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FULL SIMULATION OF IDEA MUON SYSTEM

R&D-FCC Meeting, 22 March 2024.

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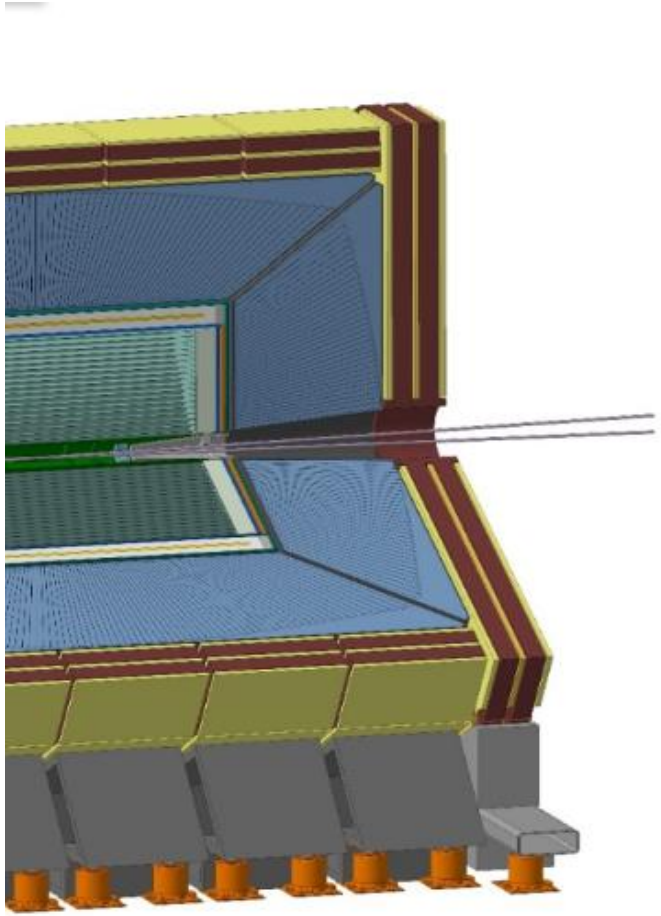
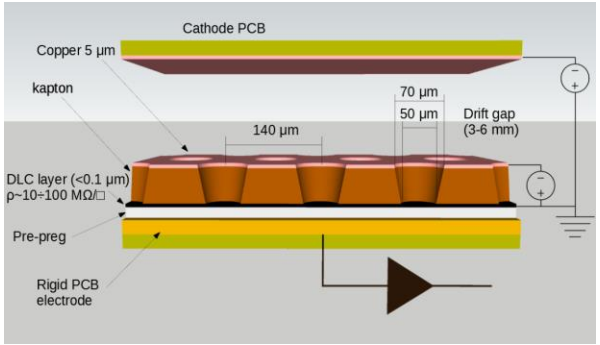
FUTURE
CIRCULAR
COLLIDER

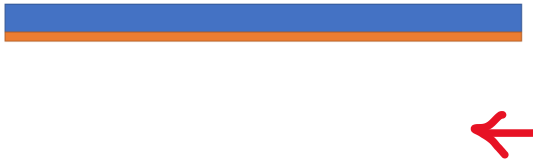


IMPLEMENTATION OF MICRORWELL MATERIAL

A complete description of the materials of the μRWELL and the geometry of the system has been done.

Component	Thickness of each layer	Material
	1.6 mm	FR_4
Cathode	35 μm	Copper
Gas gap	6 mm	$ArCO_2CF_4$
	5 μm	Copper
	50 μm	Kapton
	0.1 μm	DLC
μ-RWELL + readout PCB	35 μm	Copper
	100 μm	Film glue (same DLC density)
	35 μm	Copper
	1.6 mm	FR_4



