LUXE vacuum chambers in GEANT4

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LUXE meeting
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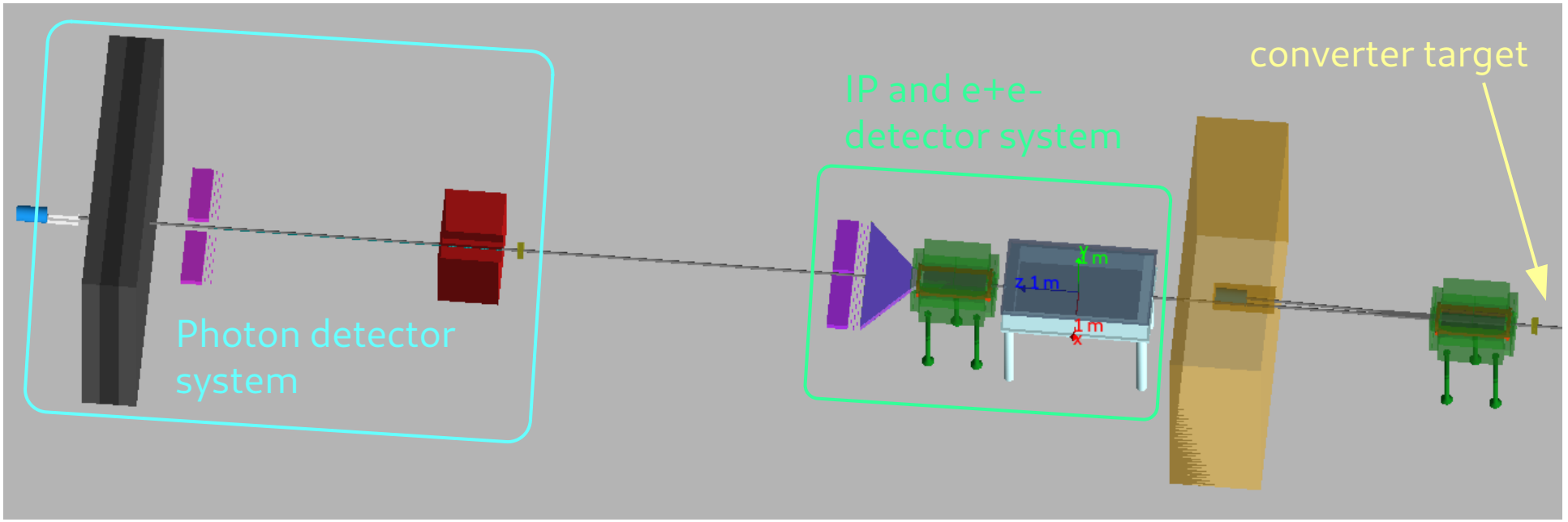
Outline

- LUXE Setup in GEANT4 simulation model
- BPPP detector system:
  - Interaction chamber;
  - Magnet;
  - Vacuum chambers;

LUXE GEANT4 setup

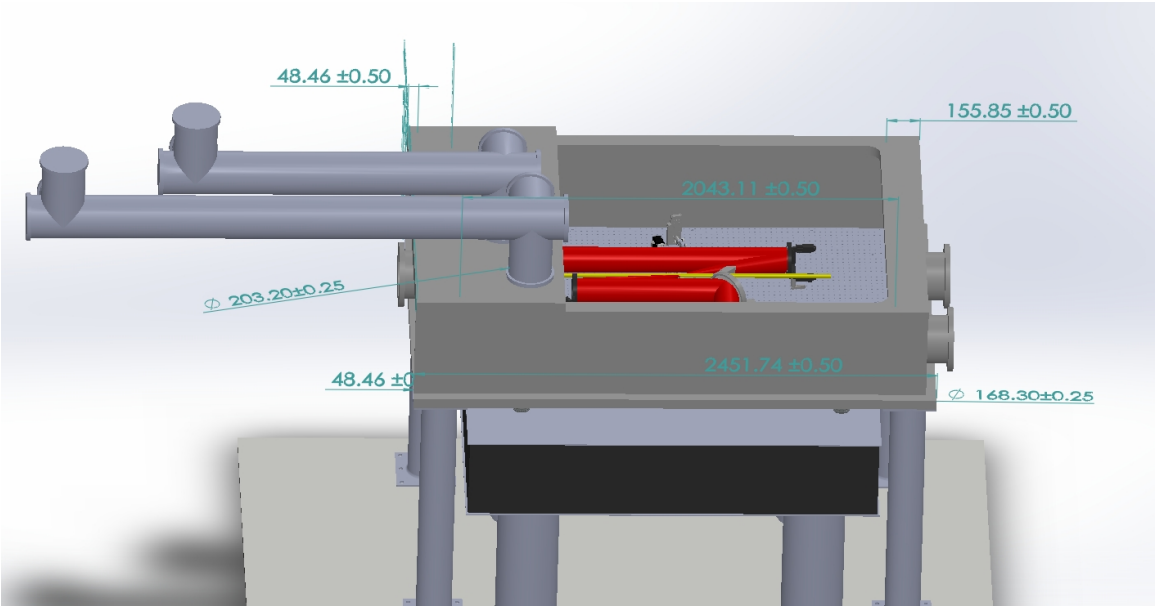
- Distance between the converter target and IP is mostly determined by the magnet and electron beam dump;
- Shorter distance – more photons at IP (~R^{-2});
- Electron positron detectors for monitoring bremsstrahlung production is not implemented;
- Forward photon detector system has simple implementation
- Rather detailed implementation of photon monitoring system based on the back scattering from the dump.



