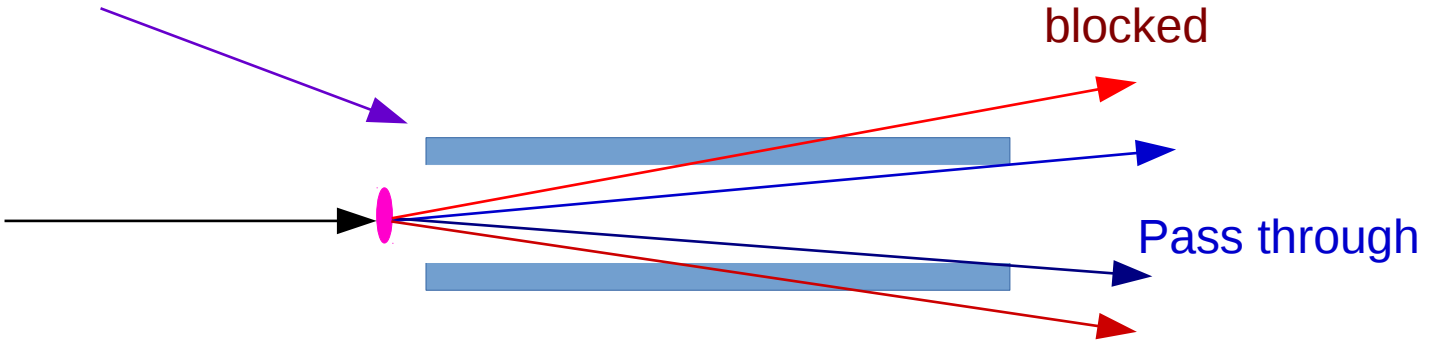
Beam pipe effect on ep yield background

Principle

Beam pipe material: stainless steel
Radiation length: ~1.7cm

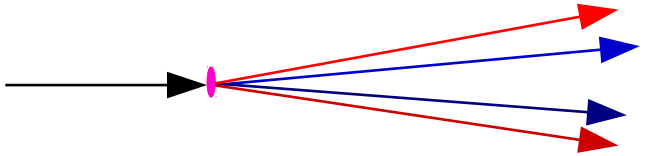
Beam pipe



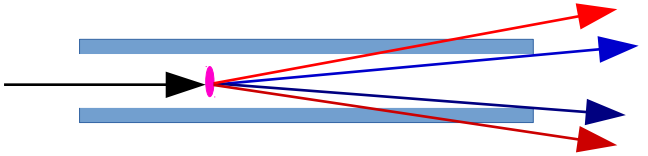
- Beam pipe filled with residue hydrogen gas
- Every 10cm, gas density change one order of magnitude.
- Small angle scattering: no block
- Larger angle scattering: blocked

