Magnet Stations for LHCb – tracking studies

Jakub Malczewski

U2 tracking workshop 15/12/2020

Magnet Stations:

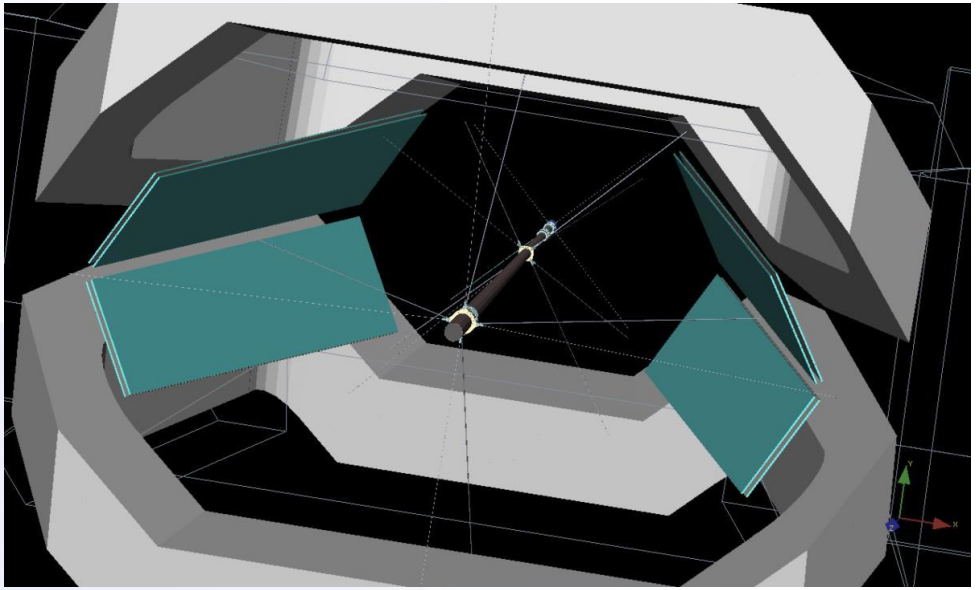
- tracker inside the magnet for soft particles

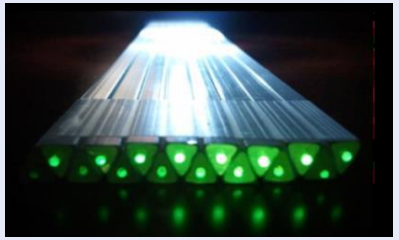
Technology:

- Scintillators inside the magnet
- Photomultipliers outside the magnet

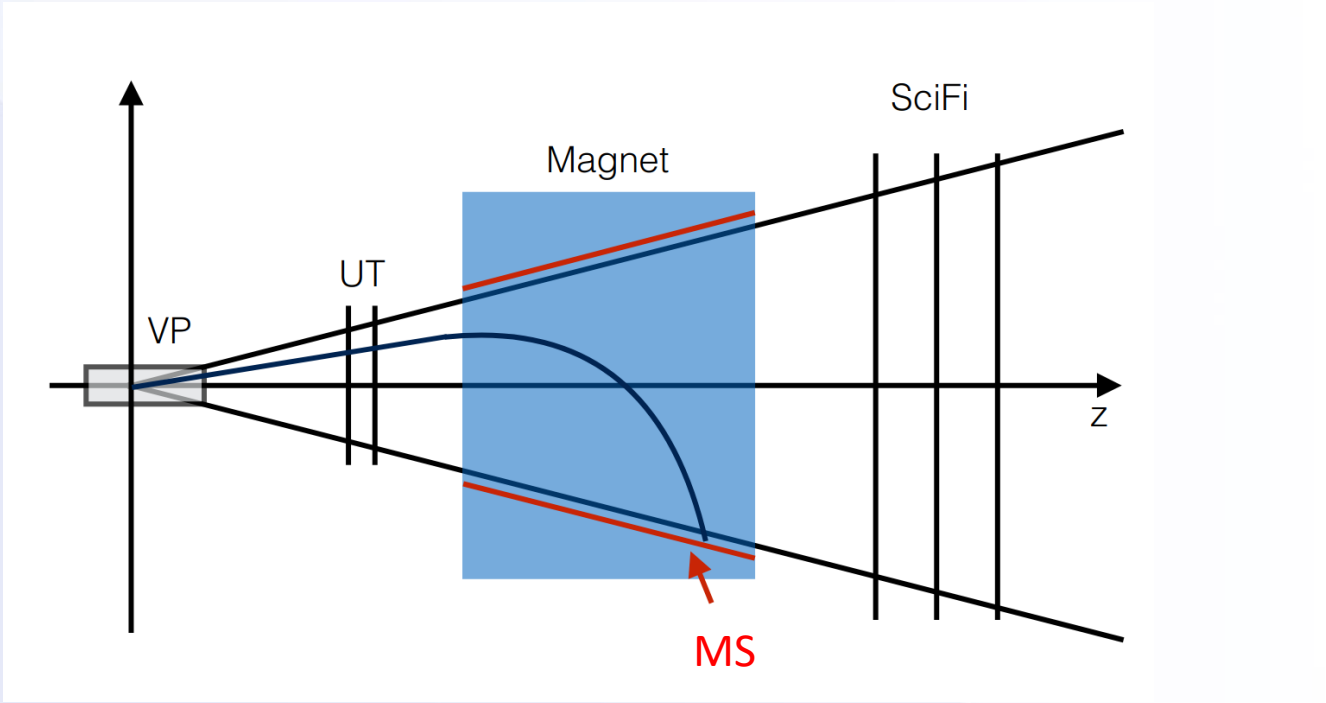
Layout:

- 4 planes x 4 layers of triangular bars
- horizontal-segmentation ~O(1mm)
- vertical-segmentation ~O(10cm)