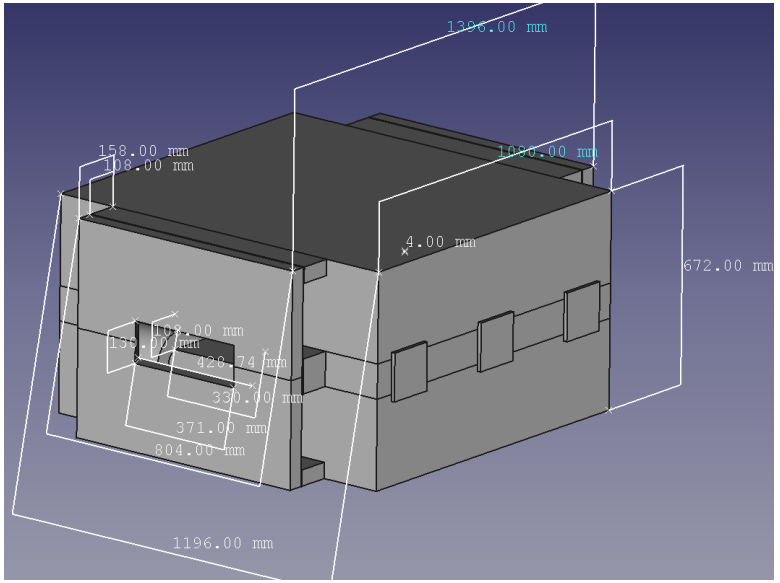
Hardware design

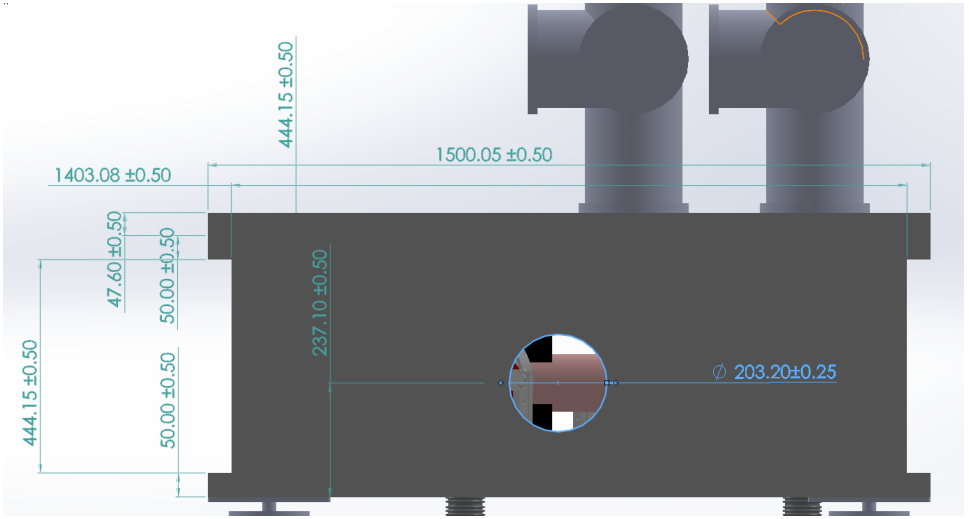
Interaction chamber

- Rectangular shape;
- Significantly larger (2.5x1.5x0.5 m^3);
- compared to previous tentative design (R=1m, H=0.25m).



