Simulation & Analysis

Noam Tal Hod

WEIZMANN INSTITUTE OF SCIENCE

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Intro

- CDR
  - electron/photon-beam background simulation topped up to ~300 BXs
    - need to reprocess these and produce:
      - cutflows, 1D bkg+sig plots (smoother)
      - 2D vertex plots to search for new hotspots
    - there are also reprocessed signal BXs with the new setup
      - mostly for photon+laser or both?

- Transition towards the TDR - see next slide

- Impact of non-EM-only processes

Towards the TDR

- Suggest to expand and maintain this non-exhaustive list and structure the coming meetings accordingly

Model in GEANT4	GEANT4 output and format	Signal simulation	Analysis
re-discuss the option to put the IP detectors in vacuum	change physics list in GEANT4 to include muons, hadrons, etc.	e+e- production (keep in mind mCP production)	implement B-field non-uniformities
check again lead-wall shielding performance	re-generate signal particles in numbers corresponding to their weight from MC	ICS signal	common analysis framework to process the G4 output
check joint between the IP chamber and the vacuum chamber	Easy hits association with tracks	inconsistency with Tony's MC (factor of 2 larger?)	Tracker: finalise clustering from Hits tree
change the exit window design according to Oz's last version	increase speed and reduce size?		Tracker: implement charge response from Edep
decrease radius of the beampipe after the vacuum chamber?	manage storage		Tracker: implement KF fit
implement beampipe in the fwd area			
profiler’s material and location			
implement BSM dump and detector			
implement proper, non-uniform magnetic fields			
in general: complete engineering flush with help from DESY and WIS eng.			

Physics list

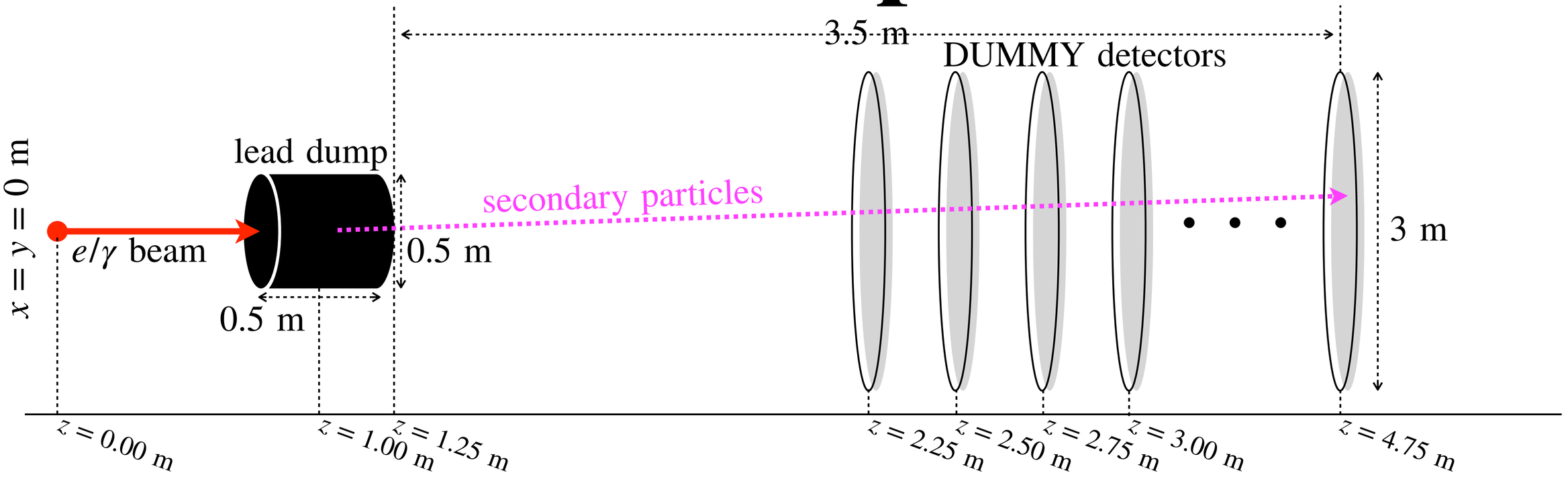
- Were using up to now with the EM-only list (PhysListEmStandard)

- For the BSM study, we wanted to check the background-free assumption (obviously this depends on the detector also)

- This triggered the question why we didn't see so far nothing but e/γ particles in and out of the dump
  - this in turn triggered a question whether or not we should be seeing other particles than e/γ also in the other areas of the experiment

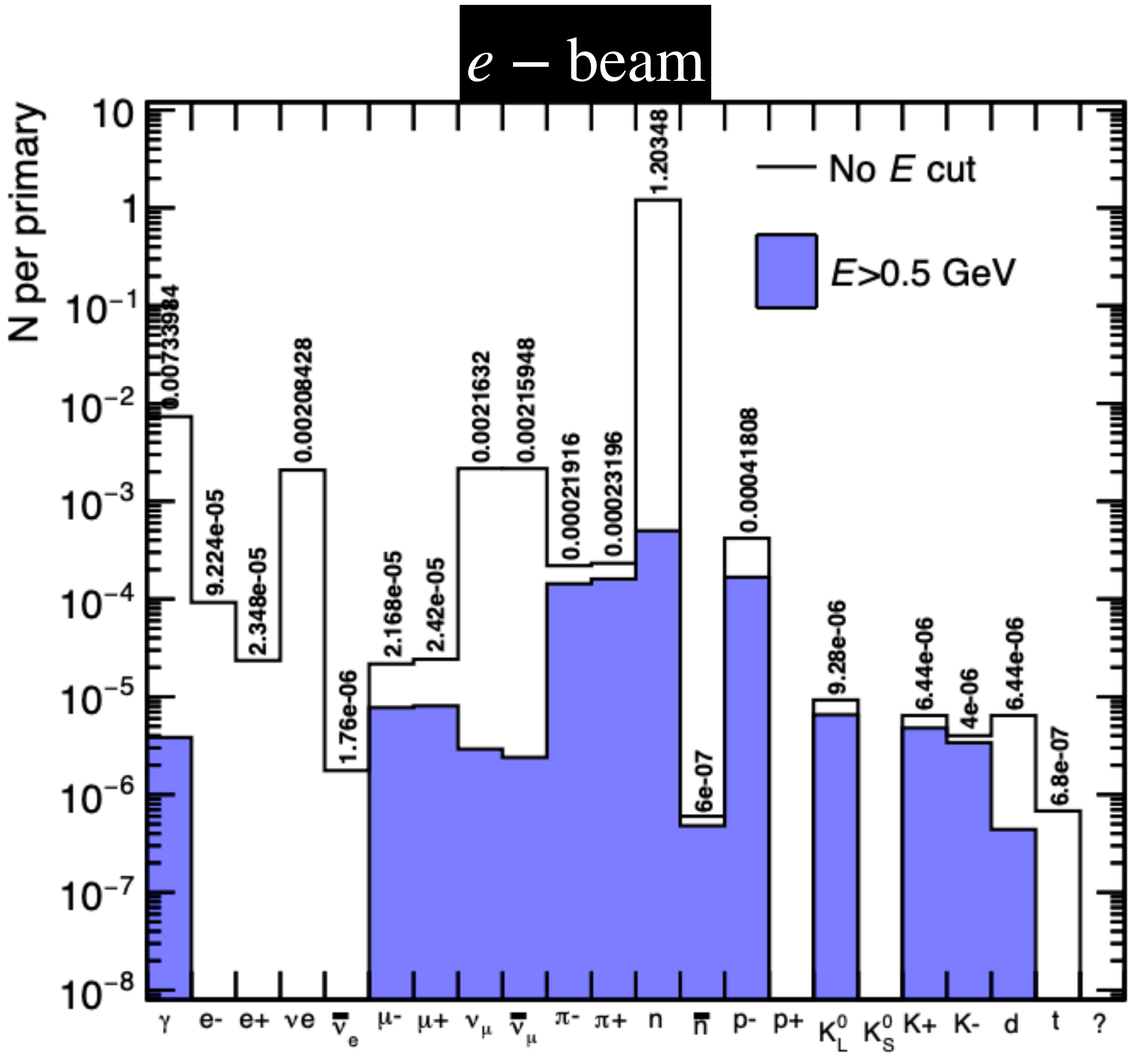
- For the BSM case we've now switched to QGSP_BERT **thanks to Sasha**:
  - "QGSP is the basic physics list applying the quark gluon string model for high energy interactions of protons, neutrons, pions, and Kaons and nuclei. The high energy interaction creates an exited nucleus, which is passed to the precompound model modeling the nuclear de-excitation."
  - "QGSP_BERT is like QGSP, but using Geant4 Bertini cascade for primary protons, neutrons, pions and Kaons below ~10GeV. In comparison to experimental data we find improved agreement to data compared to QGSP which uses the low energy parameterised (LEP) model for all particles at these energies. The Bertini model produces more secondary neutrons and protons than the LEP model, yielding a better agreement to experimental data."