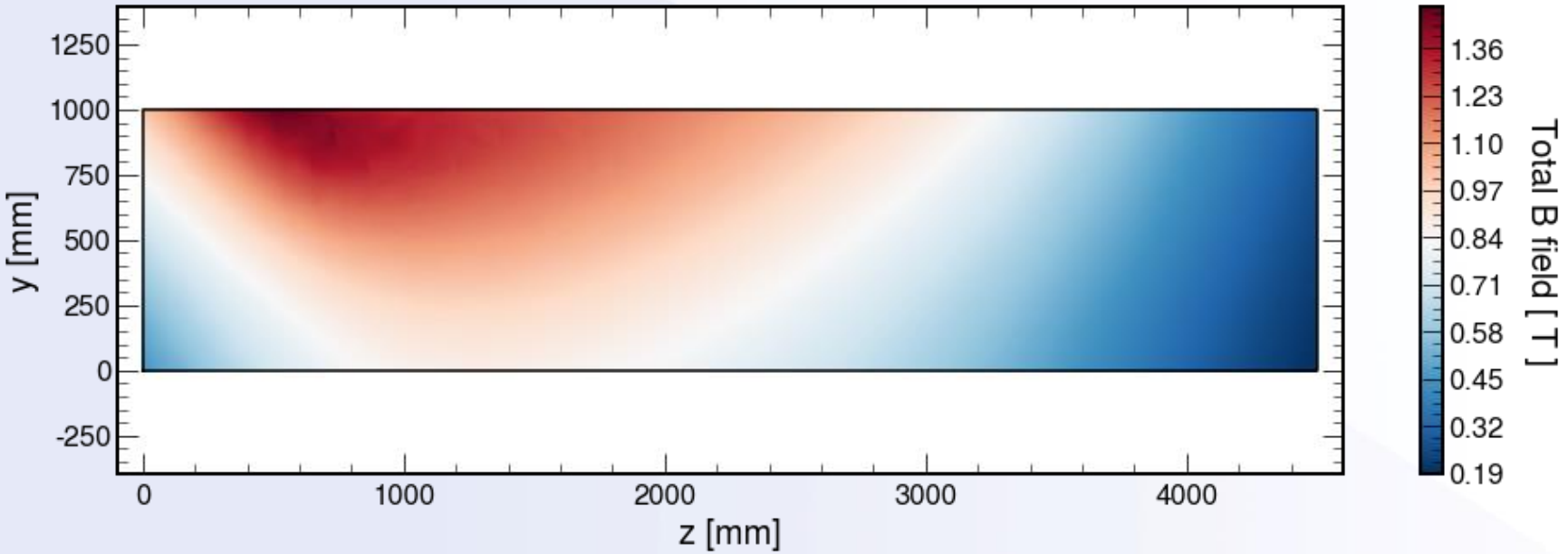
Track reconstruction in MS



clusterization → fitting (x, y, z, dx/dz, dy/dz) → matching with VELO / UT tracks

Track reconstruction in MS - challenges

- High curvature tracks (loops?)
- Magnetic field inside the detector
- Targeted lower momentum particles => higher backgrounds

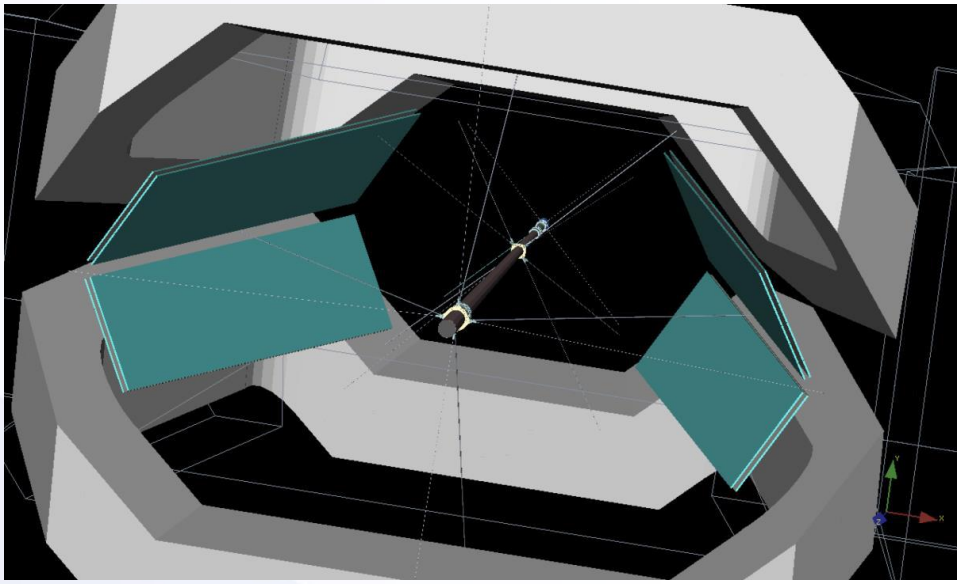


Track reconstruction in MS - simulation

- Based on simplified design
- not up-to-date detector description

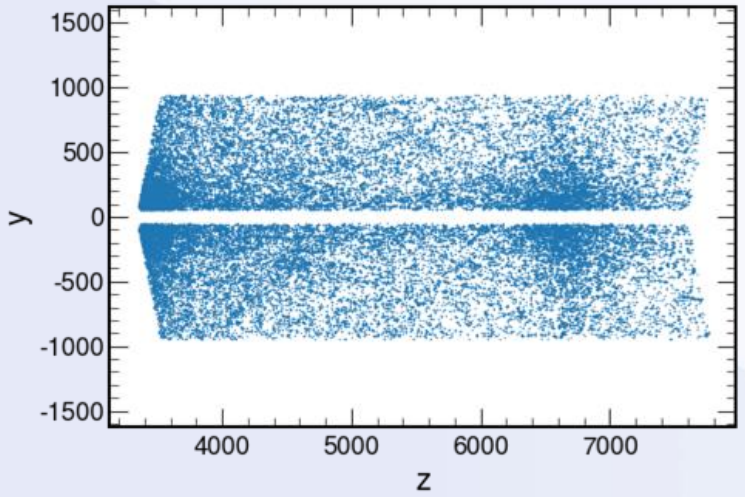
Simulation steps:

