Bkg for BSM

Noam Tal Hod

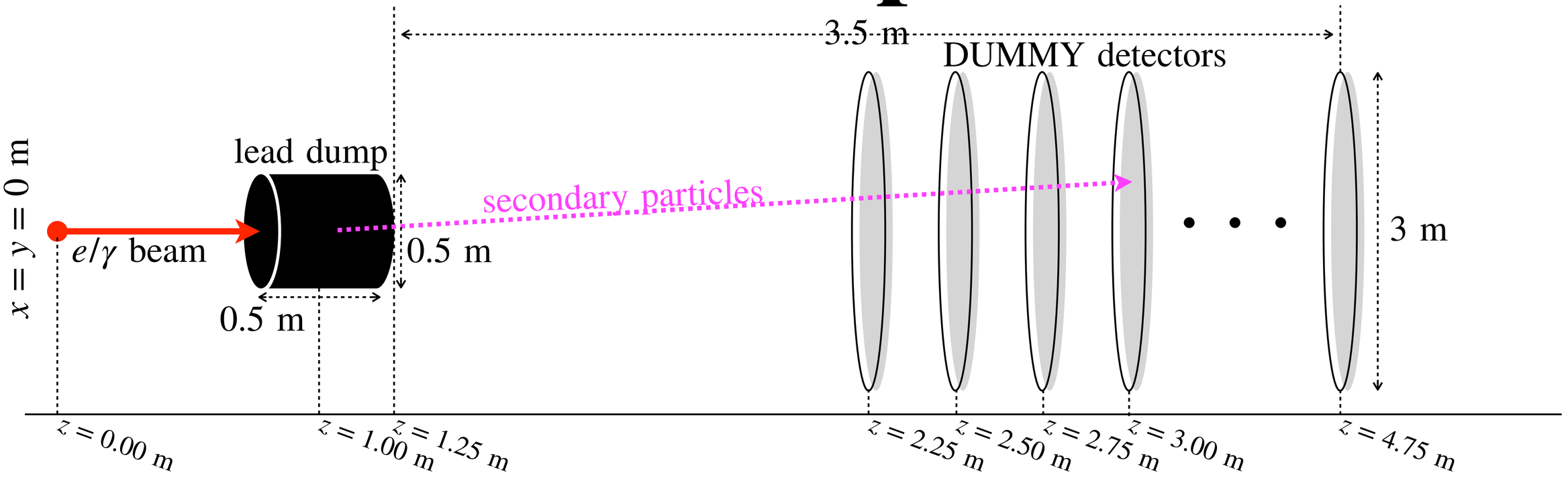
WEIZMANN INSTITUTE OF SCIENCE

Febr 1 2021

Physics list

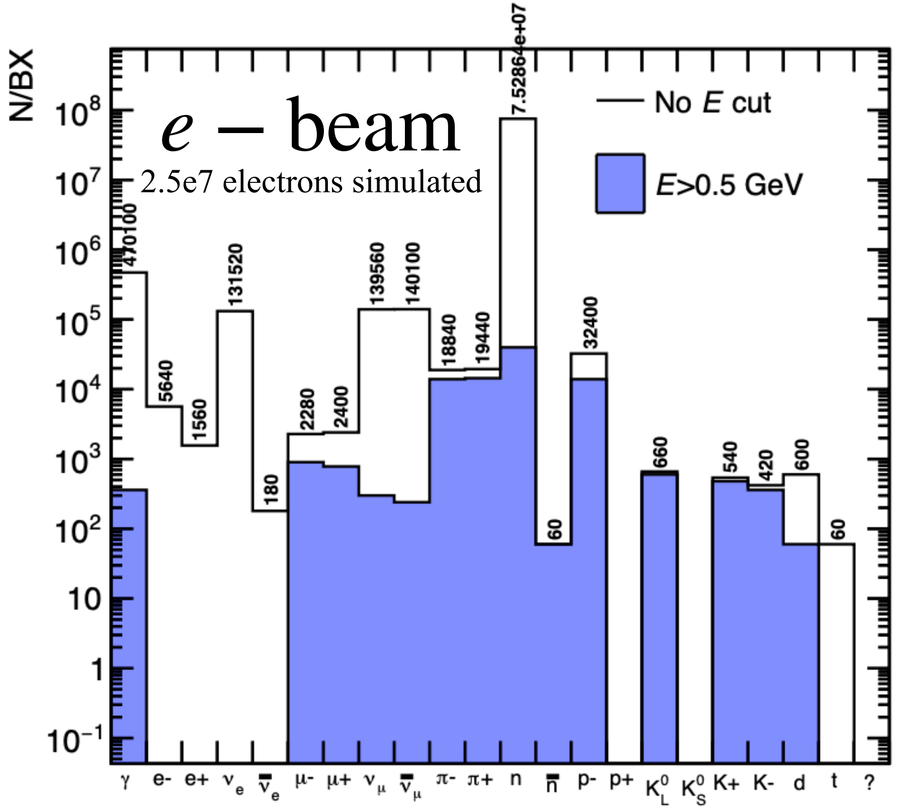
- Were using up to now with the EM-only list (PhysListEmStandard)
- For the BSM study, we wanted to check the background-free assumption (obviously this depends on the detector also)
- This triggered the question why we didn't see so far nothing but e/γ particles in and out of the dump
- For the BSM 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."