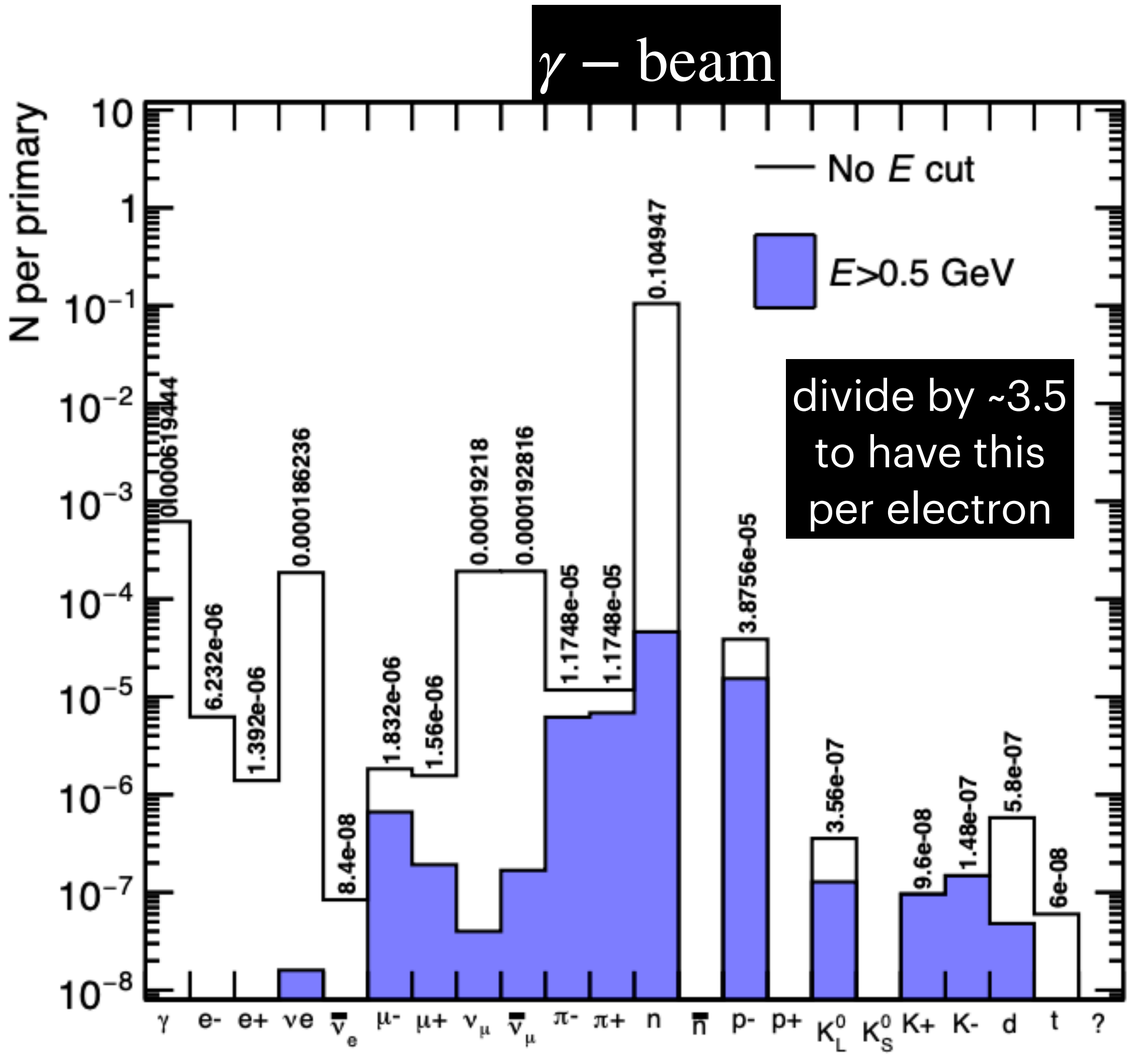
Setup



- World is in vacuum, dump is made of lead, several dummy disk-like detectors 0.25 m apart, 1 m after the dump end
- Shoot 25M electrons with fixed 16.GeV, or 250M photons with energy distributed according to the Compton photons resulting form the e+laser interaction with τ=120 fs, w_0=10 μm pulse (the new data from Tom)
- Distributions are normalised to primary particle
  - for the photon-beam: $N_{\gamma \text{ per } e} \simeq 3.5$ (not implemented below) so numbers are even smaller per primary electron
- Particles are kept only if they traverse the dummy detector within $r(x, y) < 1$ m

