

Performance Studies for ECAL-P & ECAL-E

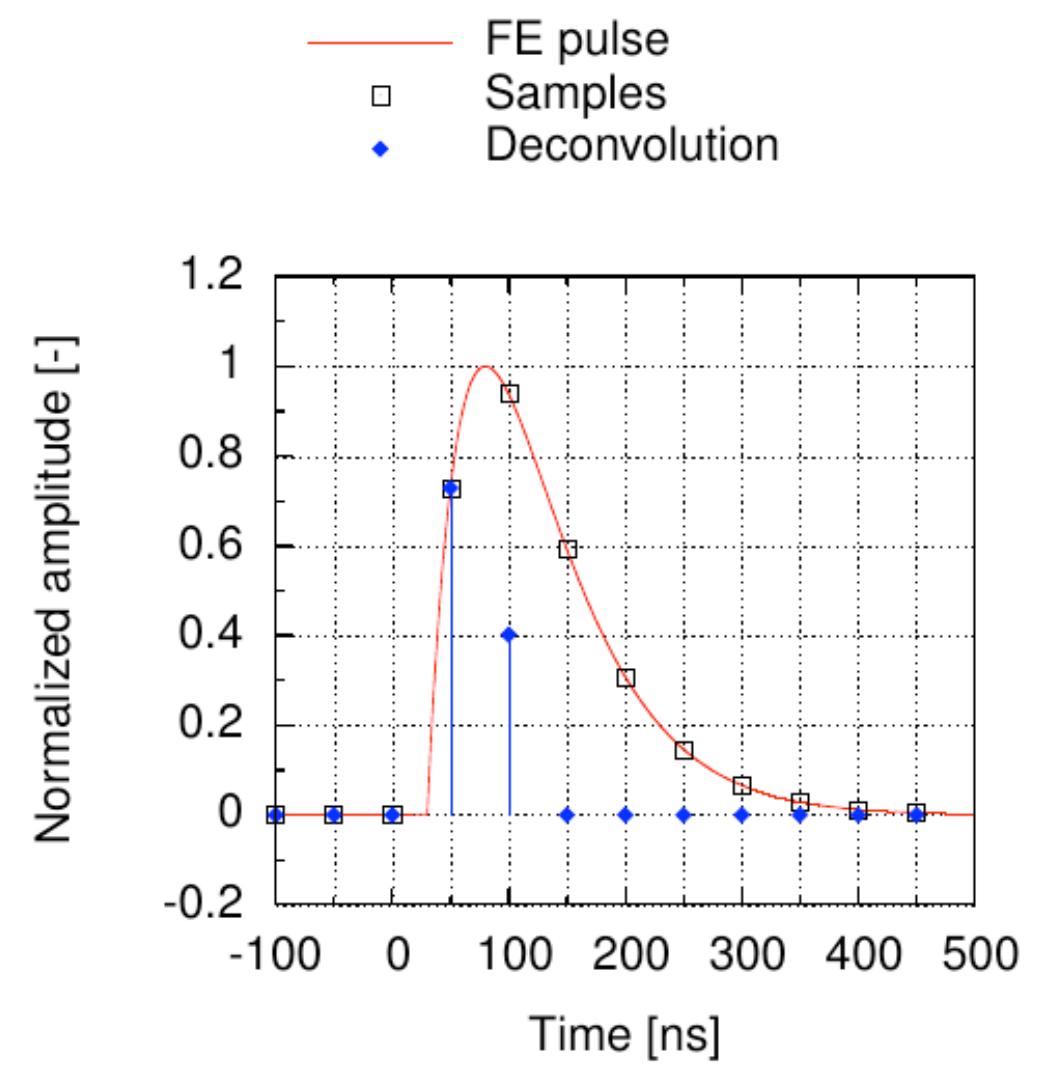
shan.huang@desy.de

- Background Timing
- ECAL-E Performance (Energy resolution)
- *Background Occupancy (Still working on)*

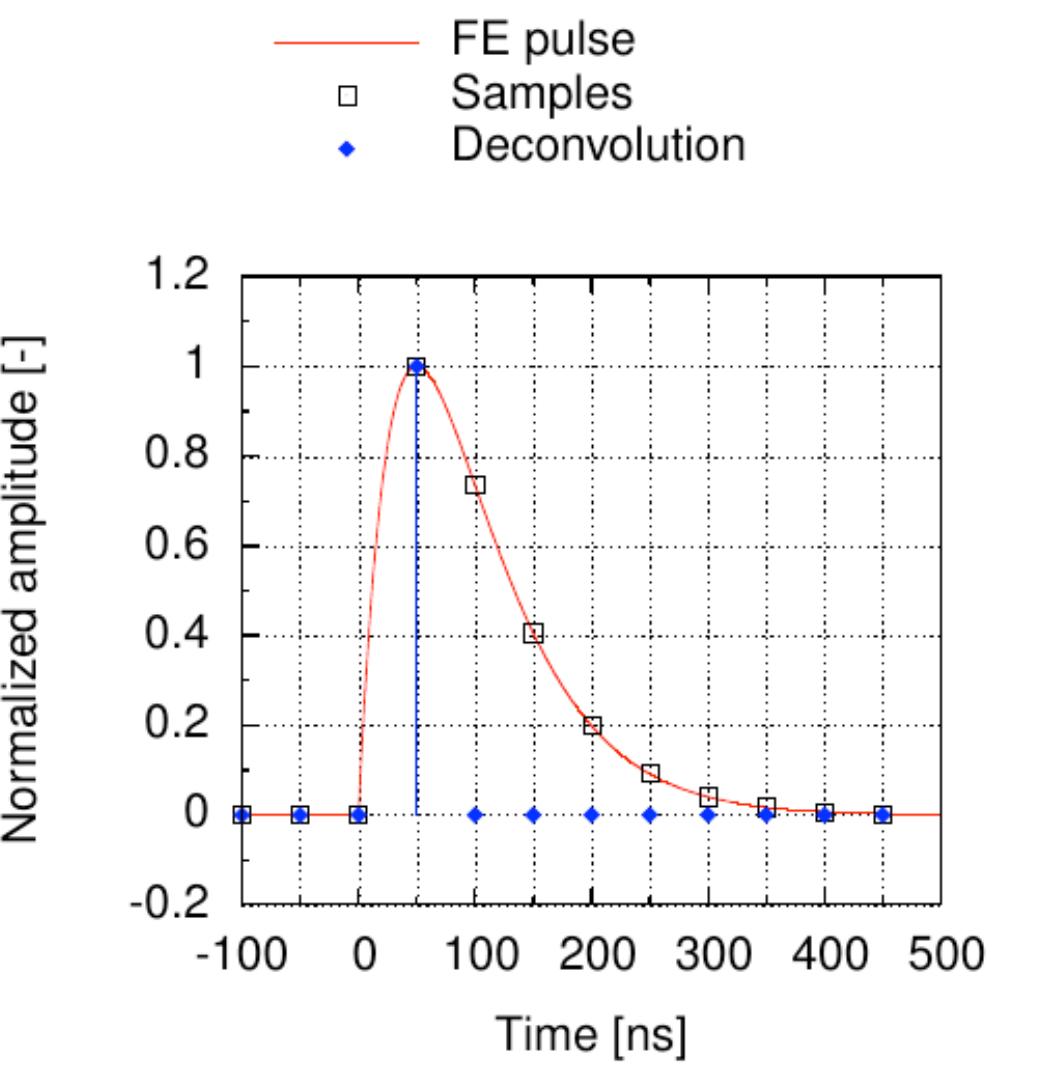
Timing for ECAL-P

Electromagnetic calorimeter on the positron arm

- Time resolution: 5 ns
- Data Taking interval: 50 ns
- Reading time: 500 ns to 1 us

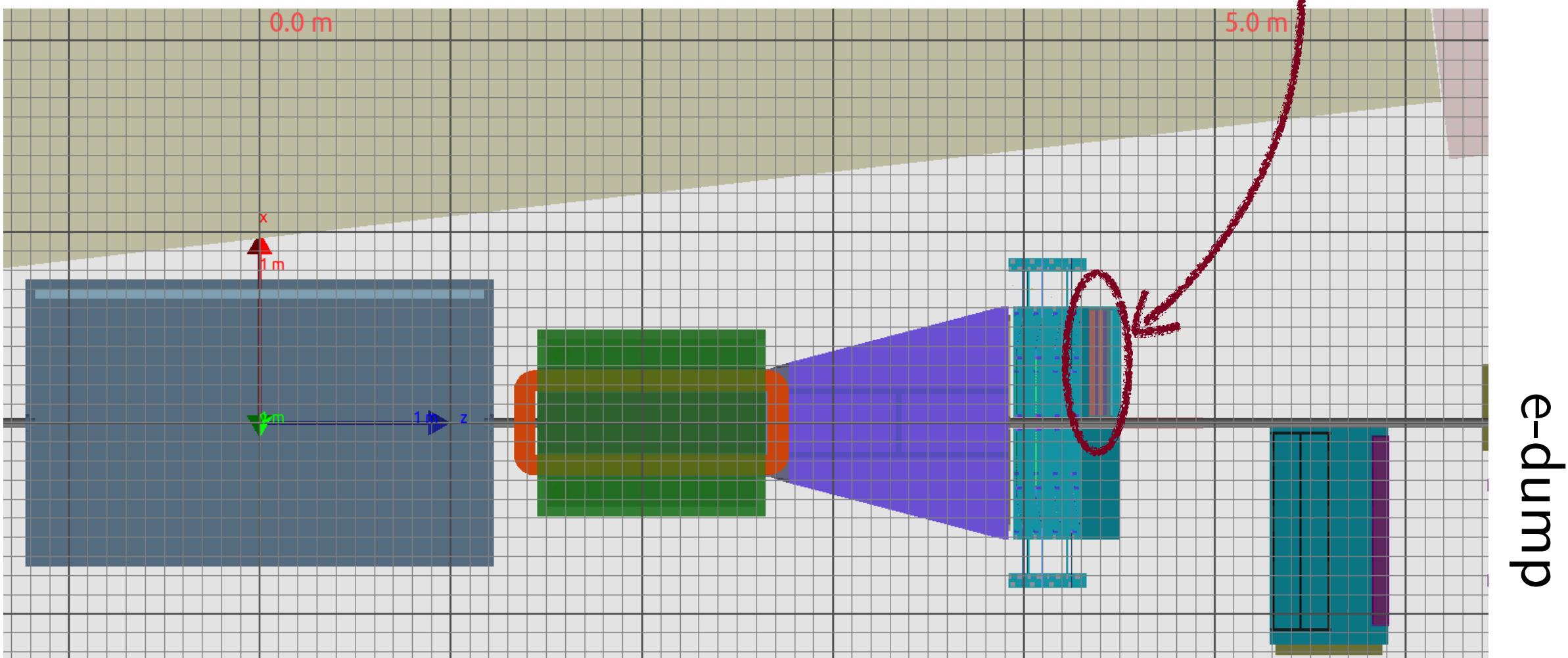
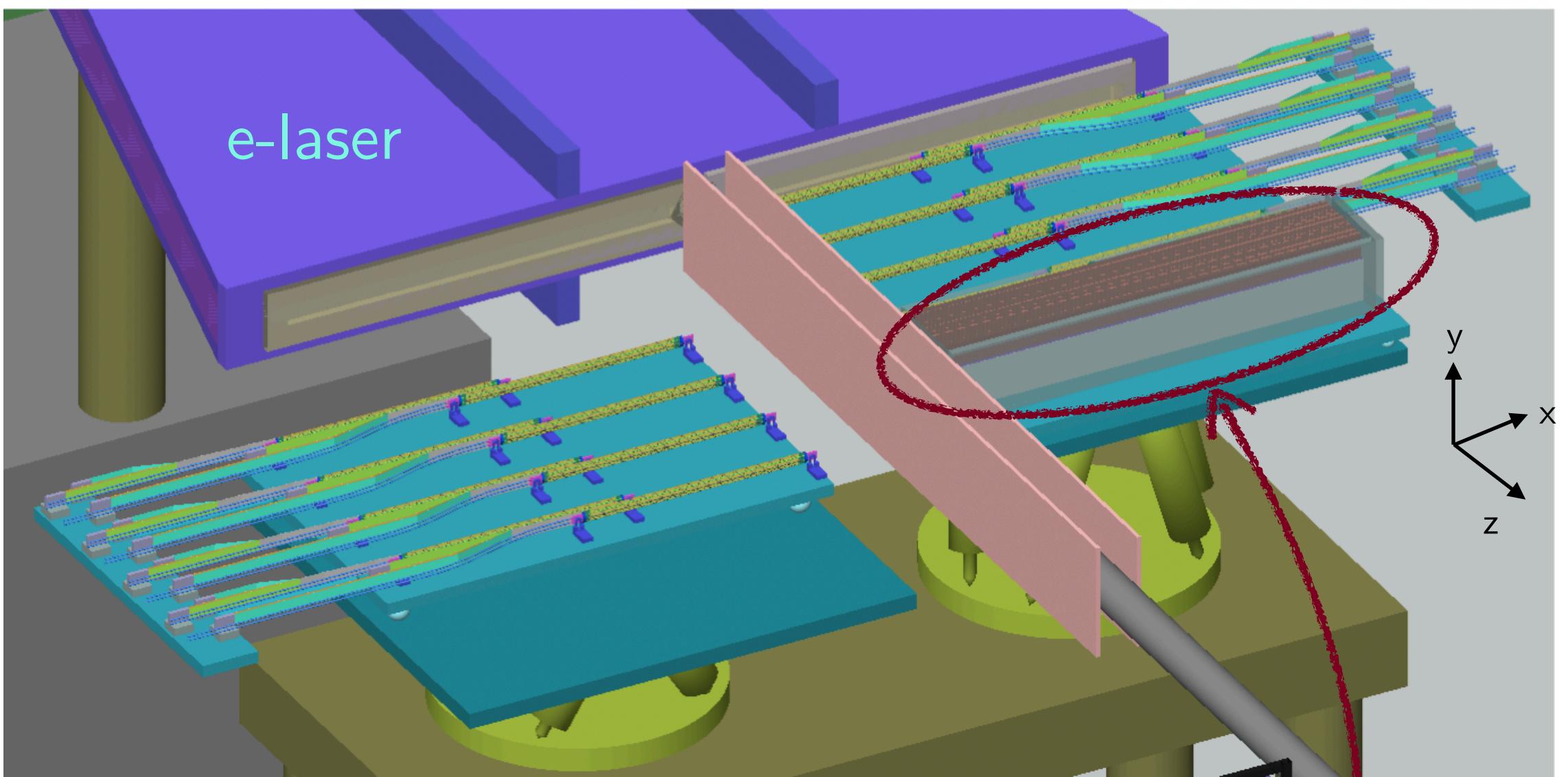


a) Example of asynchronous sampling with two non-zero filter output samples at $t_0 = 30$ ns



b) Example of synchronous sampling with only one non-zero filter output sample at $t_0 = 0$ ns

Figure 2.29: Examples of deconvolution filter output at $T_{smp} = \tau_{sh} = 50$ ns.



