Towards V13 of FOOT Simulation

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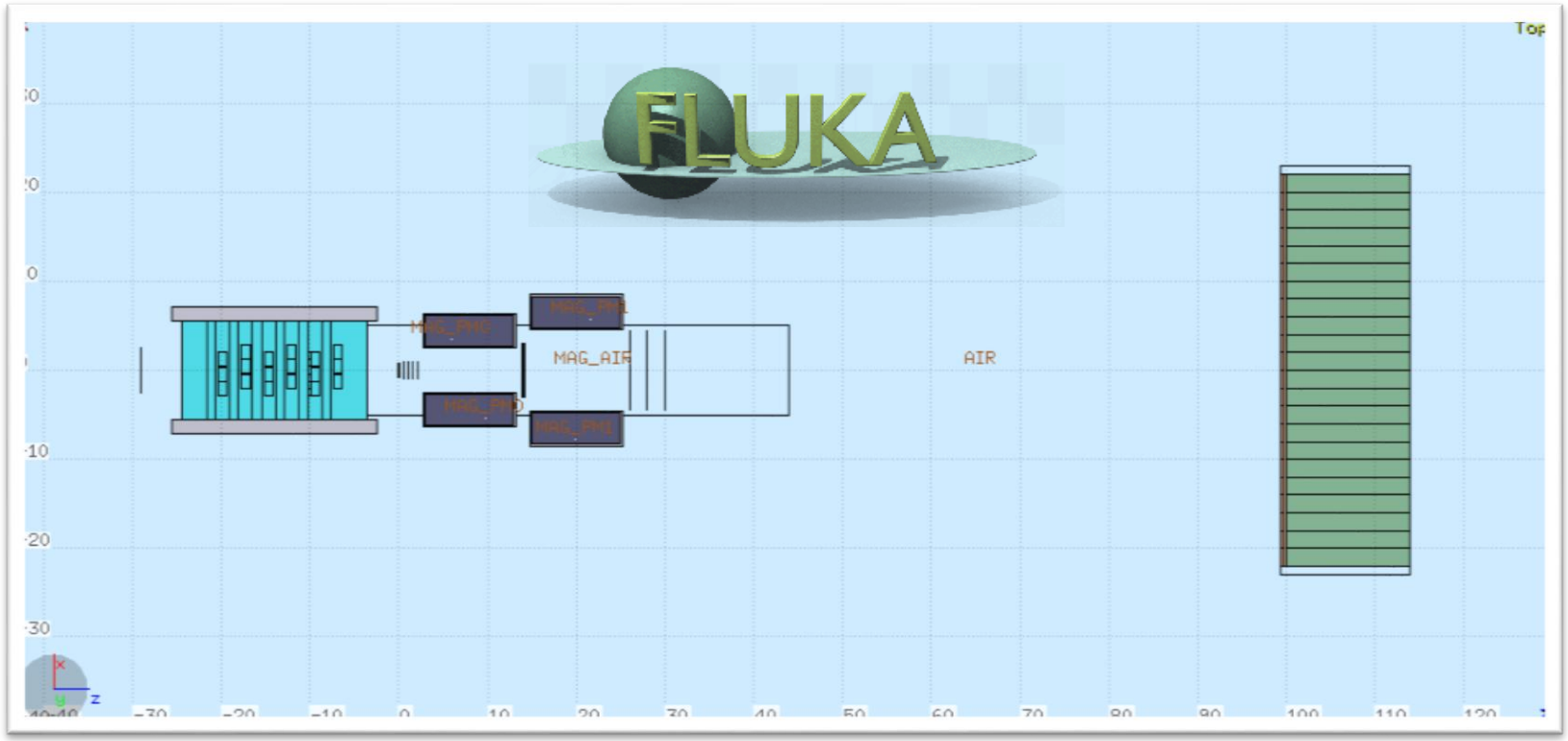
Once upon a time... there was V12.4

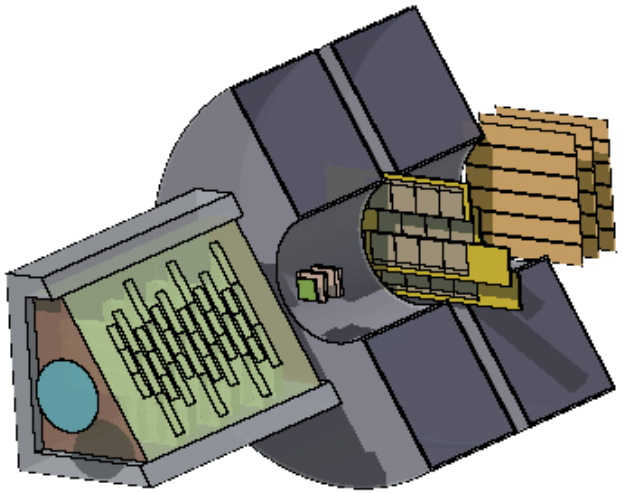


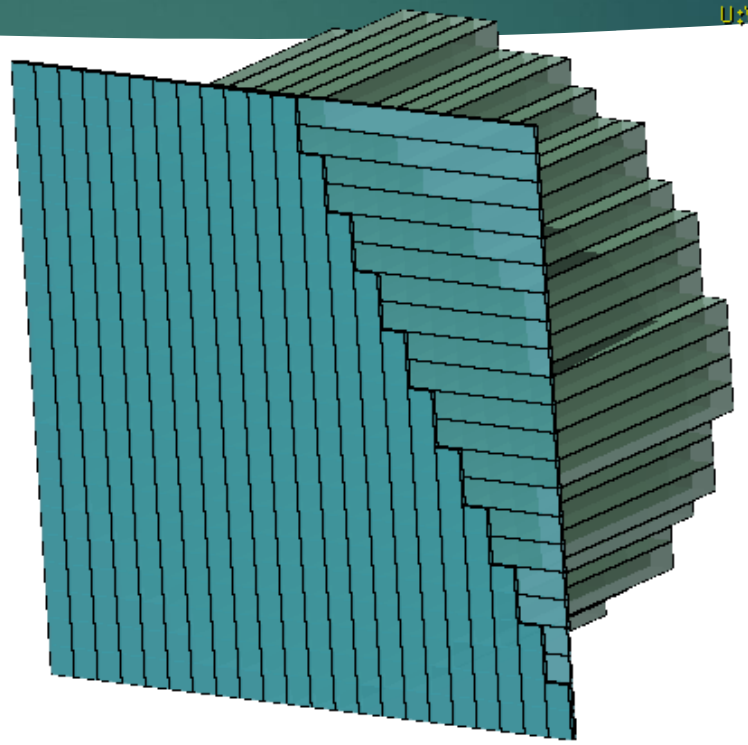
Several simulations with high statistics available on Tier3 server:

- Beams: C, O
  Recently added: He
- Targets: C, C_2H_4
- Energies: 200, 350 and 700 MeV/n

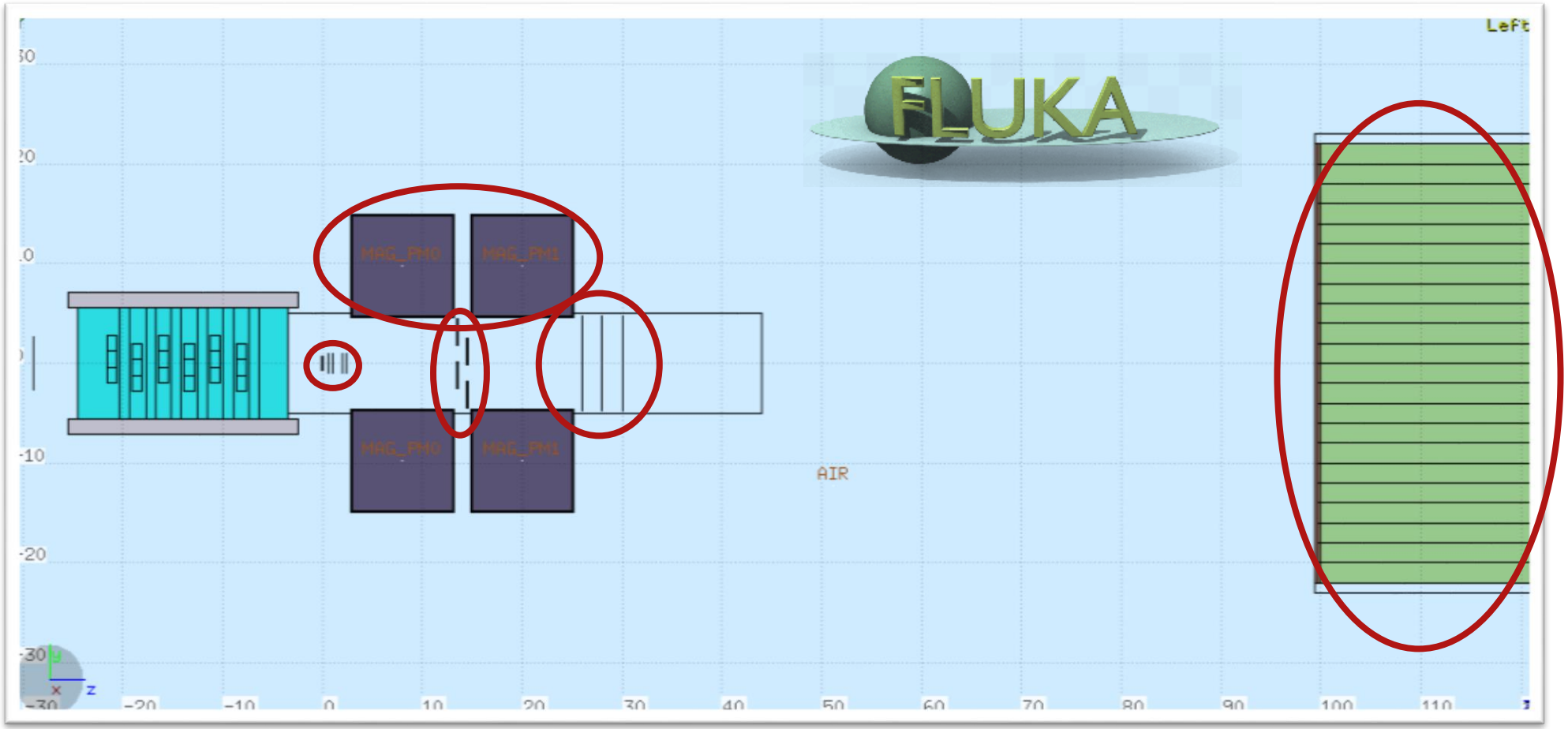
(go to the Twiki page to see the available simulation files)

V13: a brand new geometry

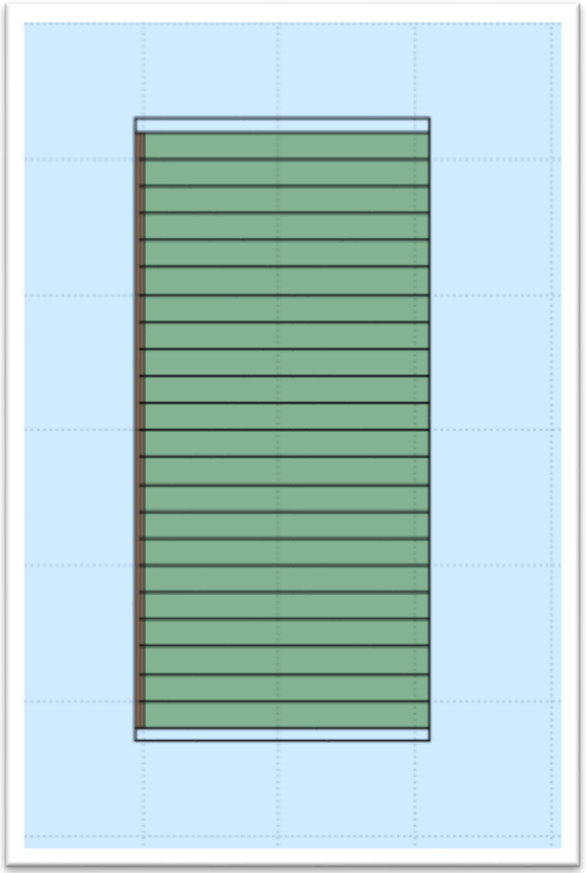




V13: what's new?