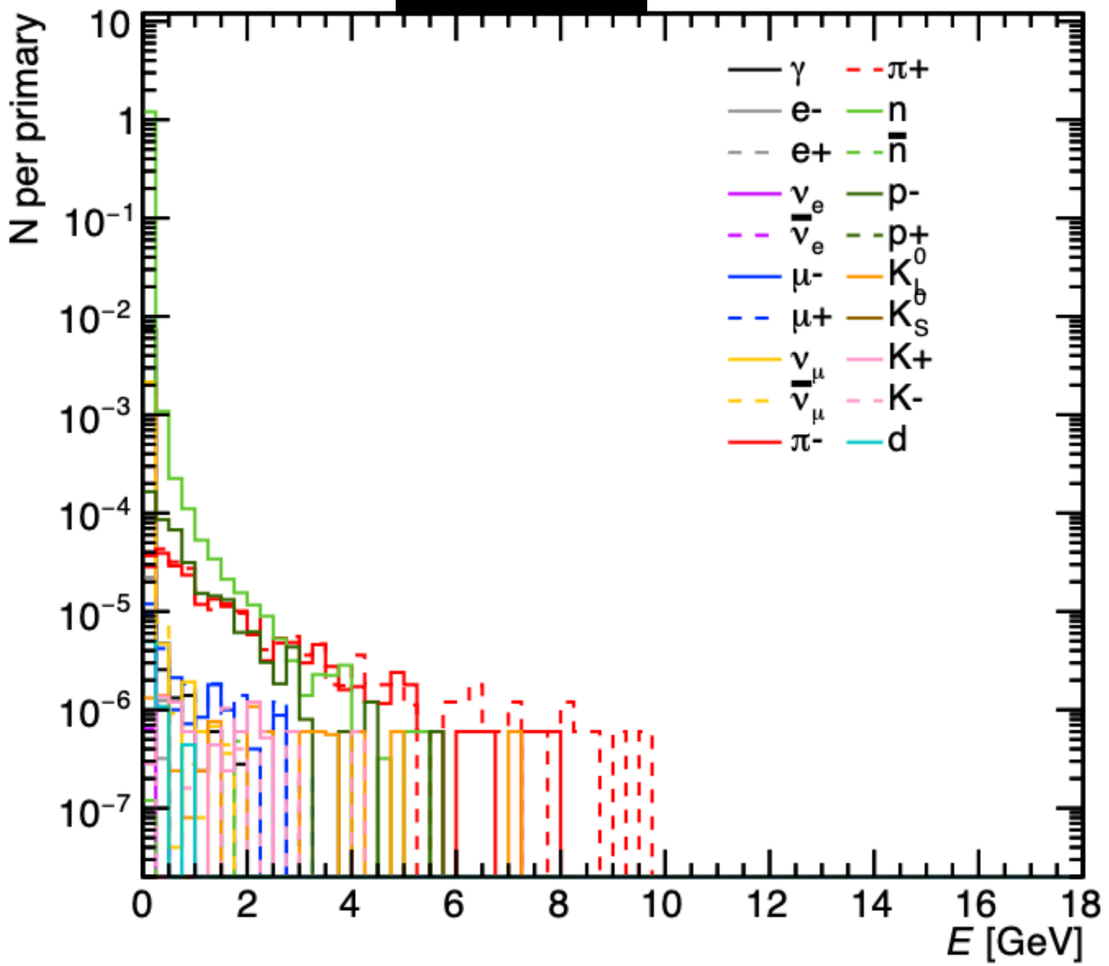
With the QGSP_BERT list



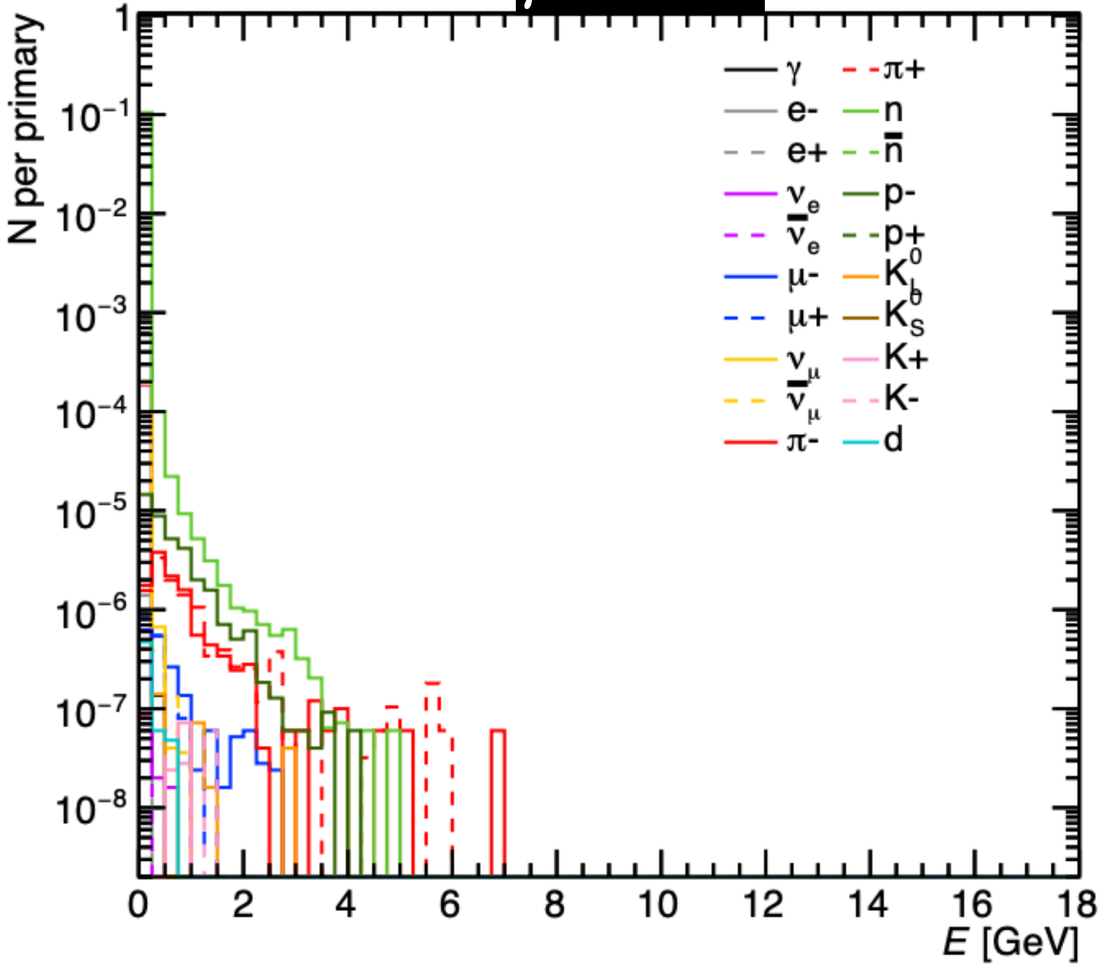


With the QGSP_BERT list

$e-$ beam

