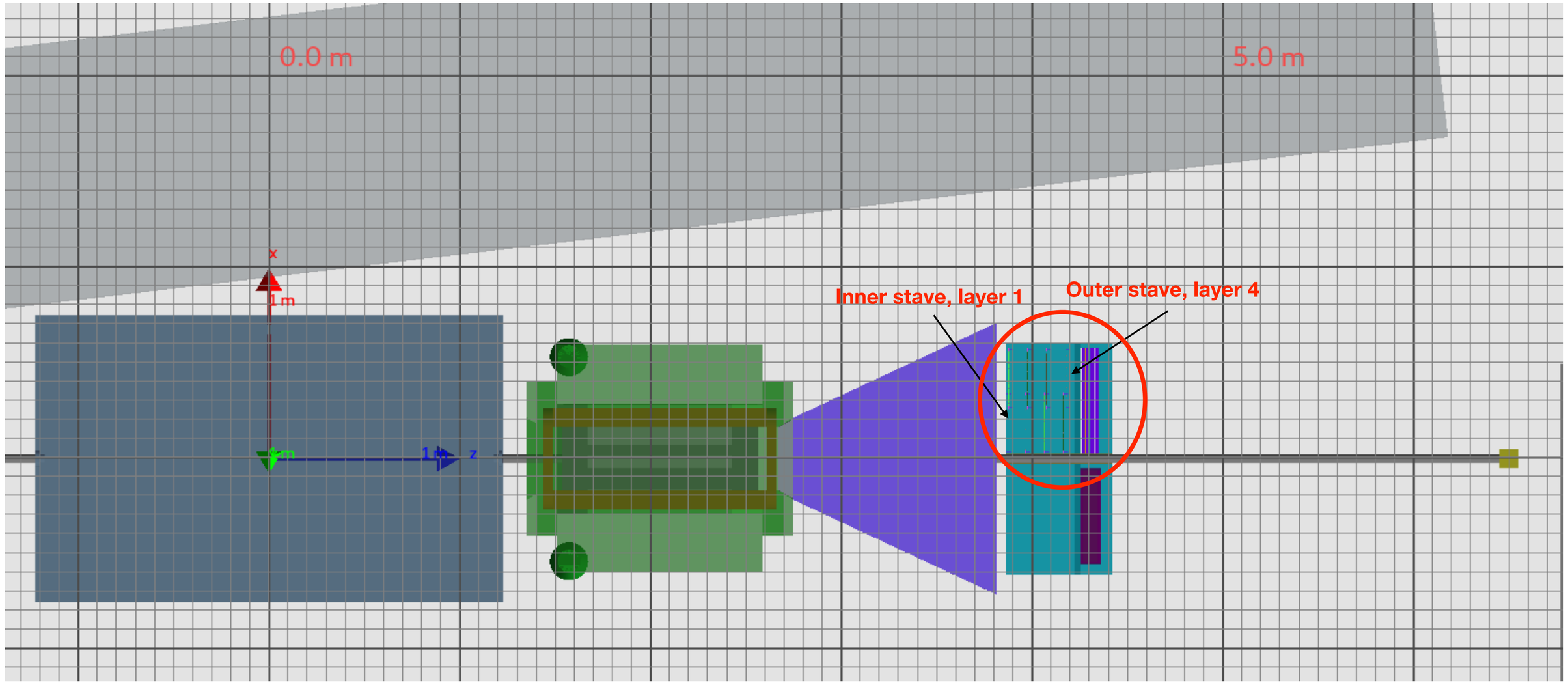
Origin of the background particles in the Tracker Subsystem

