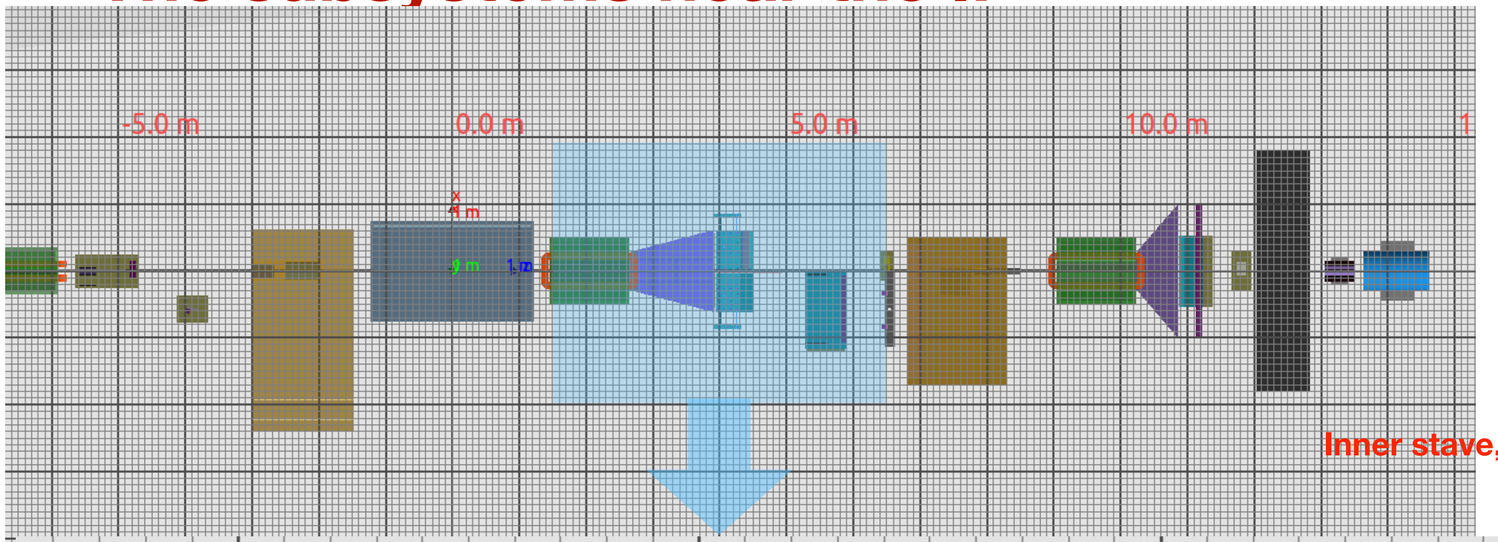
Background particles in the Tracker Subsystem

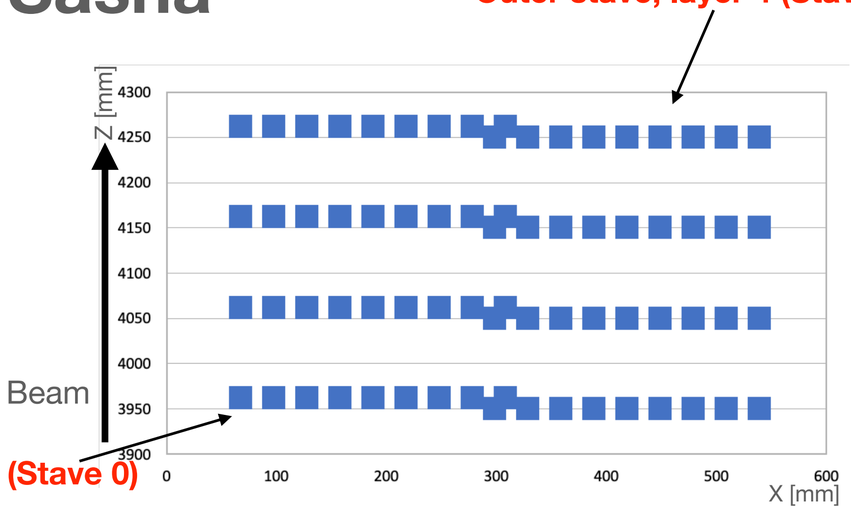
LUXE Simulation and Analysis Meeting

Arka Santra, October 5, 2021
Weizmann Institute of Science,
Rehovot, Israel

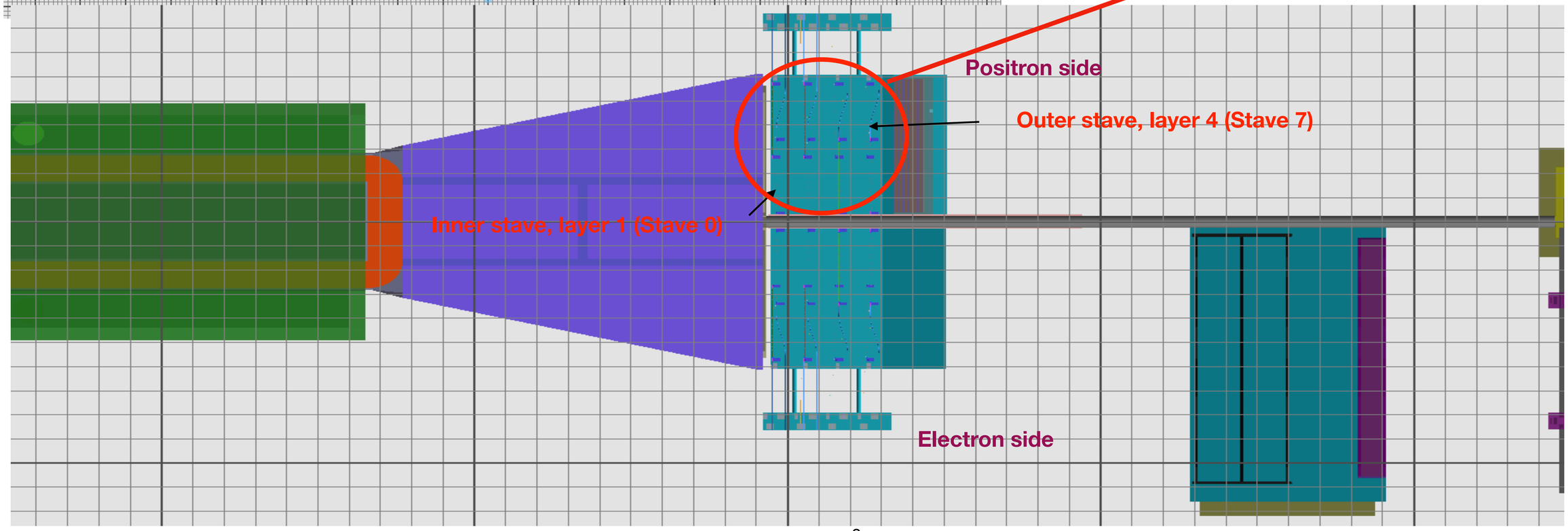
The subsystems near the IP

Plots from Sasha





Inner stave is now behind the outer stave

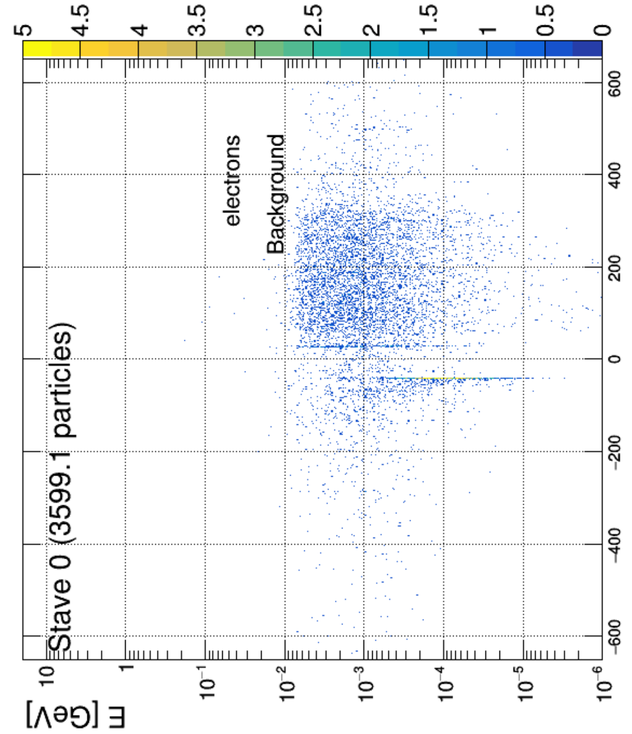


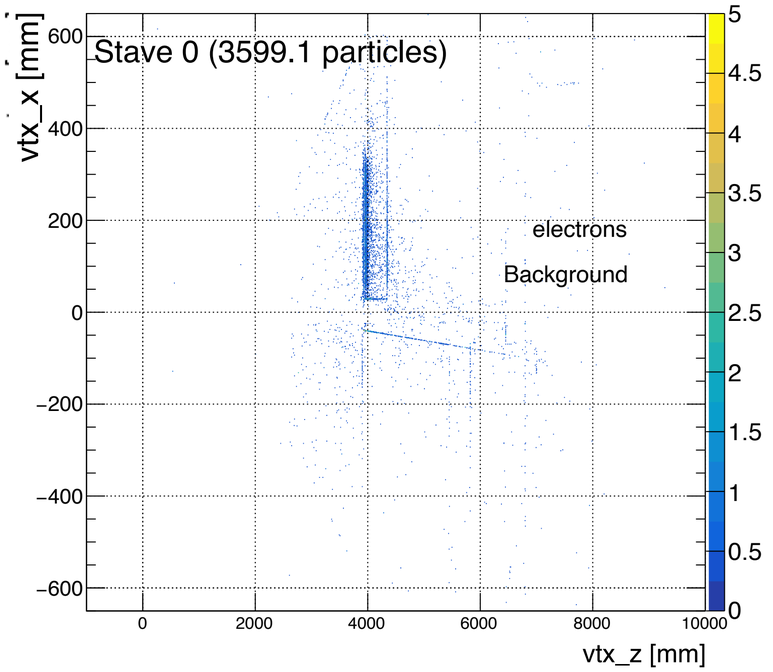
Main details:

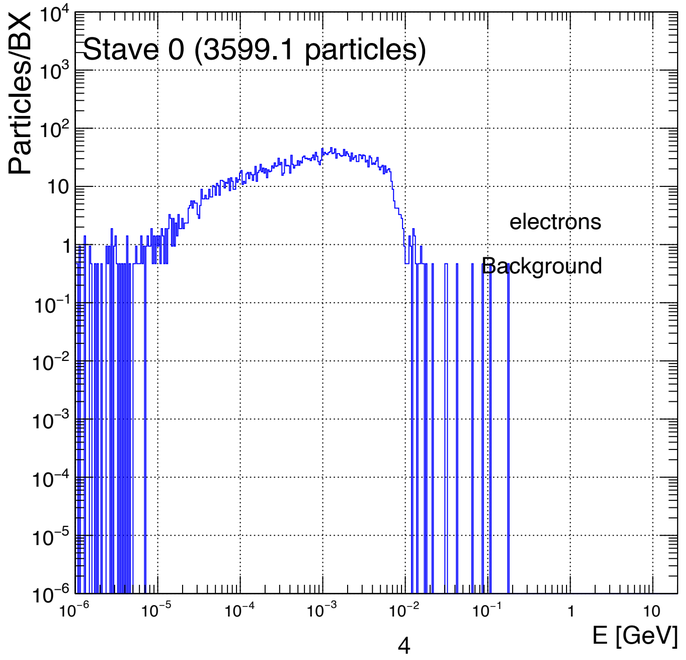
- e+laser background only setup
  - Only beam, no laser.
  - Looked at the background particles:
    - Mainly electrons, photons
  - Plots from the tracks intersecting the tracker plane (not necessarily making a hit in the tracker).
  - 2.13 BX of background samples, plots normalized to 1 BX.

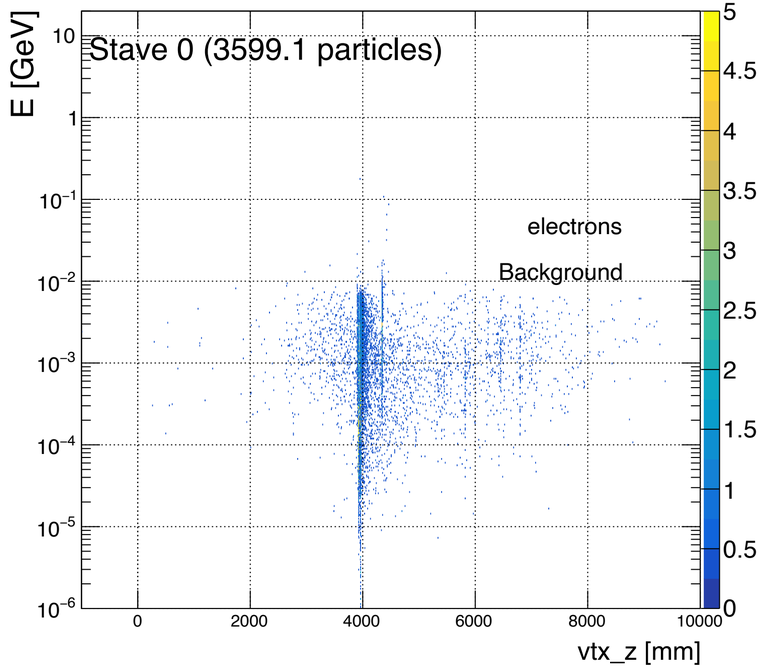
Electrons in Inner Stave, first layer of tracker

- These plots are being shown for the first time.
  - Effective 3D plot.
- Zoom out Z axis.



