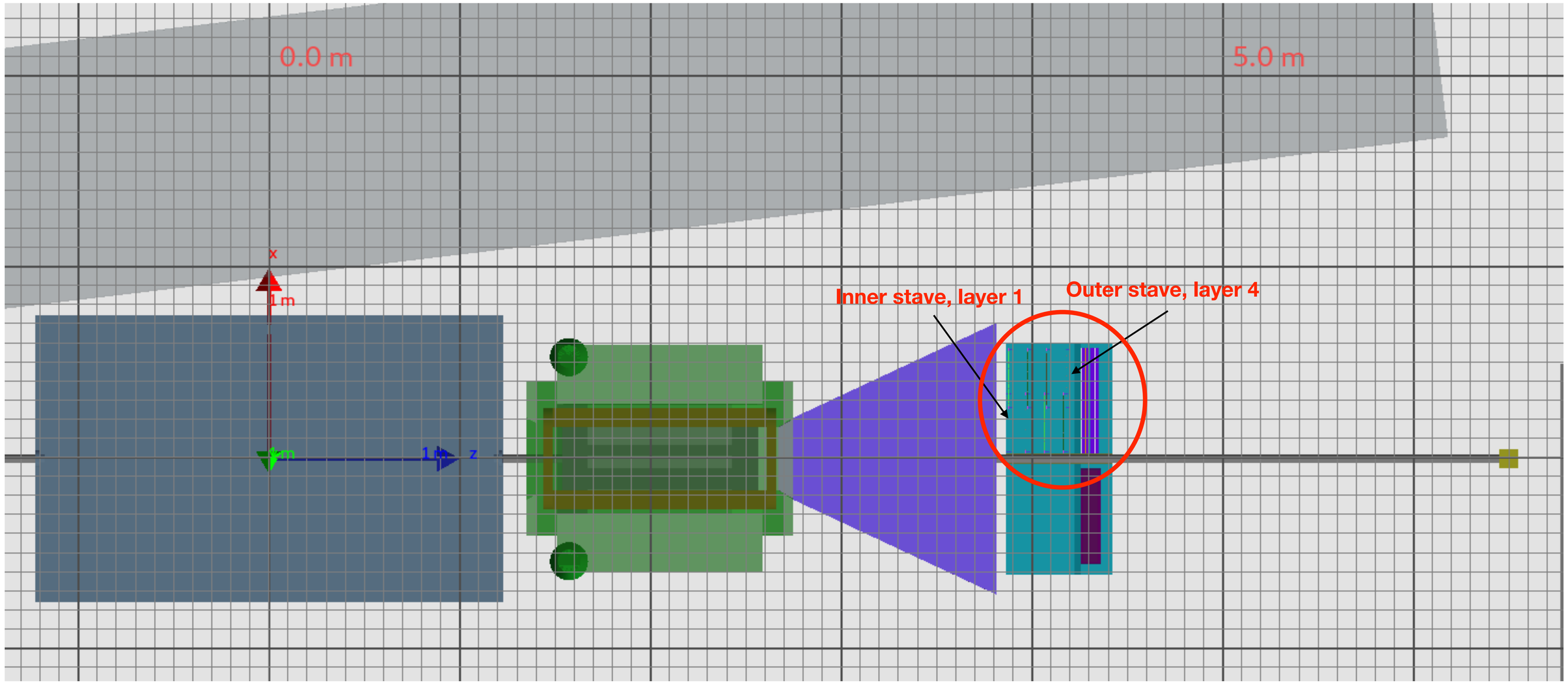
Background electrons in the Tracker Subsystem

LUXE Daily Analysis Meeting

Arka Santra, November 16, 2020
Weizmann Institute of Science,
Rehovot, Israel

The subsystems near the IP

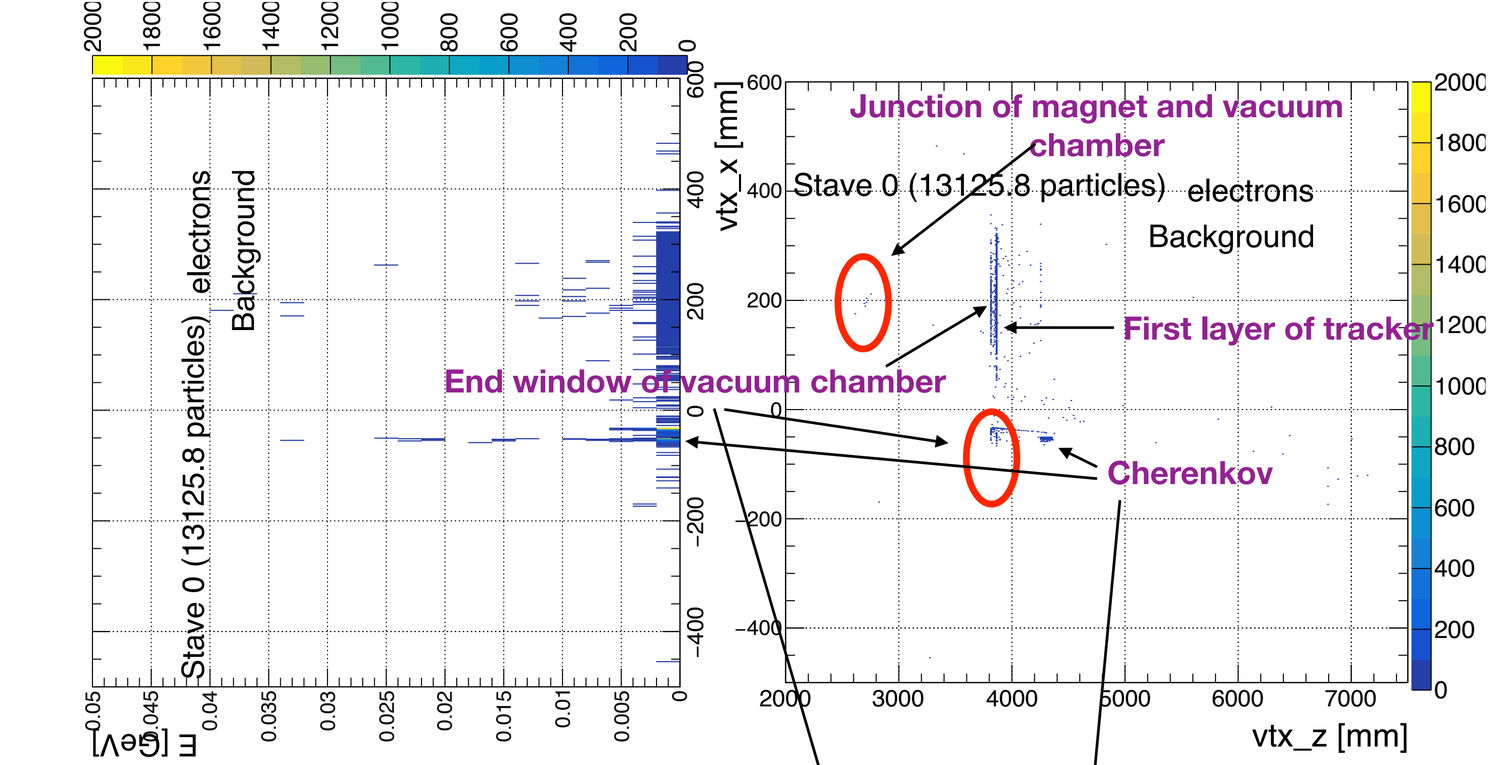


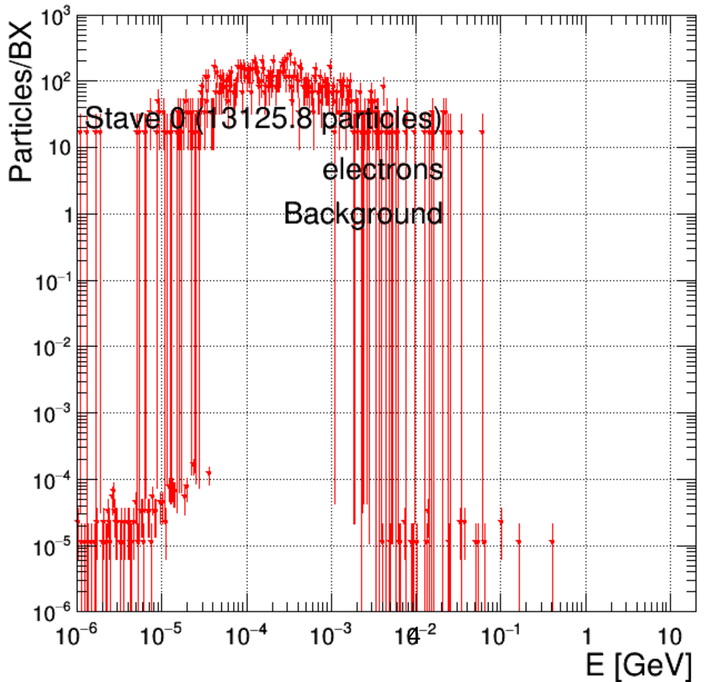
Plots from Sasha

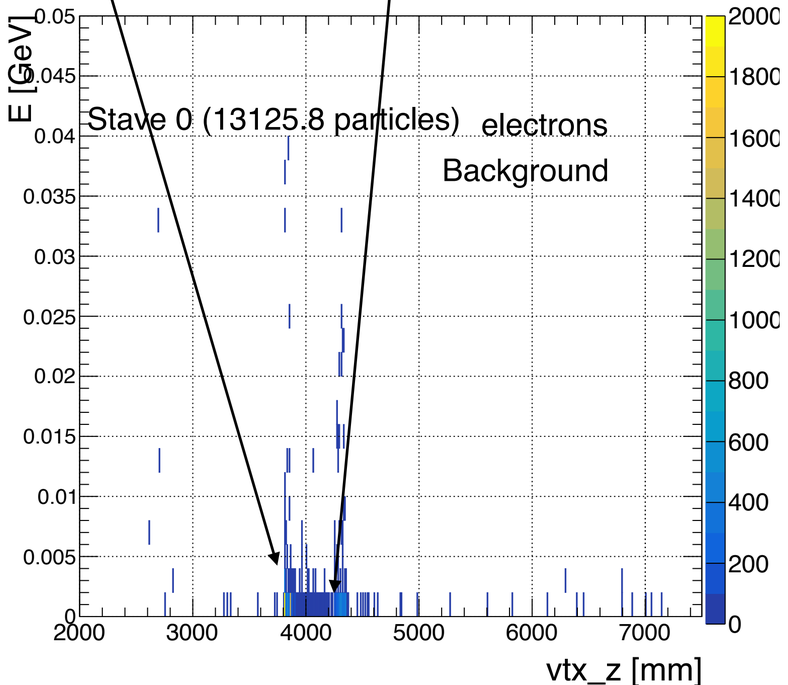
- e+laser hics setup
  - JETI 40 laser.
  - Spotsize w0 3000 nm.
  - Samples produced by Sasha.
  - Looked at the background particles:
    - electrons
  - Plots from the tracks intersecting the tracker plane (not necessarily making a hit in the tracker).

Electrons in Inner Stave, first layer of tracker

- The 2D plots were shown last time. This time, the 1D energy plot is added.
- We have high number of electrons having energies more than 40 KeV of energies.
  - They may produce hits at the tracker.
- Many electrons from the stave, coming from signal.
- What happens if we can remove mechanically unwanted electrons?

