Version 13 of FOOT Simulation: changes and first data production

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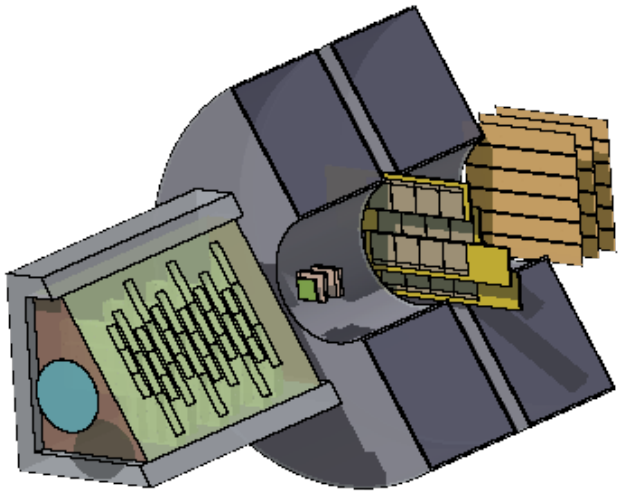
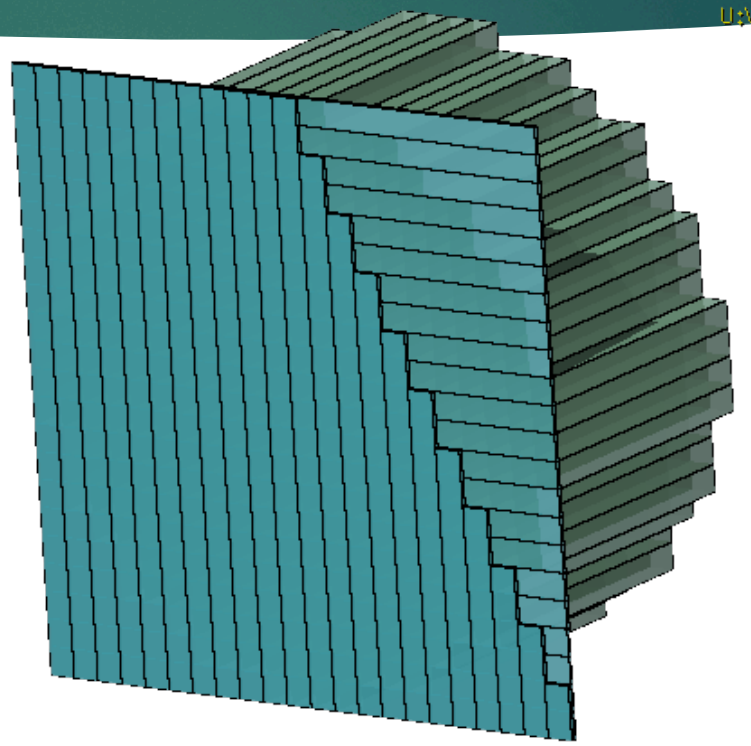
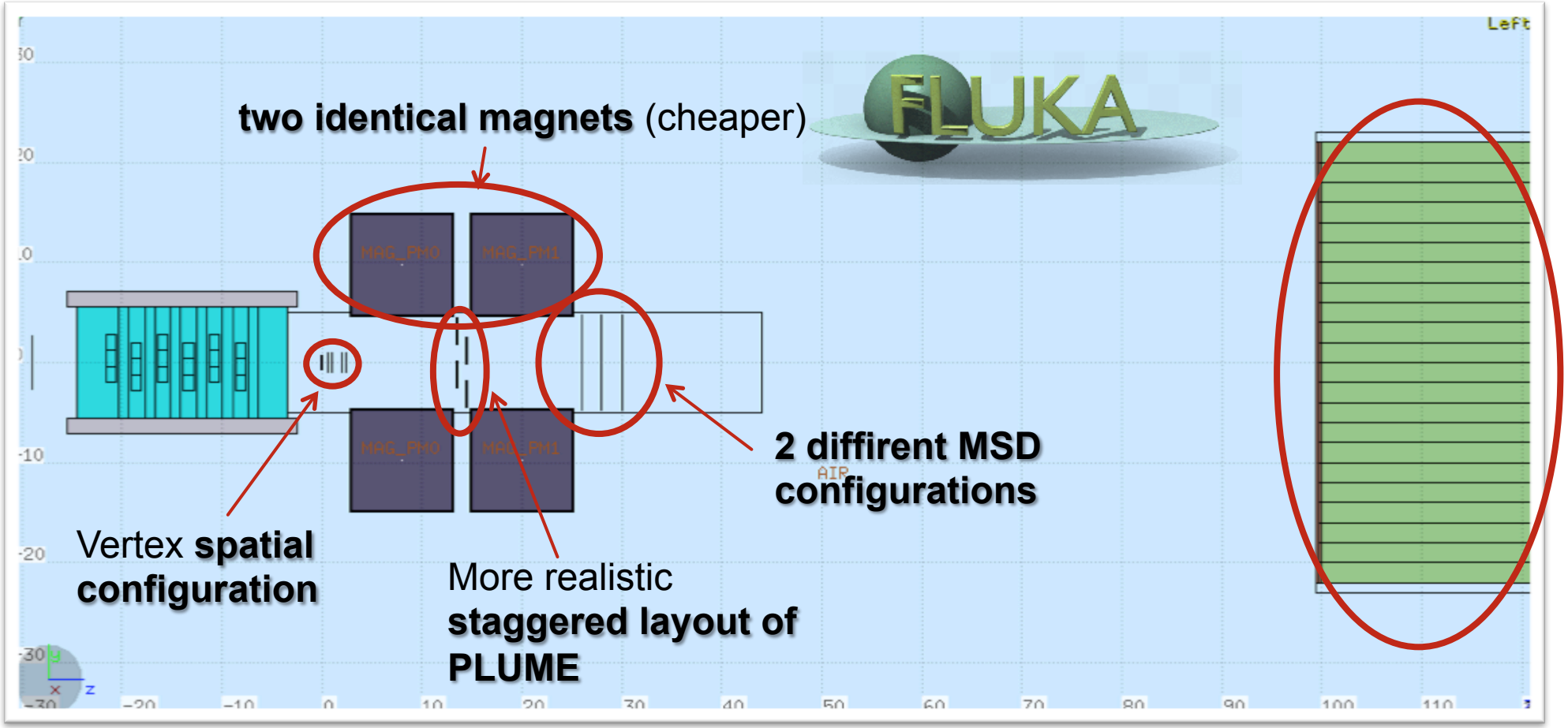
From Bologna Meeting: V13



