Stability study of triple GEM detector with radioactive source

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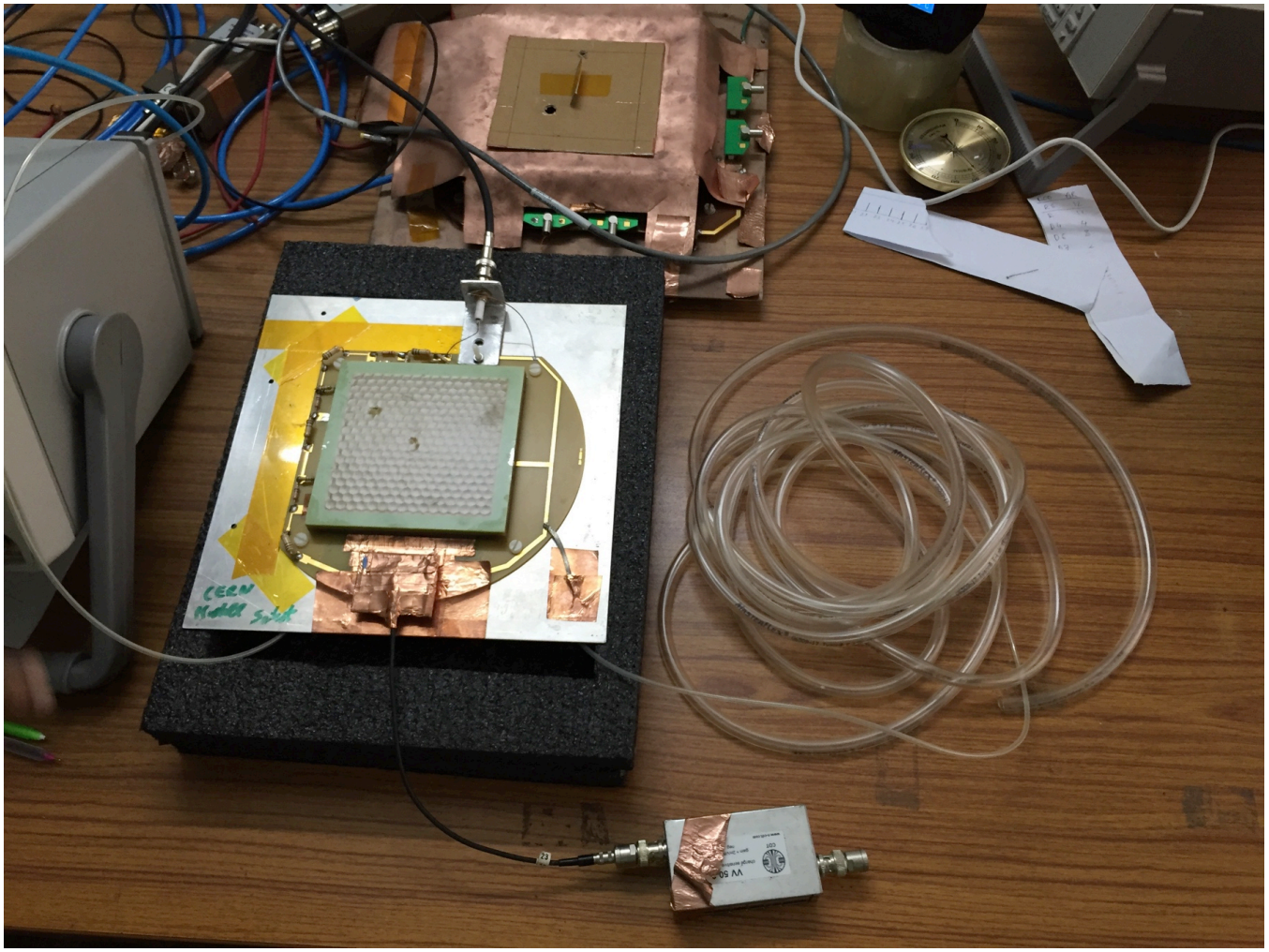
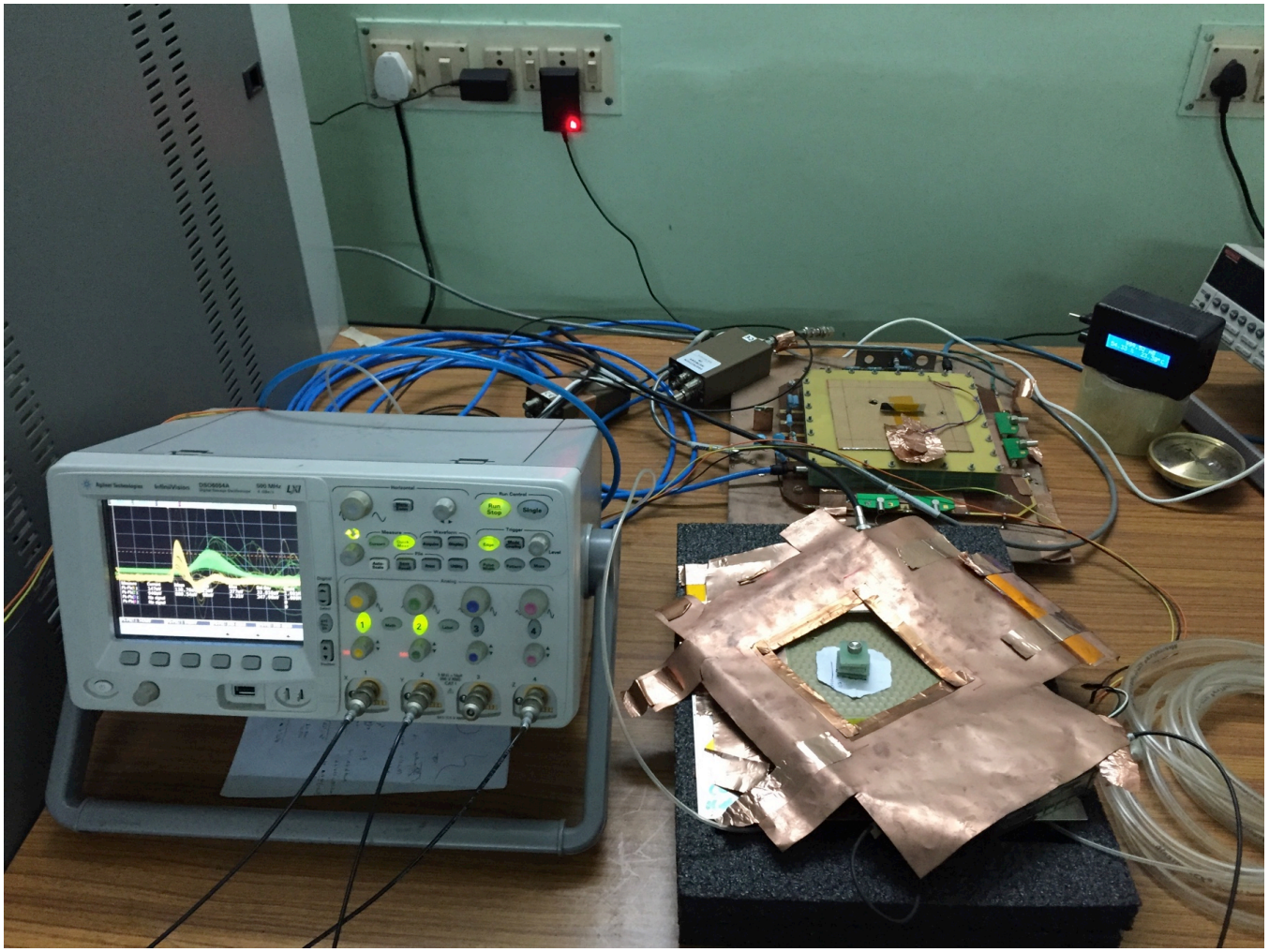
At Bose Institute, an initiative has been taken for R&D of GEM detector (stability test) for ALICE TPC upgrade and CBM Muon Chamber (MuCh)