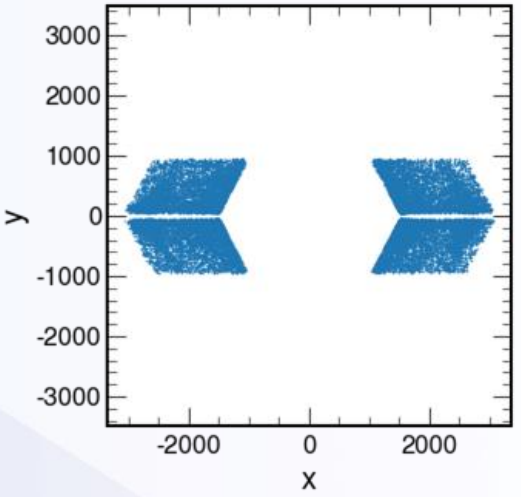
1. LHCb framewok
   - Gauss (minimum cuts for the particle selection)
   - Bool (skip MS)
   - Brunel (export of VELO/UT tracks and MS hits)
2. Python
   - xyz frame of reference transformation
   - simple enegry deposit model
   - cells implementation
   - MC linking (UT tracks ↔ MS hits)



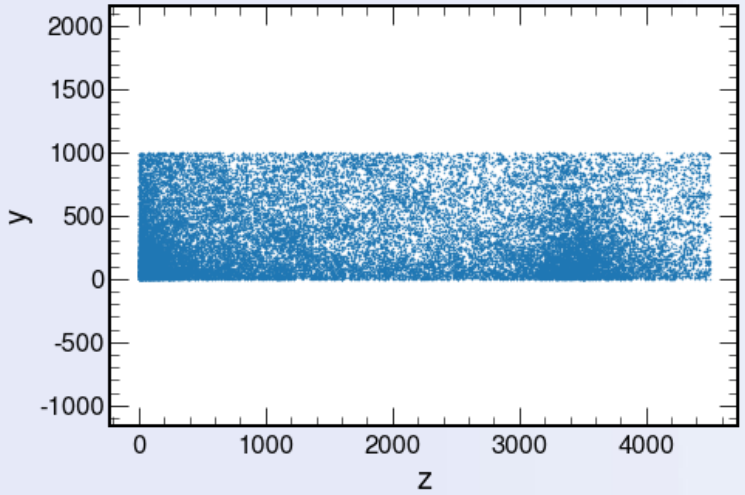
https://gitlab.cern.ch/lhcb-magnet-stations
(Gauss + Boole + Brunel)