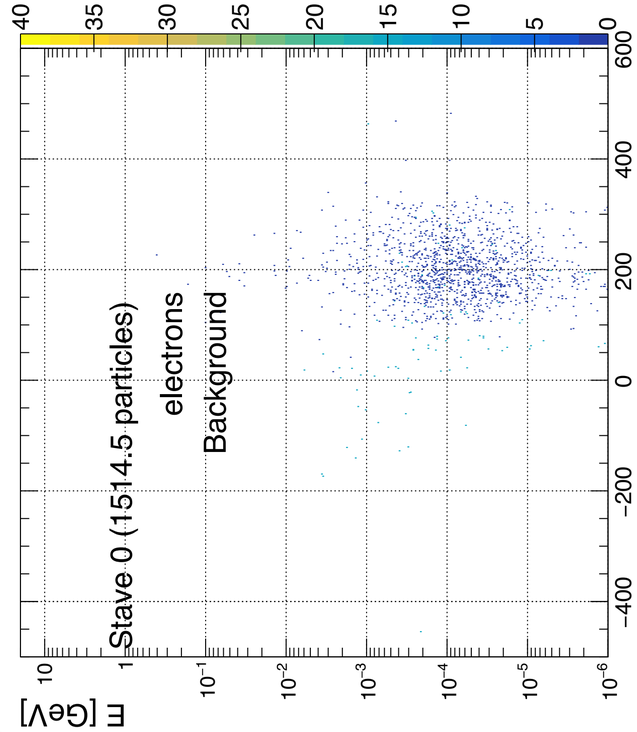


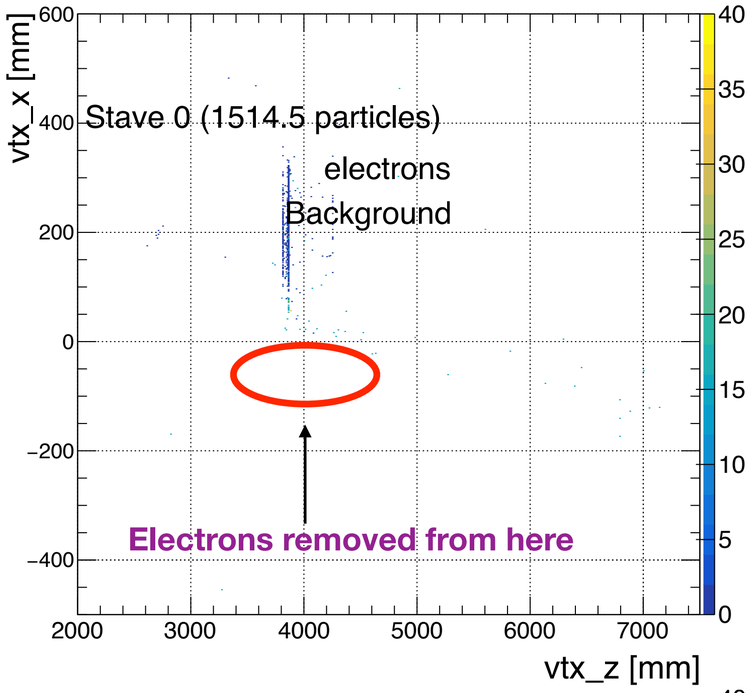


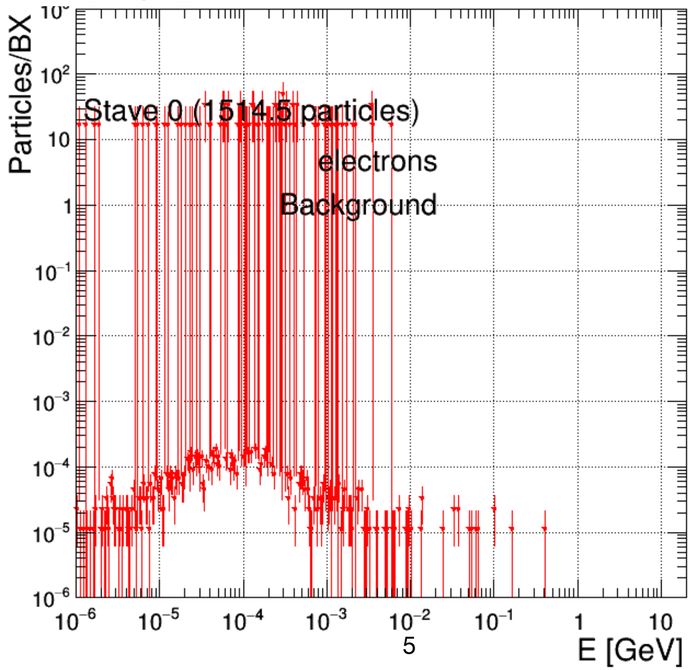


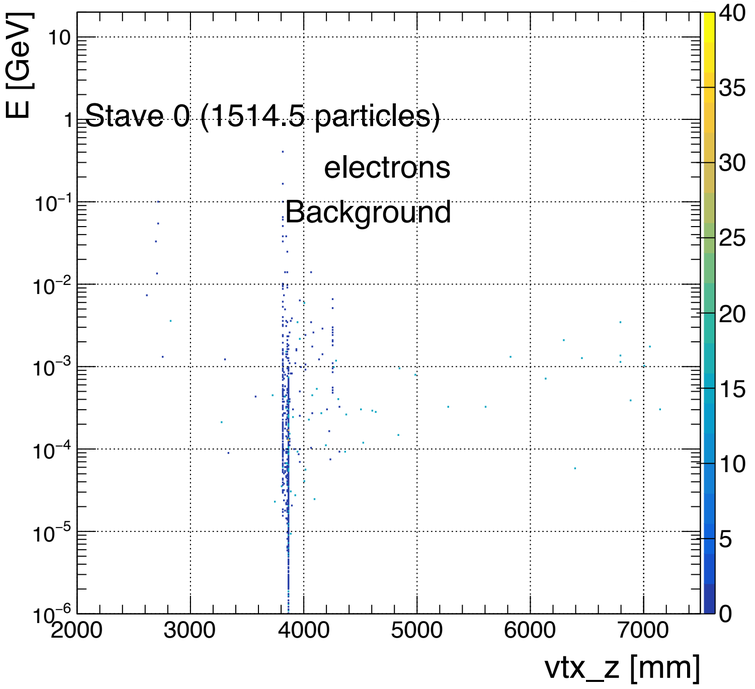
Electrons in Inner Stave, first layer of tracker, cut on vtx_z and vtx_x

- Removed electrons from vtx_x < 0 and vtx_z > 3600 mm and vtx_z < 4600 mm
- Now we have a factor of 1/9 background electrons
- Some electrons are having high weights.



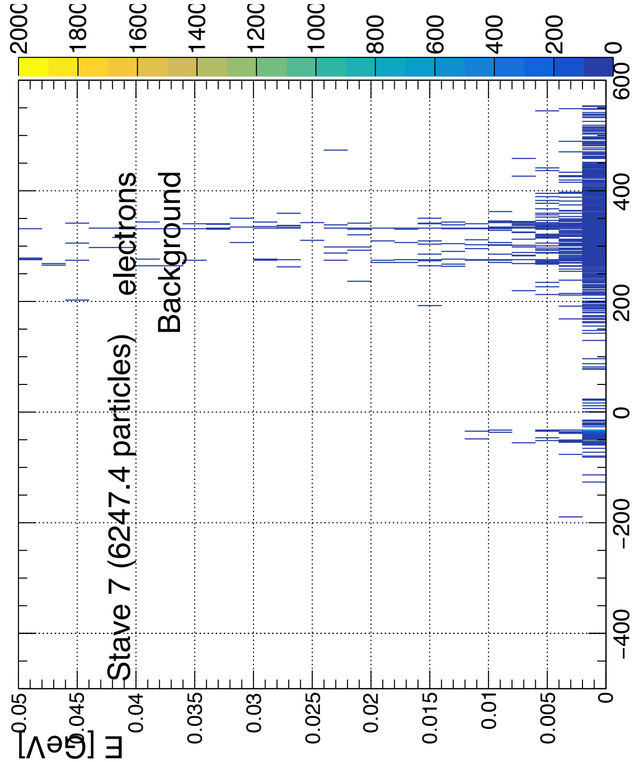


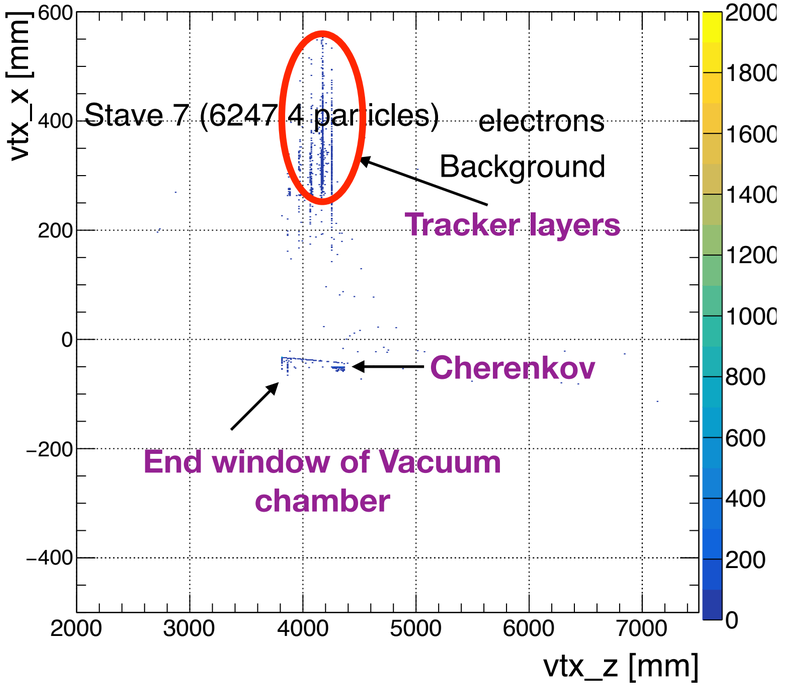


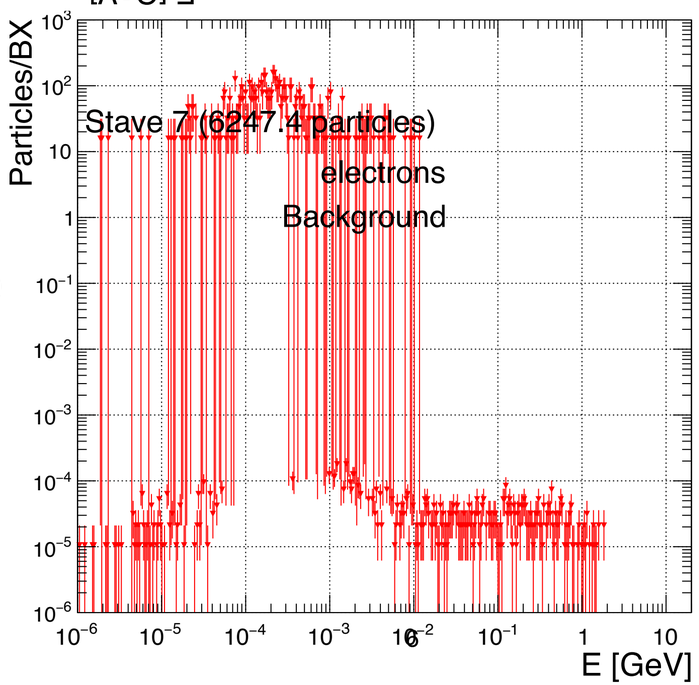


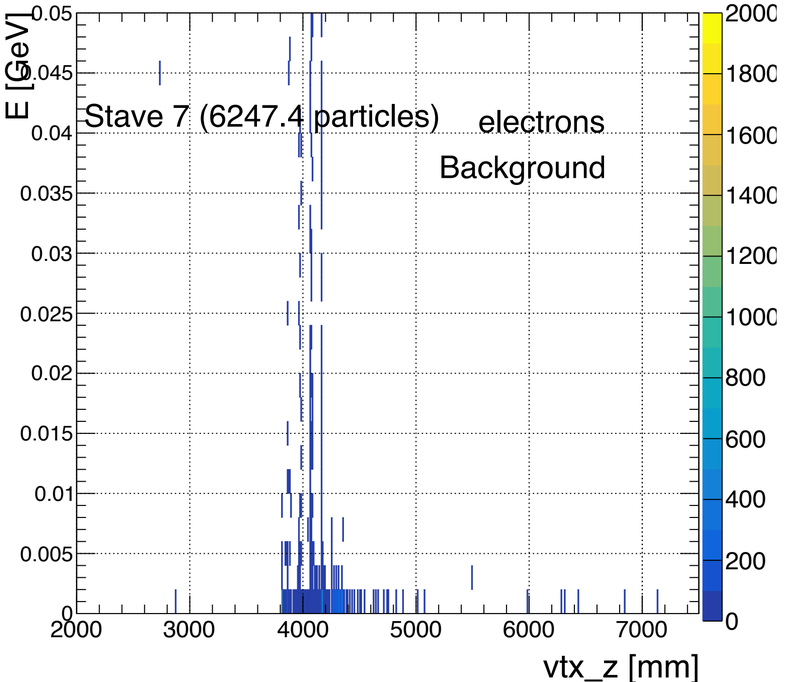
Electrons in Outer Stave, last layer of tracker

- 1D energy plot is added.
- Many electrons have energy > 100 KeV.
- Almost half of the background electrons compared to that of the first stave.