Set-up at Bose Institute

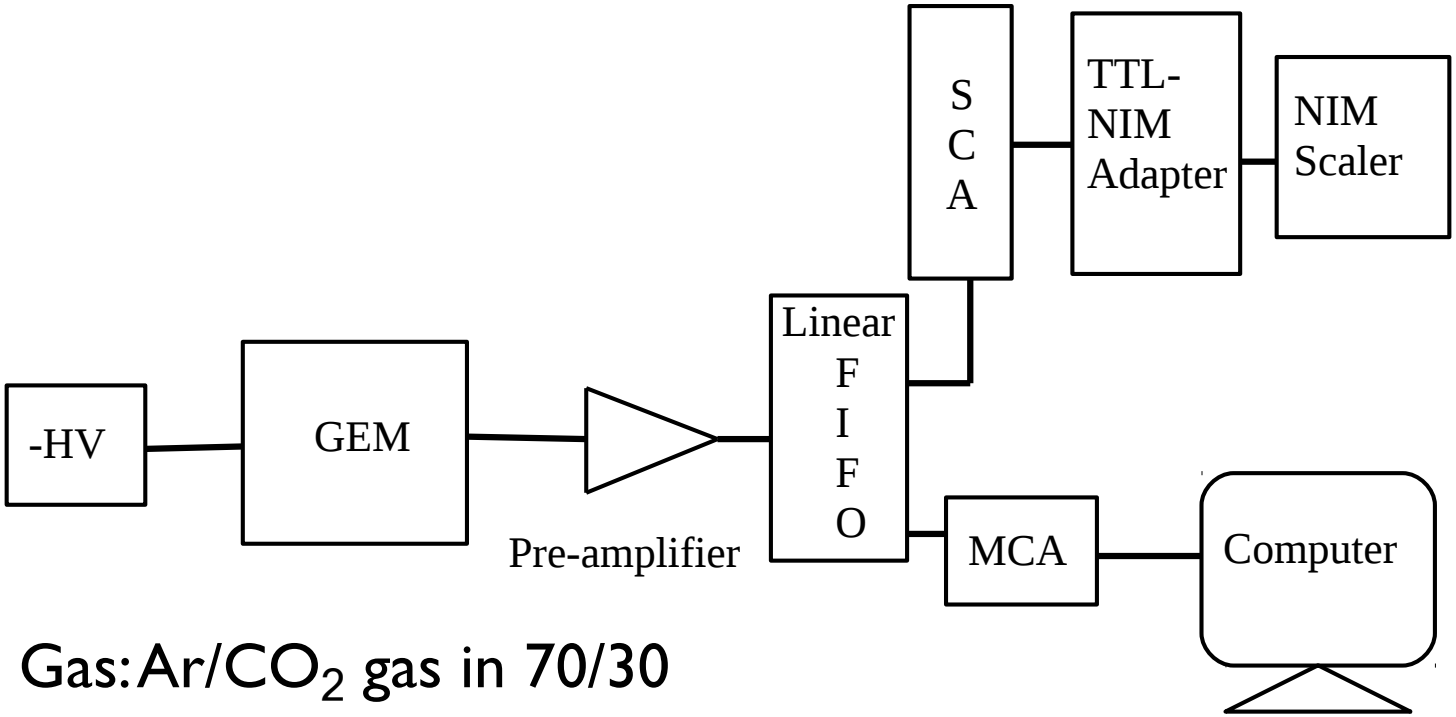
Triple GEM detector



Triple GEM detector

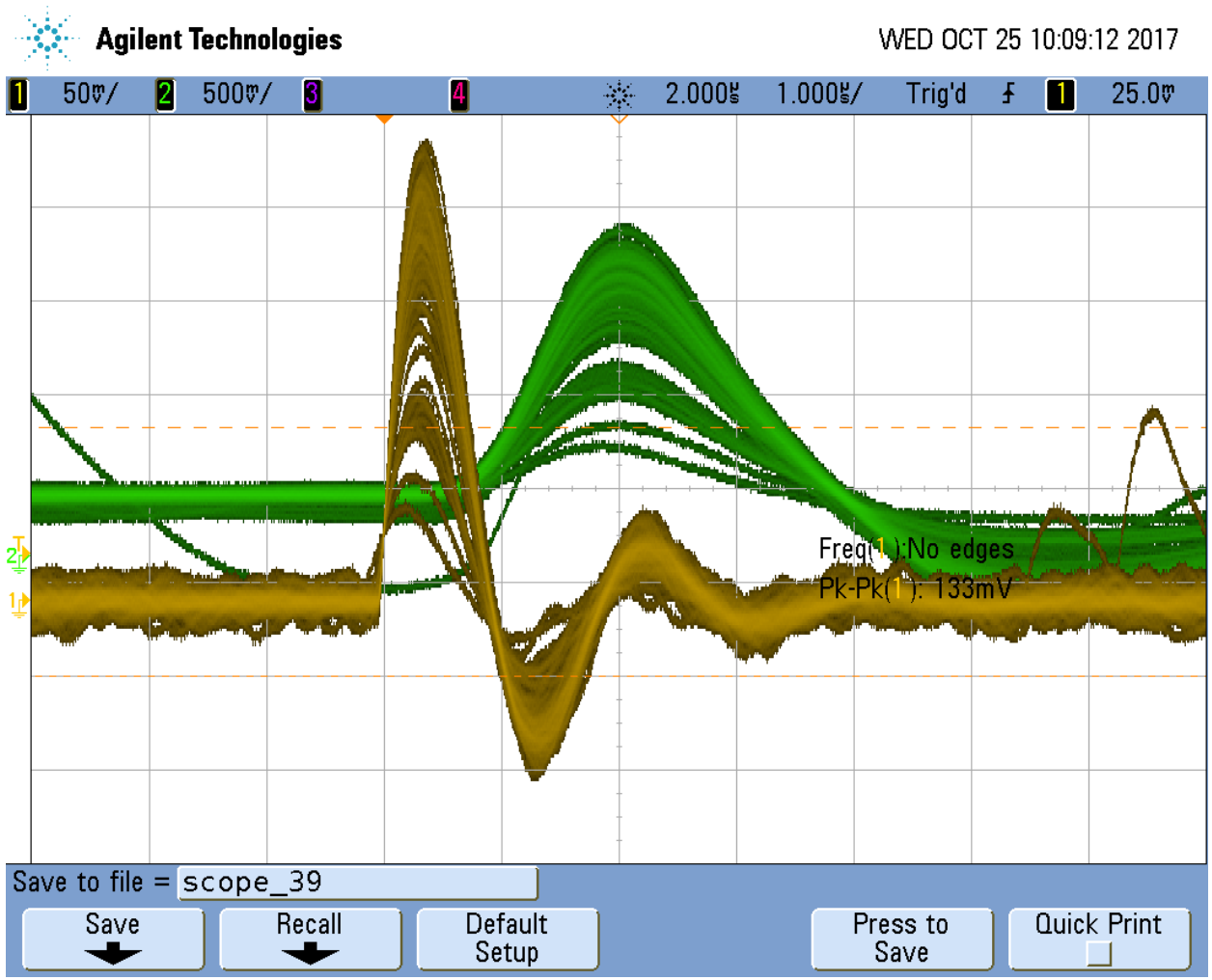


Schematic representation of the electronics setup

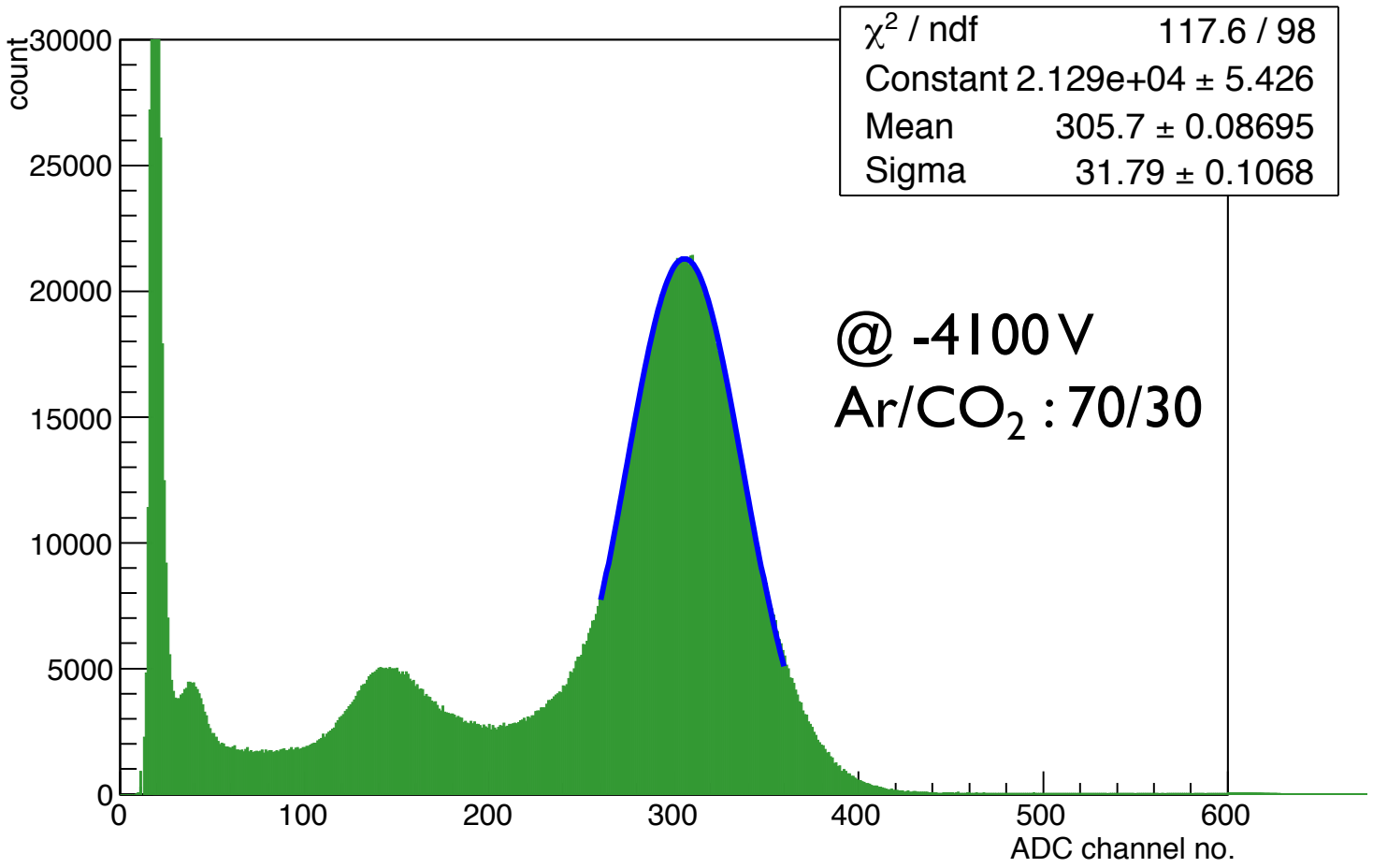


- Gas: Ar/CO_2 gas in 70/30
- Flow rate: 3 lt/hr
- Conventional NIM electronics
- Pre-amplifier: VV 50-2 (Heidelberg)