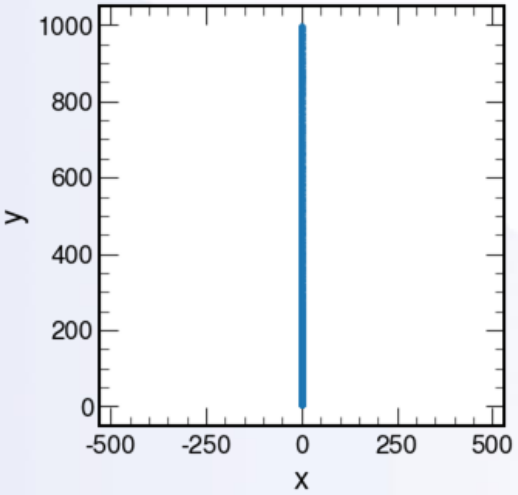
MS frame of reference and symmetries





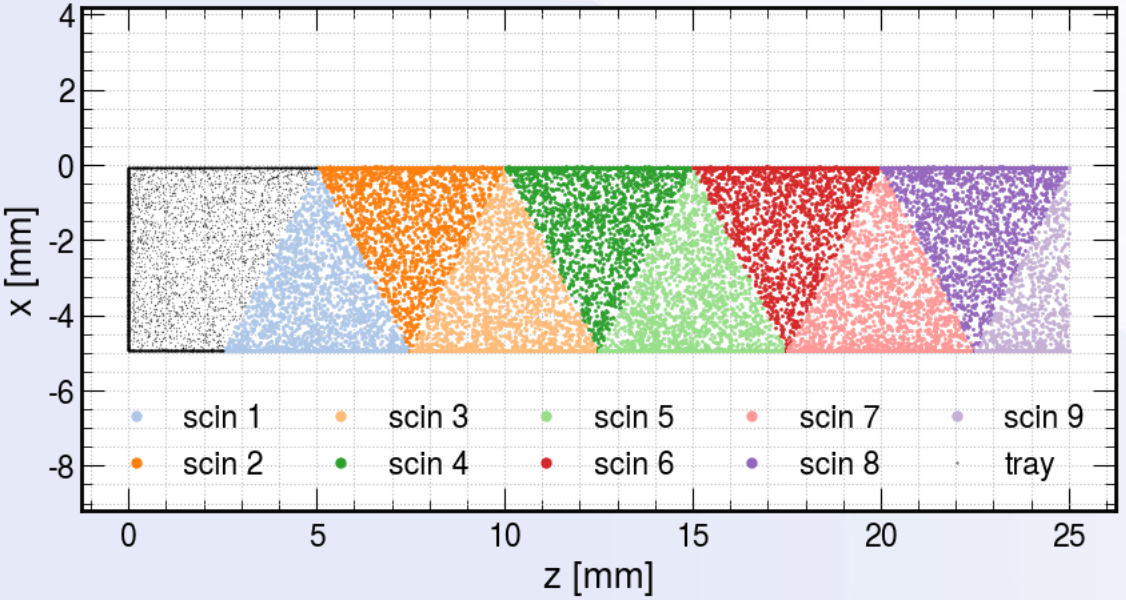
LHCb coordinate system