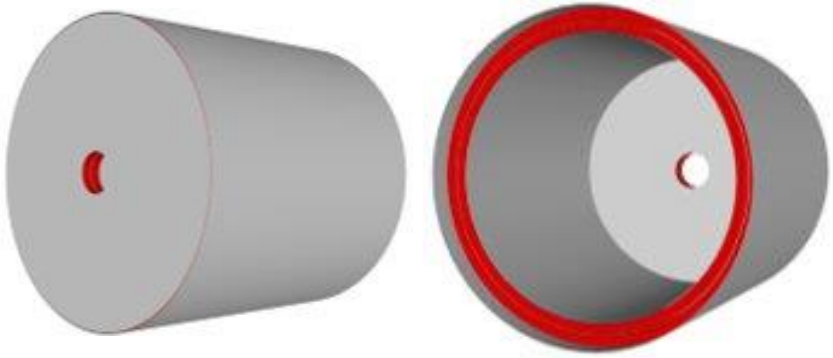


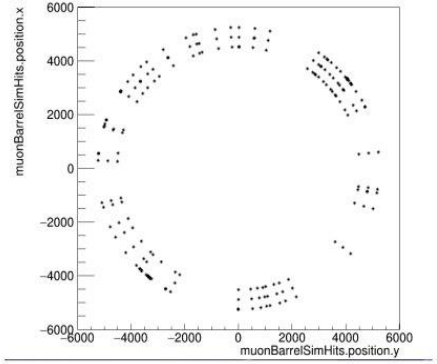
The sensitive area

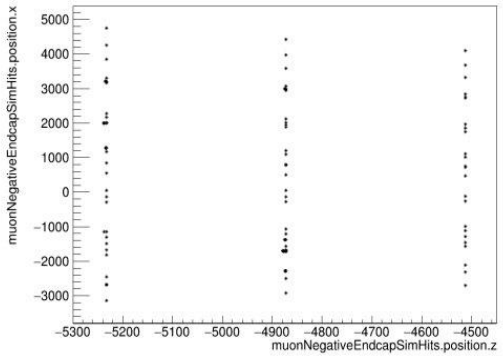
A schematic view of the various layers involved in the description of the μ-RWELL detector

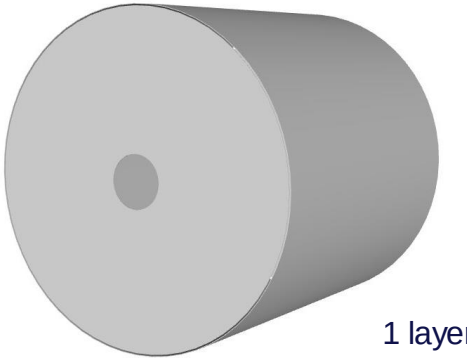
SIMPLE CYLINDRICAL SHAPED

- A complete description of the muon system as a simple cylindrical shape has been done.
- A readout system has been implemented for the cylindrical shape, with a segmentation in φ and θ direction to match the foreseen strip pitch.
- A complete description of the Preshower as a simple cylindrical shape has been done.









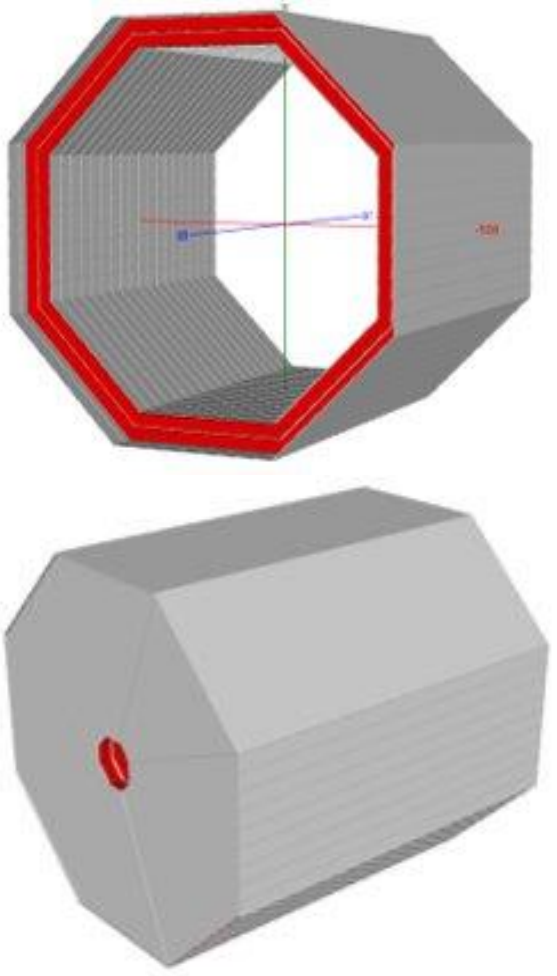
Pre-shower

1 layer of μRWELL

Left: SimHits from the barrel muon system. **Right:** SimHits from one of the endcap muon system.