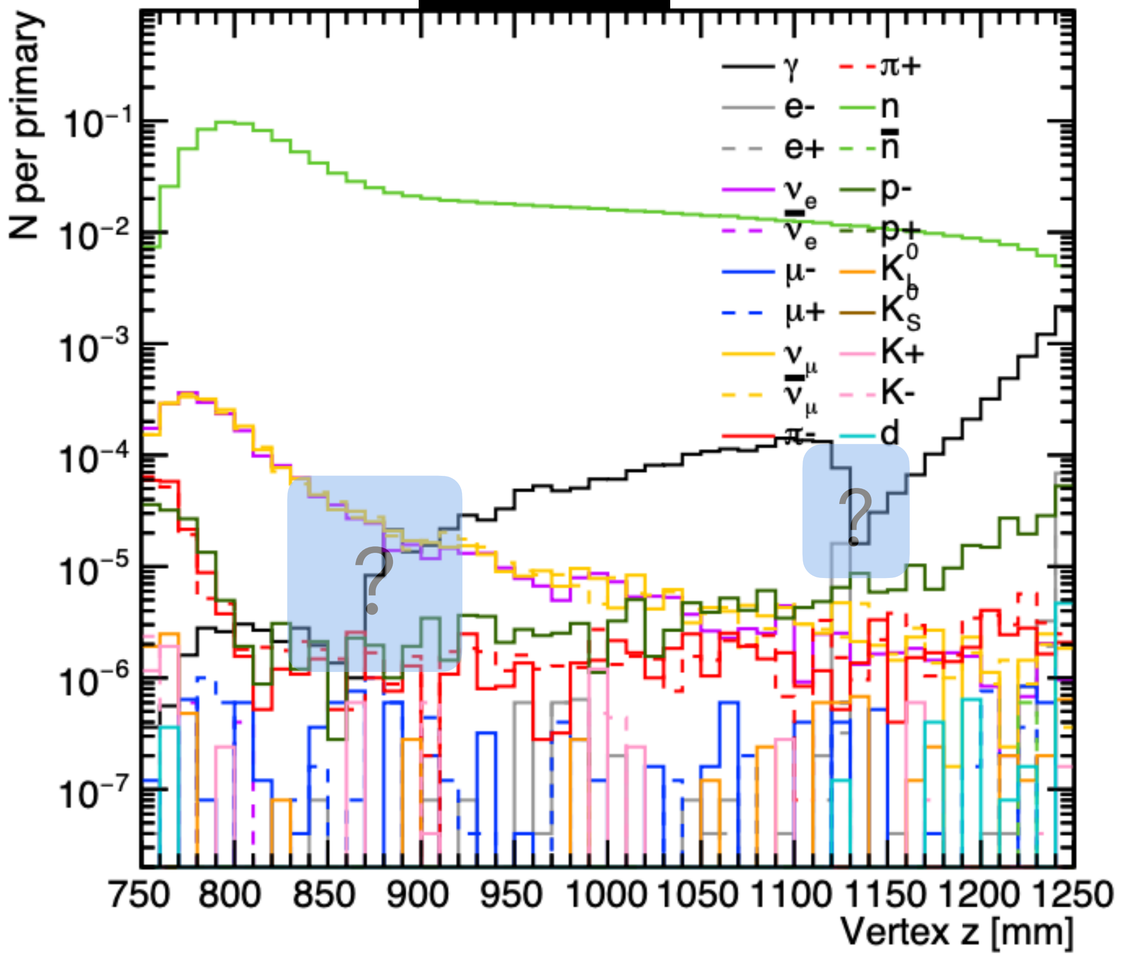


$\gamma-$ beam

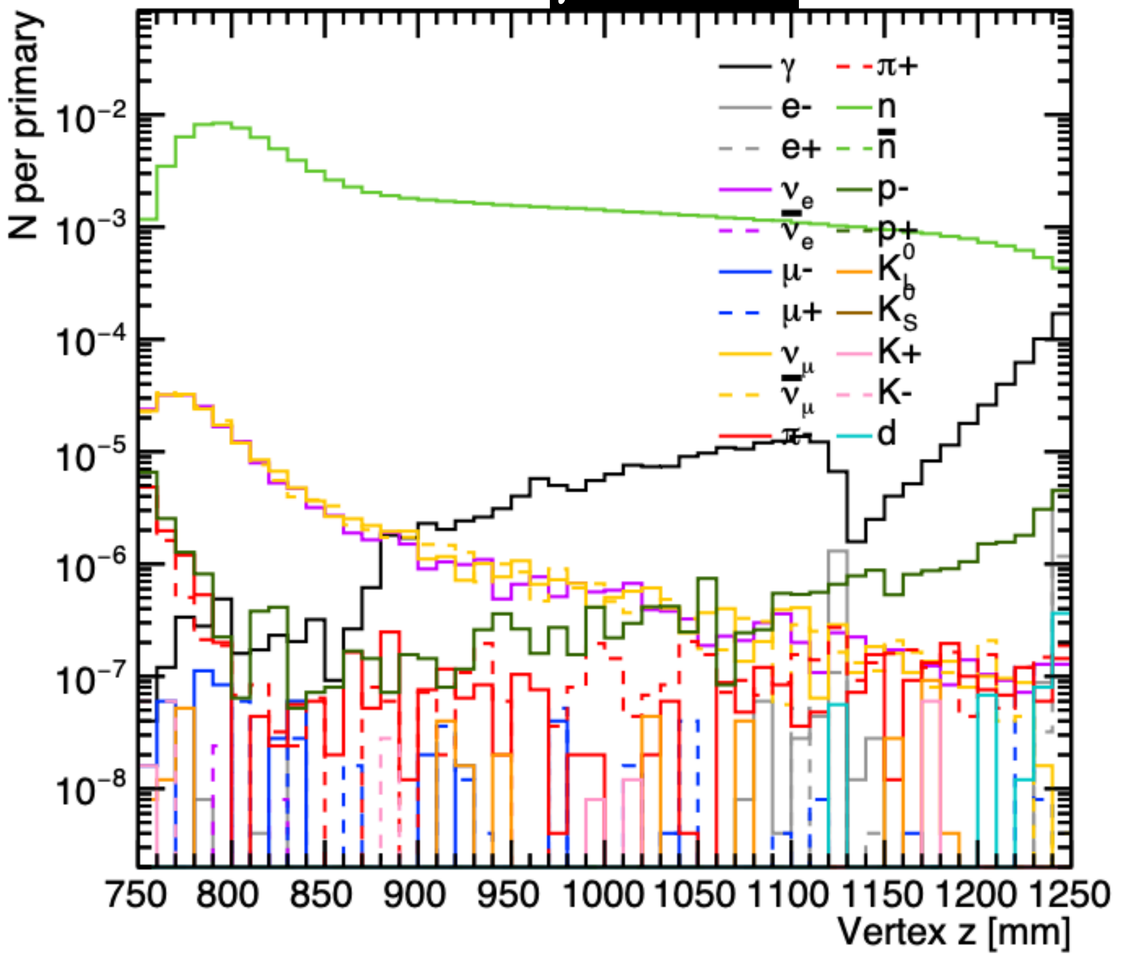


z_{vtx} all particles arriving

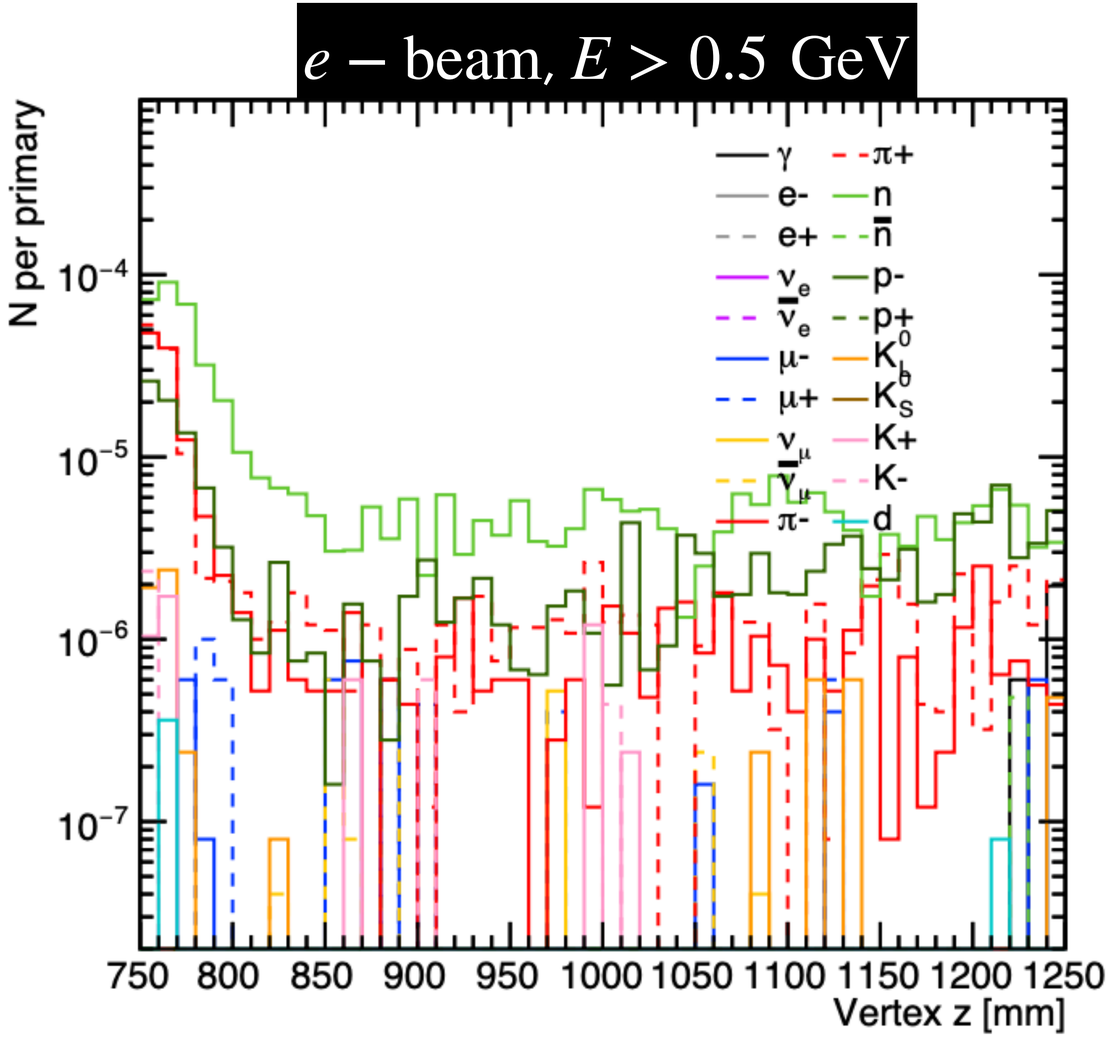