Background simulations

Background and signals are simulated with GEANT4

- Particles are emitted by gun put
 - near the bremsstrahlung target ($z = -7.4$ m), or
 - at the IP ($z = 0$)
- “**Tracks**” tree records every particles coming into the calorimeters with entering time
- “**Hits**” tree records every energy deposits on the calorimeters with deposition time

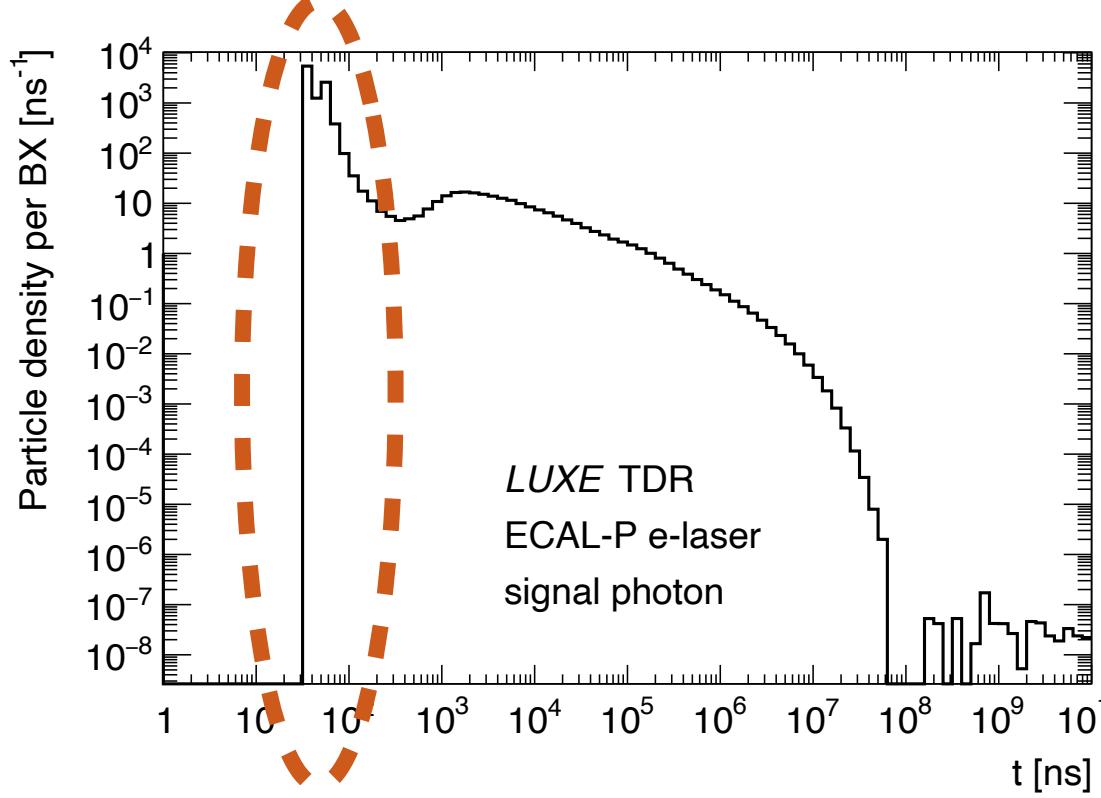
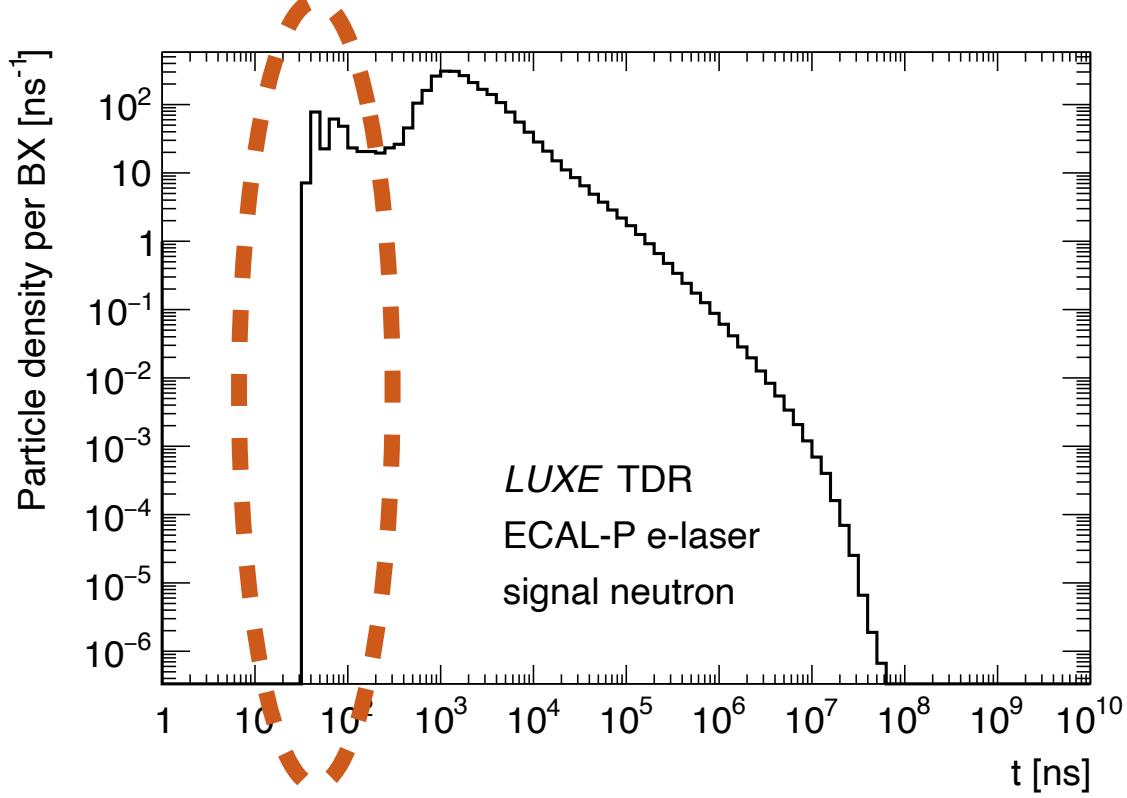
Following results come from the latest full simulation with extra shielding protection on ECAL-P.

Background sources:

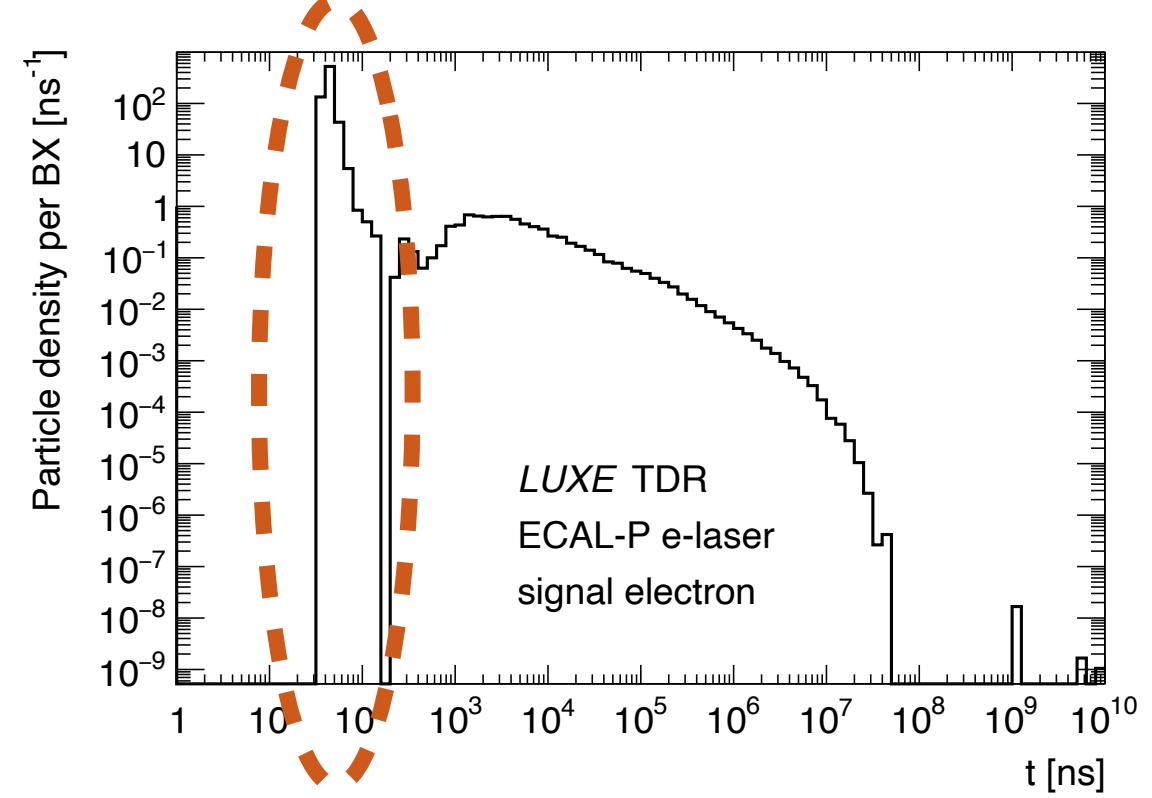
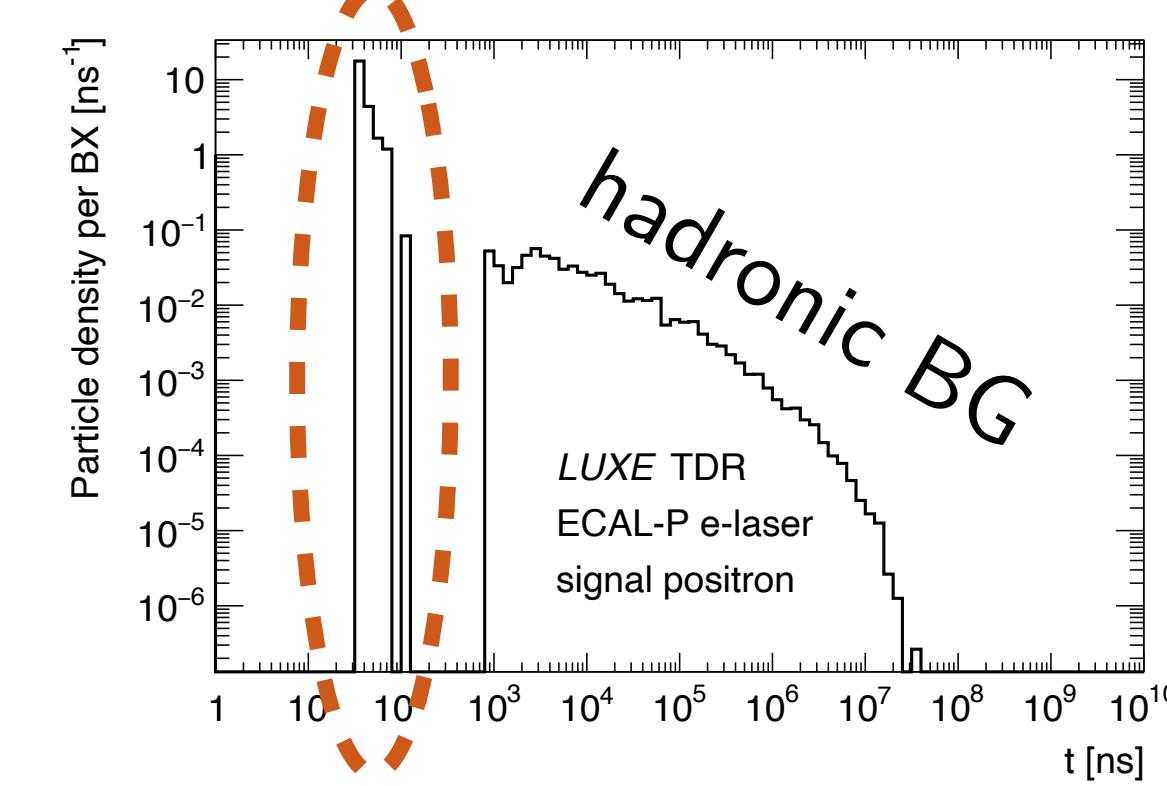
- electrons flying through the geometry
(studied in “**fast**” simulations where particles get killed at the beam dump)
- from the dumps
(studied in “**full**” simulations where hadronic backgrounds are included)
 - electron dump at $z \approx 7.5$ m (in e-laser)
 - after-target dump at $z \approx -2$ m (in g-laser)