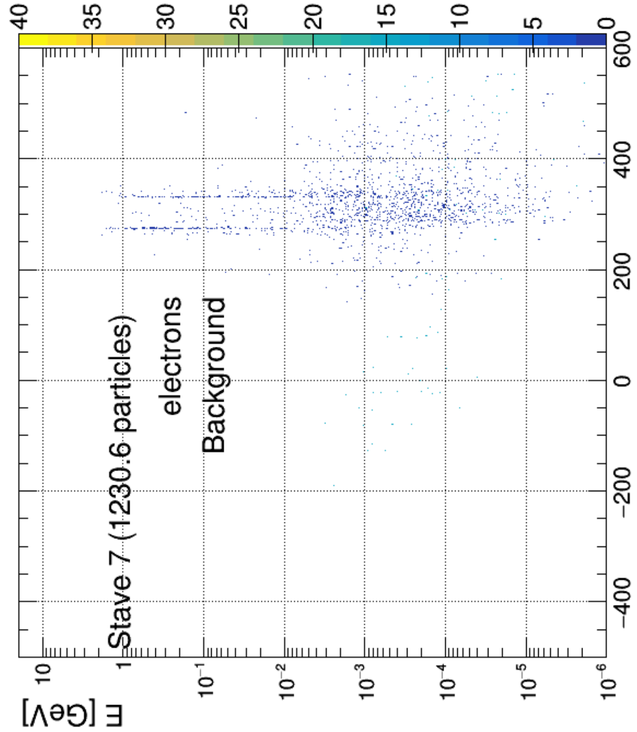


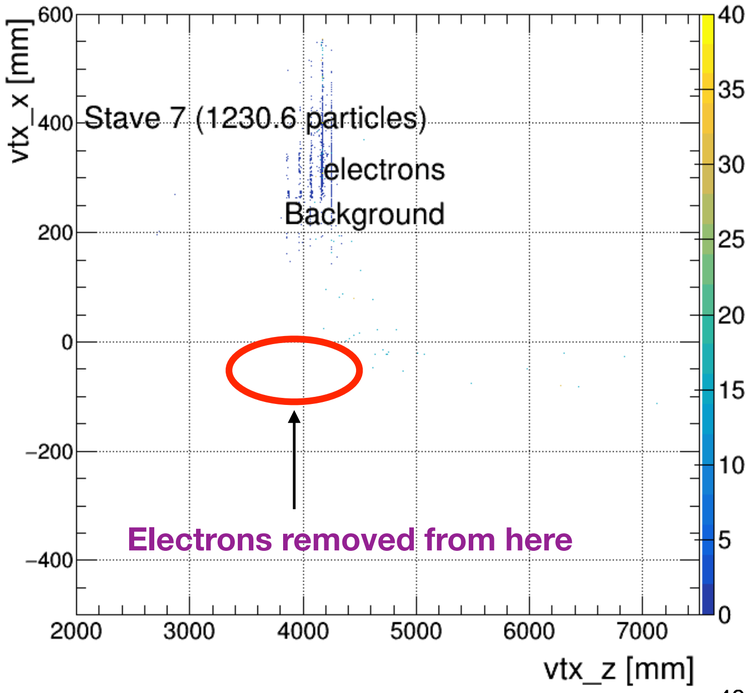


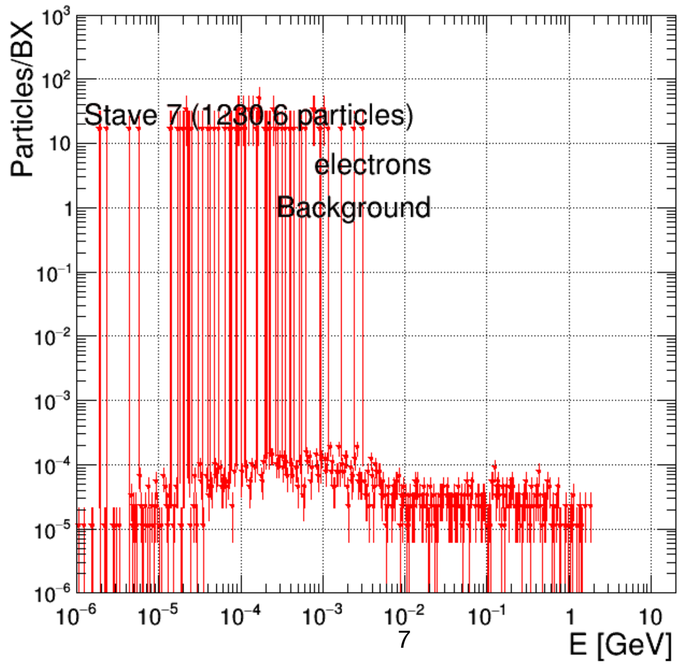


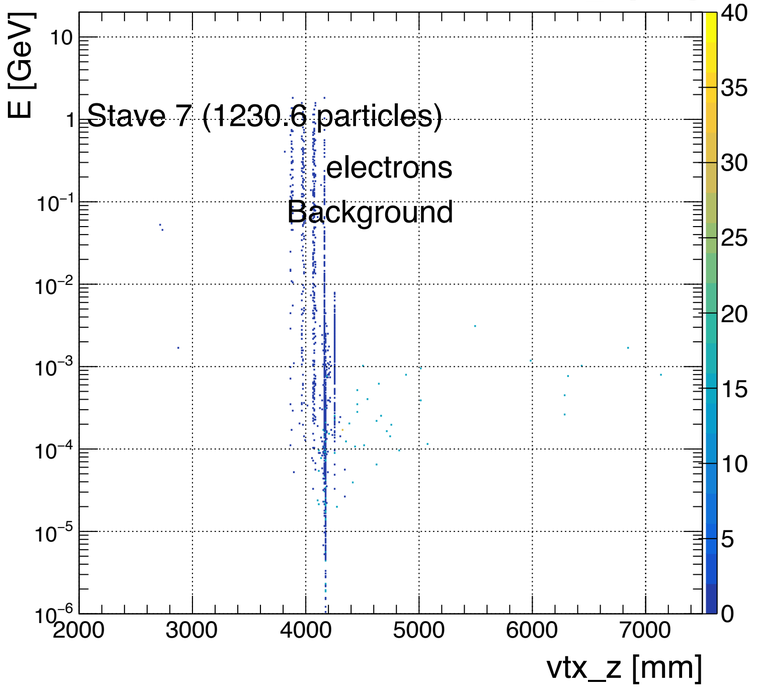
Electrons in Outer Stave, last layer of tracker, cut on vtx_z and vtx_x

- Removed electrons from vtx_x < 0 and vtx_z > 3600 mm and vtx_z < 4600 mm
- Now we have a factor of 1/3 background electrons
  - The effect is not much as the first stave.
- Most electrons from staves.







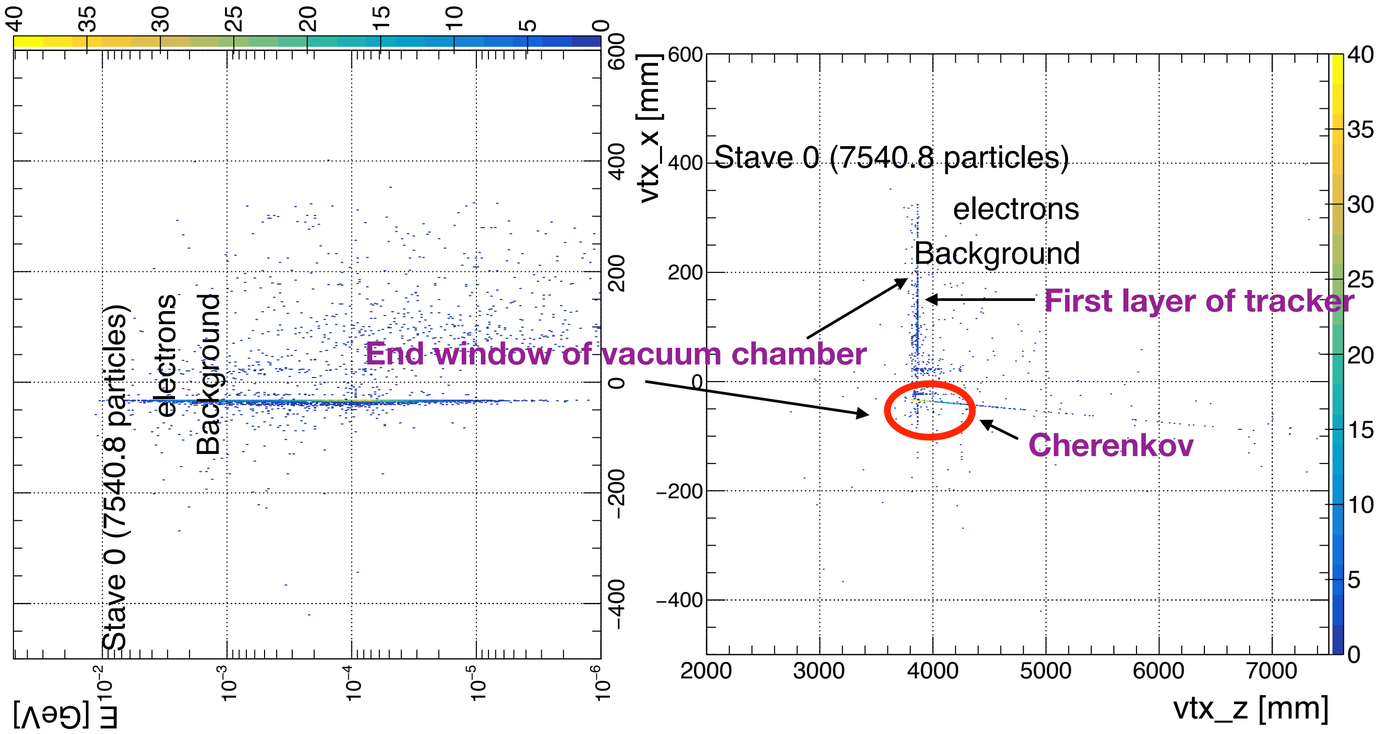


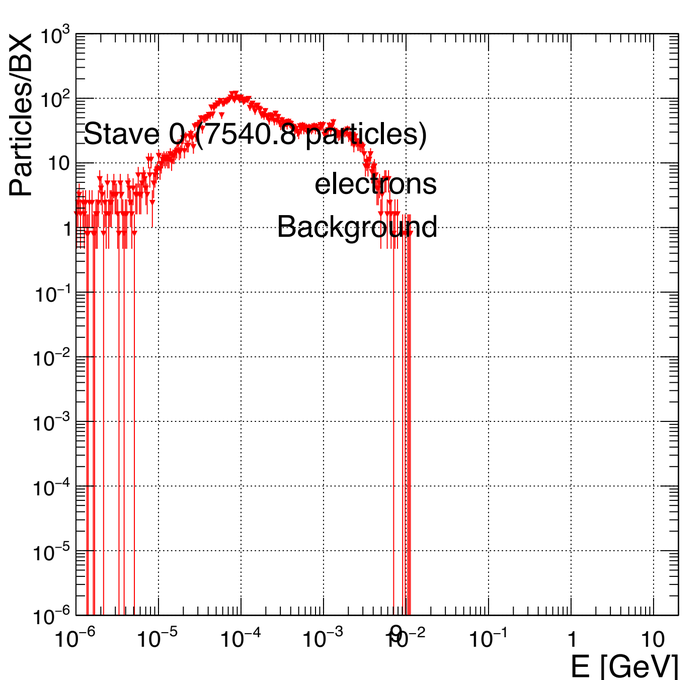
- e+laser hics setup
  - Only electron beam, no laser.
  - Easy to understand only beam related background.
  - Samples produced by Sasha.
  - Looked at the background particles:
    - electrons