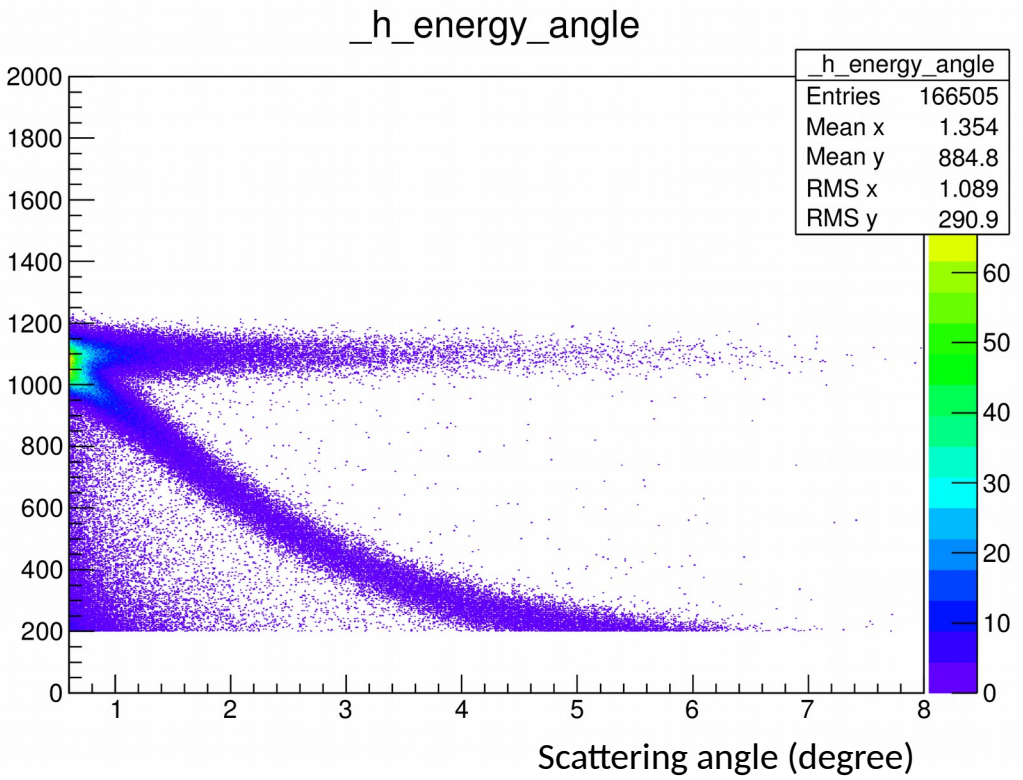
Beam pipe effect

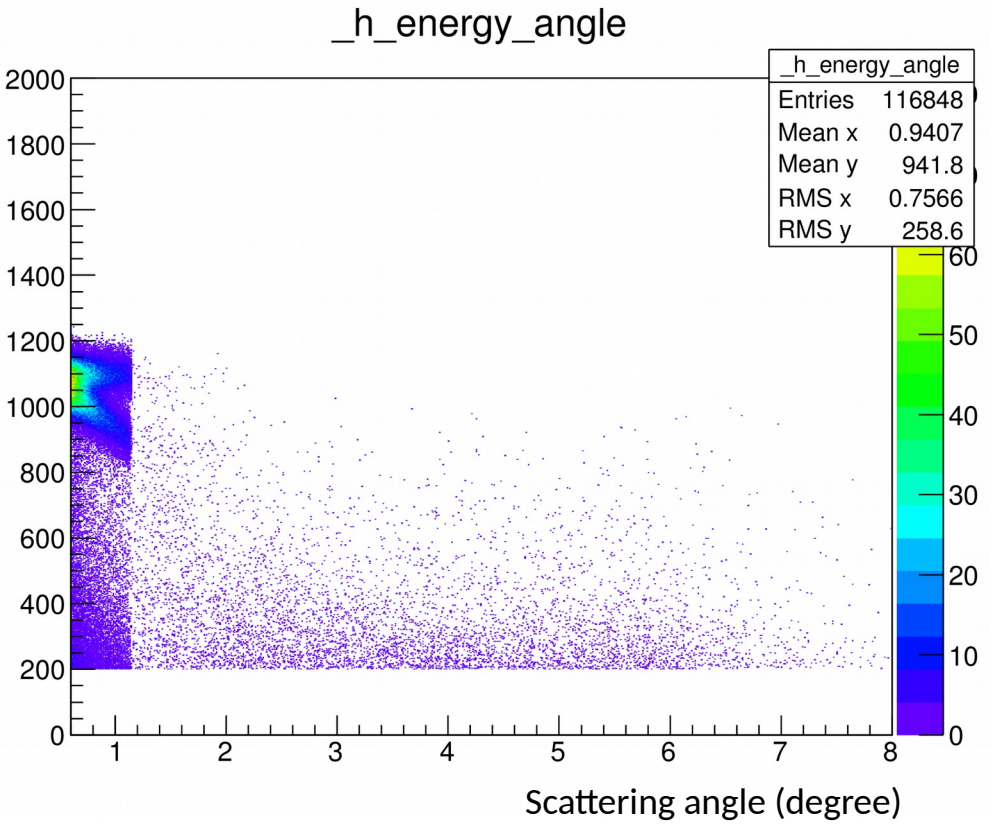
No beam pipe



With beam bipe

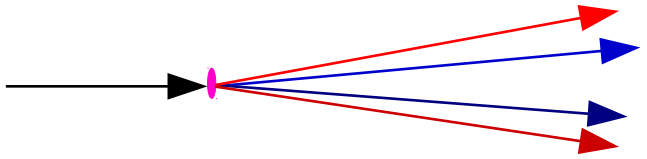




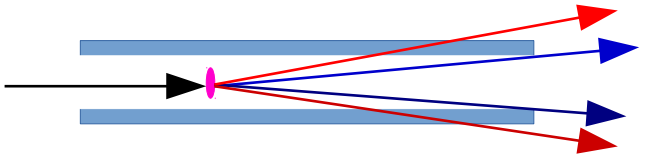


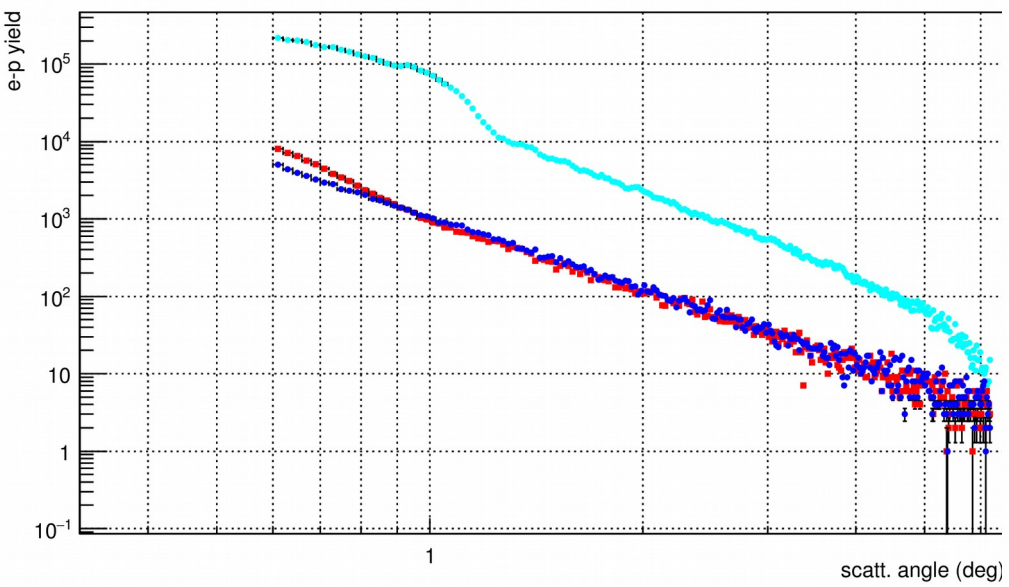
Beam pipe effect