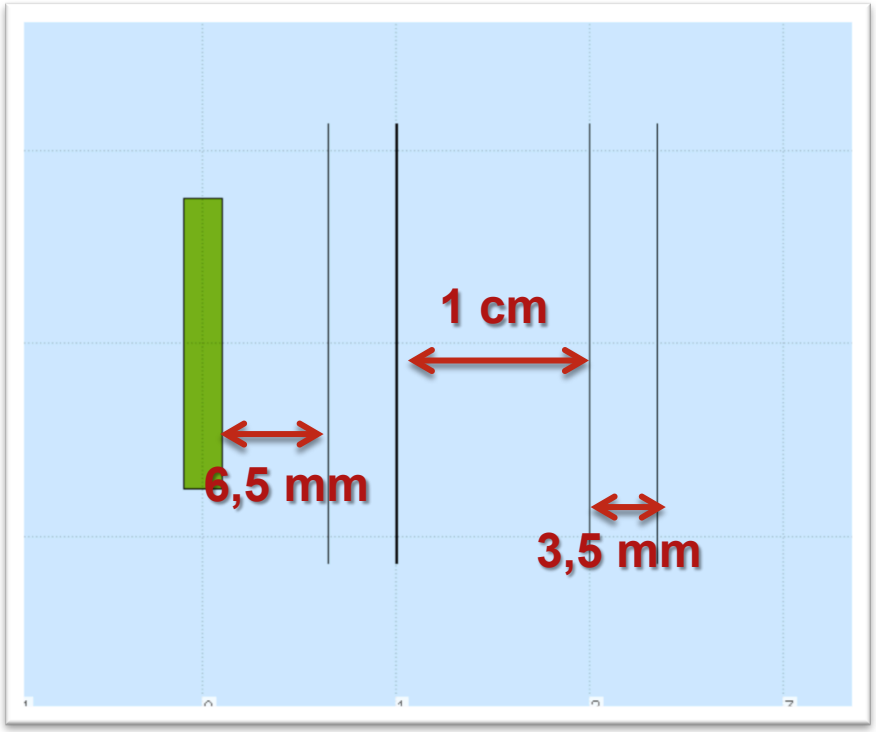


V13: what's new?



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

Vertex

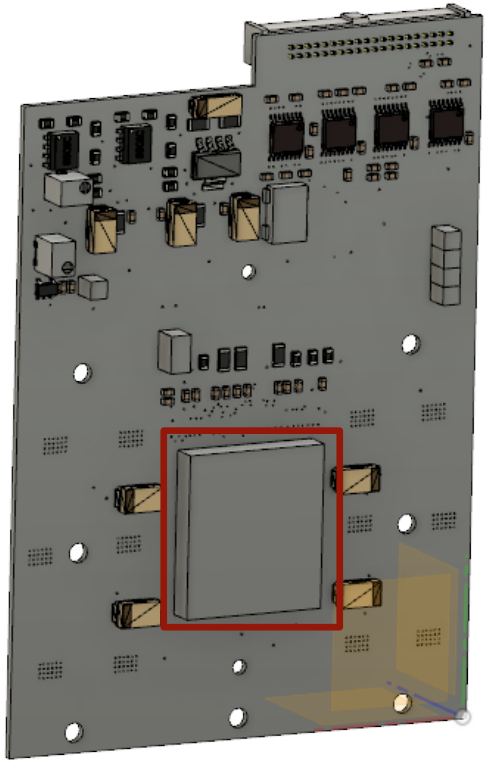


DONE

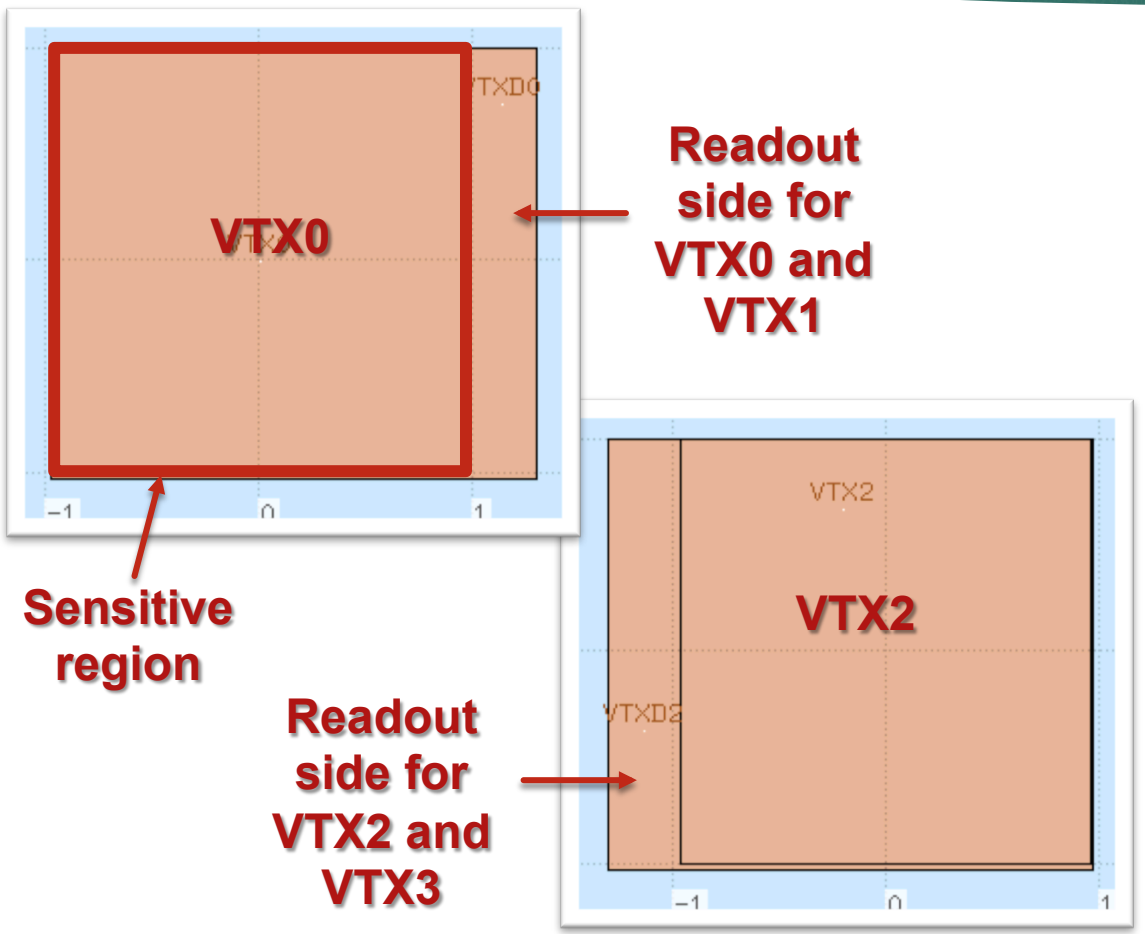
- Due to the spatial configuration of the readout regions, the vertex layers have been **coupled** and distances between them have been modified as depicted in figure