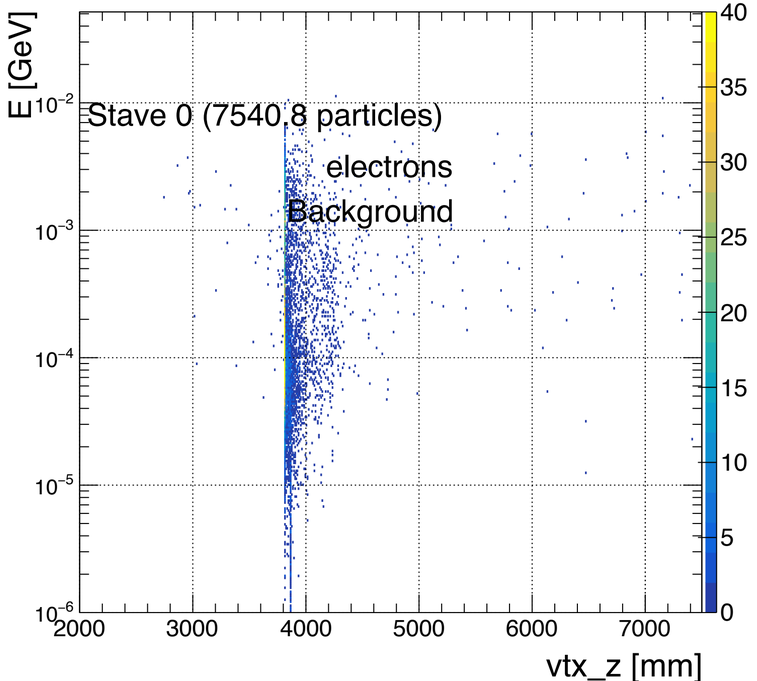
  - Plots from the tracks intersecting the tracker plane (not necessarily making a hit in the tracker).

Electrons in Inner Stave, first layer of tracker

- These plots are being shown for the first time.
- We have high number of electrons having energies more than 10 KeV.
  - Many are not from staves.
- What happens if we can remove unwanted electrons mechanically?

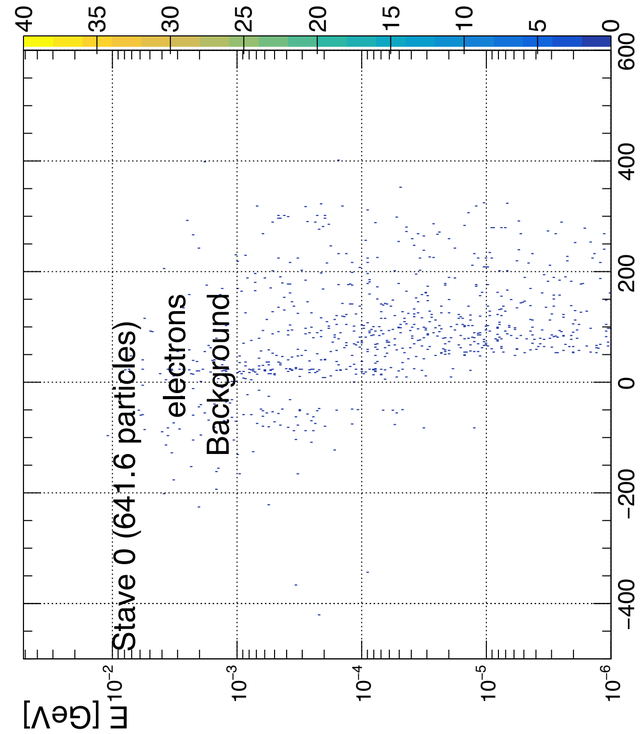


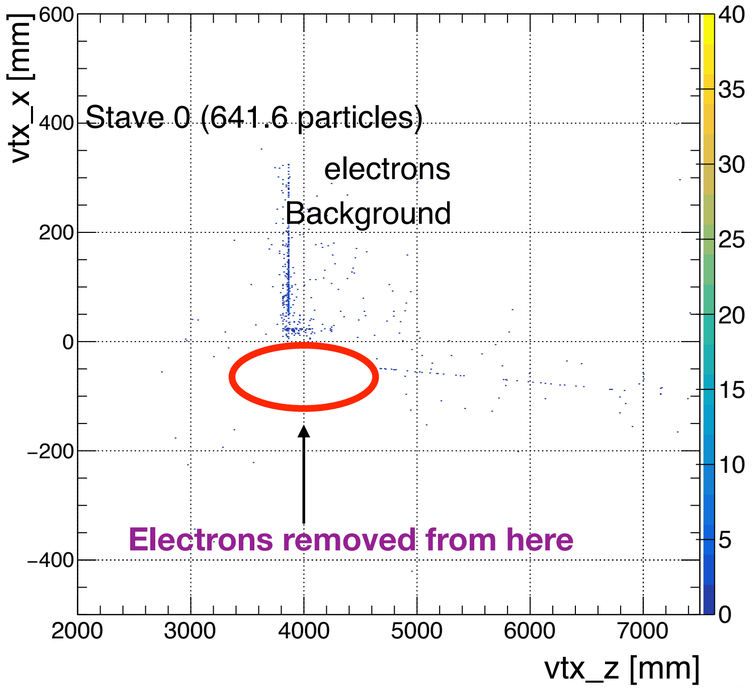


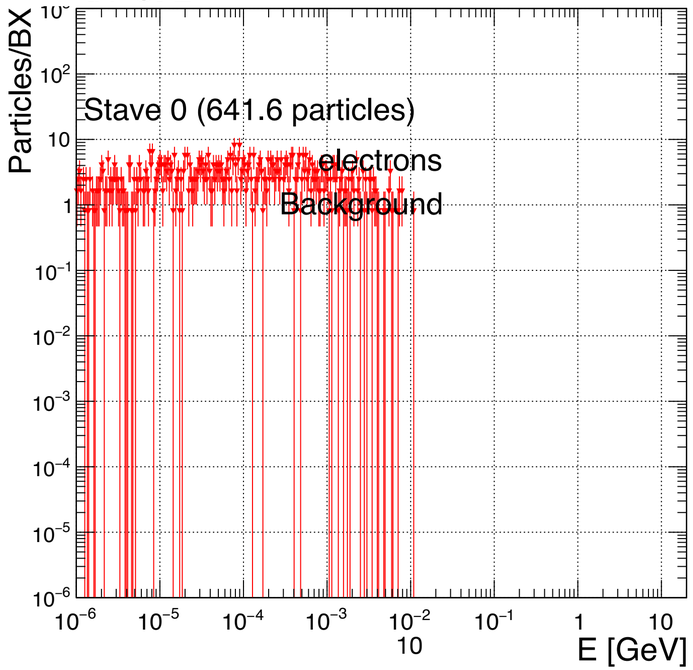


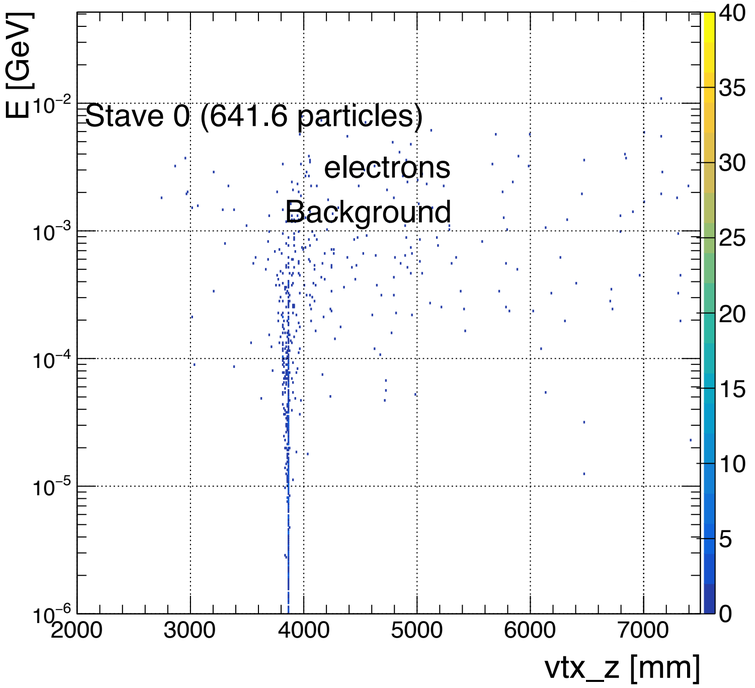
Electrons in Inner Stave, first layer of tracker, cut on vtx_z and vtx_x

- Removed electrons from vtx_x < 0 and vtx_z > 3600 mm and vtx_z < 4600 mm
- Now we have a factor of 1/12 background electrons
- The energy distribution is mostly flat.



