

Experiments On Triple-GEM at SINP

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Activities

(RD-51, CMS-GEM, ILC-TPC Collaborations)

Experiment

- Characterization of MPGDs (Bulk/Microbulk-Micromegas, Triple-GEM)

Simulation

- Device-level simulation of MPGDs (Micromegas, MSGC, MHSP, GEM, Triple-GEM)

MPGD Laboratory at SINP, Kolkata

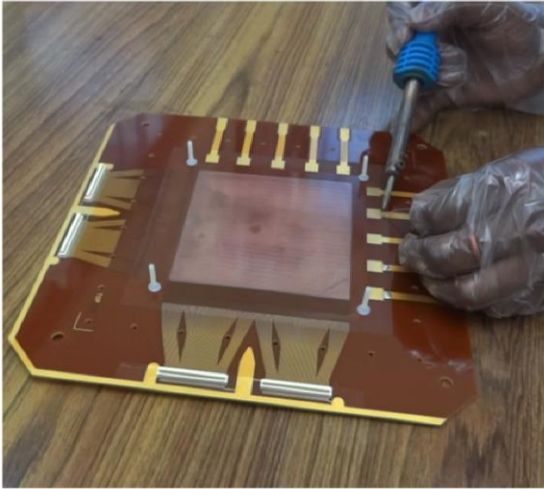


- Gas distribution system with 4-channel mixing-unit and moisture trap
- Electronics with single-parameter data acquisition system
- Fe55 source

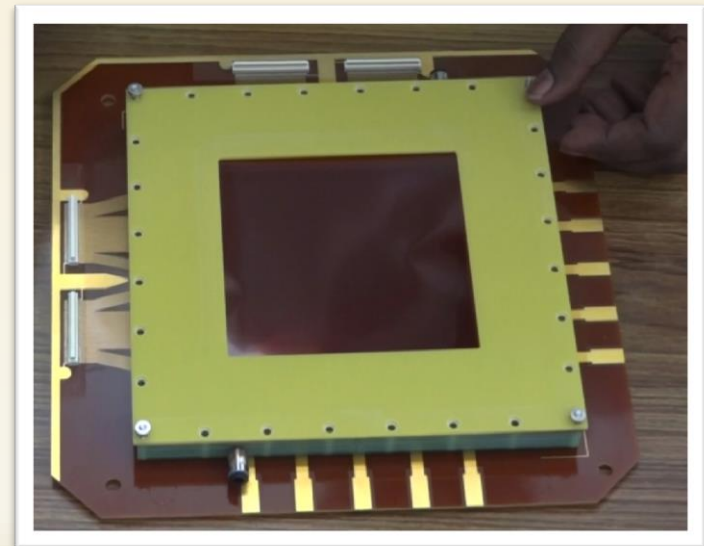
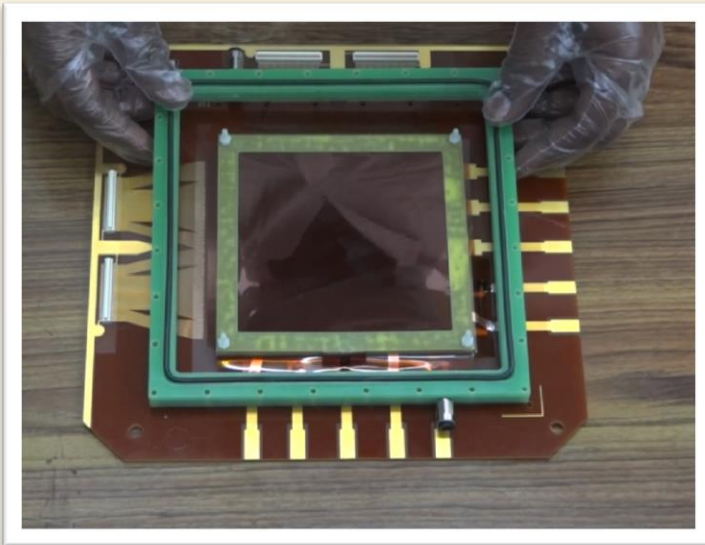
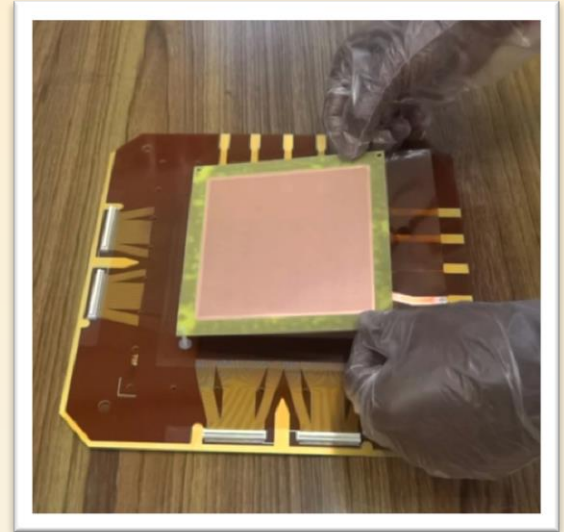
- Residual Gas Analyser to validate the actual gas composition
- Routine monitoring of gas composition



