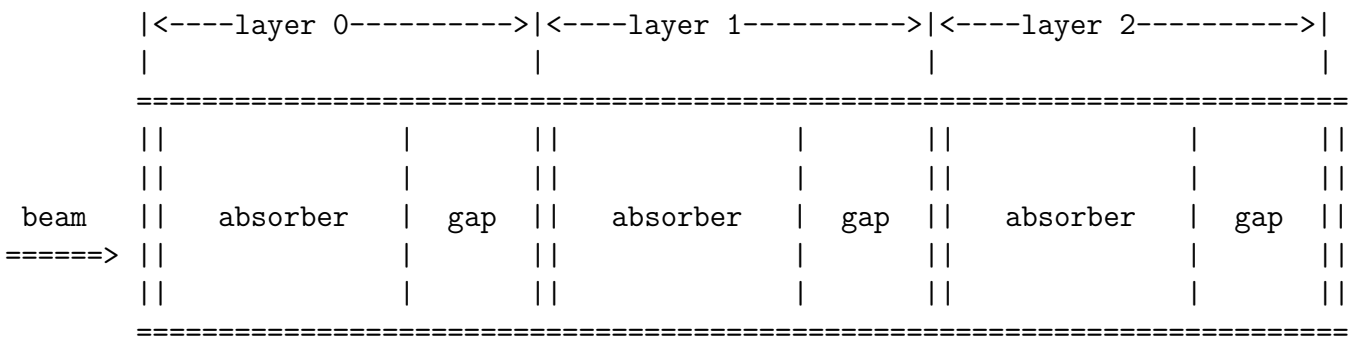
Problem 10.1.

Solution. I don't quite know what to submit for this week's homework. I have included the `vis.mac` file and the `DetectorConstruction.cc` file which I edited, but nothing else. For this reason there is no makefile, since I was working inside the Geant code itself, and only included the snippets I changed in this submission.

The examples contained in B4 all simulate a simple Sampling Calorimeter setup. According to the `README` the calorimeter is a box made of a given number of layers. A layer consists of an absorber plate and of a detection gap. The layer is replicated. The structure of the detector is shown below



The number of layers, layer geometry and used materials are listed in the code snippet below:

```
  G4int nofLayers = 10;
  G4double absoThickness = 10. * mm;
  G4double gapThickness = 5. * mm;
  G4double calorSizeXY = 10. * cm;

  auto layerThickness = absoThickness + gapThickness;
  auto calorThickness = nofLayers * layerThickness;
  auto worldSizeXY = 1.2 * calorSizeXY;
  auto worldSizeZ = 1.2 * calorThickness;

  // Get materials
  auto defaultMaterial = G4Material::GetMaterial("Galactic");
  auto absorberMaterial = G4Material::GetMaterial("G4_Pb");
  auto gapMaterial = G4Material::GetMaterial("liquidArgon");
```

In this exercise we need to define water as a new absorber material, so I defined

```
new G4Material("Water", z = 10., a = 18.01528 * g / mole, density = 0.997 * g / cm3);
```

and used this as `absorberMaterial` instead of `"G4_Pb"`.

To run the simulations I edited the `vis.mac` file to use `DAWNFILE` instead, and then defined the simulation specific inputs at the very end:

```
#/gun/particle e-
#/gun/particle proton
/gun/particle alpha
/gun/energy 10 GeV
/run/beamOn 1
```

and then I ran the simulation in batch mode by feeding the `vis.mac` file to the simulation via `./exampleB4a -m vis.mac`. I was lazy, so I did not write a bash script or anything, I just kept on commenting the particle in and out wherever I needed it. For water as the absorbing material, I just rebuilt the detector construction file `DetectorConstruction.cc` with my changes.