LUXE Simulation Meeting

Arka Santra, November 10, 2020
Weizmann Institute of Science,
Rehovot, Israel

The subsystems near the IP

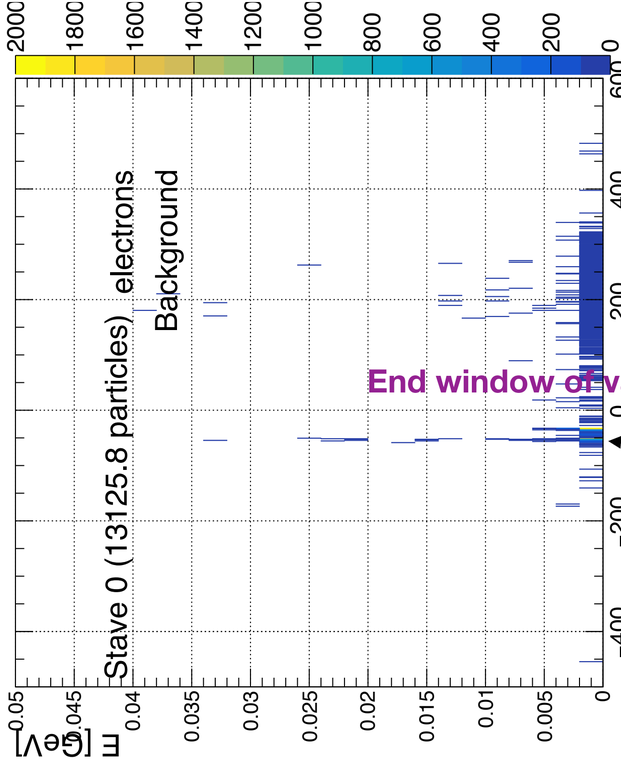


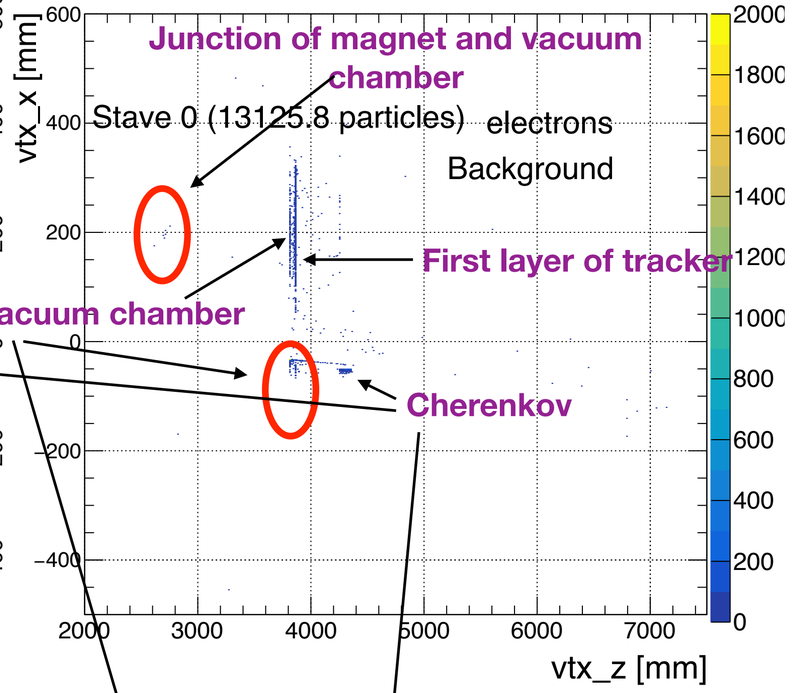
Plots from Sasha

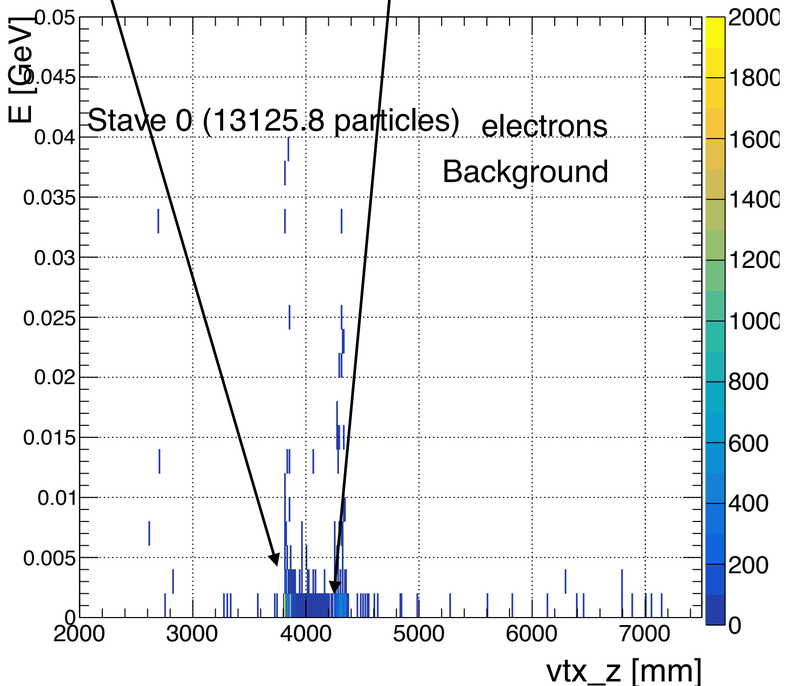
- e+laser hics setup
  - JETI 40 laser.
  - Spotsize w0 3000 nm.
  - Samples produced by Sasha.
  - Looked at the background particles:
    - electrons and gamma
  - Plots from the tracks intersecting the tracker plane (not necessarily making a hit in the tracker).

Electrons in Inner Stave, first layer of tracker

- Most of the electrons are coming from the vacuum chamber end window where the beam crosses it.
- Cherenkov also contributes.
- Some of them are from the end window of the vacuum chamber and also the first layer of the tracker. This is generated by the signal, irreducible but the rate is manageable.
- Energy is very small for most of the background electrons, <5 MeV.

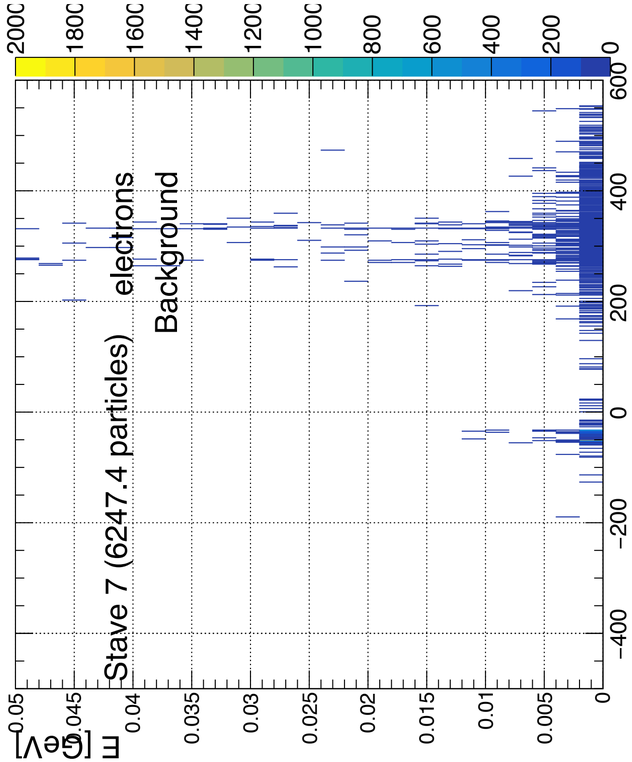


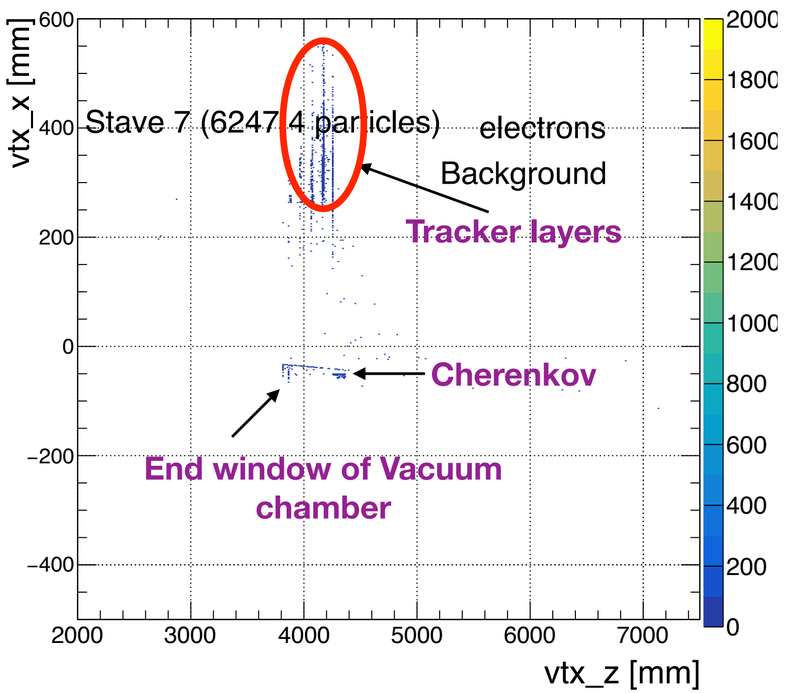


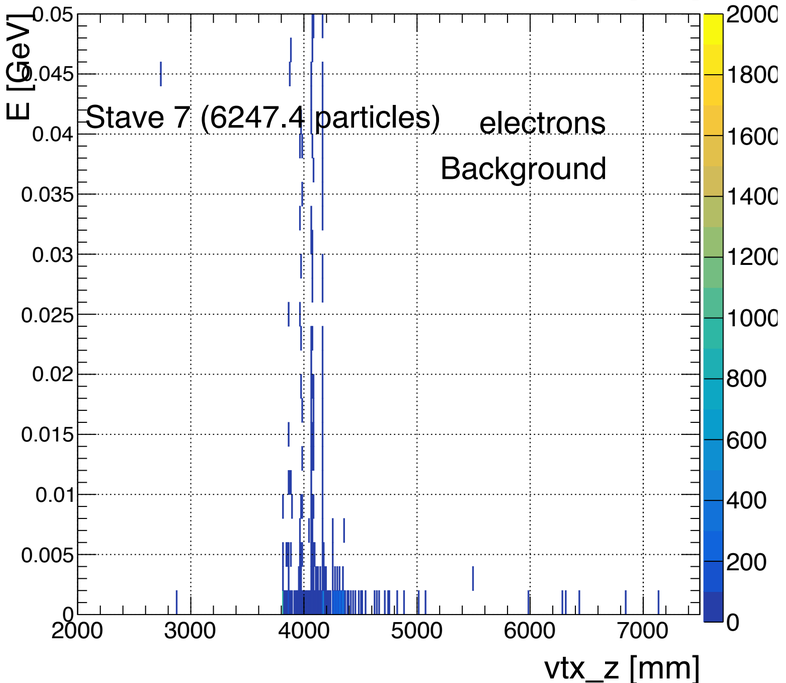


Electrons in Outer Stave, last layer of tracker

- Again the end window of vacuum chamber produces the most background electrons from the point where the beam intersects.
- For the outer stave of last layer, there are electrons coming from other staves. The rate is low but having > 30 MeV energy.
- Energy is very small for most of the background electrons, <5 MeV.