[For reference, $z(\text{ECALs}) \approx 4.5$ m]

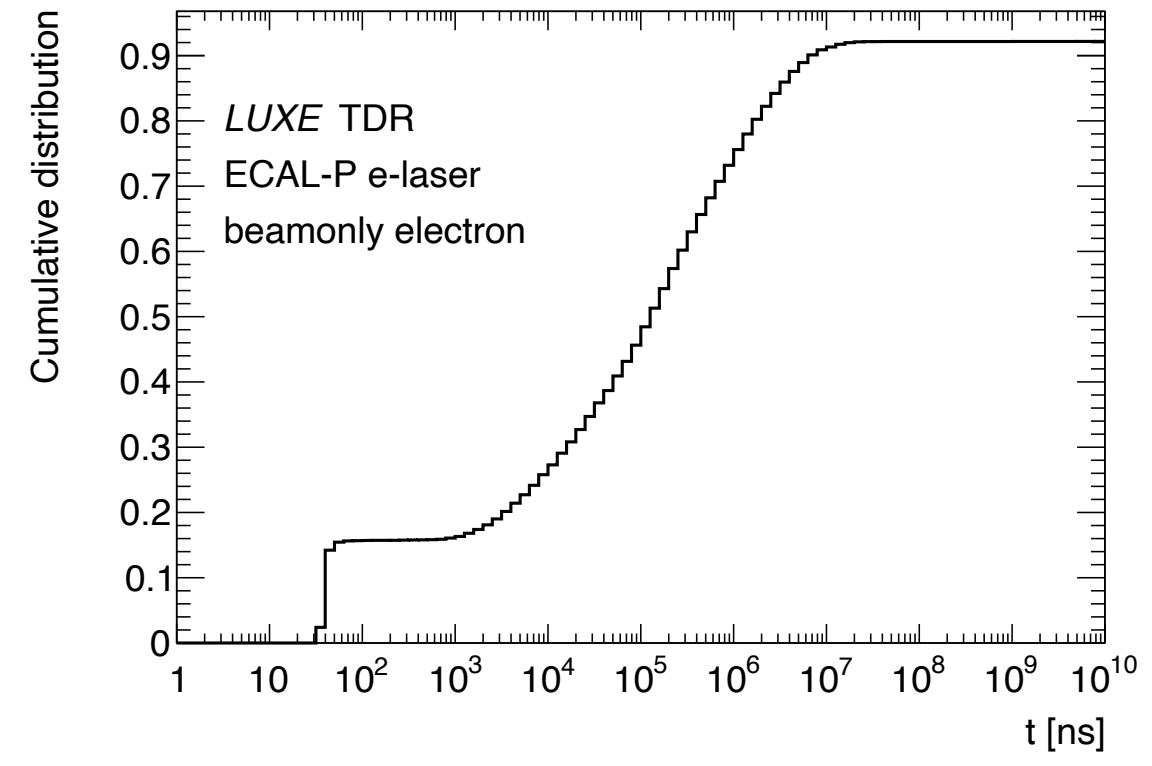
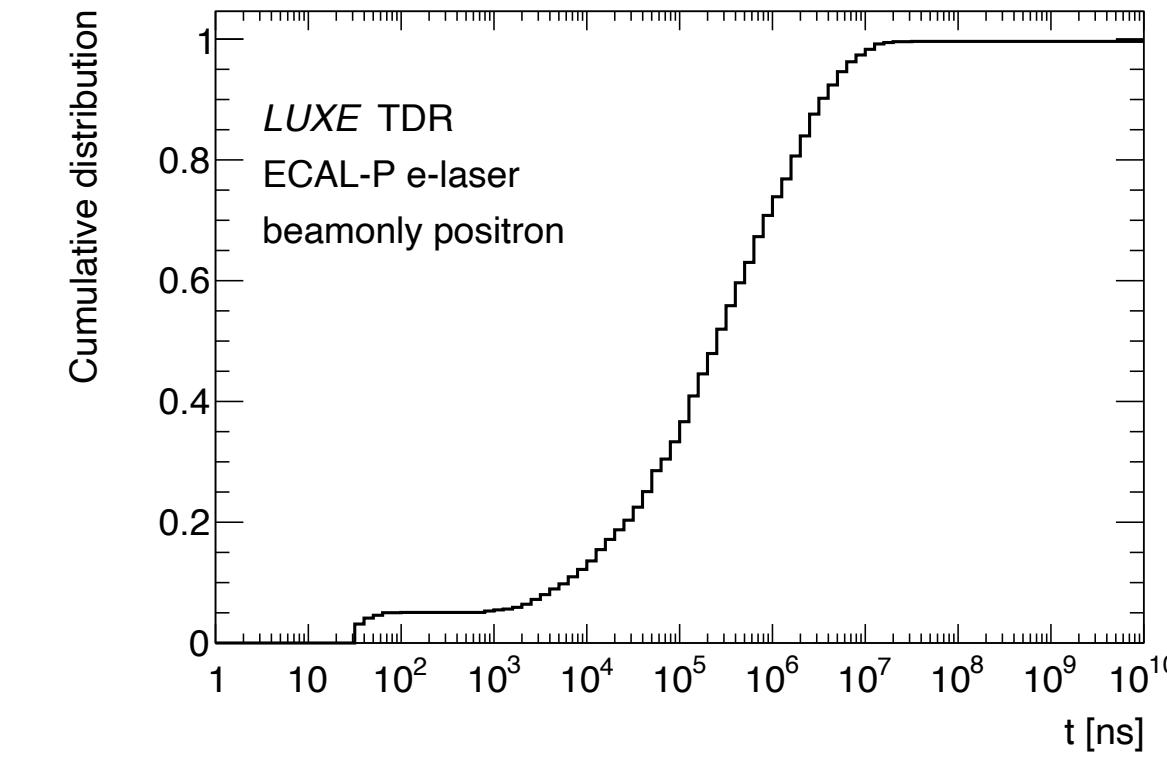
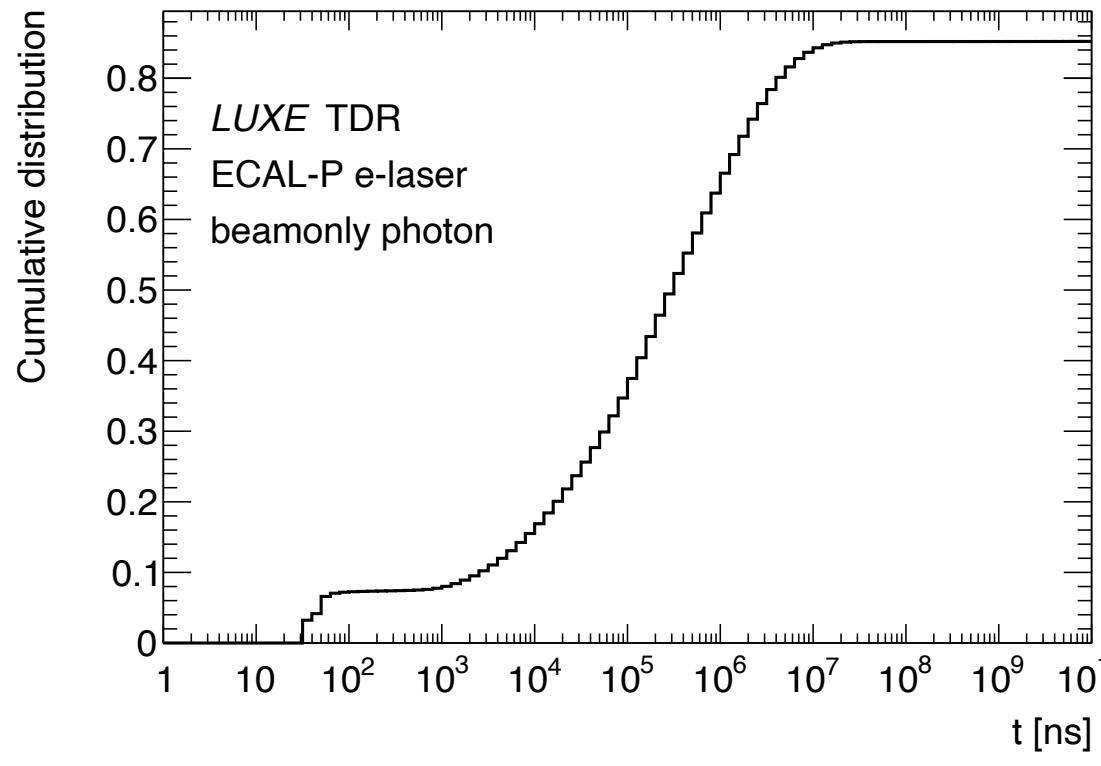
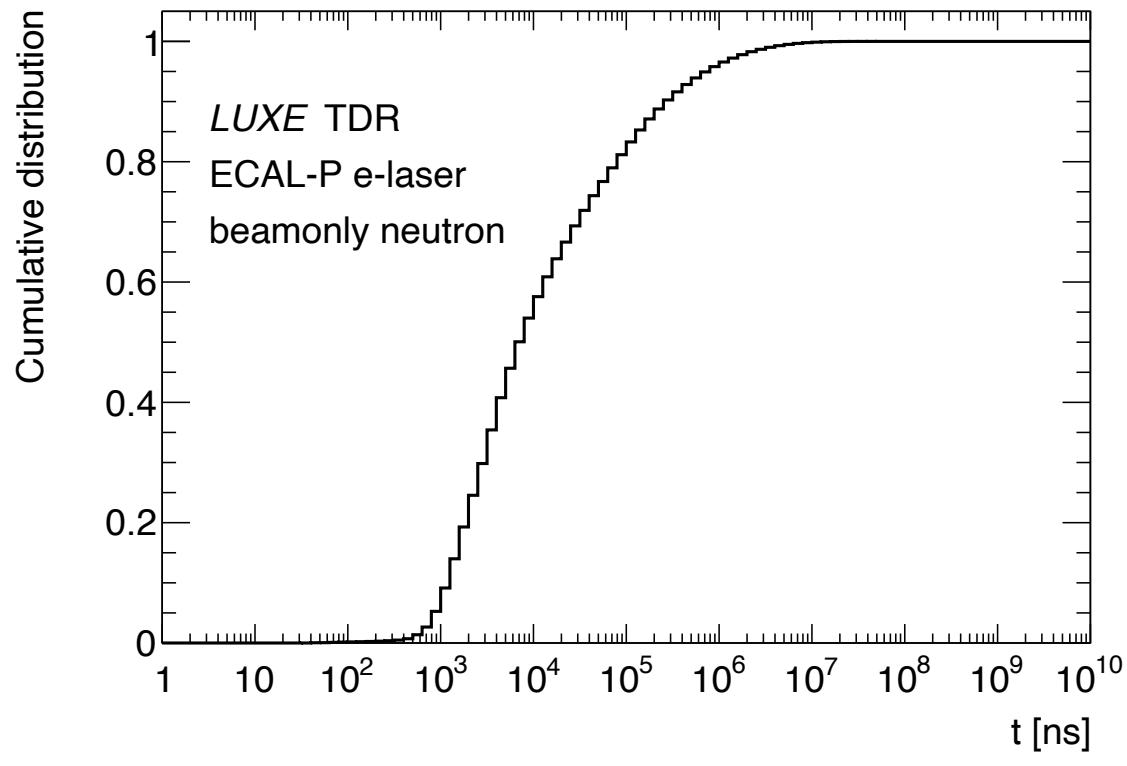
Background Tracks (number)



"fast" BG (arriving with the signal)