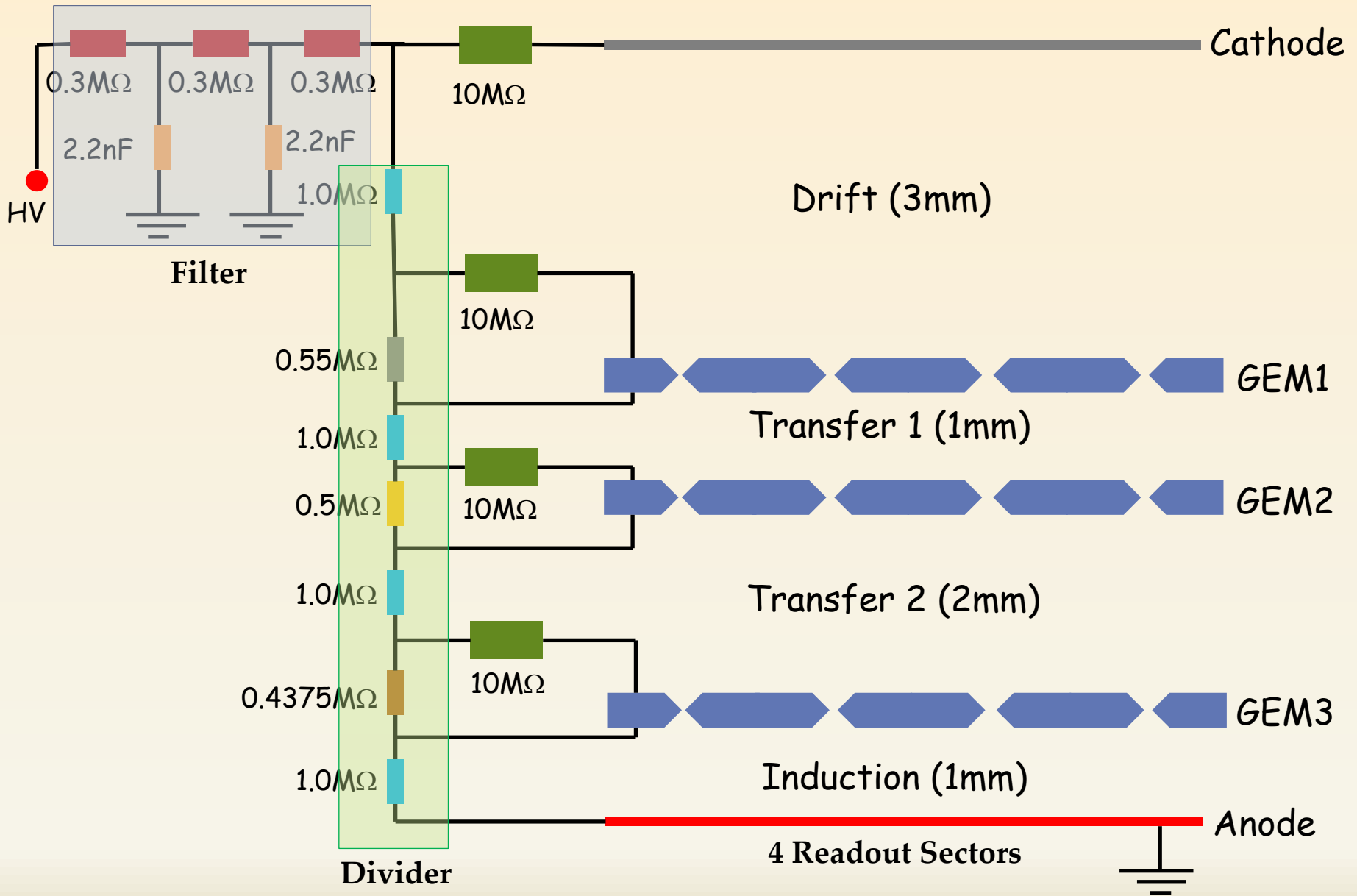
Triple-GEM Assembly



- Components procured from CERN Workshop
- GEM stages tested for HV tolerance
