A First Look into Experimental Areas

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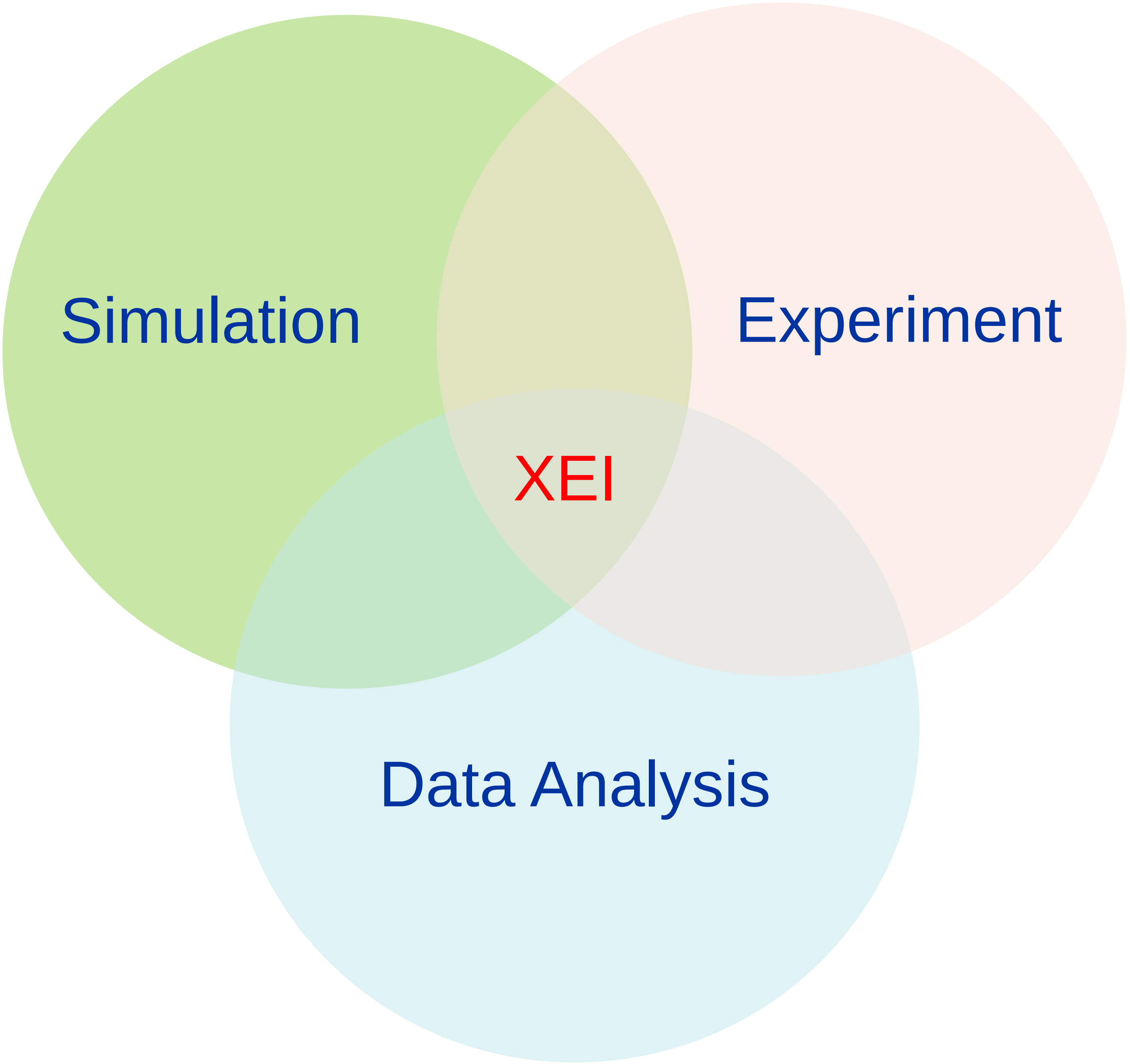
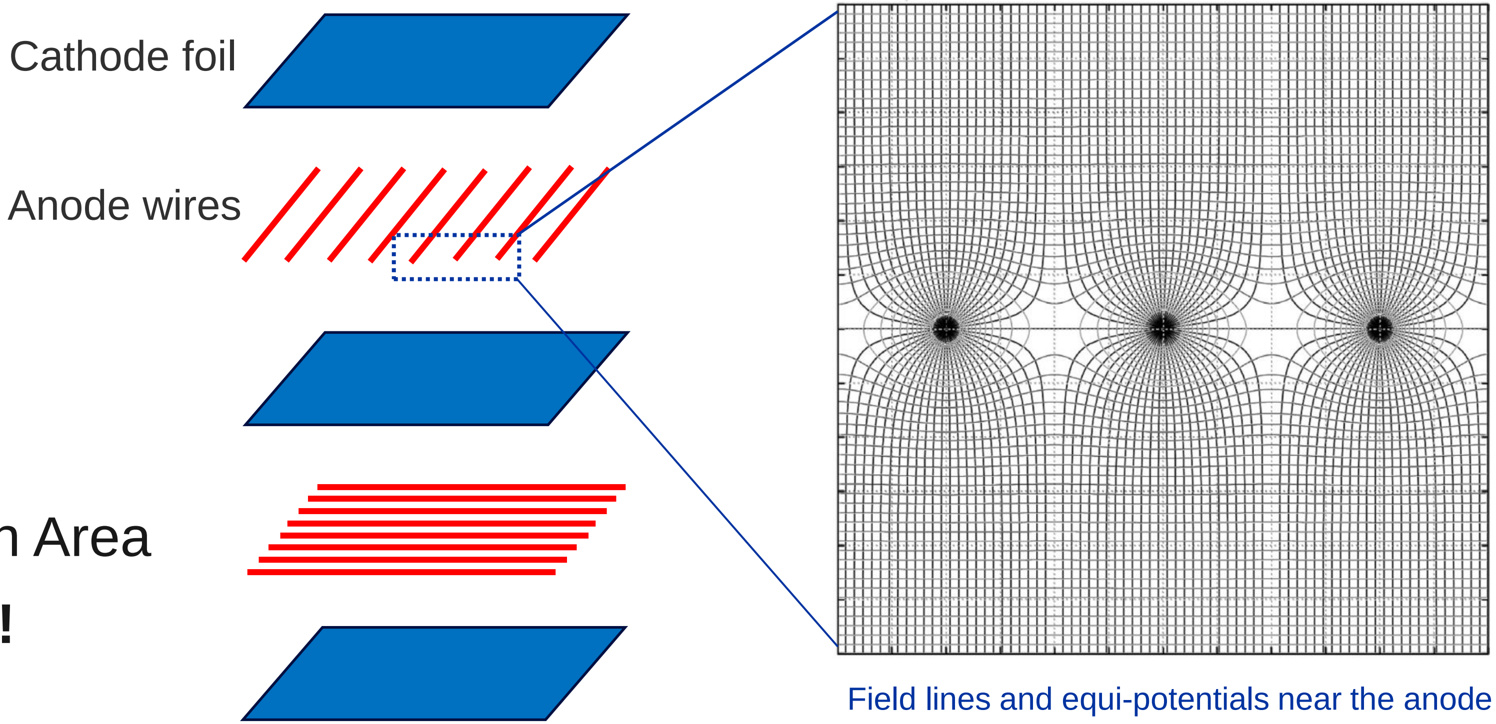
06 September 2024