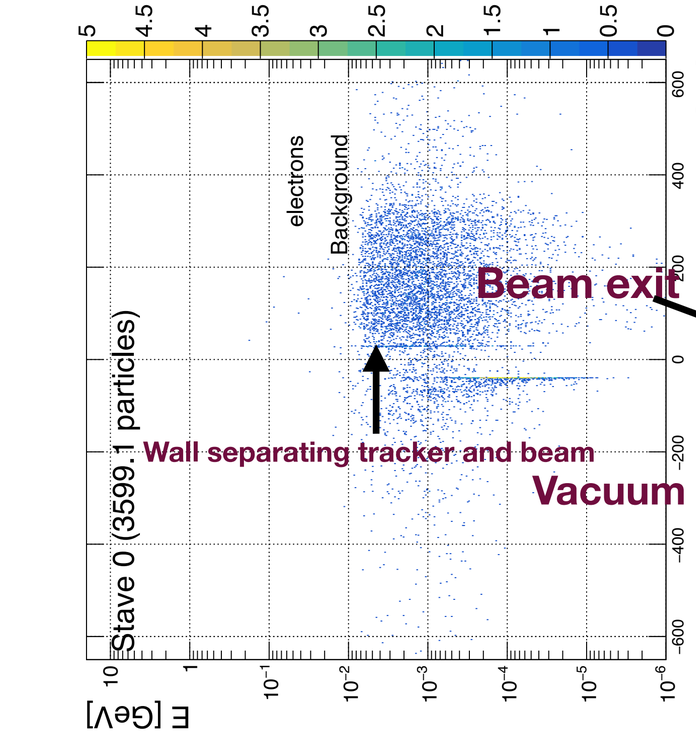


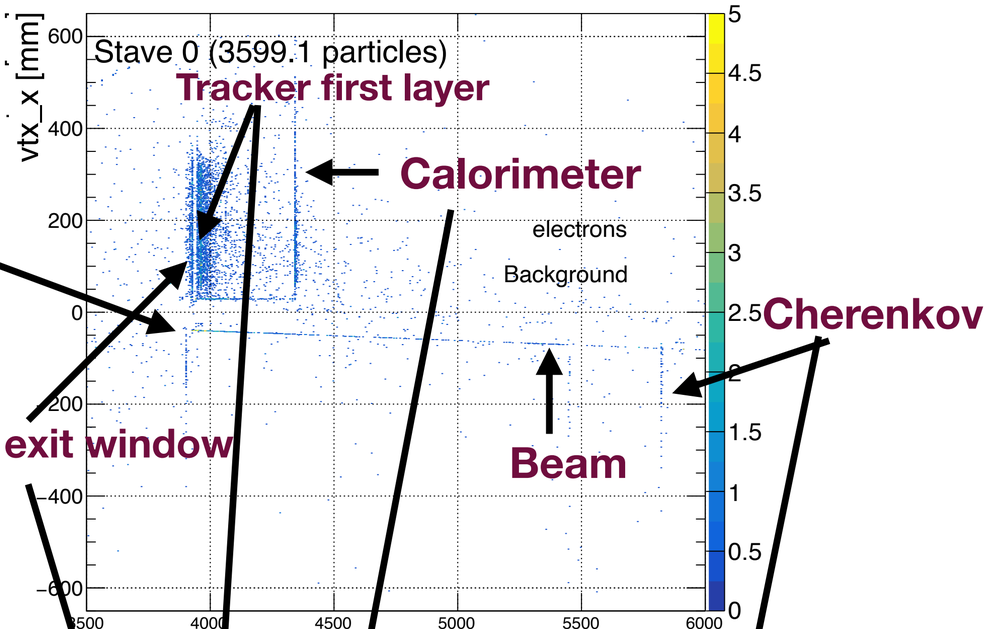


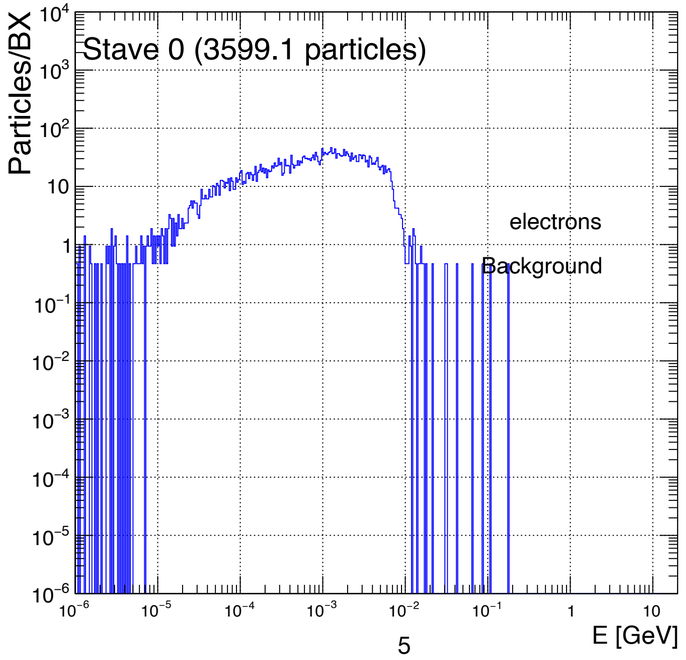


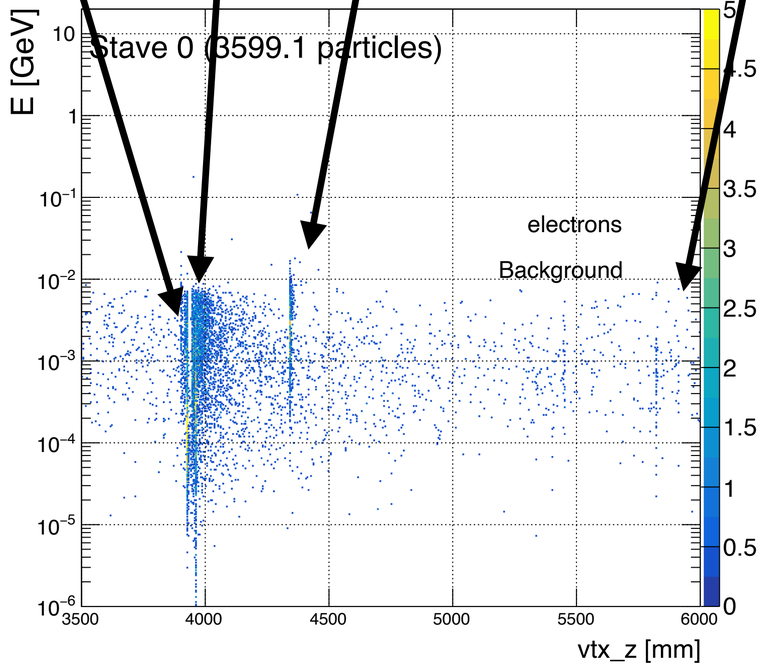
Electrons in Inner Stave, first layer of tracker

- Z axis zoomed in.
- We have high number of electrons having energies more than 10 KeV.
  - Can be ~100 MeV.
  - Many are not from staves



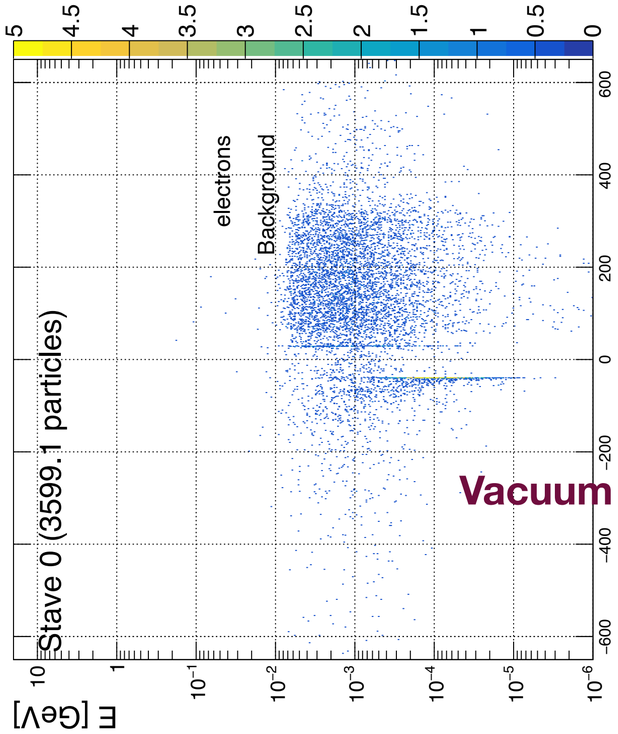


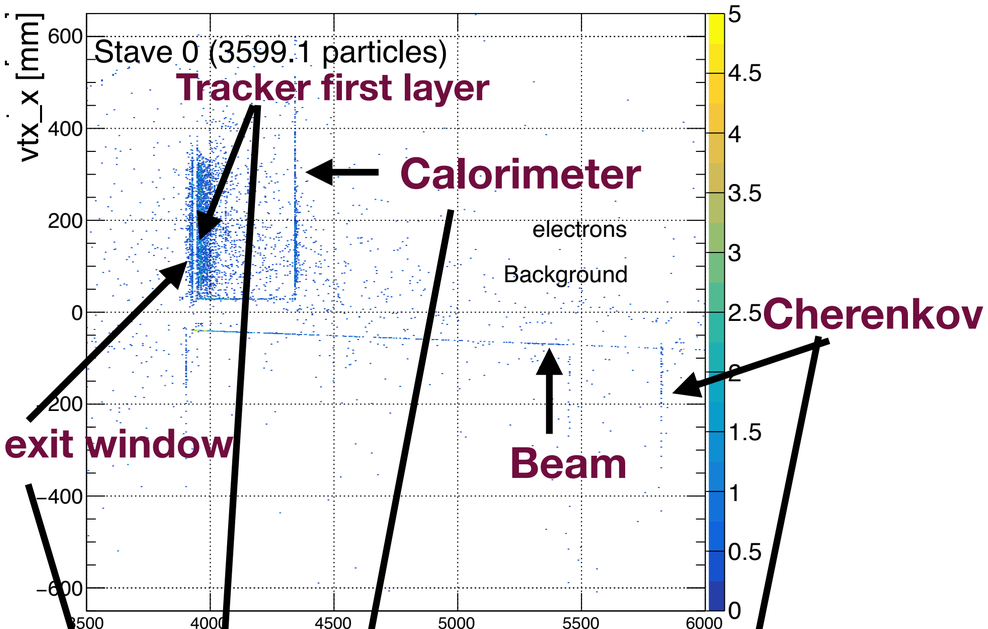


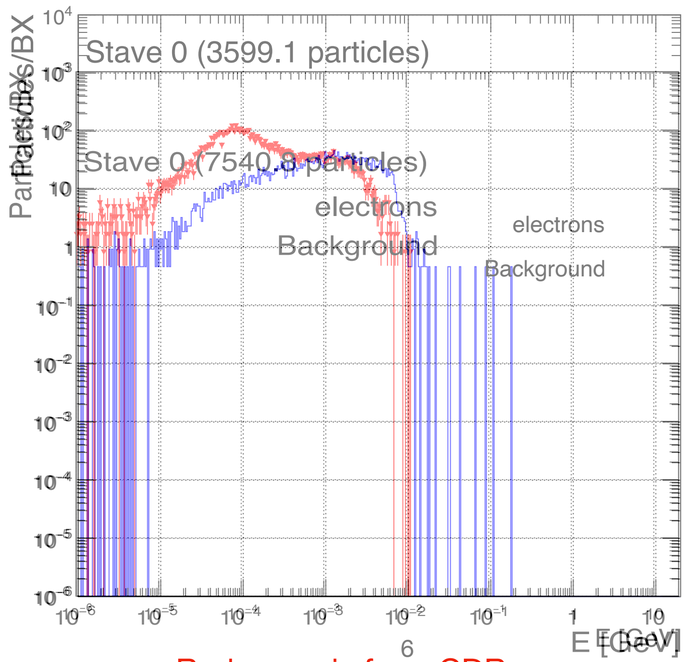


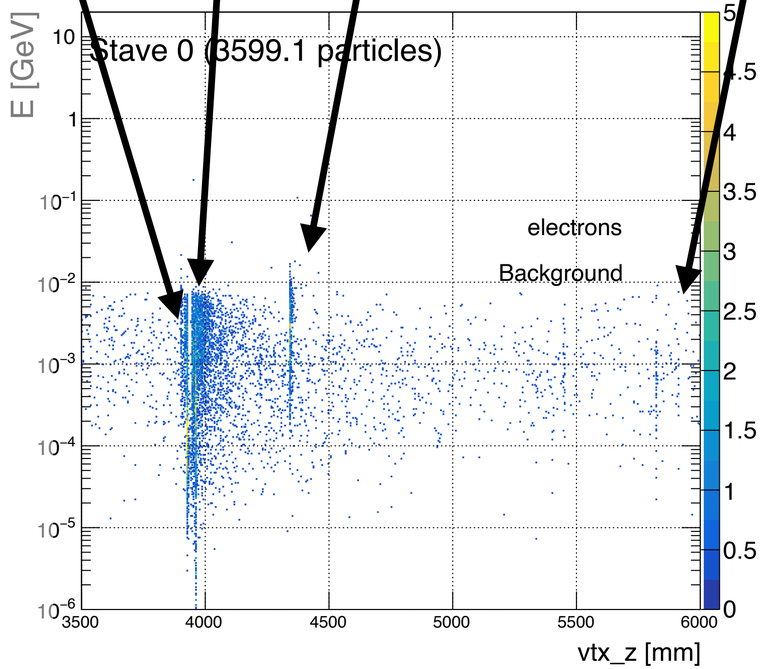
Electrons in Inner Stave, first layer of tracker