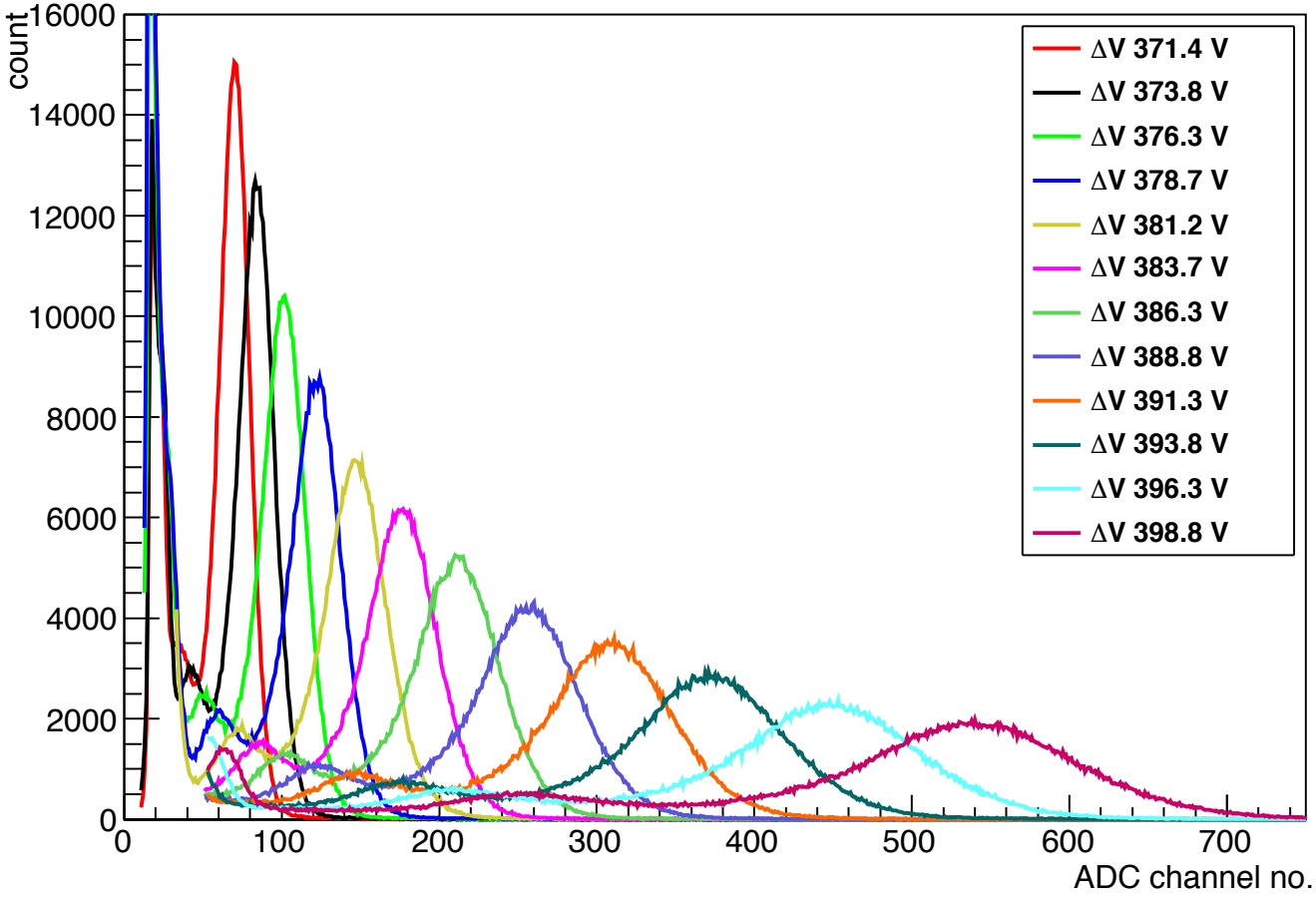
Fe^{55} Signals from GEM



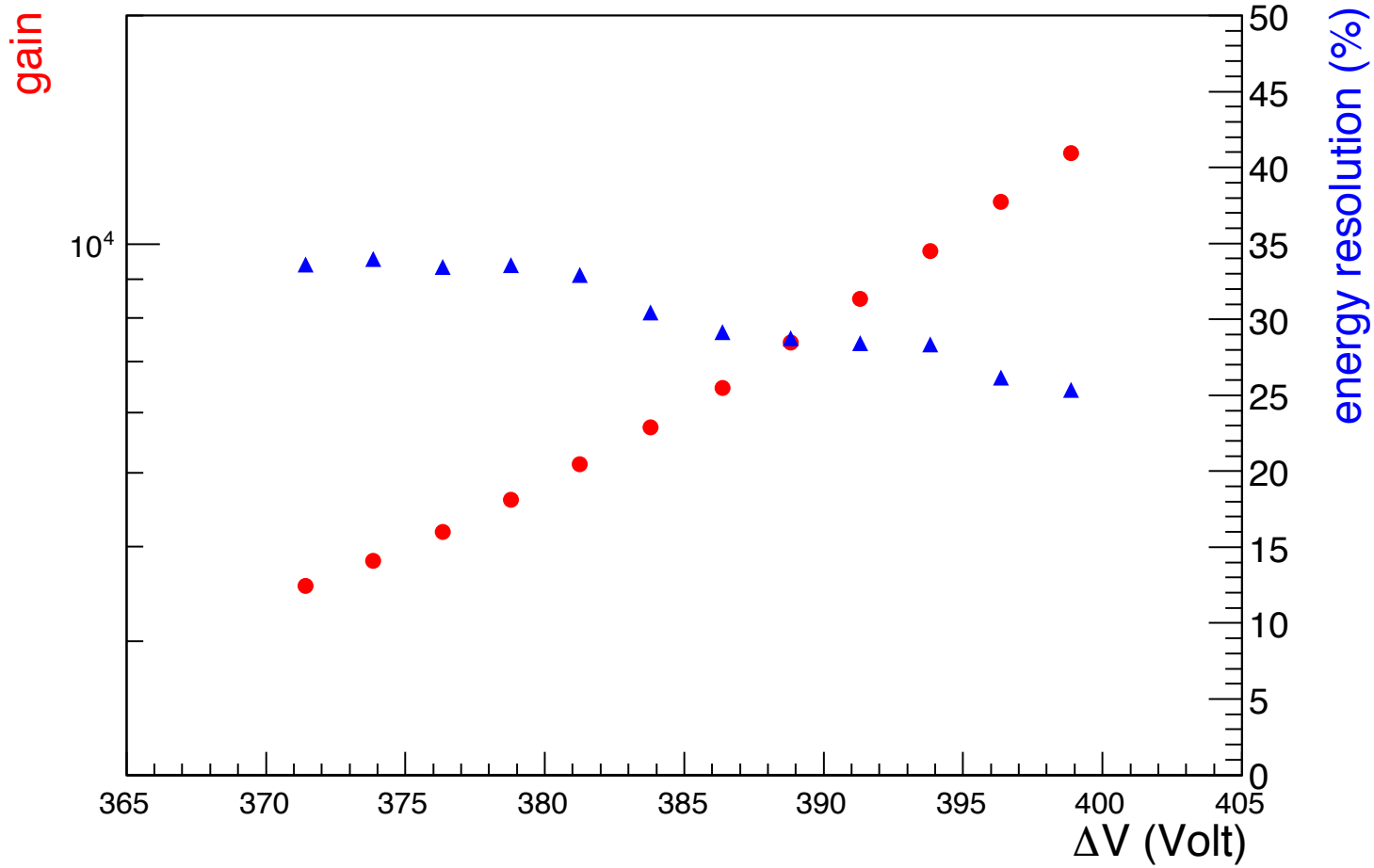
Energy Spectrum



Fe^{55} spectra at different voltages



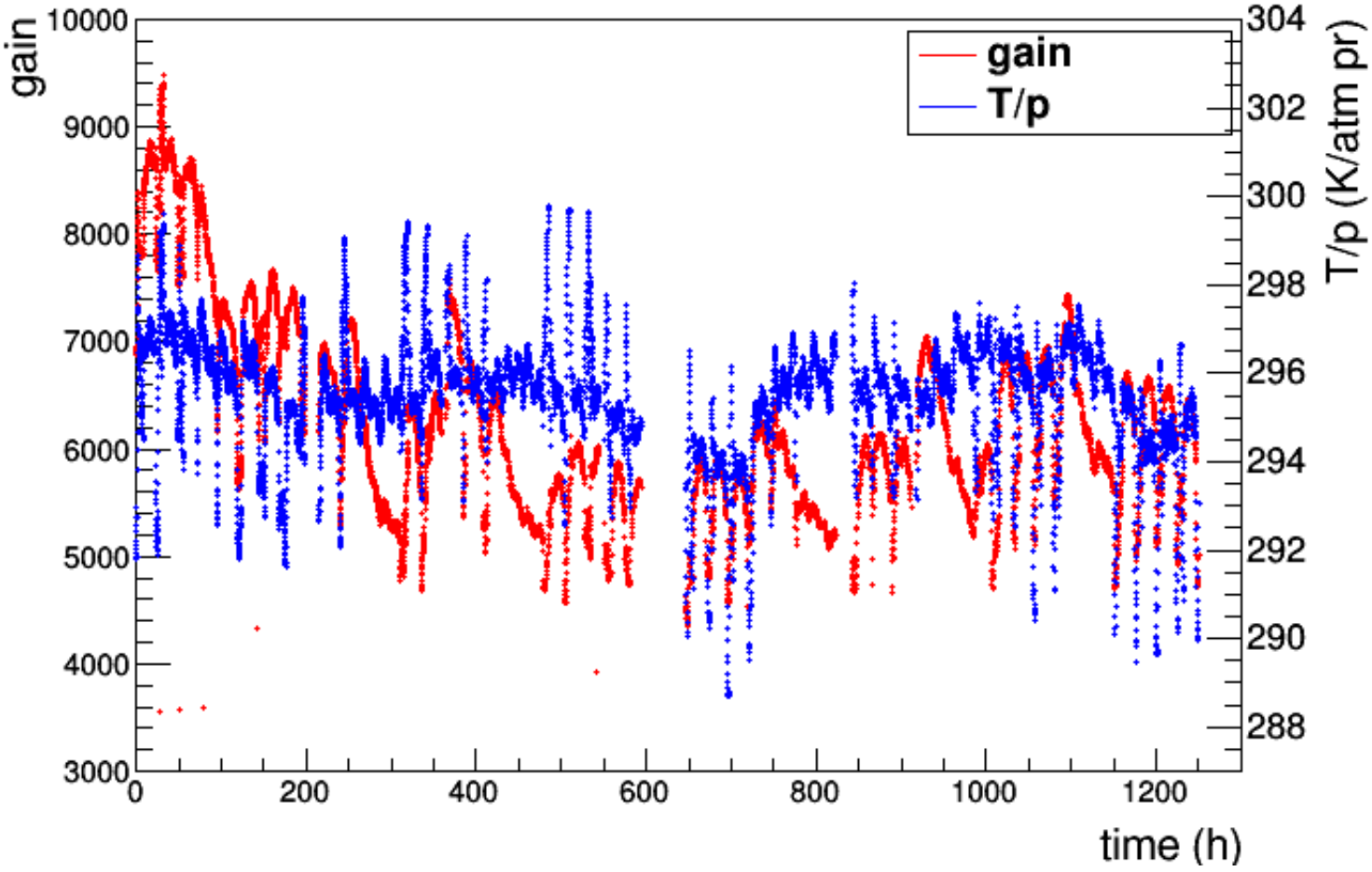
Gain and Energy resolution Vs. GEM voltage