Calorimeter



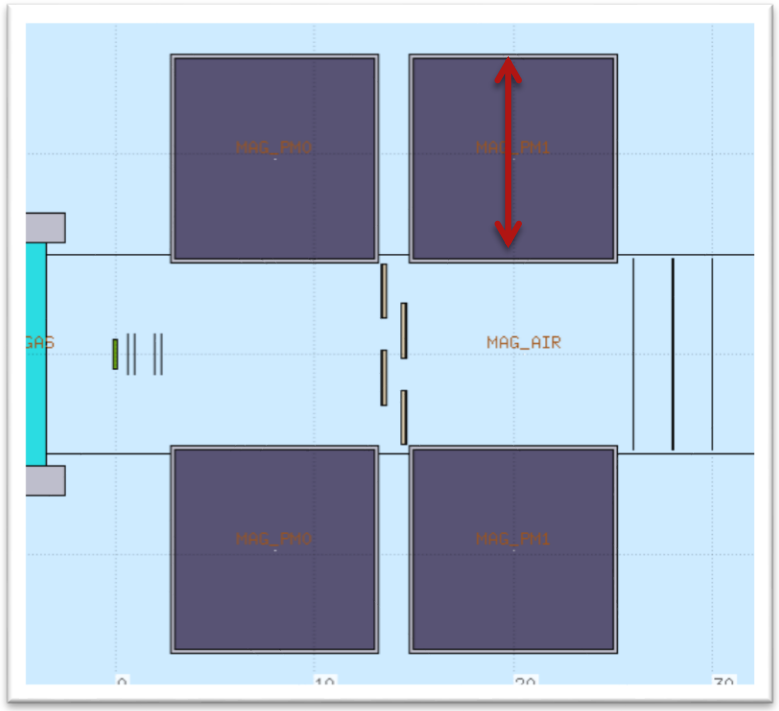
DONE

- Calorimeter BGO crystals have been **lengthened from 14 to 21 cm** since, hopefully, we will inherit ~21 cm long crystals from L3 experiment at LEP

TO DO

- Will they be **parallelepipeds or truncated pyramids**?
- Calorimeter is currently positioned 1 m downstream of the target, but this **distance** can still be optimized

Magnets



DONE

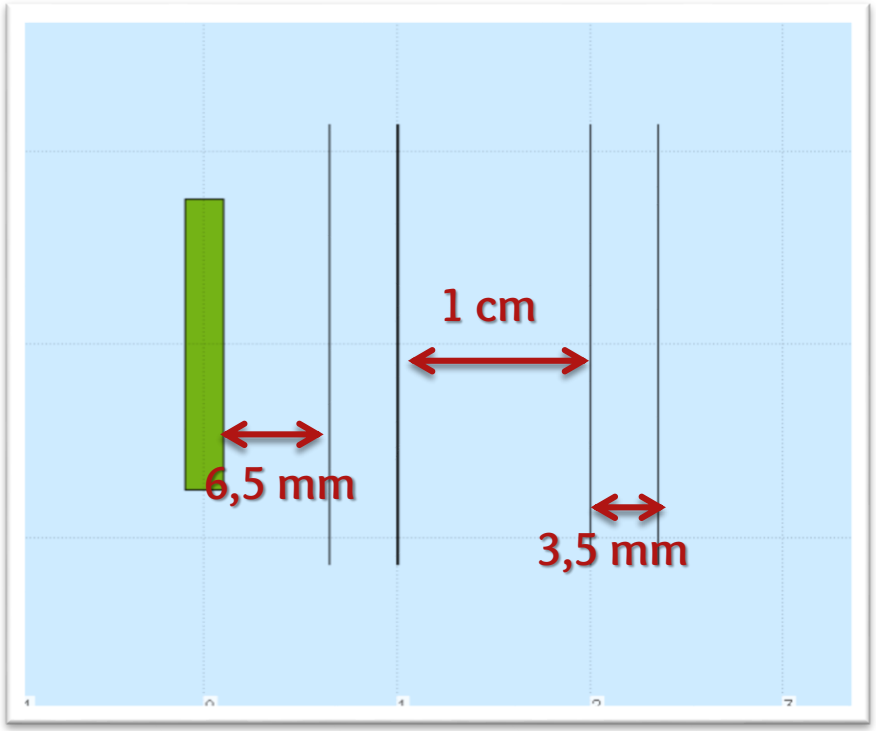
- The construction of **two identical magnets** is cheaper, so in V13 both magnets have an internal radius of about 5 cm
- The magnets **thickness** (in red) has been enlarged to a more realistic value

TO DO

- Overall final **dimensions** have still to be defined. In particular, the length in *z* has to be decided (compromise between cost and *B dl*) and also the distance between the magnets
- **Magnetic map** is still approximated (when there will be a ~finalized geometry we will ask for a realistic one)

Thanks to Eleuterio

Vertex

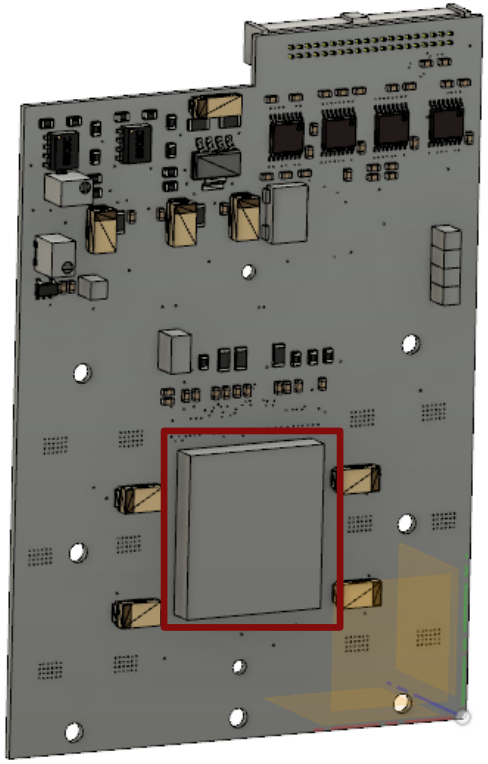


DONE

- Due to the spatial configuration of the readout regions, the vertex layers have been **coupled** and distances between them have been modified as depicted in figure