- These plots are being shown for the first time.
  - Effective 3D plot.
- We have high number of electrons having energies more than 10 KeV.
  - Can be ~100 MeV.
  - Many are not from staves





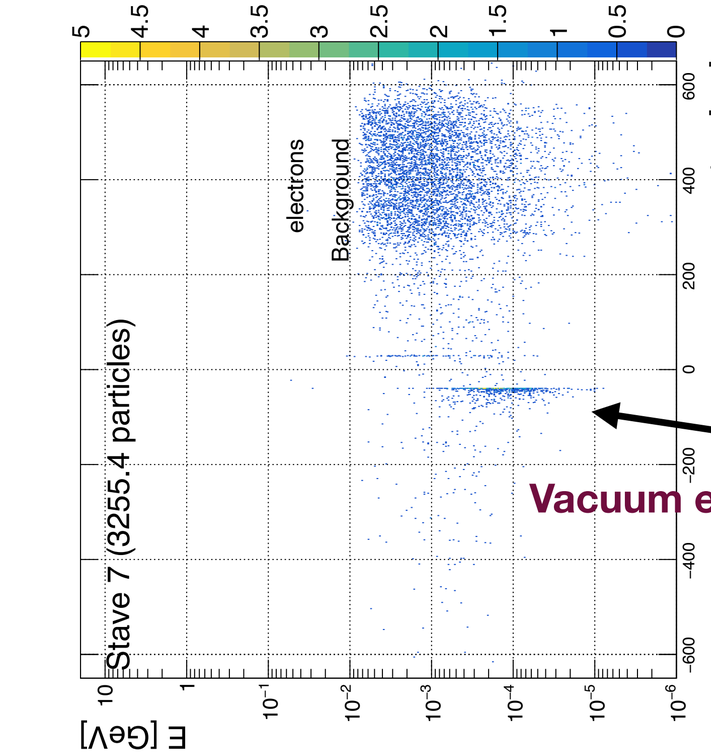


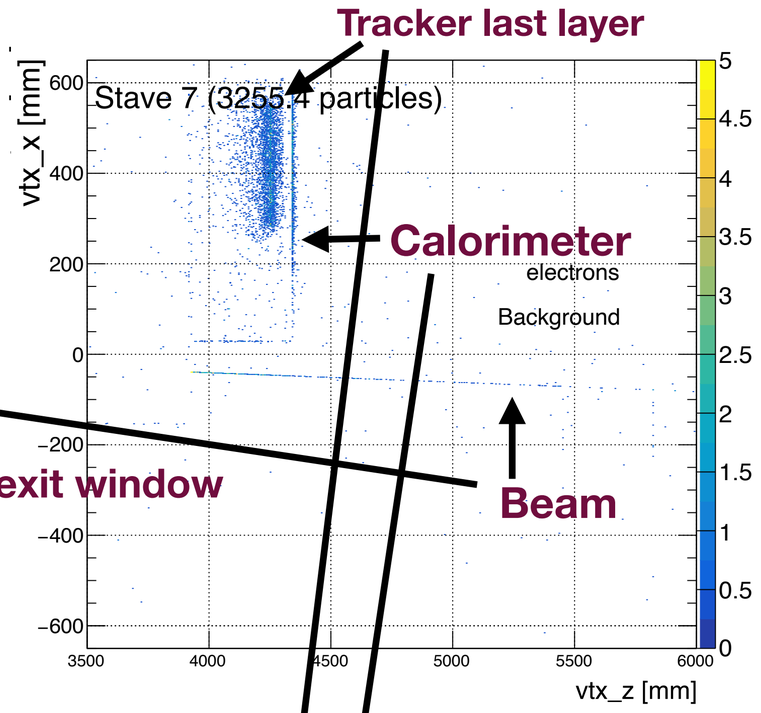


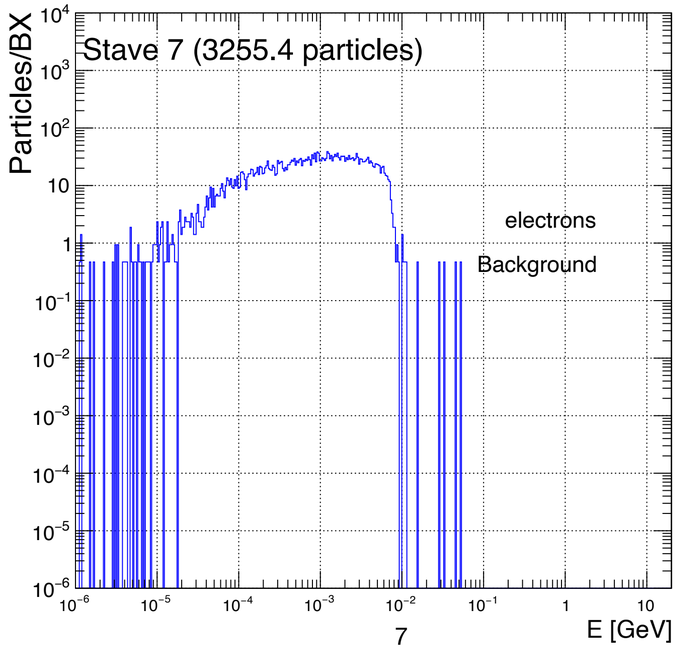
Red curve is from CDR

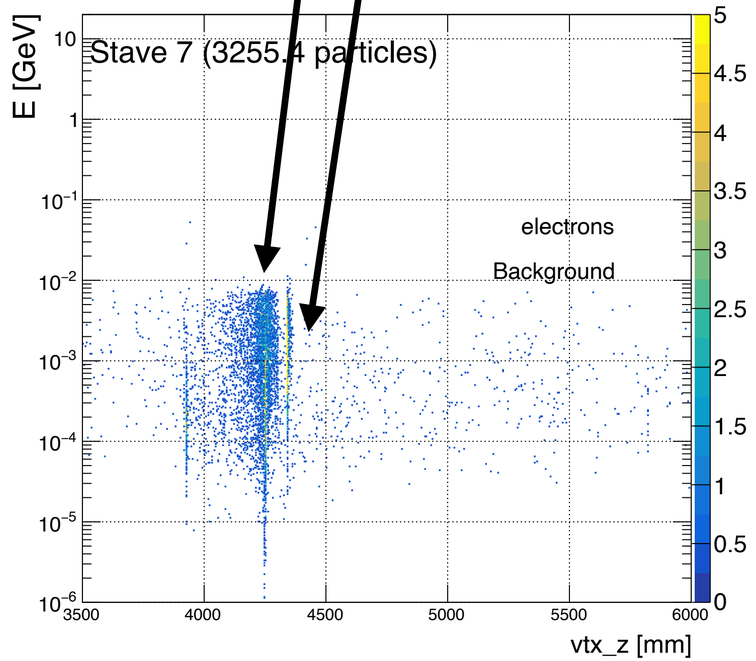
Electrons in Outer Stave, last layer of tracker

- This is now the stave 7.
- Electrons are coming from stave 7 and calorimeter mostly.
- Energy can be as high as 10 MeV.



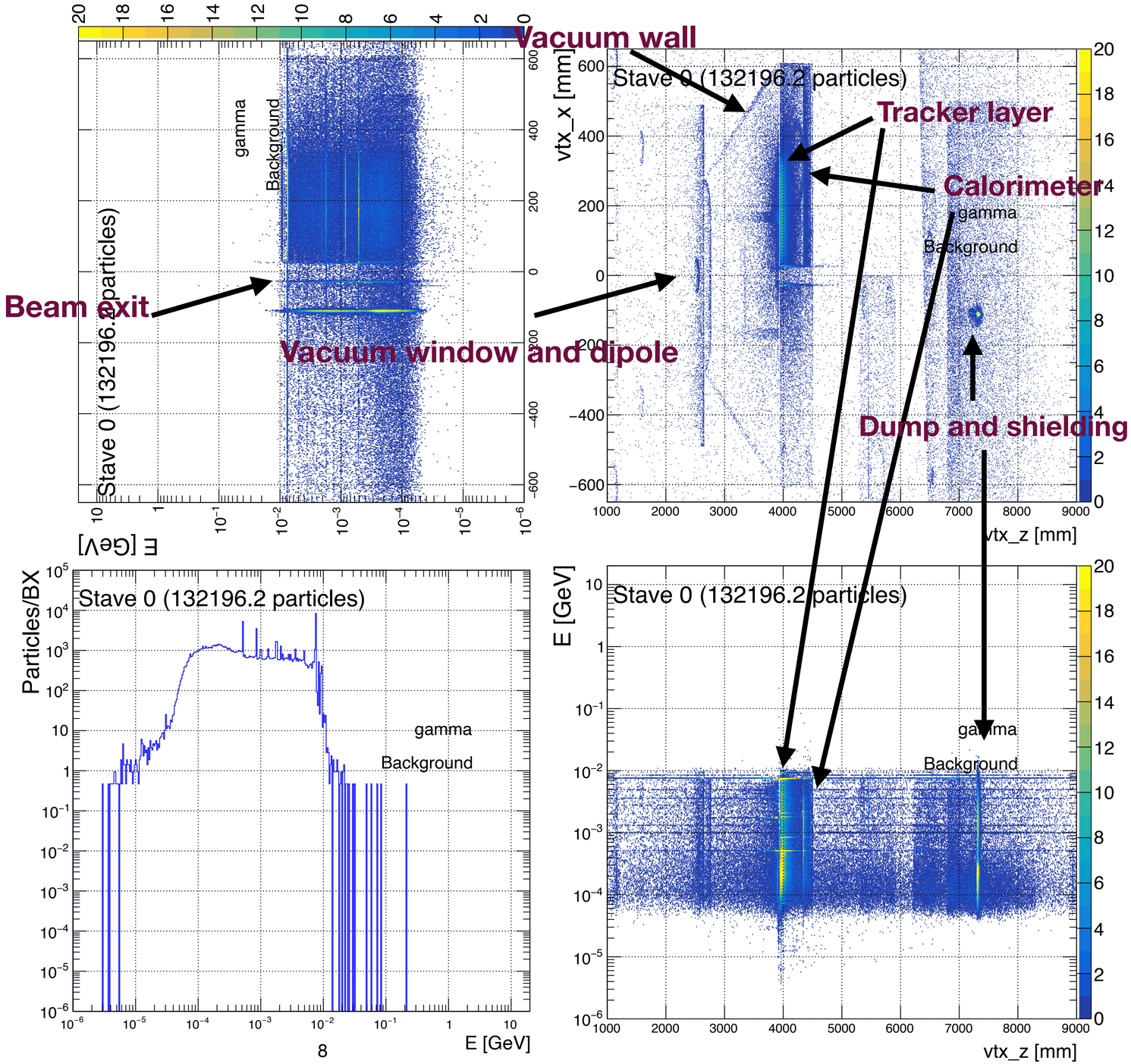






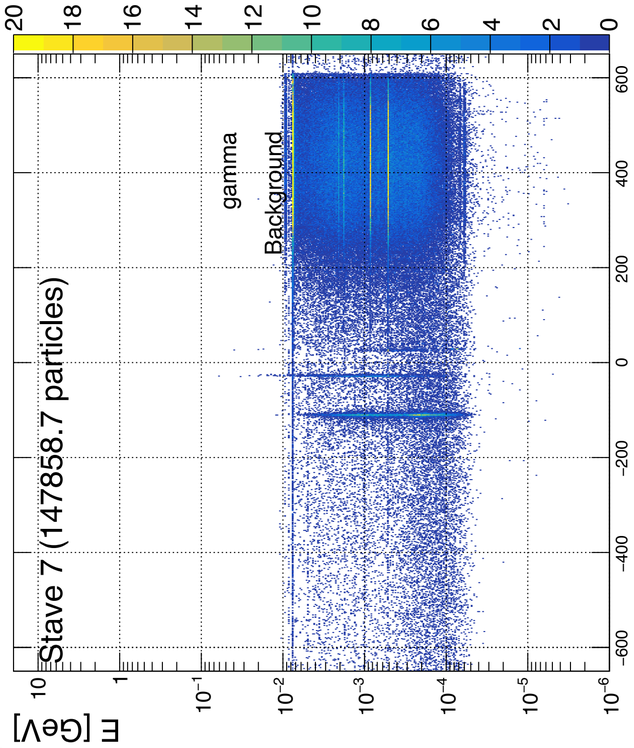
Photons in Inner Stave, first layer of tracker

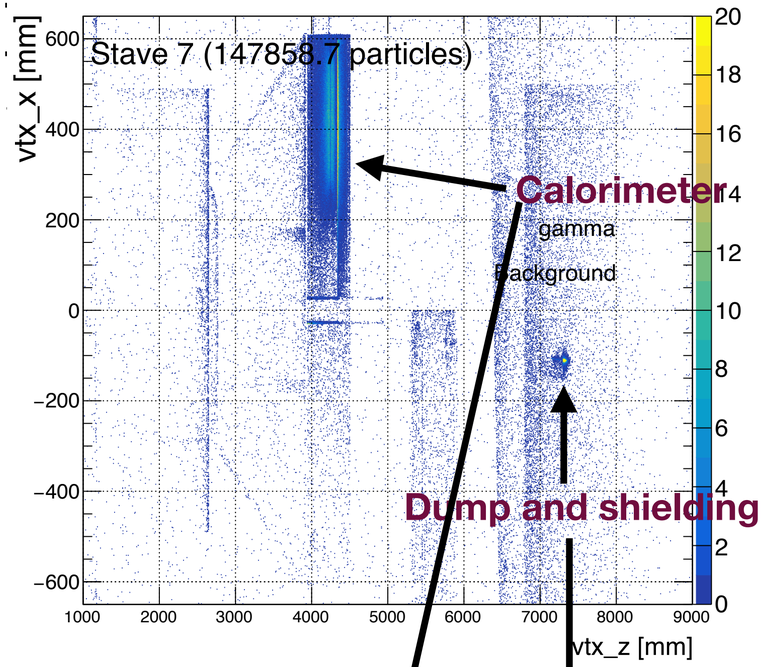
- We have high number of photons coming from dump.
  - Also from beam exit.
  - Calorimeter.
- E ~ 100 KeV to 10 MeV