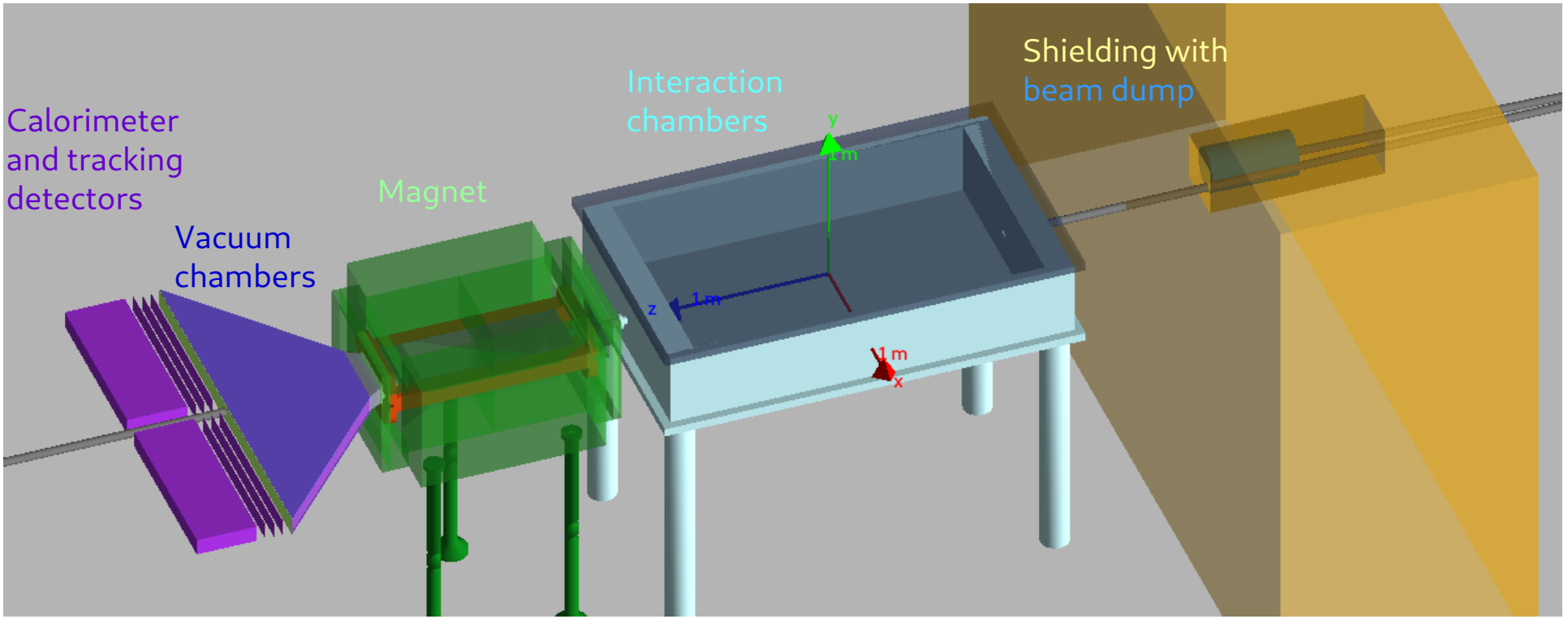
Magnet



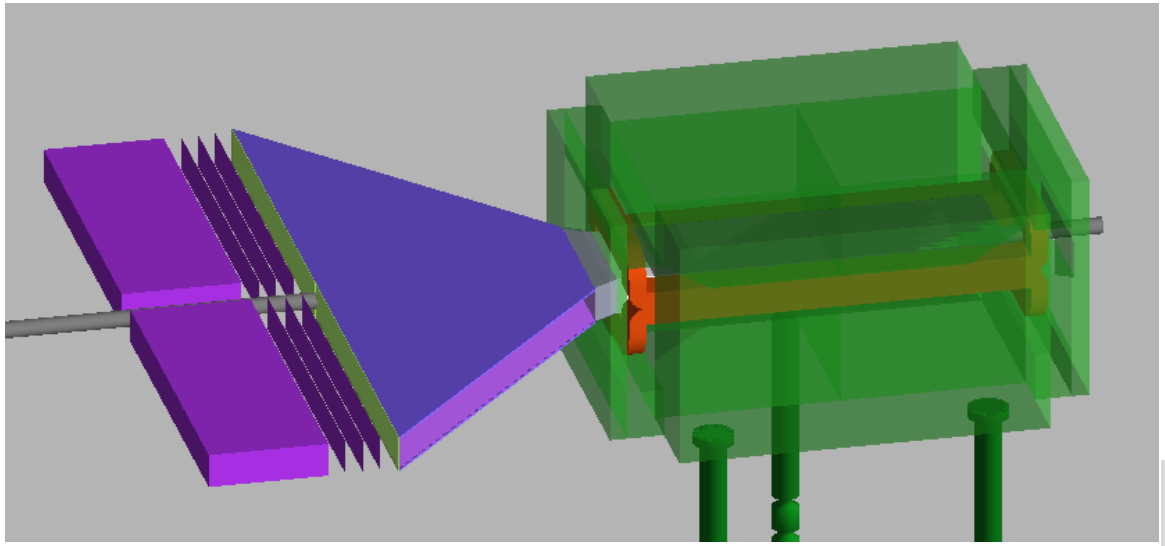


Interaction Chamber in GEANT4

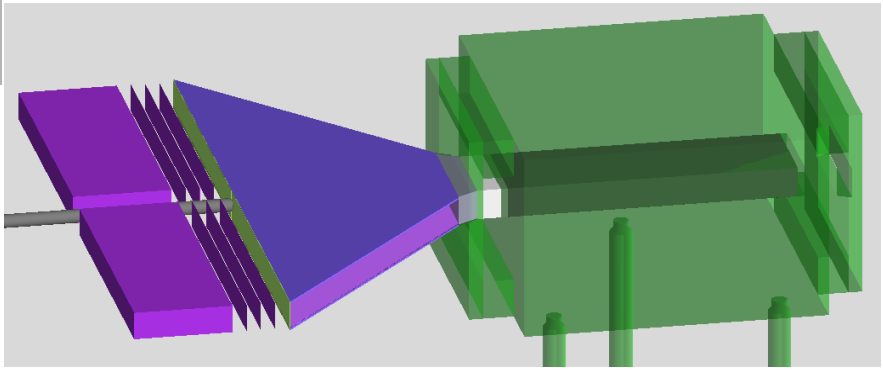
- Without laser components;
- Spectrometer moved by 550 mm ;
- Vacuum chambers for particle traveling from IP to detectors.