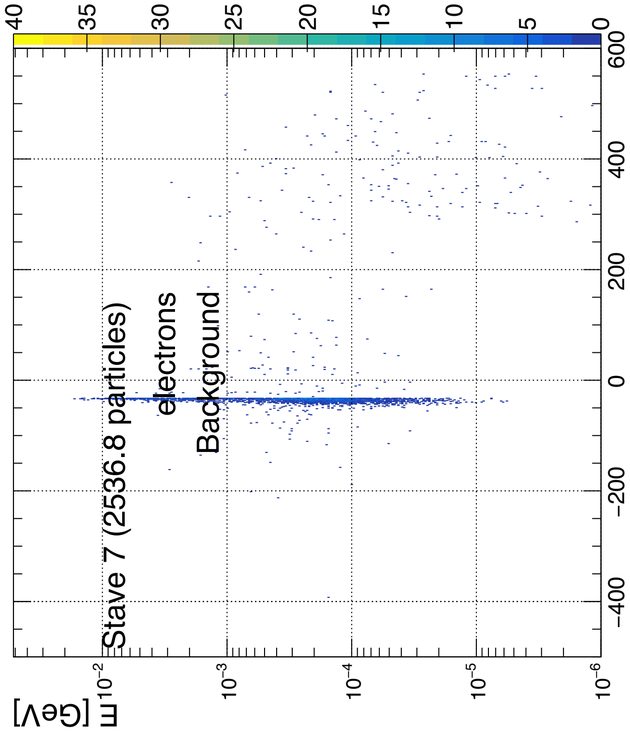


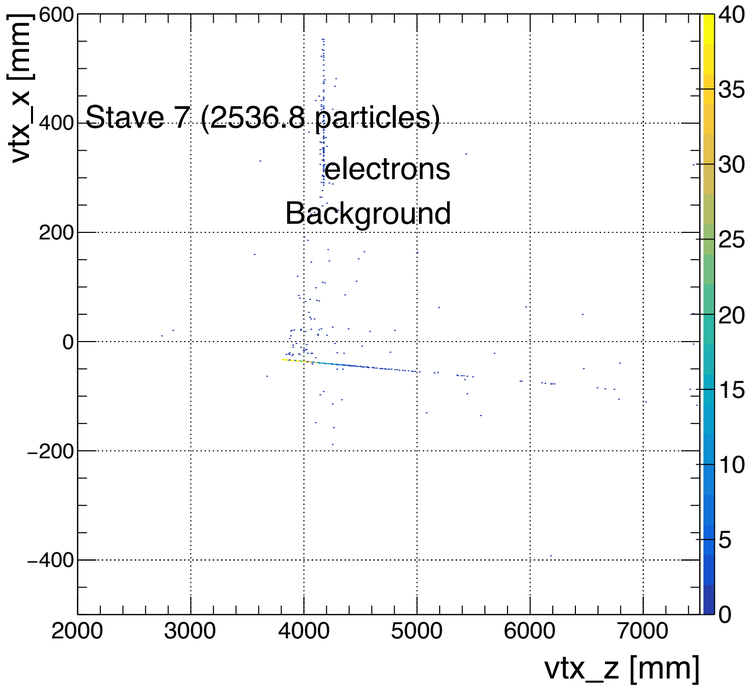


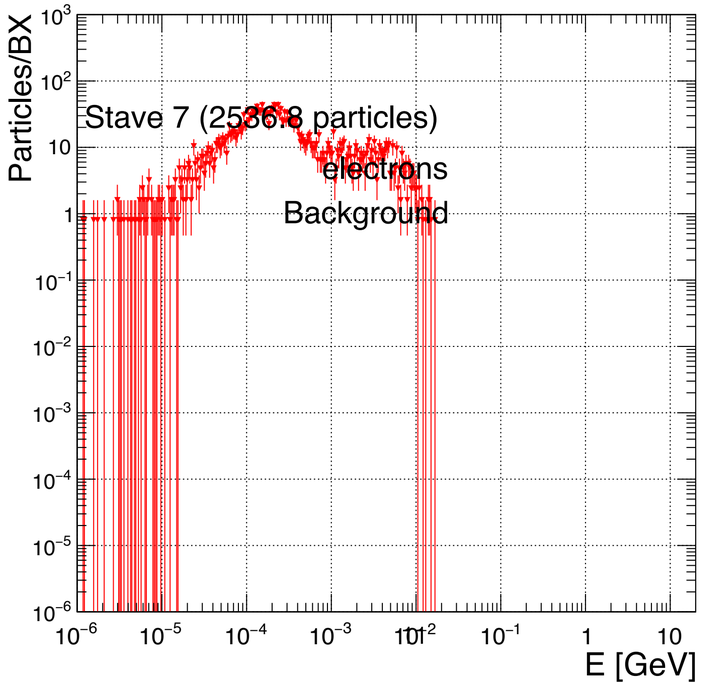


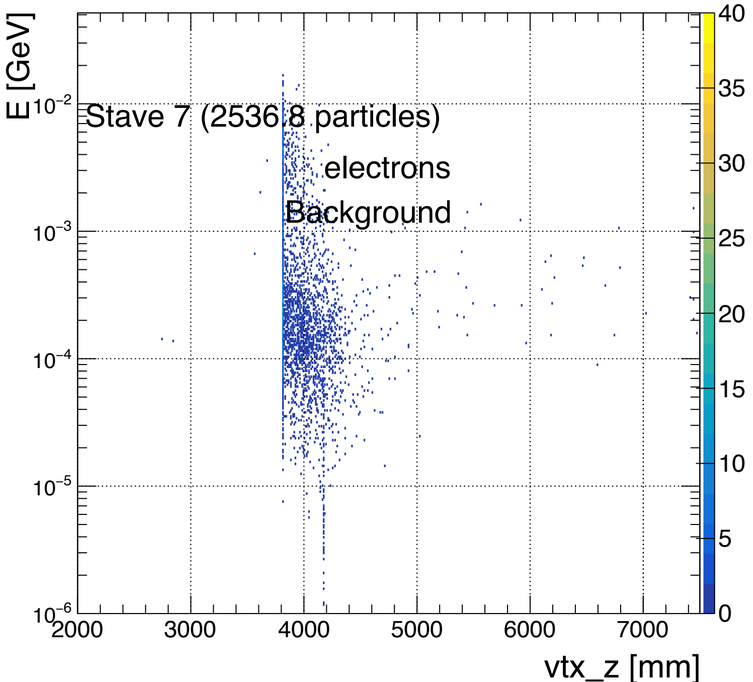
Electrons in Outer Stave, last layer of tracker

- This is now the stave 7.
- Most electrons have energies > 20 KeV.
- Some electrons from the staves, not much.



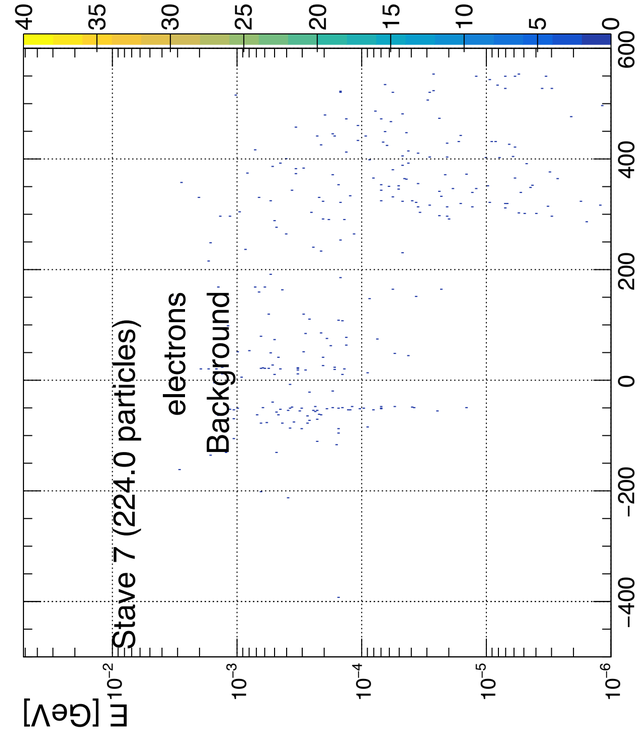


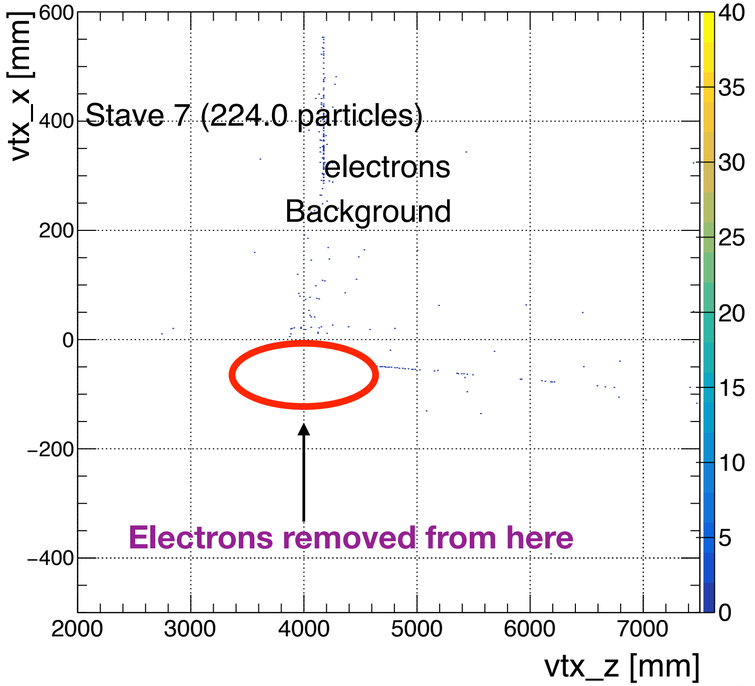


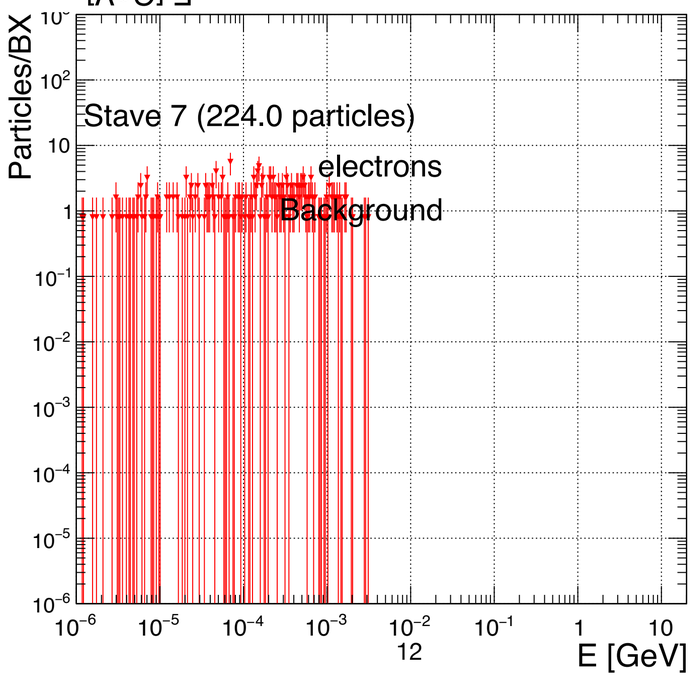


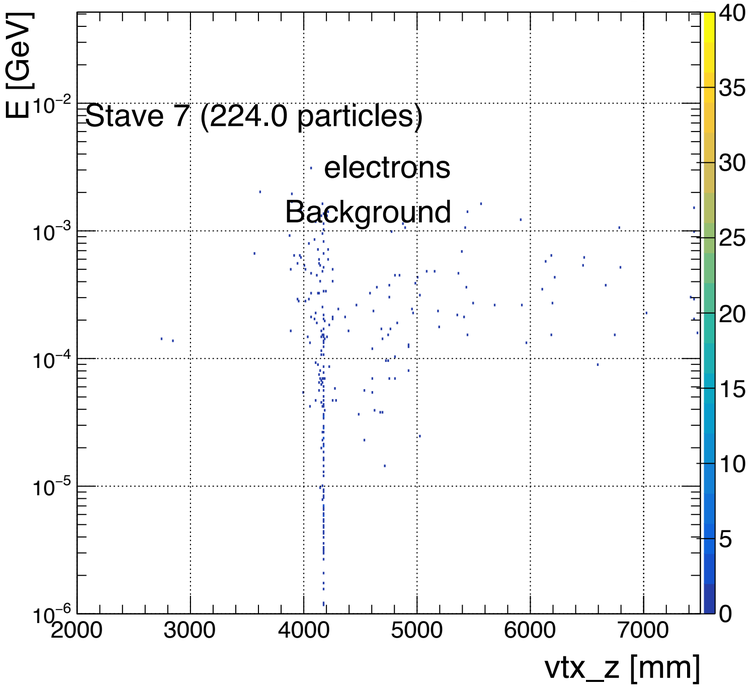
Electrons in Outer Stave, last layer of tracker, cut on vtx_z and vtx_x

- Removed electrons from vtx_x < 0 and vtx_z > 3600 mm and vtx_z < 4600 mm
- 1/10th of the electrons remain.
- Mostly flat in energy.