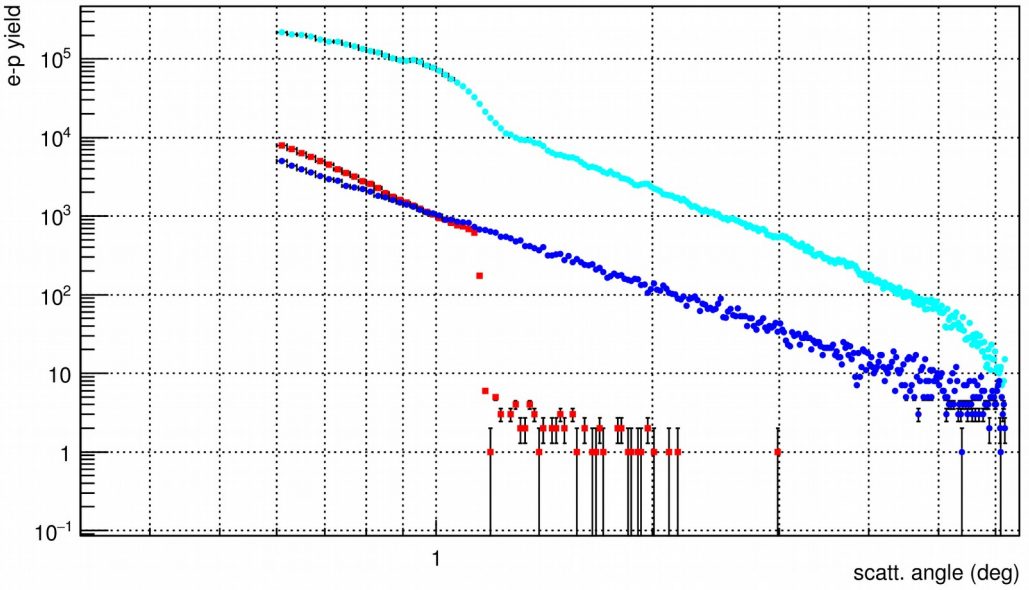
No beam pipe



With beam bipe





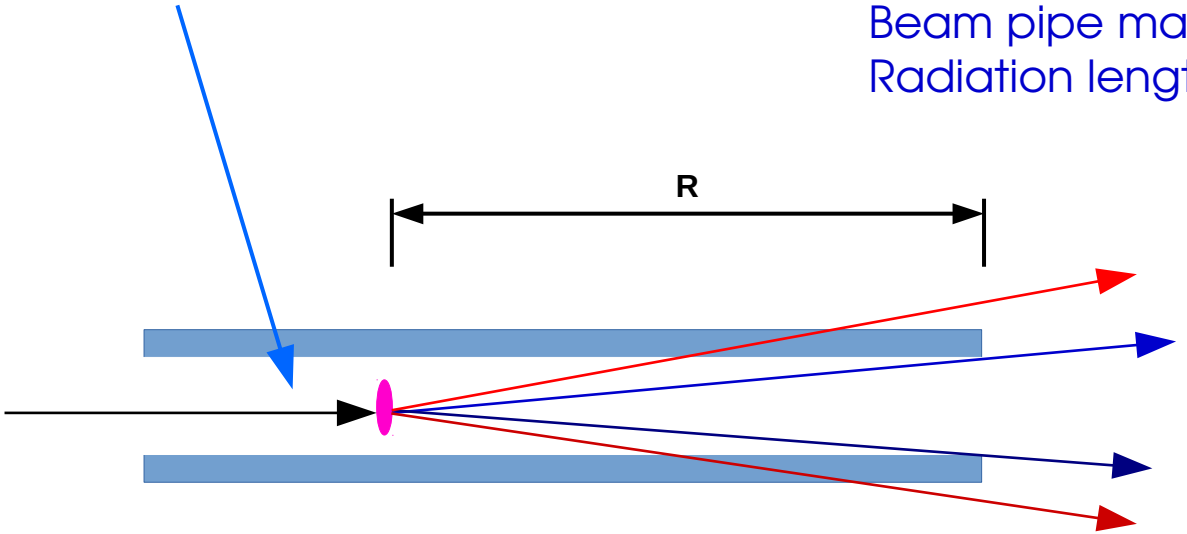


- Light blue: empty target run from 2.2 GeV data
- Blue: ep yield from target (z=0)
- Red: ep yield from a source (upstream, z = 2.2 meter, inside beam pipe)