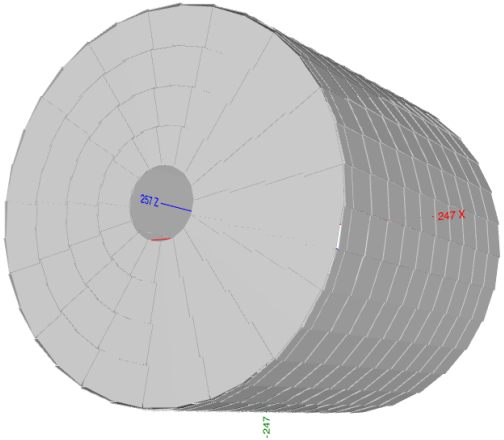
FULL MUON SYSTEM GEOMETRY

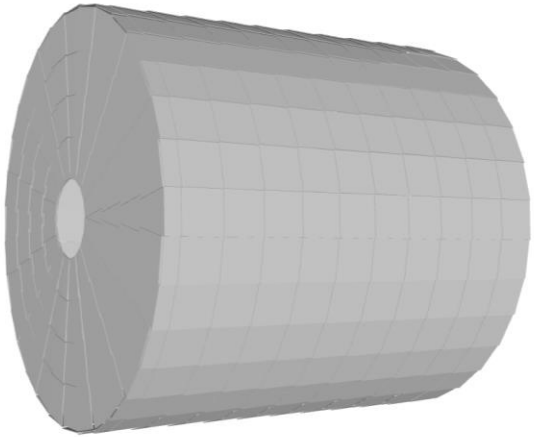
- A first draft of the **detailed version of the muon system** geometry implementation is ready.
- Building the muon system based on 50 × 50 cm2 µRWELL chambers.
- Taking into account the overlap between the chambers in 2 dimensions (to minimize the dead area as much as possible).
- The design flexible, where the user can choose the number of sides of the shape (hexagon, octagon, ….), and automatically the builder will calculate the number and places of the copied chambers.



FULL PRE-SHOWER DETAILED GEOMETRY

- The pre-shower can be built by the same muon system builder.
- The shape is almost circle (~32 sides of width 50 cm "the mRWELL side length").
- I think the barrel is OK? but in Endcap has many chamber with unusual dimensions.

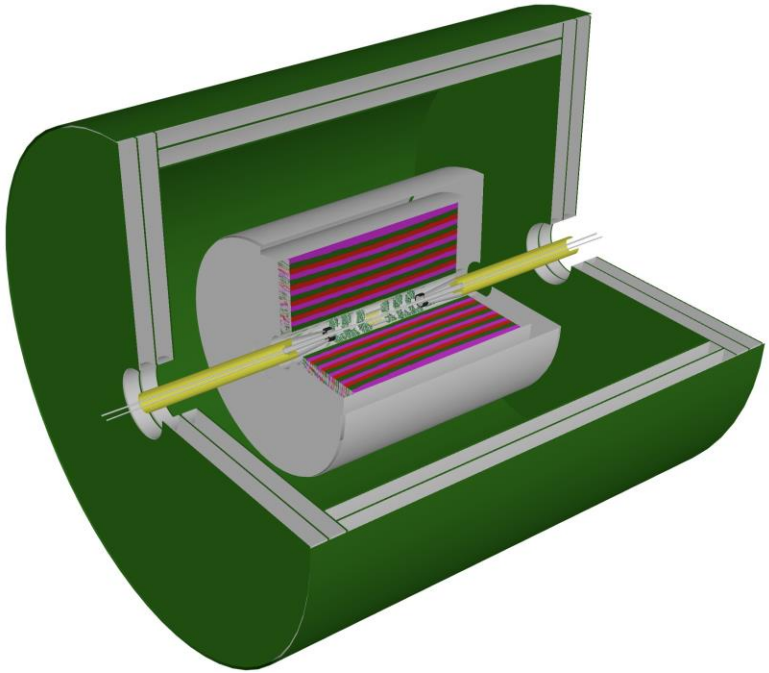




Pre-shower simulation has been assigned to another colleage from Torino.