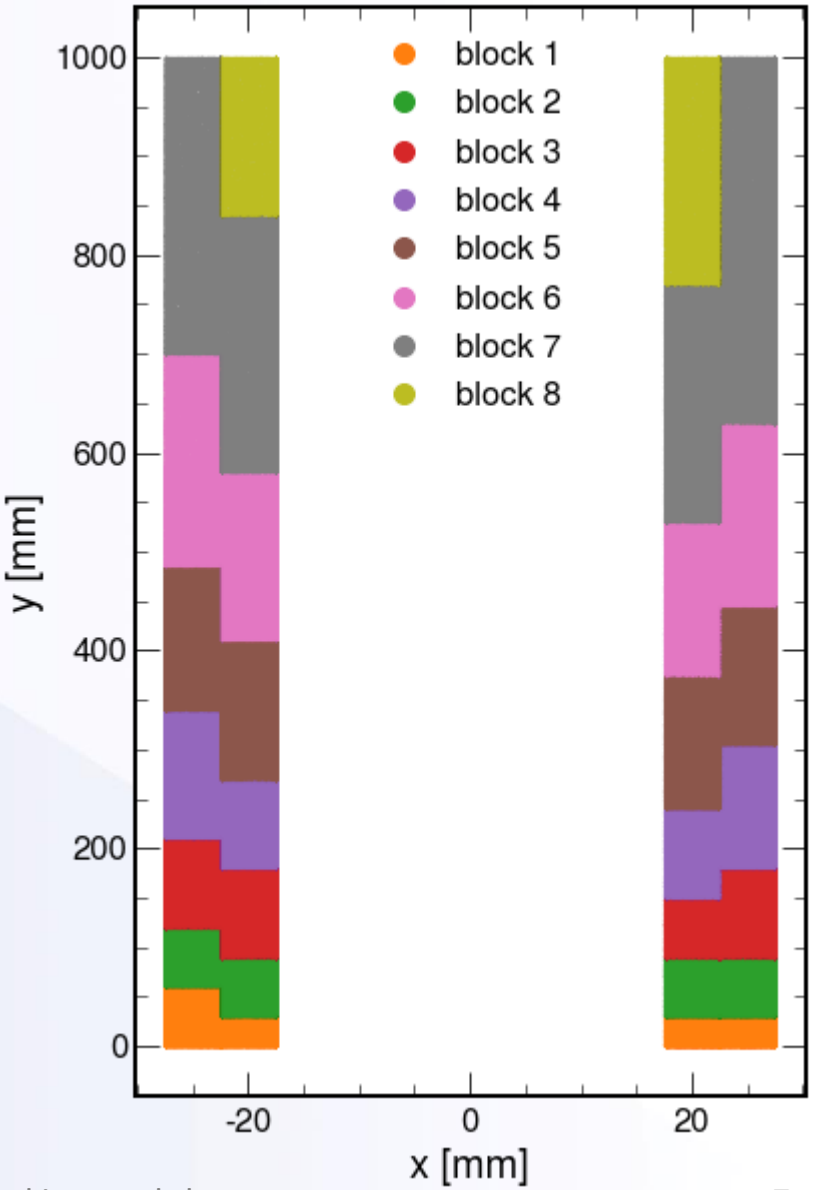




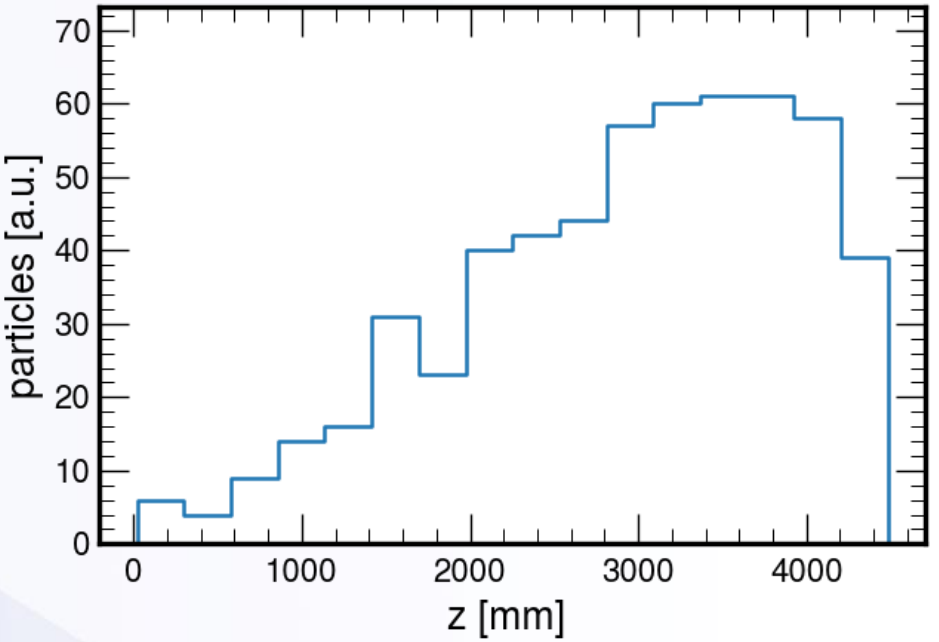
MS coordinate system and applied symmetries