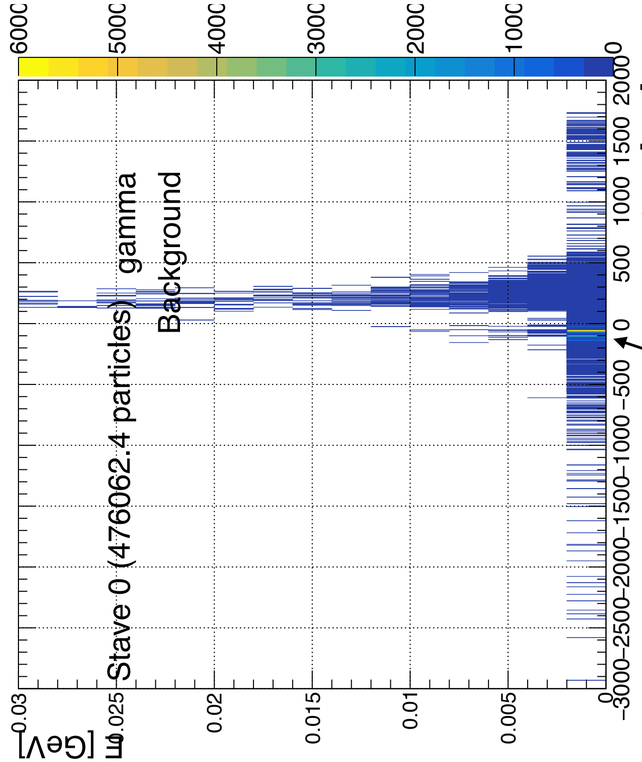


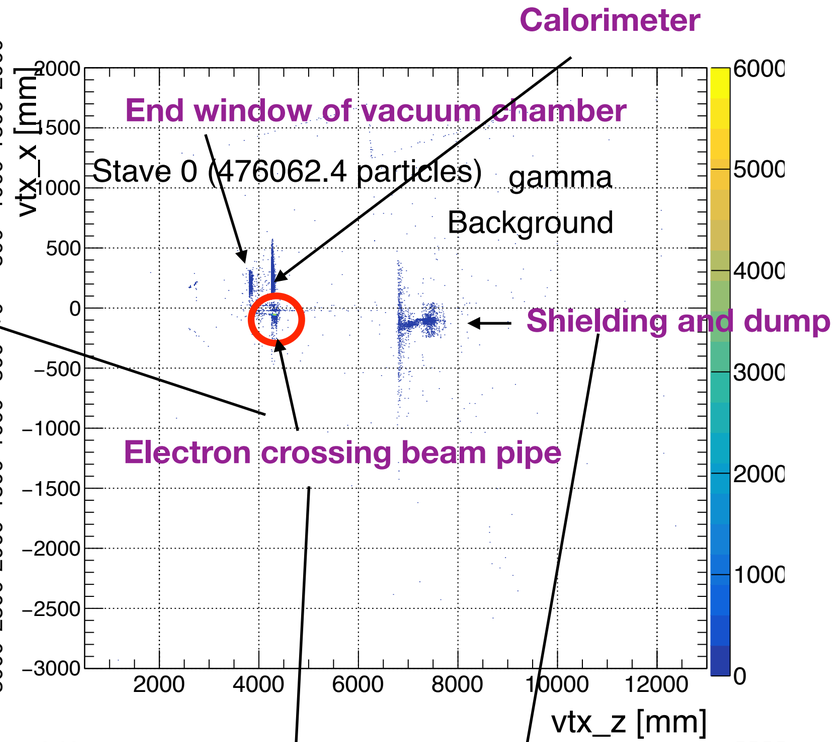


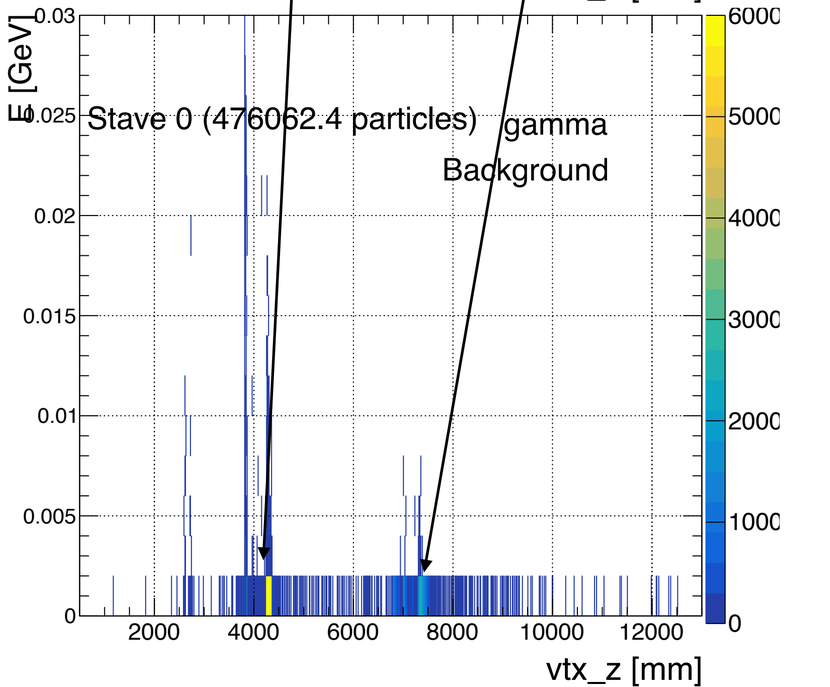


Photons in Inner Stave, first layer of tracker

- Many more sources of photons, as expected.
- Dominant source is where beam crosses the beam pipe. The rate is high but low energy.
- Some of them are from the end window of the vacuum chamber.
- Shielding and dump also contributes.
- Energy is very small for most of the background photons, <2 MeV.