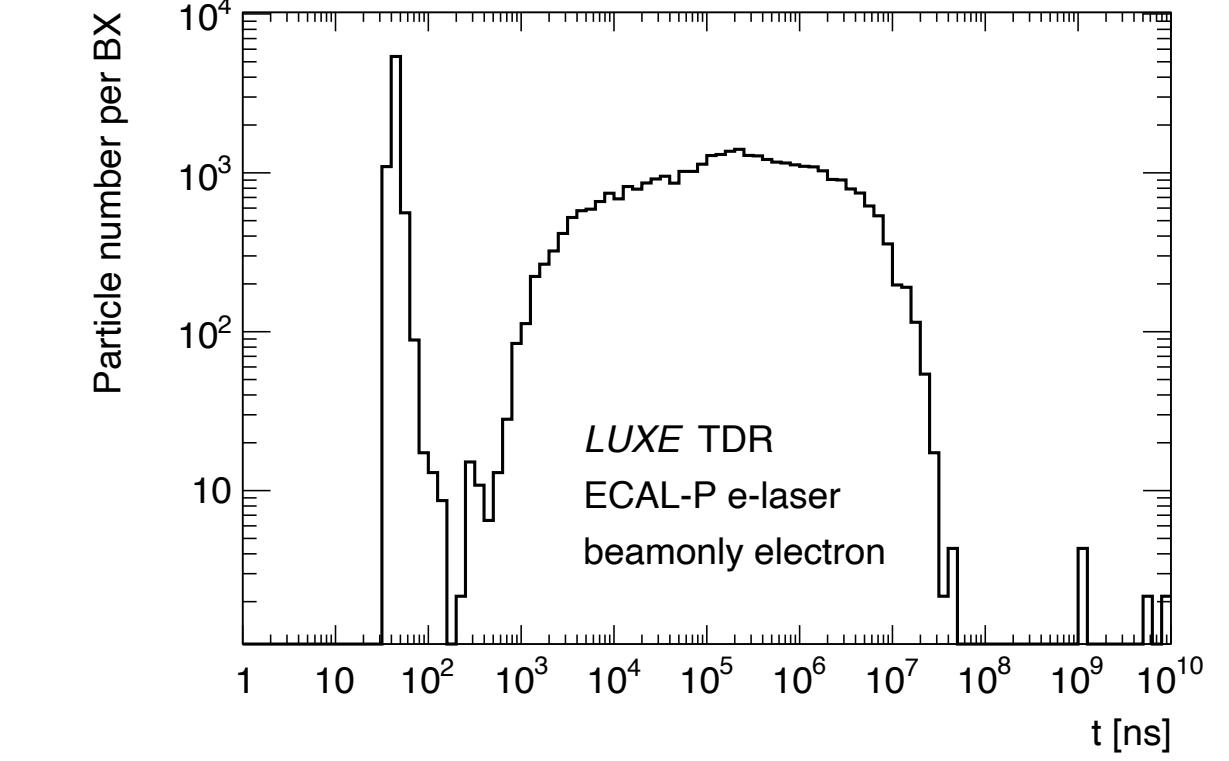
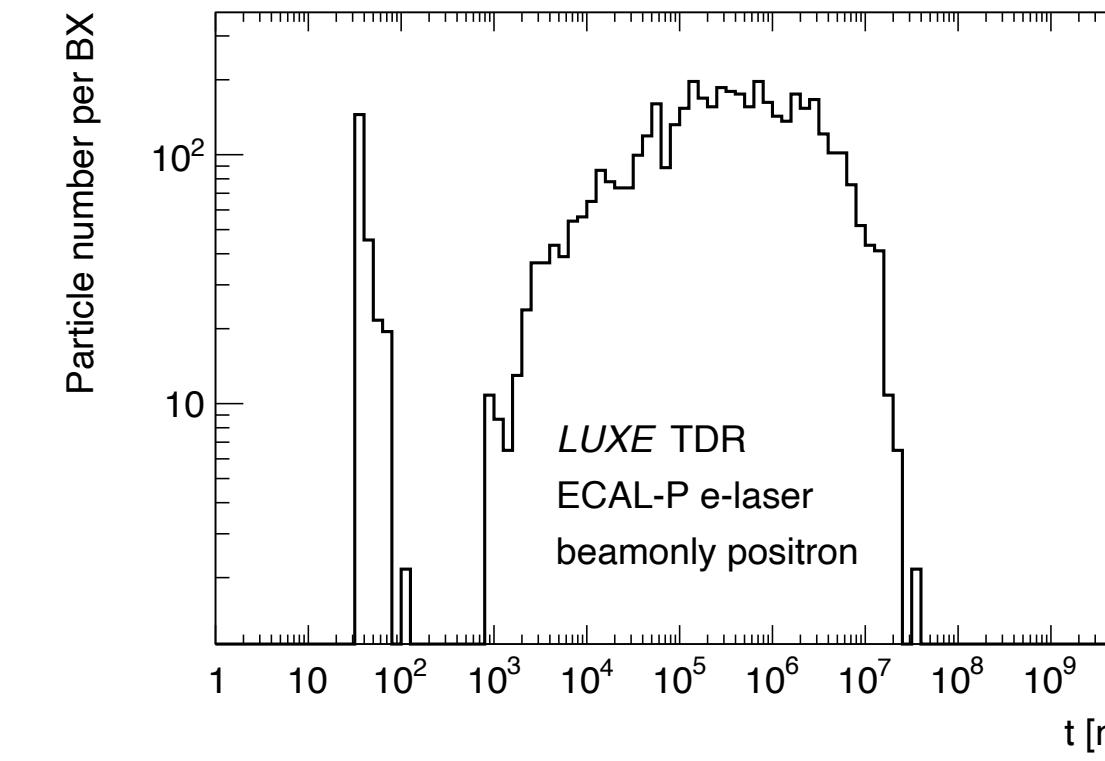
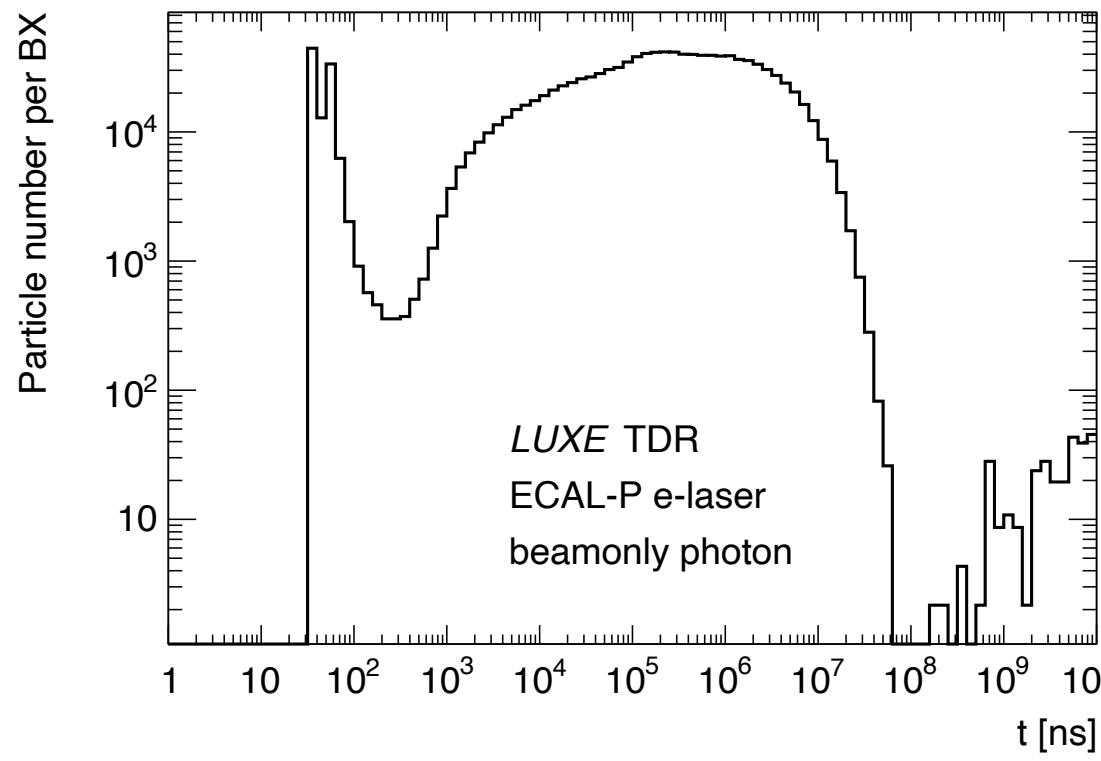
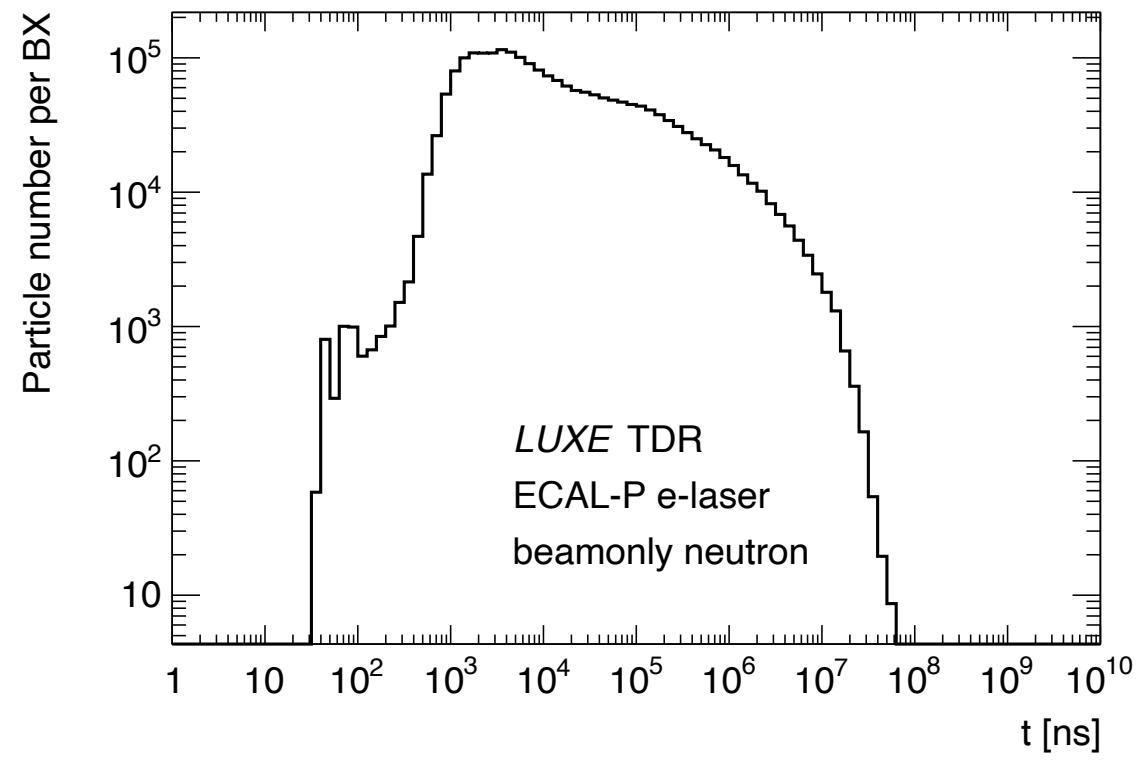