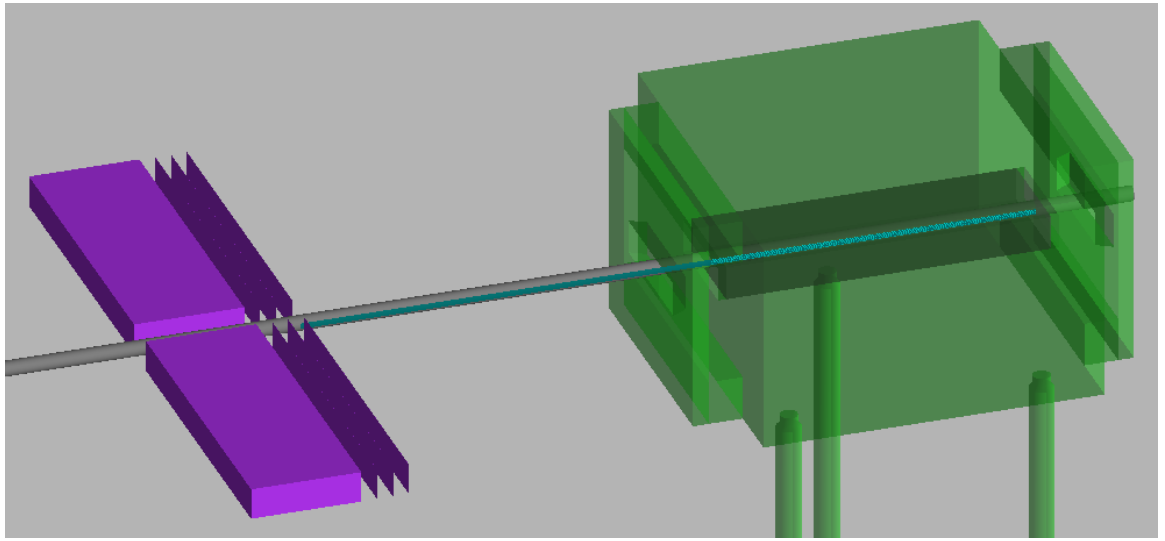
Magnet model implementation



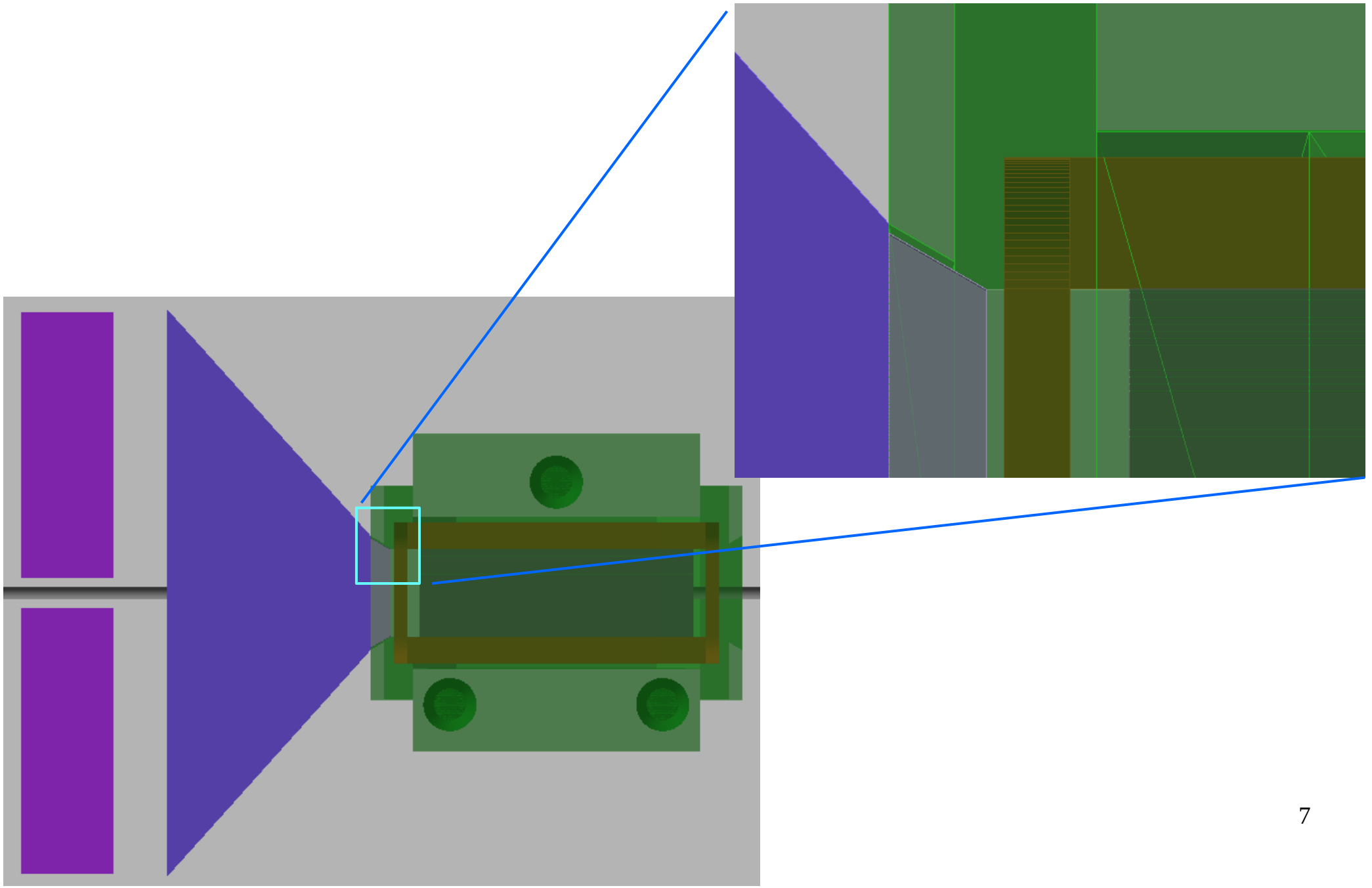
Simple, w/ vacuum chambers



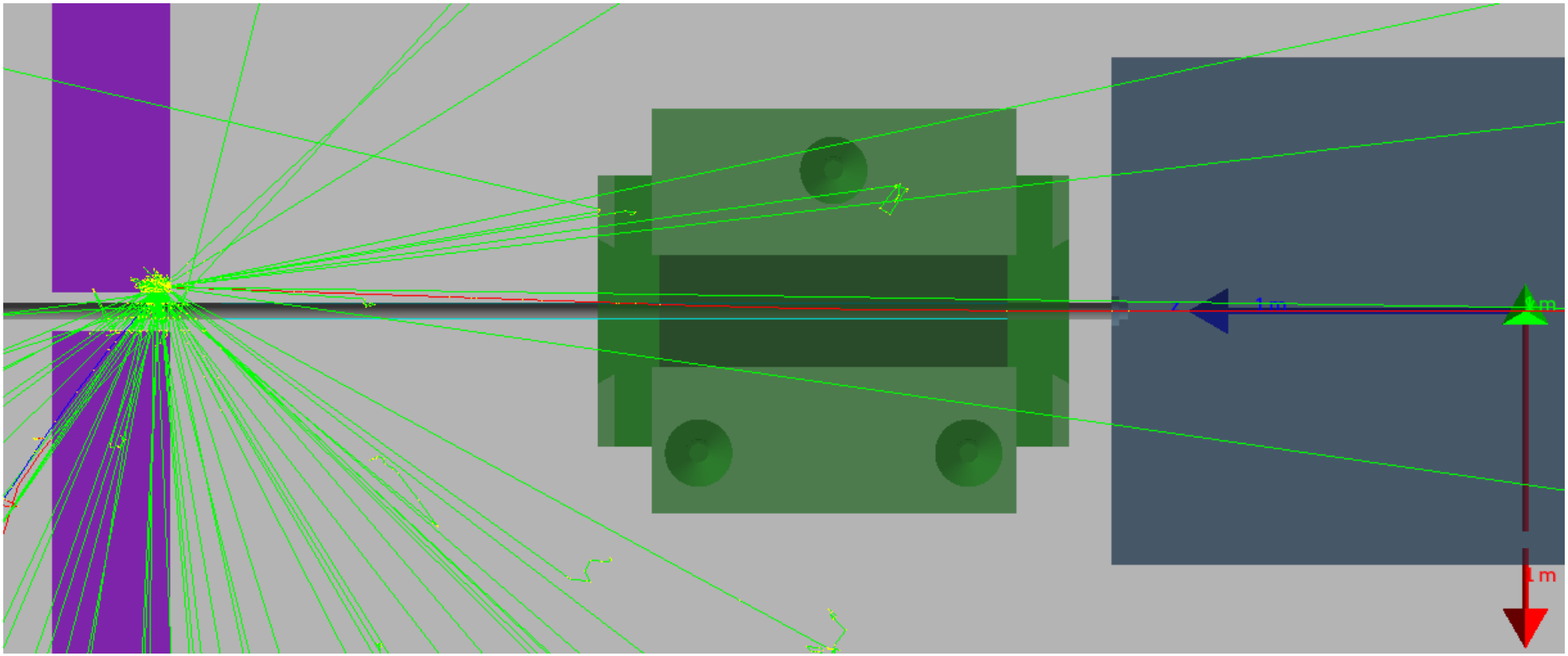
Simple, w/o vacuum chambers



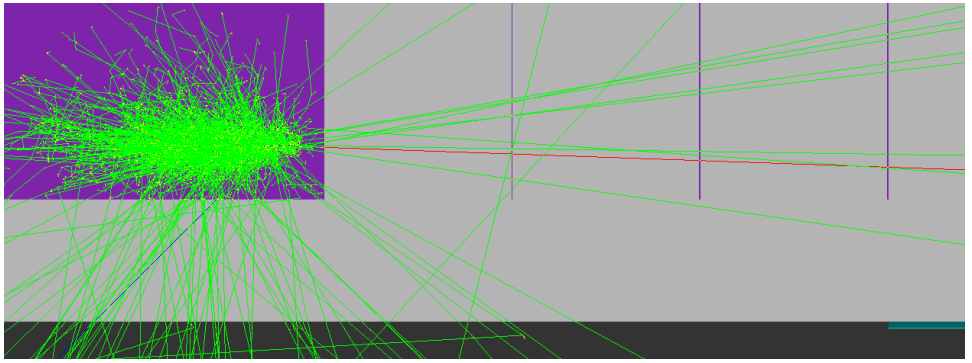
Magnet aperture



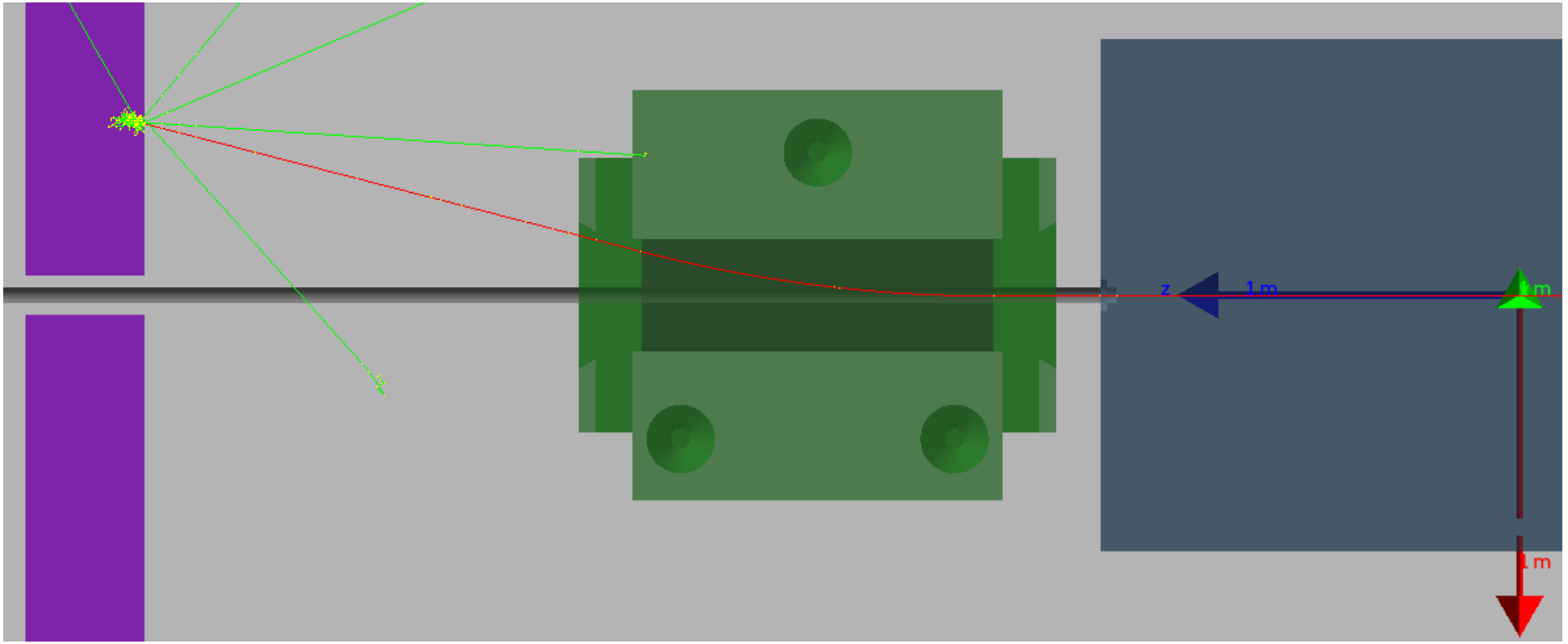
Single electron event, 15.0 GeV



- Field 1.7 T;
- Distance between the field and detector (surface to surface) 1.3 m;
- e- 15 GeV