Small angle background simulation

Filled with residue hydrogen gas

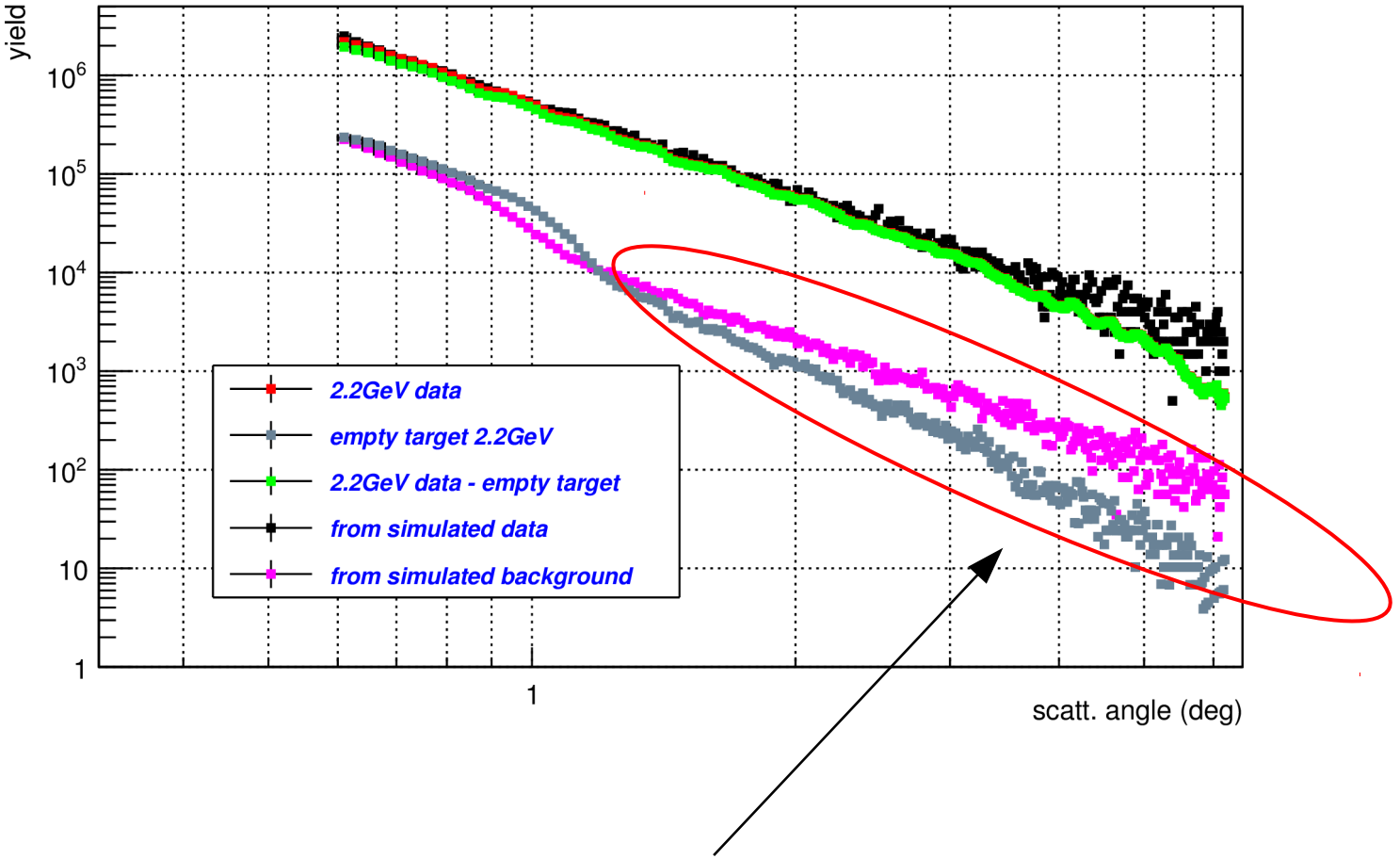
Beam pipe material: stainless steel
Radiation length: ~1.7cm



- Beam pipe filled with residue hydrogen gas
- Every 10cm, gas density change one order of magnitude, for now.
- Besides residue gas, if place one more source inside beam line, will clearly see the bump at small scattering angle.
- By varying the distance R, bump position will be varying with it.

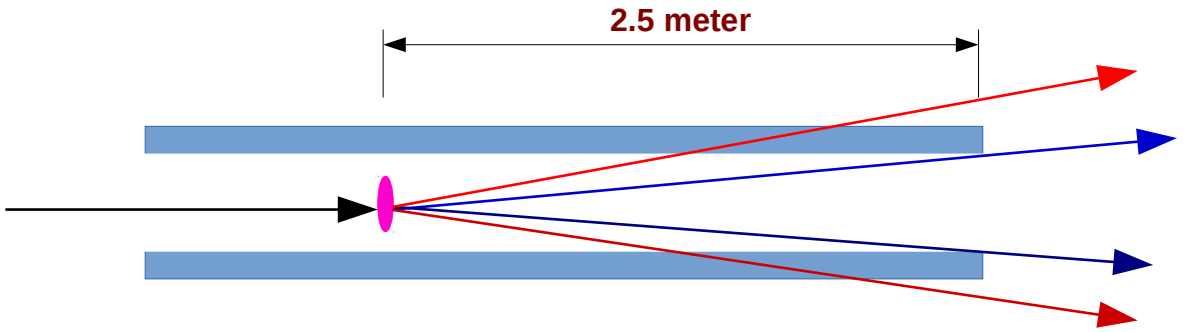
Small angle background simulation

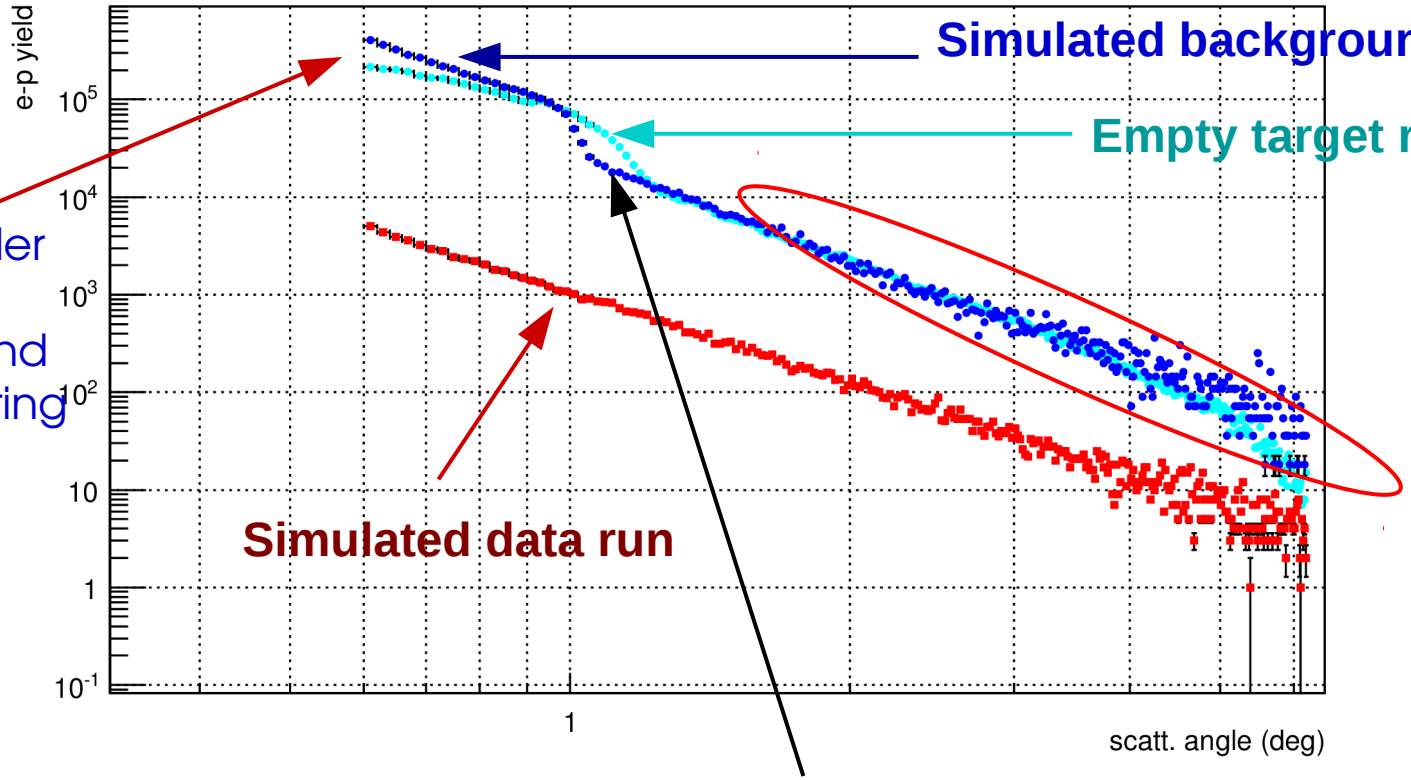
From previous week:



Discrepancy between simulation and data

Small angle background simulation

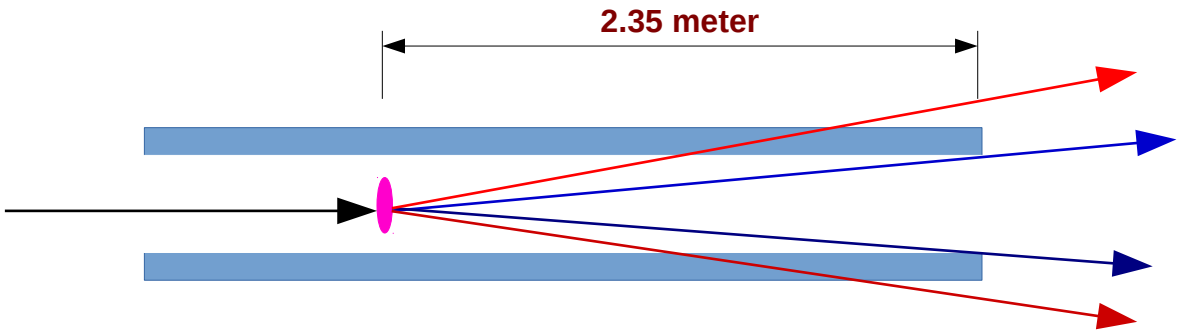


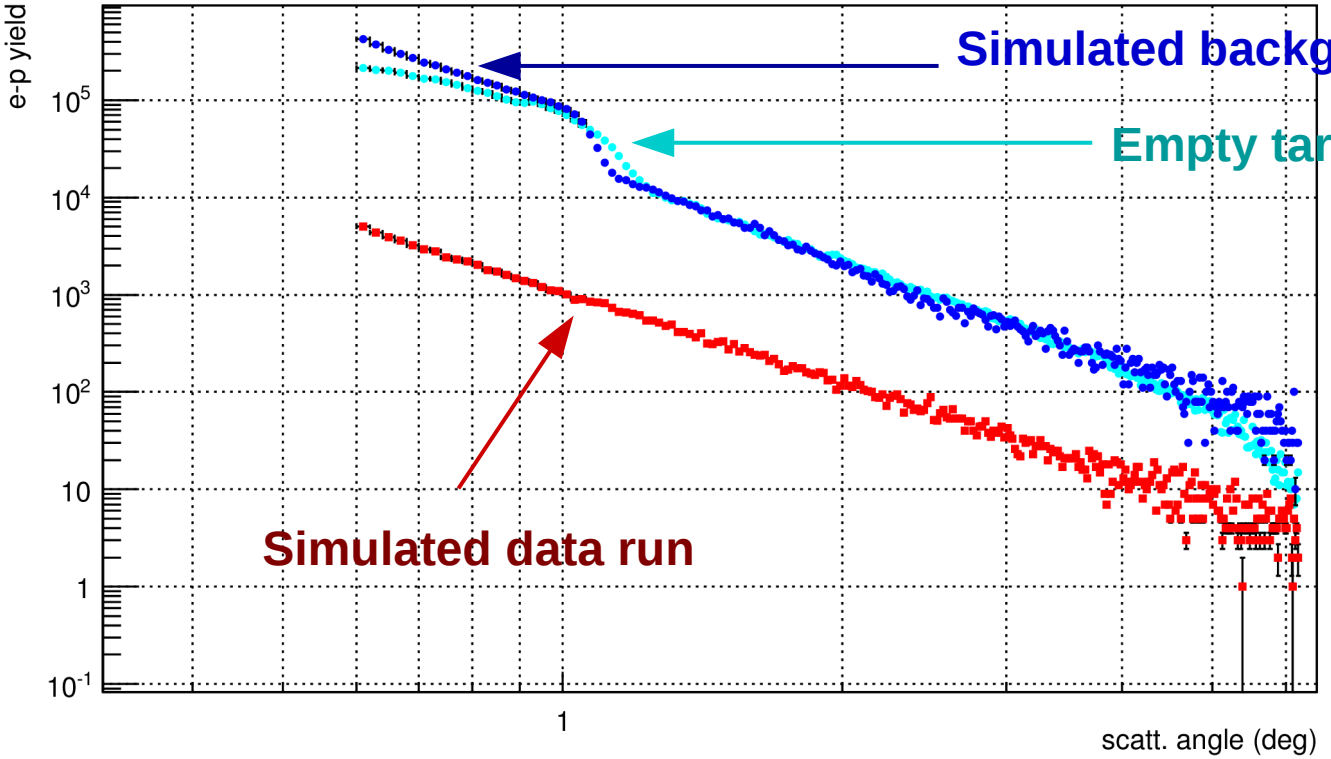


Need to consider detector acceptance and multiple scattering

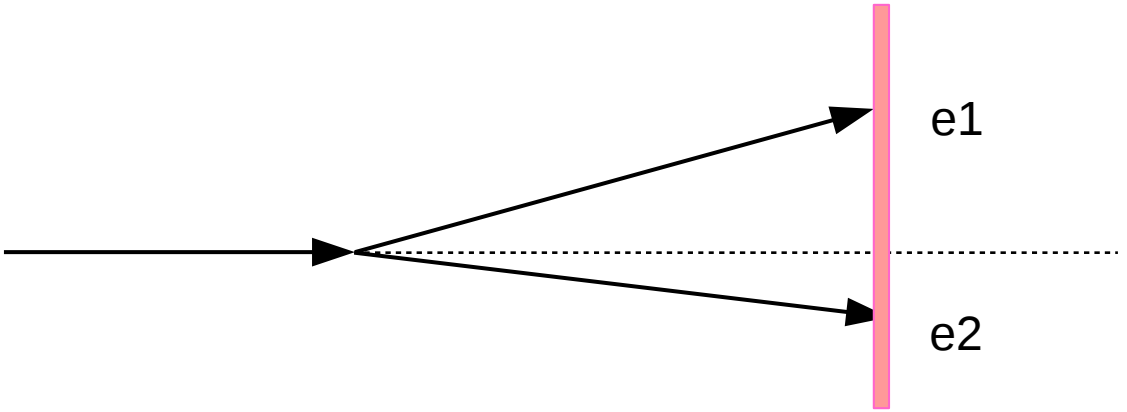
Position of bump depend on the position of source relative to beam pipe