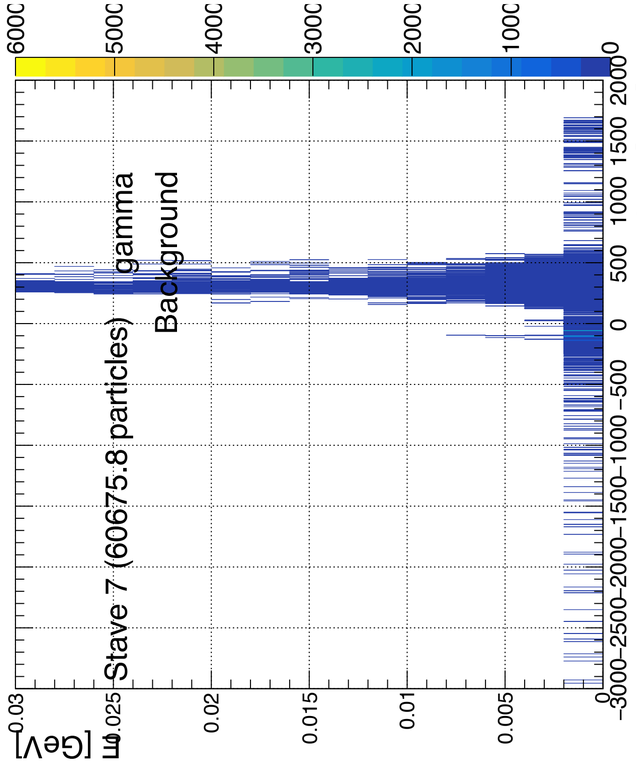


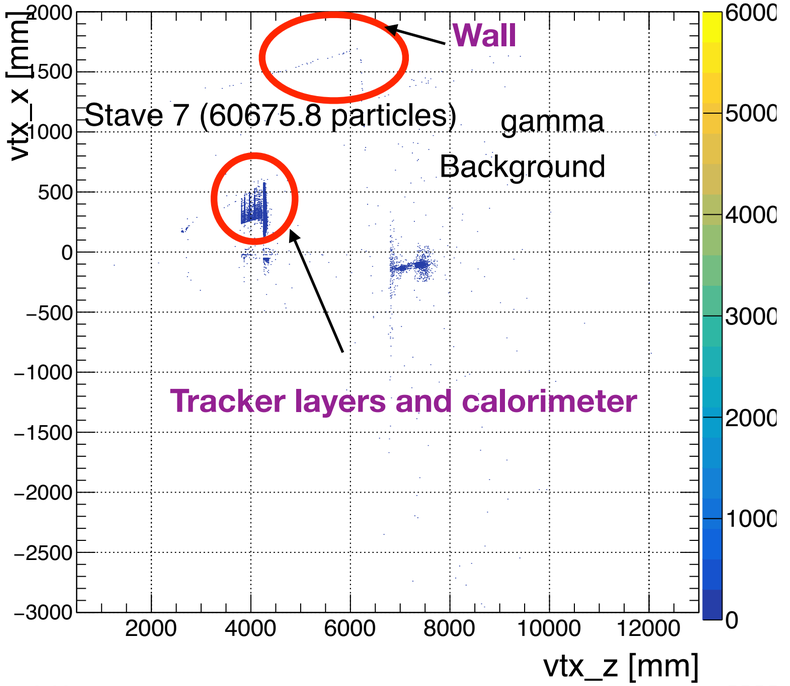


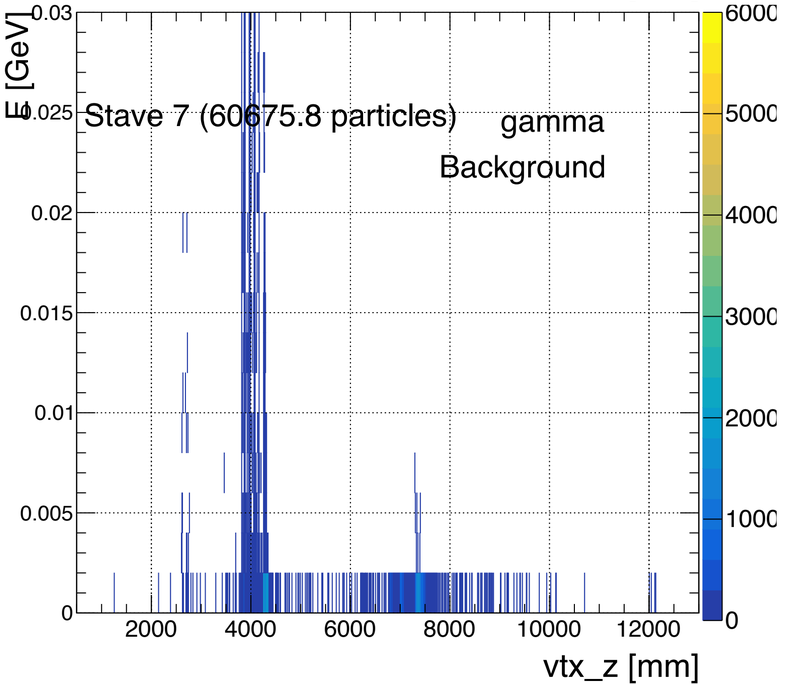


Photons in Outer Stave, last layer of tracker

- Photons from other layers of tracker.
  - E > 30 MeV but the rate is low.
- Some of them are from the end window of the vacuum chamber.
- Energy is very small for most of the background photons, <5 MeV.