TO DO

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



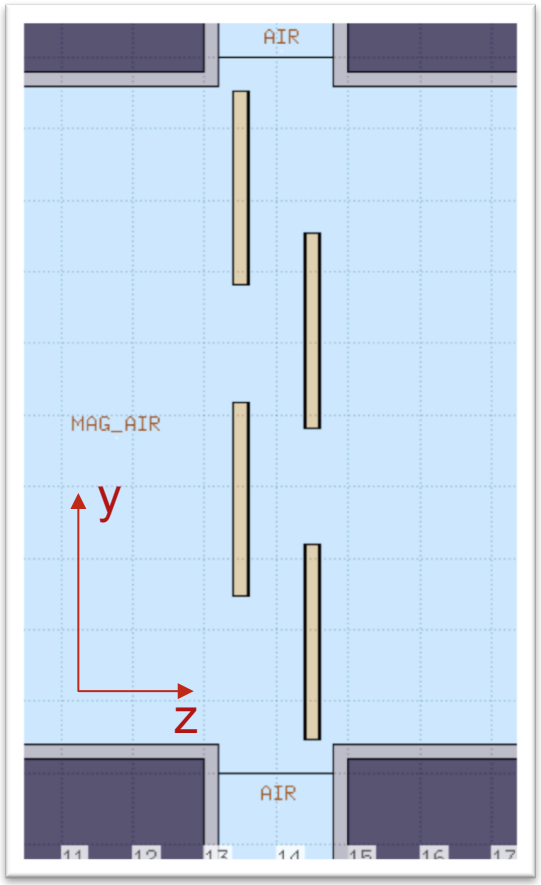
Vertex

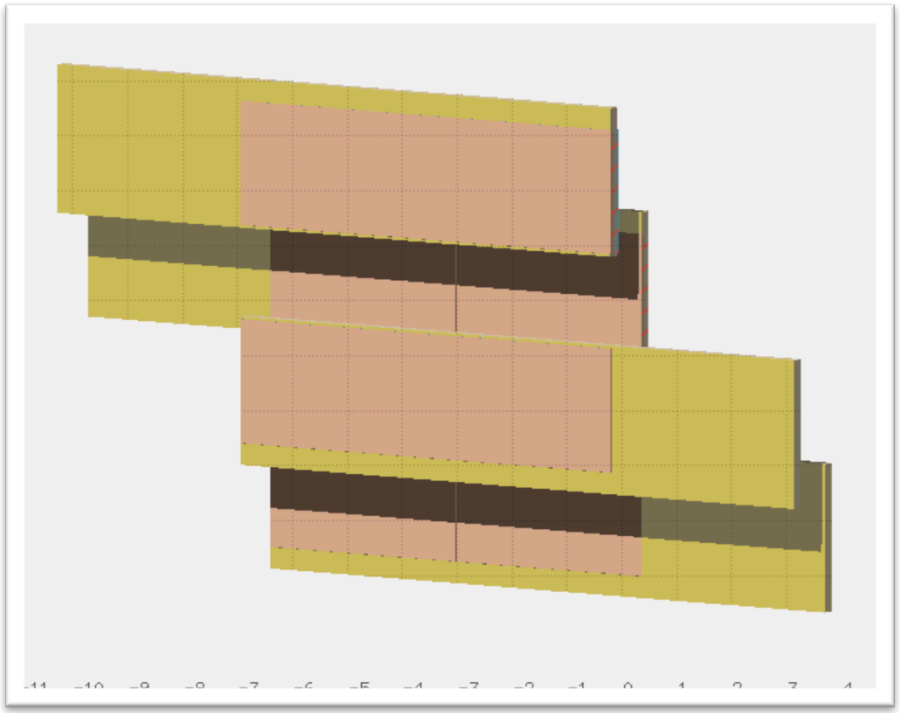


DONE

- 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

Inner Tracker





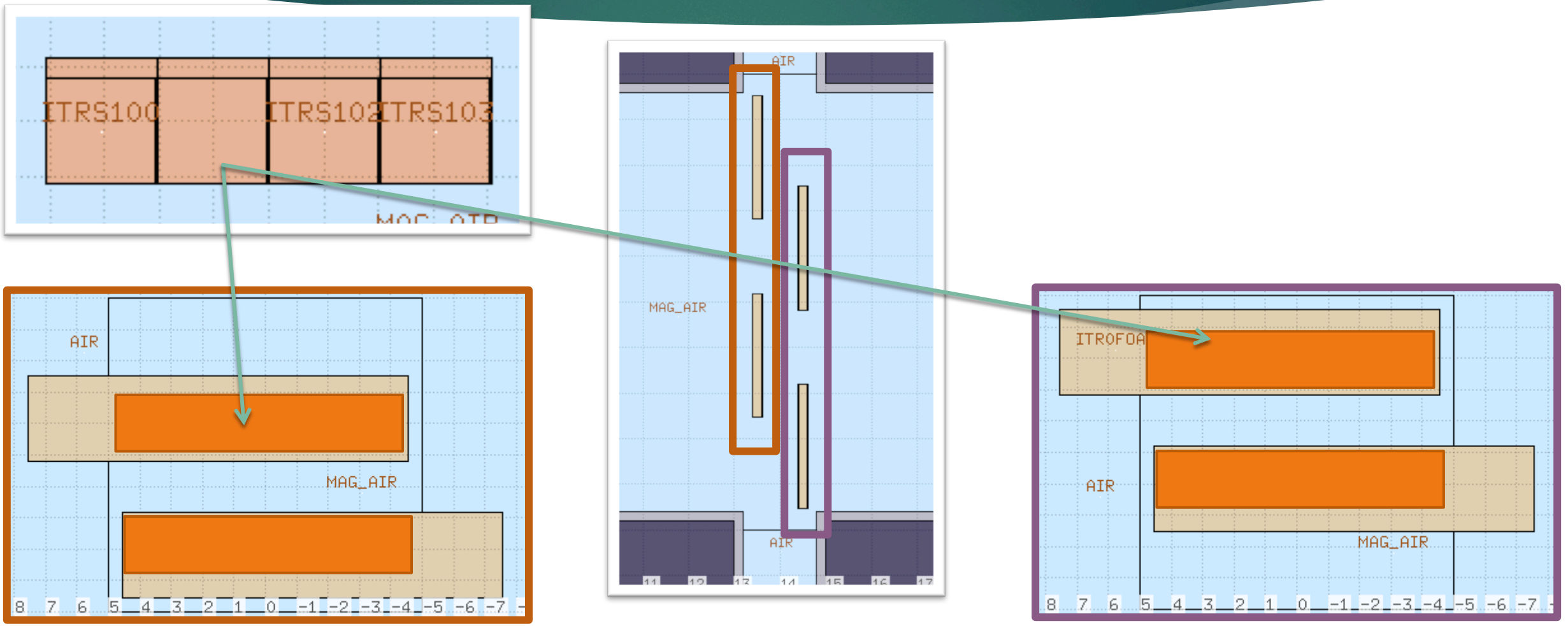
DONE

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

