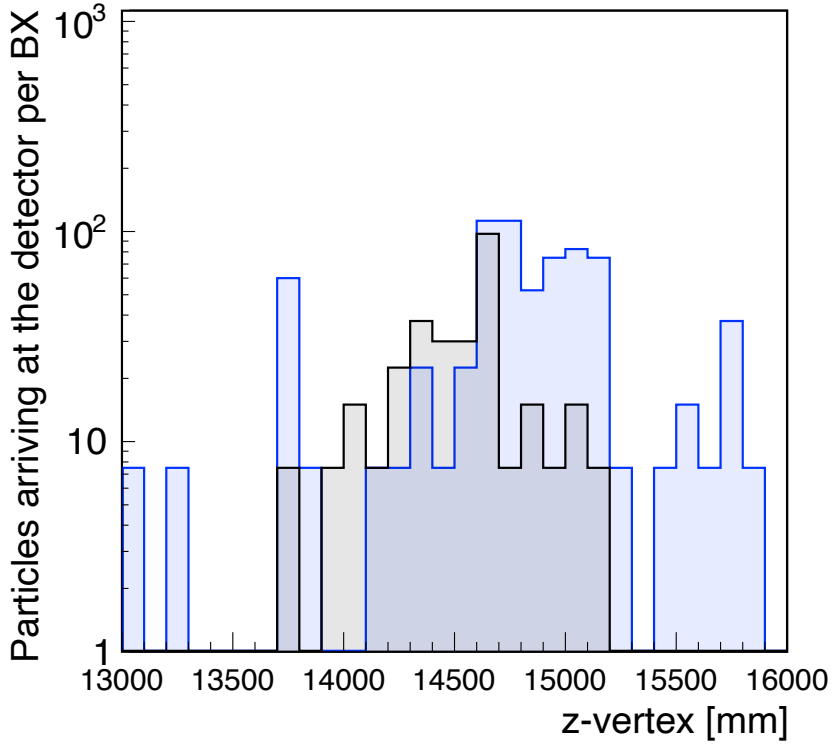


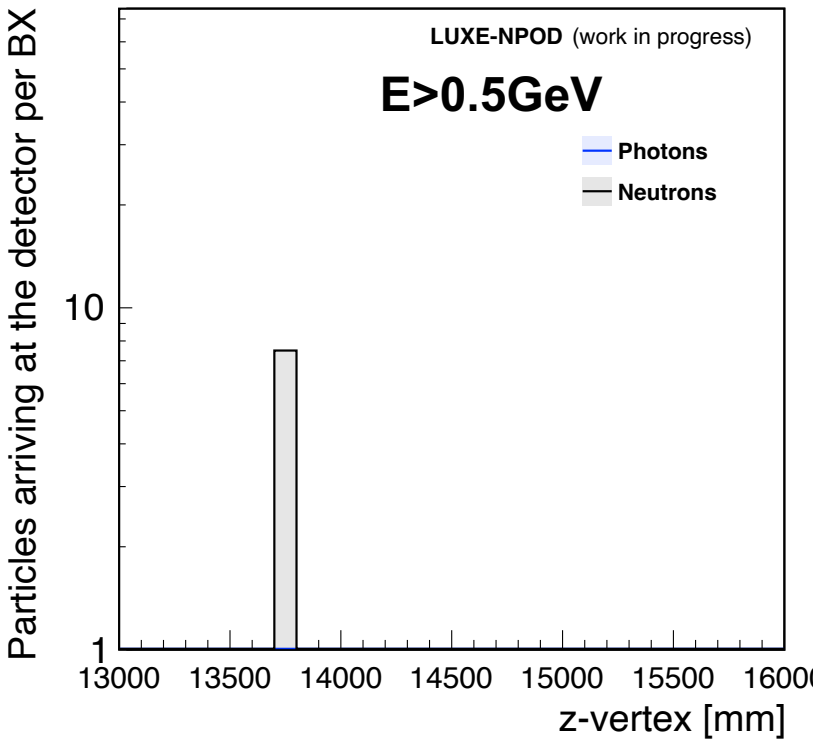
Slide from Sasha

Previous results - no magnet
G4 with BSM detector with R=1m

No magnet (previous results, 2BXs)

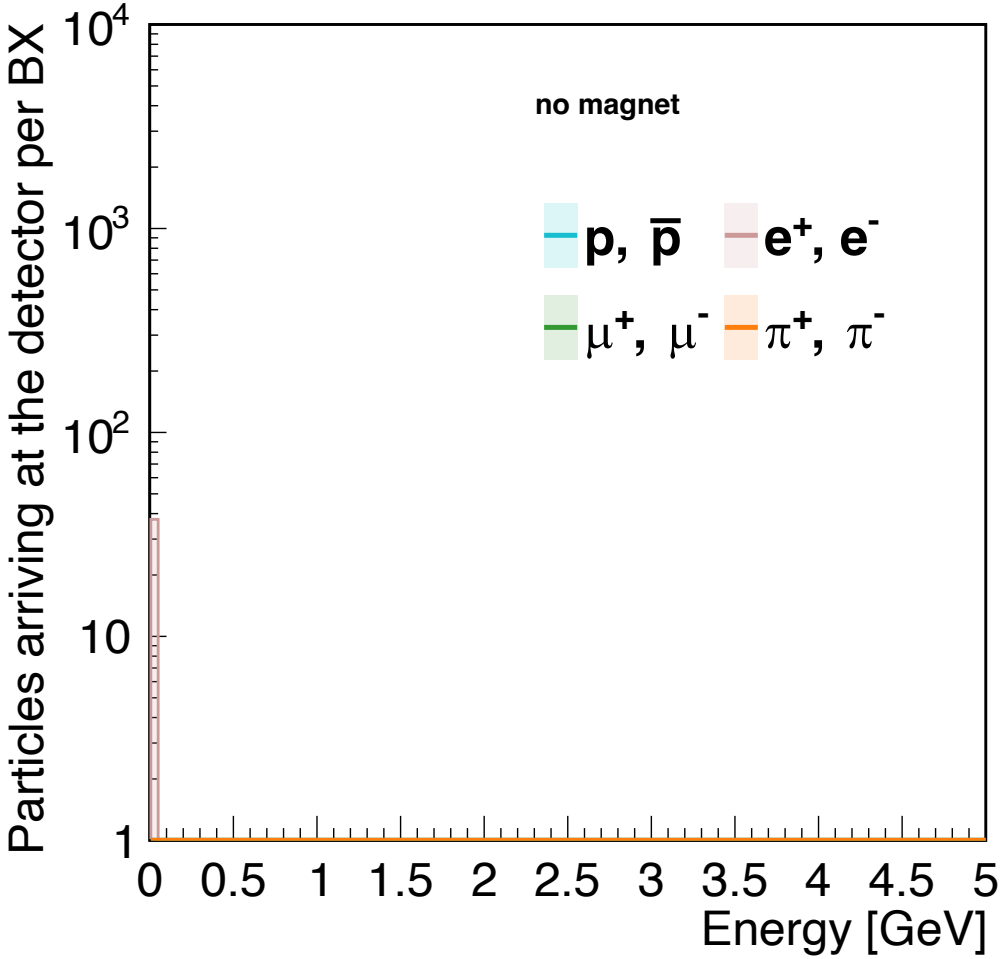






X-Y cut with calice ecal geometry

No magnet (previous results, 2BXs)



X-Y cut with calice ecal geometry