GEM Detector Mapping for MuCh (2nd Station) – CBM Experiment at FAIR

GEM Module Dimensions and Readout Plane

The GEM module used for the 2nd station of the Muon Chamber (MuCh) in the CBM experiment at FAIR has the following dimensions:

- **Length:** 110 cm
- **Width:** 40 cm

The readout plane of this GEM module is divided into **19 columns** (numbered 0 to 18) and **96 rows** (numbered 0 to 95). This division leads to a total of **1824 readout pads**, arranged in a trapezoidal shape. The size of the readout pads varies across the module: there is **high granularity** at the narrower region of the module and **lower granularity** at the broader region. This means that the readout pads are **smaller** at the narrower side and **larger** at the broader side.

FEBs and Connector Pins

To enable data acquisition (DAQ) and analysis, each of these 1824 readout pads is connected to a **Front-End Board (FEB)**. Each FEB has **128 connector pins**, and to cover all the readout pads for this GEM module, **15 FEBs** are required.

- **Total connector pins:** 128 pins/FEB $\times$ 15 FEBs = **1920 connector pins**

Thus, there are **1920 connector pins** available, but since the GEM module has only **1824 readout pads**, there are **96 connector pins** that remain unconnected to any readout pad.

Pulser Injection and Unconnected Pads

Out of the 1824 readout pads connected to a connector pin on the FEB, **7 pads are intentionally left empty**. These 7 empty pads are designated for **pulser injection**, ensuring the proper functioning and calibration of the system.

MuChChanCount Assignment

Each of the 1824 connected readout pads is assigned a unique number called **MuChChanCount**, (MuChChanCount stands for MuCh Channel Count). The assignment is as follows:

- **FEB 1** has 128 connector pins. The readout pads connected to these pins are assigned **MuChChanCount** values from **1 to 128**.
- For each subsequent FEB (FEB 2 to FEB 15), the readout pads are similarly assigned MuChChanCount values, continuing from the previous FEB.

For instance:

- **FEB 1**: MuChChanCount = 1 to 128
- **FEB 2**: MuChChanCount = 129 to 256
- and so on, until **FEB 15**, which will cover MuChChanCount = 1793 to 1920.

This mapping ensures a clear and systematic connection between the readout pads and the FEBs, enabling efficient data collection and analysis.

GEM Segment Distribution Visualization

The distribution of segments in the GEM module is visually represented using realistic XY coordinates. The image below shows how the segments are arranged, with different regions of the GEM module color-coded to indicate their corresponding MuChChanCount.

This image illustrates the trapezoidal shape of the GEM module and how the readout pads are assigned different MuChChanCount values across the module, with the varying pad sizes depending on the position along the module's length.

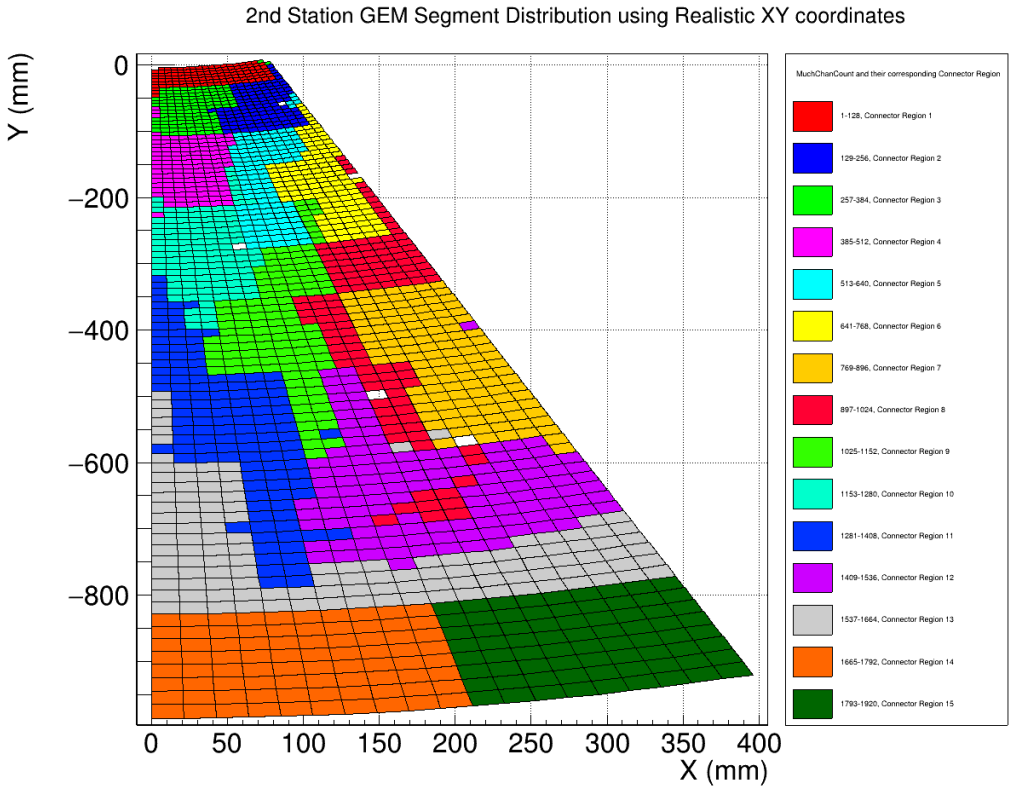

Figure 1: 2nd Station GEM Segment Distribution using Realistic XY coordinates. Each color corresponds to a unique MuChChanCount range.