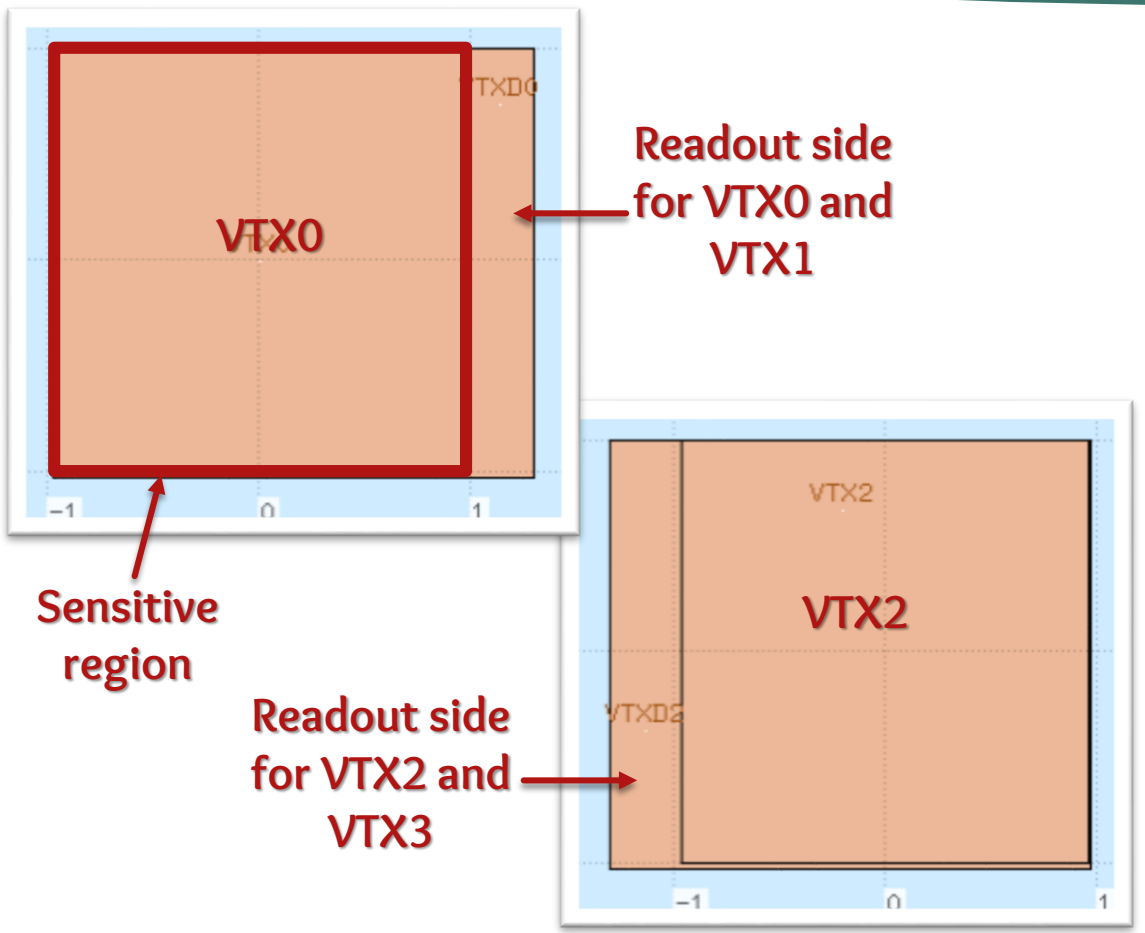
TO DO

- **Distance** from the target still has to be optimized
- Introduce the **electronic boards** that will surround the sensors