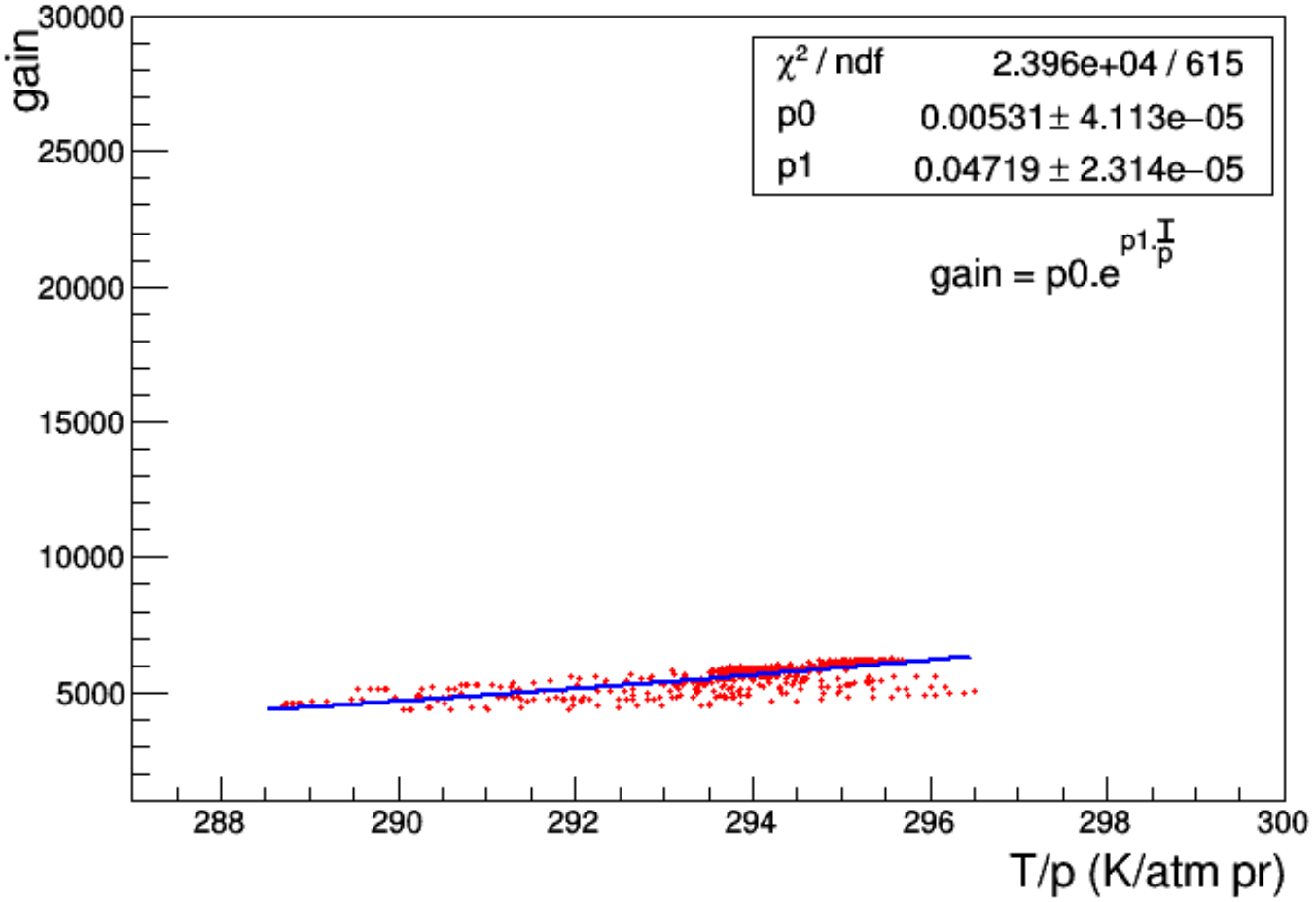
Experimental details

- Same Fe^{55} source used for irradiation and monitoring spectrum
- Gas: Ar/CO_2 70/30
- Constant applied voltage to the divider: -4100 V
- $\Delta V \sim 384$ V
- Rate ~ 350 kHz in 50 mm^2 area
- Fe^{55} spectrum obtained in every 10 minutes
- Temperature, pressure are measured continuously