Density Profile

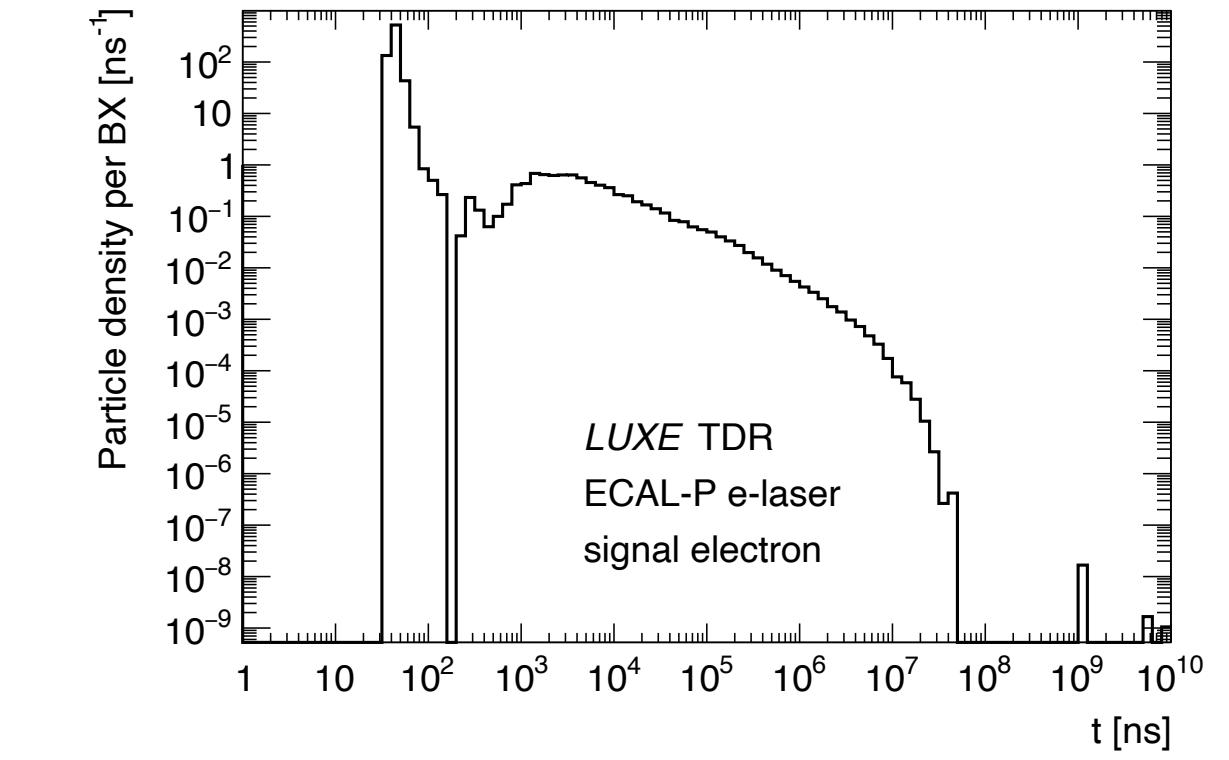
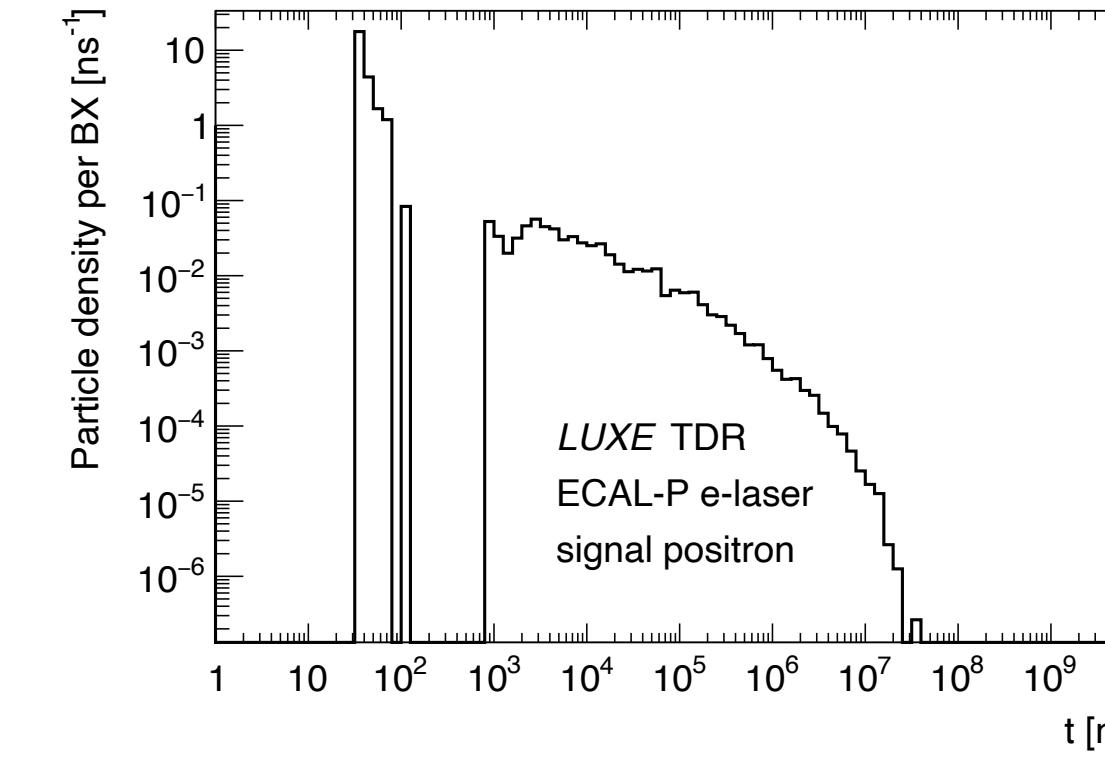
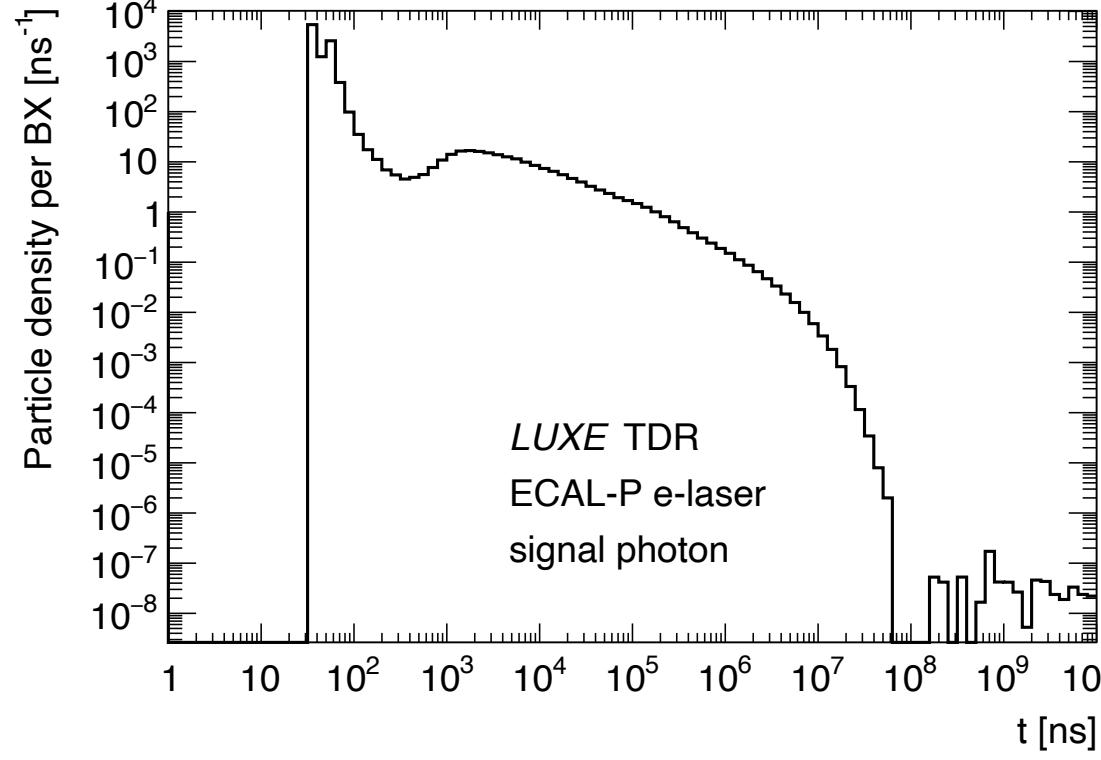
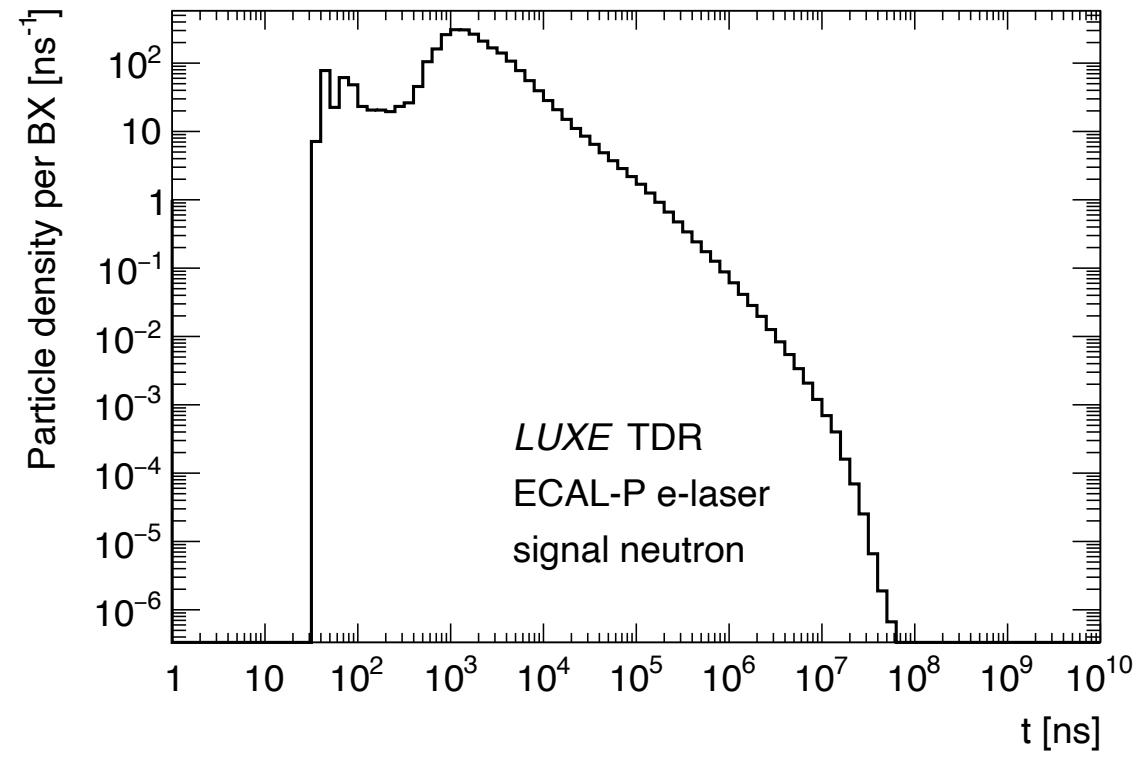


Cumulative Profile

Particle number vs density (per bin)



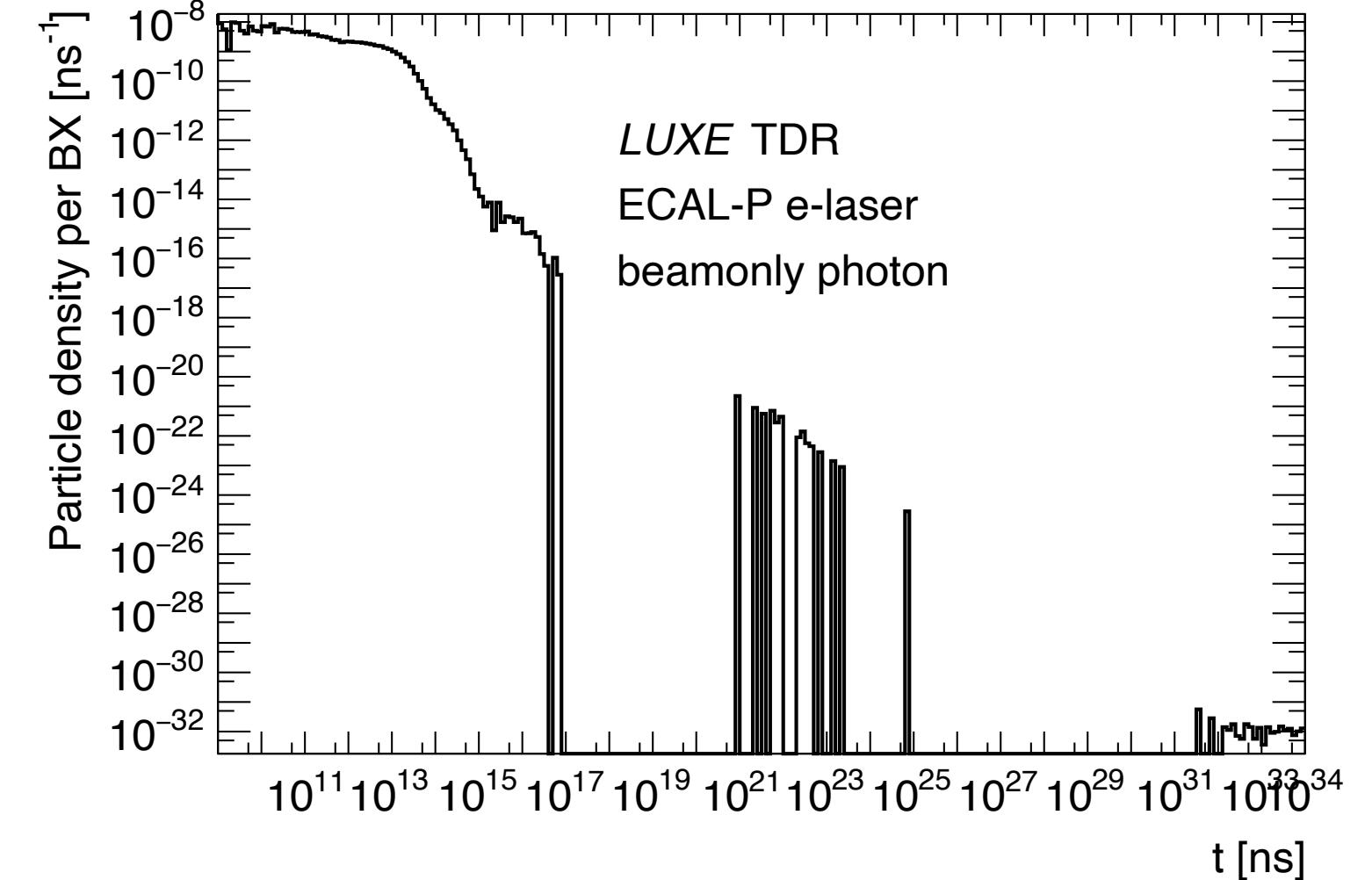
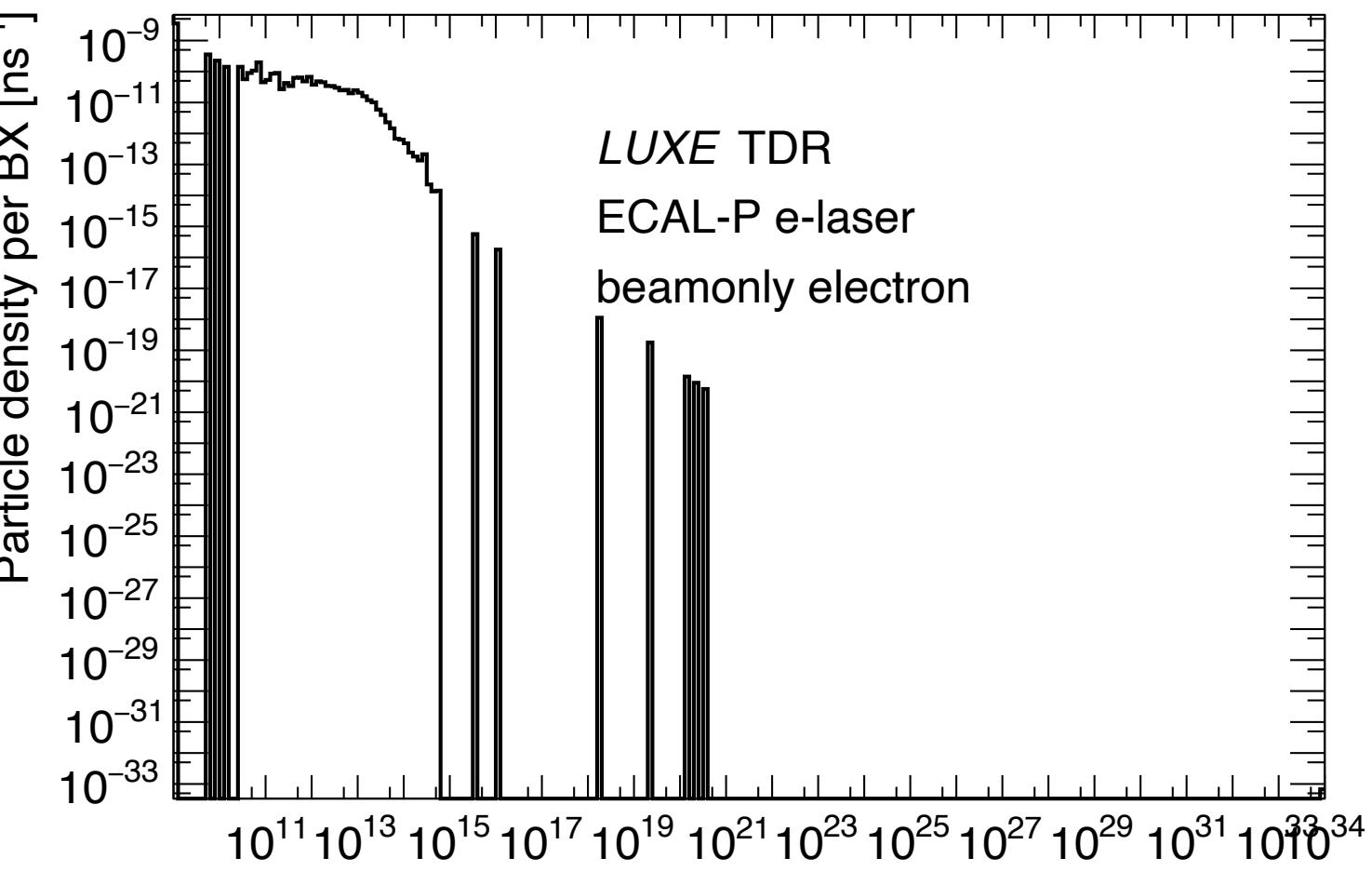
Number Profile