Small angle background simulation





Vertex from ee events



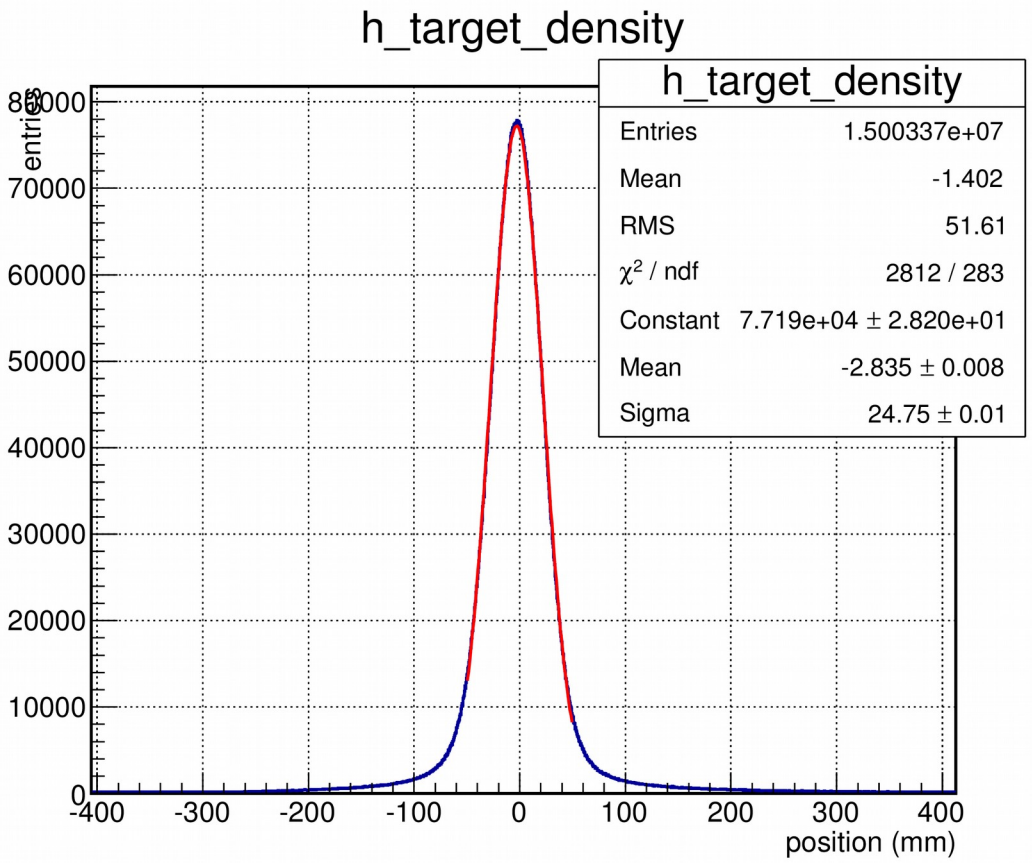
- Beam energy fixed at 1100MeV, 2141MeV
- Offsets corrected
- If omit electron mass,

$$\frac{E_1}{E_2} = \frac{\sqrt{1+(z/r_1)^2}}{\sqrt{1+(z/r_2)^2}} \approx \frac{r_2}{r_1}$$

- Get energy for each electron
- Get scattering angle, → get z distance.