- Assembled for 3:1:2:1 configuration (centre to centre)



Triple-GEM Connection

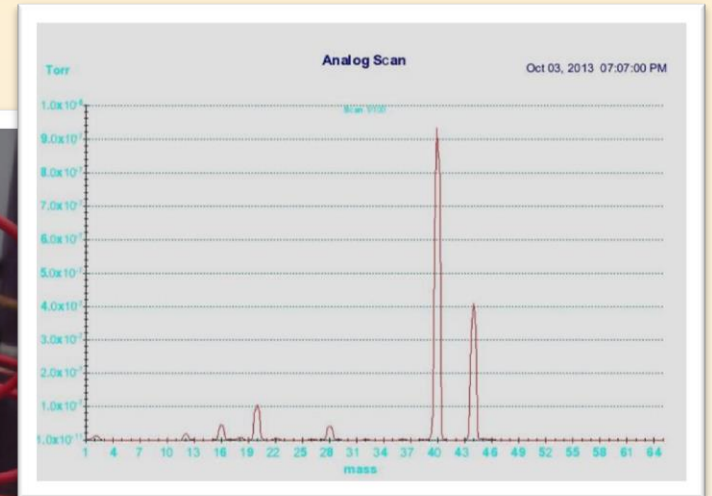
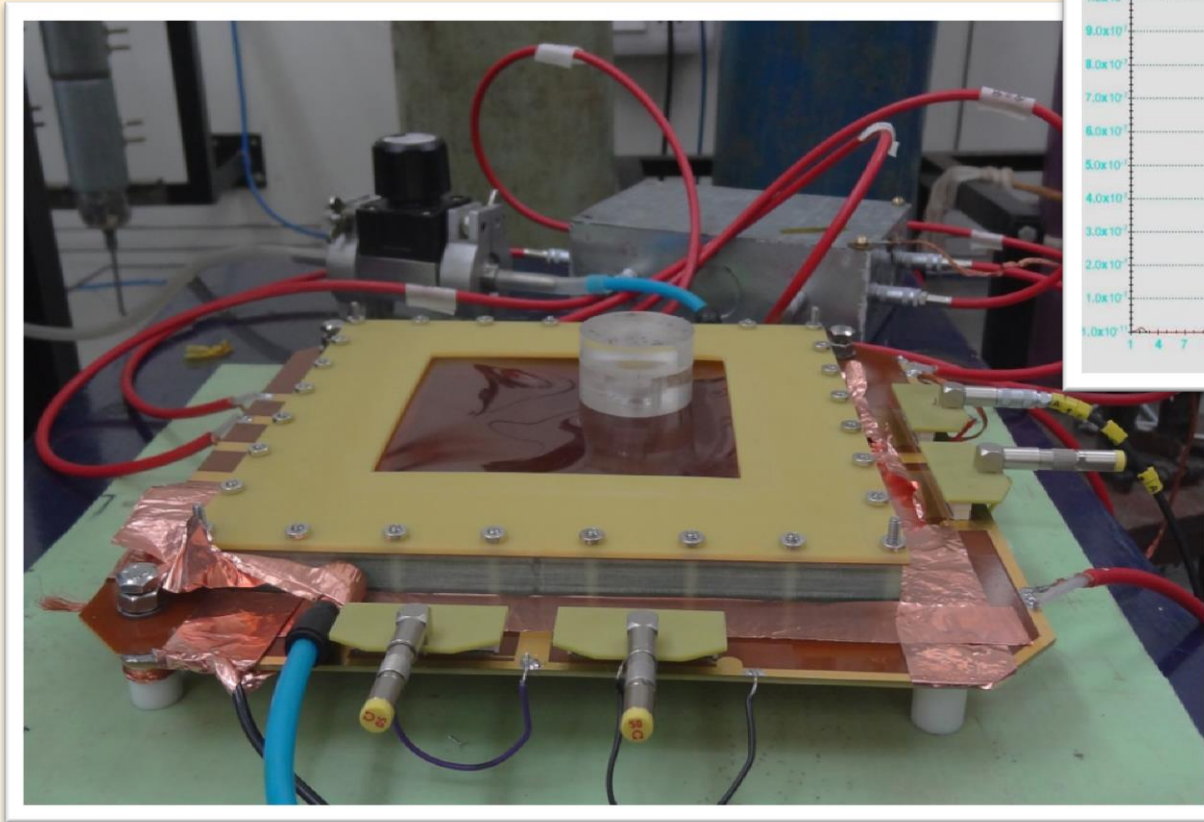