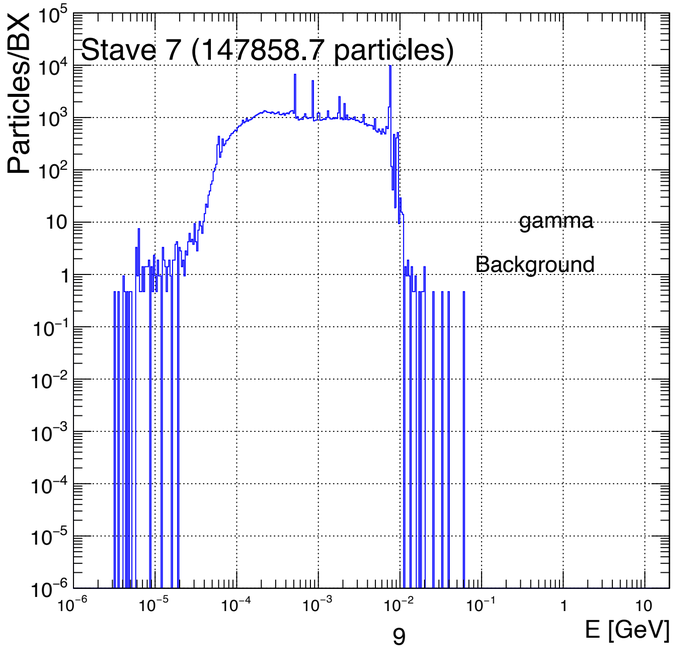


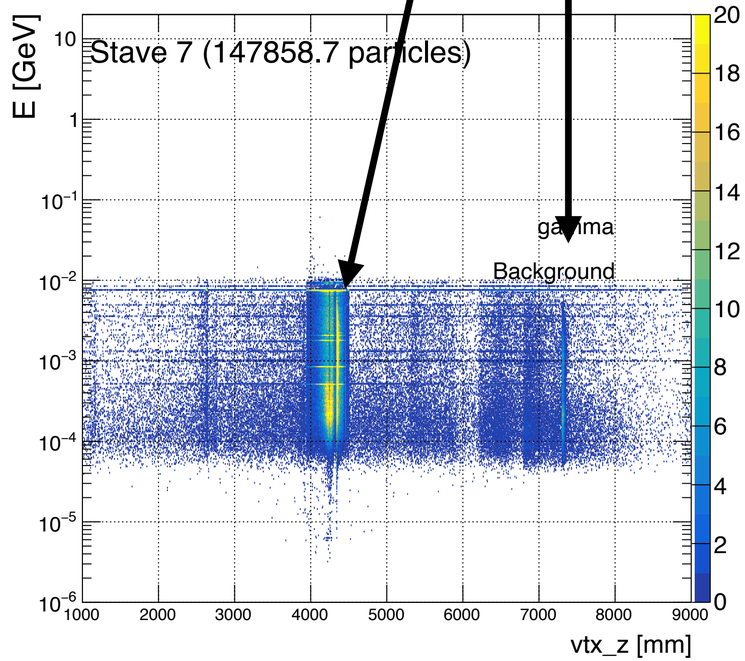
Photons in Outer Stave, last layer of tracker

- This is now the stave 7.
- Most photons are coming from the calorimeter and shield.
- Some photons from the staves, not much.



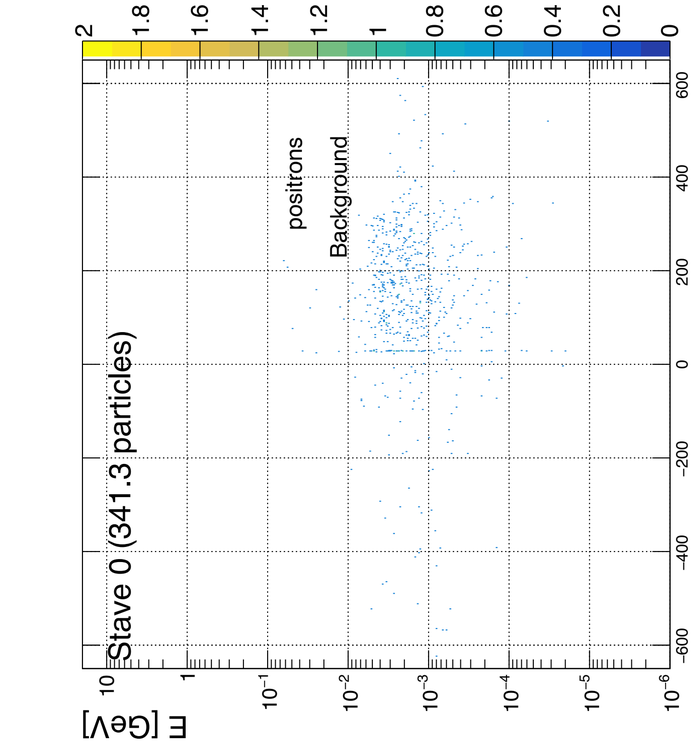


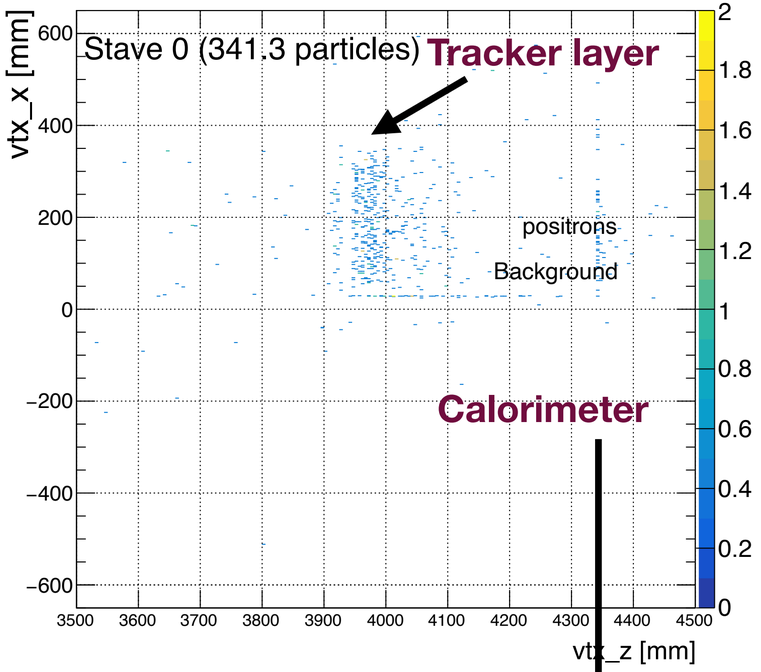


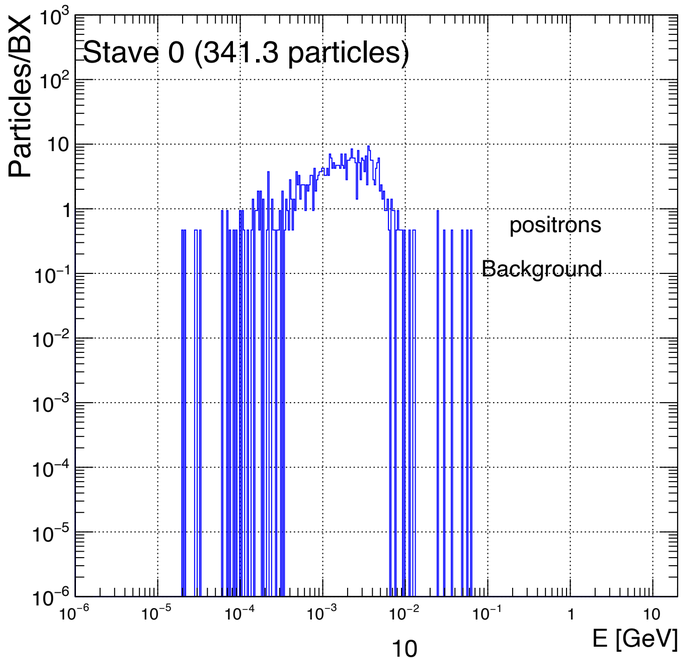


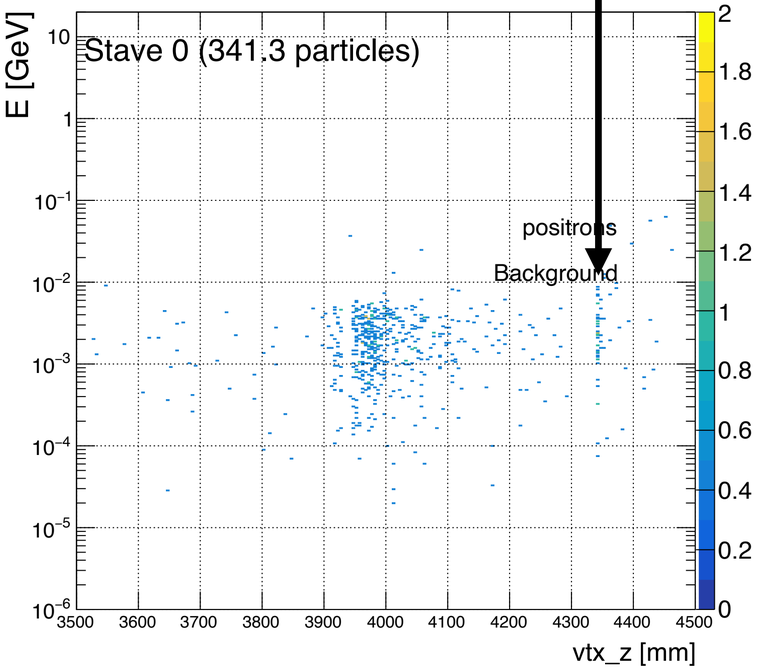
Positrons in Inner Stave, first layer of tracker

- Few positrons.
  - Most are from the stave itself.
  - A few from the calorimeter and the wall between beam and tracker.