Simulation
Experiment
XEI
Data Analysis

1. Multi-Wire Proportional Chamber (MWPC)

Overview of MWPC



Field lines and equi-potentials near the anode wires in the MWPC. (Fabio Sauli, 2015)

Issues:

- Lost expertise
- # of spares critical
- Only beam profile monitor in North Area

→ **Need to build new chambers!**

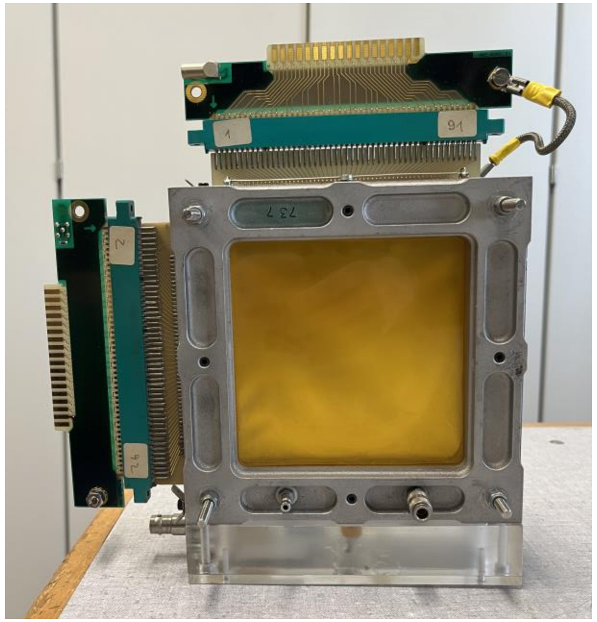
Status Quo

- Old MWPC design is complex and difficult to replicate (stack of planes screwed together with gas holes in between)

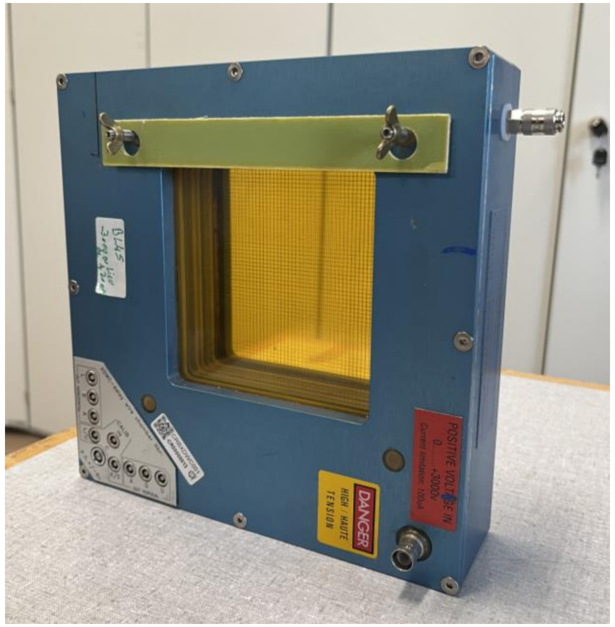
- Delay Wire Chamber has a newer and simpler design: **fully encased with wires for cathodes**