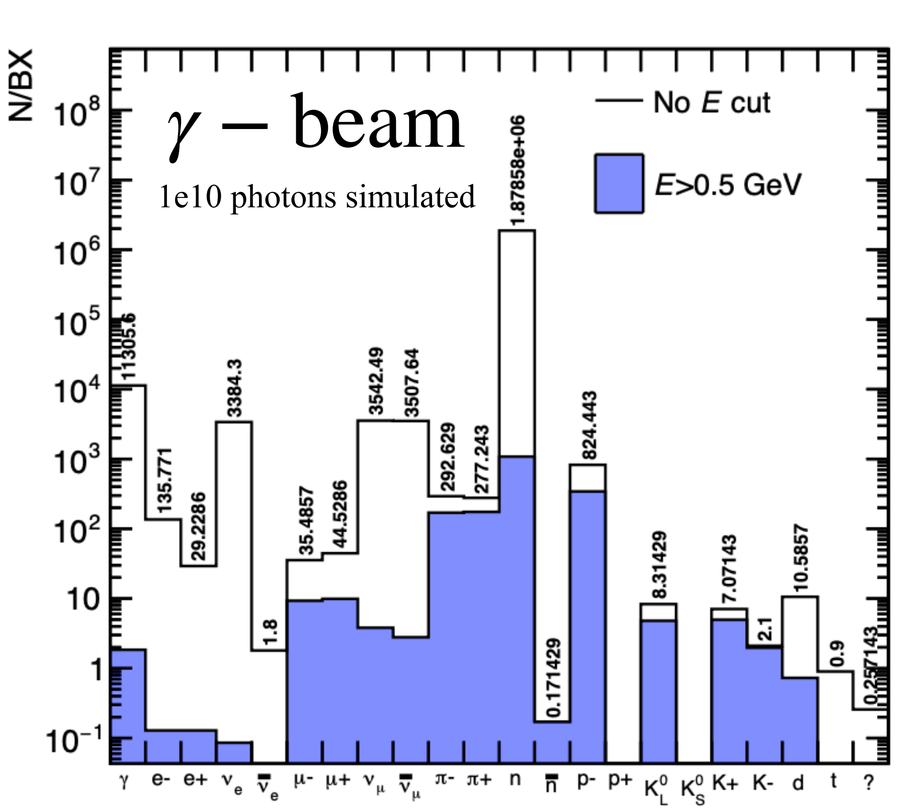
Setup



- 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 2.5e7 electrons with fixed 16.5 GeV, or 1e10 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 one BX (recall that for the photon-beam discussed here: $N_{\gamma \text{ per } e} \simeq 3.5$)
- Particles are kept only if they traverse the dummy detector within $r(x, y) < 1$ m

Plots





- For all plots see: https://drive.google.com/file/d/1bk-nekhNgDKHwHQR33JXiHNmD1QAXwns/view?usp=sharing
- The left plots on each page are for electron-beam (with 2.5e7 primary electrons)
- The right ones are for photon-beam (with 1e10 primary photons)
- Otherwise everything should be self explanatory from the titles, the axes and the legends

Summary

- lots of neutrons and protons, some pions and muons from the dump
- much smaller bkg in the photon-beam than electron-beam (less energy…)
- for the stat simulated: ~2 photons/BX above 0.5 GeV in the photon-beam case, while in the electron-beam case there are ~400 of those
- effectively ~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 as insensitive as possible to neutrons and provide energy+pointing of photons
  - in this case, we can require two photons + vertex + $\mu/\pi/p$ veto, so the search can be claimed to be be ~effectively bkg-photon-free.
  - note: $K^0_{L/S}$ can still give $\pi^0 \to \gamma\gamma$ (together with electrons, muons and charged pions) but this is out of the mass range