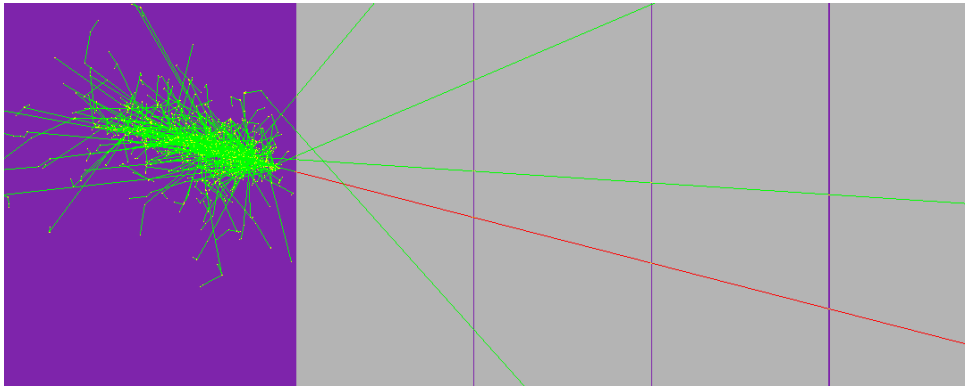


Single electron event, 2.1 GeV



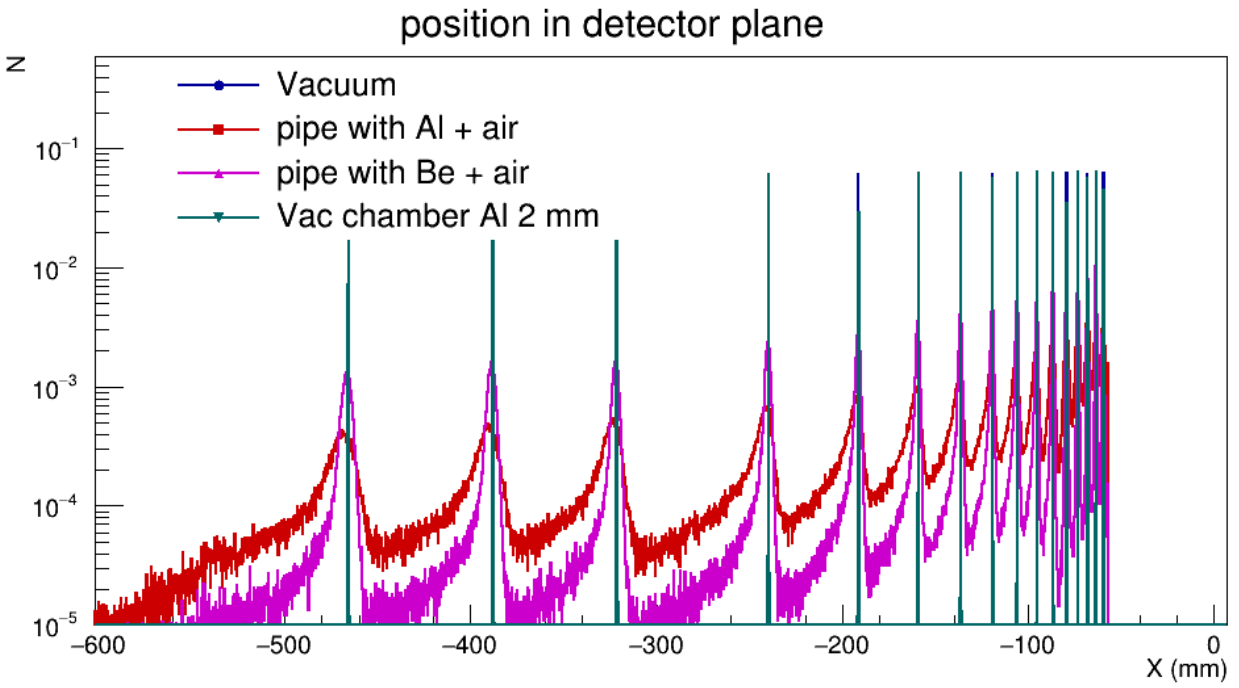
- Field 1.7 T;
- Distance between the field and detector (surface to surface) 1.3 m;
- e- 2.1 GeV