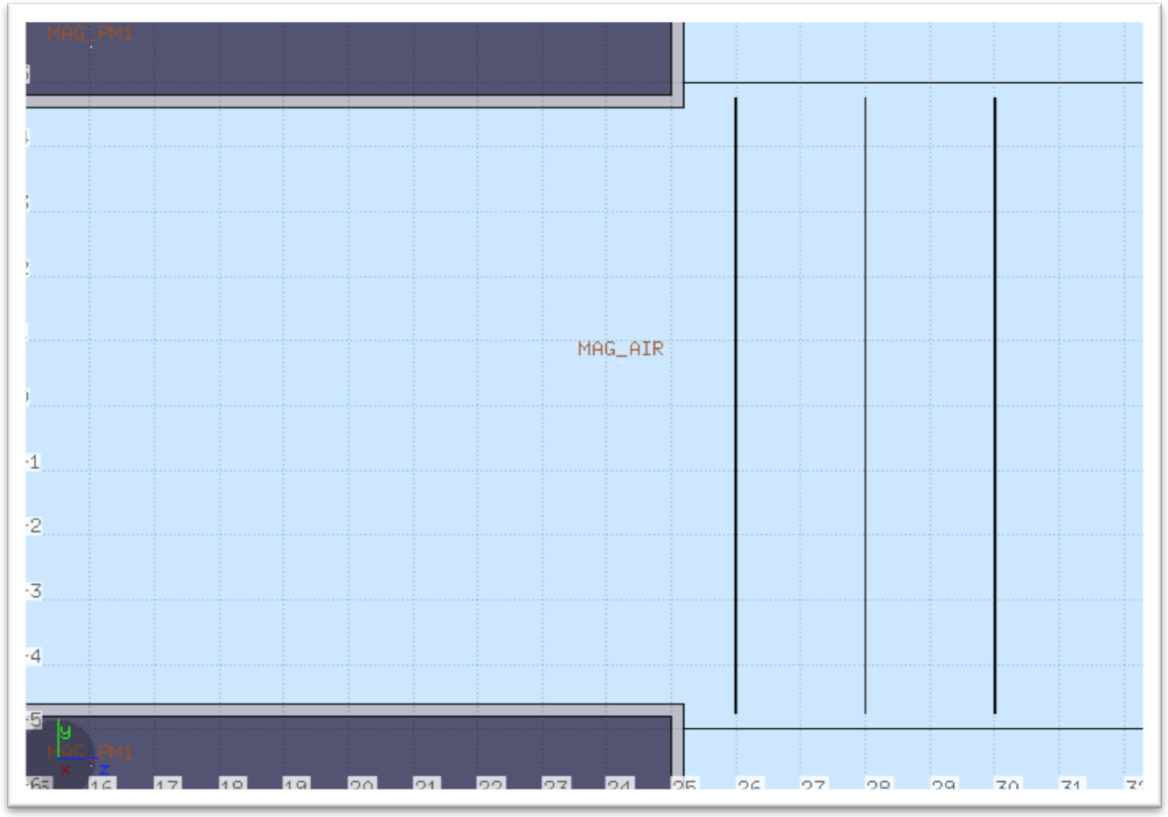
TO DO

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

Inner Tracker



Microstrip Detector



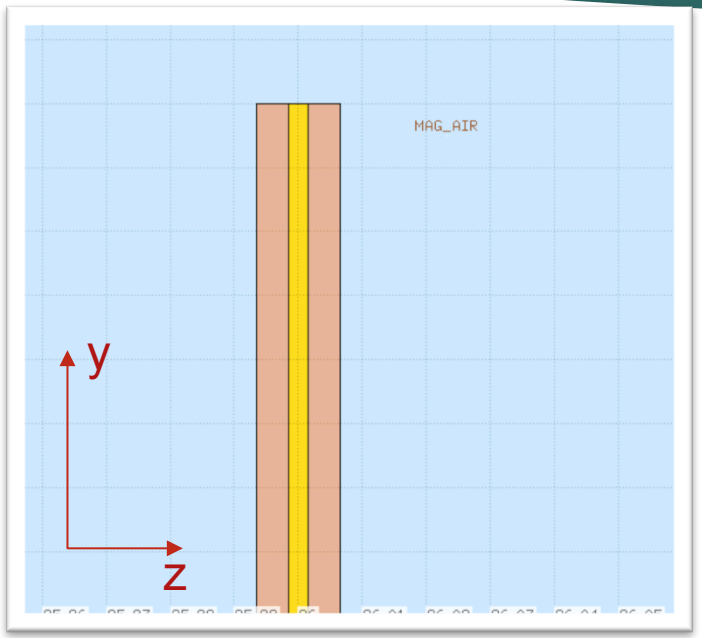
DONE

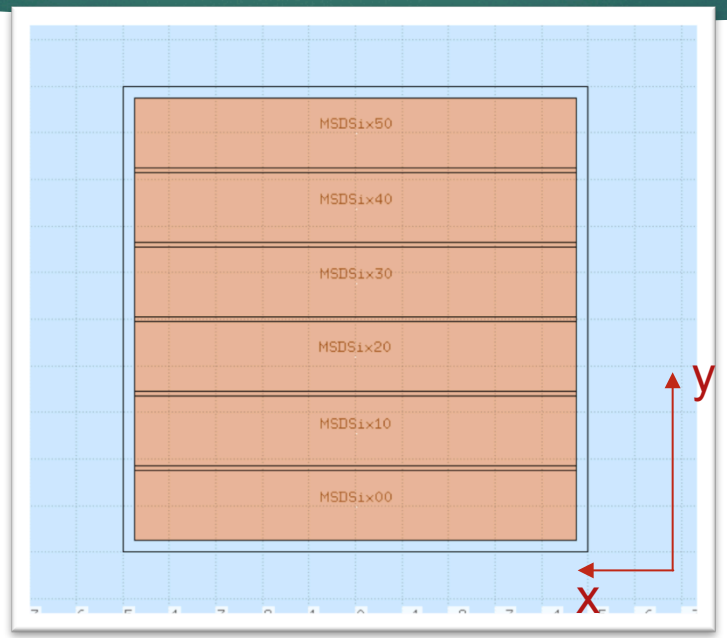
- **3 planes** of Silicon Microstrips
- 2 cm distance between planes
- **Strip pitch** 125 μm
- 2 different **configurations** (see next slide)