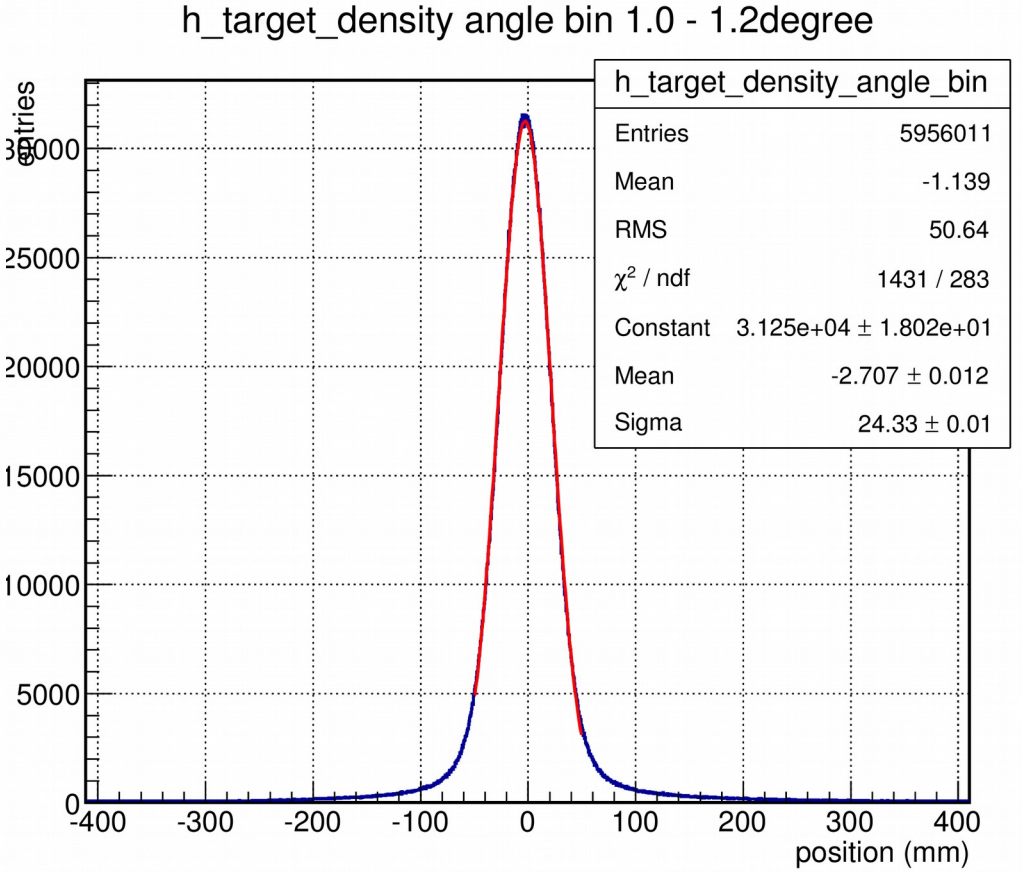
Vertex from ee events

Production run



All moller events

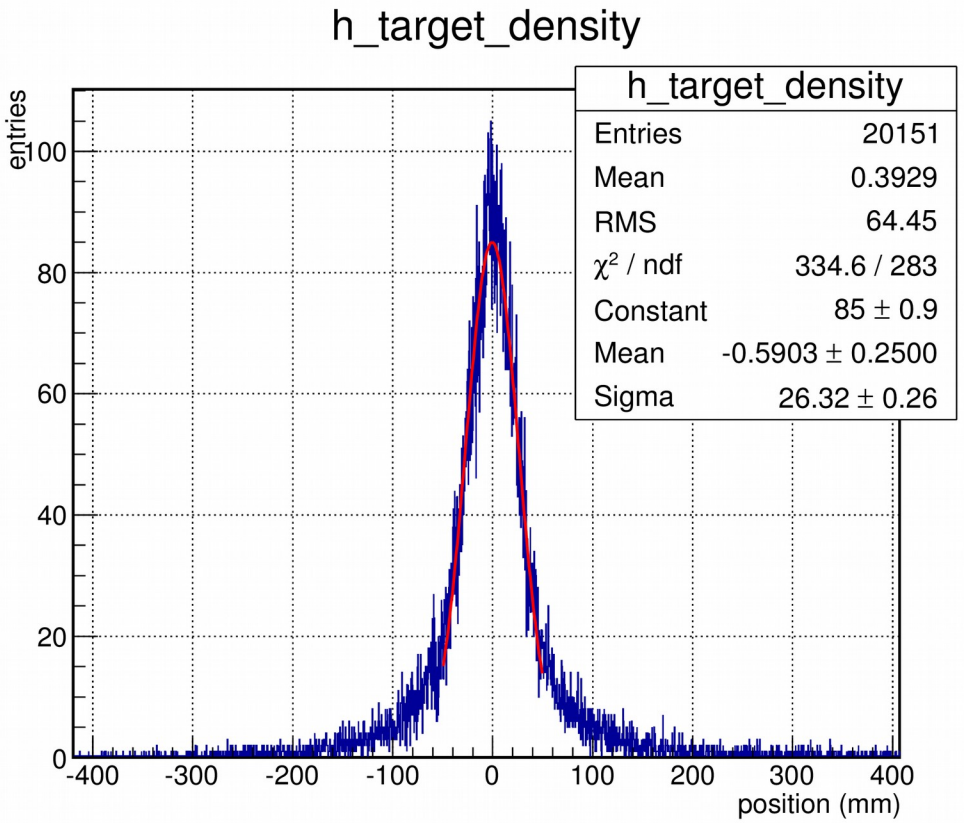
Production run



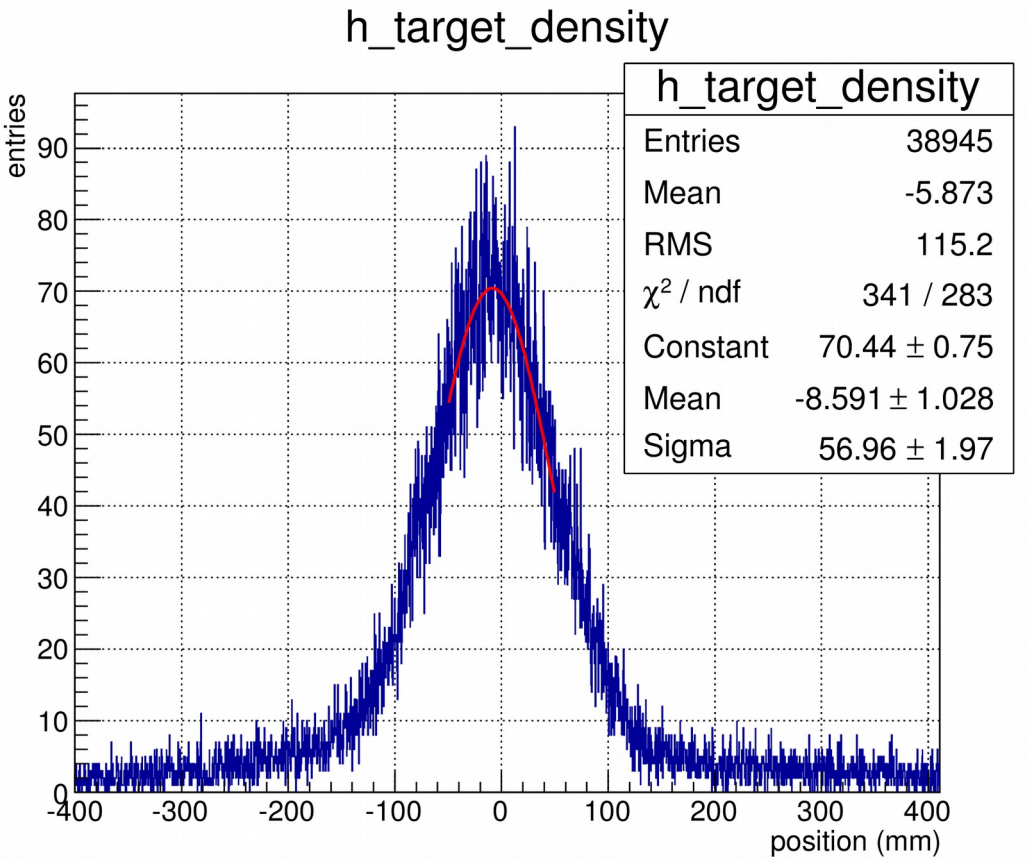
In a ring 1.0 degree – 1.2 degree

Vertex from ee events

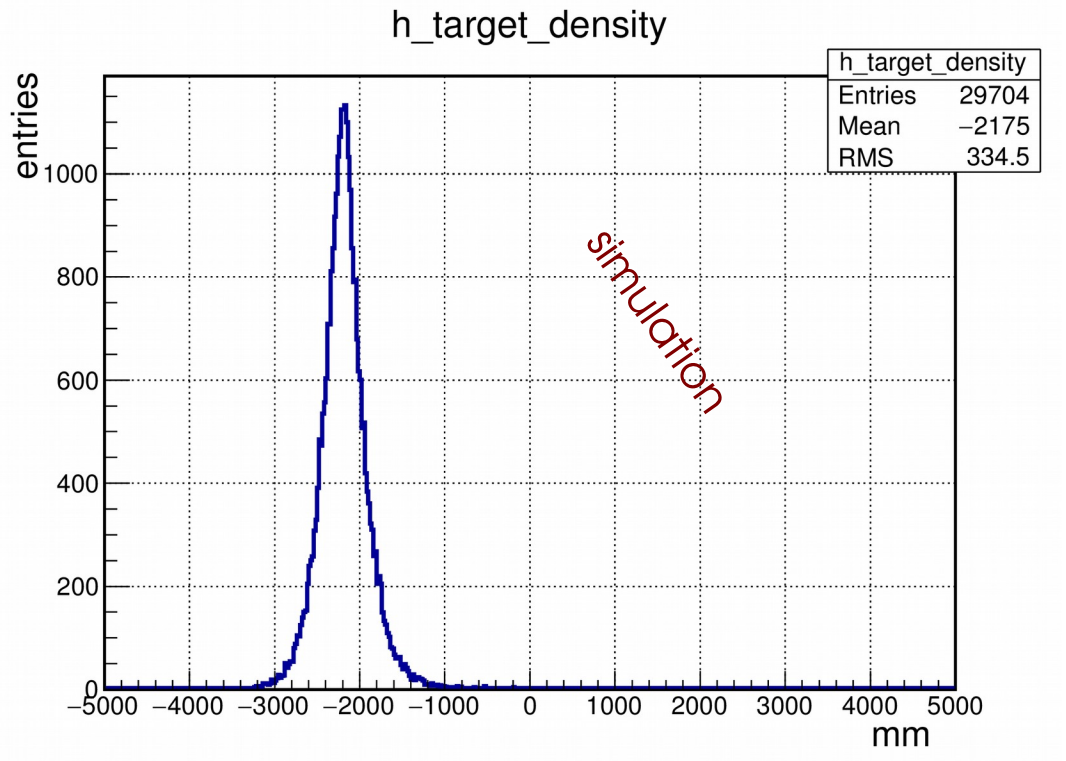
Carbon run



Empty target run



Vertex from ee events (from simulation)



In simulation, a 4cm meter long, uniform density, hydrogen gas source were placed 2.2 meter upstream.

- ee has enough kinematic constraints, if some ee events are from upstream background, we will be able to tell (will see another peak at upstream).
- In fact upstream ee events will be stopped by beam pipe, while small angle ep events can pass through.
- So this distribution does not apply to ep yield background study.