Voltage-Current Tabulation

HV (V)	I (μ A)	Cathode (V)	G1 Top (V)	G1 Bot (V)	G2 Top (V)	G2 Bot (V)	G3 Top (V)	G3 Bot (V)
4750	820	4340	3550	3150	2330	1956	1141	800
4700	811	4290	3510	3110	2300	1933	1134	790
4650	803	4240	3470	3080	2270	1911	1121	781
....
....
4350	751	3965	3250	2880	2125	1787	1048	730
4300	742	3920	3210	2840	2100	1767	1036	721

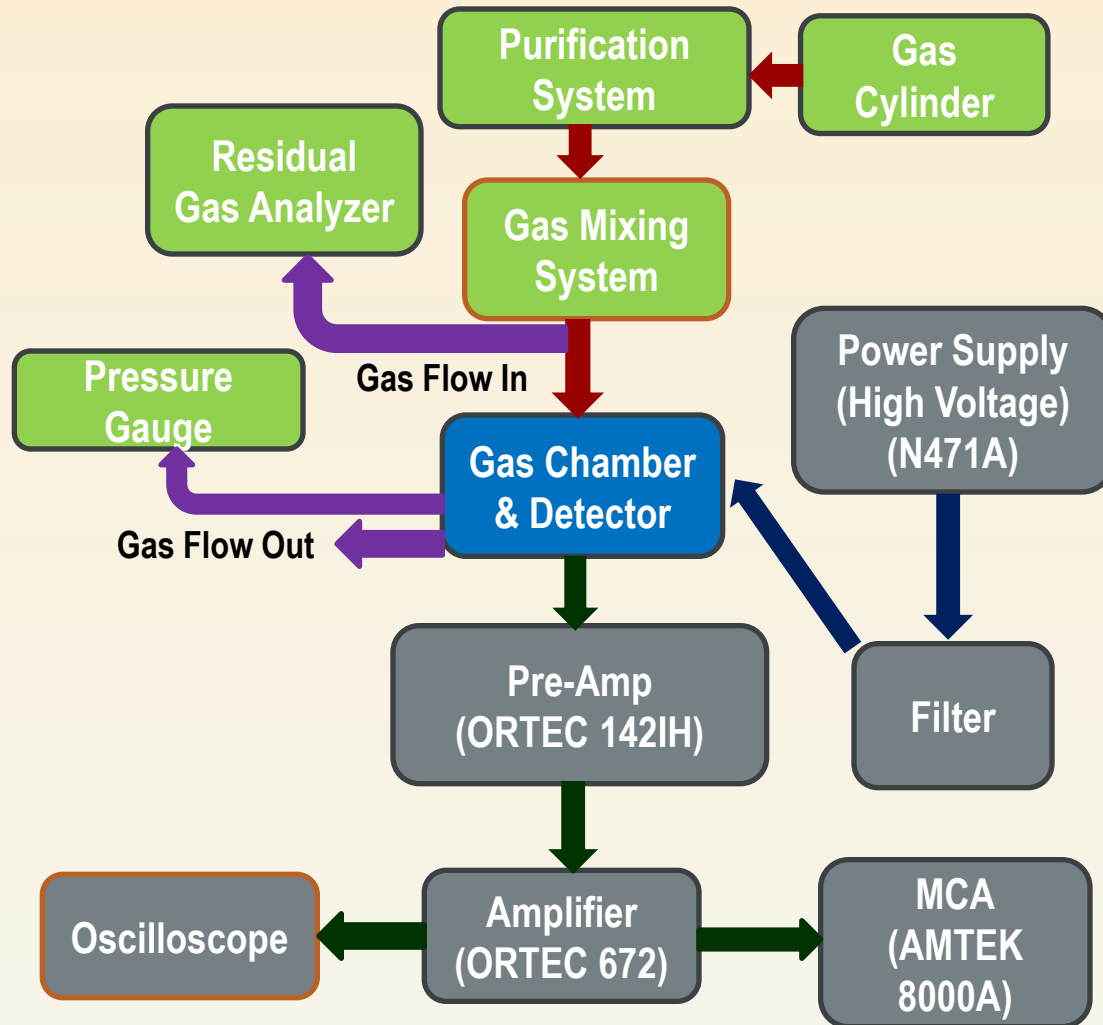
- Voltages measured at all planes for HV supply 4300-4750 V
- Drift Voltages range from 3920-4340 V
- Current flow read from HV supply

Triple-GEM Test

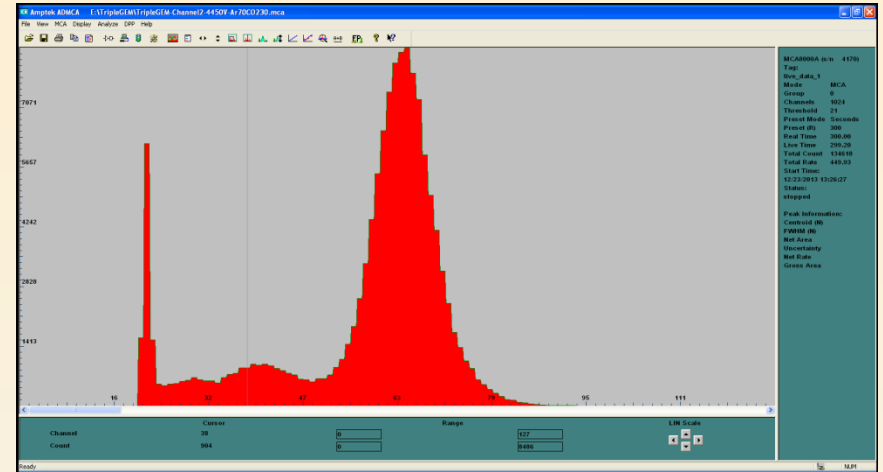
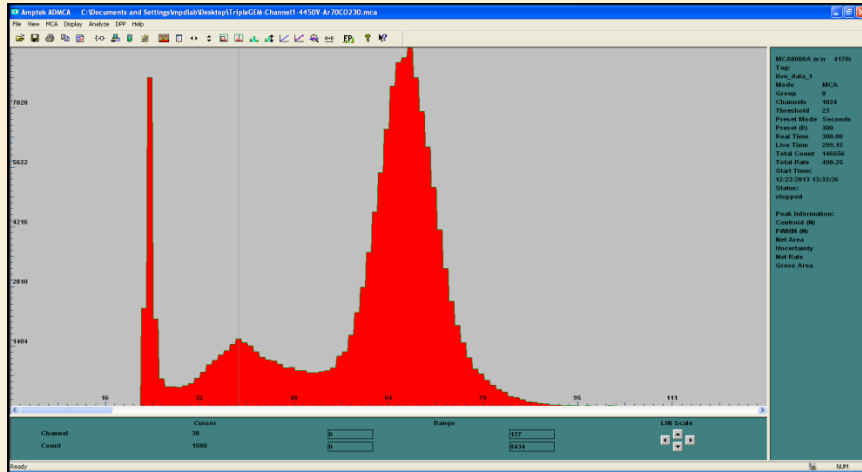