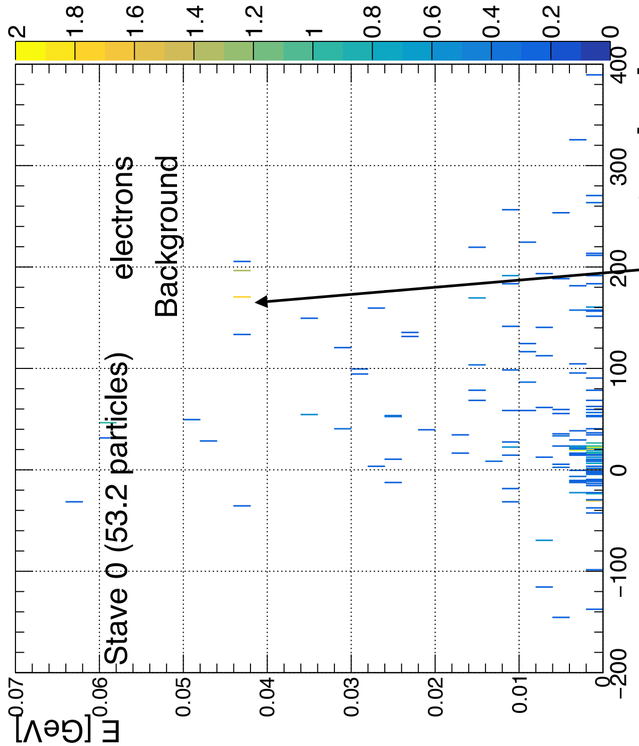


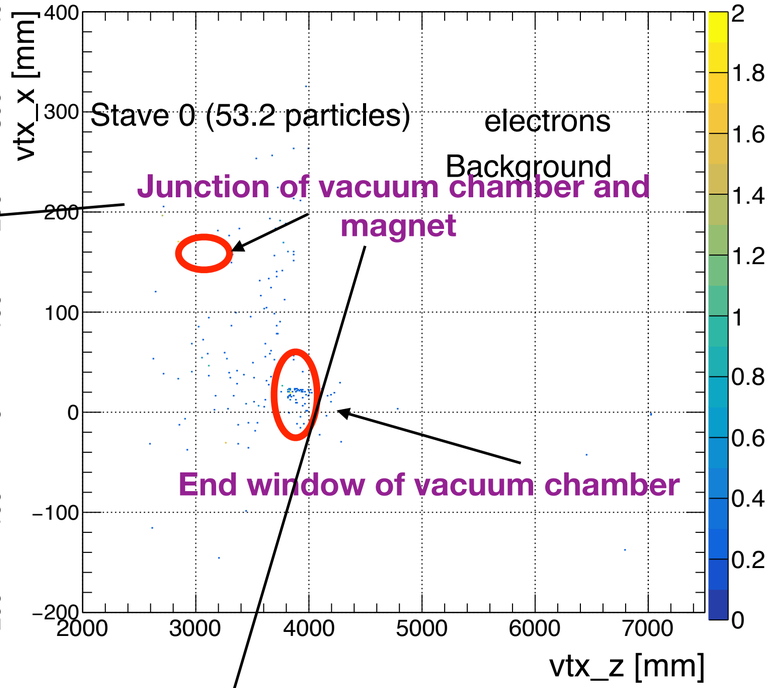


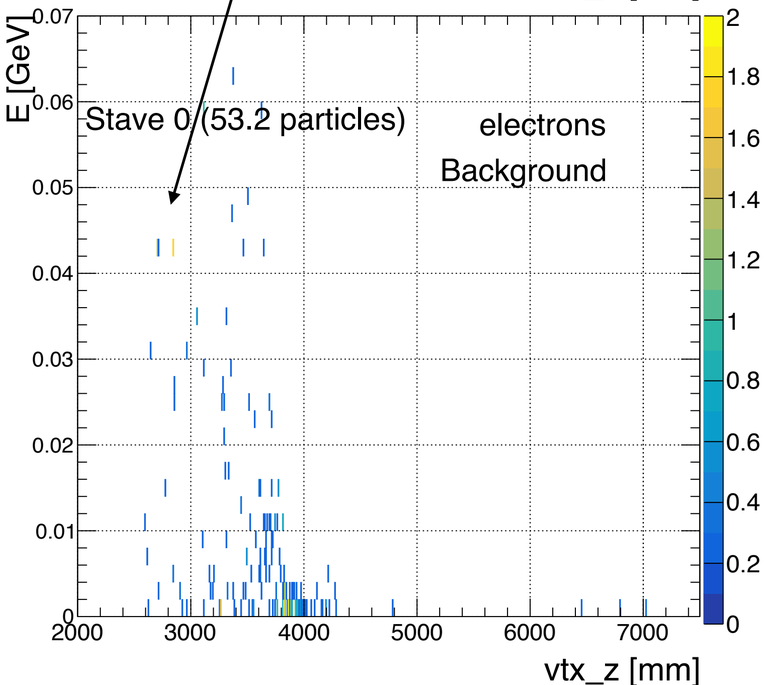
- gamma+laser background
  - Samples produced by Sasha
  - Background particles electrons and photons.
  - Plots from the tracks intersecting the tracker plane (not necessarily making a hit in the tracker).

Electrons in Inner Stave, first layer of tracker

- Very low number of background electrons.
  - E < 2 MeV mostly.
- Maximum electrons are coming from the junction of magnet and vacuum chamber.

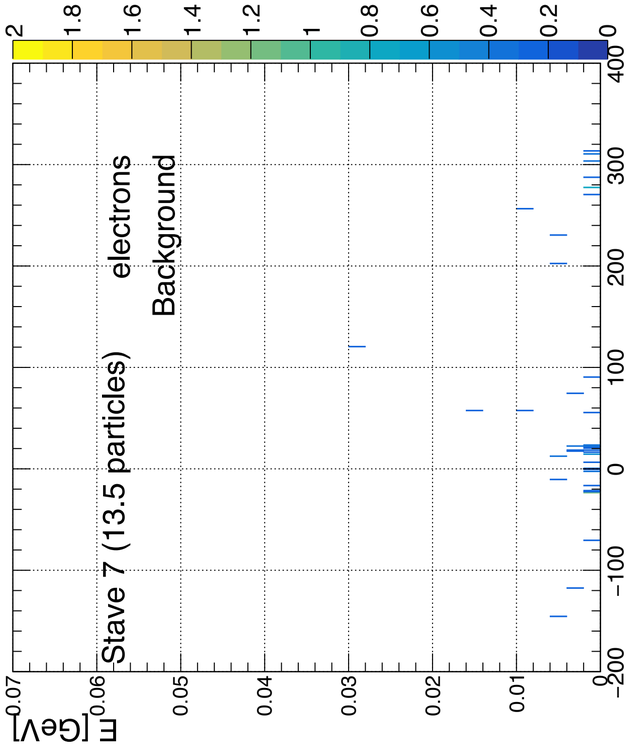


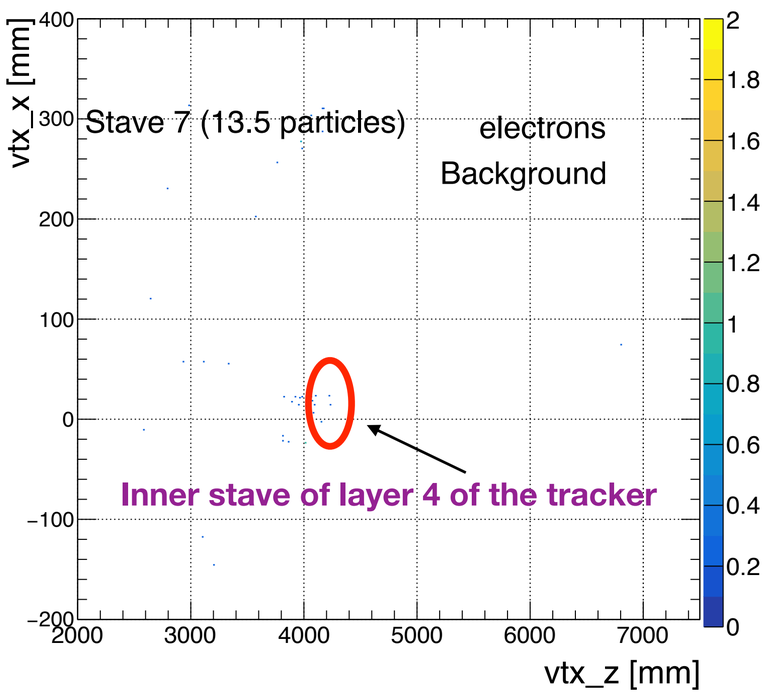


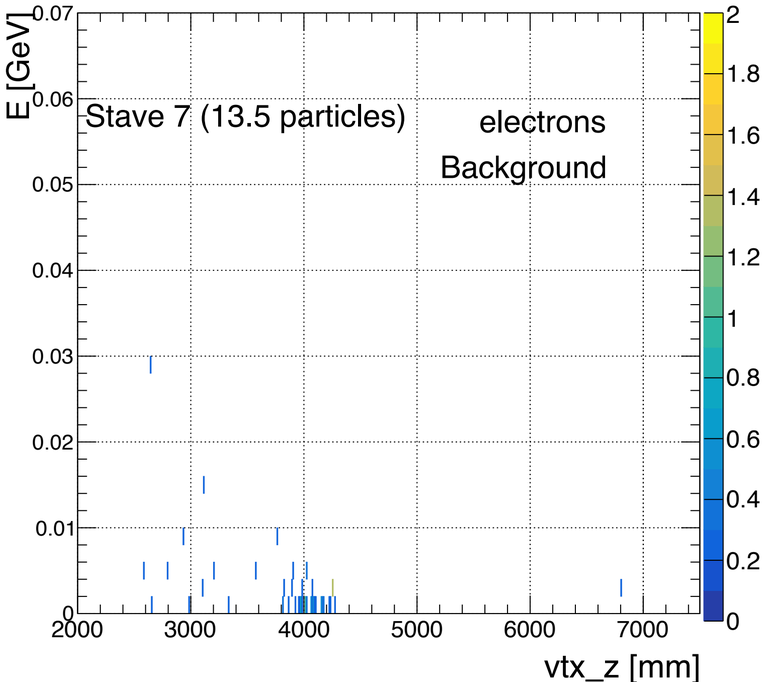


Electrons in Outer Stave, last layer of tracker

- Very low number of background electrons to see anything conclusive.
  - E < 2 MeV mostly.
- Maximum electrons are coming from the junction of magnet and vacuum chamber.