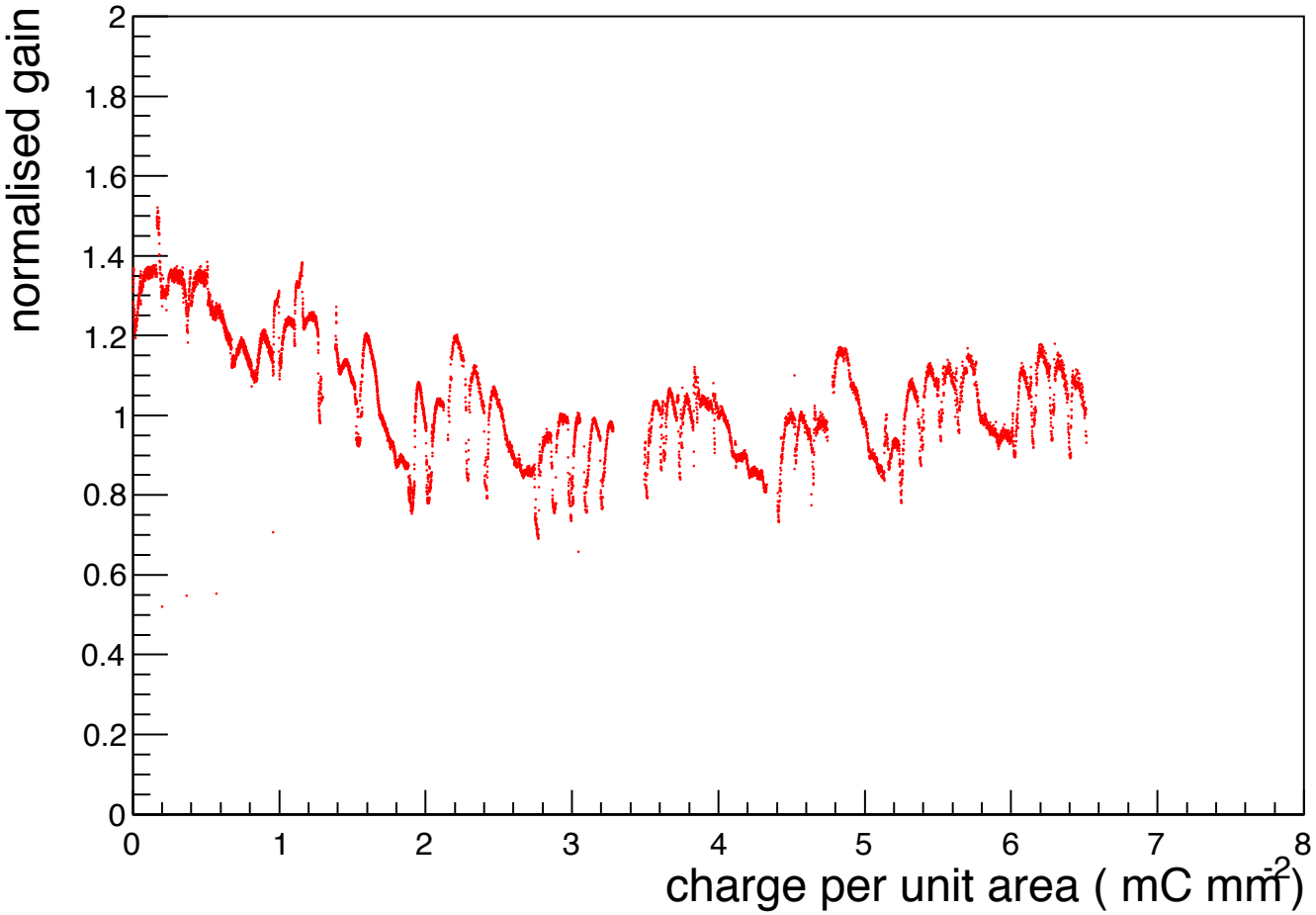
Gain and and T/p Vs. time



Correlation of gain and T/p

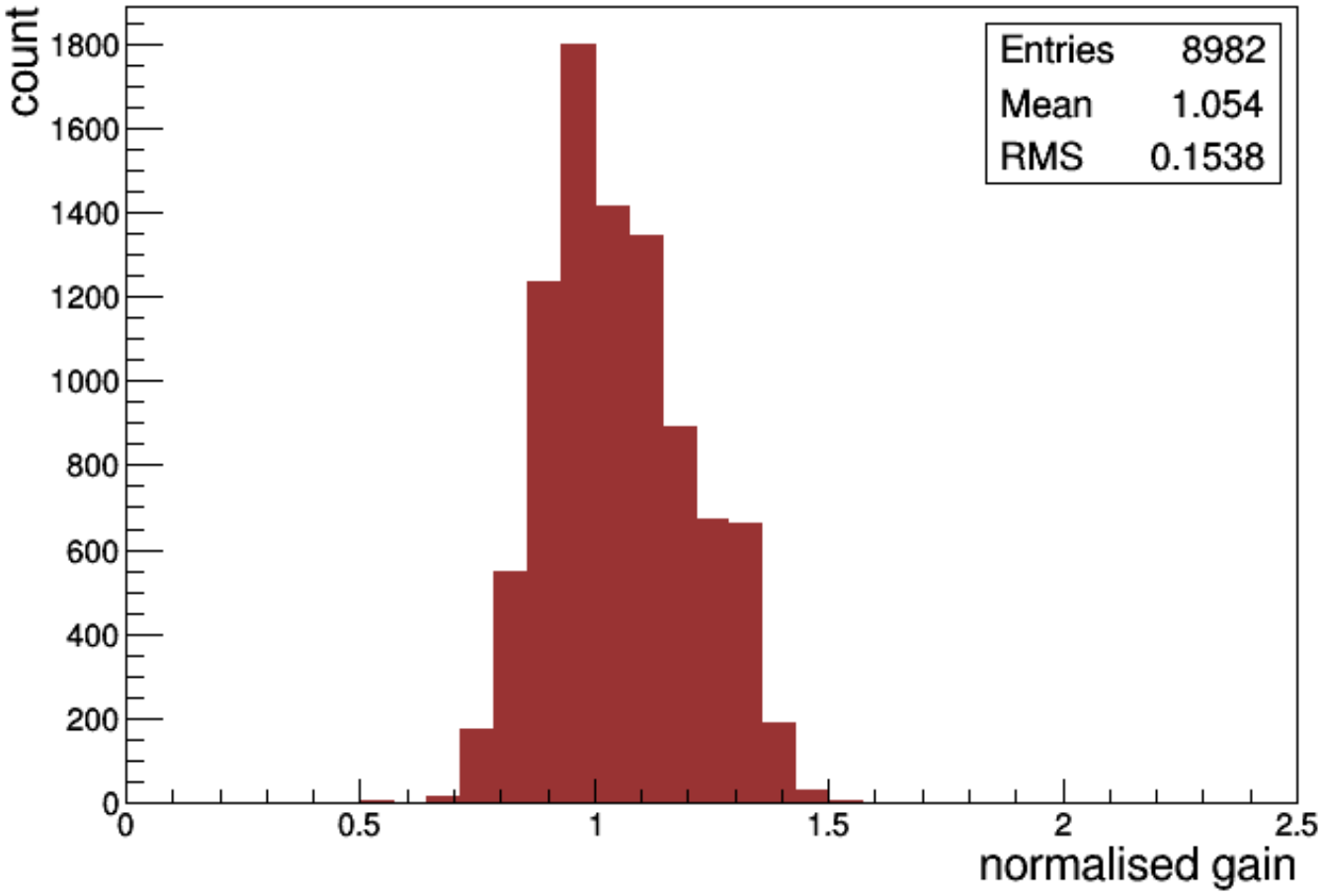