Thanks to Eleuterio

Vertex

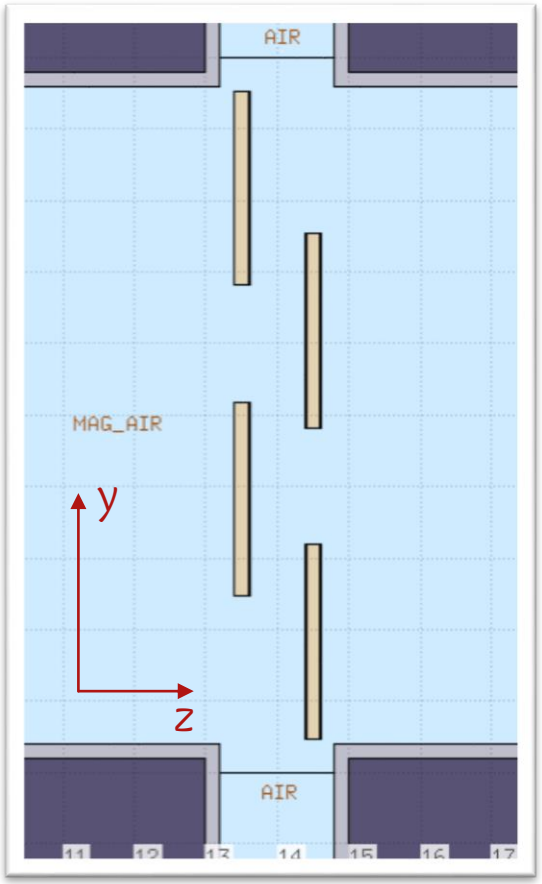


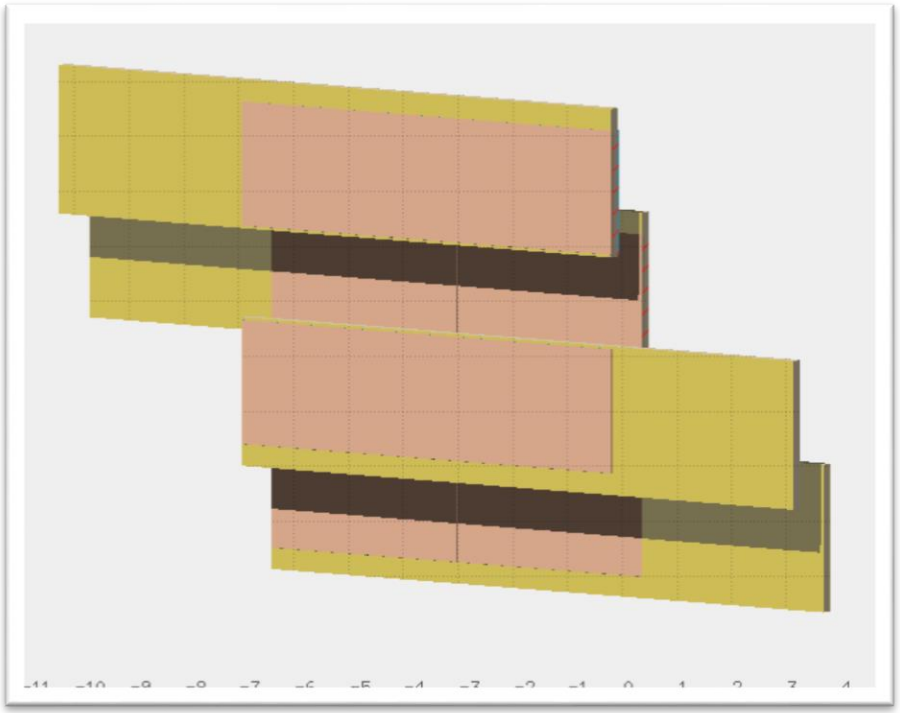
DONE

- Real MIMOSA28 geometry has been implemented:
  - Total area: 20,22 x 22,71 mm^2
  - Active area: ~19,21 x 19,87
  - 928 rows x 960 columns
  - Pixel pitch: 20,7 µm
  - Thickness: 50 µm
- The two planes in the same couple will be read from the same side, while the others from the opposite
- Improved management of **simulated hits** in pixels

Thanks to Eleuterio

Inner Tracker





DONE

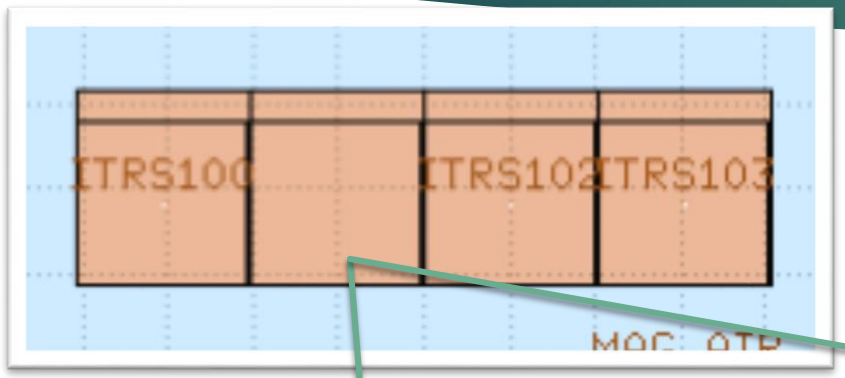
- The Inner Tracker has been **split in 4**: the **PLUME geometry** has been implemented, along with real MIMOSA28 geometry (4 M28 in each PLUME)

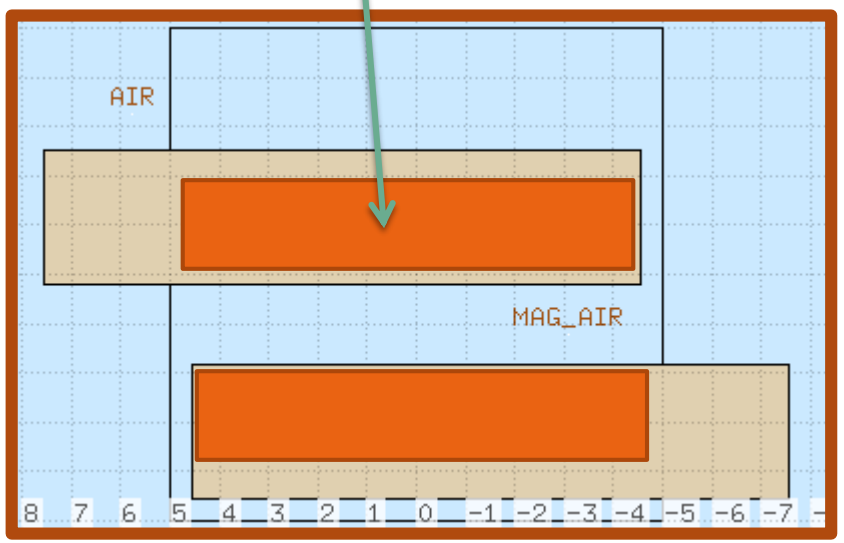
TO DO

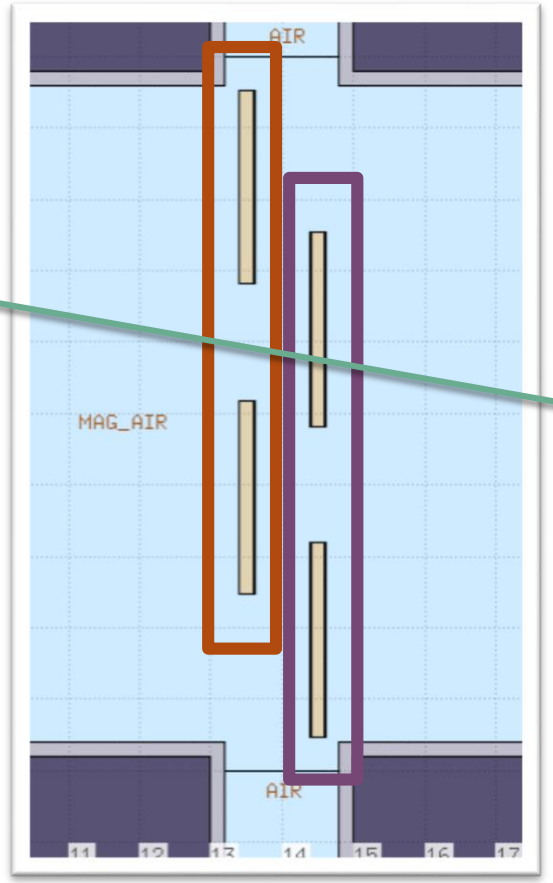
- **Distances** between PLUMEs (in *z* and *y*) have to be optimized