Simulated cells layout

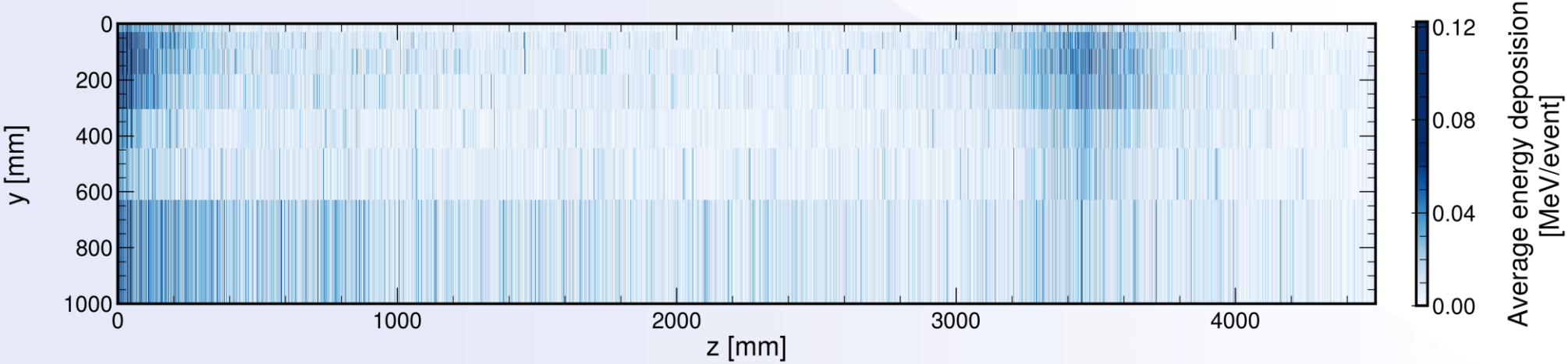




MCHit z-position for particles with UT tracks



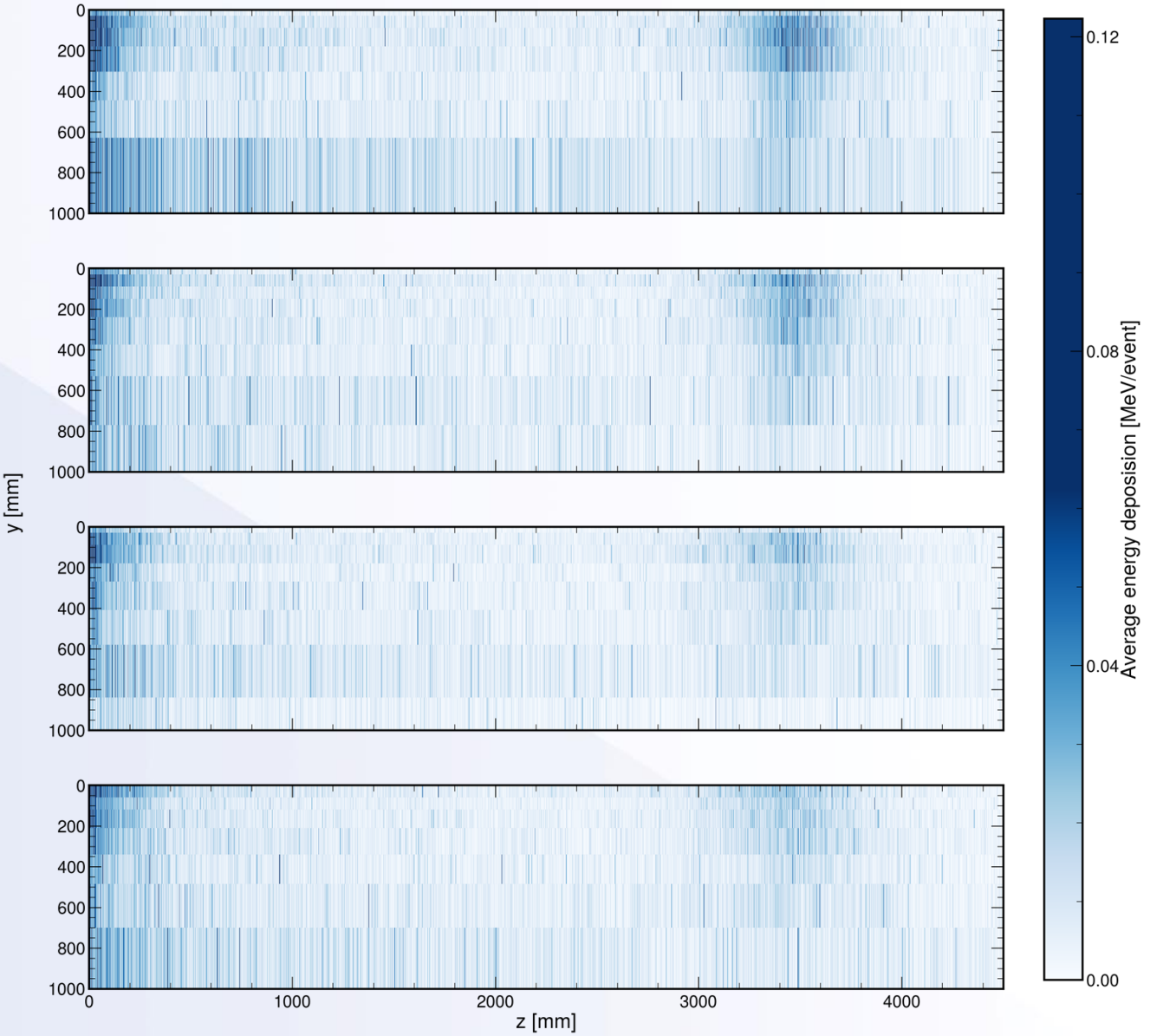
Average energy deposition per bunch crossing per cell