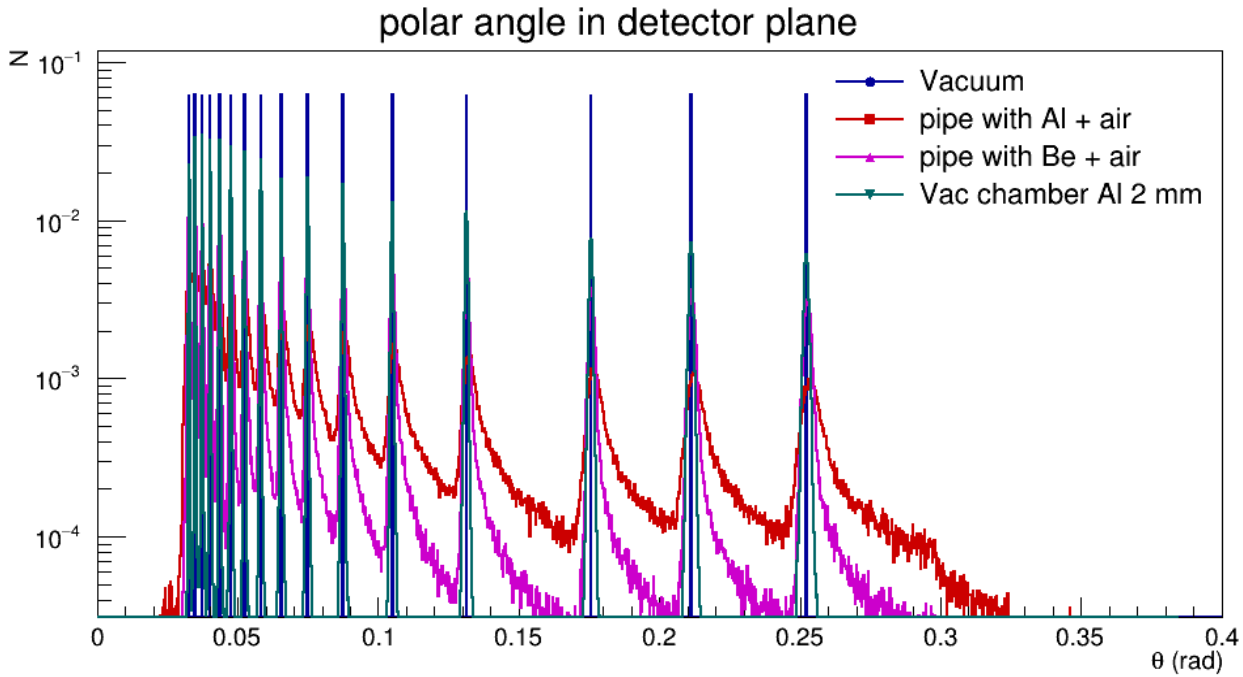
2.0 GeV hits the magnet a bit



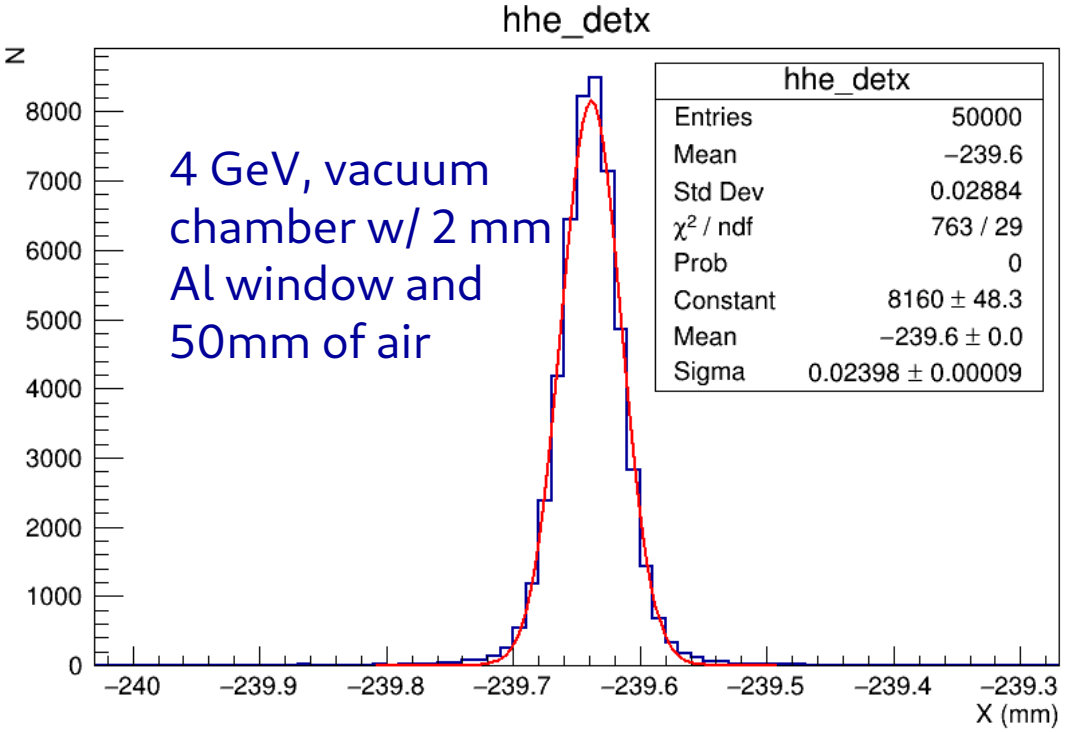
Performance of different IP - detector interfaces

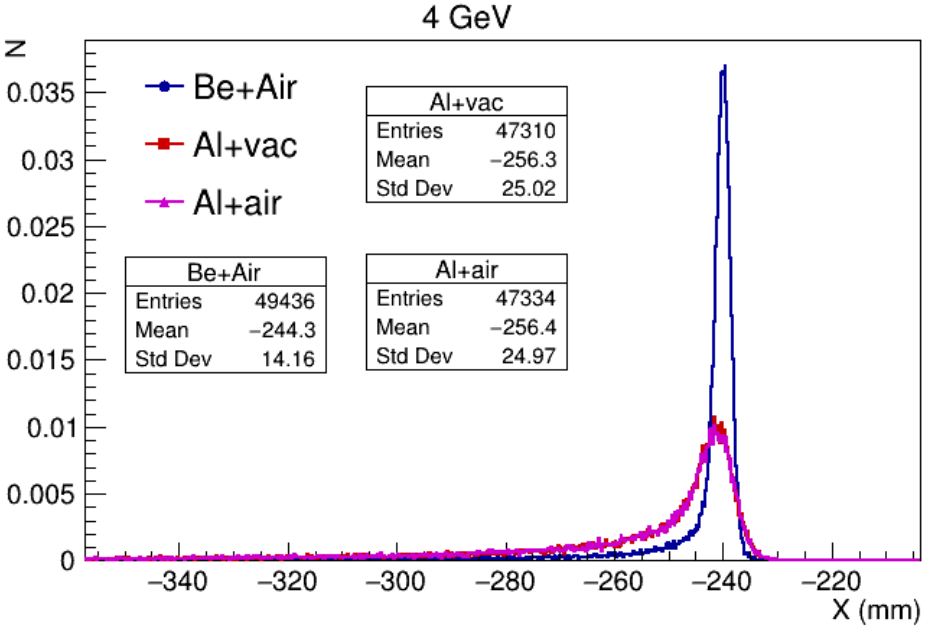
- 50k electrons with energies
- 2.1, 2.5, 3.0, 4.0,... 16.0 (GeV).
- Vacuum;
- Beam pipe with Al windows;
- Beam pipe with Be windows;
- Vacuum chambers with Al windows of 2 mm;
- True MC comparison.