- **Foils vs. Wires**

Simplify design + Cut material budget



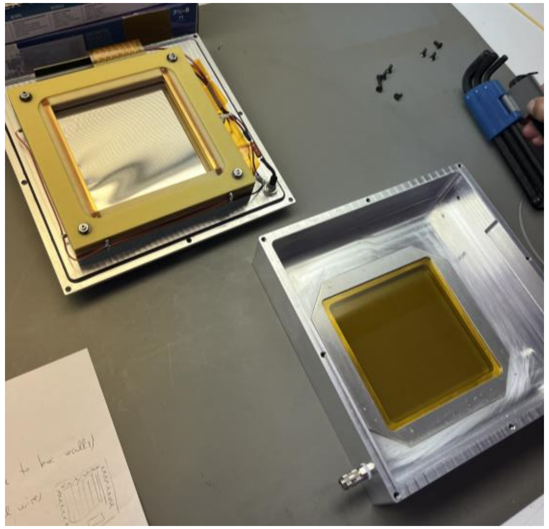
MWPC from 1970s

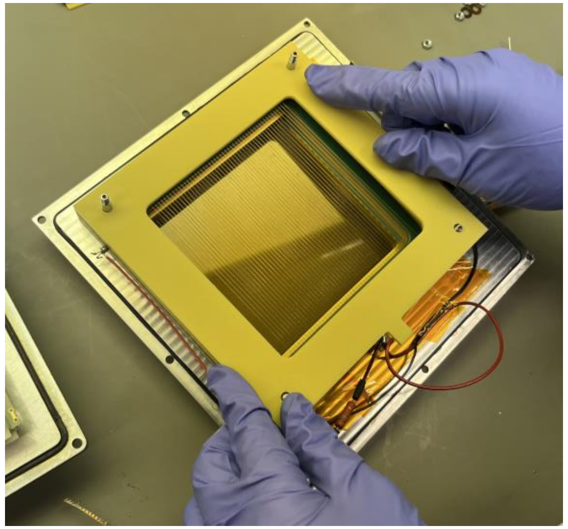


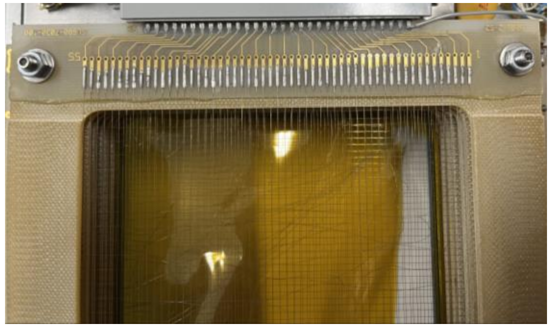
DWC from 1990s

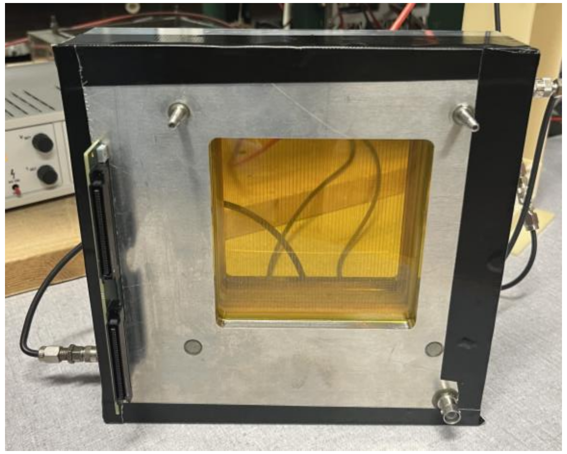
Prototype

- New case – gas-tight
- New wire planes (wires for cathodes).
- New interface – take signals out of the case through a specialized PCB
- Collaboration between SY-BI, BE-EA and EP-DT
- **Simulation is necessary to fully understand the physics of signal formation**





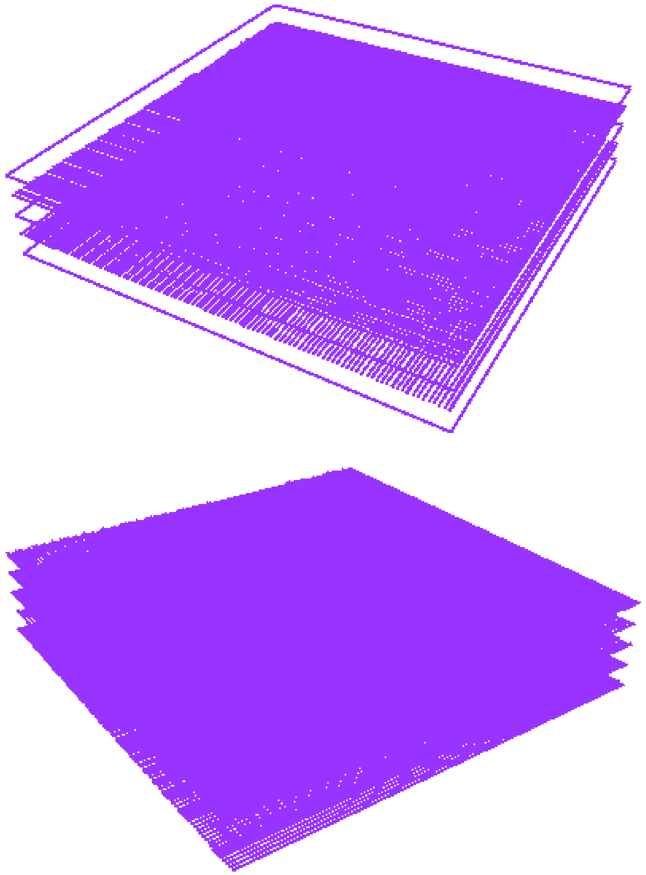




MWPC prototype with wire cathodes

Simulation of MWPCs

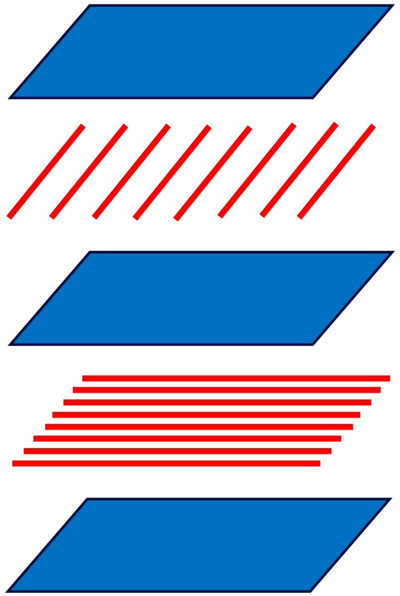
Simulation software:	Garfield++, ROOT
Libraries:	Magboltz, neBEM, Heed, RKF integration
Gas type:	Ar (50%) and CO2 (50%)
Temperature:	298.15 K
Pressure:	1.1 bar
Active area:	10 cm x 10 cm
Plane Spacing	5 mm
# of wires in each layer	100
Cathode voltage:	- 4000 V
Anode voltage:	0 V
Particle:	Cosmic muon (170 GeV)



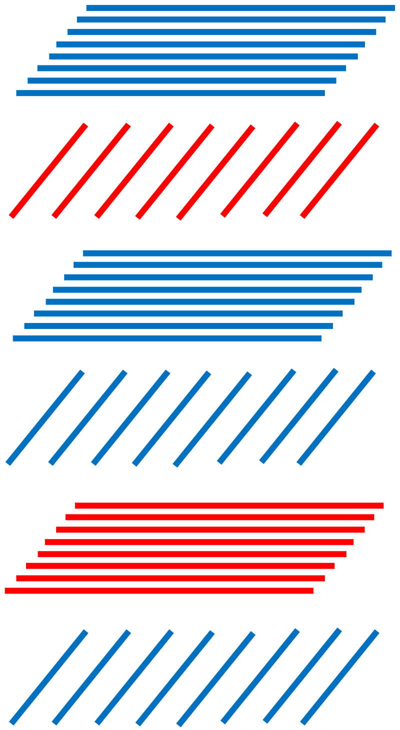
Example geometries of MWPC generated in Garfield++