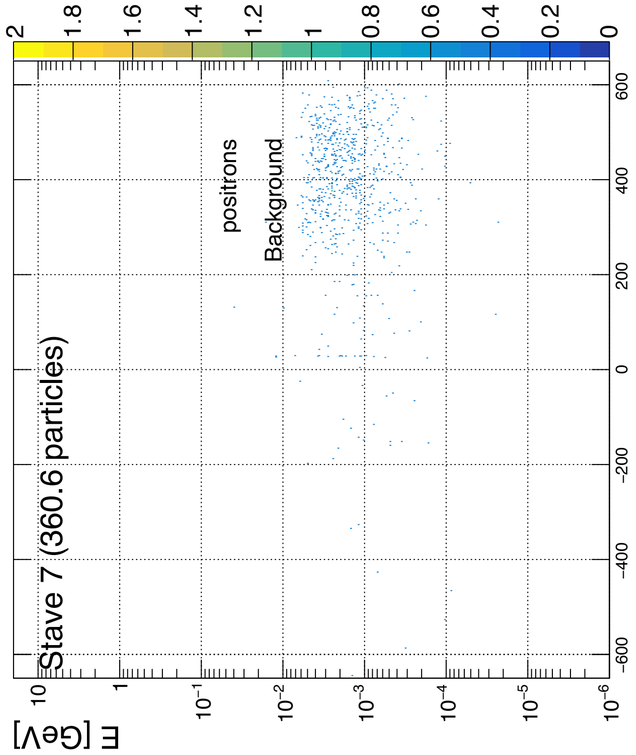


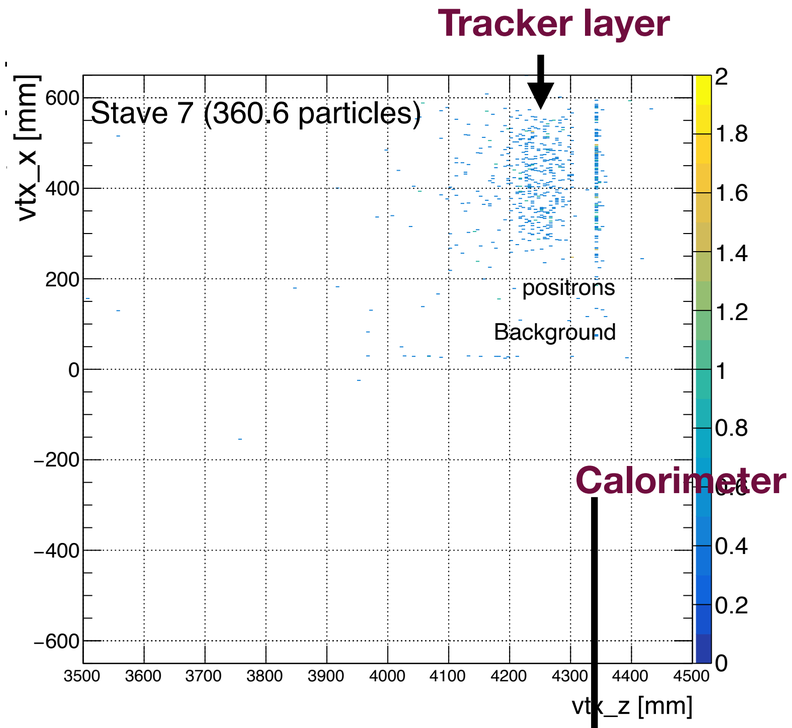


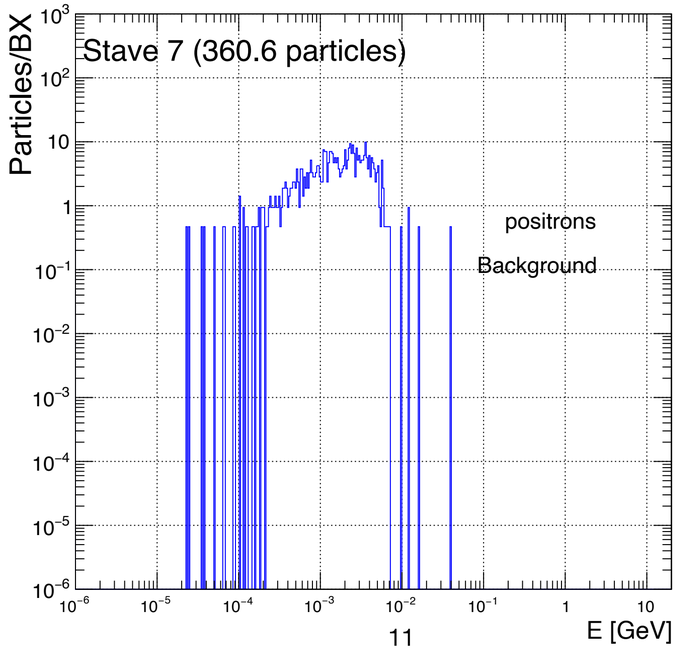


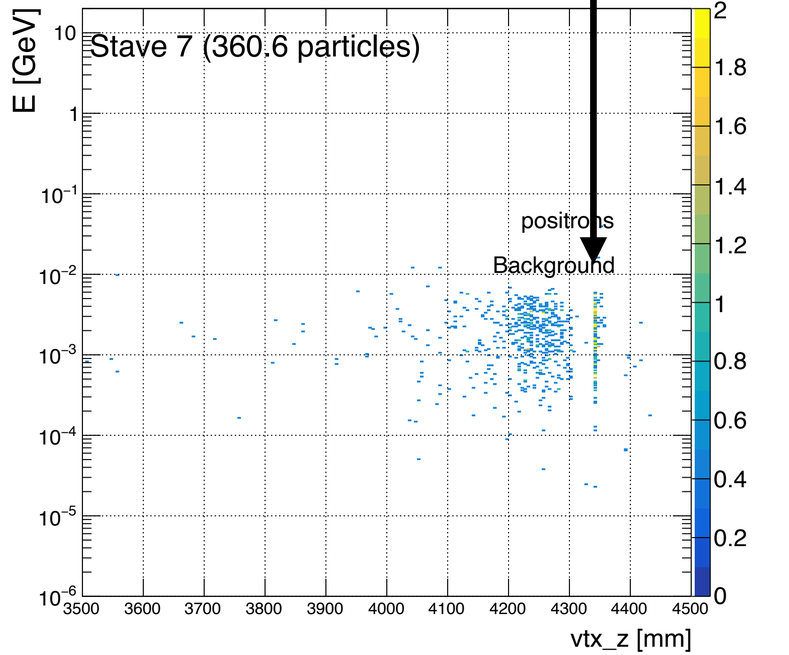
Positrons in Outer Stave, last layer of tracker

- Few positrons.
  - Most are from the stave itself.
  - A few from the calorimeter.









Summary table of the number of background particles

Only electron beam, e+laser	Electrons/BX [CDR]	Electrons/BX [Now]	Relative difference: (Now - CDR)/CDR
Inner stave, first layer	7540.8	3599.1	-52%
Outer stave, last layer	2536.8	3255.4	28%

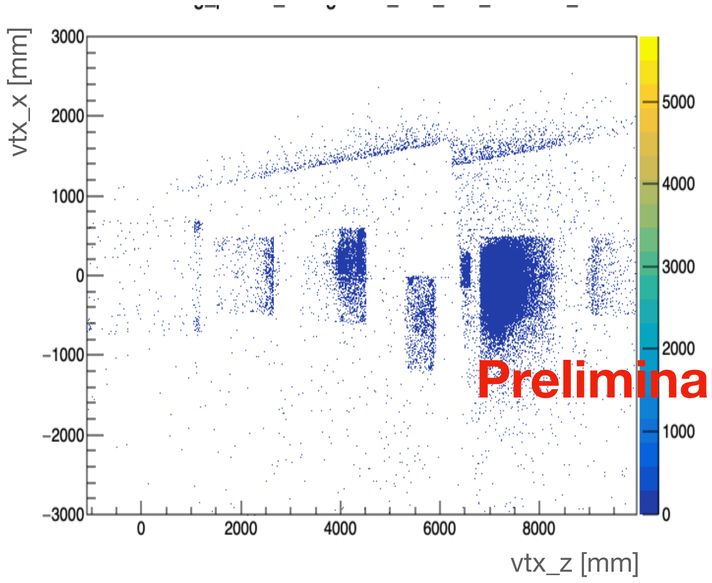
Only electron beam, e+laser	Photons/BX [CDR]	Photons/BX [Now]	Relative difference: (Now - CDR)/CDR
Inner stave, first layer	476062.4	132196.2	-72%
Outer stave, last layer	60675.8	147858.7	144%

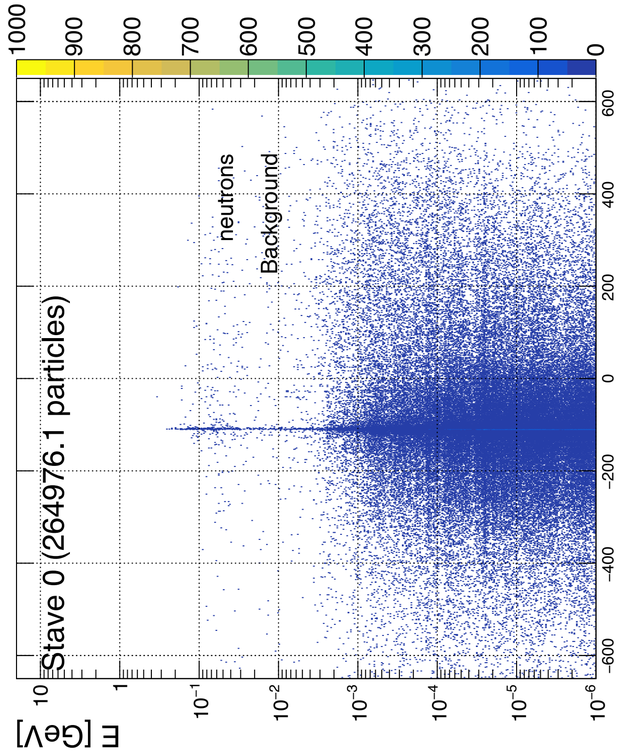
Only electron beam, e+laser	Positrons/BX [CDR]	Positrons/BX [Now]	Relative difference: (Now - CDR)/CDR
Inner stave, first layer	13	341.3	2500%
Outer stave, last layer	8	360.6	4400%

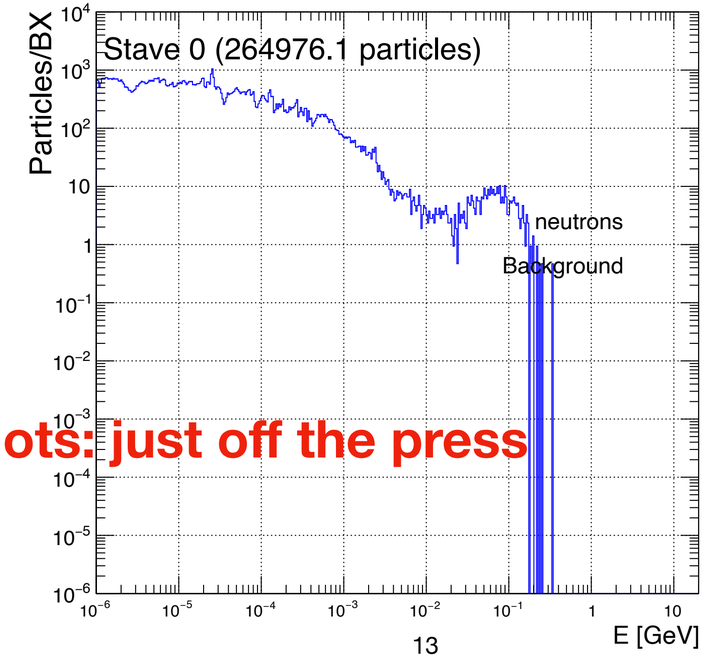
Now positrons are 1 order of magnitude higher, still much less than the electrons

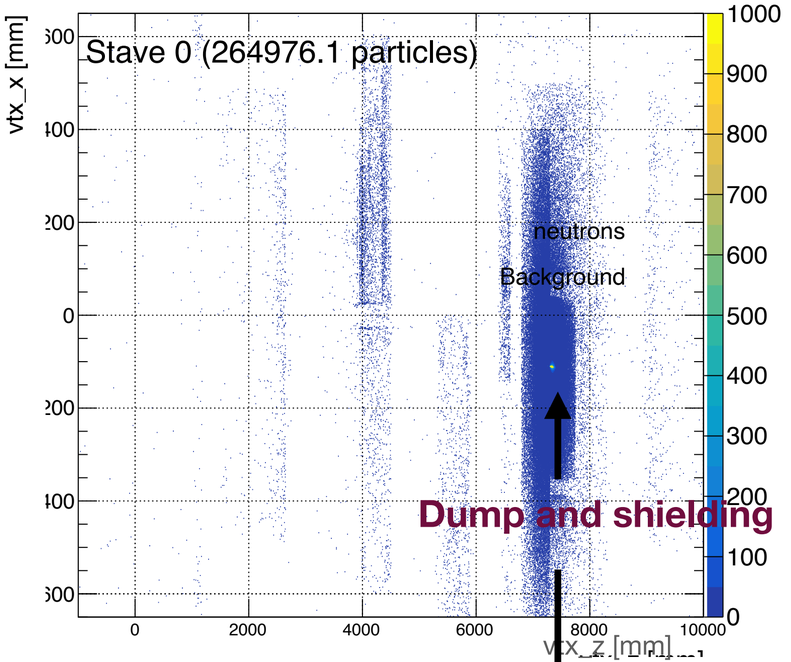
Neutrons in Inner Stave, first layer of tracker

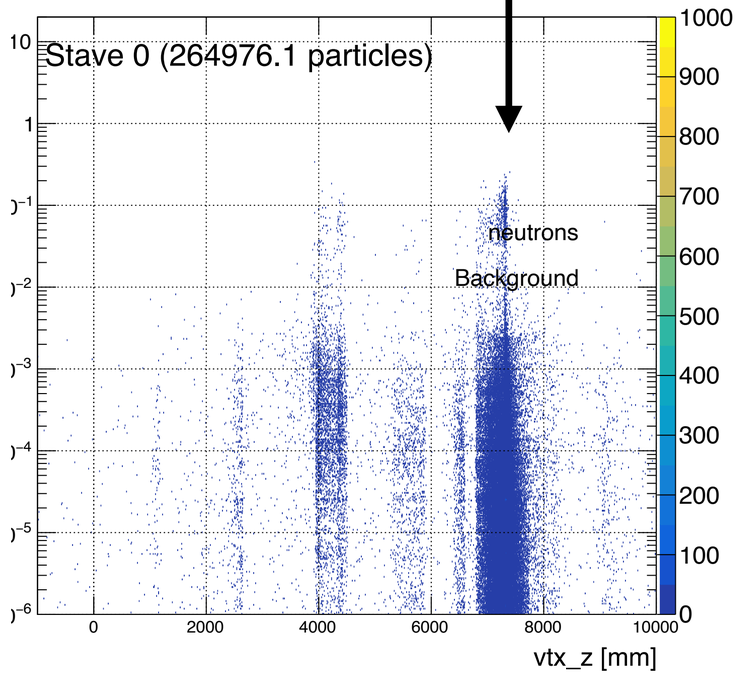
- Zoom out Z axis.
- Many neutrons now.