Normalised gain Vs. dQ/dA



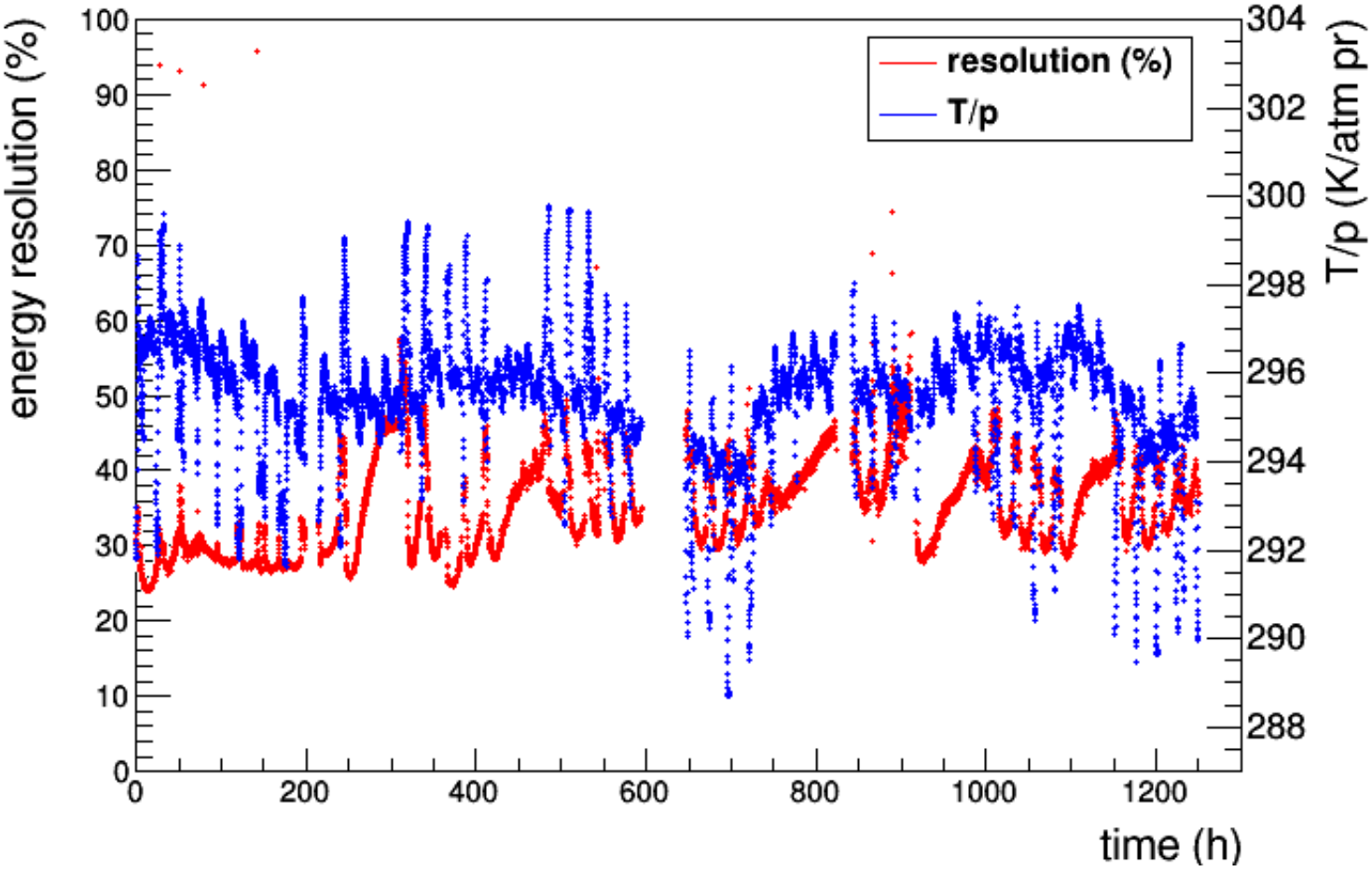
S. Roy, et al., Nucl. Instrum. Methods A (2018), https://doi.org/10.1016/j.nima.2018.10.060.