Configurations to Simulate

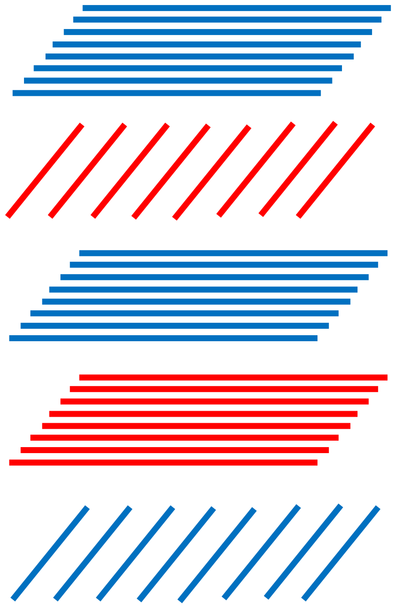
Config 1:
- 1970s
- 5 layers
- Foil cathodes



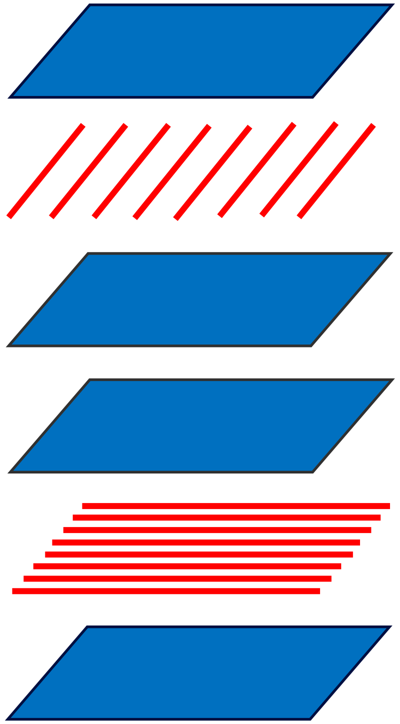
Config 2:
- 1990s
- 6 layers
- Wire cathodes



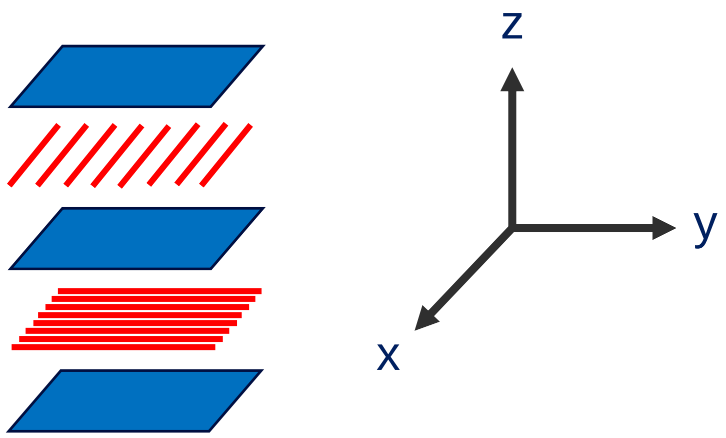
Config 3: New
- 5 layers
- Wire cathodes
- **Mounted, didn’t work**



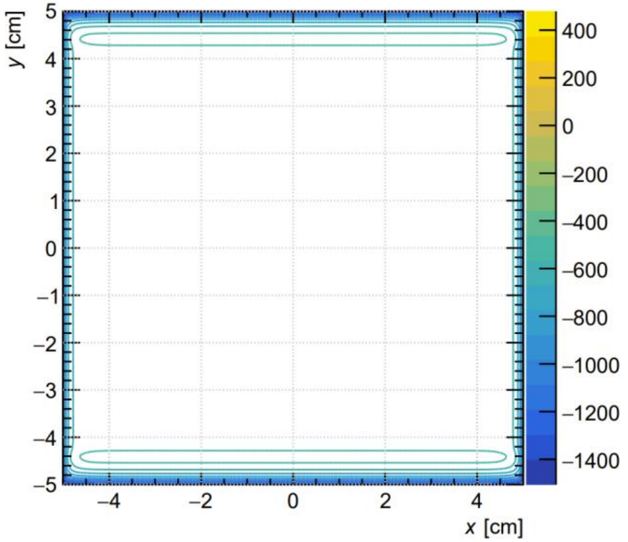
Config 4: New
- 6 layers
- Foil cathodes
- **Mounted, worked**