Using the preset absorbing material we get the following three plots:

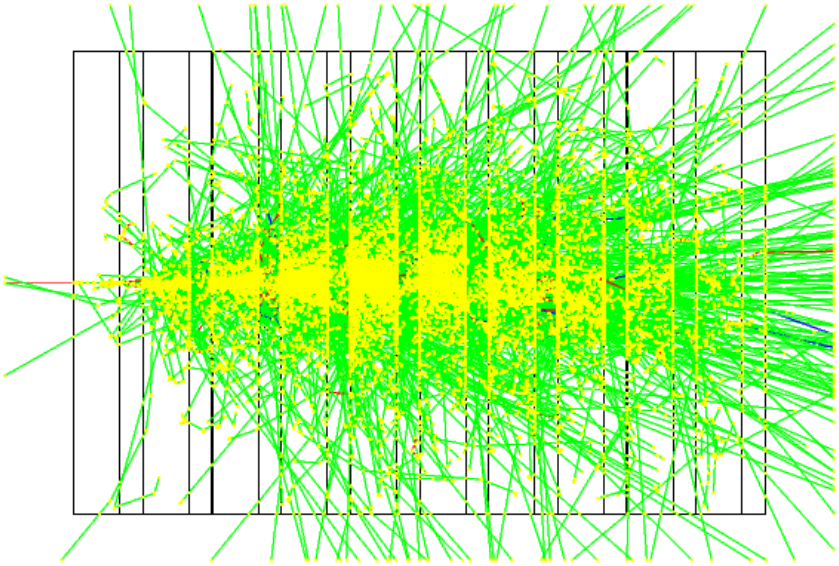


Figure 1: 10 GeV e^- (`G4_Pb` absorbing material)

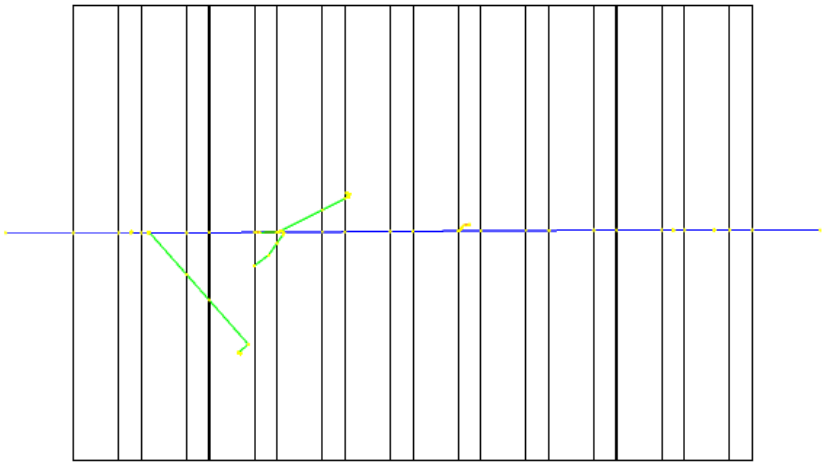


Figure 2: 10 GeV p^+ (`G4_Pb` absorbing material)

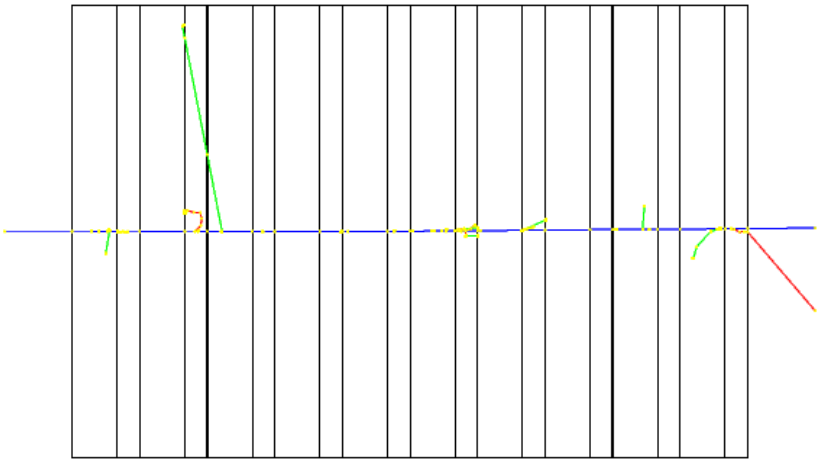


Figure 3: 10 GeV α^{2+} (`G4_Pb` absorbing material)