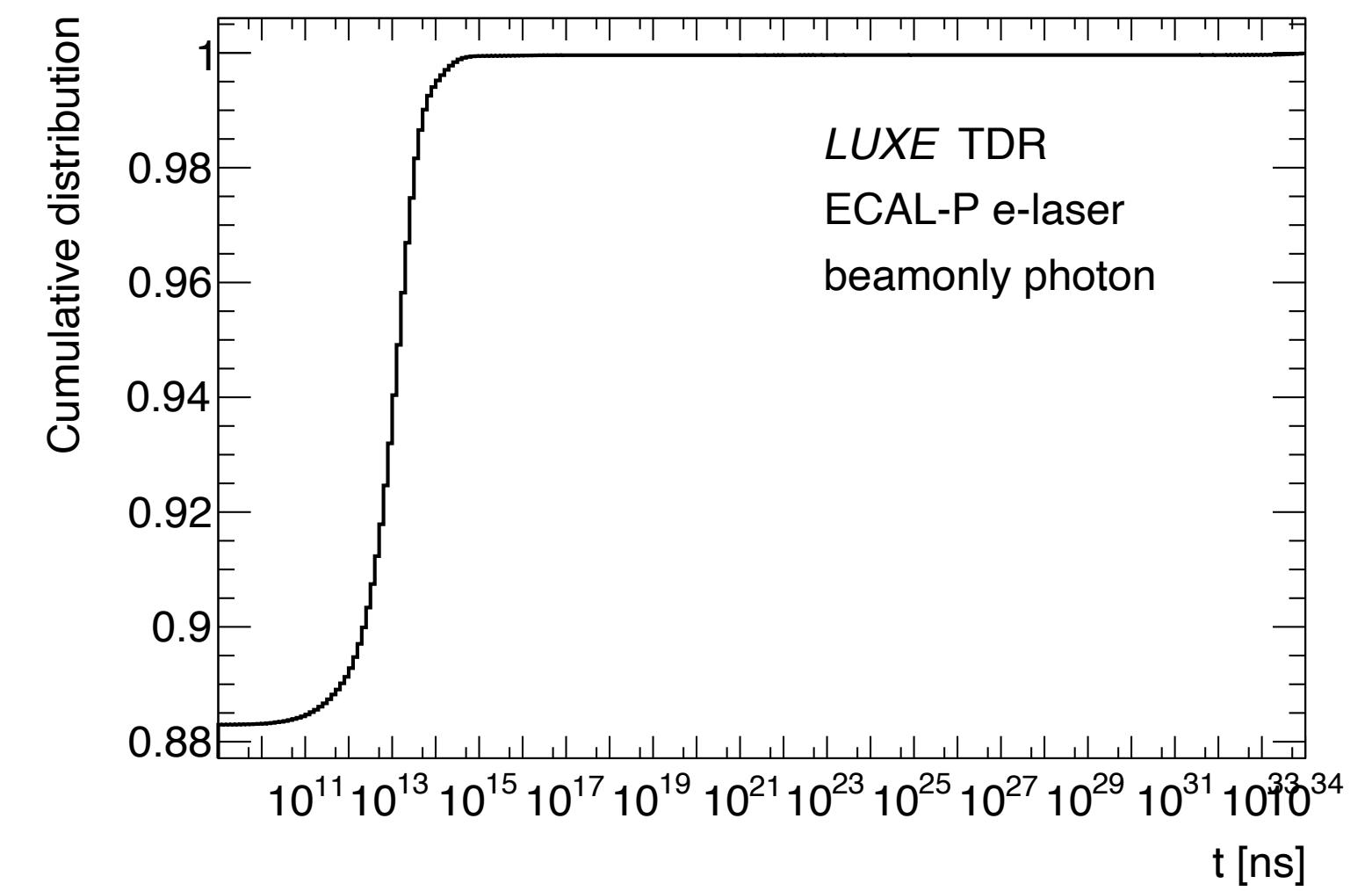
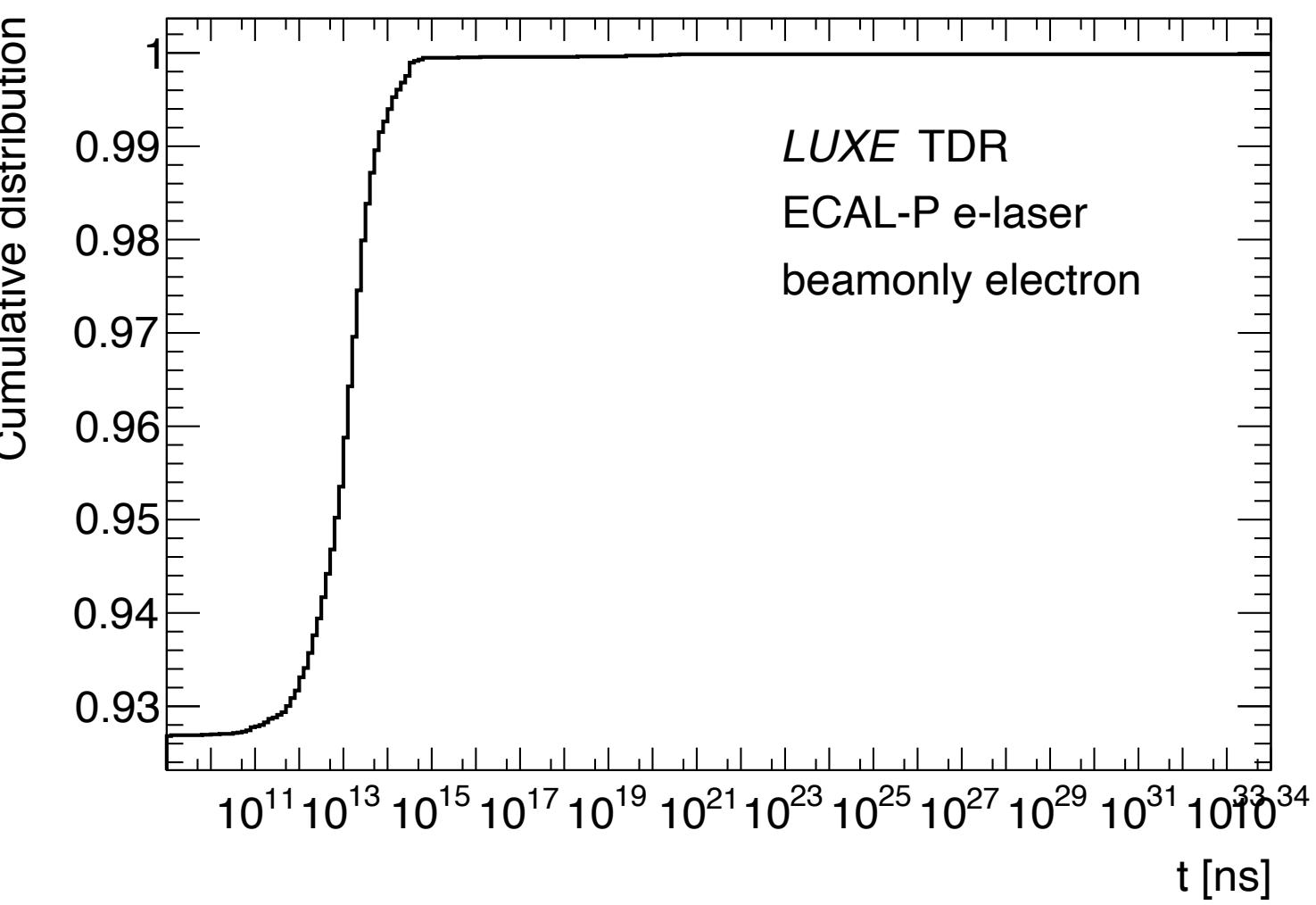
Density Profile

after 1 second...

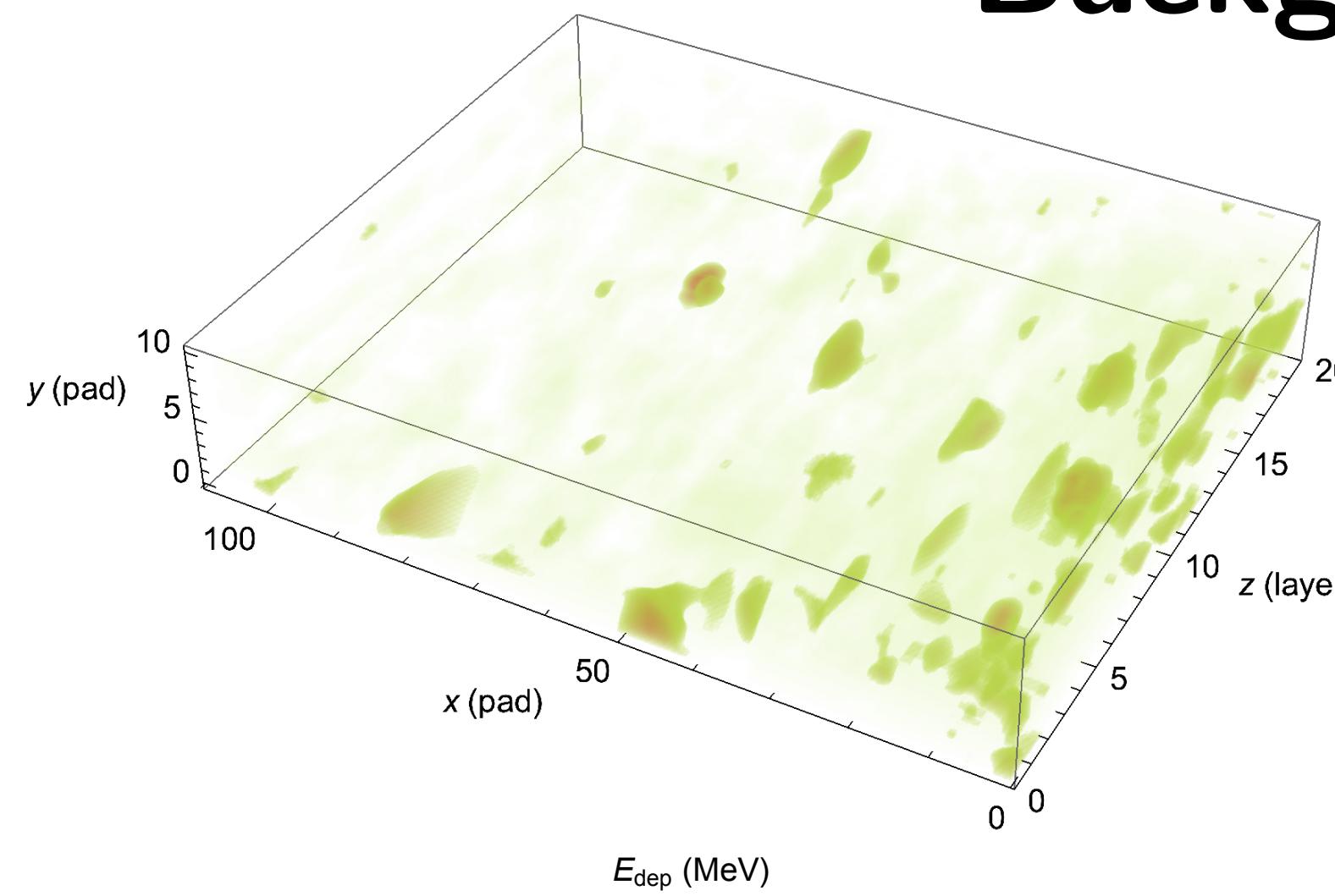
Densities of particles after 1 s
are significantly lower than the
main BG