- Test done with ^{55}Fe source
- Gas mixture Ar/CO₂ (70:30) at STP

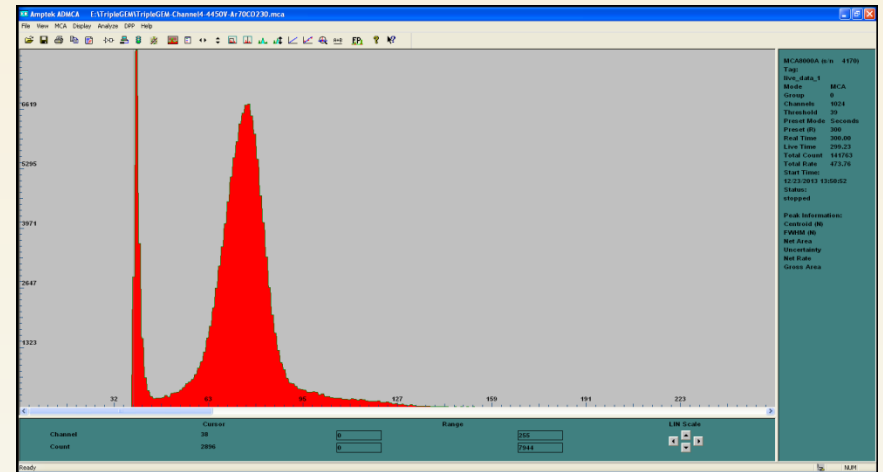
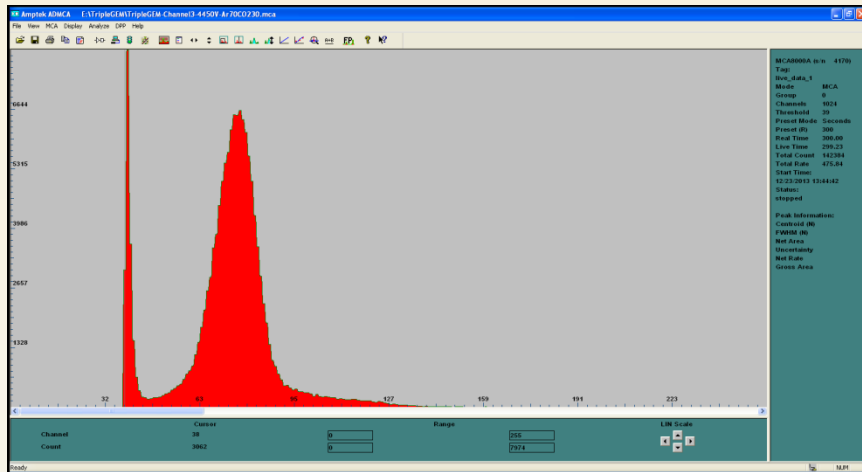
Schematic Setup