FULL IDEA DD4HEP IMPLEMENTATION

- The simple Muon System and Pre-shower have been included in the full IDEA DD4hep implementation.
- I have opened a PR to include the detailed version too.
- DR Calorimeter is still missed. But a simple version will be implemented soon, so we can do the **multiple scaterring study.**
- The full implementation now is available on **k4geo**



From Brieuc talk at Annecy

READOUT SYSTEM

- Description of the readout is made for every single layer represents the system.
- Chamber represents the 50 * 50 cm2 the µRWELL chamber.
- The sensitive layer is the gas layer, where I divided it into 2D grid depending on 1.4 mm strip pitch.

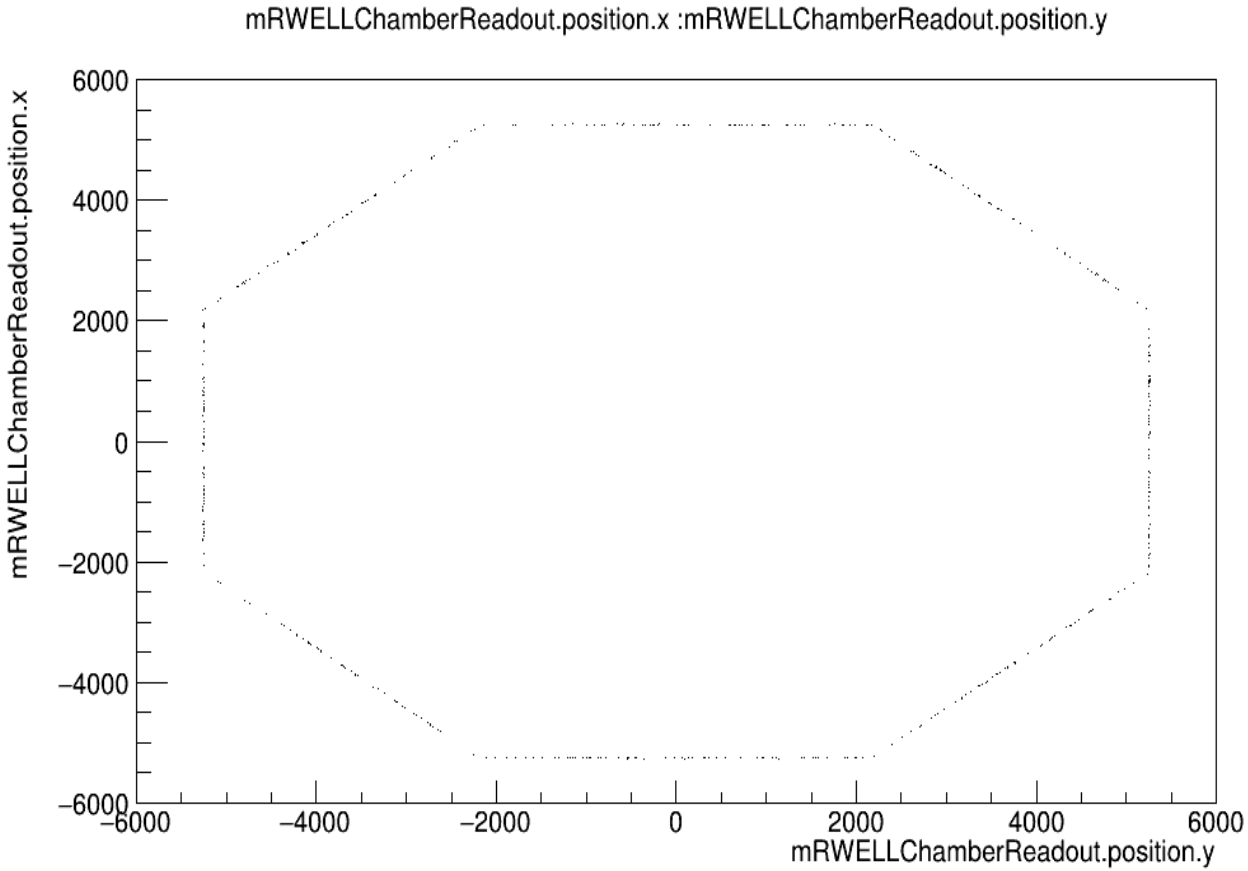
```
<readout name="mRWELLChamberReadout1">
  <segmentation type="CartesianGridXY" grid_size_x="1.4*mm" grid_size_y="1.4*mm"/>
  <id>system:3,chamber:14,gasLayer:1,x:9,y:-9</id>
</readout>
```

Numbers here represents the bit field, where the date to be saved.