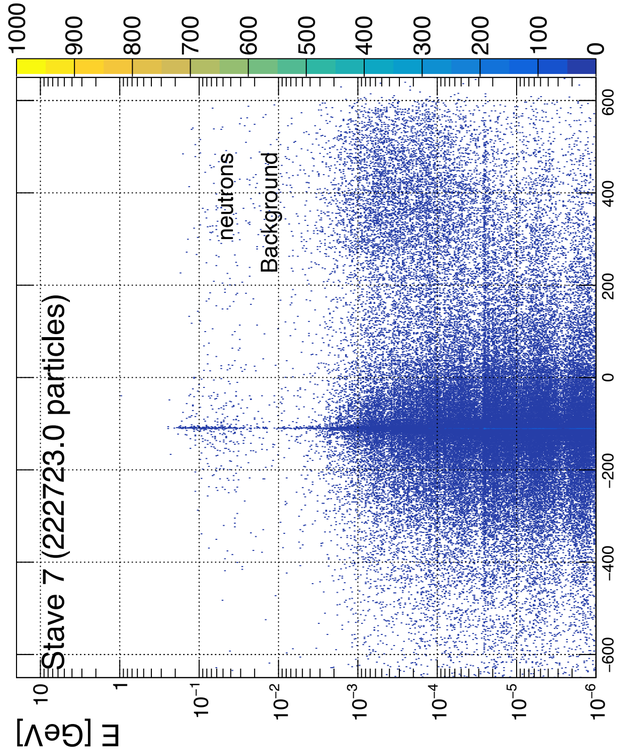


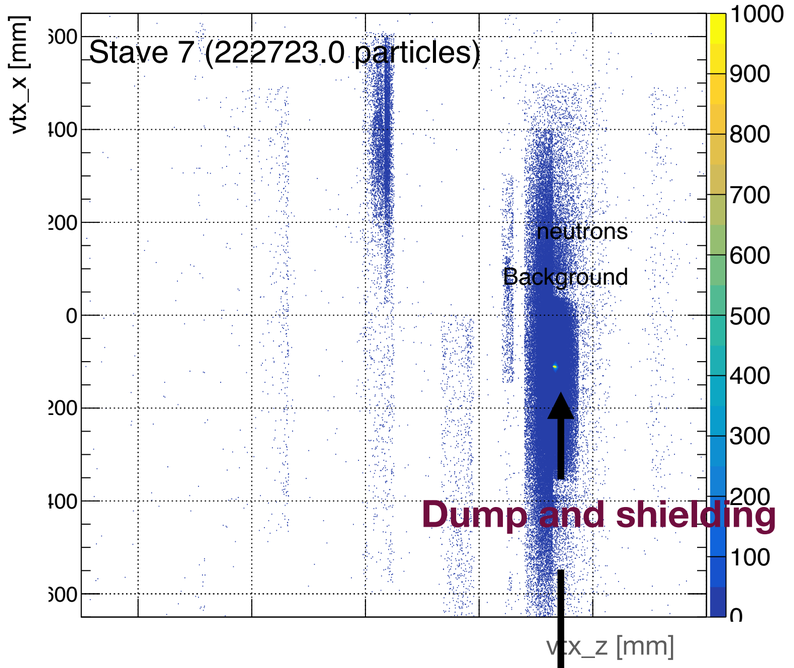


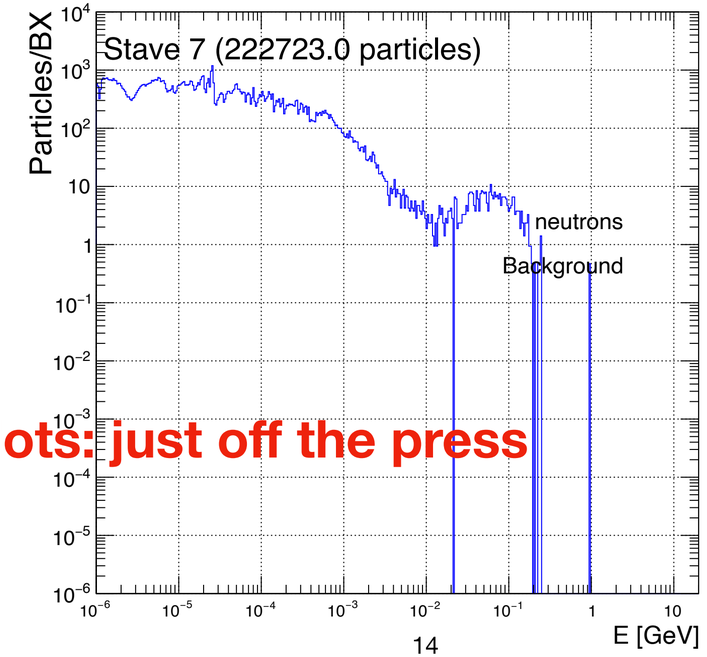
Preliminary plots: just off the press

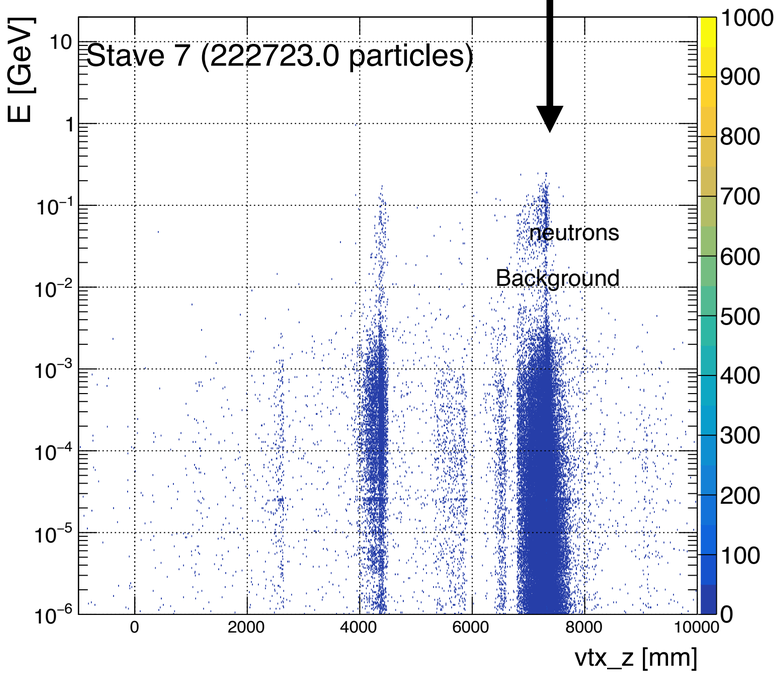
Neutrons in Outer Stave, last layer of tracker

- Zoom out Z axis.





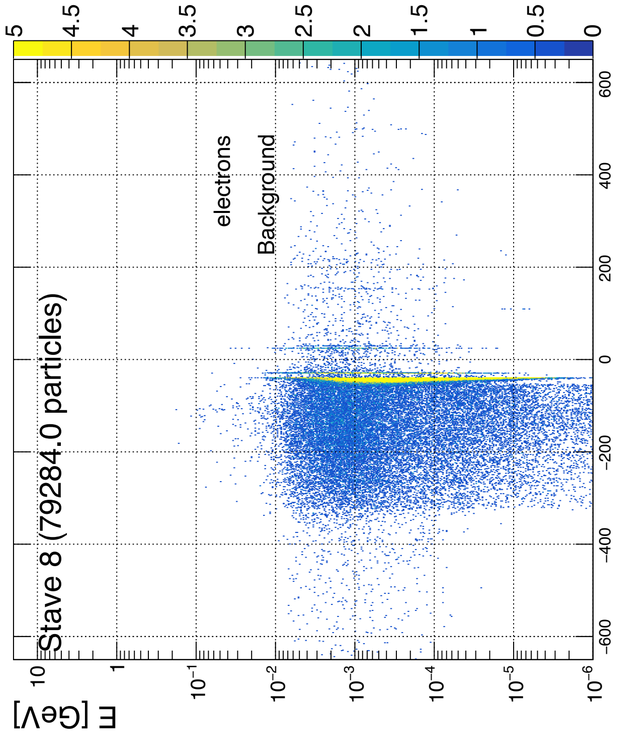


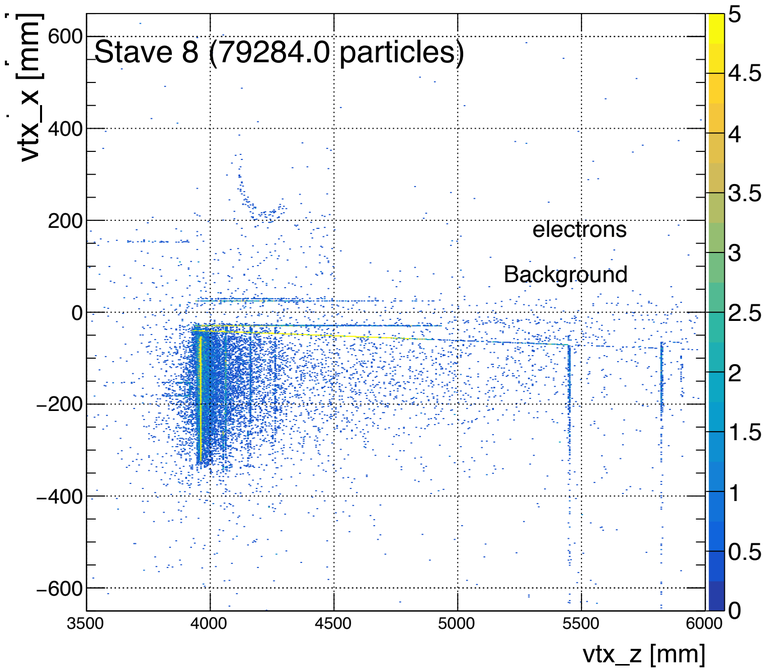


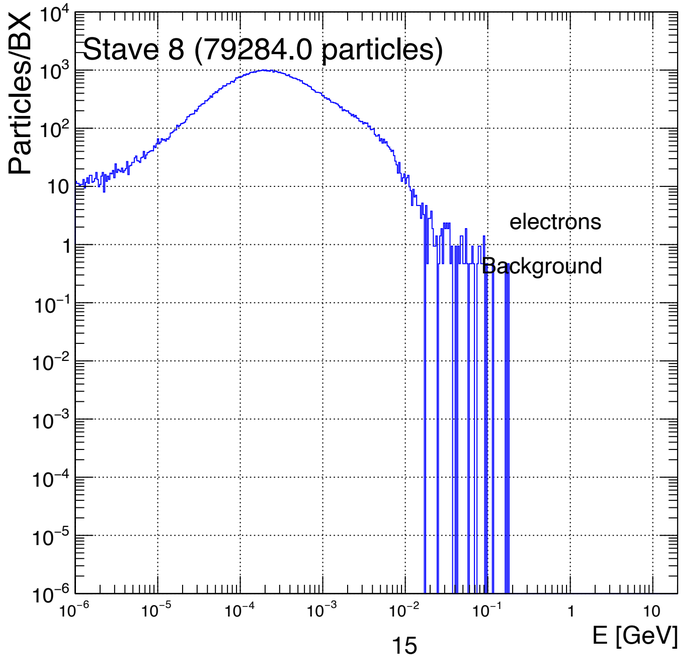
Preliminary plots: just off the press

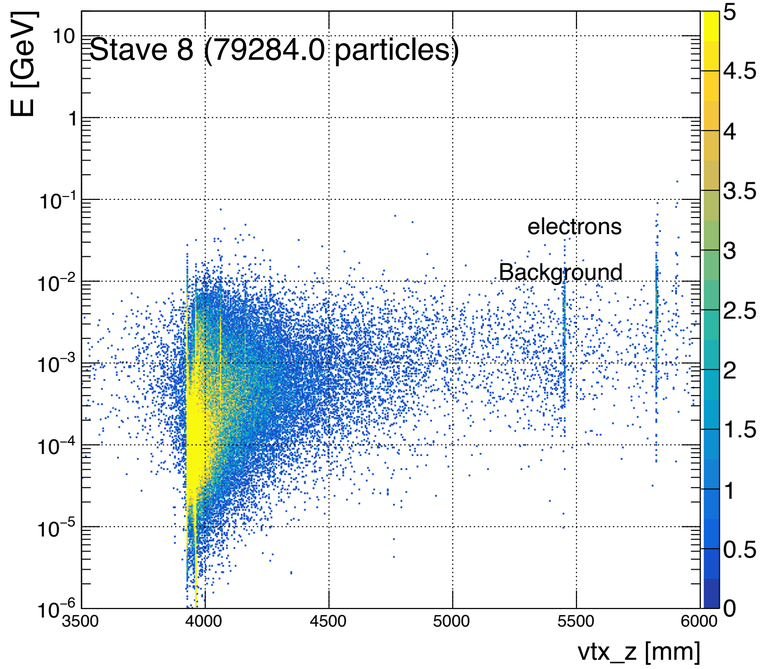
Electrons in Inner Stave, first layer of tracker: Electron side

- Zoom in Z axis.
- Too much electrons:
  - Did the electron side get properly lowered?







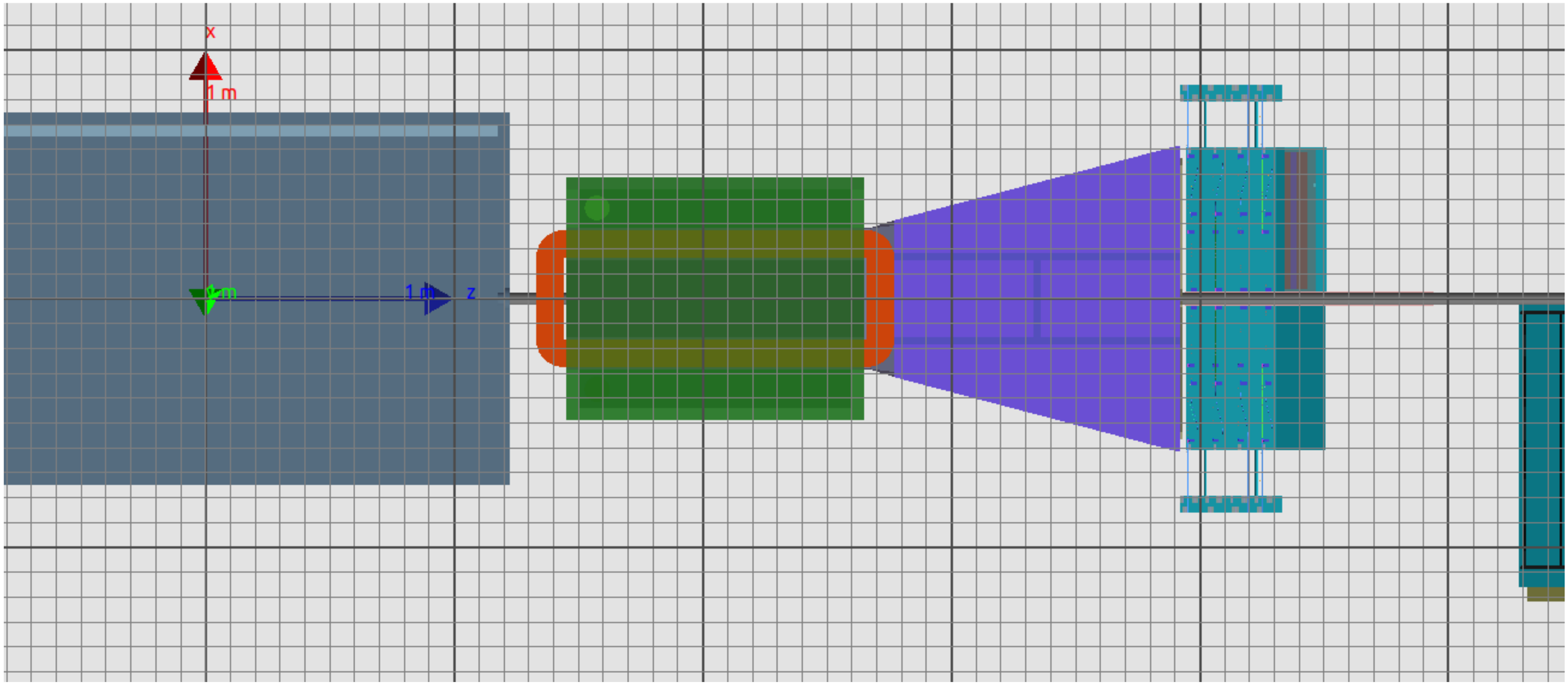


Summary

- A brief study of the origin of the background particles.
  - Studied e+laser, only the electron beam.
- Background electrons:
  - Mostly coming from the beam exit, beam in the air and the plate between the tracker and beam pipe
  - Also calorimeter
- Background photons:
  - Coming from the vacuum wall, exit window, dump and shielding
  - They will create much less hits on the tracker though.
- Background positrons:
  - Coming from the tracker staves and calorimeter.
- Checked other particles
  - Protons:
    - 7 particles/BX in the Stave 0
    - 3.8 particles/BX in the Stave 7
  - Muons:
    - 0.9 particles/BX in the Stave 0
    - 0 particles/BX in the Stave7
  - Pions:
    - 0.5 particles/BX in the Stave 0
    - 0 particles/BX in the Stave 7
- Analysis of deposit of energy (“hits”) in the tracker plane:
  - Work in progress.