Pulse Height Spectra for 4 Readout Sectors

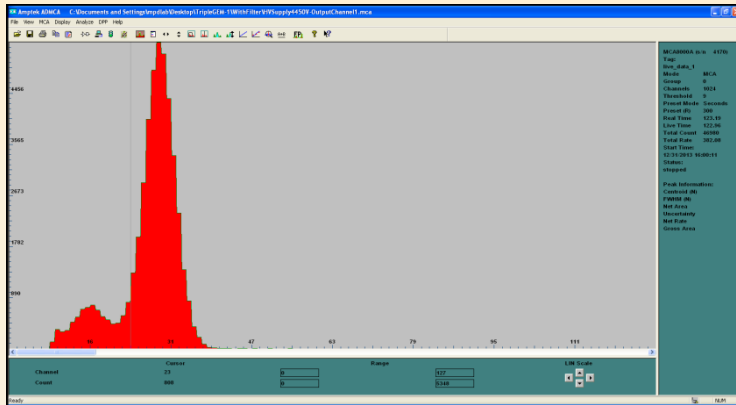


HV = 4450 V

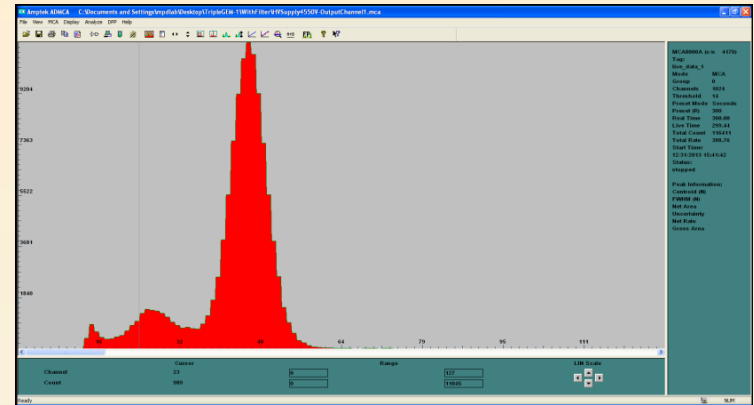


Without filter

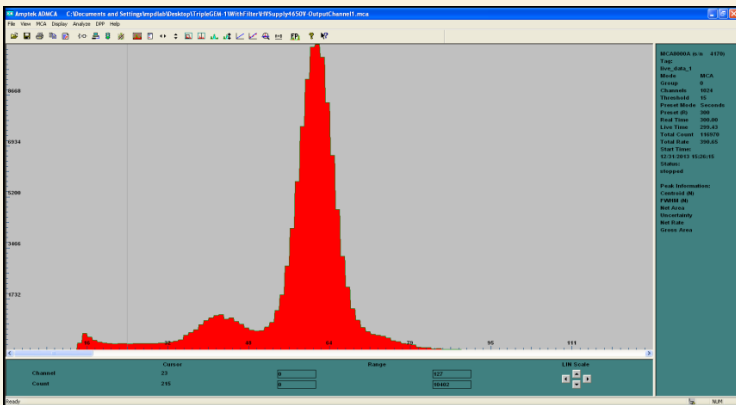
Pulse Height Spectra For Different HV



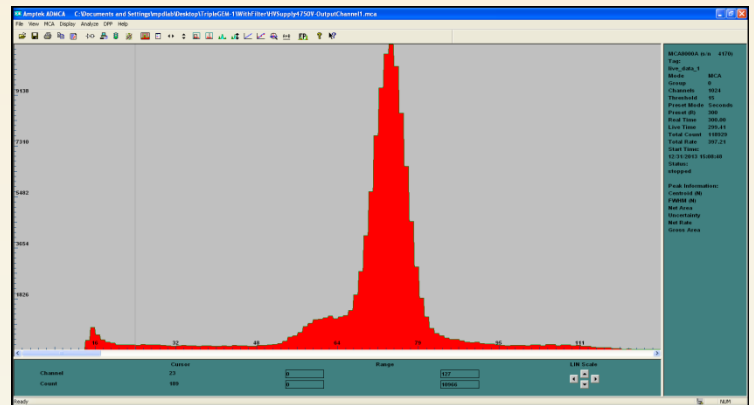
4450 V



4550 V



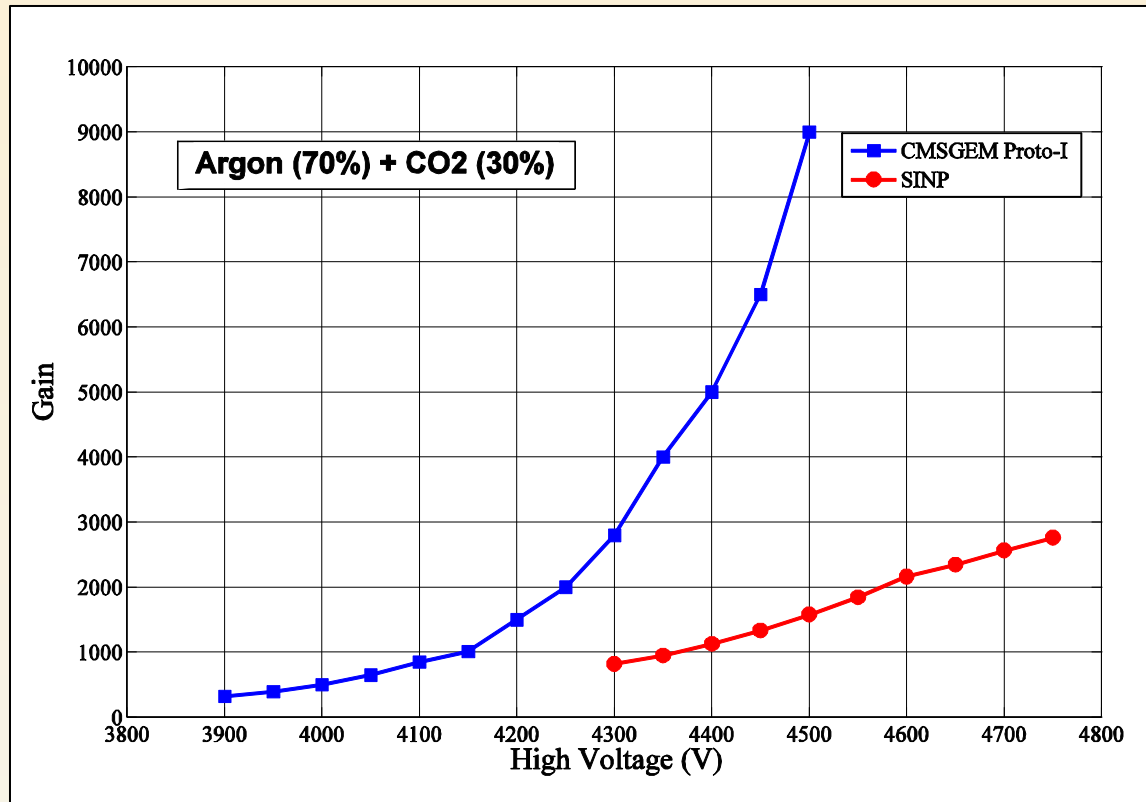
4650 V



4750 V

With filter

Gain Variation with High Voltage



- Assumed that the HV filter and voltage divider configurations are same in both the cases.

Results for Typical Configurations

Experimental setup with Ar:CO₂ (70:30)

High Volt (V)	Cathode (V)	Current (muA)	G1 (V)	G2 (V)	G3 (V)	Gain
4300	3920	742	370	333	315	821
4400	4010	760	375	342	322	1129
4500	4100	777	380	351	330	1577
4600	4190	794	390	360	337	2105
4700	4290	811	400	367	344	2565

Simulation setup for Ar:CO₂:CF₄ (45:15:40)

Cathode (V)	G1 (V)	G2 (V)	G3 (V)	G_{eff}
3749	460	418	365	500

- Penning transfer of 50% included for calculating effective gain.

Remarks and Future Plans

- A Triple-GEM, assembled using components procured from CERN, has undergone initial tests. This has made us confident of assembling prototypes and carrying out measurements.
- There are several issues with noise, gain, high voltage distribution to be resolved before starting the characterization studies in full swing.
- The disagreement of the measured gain with other reports is yet to be understood. Comparison with simulation shall be carried out very soon.
- Several items like CF₄ gas, x-ray source, multi-parameter data acquisition is being procured for full-fledged measurements.

Acknowledgements

Collaborators (Special Mentions)

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Acknowledgements

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Thank You All !!