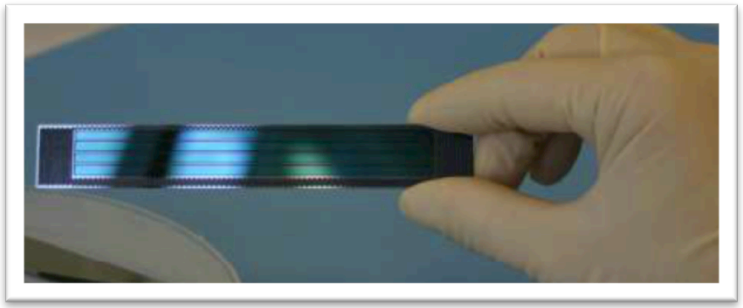
TO DO

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

Microstrip Detector. Configuration 1







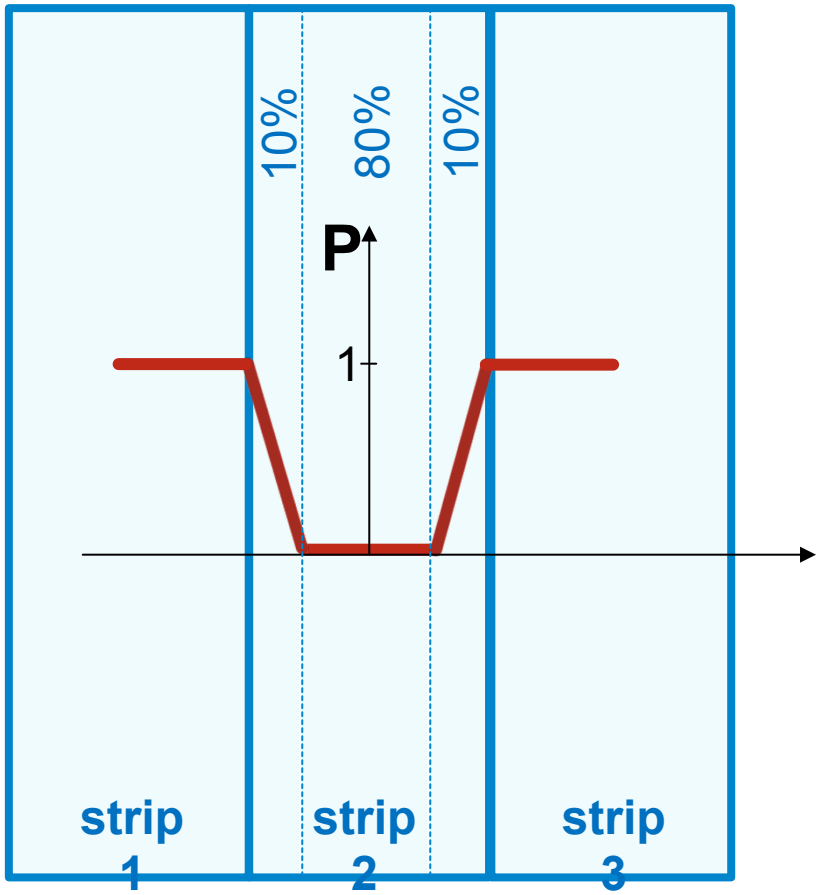
V13.0

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

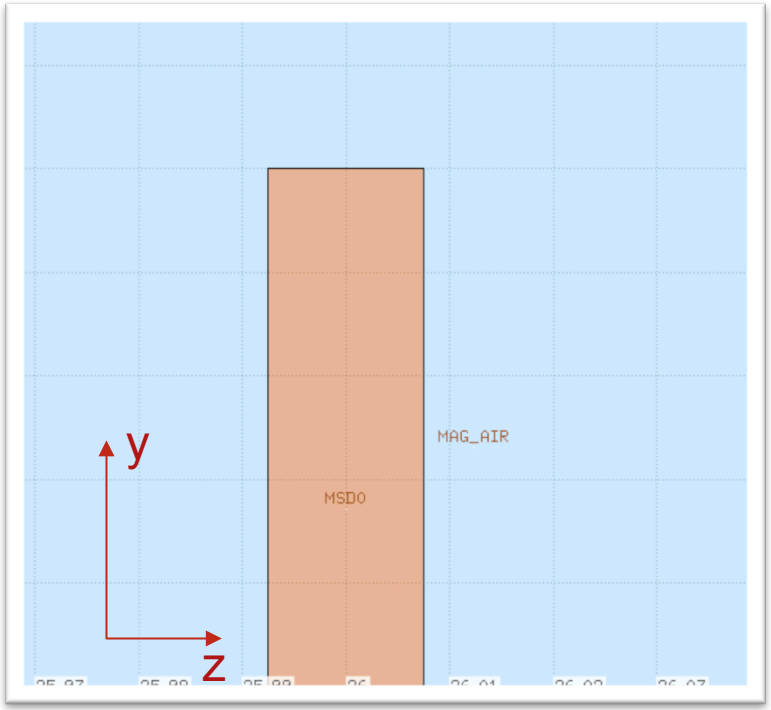
- **Charge sharing**: as the charge produced in a microstrip by ionizations drifts, it can partly be collected by the next strip
- Charge sharing occurs in **~20%** of the interactions
- Charge sharing **probability** is a function of the distance from the nearest strips (see figure)

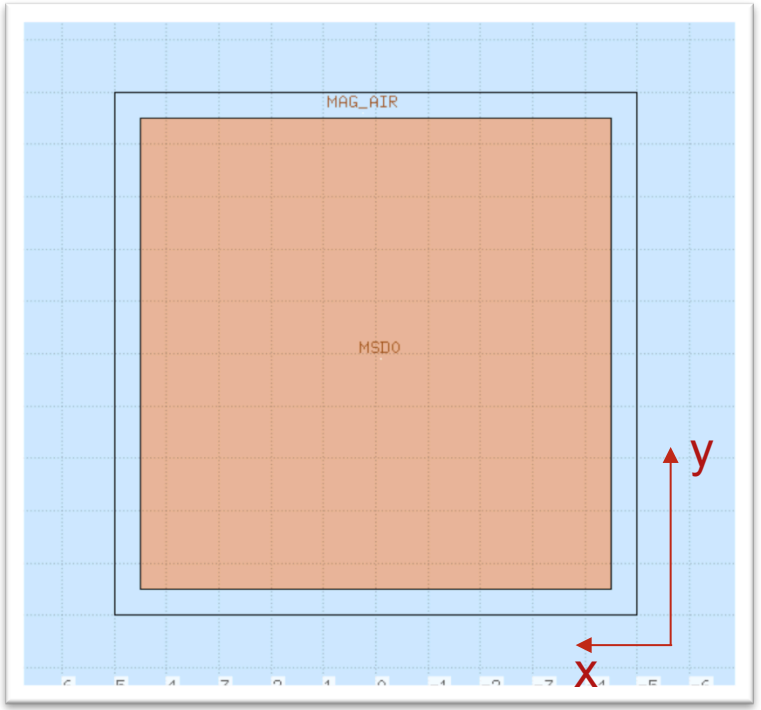
ONGOING

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

Thanks to Leonello

Microstrip Detector. Configuration 2





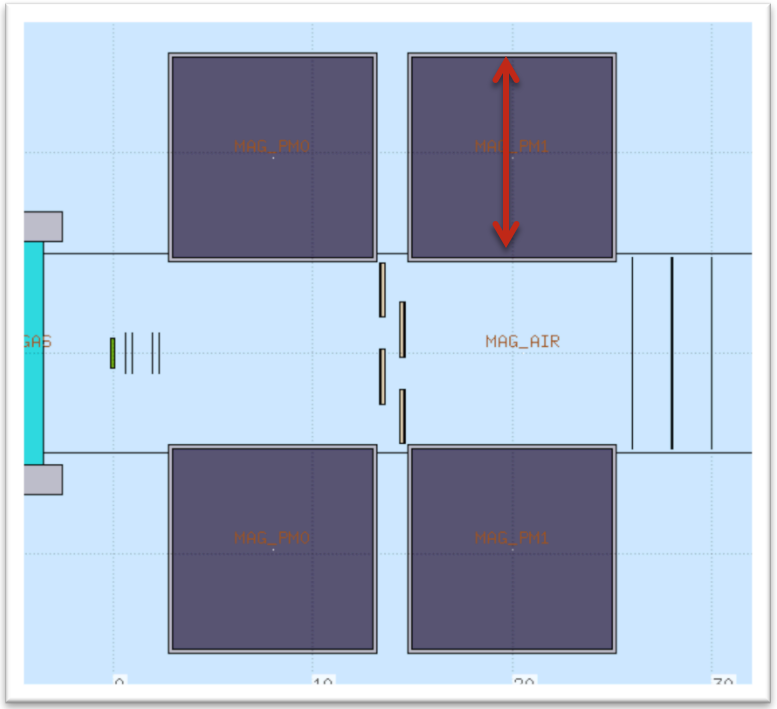
V13.1

DONE

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

Thanks to Leonello

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)
- **Warning: the financial estimates were evaluated for magnets shorter than in V12.4 (7 cm against 10 cm). What's the impact?**