With water as the absorbing material we obtain the following pictures

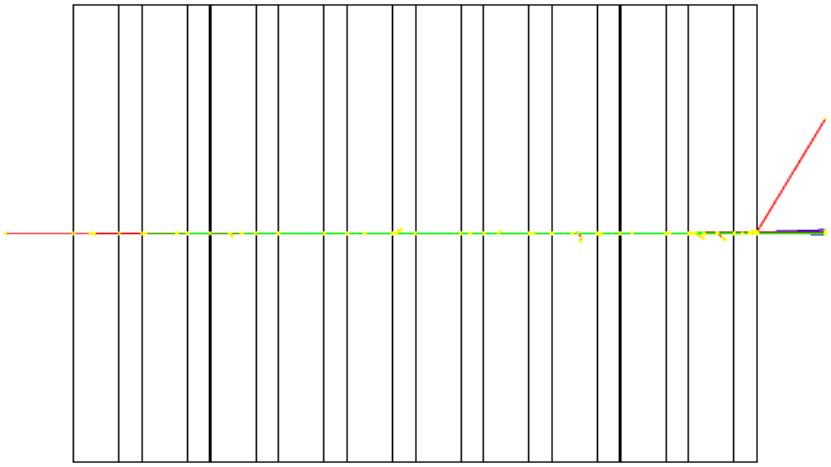


Figure 4: 10 GeV e^- (Self-defined `Water` as the absorbing material)

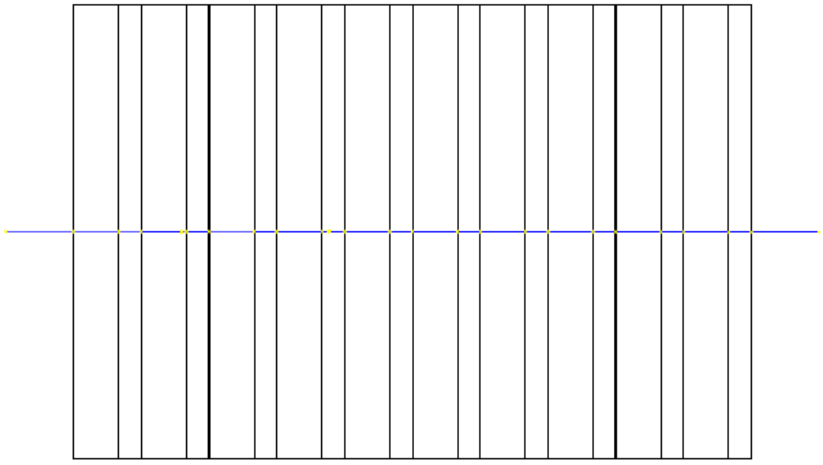


Figure 5: 10 GeV p^+ (Self-defined `Water` as the absorbing material)

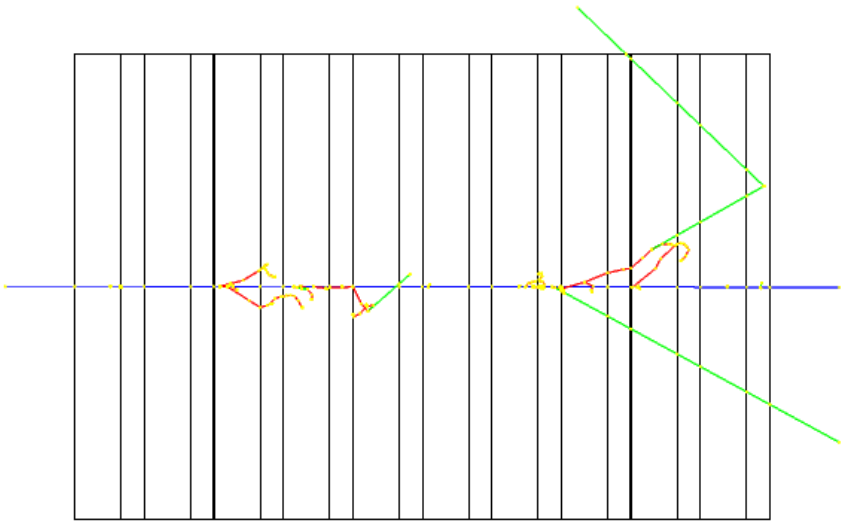


Figure 6: 10 GeV α^{2+} (Self-defined `Water` as the absorbing material)