$e-$ beam

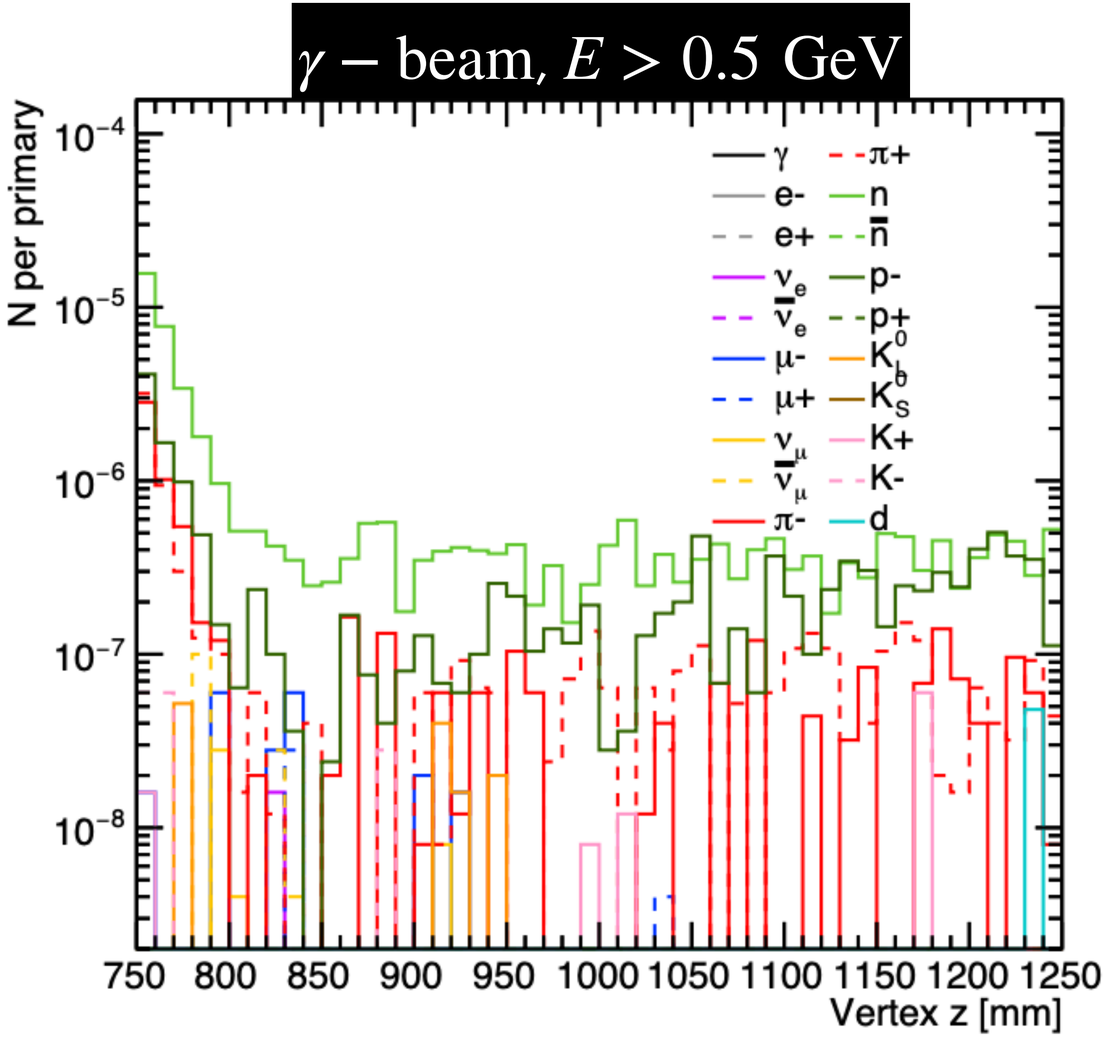


$\gamma-$ beam



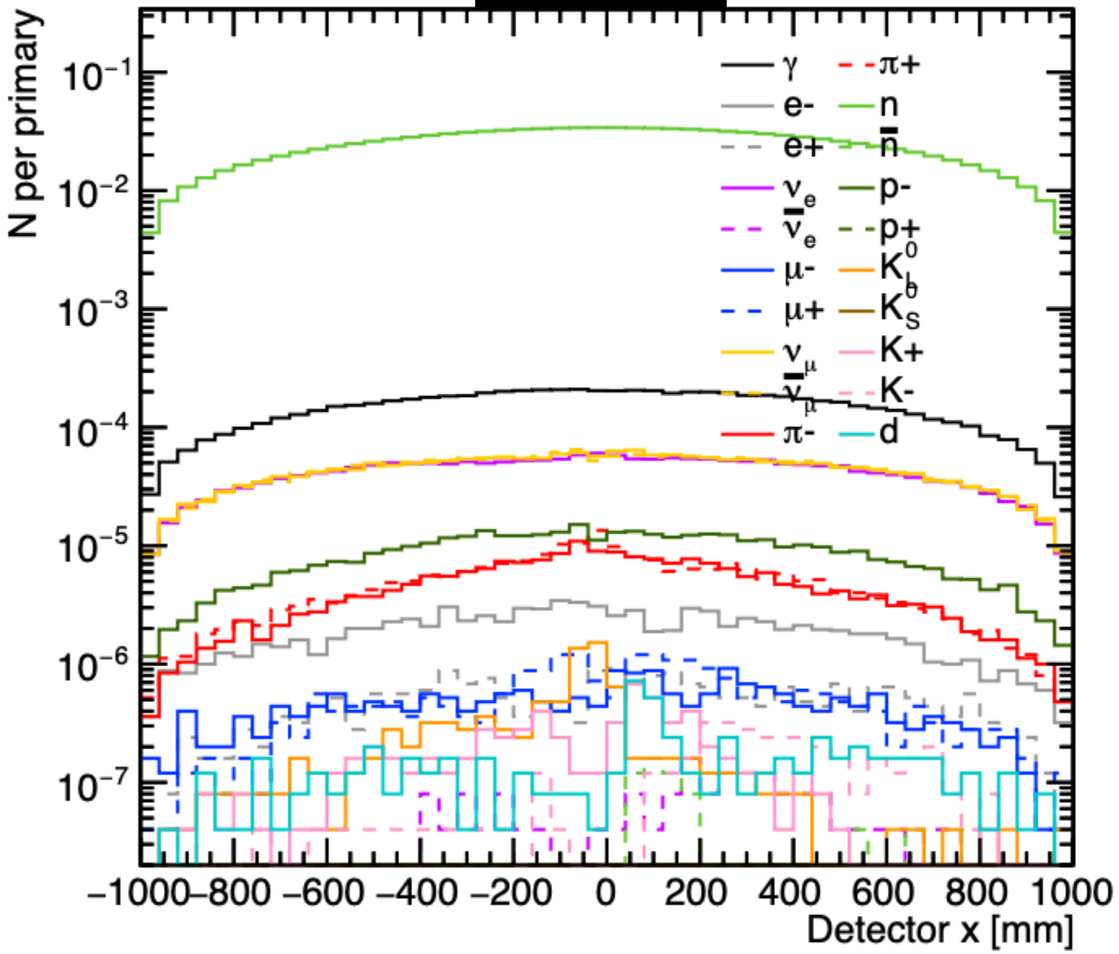
z_{vtx} all particles arriving, $E > 0.5$ GeV