Sub Versions

V13.0.0 and V13.1.0

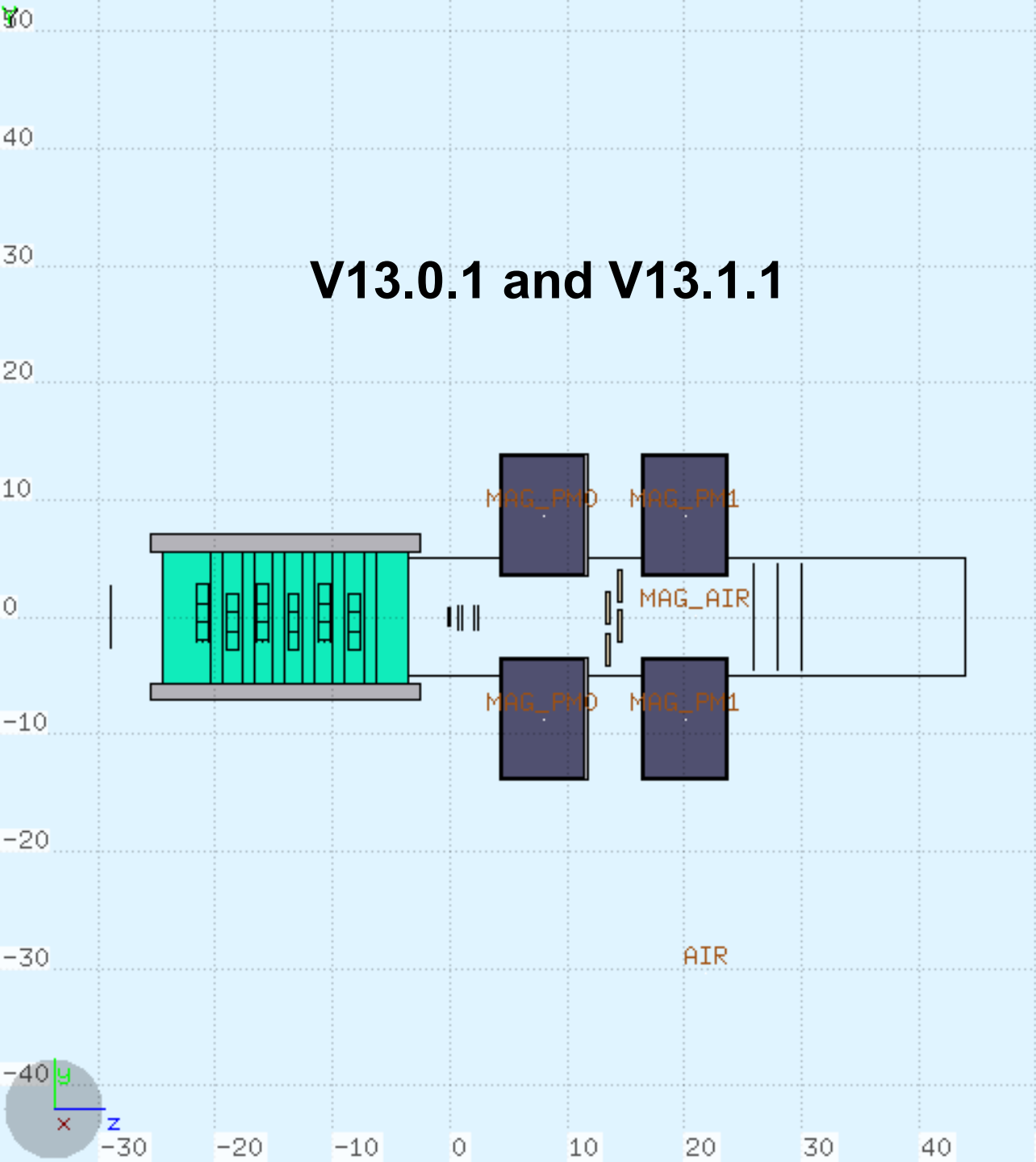
- V12.4 design: magnet length = 10 cm
- USED FOR CDR. Approximate Field map!!

V13.0.1 and V13.1.1

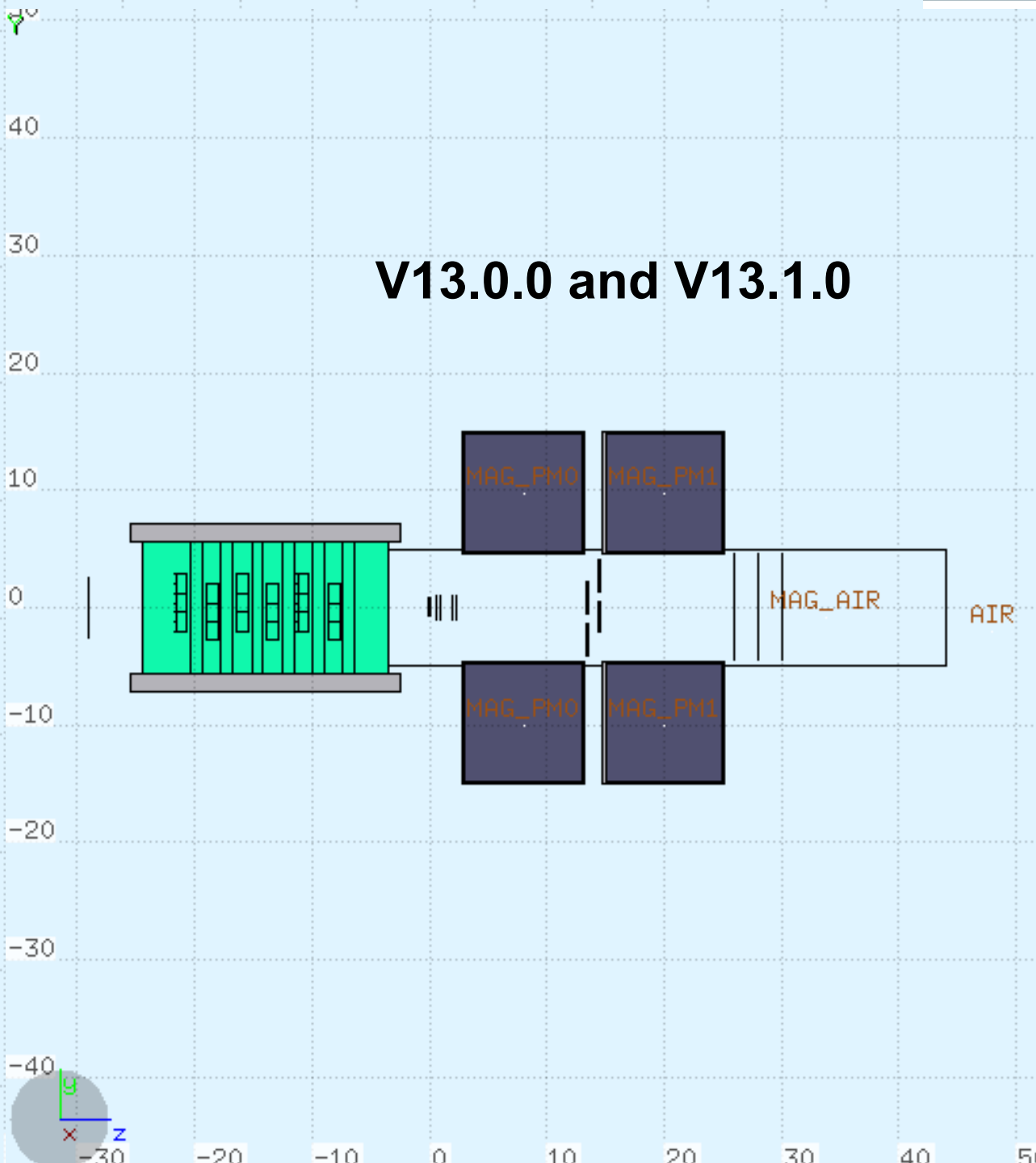
- Short magnet length = 7 cm (first design by C. Sanelli)
- Realistic Field map calculation

The first digit instead refers to the MSD configuration

V13.0.1 and V13.1.1



V13.0.0 and V13.1.0



Test productions

- On Tier3 in /gpfs_data/local/foot/Simulation
- Subdirectories:
  - V13.0.0
  - V13.1.0
  - V13.0.1
  - V13.1.1

  In each subdirectory: 16O_C2H4_200_1.root

  10^7 Oxygen primaries @200 MeV/u against a 2 mm C_2H_4 target: ~100k intelastic interactions on target