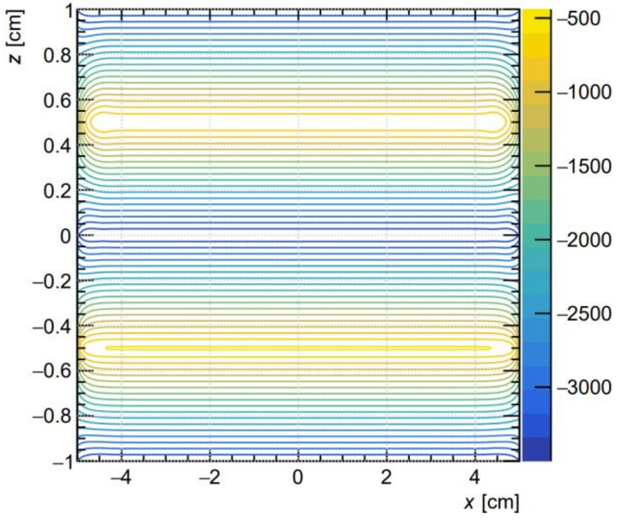
Visualisation of Electric Potential



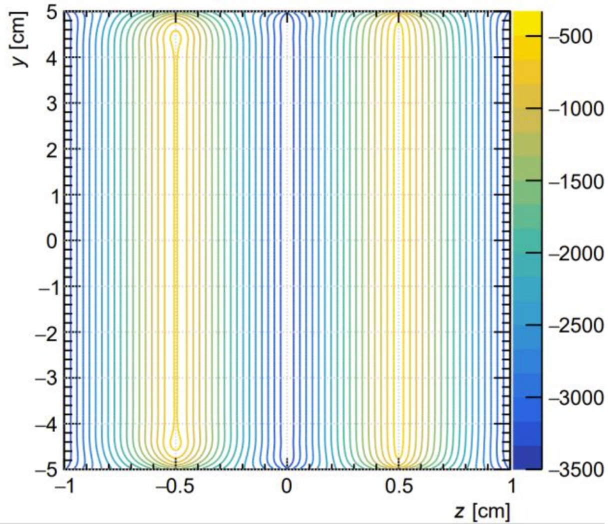
E.g. Config 1



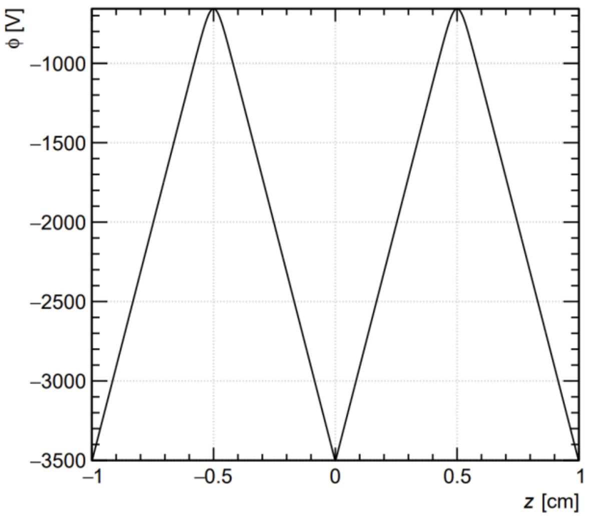
Potential contour in the x-y plane.



Potential contour in the x-z plane.



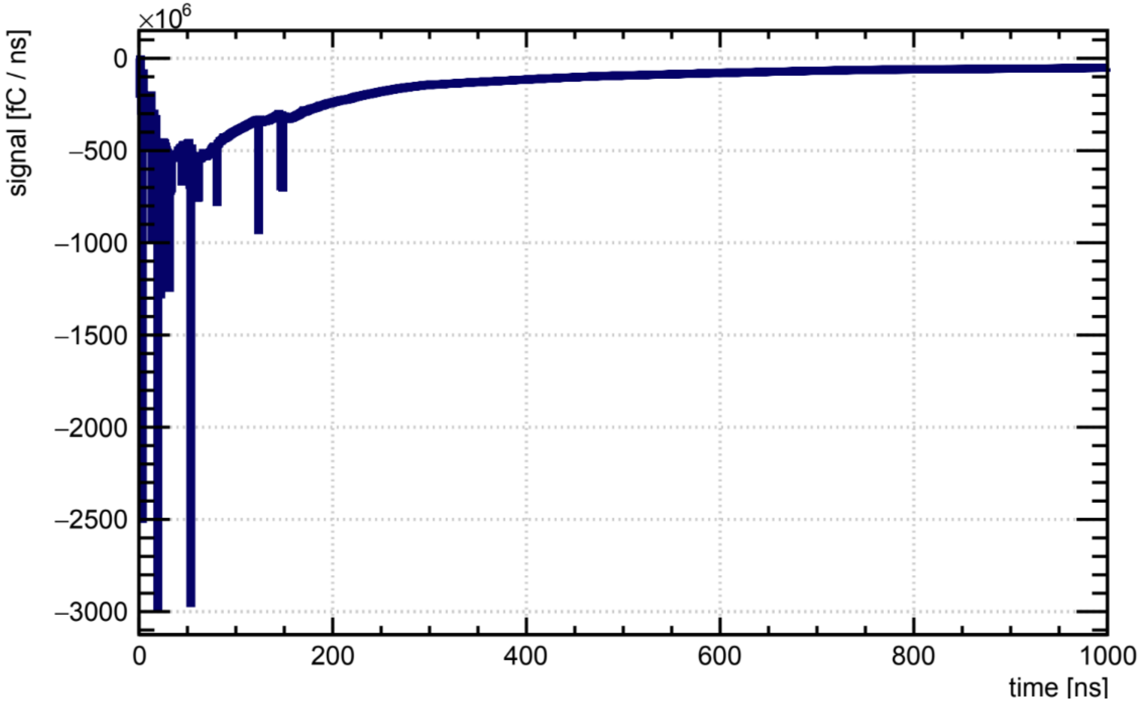
Potential contour in the y-z plane.



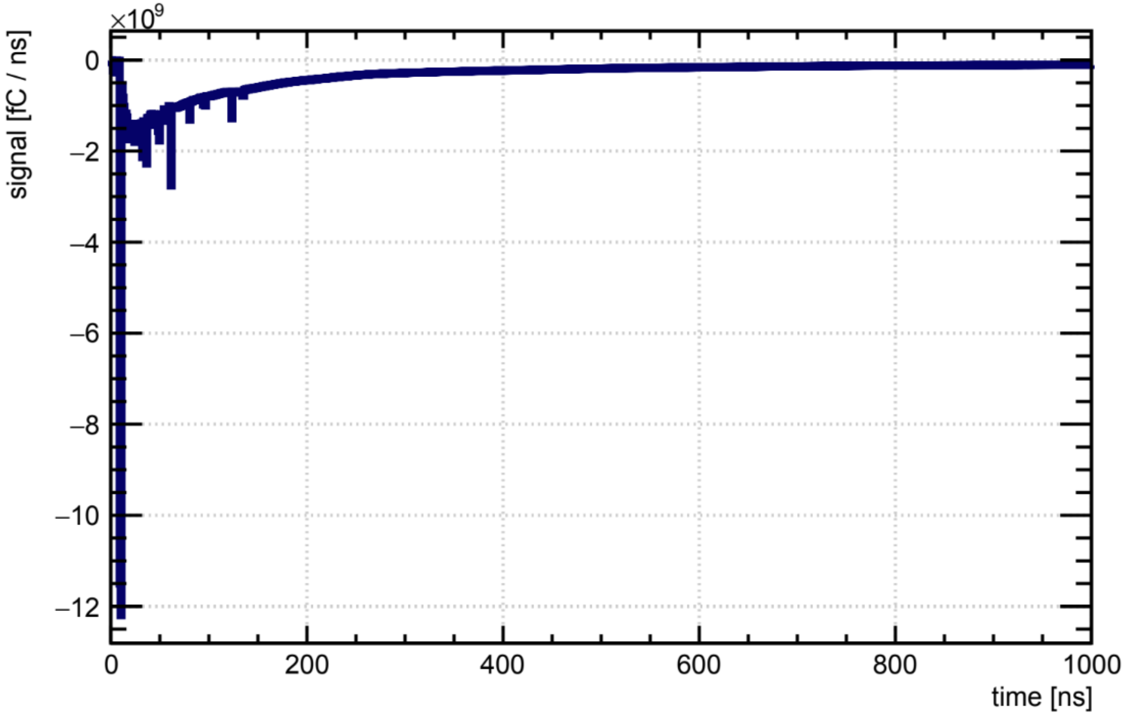
Potential profile along the z axis.

