

Measuring Gas Electron Multiplier (GEM) Characteristics

Aim of the Experiment:

1. To measure the I-V Characteristics of the 10 X 10 cm² GEM detector.
2. To plot the Energy Spectrum using Multi Channel Analyzer (MCA) by irradiating the detector with X-ray / radioactive source.

Experimental Setup

Once the triple-GEM chamber has been properly grounded we are ready to begin setting up the nuclear instrumentation modules (NIM) that will be used in the experiment. The specific instrumentation which will be used are:

- Pre-Amplifier
- Amplifier
- MCA Unit

Additionally, we require a power supply cable of supplying the requisite potential to the chamber with sufficient safety controls to protect the GEM-foils from internal discharges. Programmable high voltage (HV) power supplies manufactured by CAEN are ideal for this purpose due to their programmable trip protection.

Procedure:

To start the experiment, the detector must be kept on continuous flow of Argon & CO₂ gas mixture (Ar:CO₂ :: 70:30).

The charge sensitive preamplifier should be connected to the readout via the LEMO connection present on the chamber's HV circuit.

The programmable power supply should also be connected to the chamber's HV circuit via a red SHV cable and using HV Filter in between the Detector's HV Divider and the Power Supply.

The following procedure should be followed:

For I-V Measurement

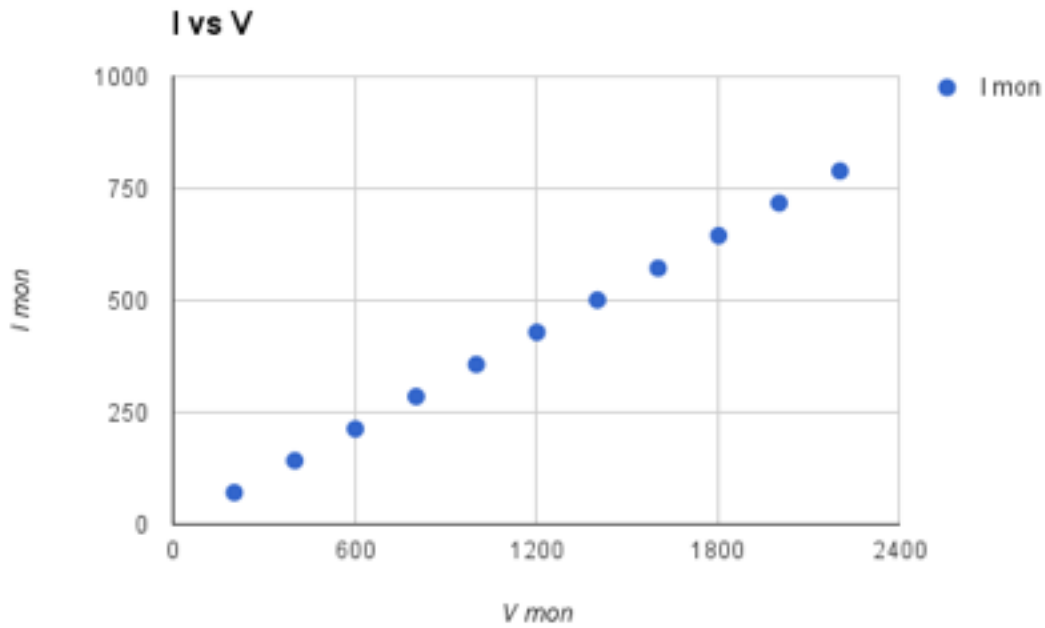
1. Connect the **ENERGY** output of the preamplifier to the **INPUT** of the Amplifier.
2. Send the **OUTPUT** from the amplifier to **CH1** of Oscilloscope to monitor the noise and obtain signal.
3. Connect the programmable power supply to the interfaced PC to ramp up the High Voltage and measure the corresponding Current values.
4. At each step measure the Resistance value from the previous reading of Current and Voltage to set the maximum current value corresponding to the next input Voltage.
5. Repeat Step 4 till a maximum voltage (~ 4kV) is attained at which you are able to see a signal (using X-ray / radioactive source) in the Oscilloscope.
6. Plot the I-V from the monitored values of Current and Voltage.

For Obtaining Spectrum using MCA

1. Connect the **ENERGY** output of the preamplifier to the **INPUT** of the Amplifier.
2. Use a splitter to send the **OUTPUT** from the amplifier **CH1** of the oscilloscope as well as the **SIGNAL INPUT** of the MCA.
3. Interface the MCA with a PC using **USB** and open the MCA program and configure its settings.
4. Without the source, press the **Start/Stop** button in the software to acquire pedestal data and record the channel number.
5. Change the **Low Level Discriminator (LLD)** value in the **MCA** tab of the **Acquisition Setup** menu to the channel you determined in the previous step.
6. Now place the X-ray / radioactive source. It will start irradiating the detector. Again press the **Start/Stop** button to acquire a quick spectrum to see the remaining pedestal counts.
7. Again change the **Low Level Discriminator** value in the **MCA** tab of the **Acquisition Setup** menu to remove the remaining pedestal counts.
8. Set the **Preset Real Time** value in the MCA settings so that the MCA will now acquire data for 5-10 minutes. Press the **Start/Stop** button to acquire a long spectrum.

Results:

1. One should obtain the following I-V:



2. The following MCA Spectrum shall be obtained (e.g. using X-ray source):