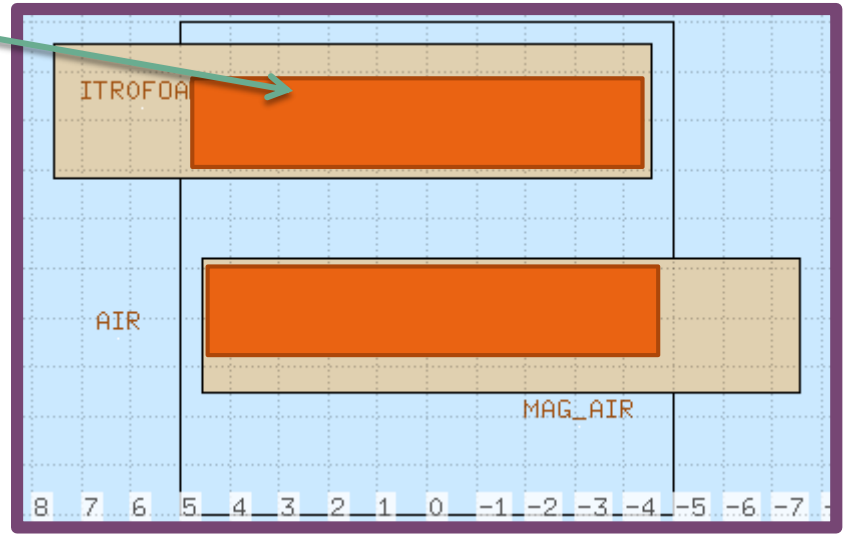
Thanks to Eleuterio

Inner Tracker



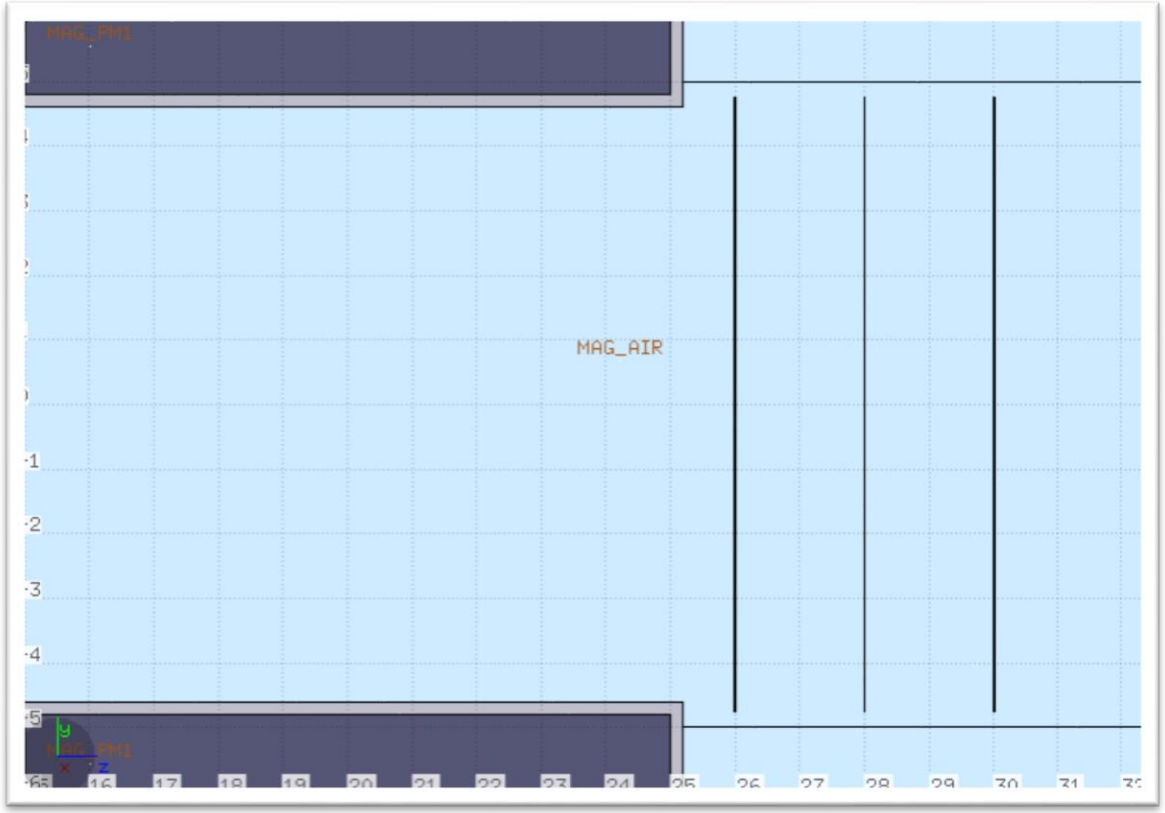






Thanks to Eleuterio

Microstrip Detector



DONE

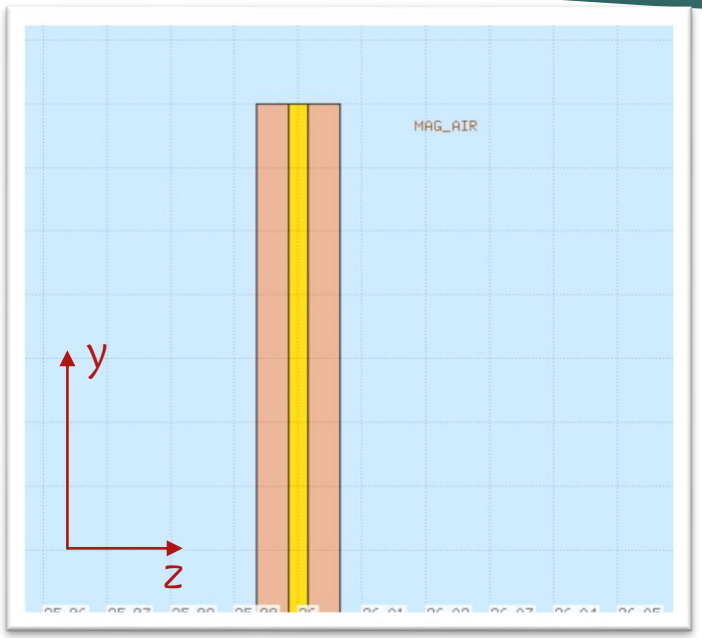
- **3 planes** of Silicon Microstrips
- 2 cm distance between planes
- **Strip pitch** 125 μm
- 2 different **configurations** (see next slide)