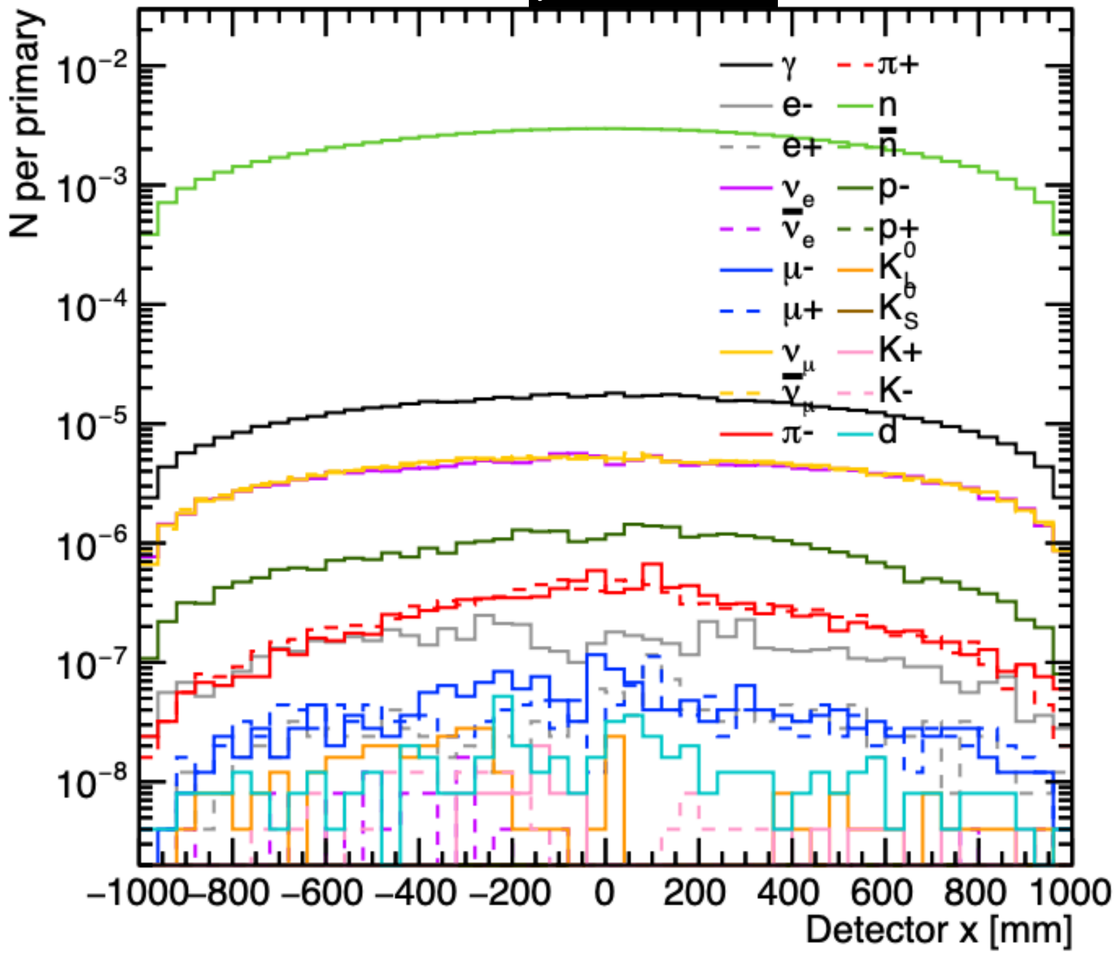


x_{det} all particles arriving

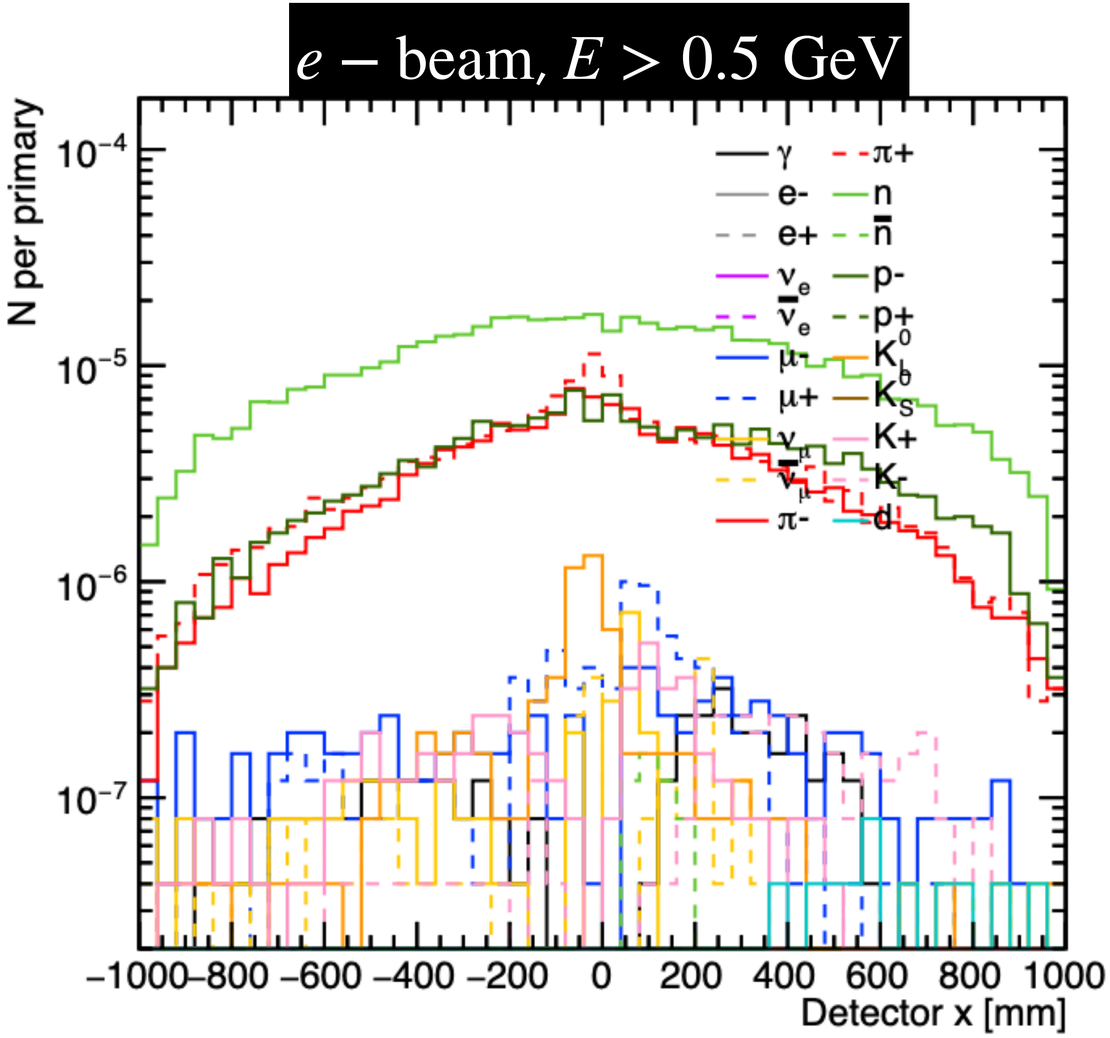
e – beam

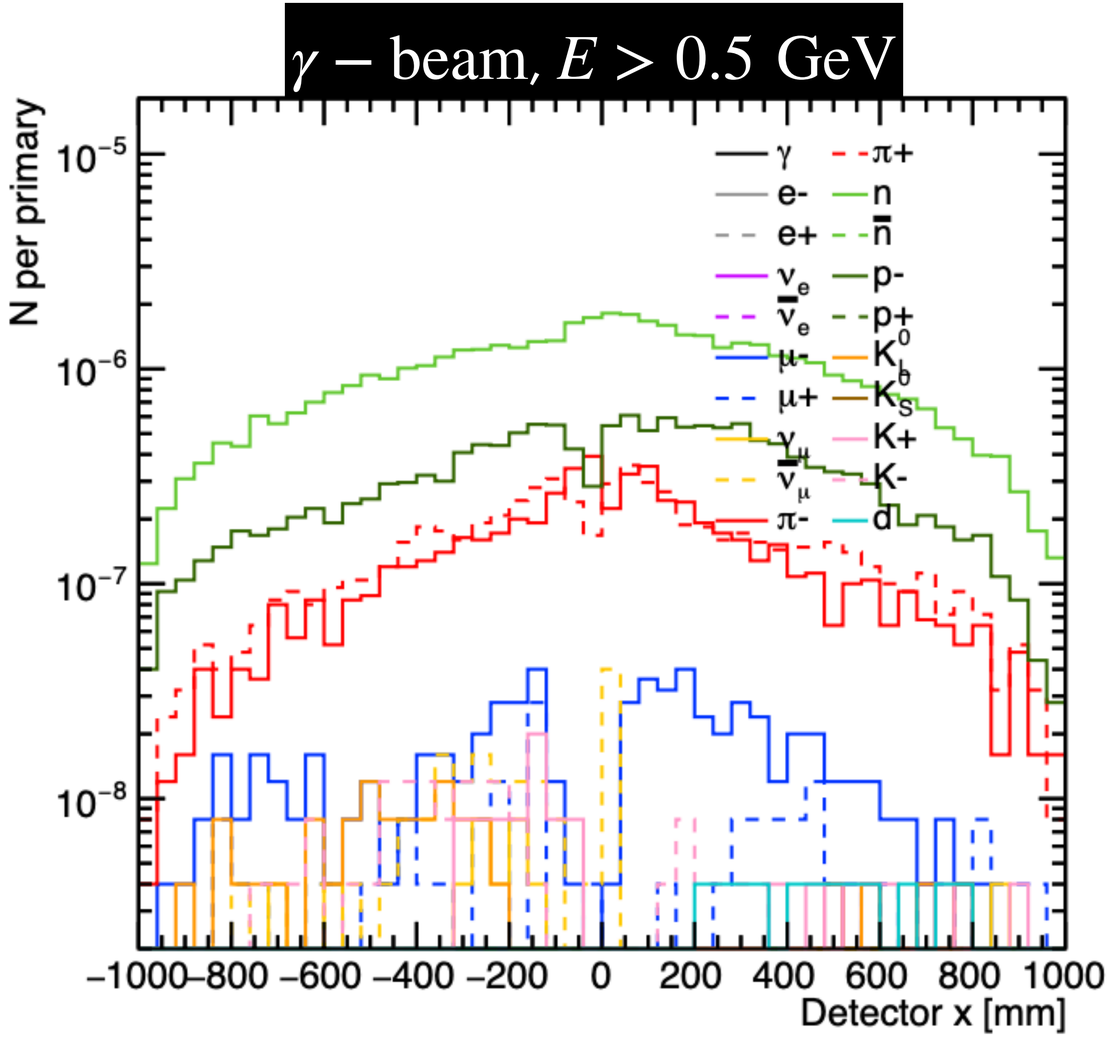