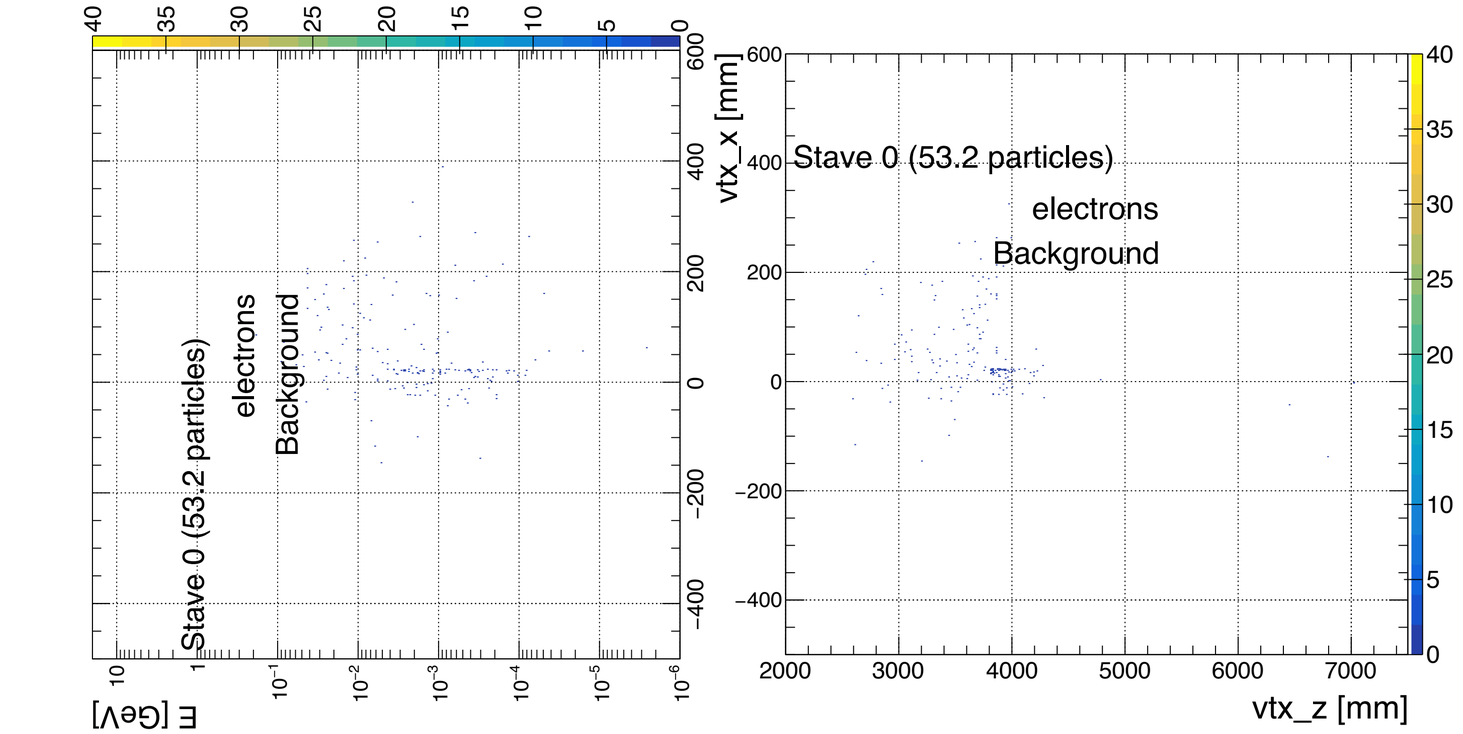


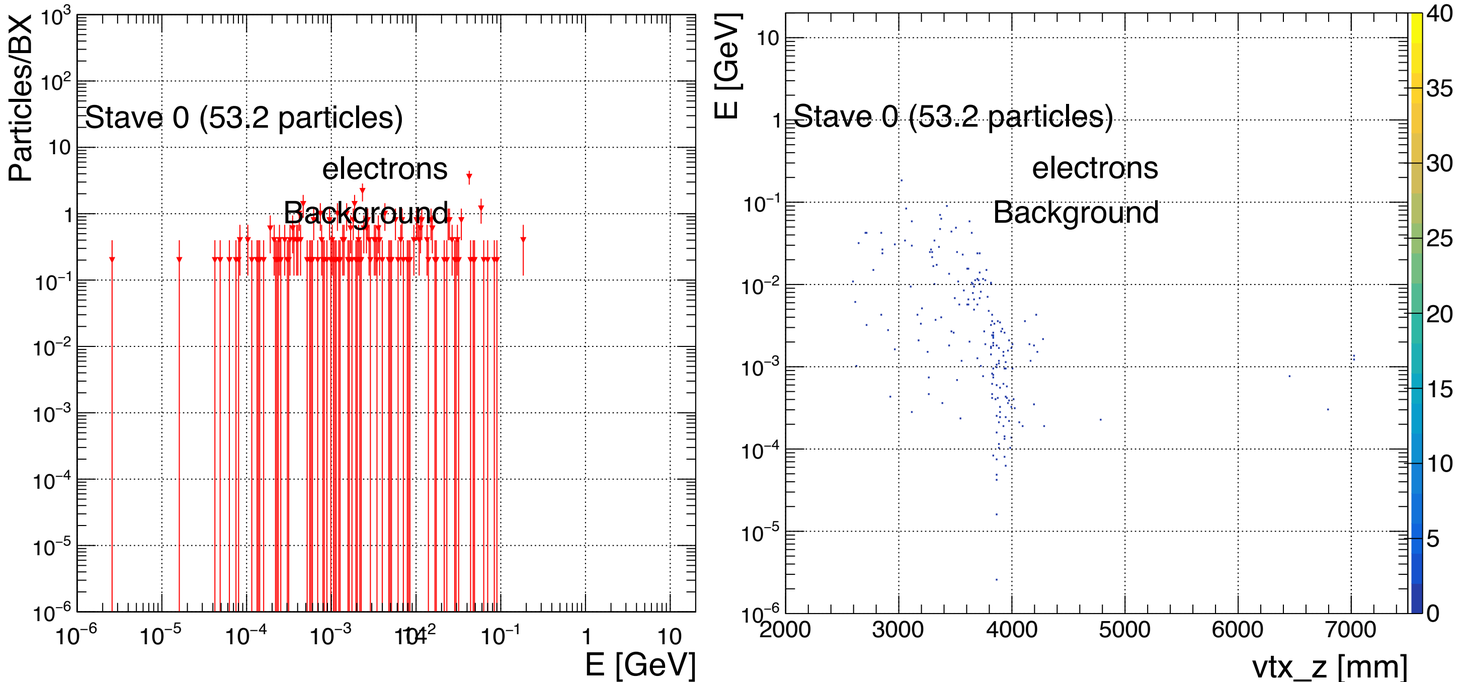


- gamma+laser background
  - Samples produced by Sasha
  - Background electrons.
  - Plots from the tracks intersecting the tracker plane (not necessarily making a hit in the tracker).

Electrons in Inner Stave, first layer of tracker

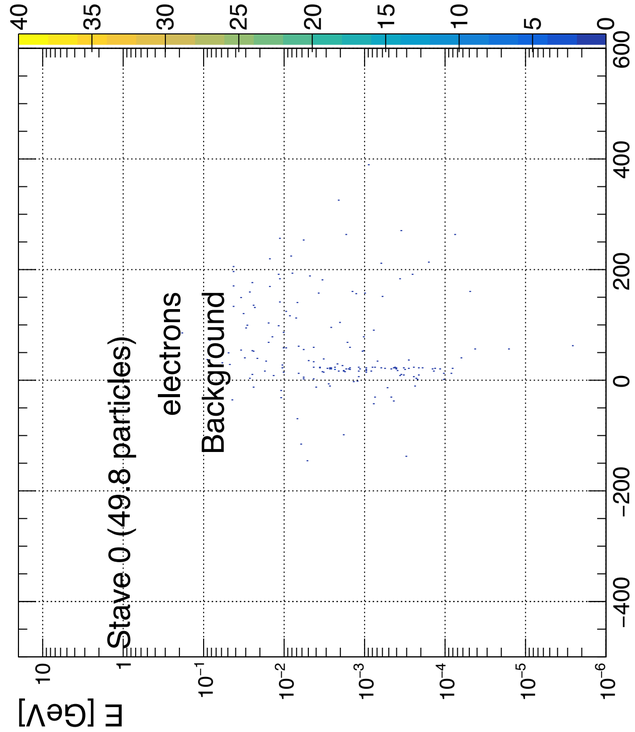
- This time, no electron beam to begin with, so less number of electrons.
- The background is coming from different places - not possible to reduce by mechanically cutting.

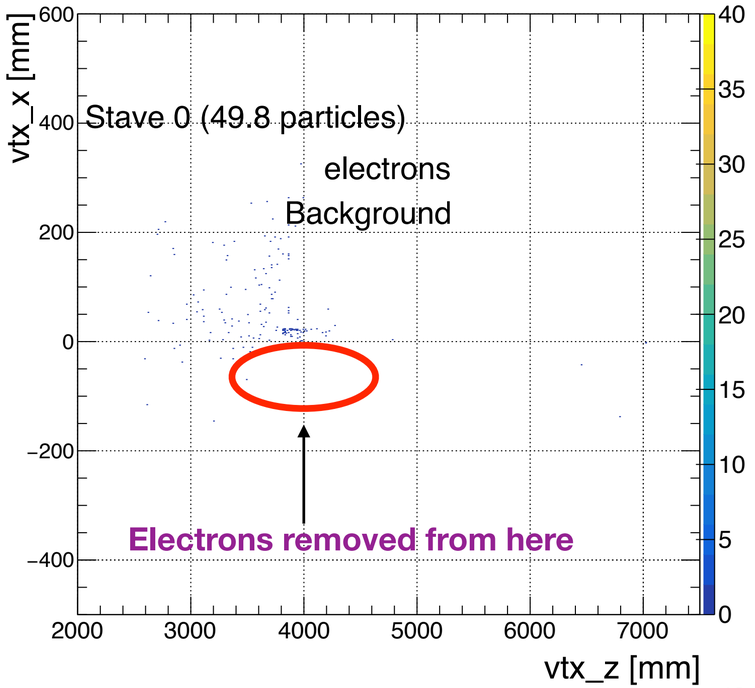


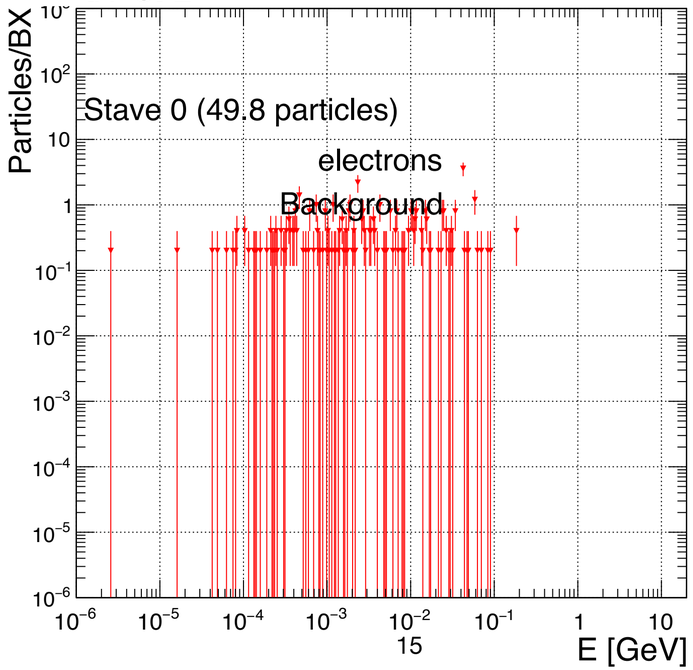


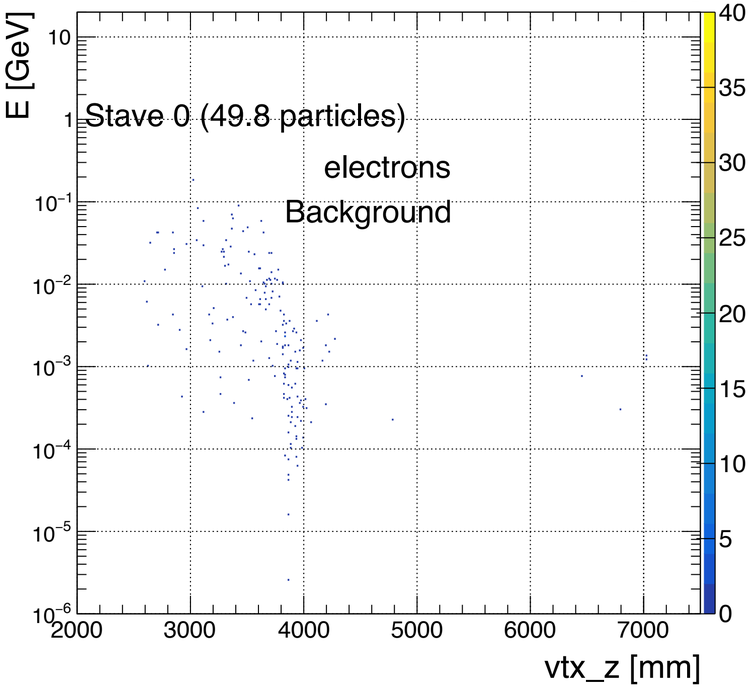
Electrons in Inner Stave, first layer of tracker, cut on vtx_z and vtx_x

- Removed electrons from vtx_x < 0 and vtx_z > 3600 mm and vtx_z < 4600 mm
- But not much effect as understandable from the previous slide.