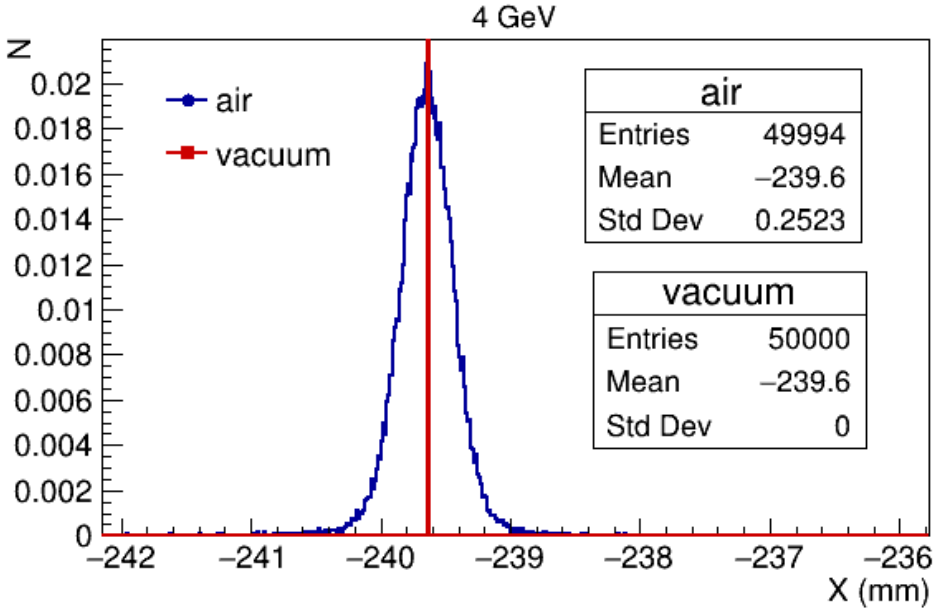


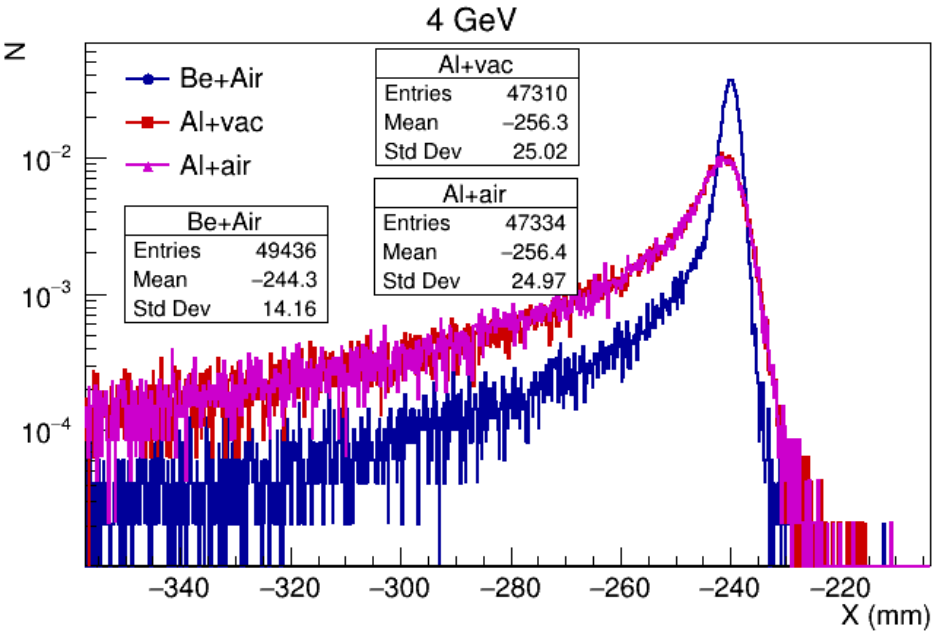


Vacuum, air, Al, Be, vacuum chamber

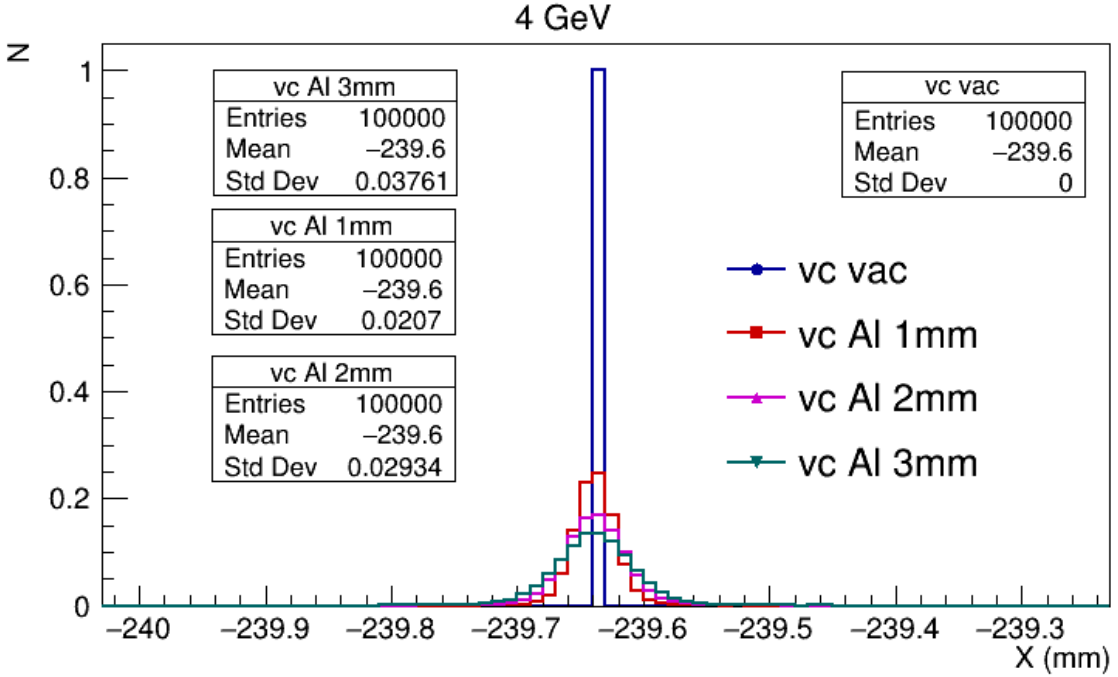


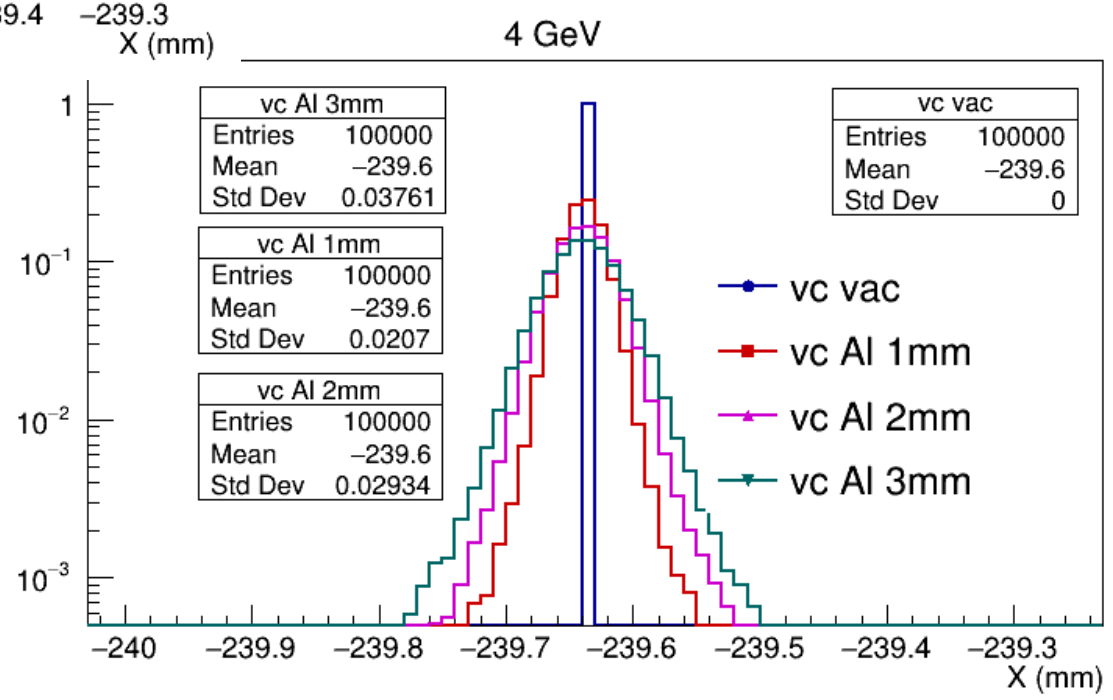






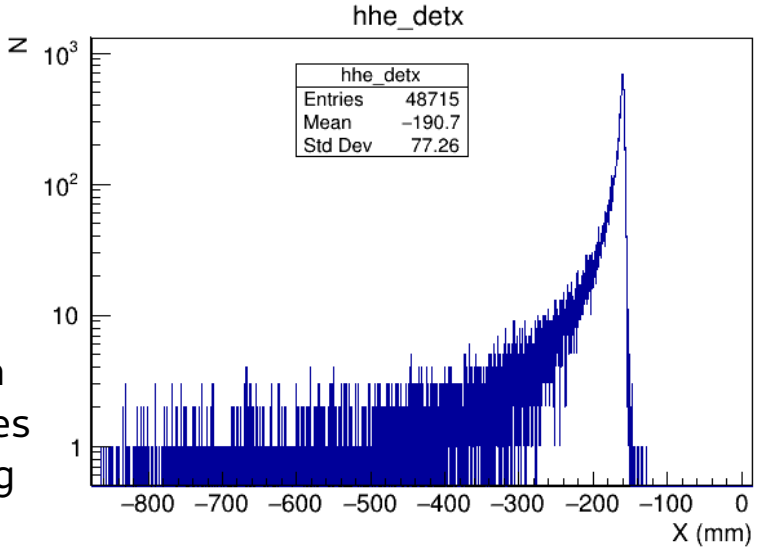
4 GeV, vacuum chamber with different window thickness

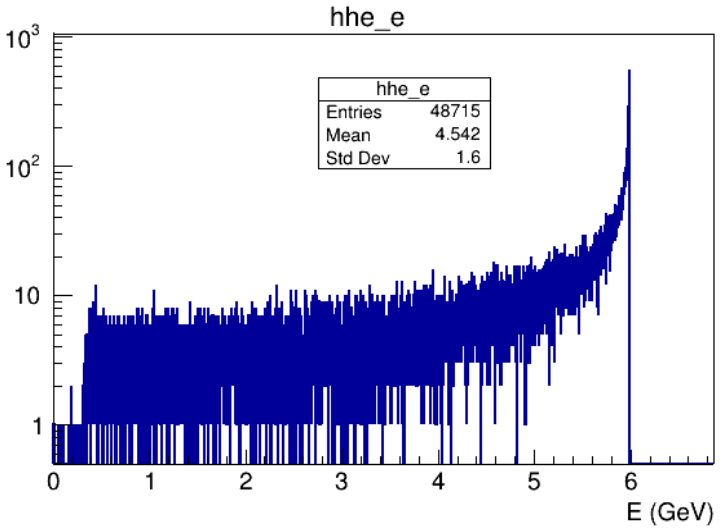


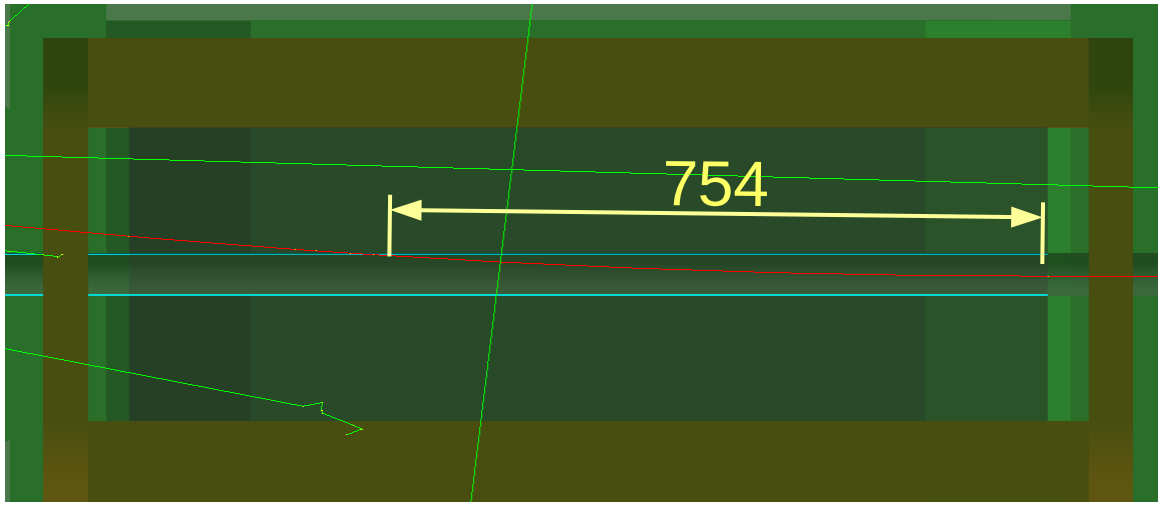


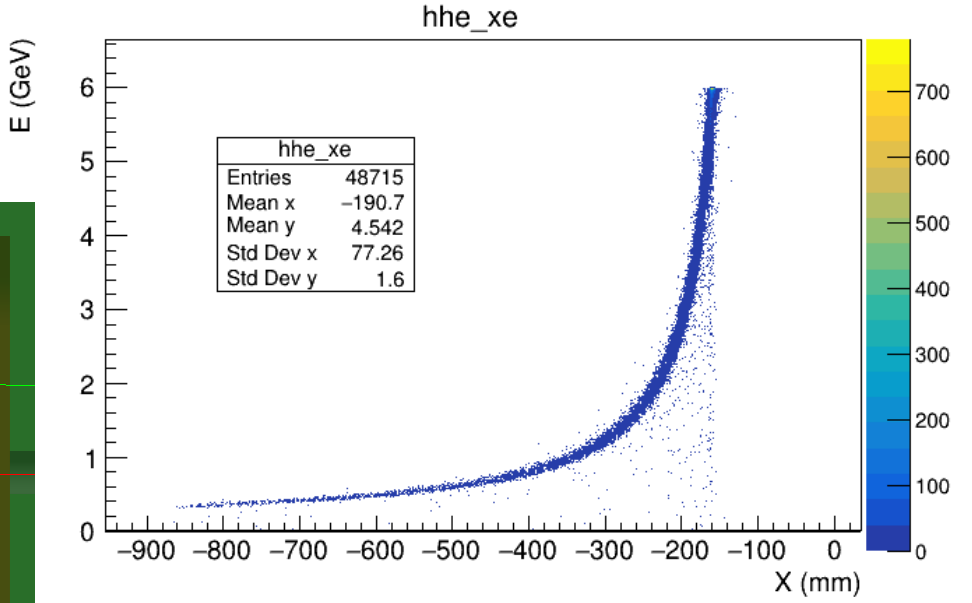
6 GeV electrons

- Beam pipe with Al windows;
- 50k electrons;
- Only primary particles are selected;
- After (~75cm) crossing beam pipe (1.651mm) particle looses energy and continue traveling in magnetic field;
- It produce consistent, but wrong x, E.









Summary

- Detailed implementation based on 3D CAD models of the e+e- spectrometer is available: magnet, IP chamber, vacuum chambers and beam dump.
- Implementation of infrastructural components is in progress, important for background simulation.
- BPPP setup with vacuum chambers looks interesting and could provide better momentum resolution for the spectrometer compared to simple beampipe solution.