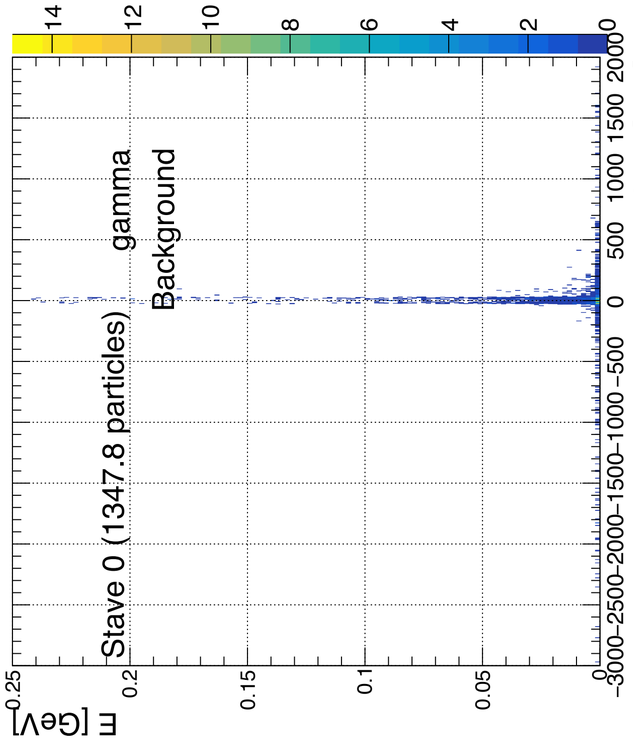


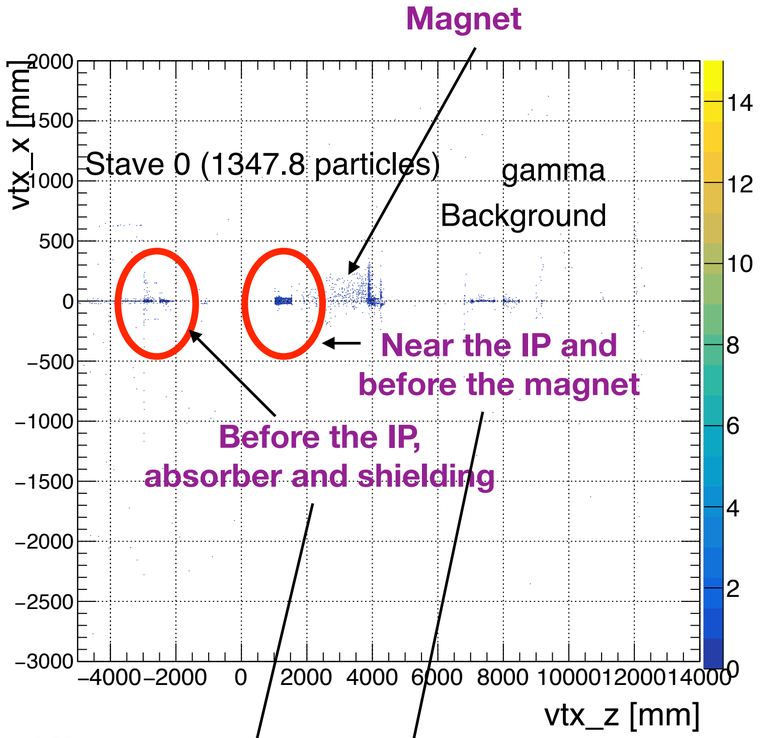


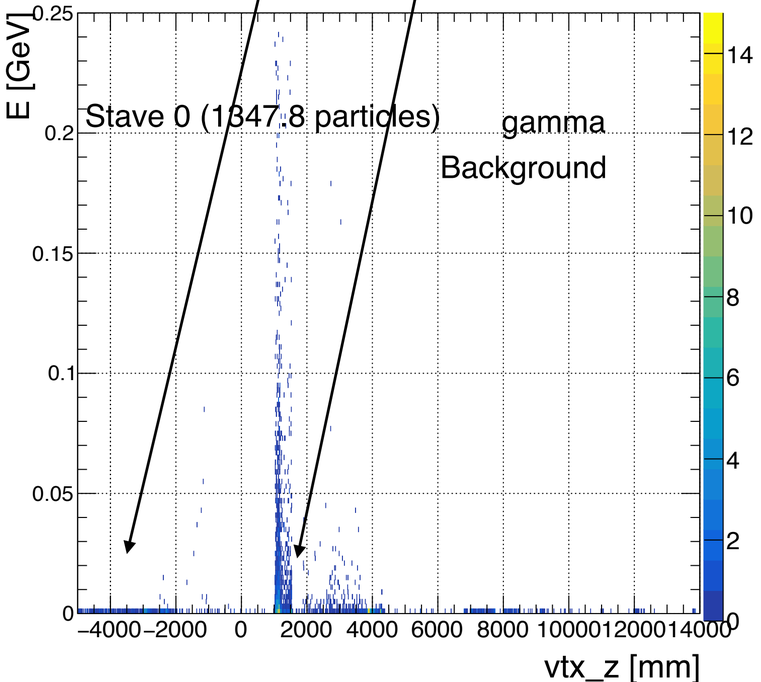


Photons in Inner Stave, first layer of tracker

- Again many photons.
  - Many sources of them.