Summary table of the number of background electrons

JETI40, e+laser	Electrons/BX	Electrons/BX after the vtx cut
Inner stave, first layer	13125.8	1514.5
Outer stave, last layer	6247.4	1230.6

Only electron beam, e+laser	Electrons/BX	Electrons/BX after the vtx cut
Inner stave, first layer	7540.8	641.6
Outer stave, last layer	2536.8	224.0

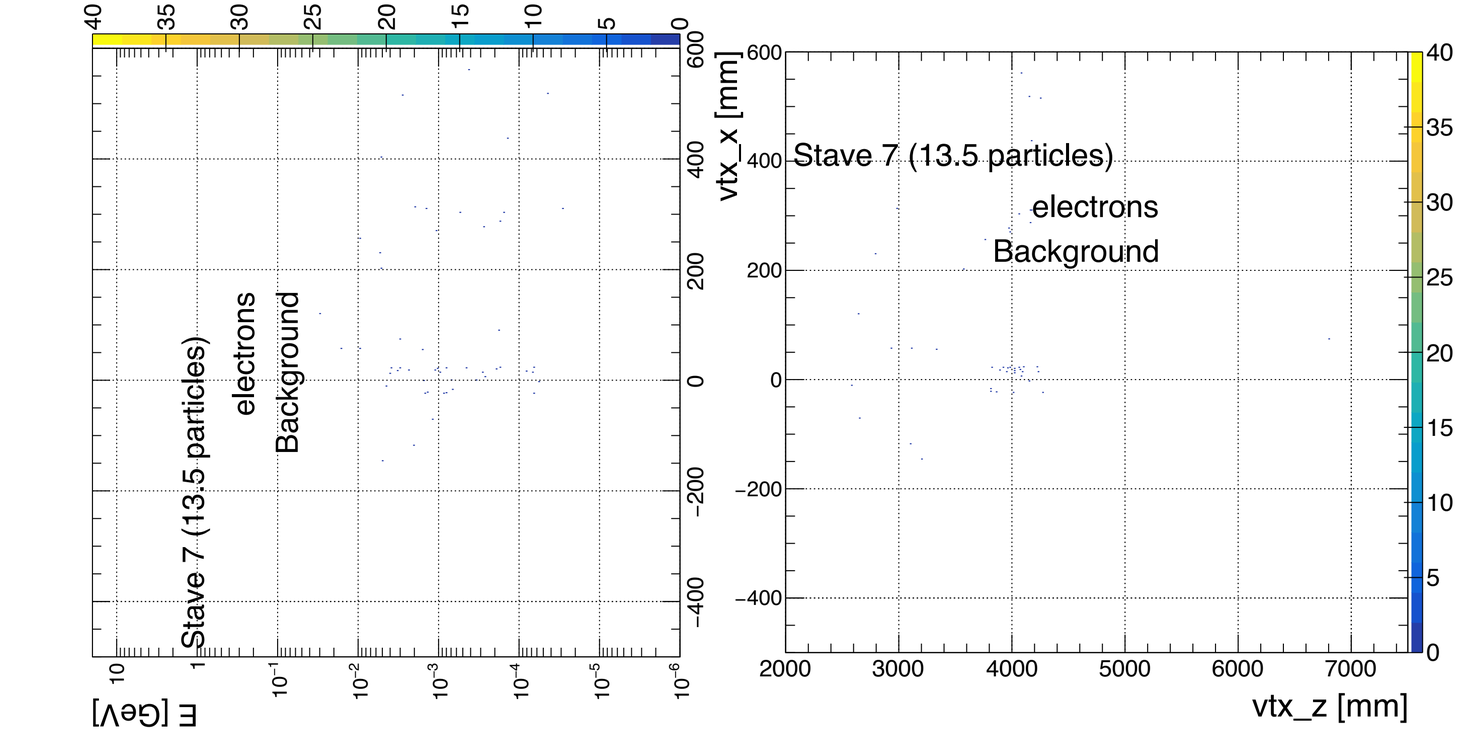
Only photon beam, g+laser	Electrons/BX	Electrons/BX after the vtx cut
Inner stave, first layer	53.2	49.8
Outer stave, last layer	13.5	11.4

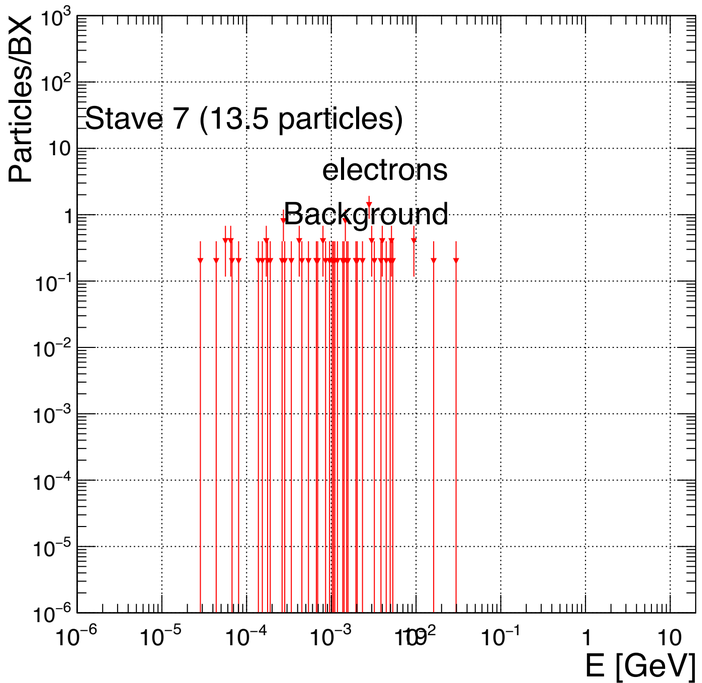
Summary

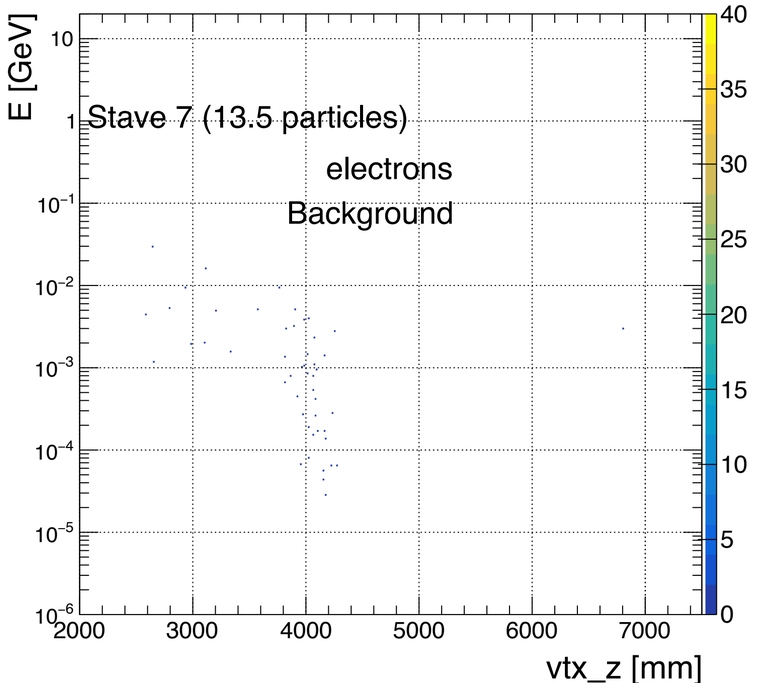
- A brief study of the origin of the background electrons.
  - Studied JETI40 e+laser hics, only electron beam and photon+laser setup.
- For the JETI40 hics, the “mechanical” vtx cut removed factor of 9 of background electrons.
  - The cut is not so effective for the last staves.
- First look at the electron beam only setup.
  - The “mechanical” vtx cut can remove factor of 12 of background.
- Photon+laser setup - vtx cut is not effective.
- For best tracker performance, we should aim to have ~10^2 background electrons.
- Analysis of deposit of energy (“hits”) in the tracker plane:
  - A bit convoluted as different trees have different information: need to coherently add those trees to make meaningful plots.
  - Work in progress.

Bonus slides

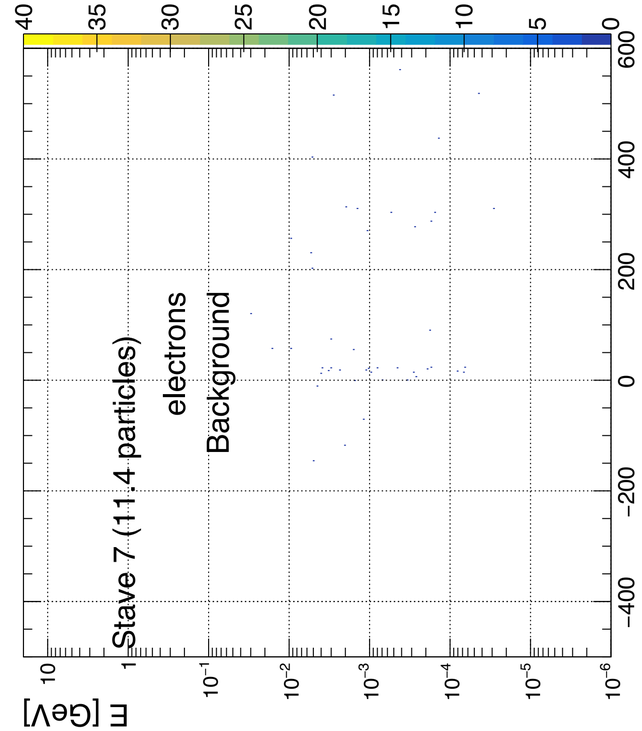
Electrons in Outer Stave, last layer of tracker (g+laser)