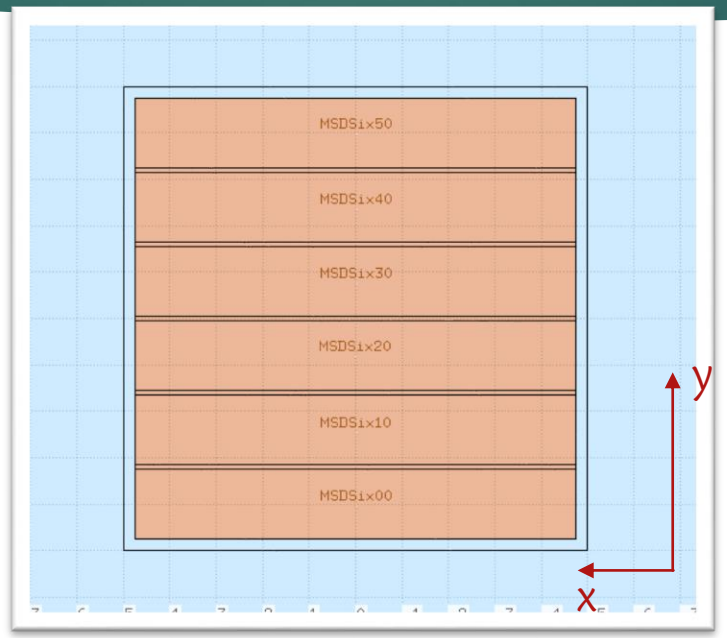
TO DO

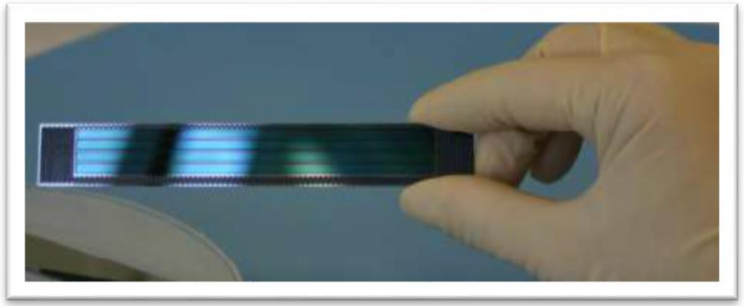
- **Distances** between the planes
- **Number** of layers (does the resolution on momentum improve if we add another, and maybe thinner, layer?)

Thanks to Leonello

Microstrip Detector







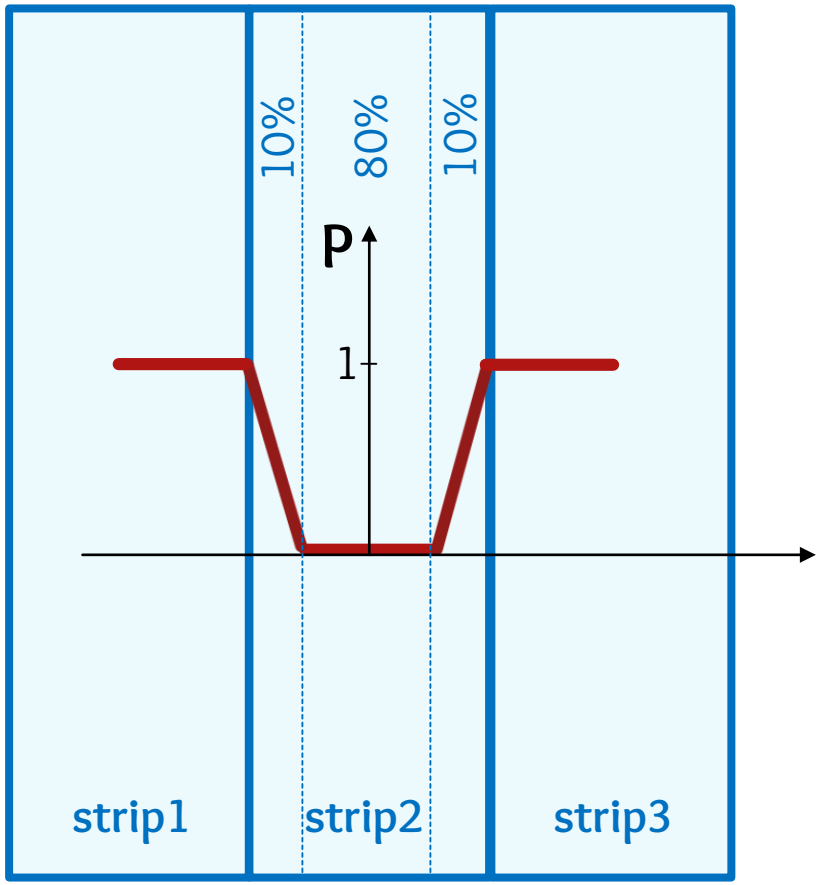
V13.0

DONE

- Each plane: **2 layers** of Silicon Microstrips (50 µm thick)
- Interleaved with a **Kapton foil** (30 µm thick)
- **Bars** 1.5x9 cm^2
- **Insensitive regions** between bars 1 mm
- **LGAD** system