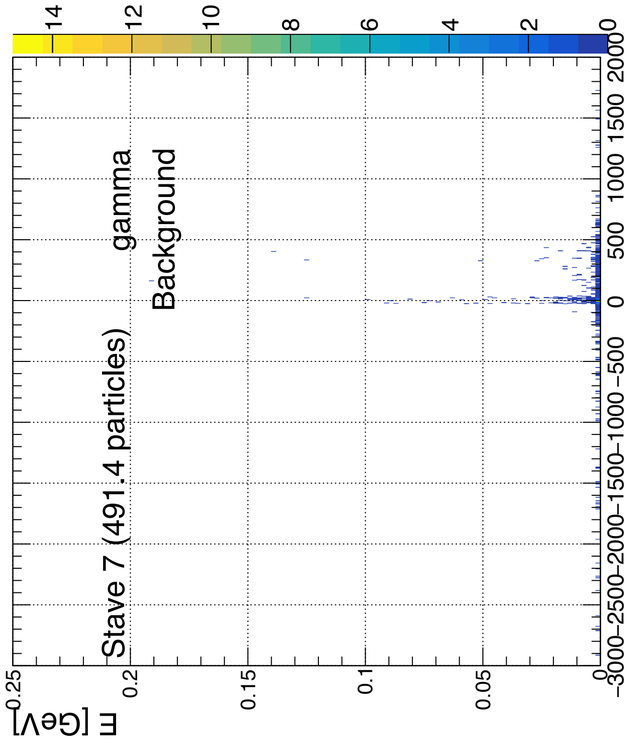


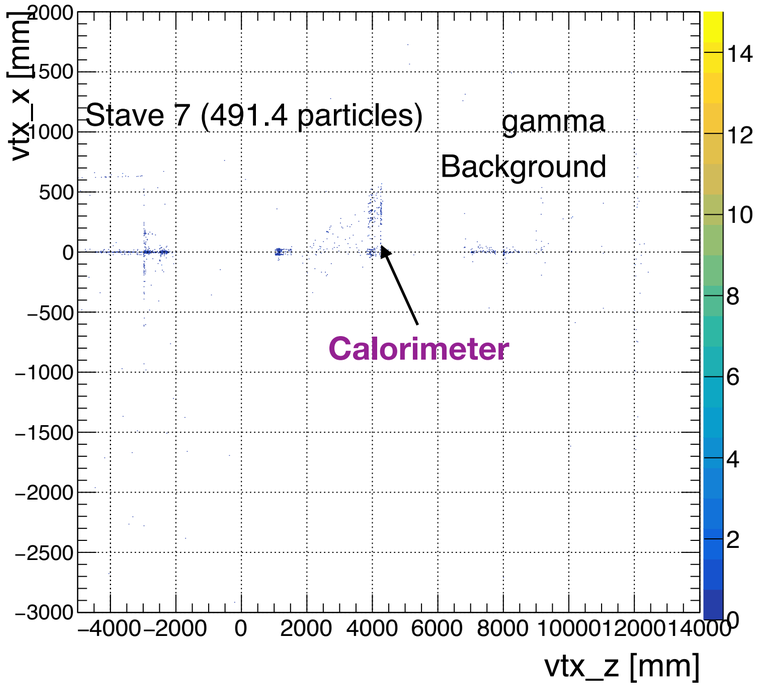




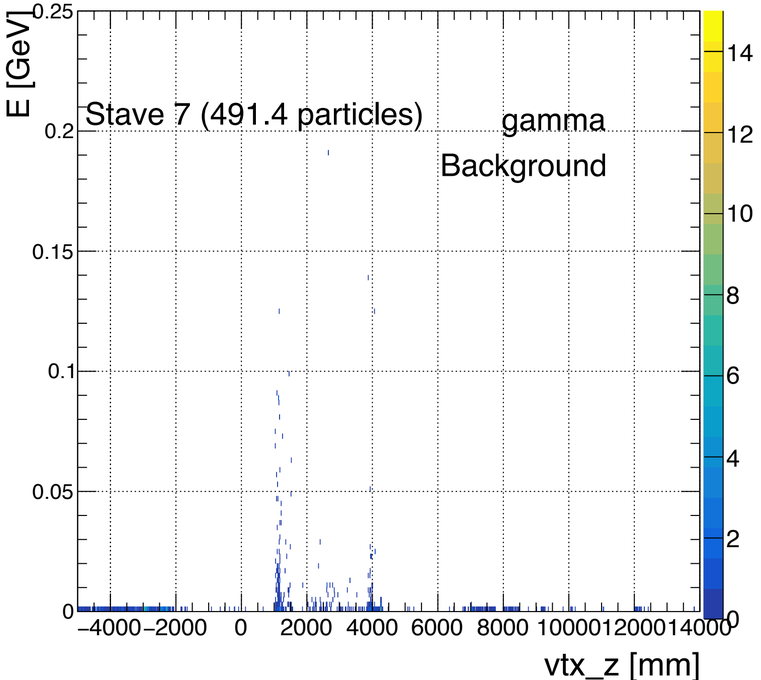
- Some photons from before the IP, but low energetic and low rate.
- High energetic photons are from x=0 and z>1000 and z<1500 mm, after the IP.
- Some are from the magnet.
- Some photons are from the photon converter at z> 8000mm.

Photons in Outer Stave, last layer of tracker





- Not many photons as the first layer.
- Some photons from before the IP, but low energetic and low rate.
- High energetic photons are from x=0 and z>1000 and z<1500 mm, after the IP.
- Some are from the magnet.
- Some photons are from the photon converter at z> 8000mm and shielding at z>7500.



Summary table of the number of background particles

JETI40 hics	Electrons/BX	Gamma/BX
Inner stave, first layer	13125.8	476062.4
Outer stave, last layer	6247.4	60675.8

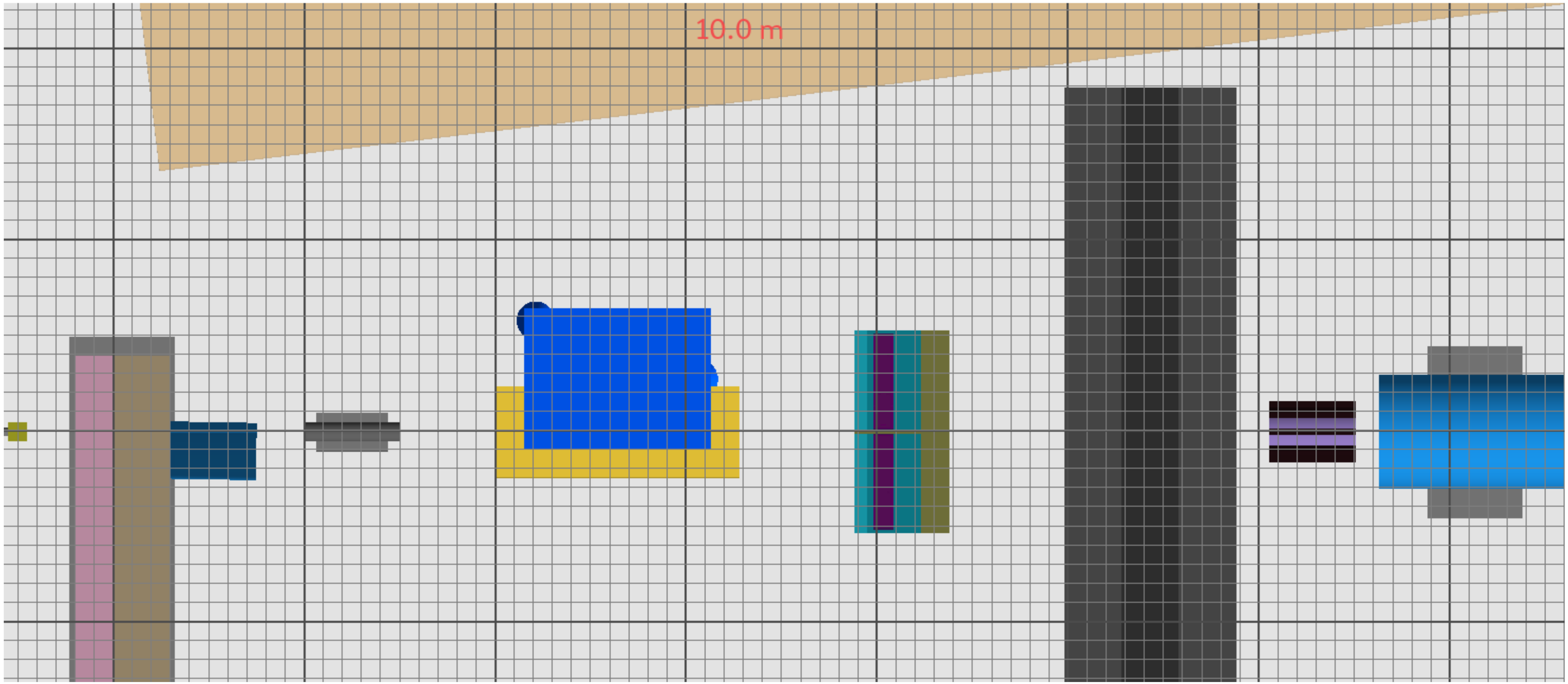
g+laser	Electrons/BX	Gamma/BX
Inner stave, first layer	53.2	1347.8
Outer stave, last layer	13.5	491.4

Summary

- A brief study of the origin of the background electrons and photons.
  - Most of them are low energetic, should not create any issue in our tracker system. But work ongoing to know their effects.
- JETI40 hics
  - Most of the background electrons are coming from the end of the vacuum chamber window.
    - This can be reduced.
  - Some of the electrons are from the trackers (due to signal) but have low energies.
    - Need to see if they can make hits in the tracker.
  - Photons are coming from the beam crossing the beam pipe, calorimeter, shielding and dump.
- Photons
  - Photons are coming from the inside of magnet (junction?) and the shielding and absorber.
  - Not many background electrons here.