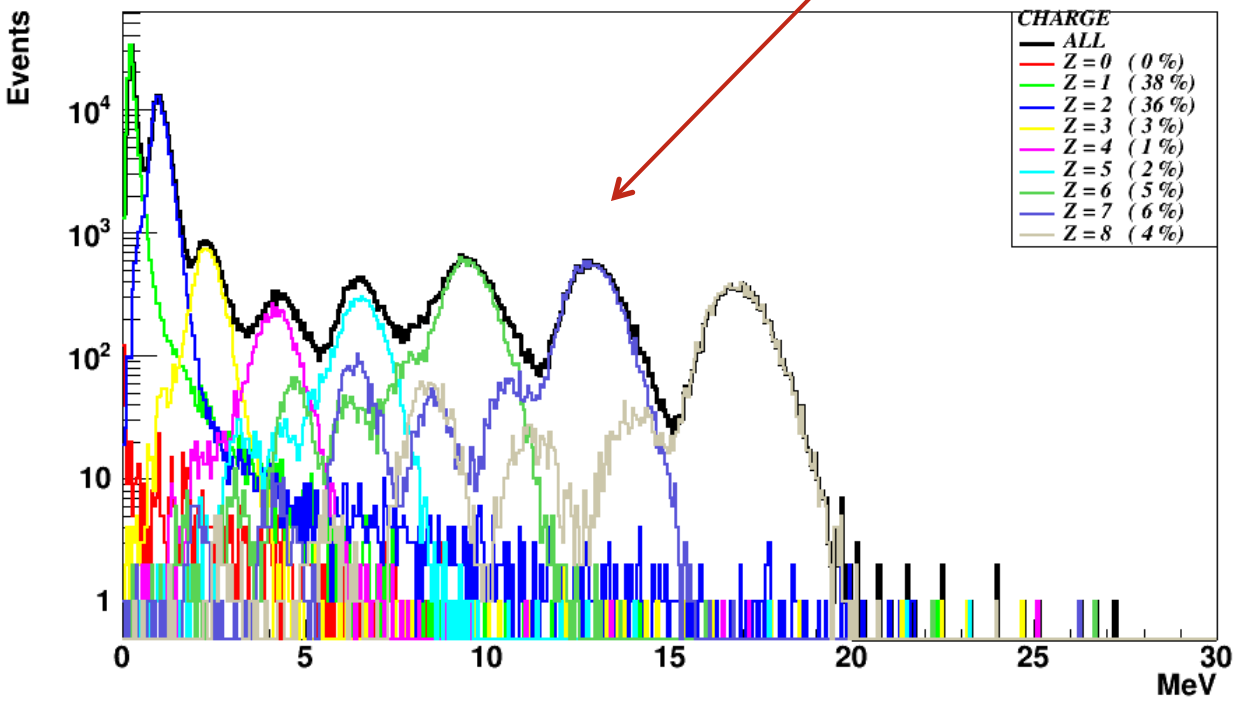
  A first snapshot to evaluate the new setup. Probably more statistics is necessary. It can be produced shortly after an OK from the first checks

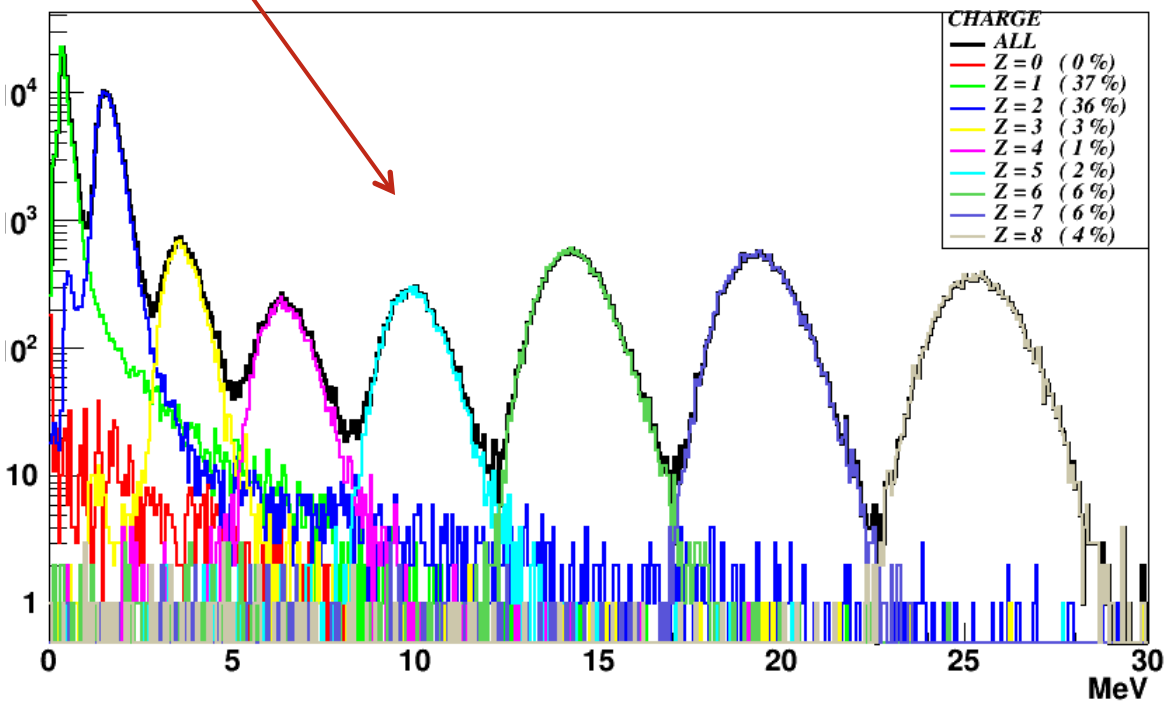
To be tested urgently

- Possible worsening due to the more realistic Plume structure
- Fragmentation probability
- **Momentum resolution:** how much the reduced magnetic length contributes?
- From Bologna Meeting: 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 dimension
  - Thickness of Scintillator *(typical exsercise to be carried on with ad-hoc simulation)*

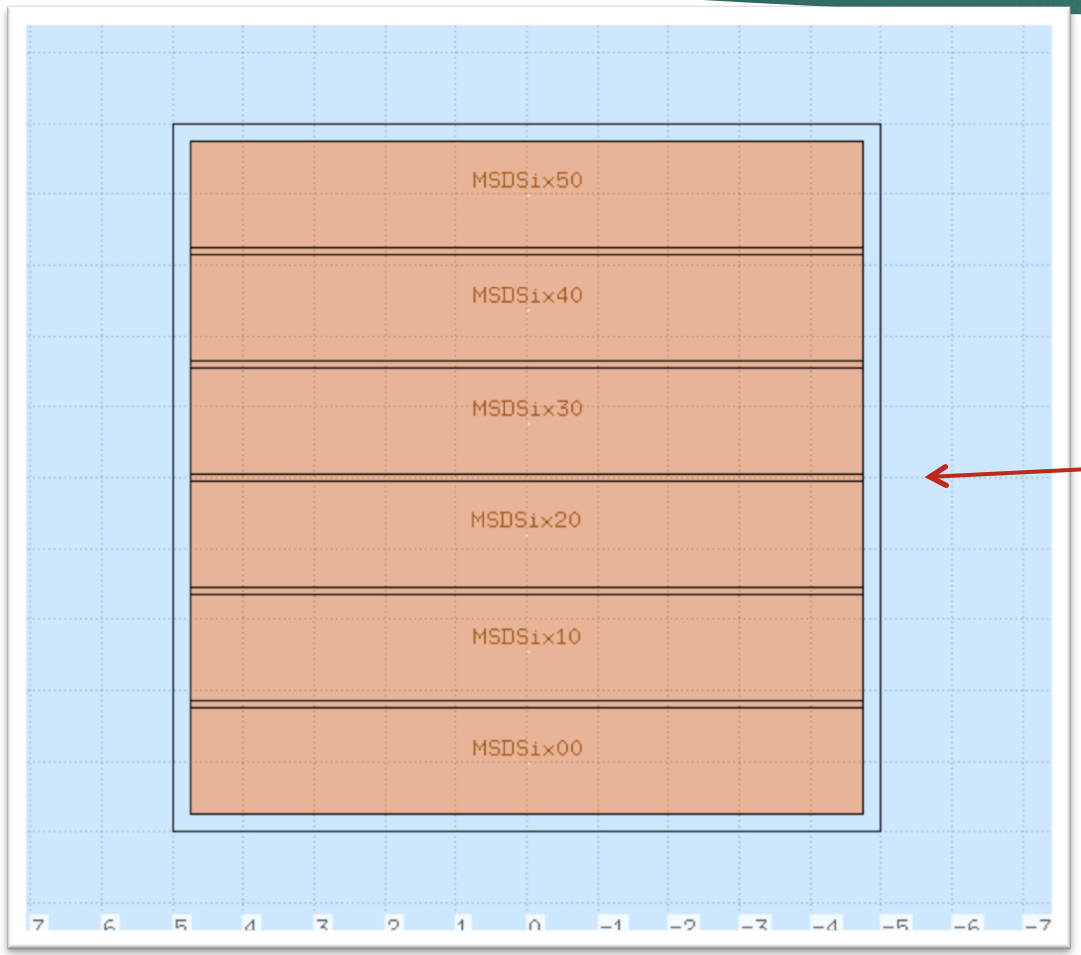
A first remark from a preliminary comparison between the two different MSD setup (V13.0.x vs V13.1.x)