Every readout system has a maximum 64 bits.

READOUT SYSTEM

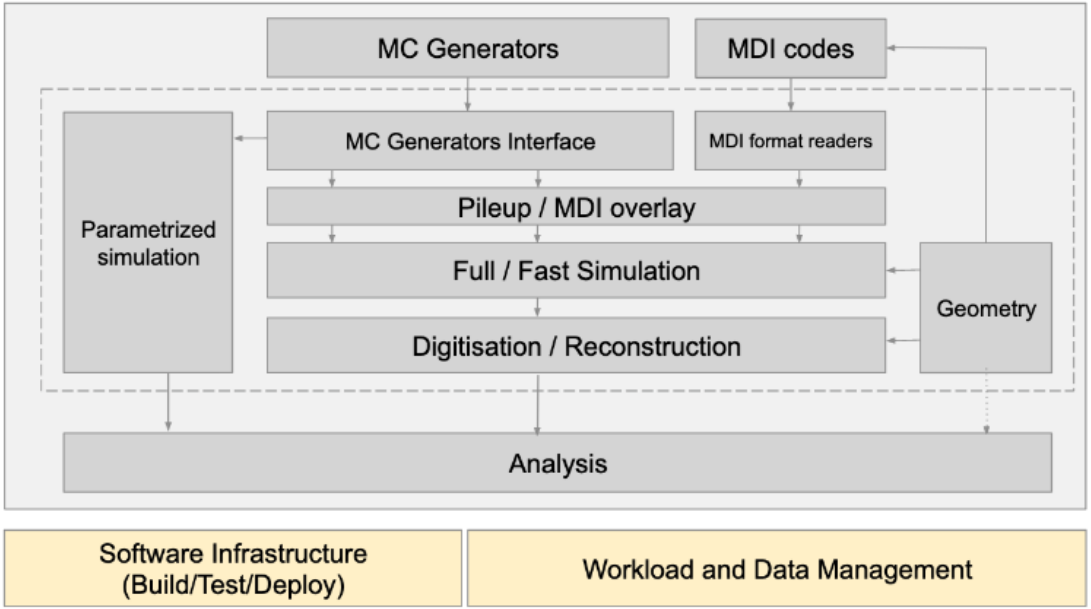
- Example of readout hits from the first barrel layer.
- 1000 events simulated



DIGITIZATION (ONGOING):

In order to convert the **SimHits** into **DigiHits**, some parameters have been implemented from the μRWELL test beam results:

- μRWELL efficiency: ~ 95%.
- μRWELL pre-shower candidate space resolution: ~ 100 μm.
- μRWELL muon system candidate space resolution: ~ 400 μm.



All can be connected by **Gaudi**

DIGITIZATION (ONGOING):

- A first draft of k4RecTracker has been built for the MUON digitizer.
- It can be called in a **Gaudi** algorithm with the name **MUONsimpleDigitizer**

```
# Digitize tracker hits
from Configurables import MUONsimpleDigitizer
muon_digitizer = MUONsimpleDigitizer("MUONsimpleDigitizer",
    inputSimHits = saveMuonBarrelTool.SimTrackHits.Path,
    outputDigiHits = saveMuonBarrelTool.SimTrackHits.Path.replace("sim", "digi"),
    readoutName = "MuonChamberBarrelReadout",
    xResolution = 0.4, # mm
    yResolution = 0.4, # mm
    OutputLevel=INFO
)
```

- μRWELL muon system candidate space resolution: ~ 400 μm.
- μRWELL pre-shower candidate space resolution: ~ 100 μm.
- An efficiency parameter to be added.