Average energy deposition per bunch crossing per cell

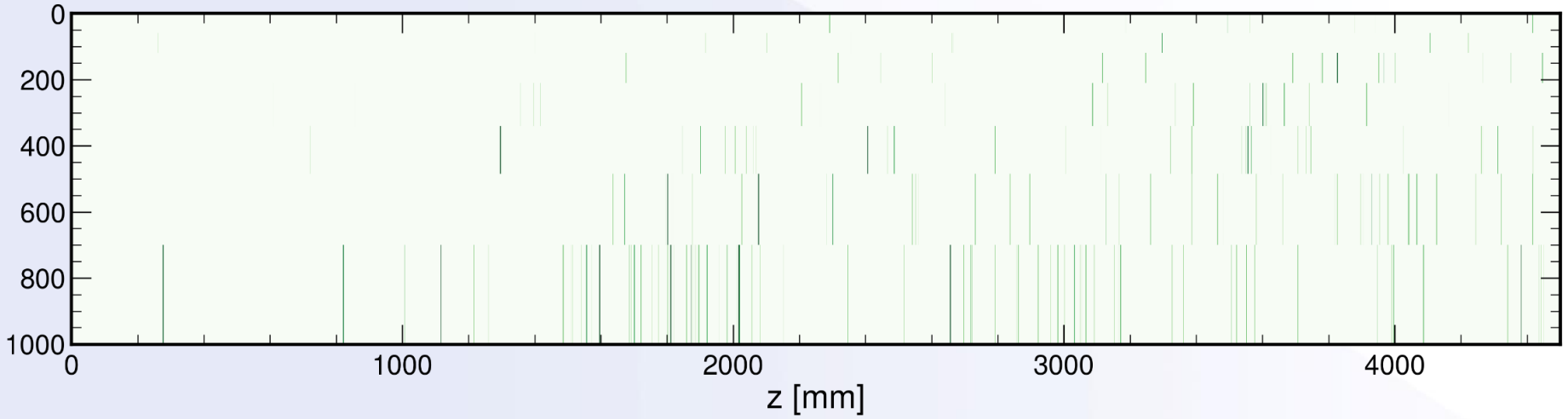
Bottom left quarter of MS
4 layers:

- top plot – most inner one
- bottom plot – most outer one



Track reconstruction in MS – current status

- We divided MS simullation into two parts:
  1. LHCb simulation with simplified MS model
  2. Flexible python MS implementation
- We studied qualitatively expected sources of a background
- We are ready to start developing a clusterisation and tracking alghorithms



Useful python libraries

```
import uproot4 as up  #try it!
import awkward1 as ak
import pandas as pd
import numpy as np
from numba import jit
from matplotlib import pyplot as plt
import mplhep as hep
import k3d
```