Thanks to Leonello

Microstrip Detector



V13.0

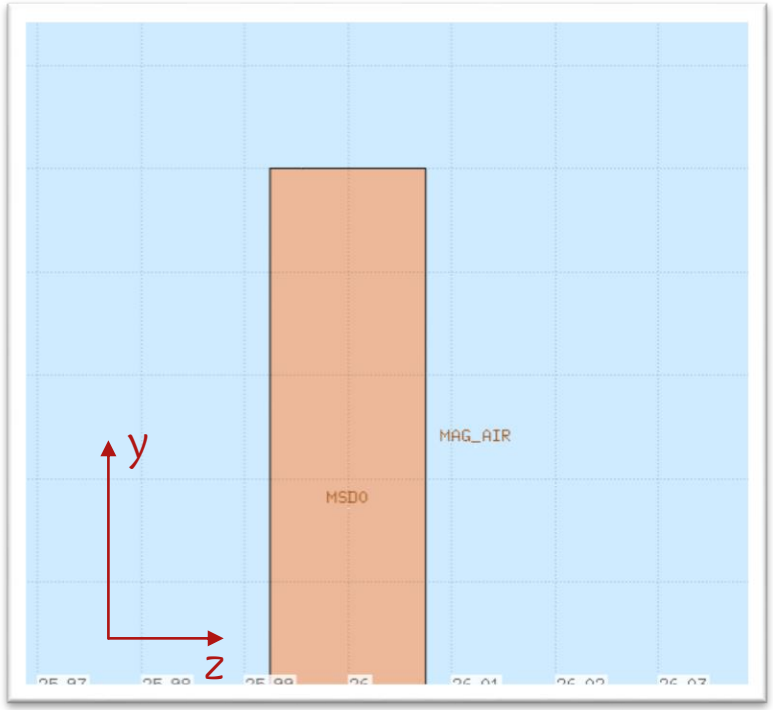
- **Charge sharing**: as the charge produced in a microstrip by ionizations drifts, it can partly be collected by the next strip
- Charge sharing occurs in **~20%** of the interactions
- Charge sharing **probability** is a function of the distance from the nearest strips (see figure)

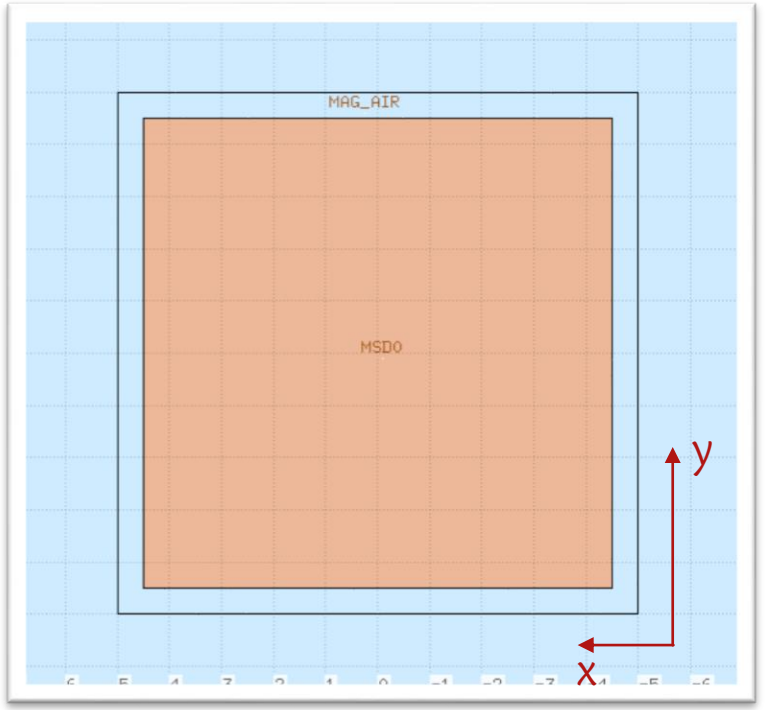
ONGOING

- **Implementation of charge sharing** at reconstruction level

Thanks to Leonello

Microstrip Detector





V13.1

DONE

- Each plane: **1 single layer** of Silicon Microstrips (150 μm thick)
- No Kapton foil
- No insensitive regions
- No LGAD system

Thanks to Leonello

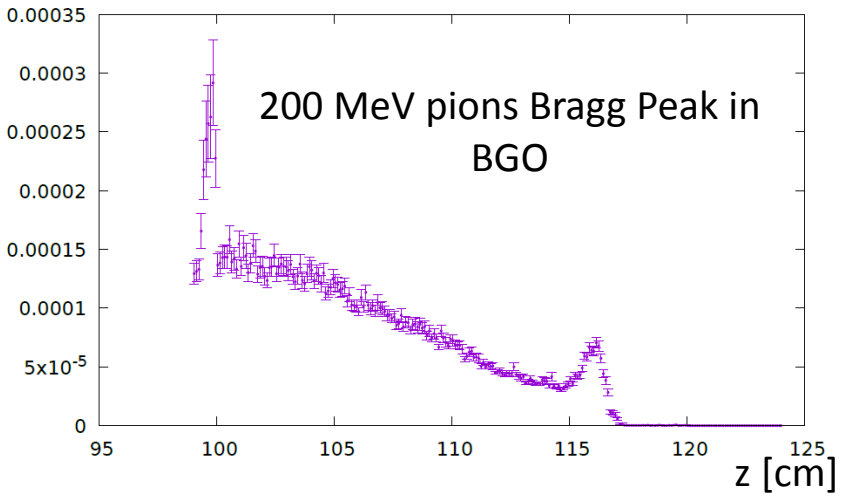
Future works - Simulation

- **Simulation of FOOT V13** will be available in the next days (check the Twiki page)
- Update the git repository and the instructions on how to run the simulation on the dedicated Twiki page
- We are currently **integrating the geometry software in the reconstruction framework**
- A lot of **parameters have to be optimized and defined** in order to be correctly reproduced in simulation:
  - Distance of vertex, calorimeter, ecc. from target
  - Distances between the PLUMEs and between the Microstrip Detector layers
  - Layout of the Microstrip Detector
  - Dimensions of the magnets
  - Distance between scintillator and calorimeter
  - Calorimeter shape (parallelepipeds o truncated pyramids) and dimensions
- Provide the **final magnetic map**

Future works - Reconstruction

- In the reconstruction stage, we have to introduce:
  - **Clustering** in Inner Tracker and calorimeter
  - Scintillator luminous response and resolution dependence on the **hit position**
- Provide a new **event display** adapted to the new geometry
- At high energies (radioprotection in space measurements), what is the impact of pions on the calorimeter response?

Pions production energy threshold is ~290 MeV (±Fermi momentum in case of nucleus-nucleus collision)




Thank you