Distribution of normalized gain

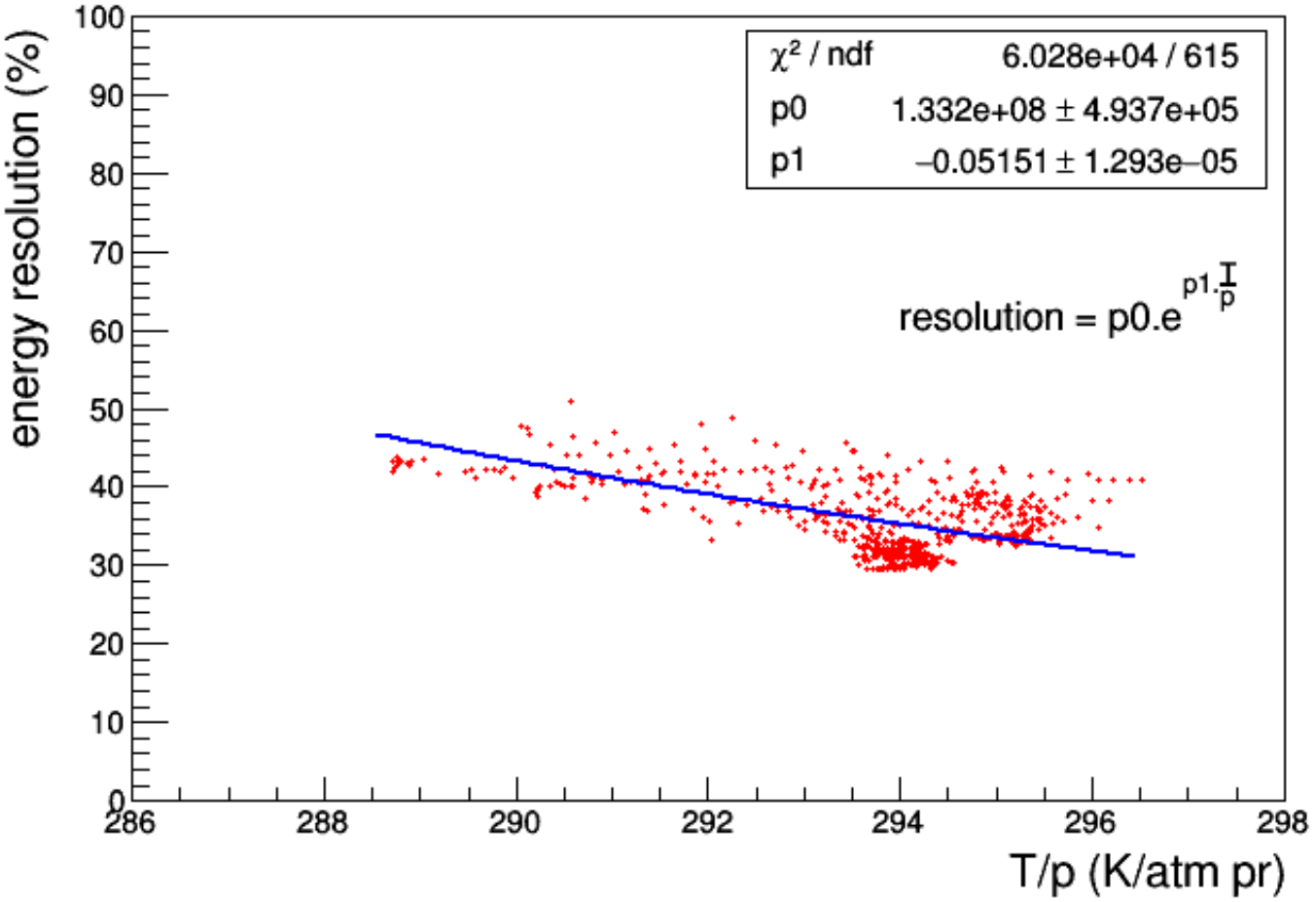


Fluctuation ~15%

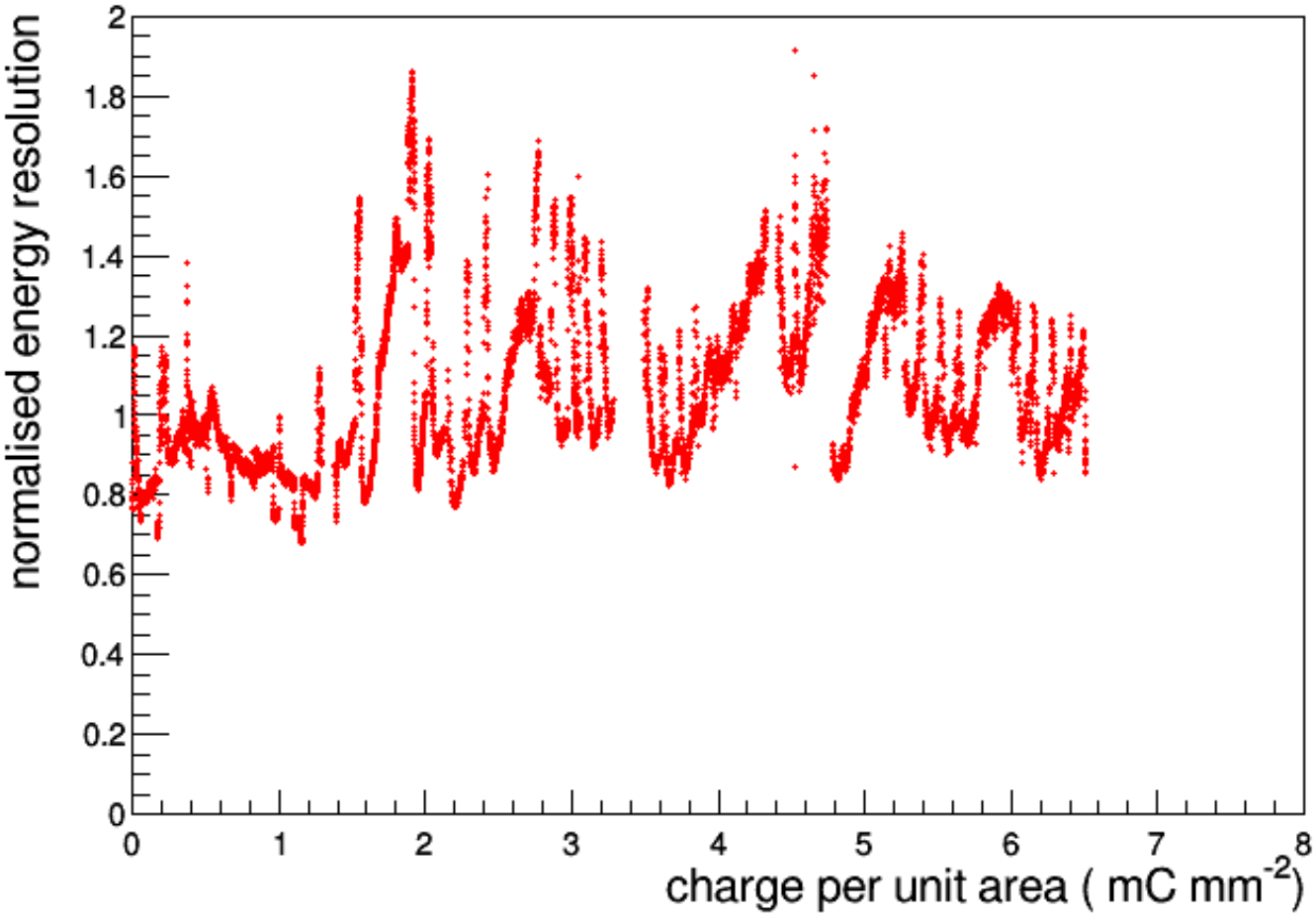
Energy resolution Vs. time



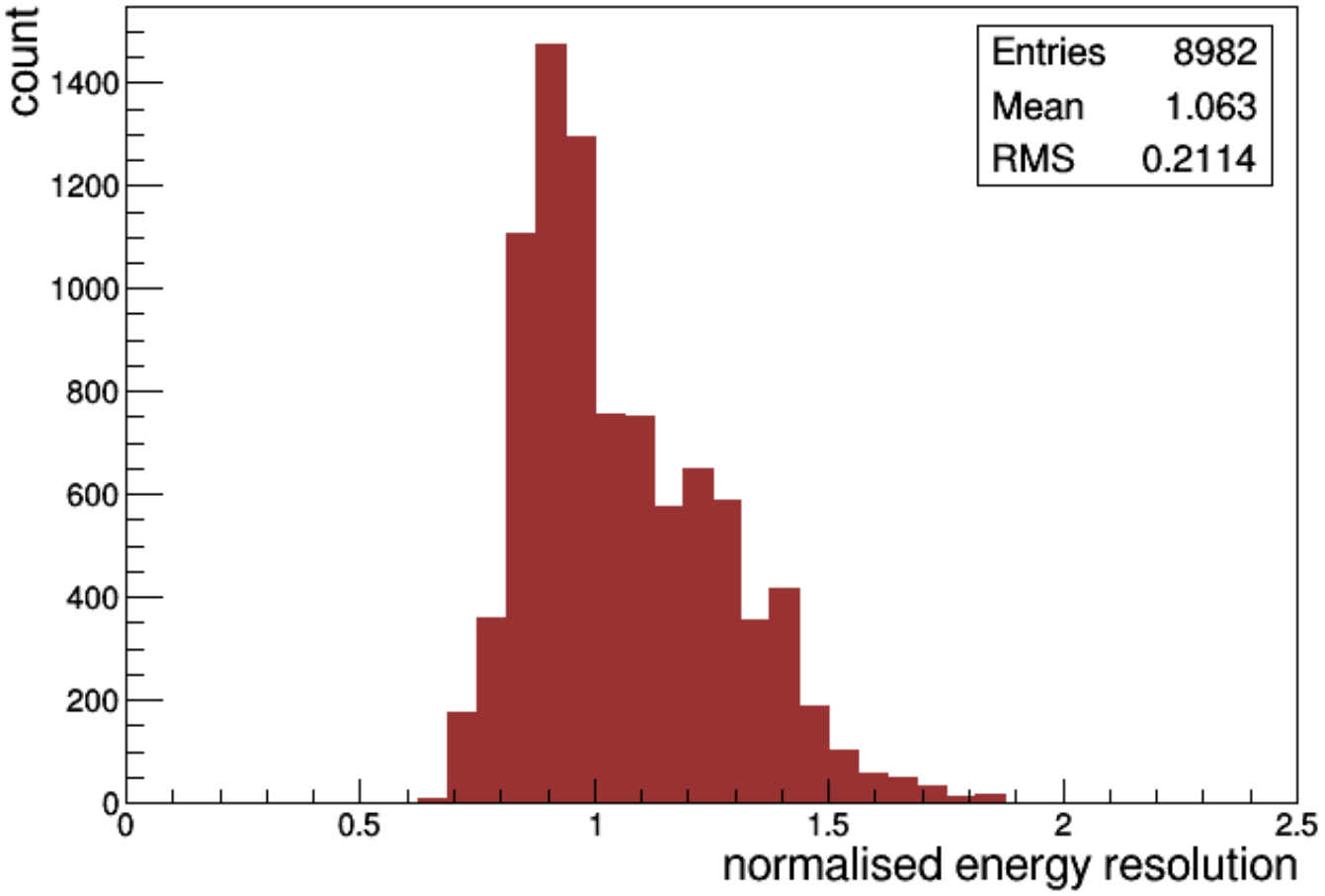
Energy resolution Vs. T/p



Normalised resolution Vs. dQ/dA

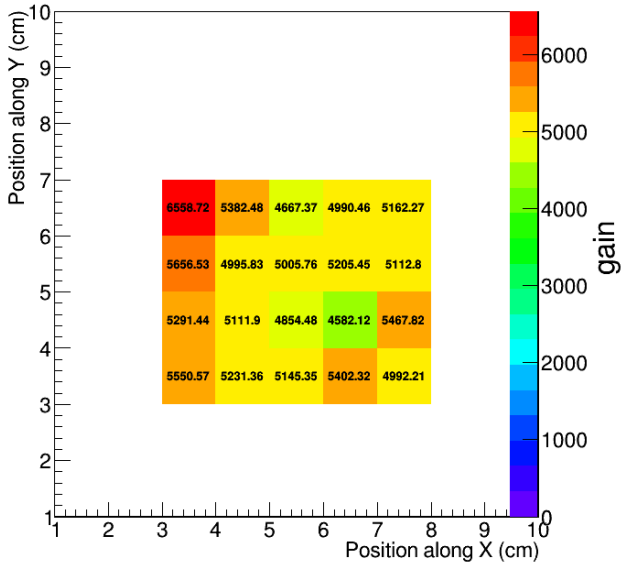


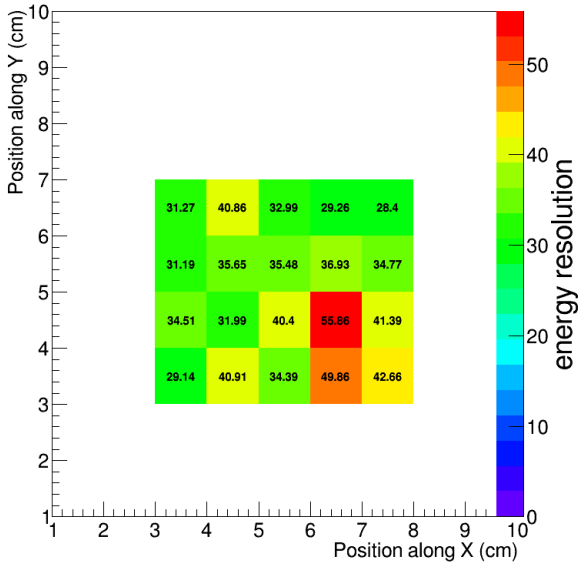
Distribution of normalised energy resolution

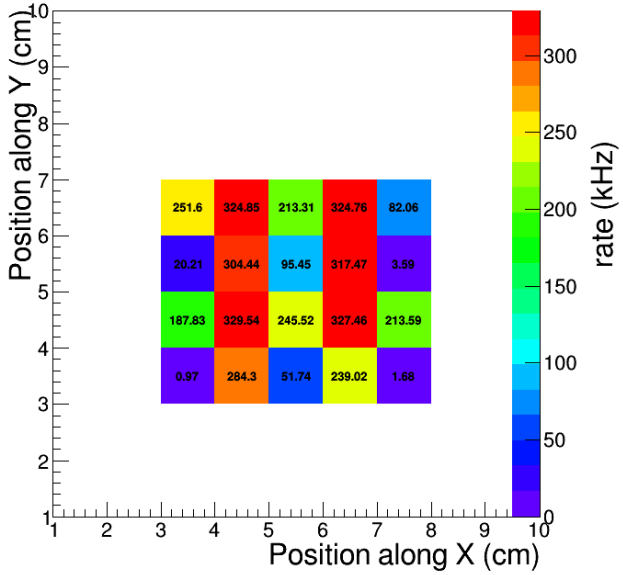


Fluctuation ~20%

Uniformity







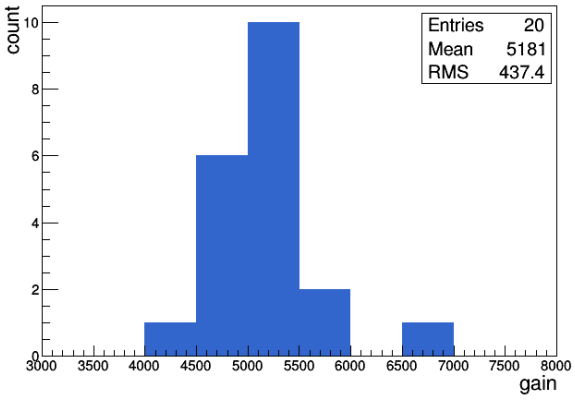
Gain

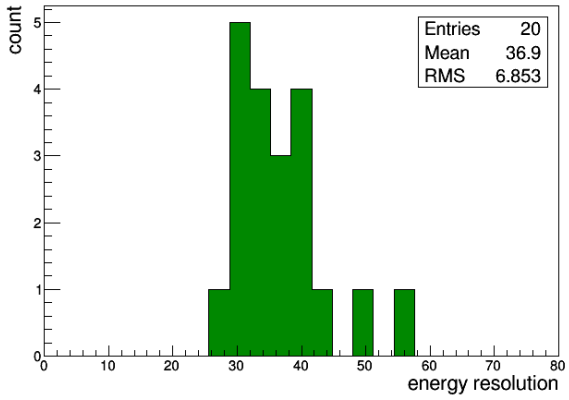