R. Spighi





Very probable explanation

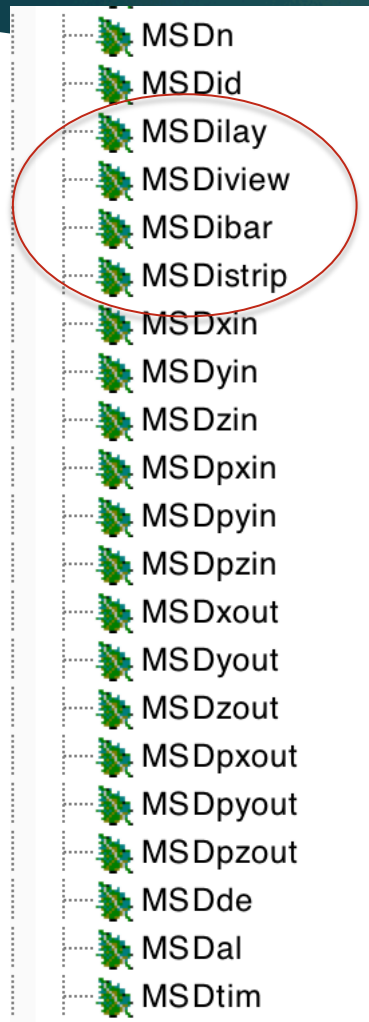


A naivety:
Perfect alignment of central dead region

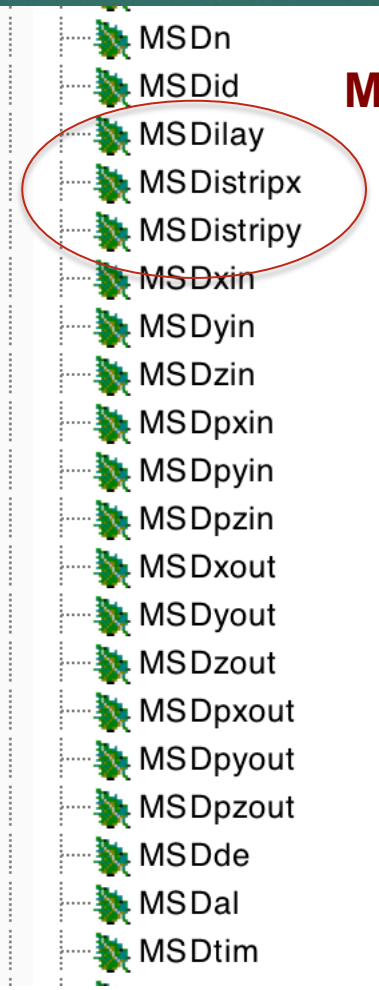
Again from Bologna Meeting

- 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

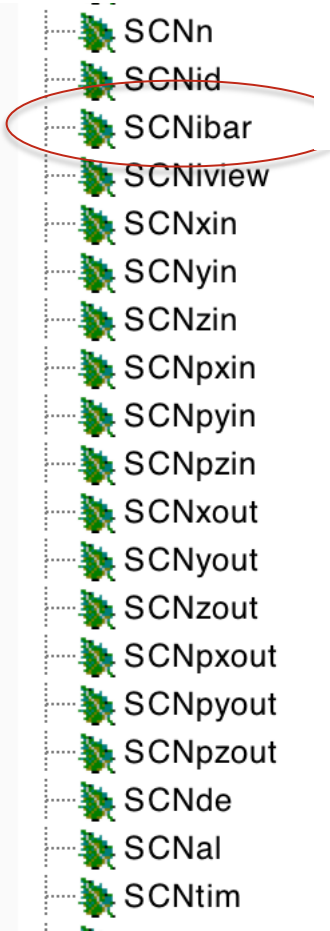
Root Technicalities: variable names



MSD in V13.0.x

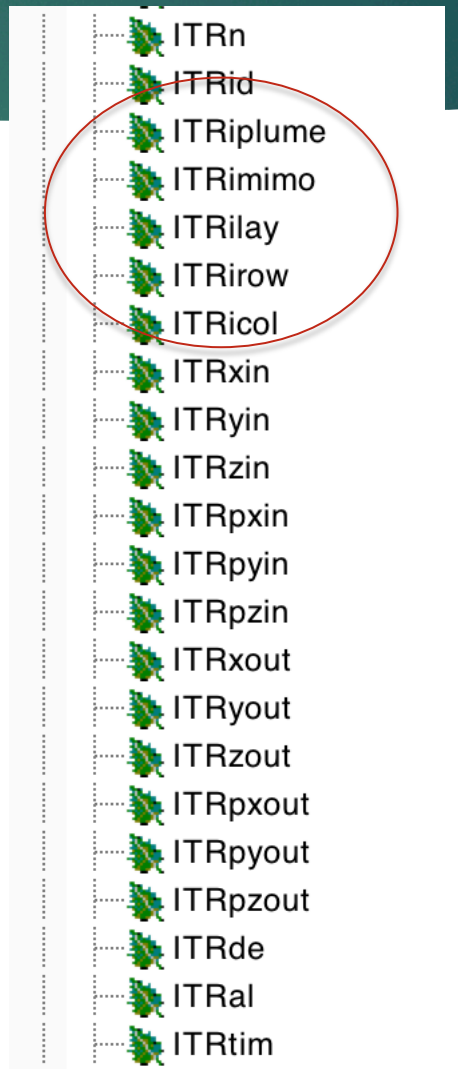


MSD in V13.1.x



Notice the change in name

Root Technicalities: variable names



ITR (Plume)

Take Home Message

- A lot of different configurations to prepare and test.
- Which are the most urgent priorities? *(in my mind the 1st is P resolution)*
- We need manpower, mostly to analyze simulated data for the moment, and enlarge the team, working in a coordinated way...

  Now!

Thank you