Total Raw Signals – Config 1

First anode layer



Second anode layer



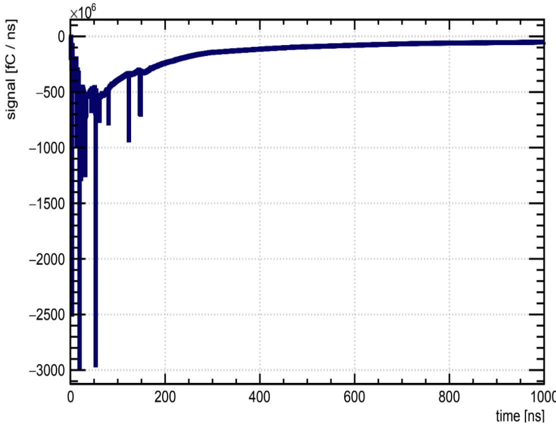
Comparison of Total Raw Signals

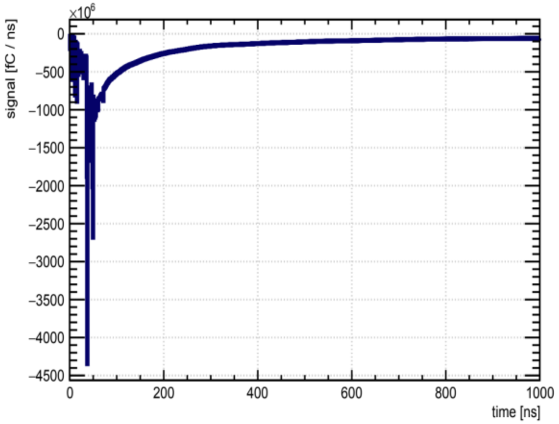
Config 1

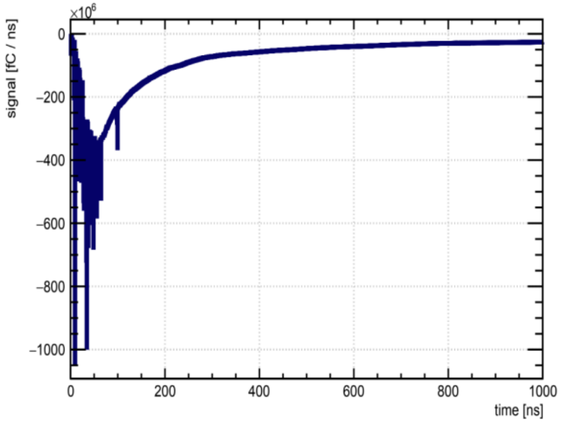
Config 2

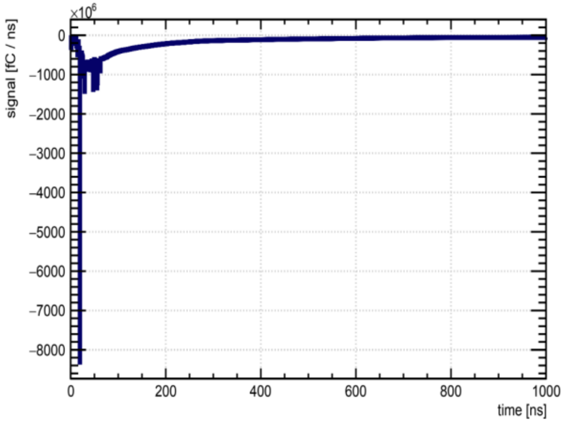
Config 3

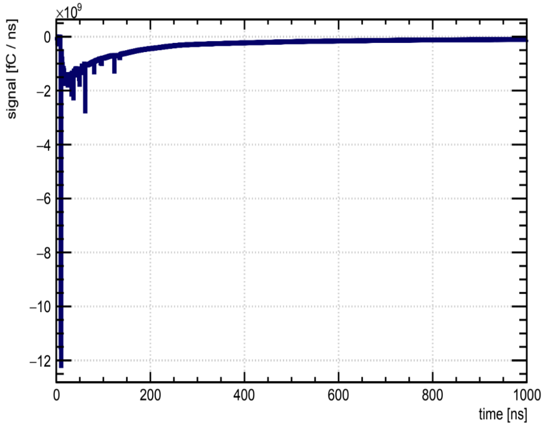
Config 4

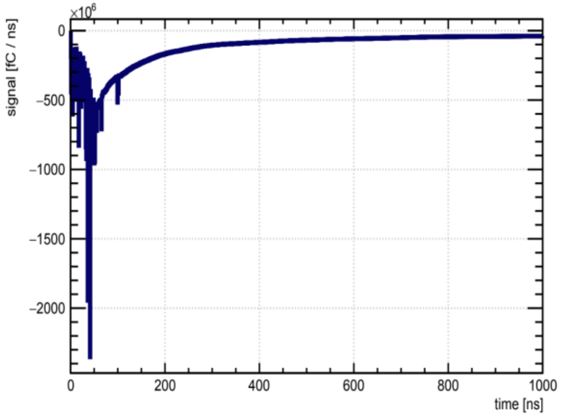


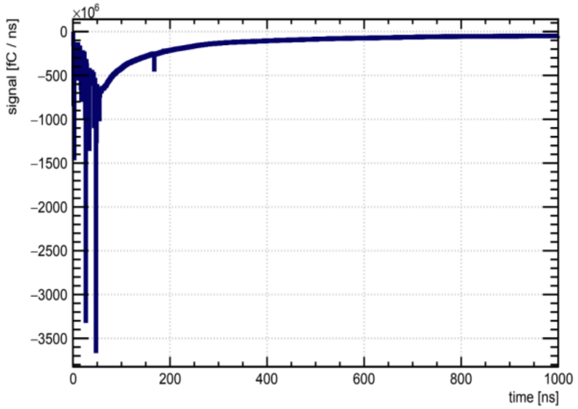


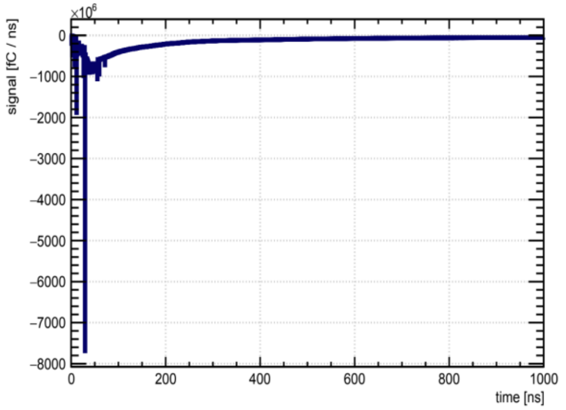












MWPC Simulation TODOs:

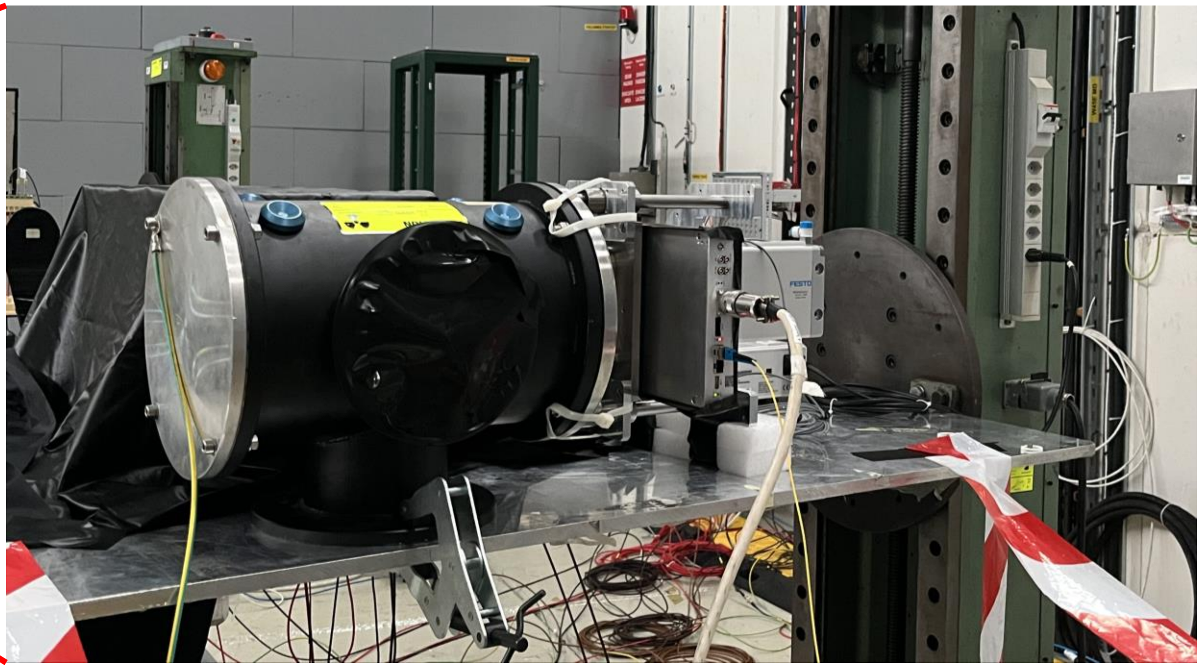
- Replace neBEM with analytical potential functions. → **Improve accuracy and run-time.**
- **Simulate many incident particles.**
- Apply the transfer function of read-out electronics. → **Simulate smooth output signals.**
- Visualize induced signals from individual anode wires. → **Compare position tracking capabilities.**

2. Characterisation of XBPF in a Beamline

East Area

Installation and alignment of detectors with beamline.

Configuration of beamline seen from upstream.

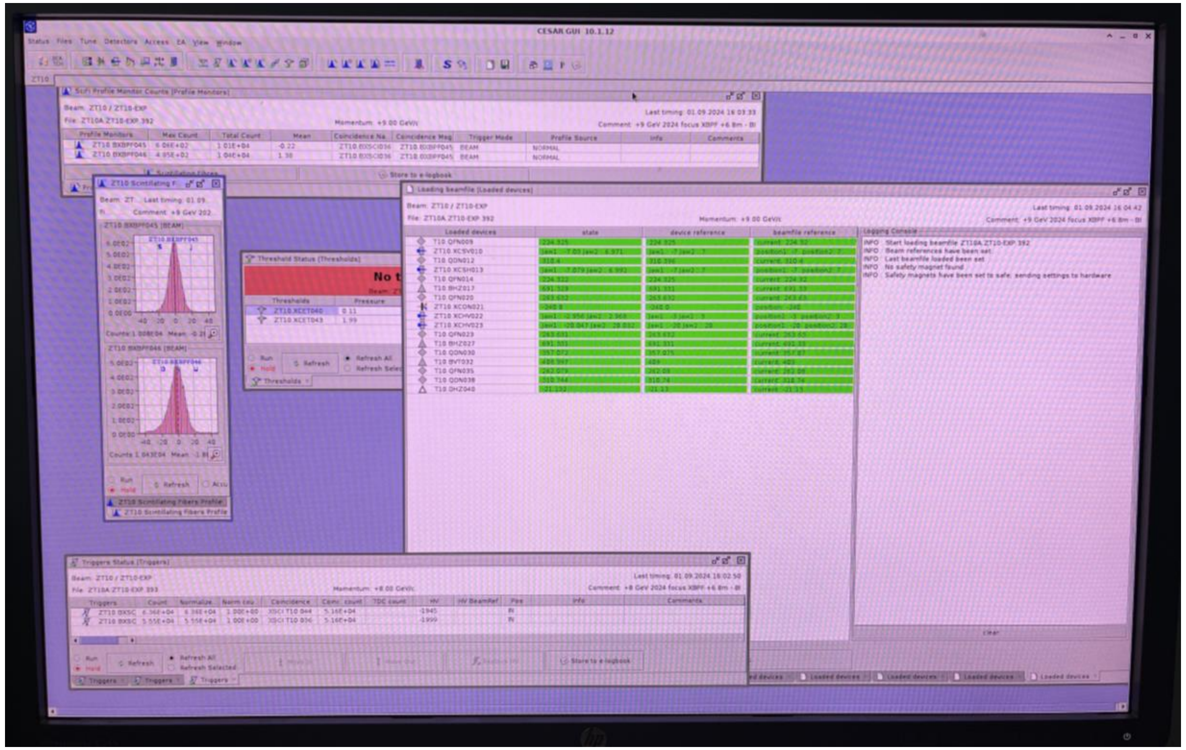


XBPF mounted on a DESY table.