γ – beam

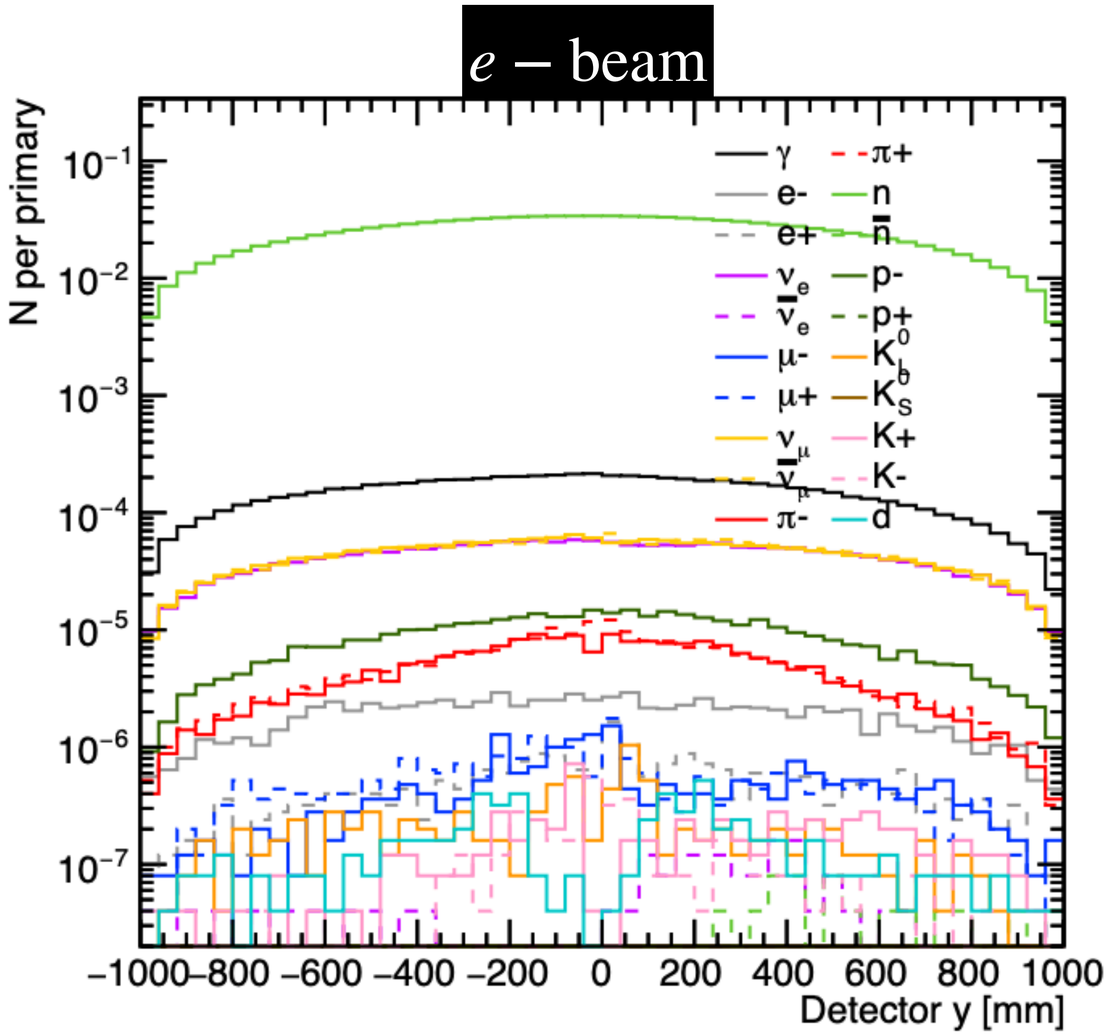


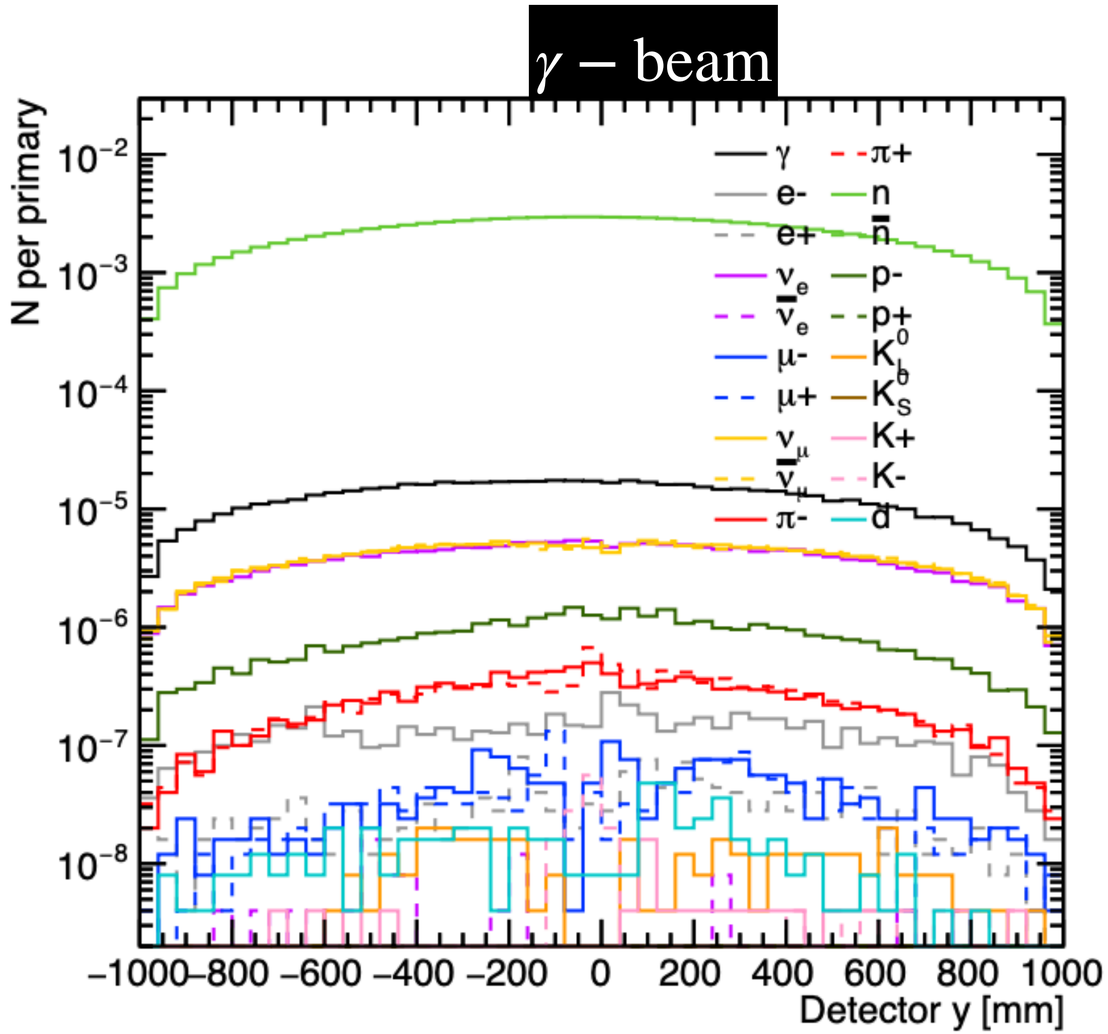
x_{det} all particles arriving, $E > 0.5$ GeV