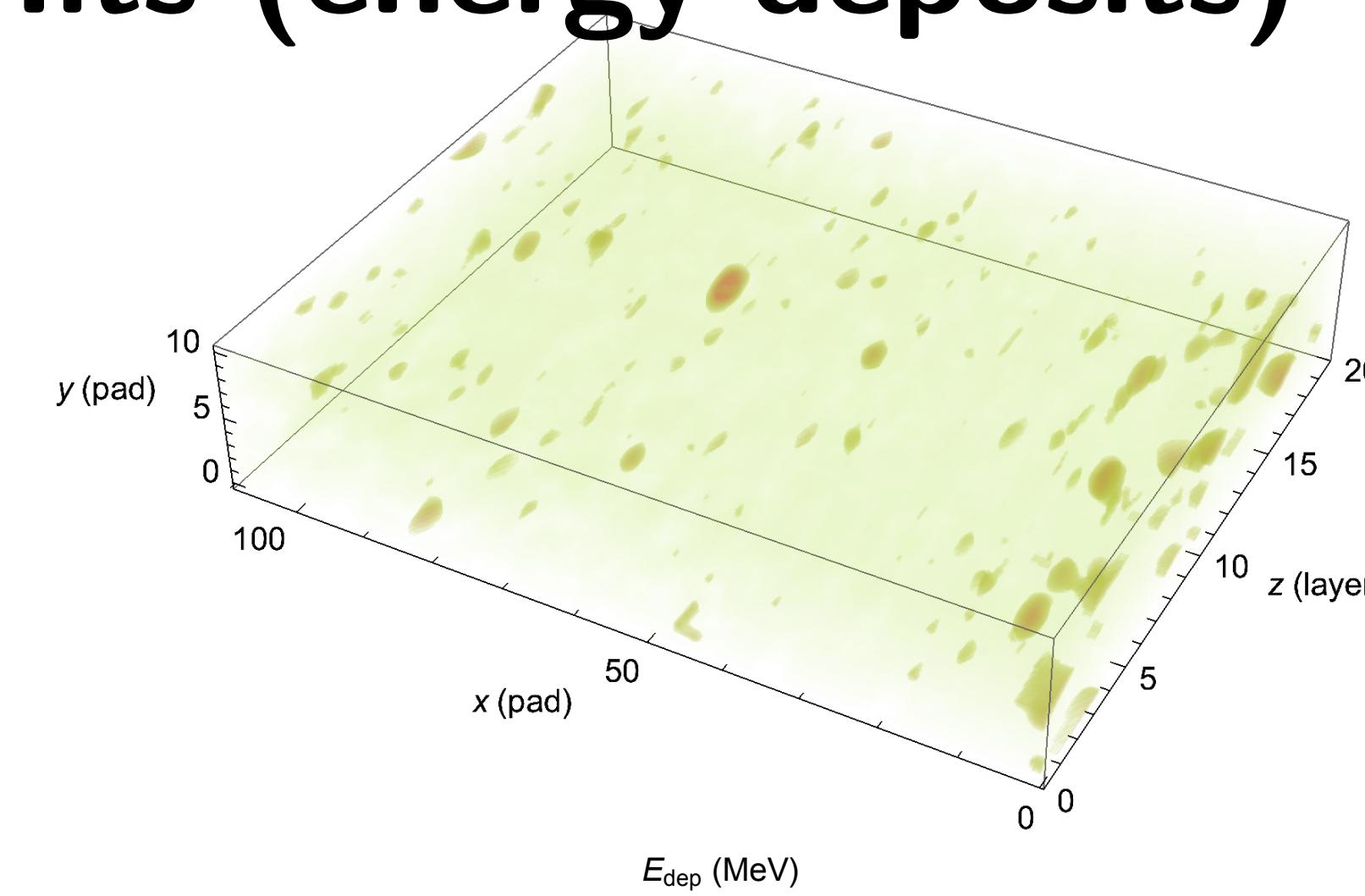
7% electrons and 11% photons
are shown after 1 s



Background Hits (energy deposits)

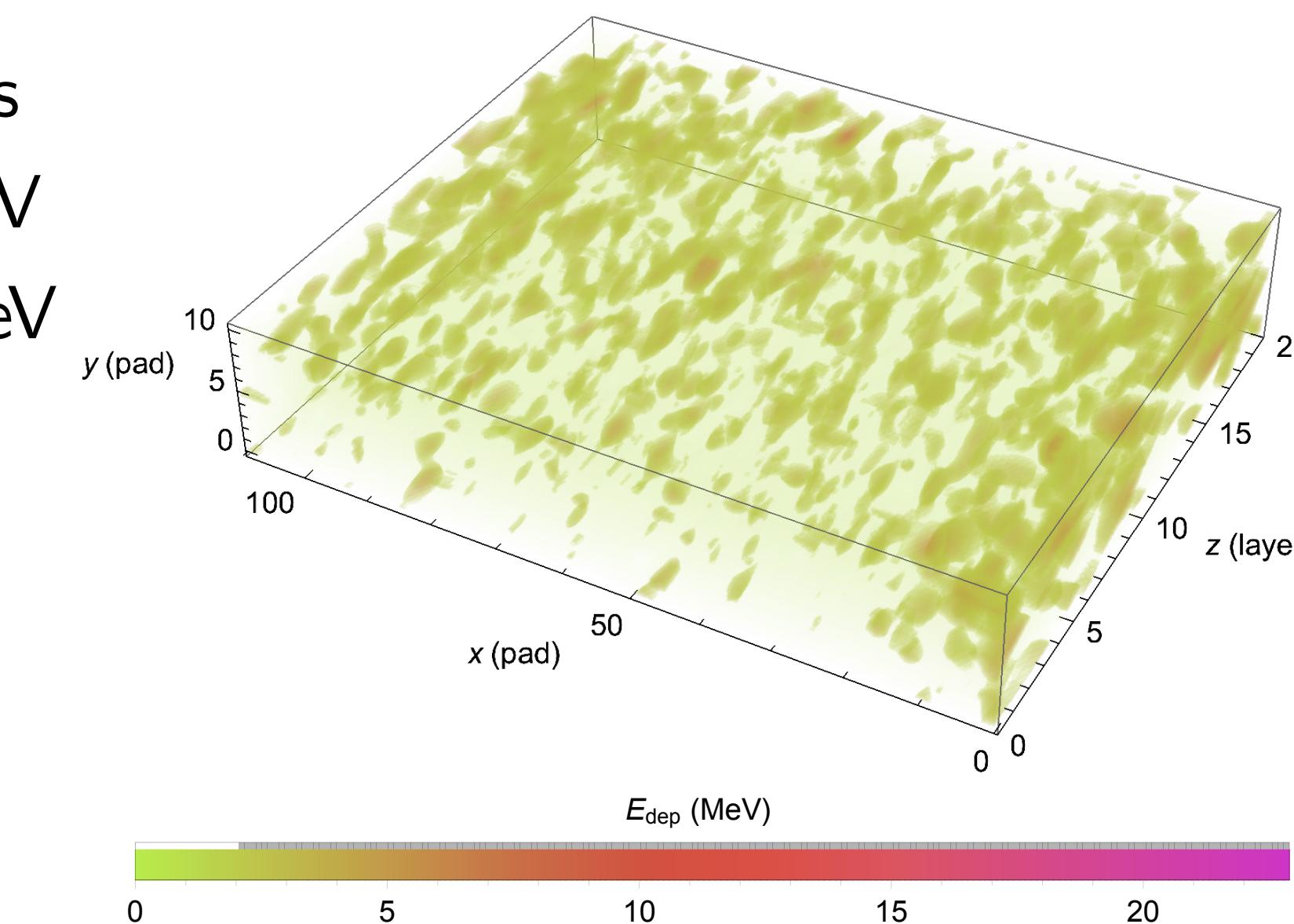


1 us
2.1 GeV
18 MeV

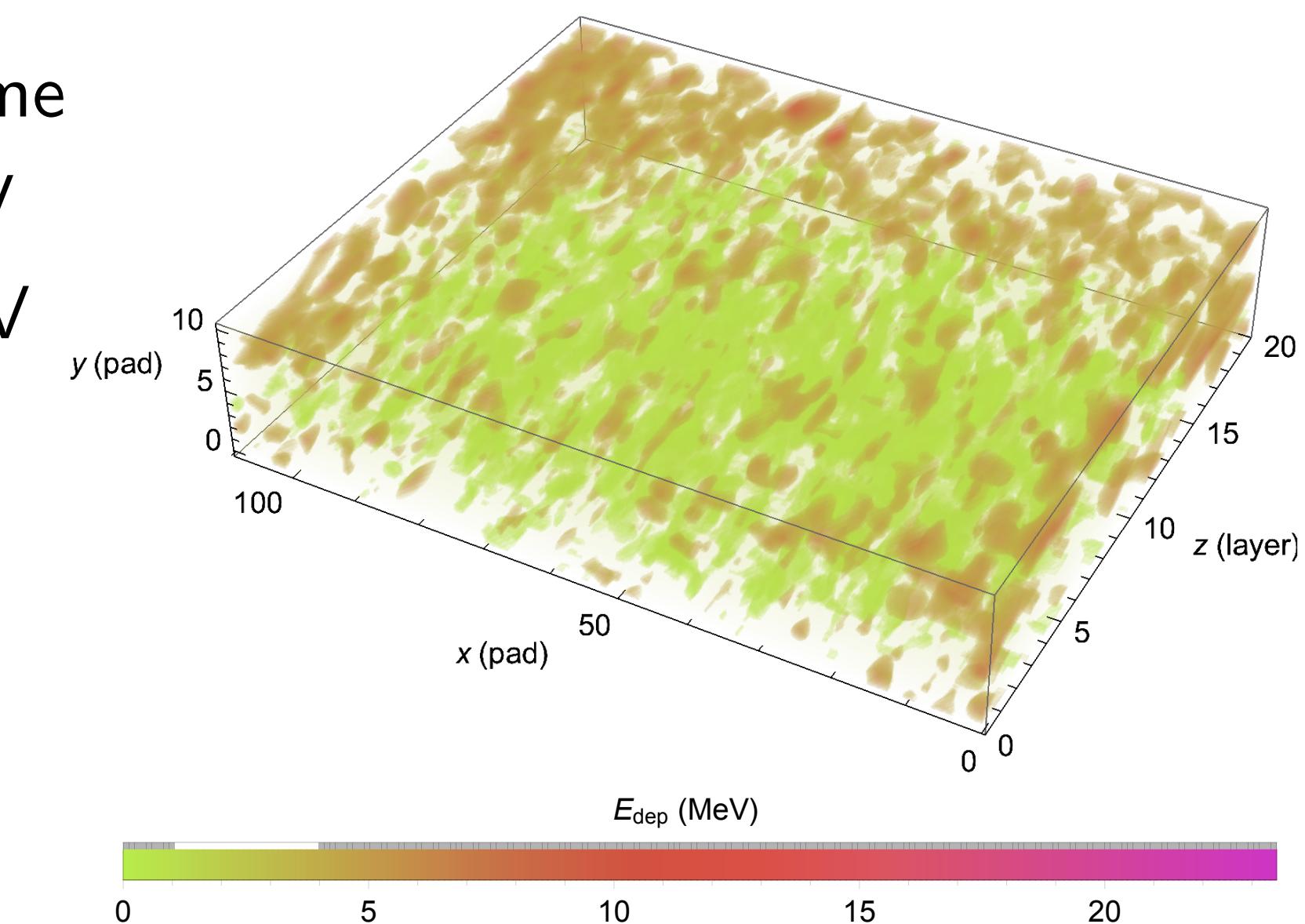


10 us
15 GeV
27 MeV

100 us
33 GeV
27 MeV



Full time
62 GeV
27 MeV



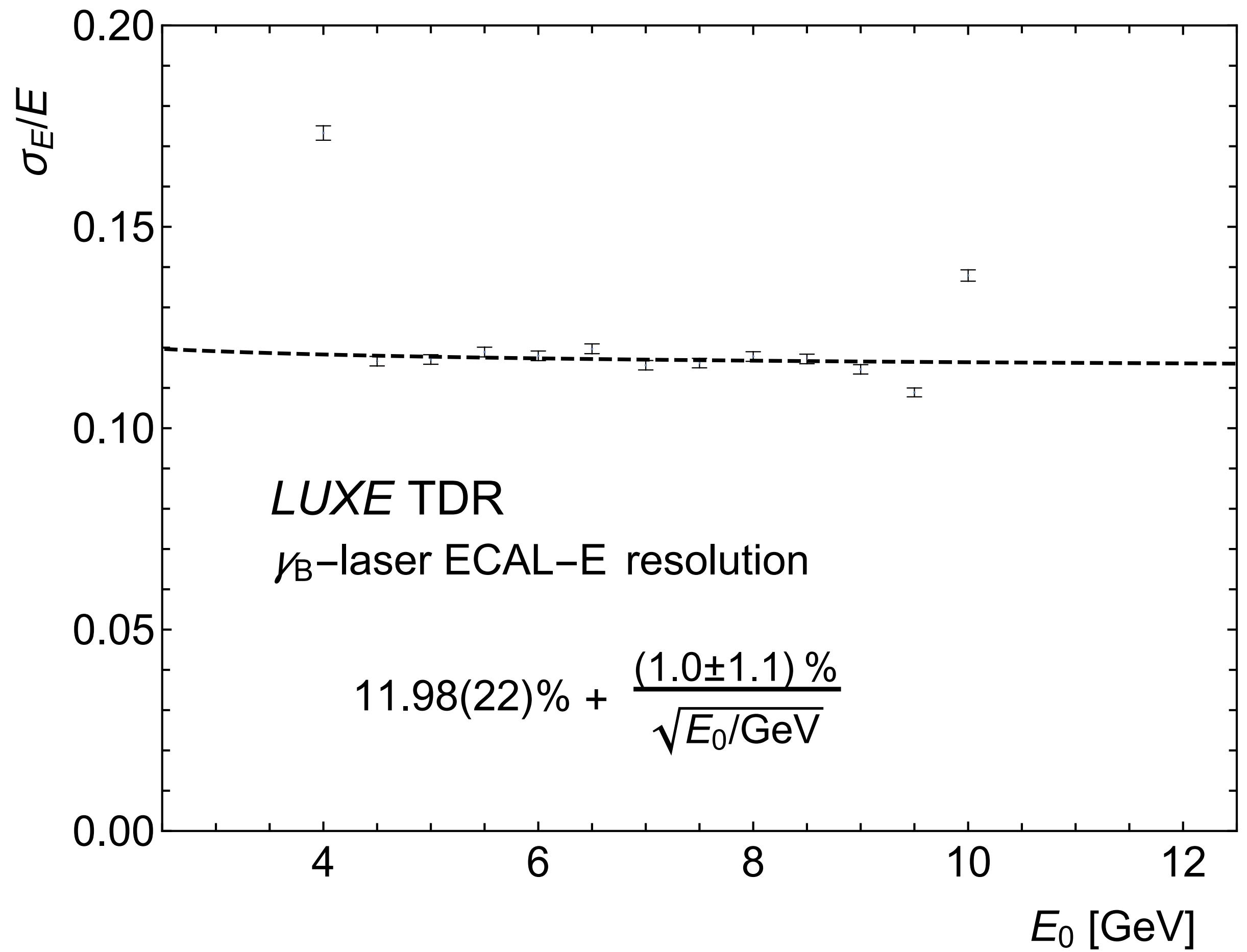
ECAL-E (CALICE) performance

Methods:

- Shoot mono-energetic electrons into the geometry
 - 5000 per energy
 - ranging from 3 to 12 GeV every 0.5 GeV
- Check the total energy deposits created by one particle over the 5000 particles
- A rough position-energy relation
 $x * E = -1000 \text{ mm GeV}$

ECAL-E geometry:

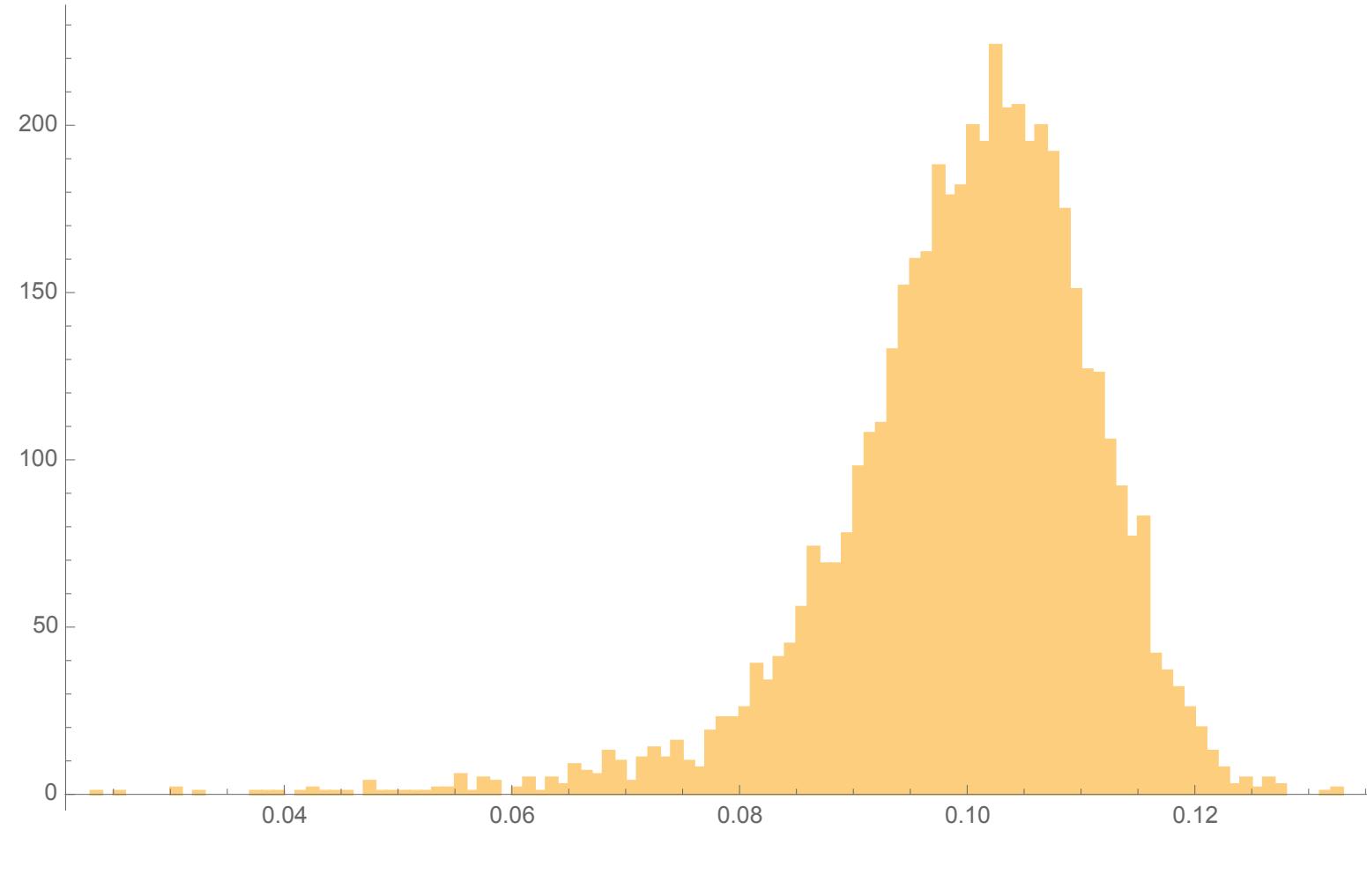
- x in -102 to -280 mm (10 to 3.5 GeV)
- y in -56.8 to 121.2 mm
- z in 4352 to 4577 mm every 15 mm



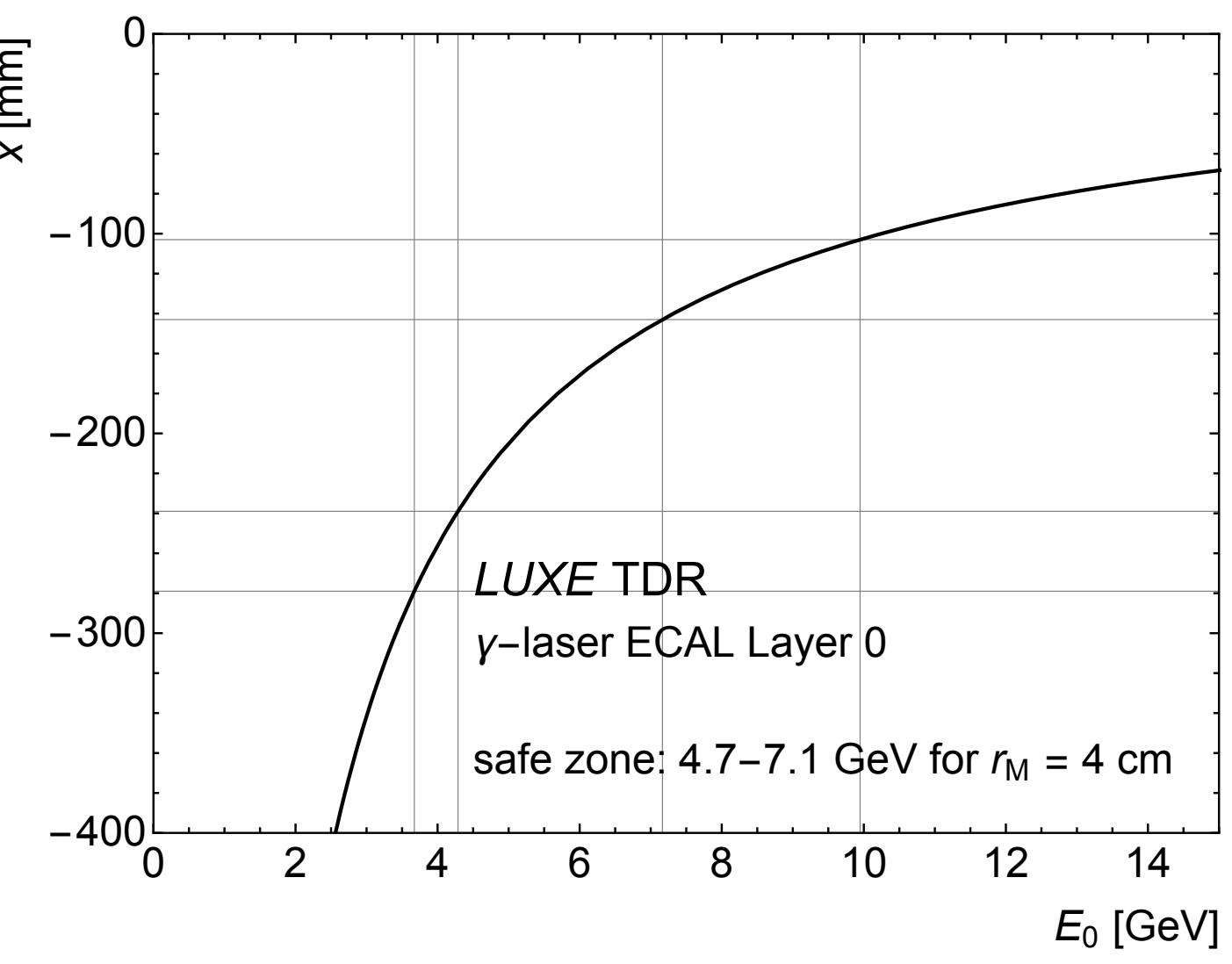
ECAL-E (CALICE) performance

Reasons for the misshaped

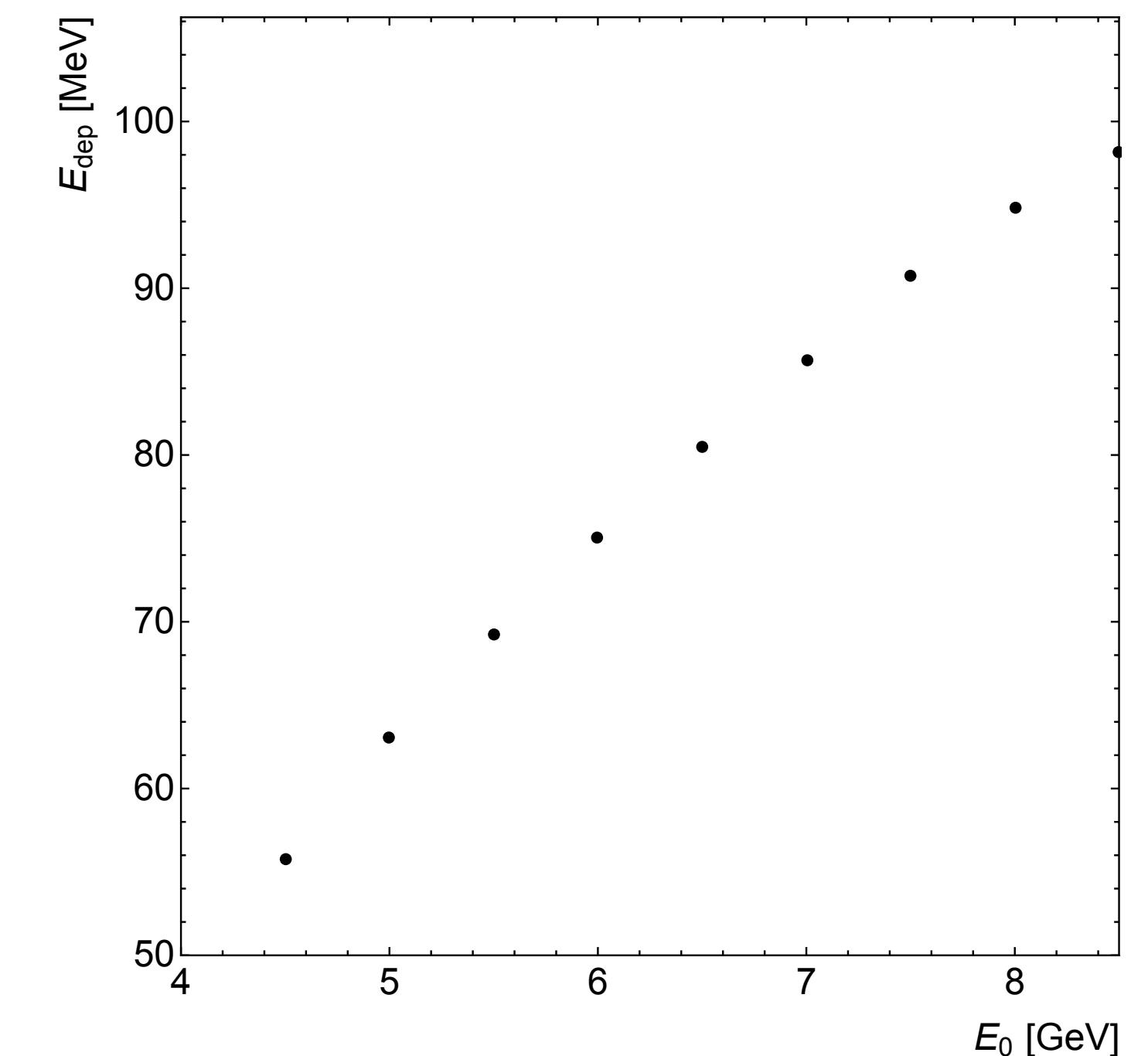
- Leakage?
- Large interval on z direction?



Edep distribution for 9 GeV electrons



Position-Energy relation



Average Edep over electron energy

Next step...

- Using Louis's methods to see the BG+Signal/Signal ratio distribution
- Background in a size-reduced ECAL-P?
- Implement with the latest ECAL-E
- Background generator for CNN...