Energy resolution

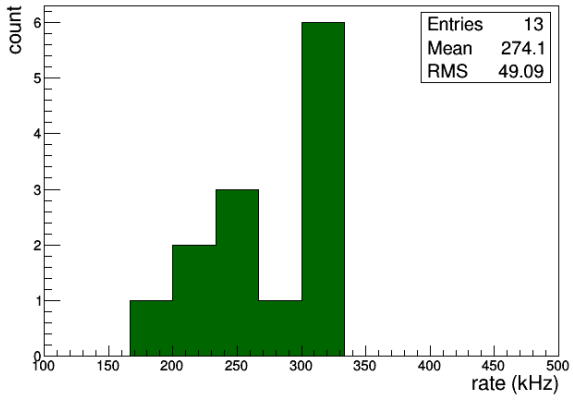
Rate

S. Chatterjee, et al., Nucl. Instrum. Methods A (2018), https://doi.org/10.1016/j.nima.2018.08.068.

Uniformity







Fluctuation ~8.4%

18.6%

17.9%

Summary

- Characteristic studies are performed for GEM detector with Ar/CO_2 gas mixture using conventional NIM electronics.
- Count rate, gain, energy are studied
- Stability of gain and energy resolution at high rate is under investigation for GEM detector. No ageing after accumulation of 7 mC/mm^2
- Uniformity checked

Thank you!