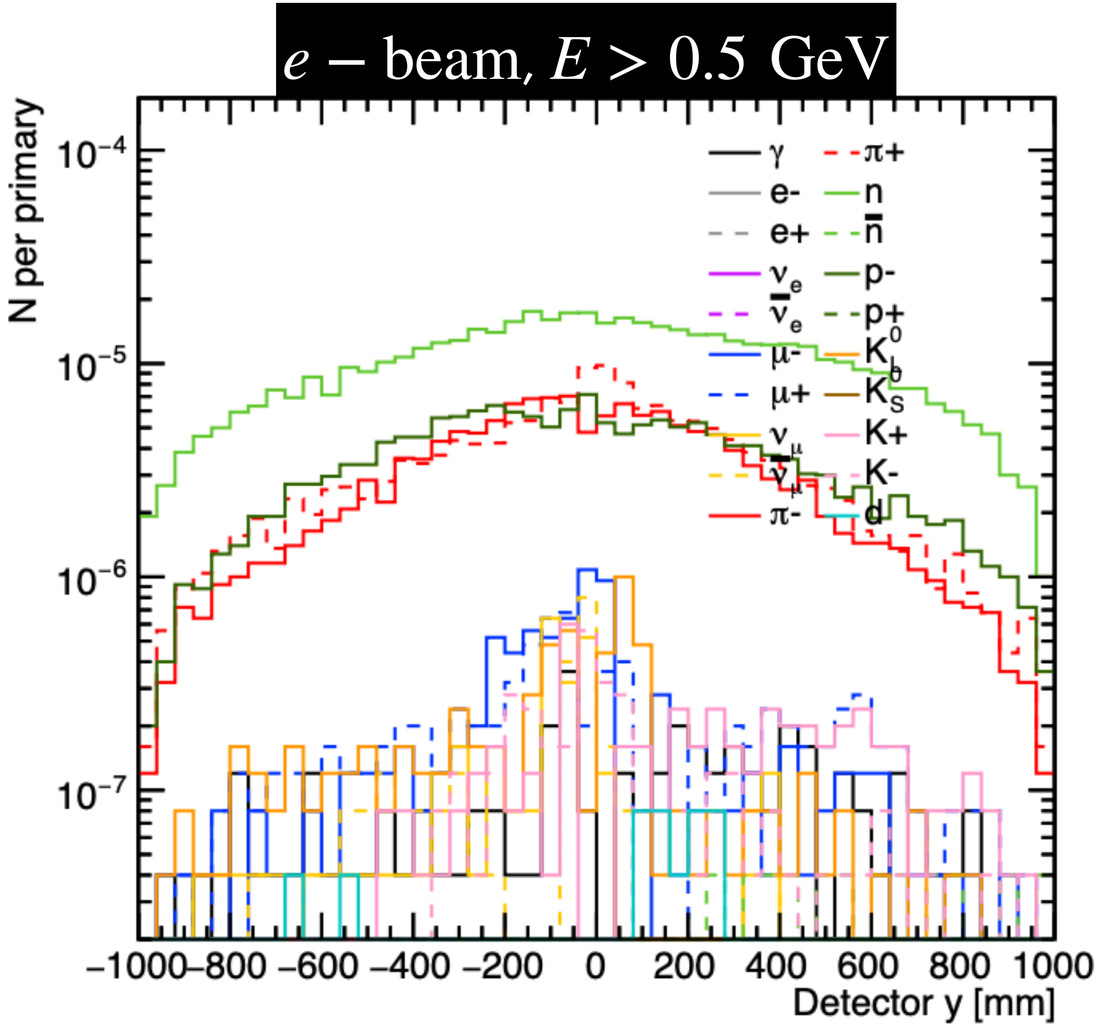


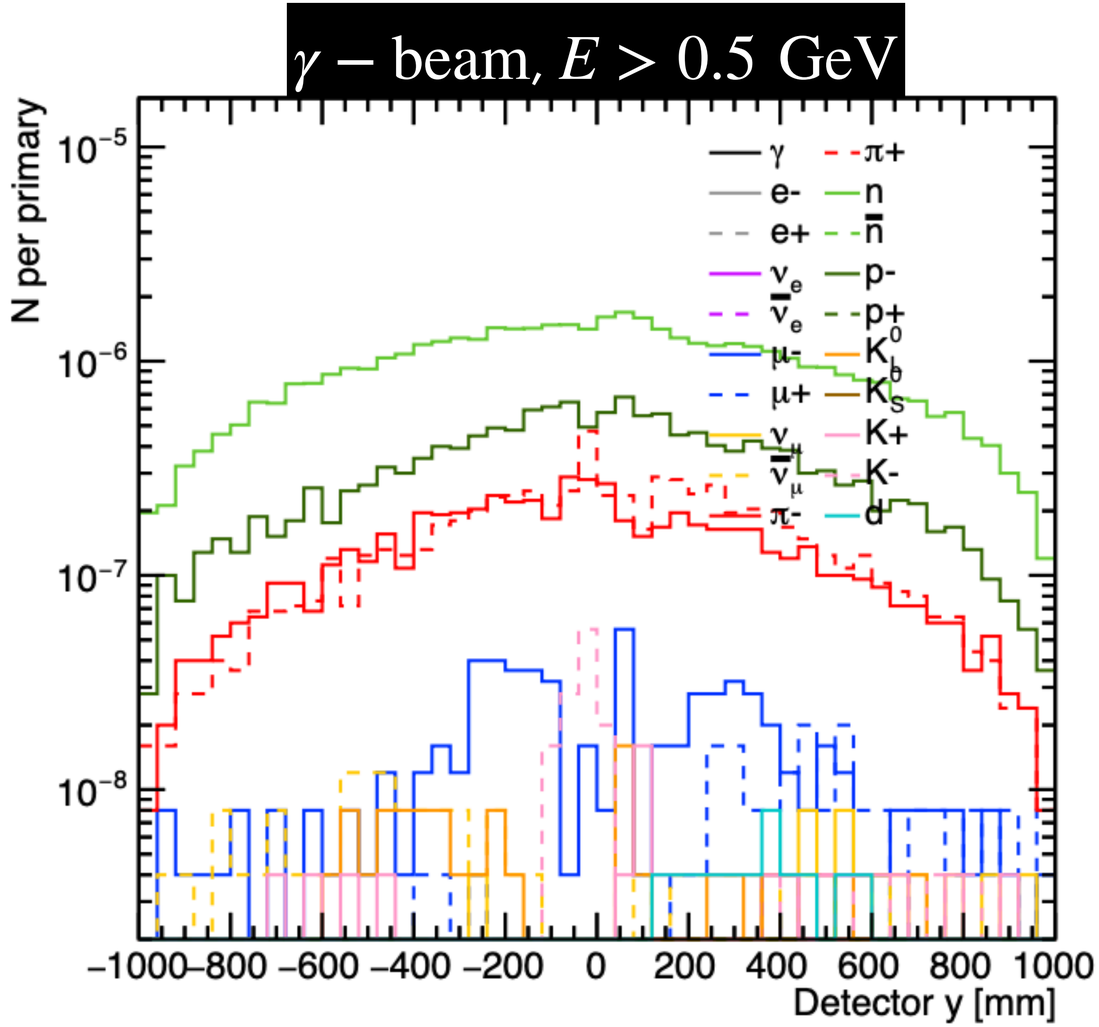
y_{det} all particles arriving



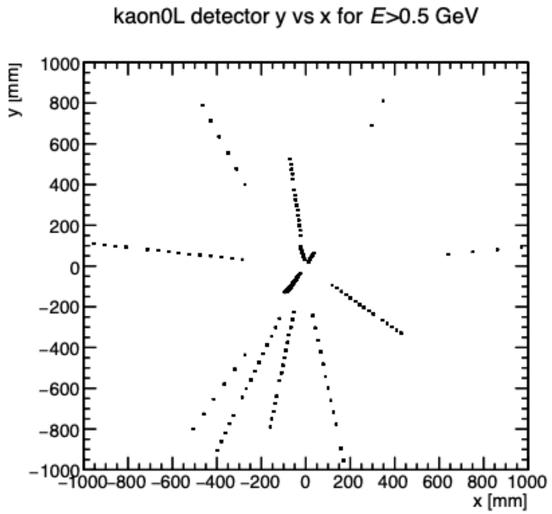


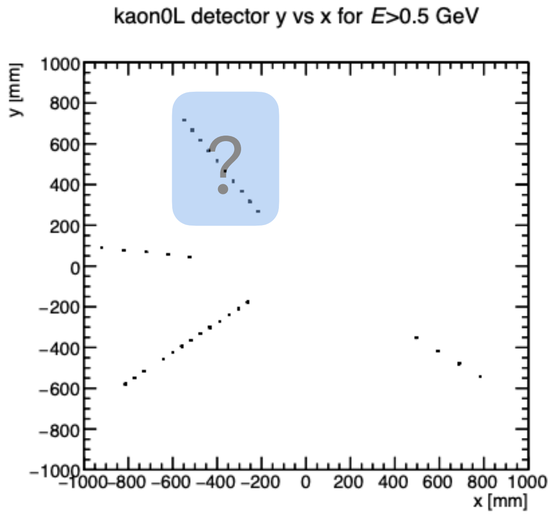
y_{det} all particles arriving, $E > 0.5$ GeV

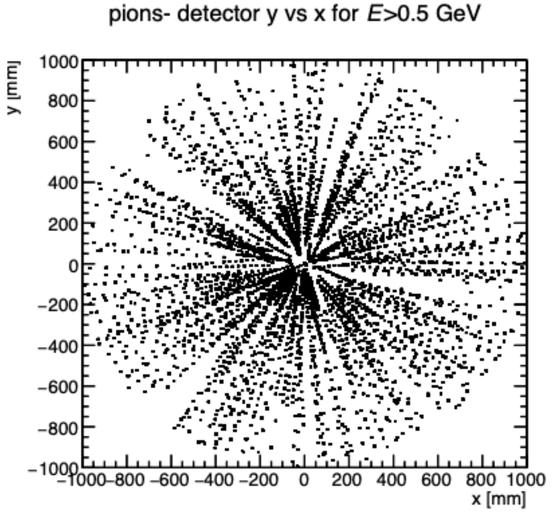


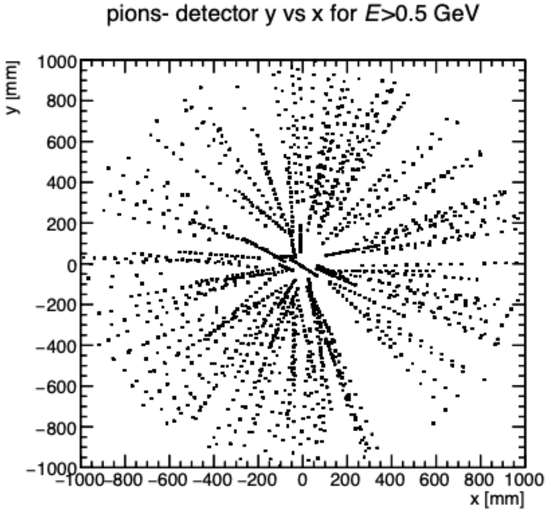


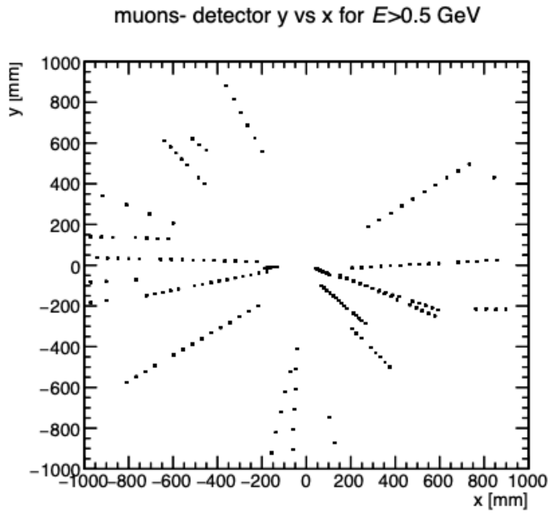
Directions are quantised?

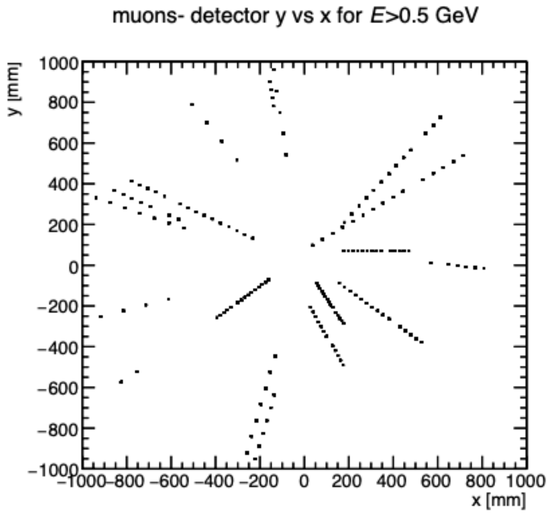












Summary

- In general:
  - lots of neutrons and protons, some pions and muons from the dump
    - will be also produced in our 2nd dump (between the IP and the fwd part)
  - much smaller bkg in the photon-beam than electron-beam (less energy…)
  - we must redo the bkg simulation with this physics list (slower)

- BSM part
  - zero photons in the photon-beam case, while in the electron-beam case there are: XFEL electrons-on-dump is not bkg free!
  - zero electrons/positrons in both cases
  - need a magnet after the dump to sweep charged particles ($\mu^{\pm}, \pi,^{\pm}, p^{\pm}, K^{\pm}$)
  - detector should be insensitive to neutrons and provide energy+pointing of photons, maybe with a possibility to reject e.g. muons behind (would be needed for cosmics)
    - in this case, we can require two photons + vertex + $\mu/\pi/p$ veto, so the search can be claimed to be be ~bkg-free.
    - note: $K^0_{L/S}$ can still give $\pi^0 \to \gamma\gamma$ (together with electrons, muons and charged pions)