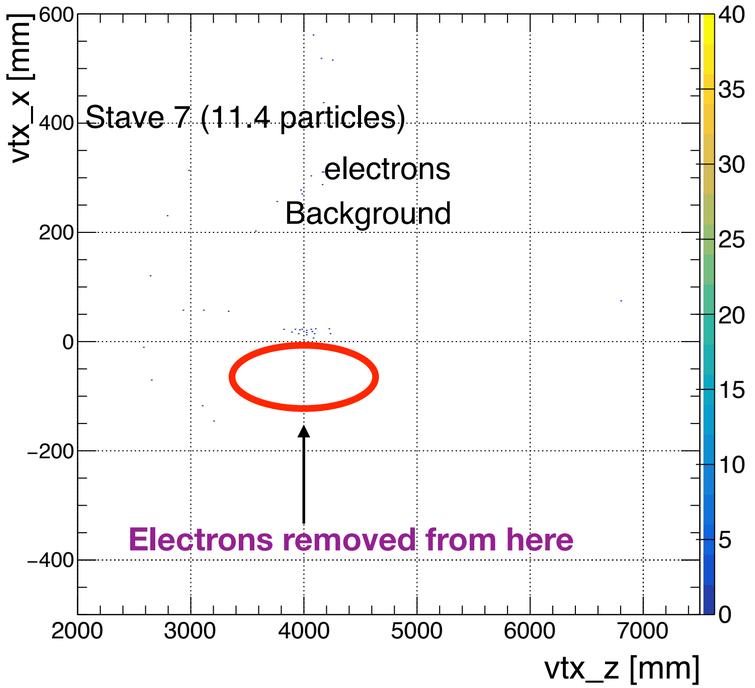


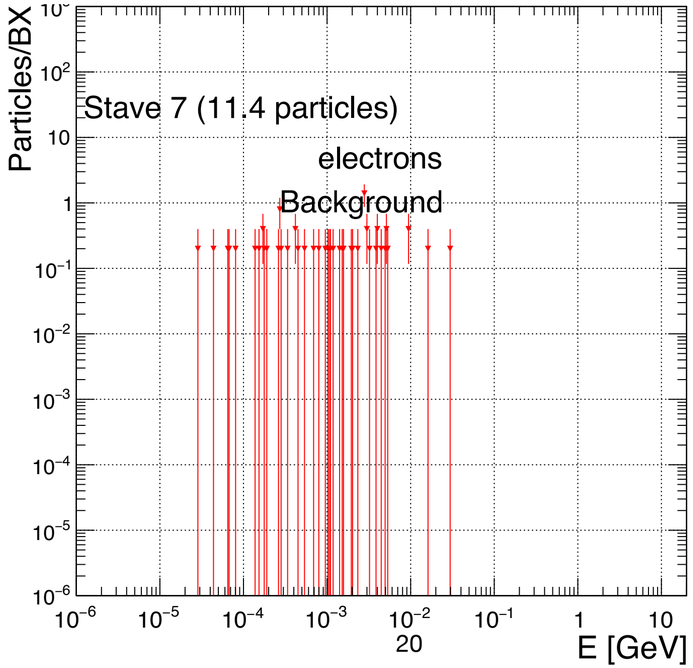


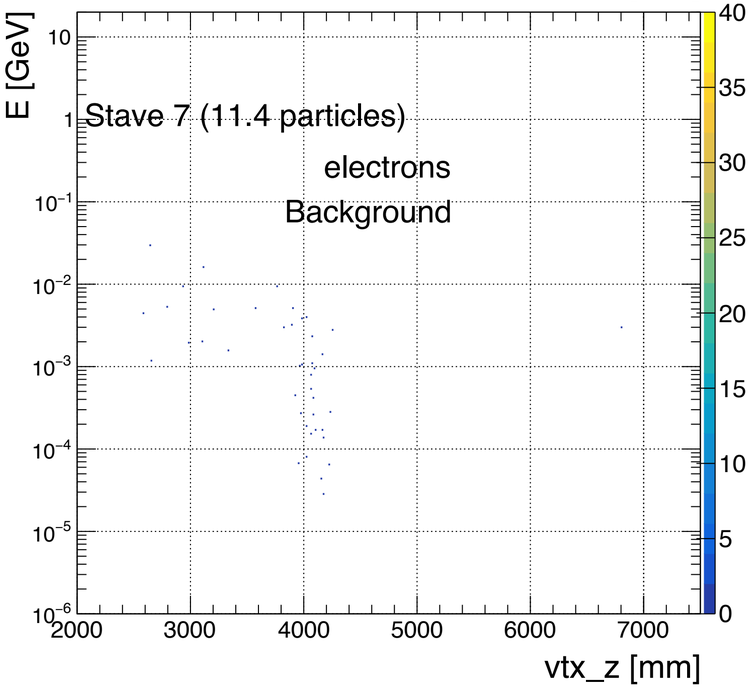


Electrons in Outer Stave, last layer of tracker, cut on vtx_z and vtx_x (g+laser)

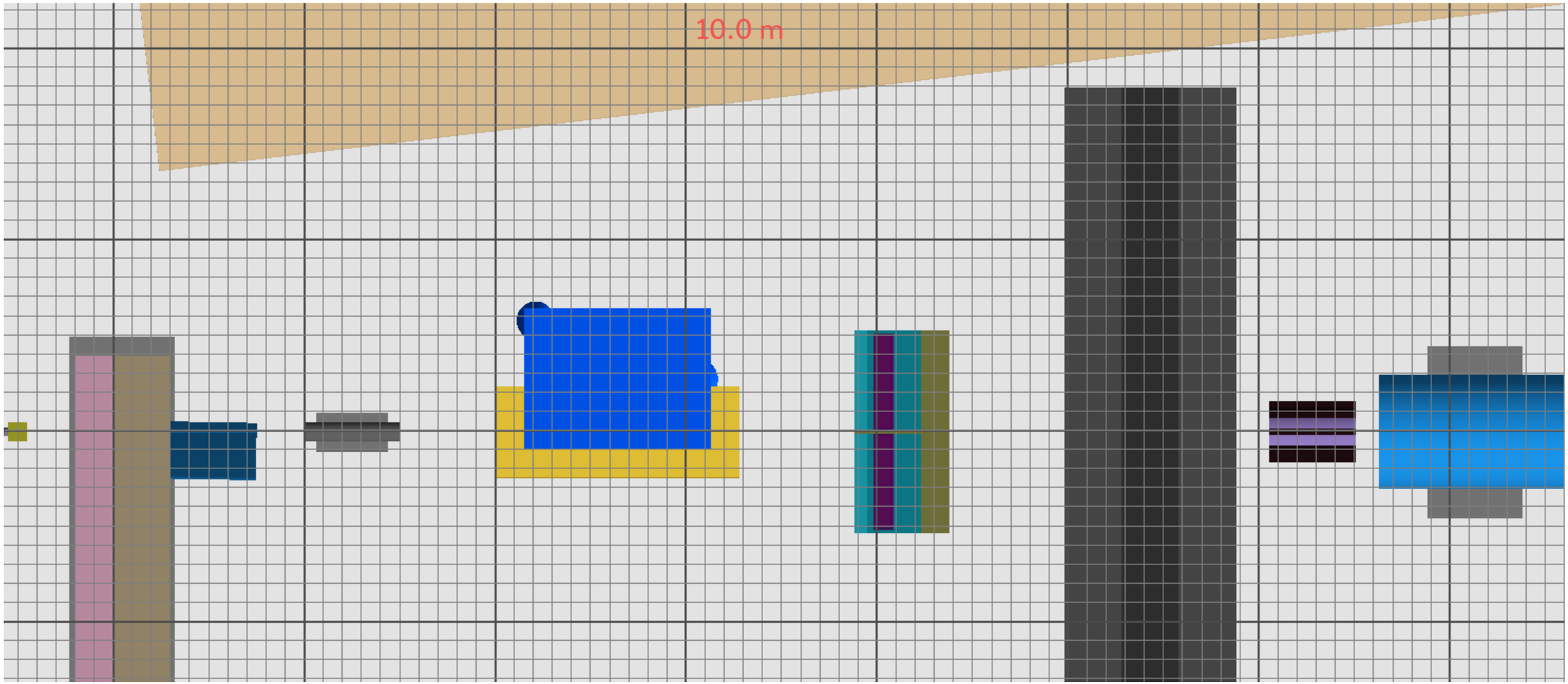






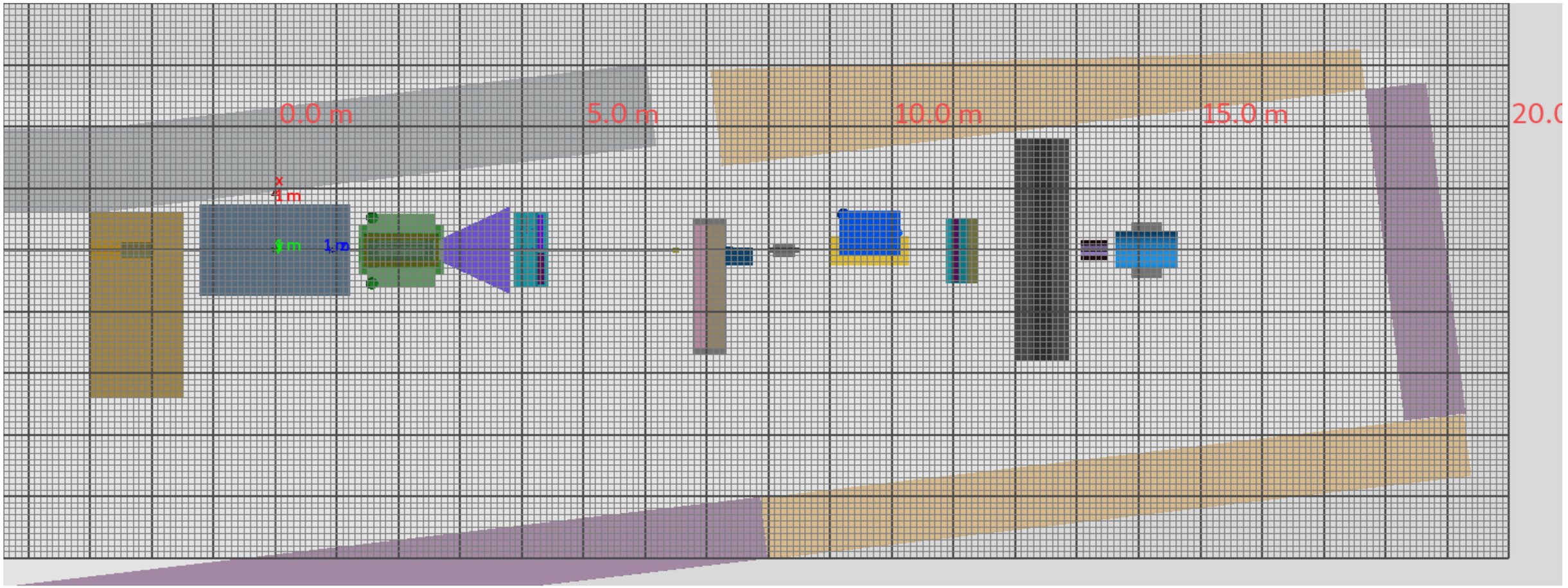


The subsystems near the beam dump



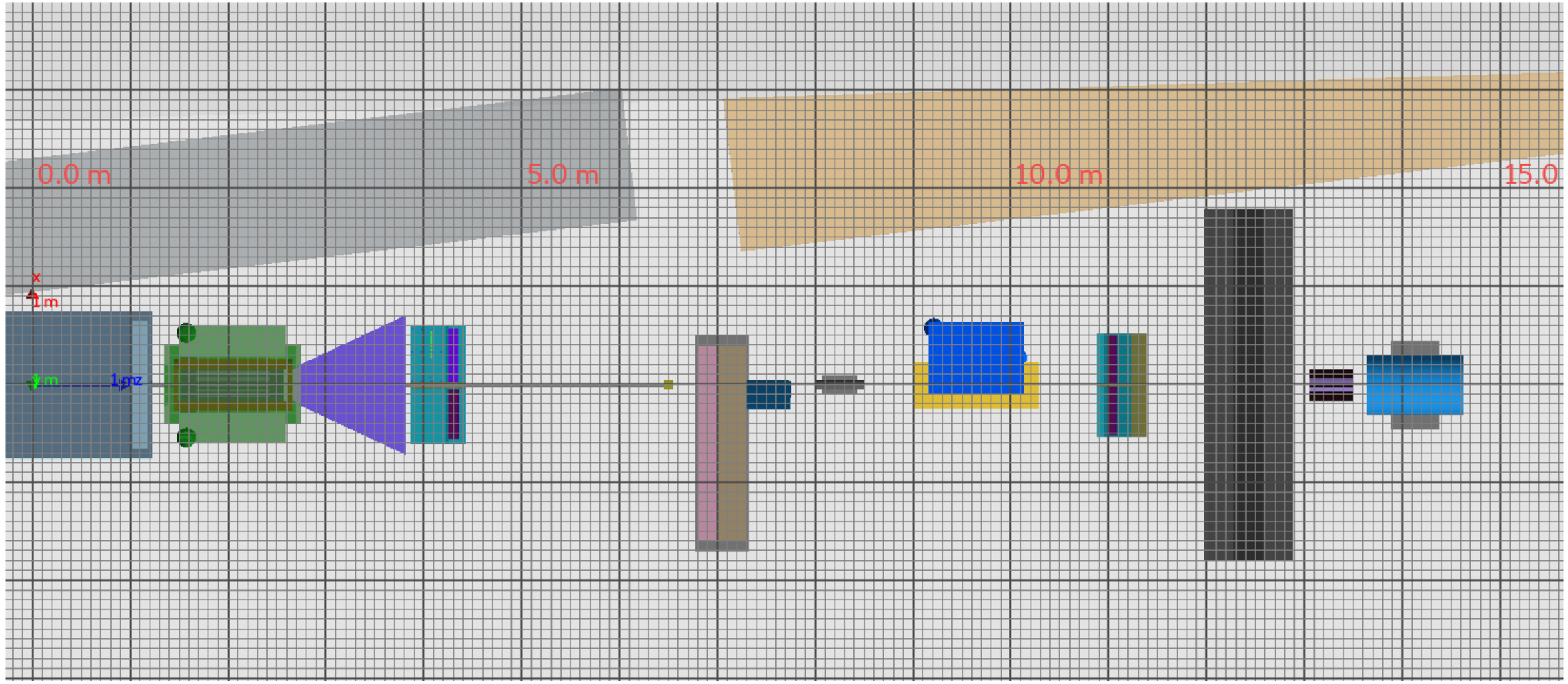
Plots from Sasha

The entire subsystem



Plots from Sasha

The subsystems from the IP to beam dump



Plots from Sasha