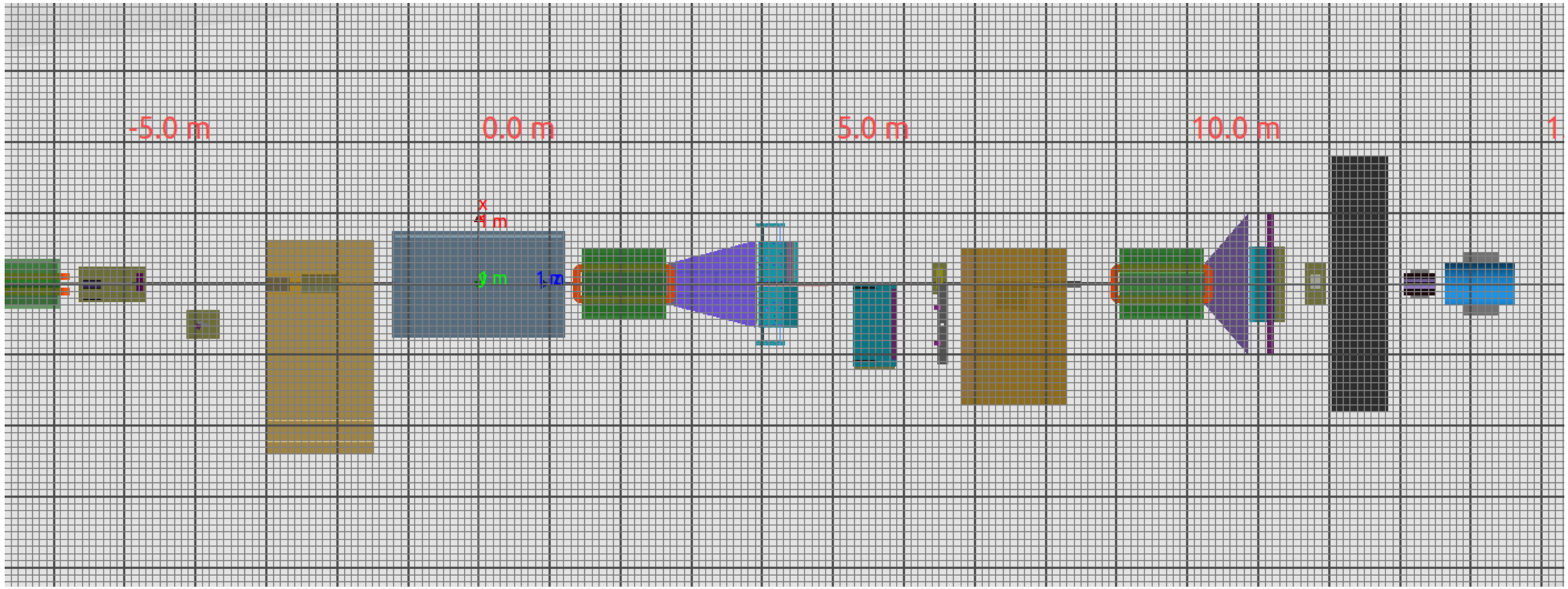
Bonus slides

The subsystems near the beam dump



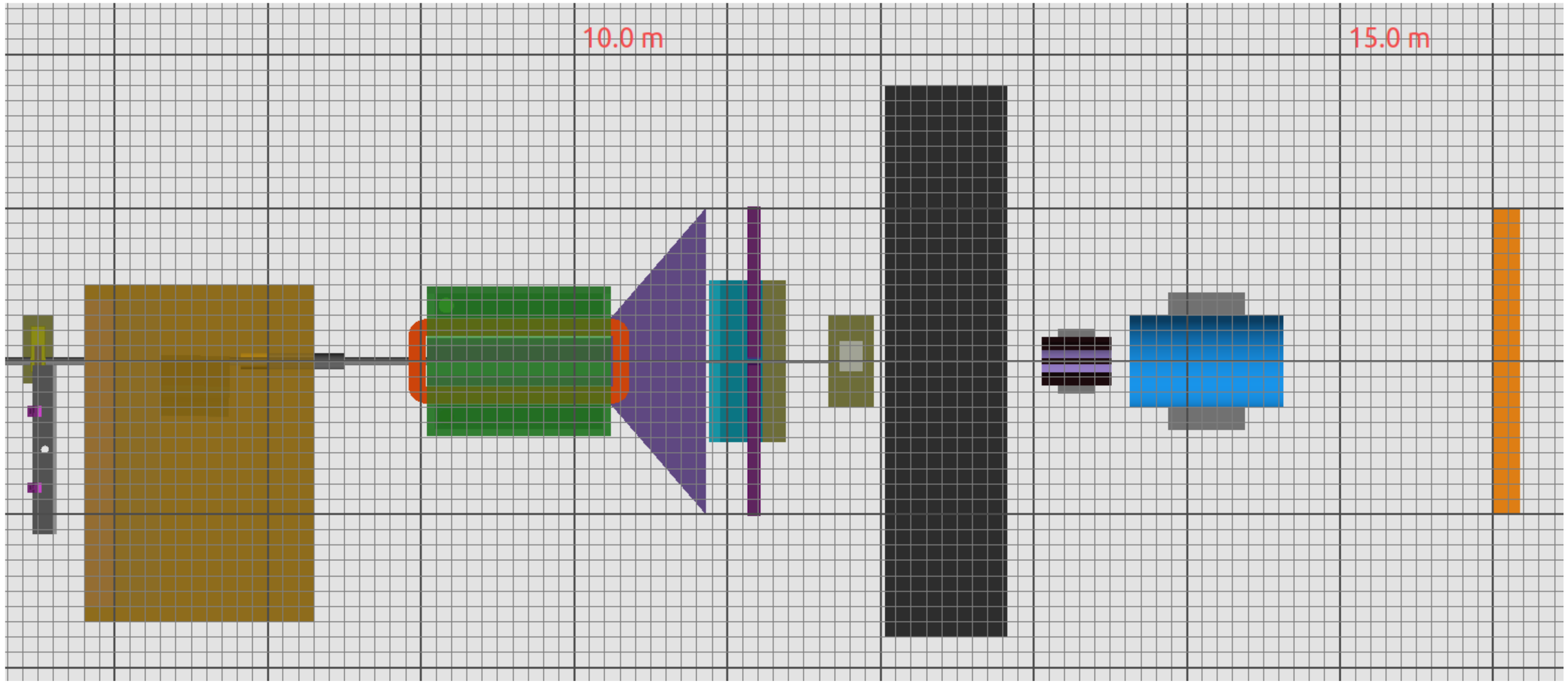
Plots from Sasha

The entire subsystem



Plots from Sasha

The subsystems from the IP to beam dump



Plots from Sasha

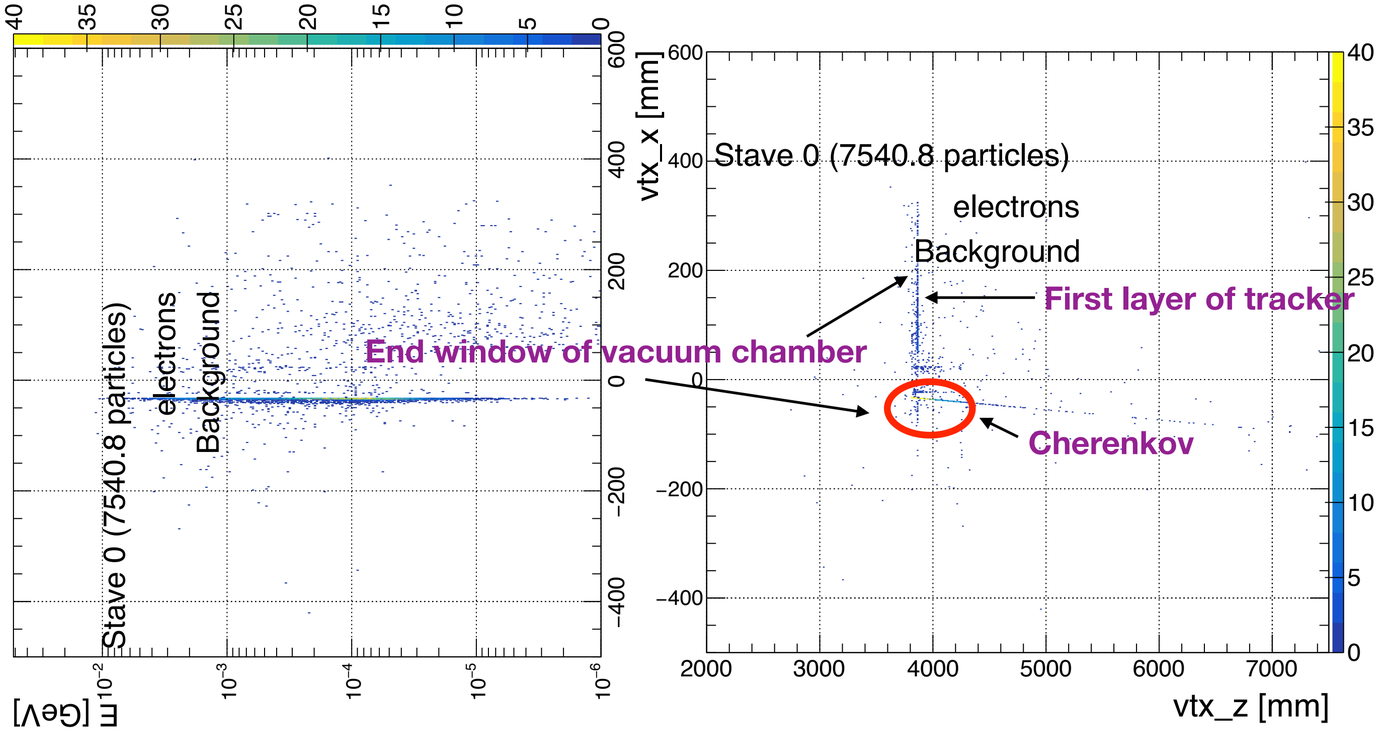
CDR plots

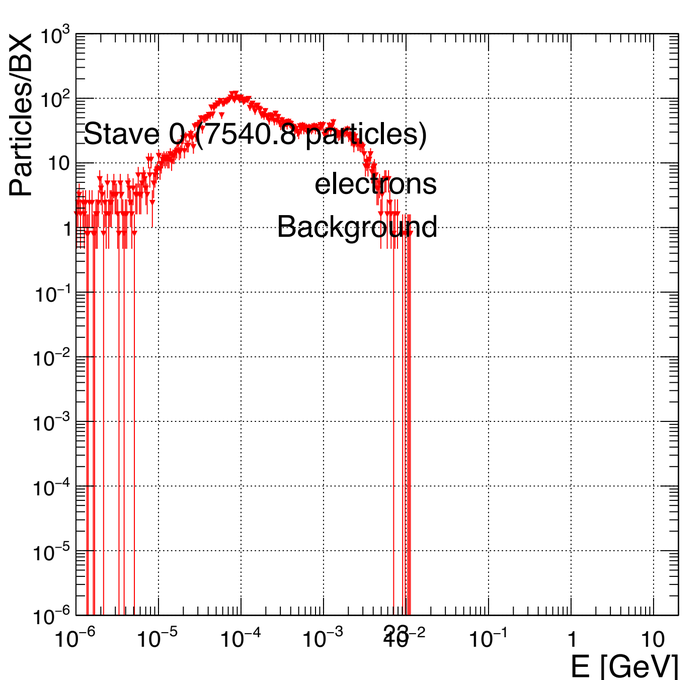
- e+laser hics setup
  - Only electron beam, no laser.
  - Easy to understand only beam related background.
  - Samples produced by Sasha.
  - Looked at the background particles:
    - electrons

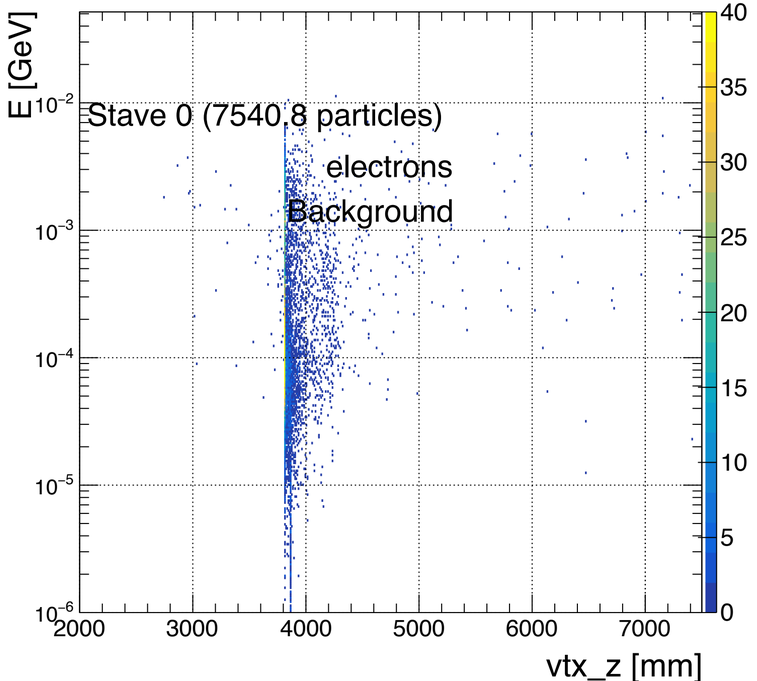
  - Plots from the tracks intersecting the tracker plane (not necessarily making a hit in the tracker).