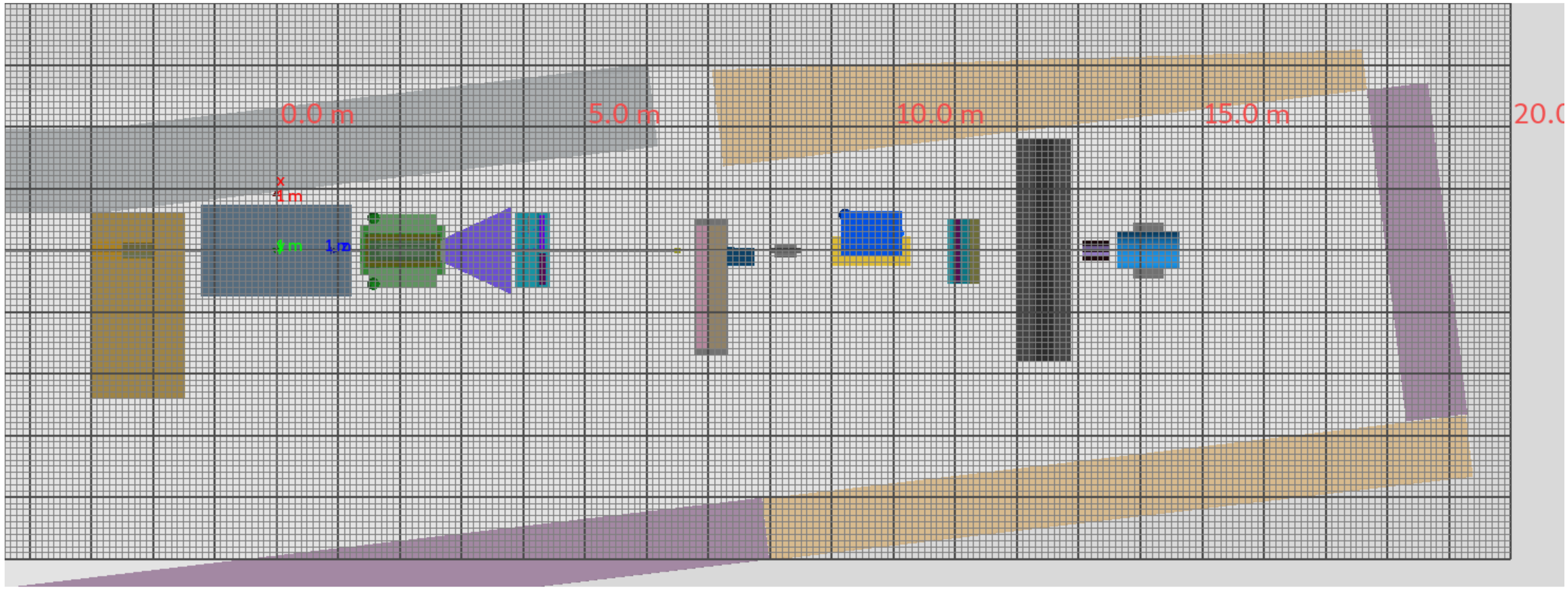
Bonus slides

The subsystems near the beam dump



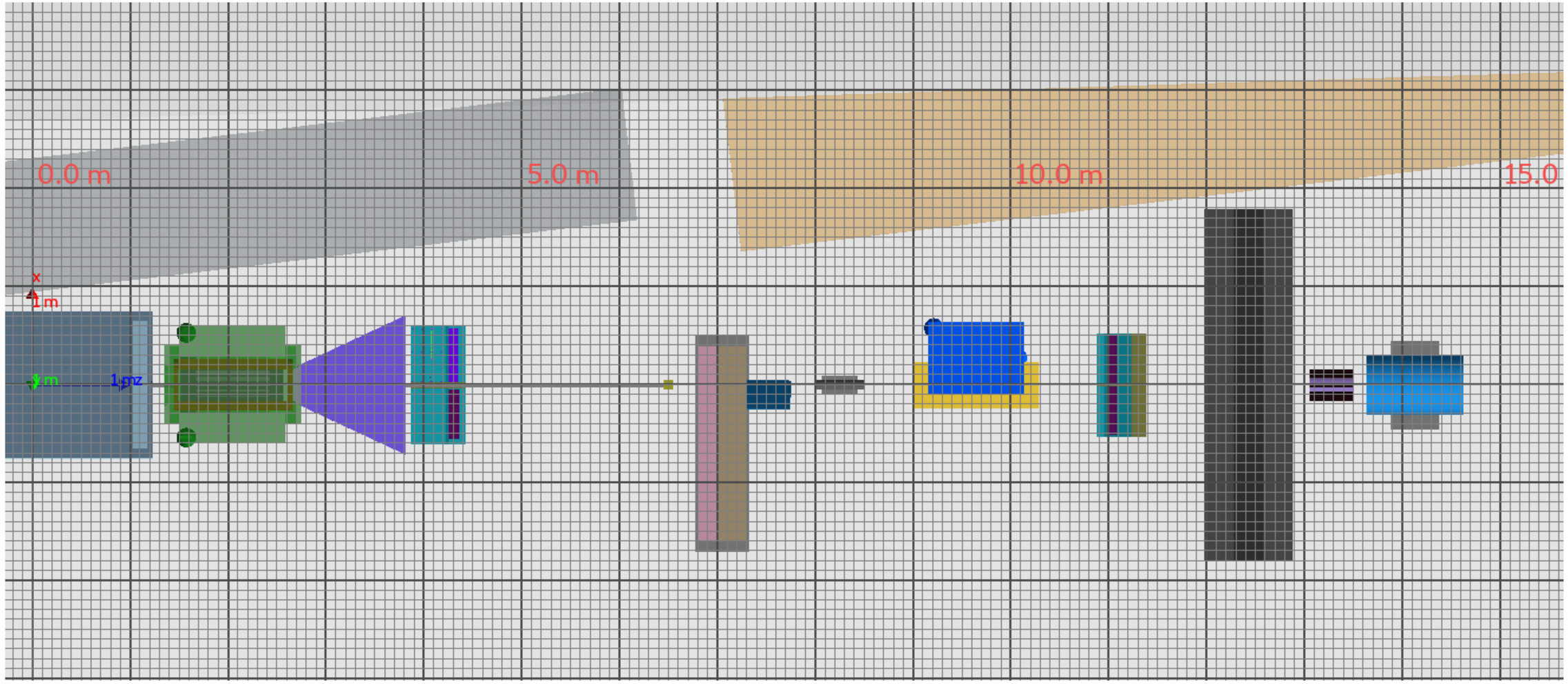
Plots from Sasha

The entire subsystem



Plots from Sasha

The subsystems from the IP to beam dump



Plots from Sasha