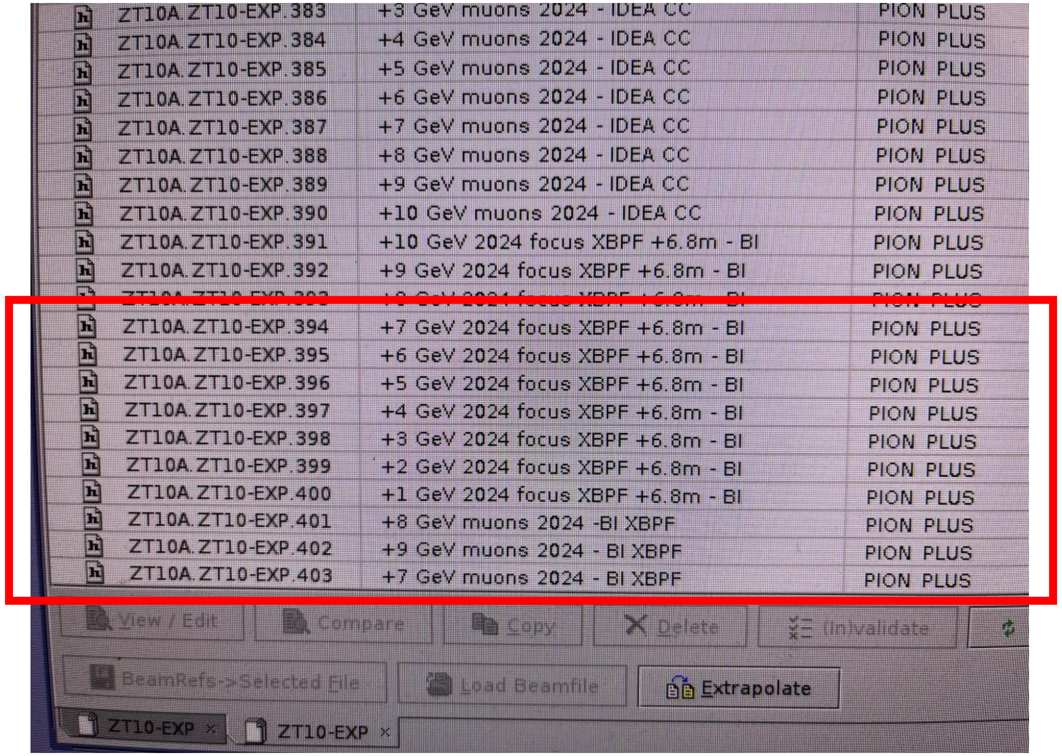
2. Characterisation of XBPF in a Beamline

Beam control with CESAR GUI.

- **East Area: Beam of π^+. Momentum +1 GeV/c to +10 GeV/c.**



Loading beam file. Green of success.

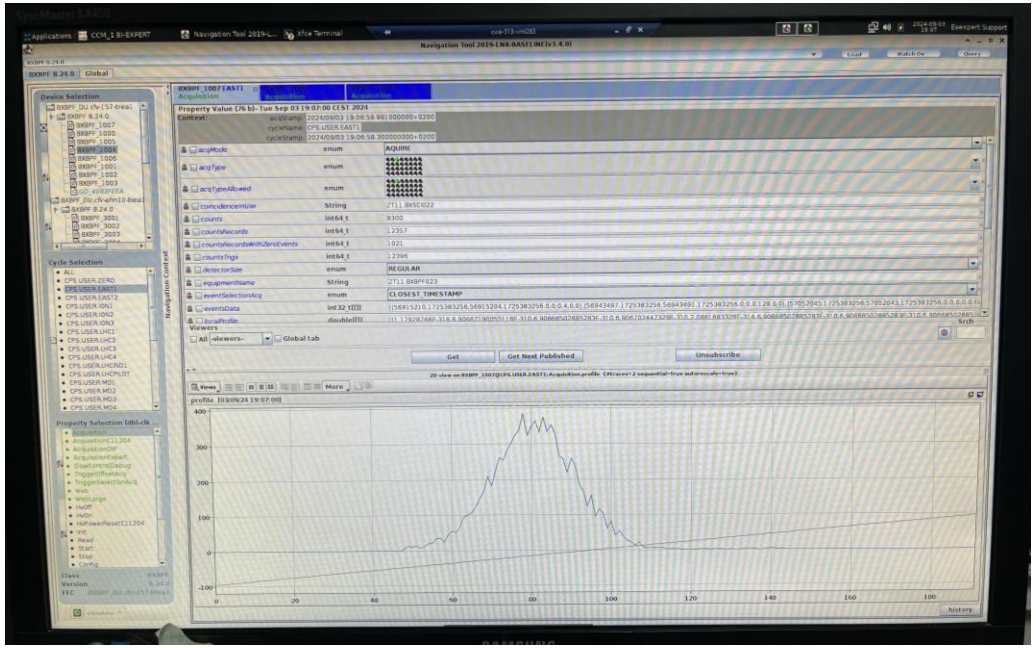


List of beam files used.

2. Characterisation of XBPF in a Beamline

Data collection with the FESA Navigator.

- Collect data for the prototype XBPF and the vertical + horizontal beam XBPFs (references).
- Conducted homogeneity test on the prototype using a 3 GeV pion plus beam.



FESA Navigator interface. Data is collected every spill.

Summary

- Simulated four designs of MWPCs and compared their raw signal outputs.
- Assisted with the installation of the XBPF in the T10 East Area. Installation in H8 North Area is ongoing.
- Learned to operate beamlines using the CESAR GUI and collected data using the FESA Navigator.

TODOs:

- Improve MWPC simulation.
- Compare MWPC simulations against real MWPC signals from a source (e.g. Sr-90).
- Test the XBPF prototype in the North Area – ongoing.
- Analyze the XBPF data – ongoing.
    - Reconstruct profile, check for stability and homogeneity.
    - Check for cross-talk and multiplicity – determine if neighbouring fibres are activated.

Thank you!