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?

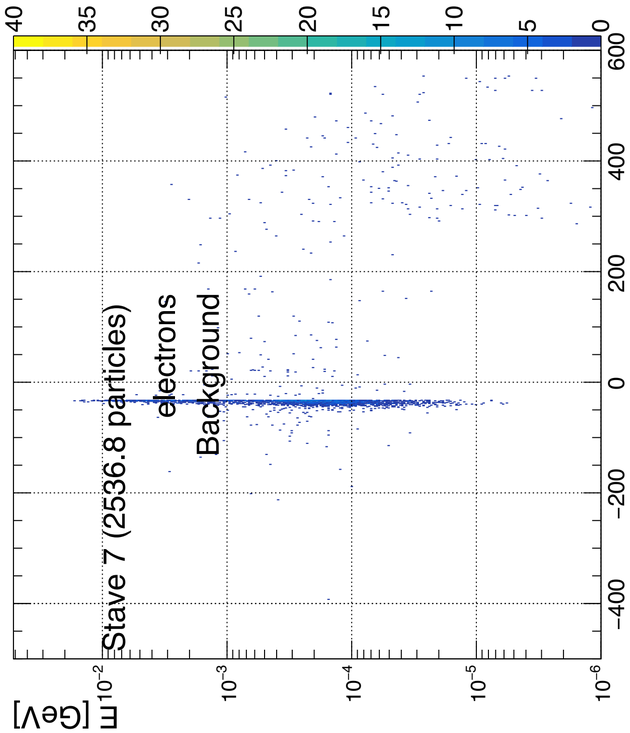


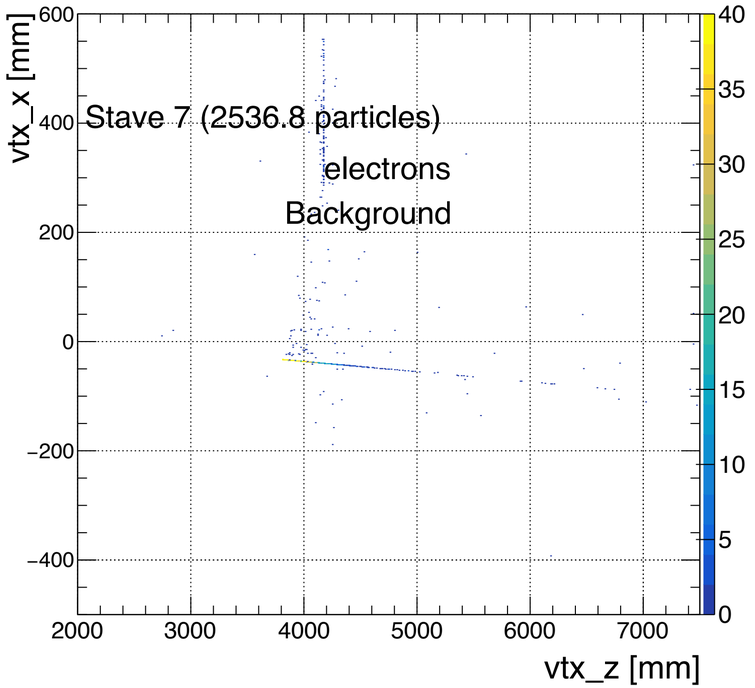


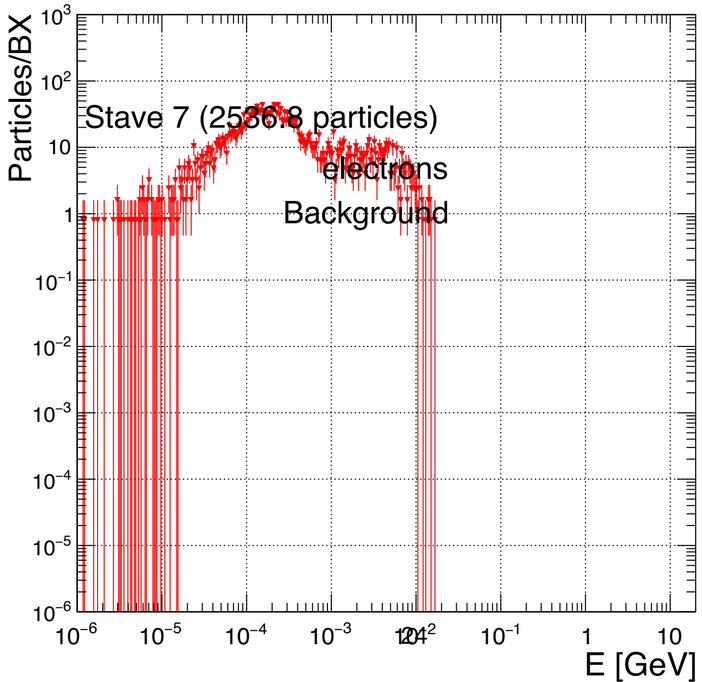


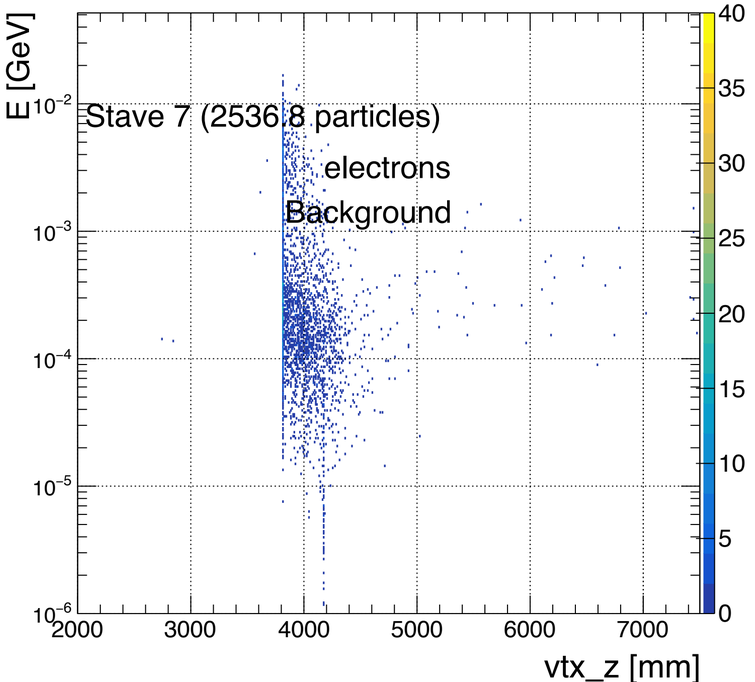
Electrons in Outer Stave, last layer of tracker

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



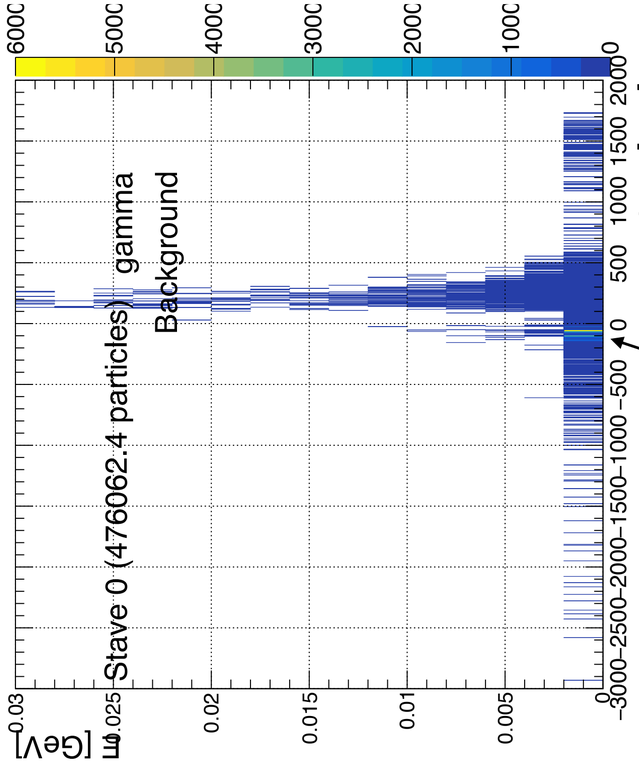


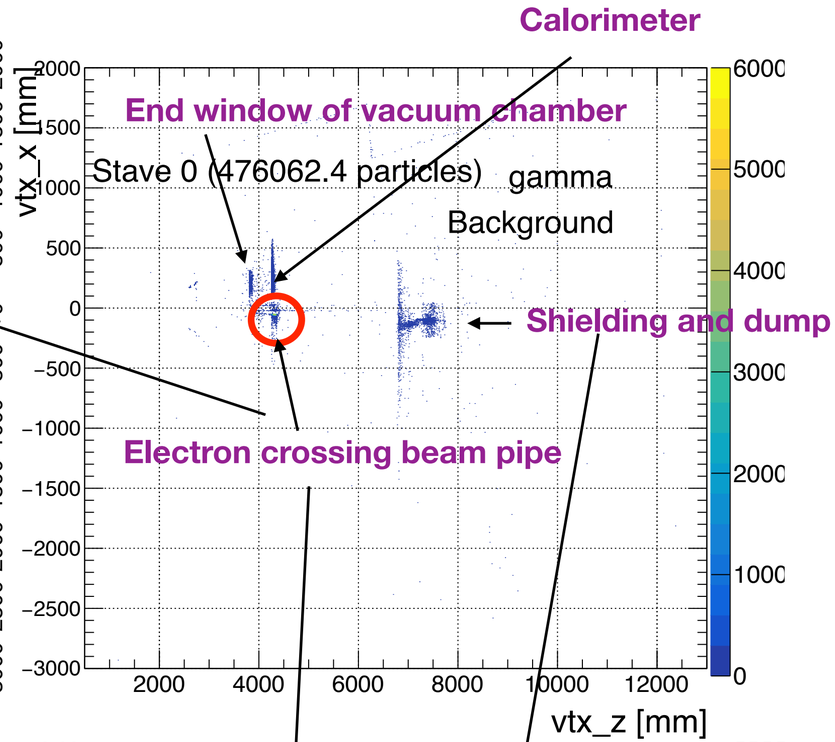


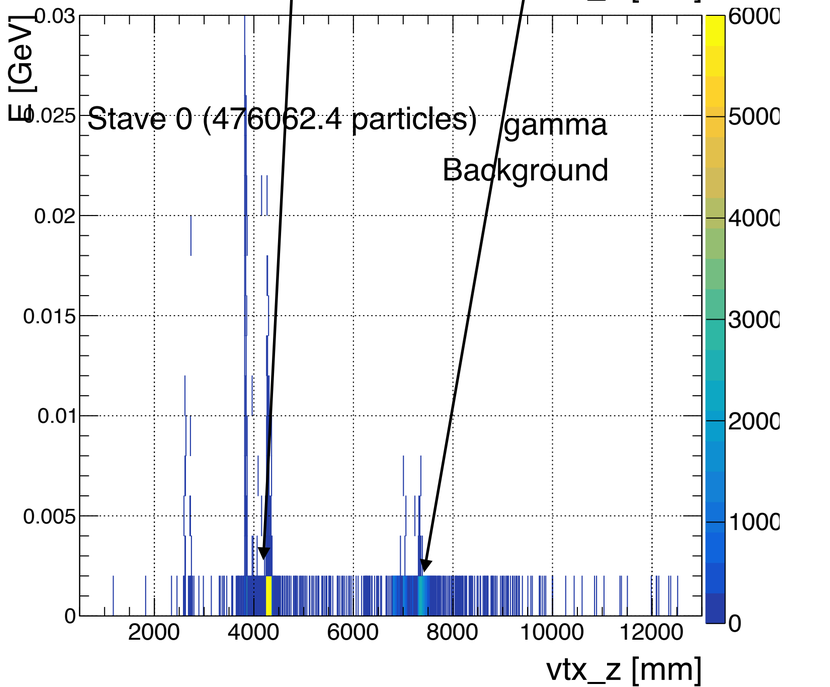


Photons in Inner Stave, first layer of tracker

- 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.