Detector for testing GEM-foils and readout PCB

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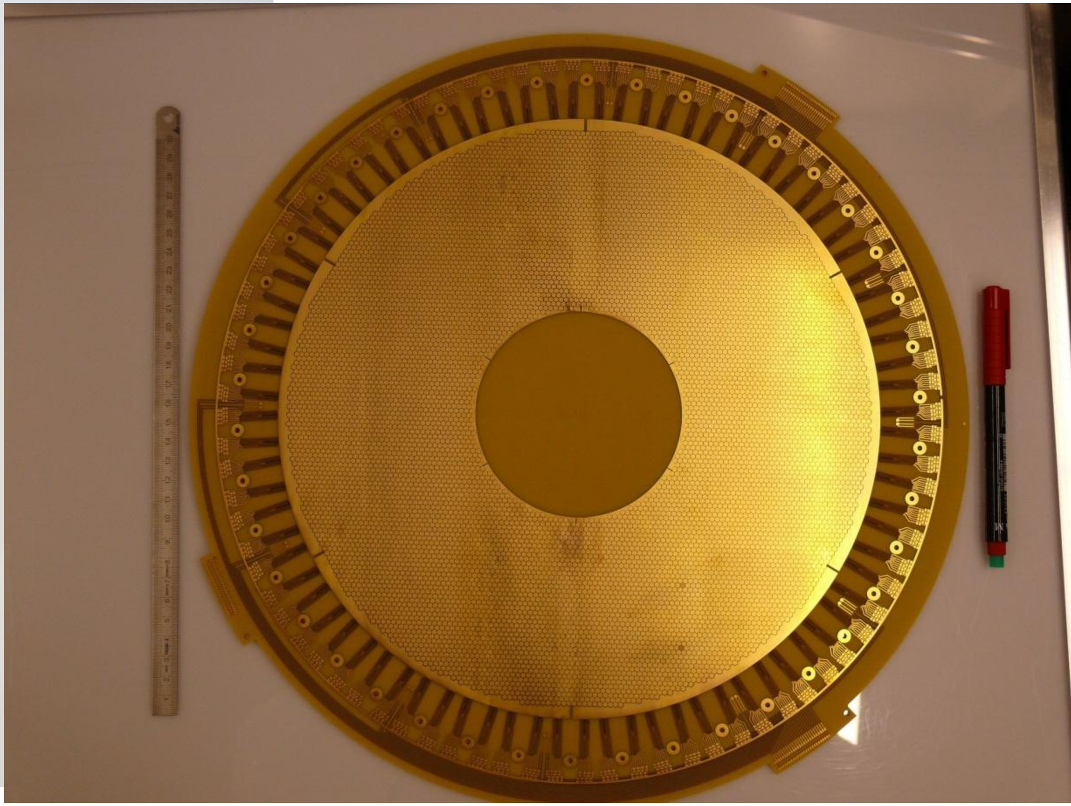
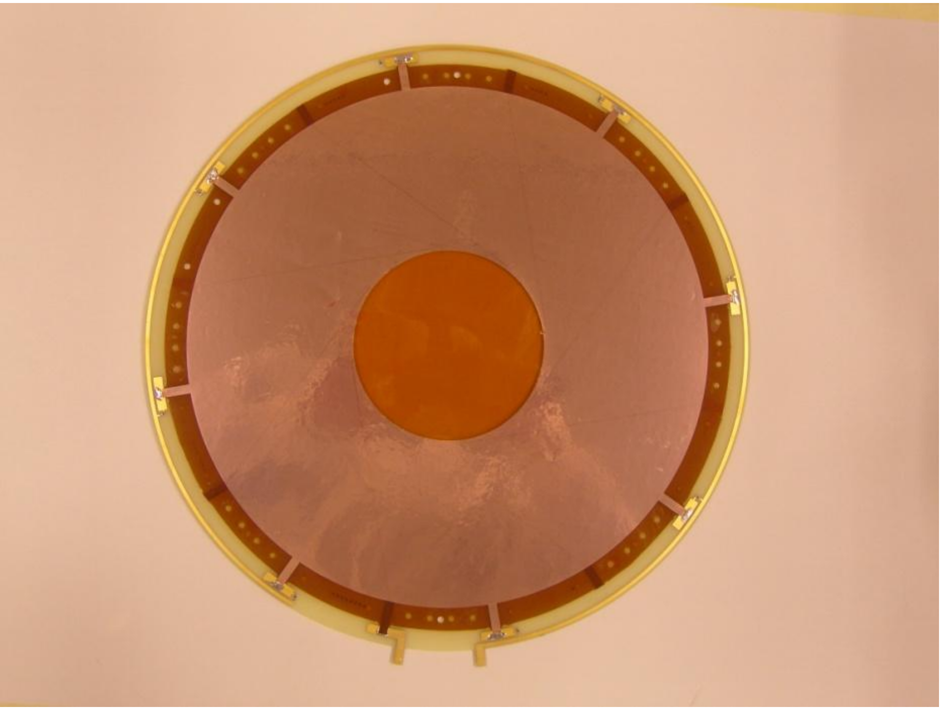
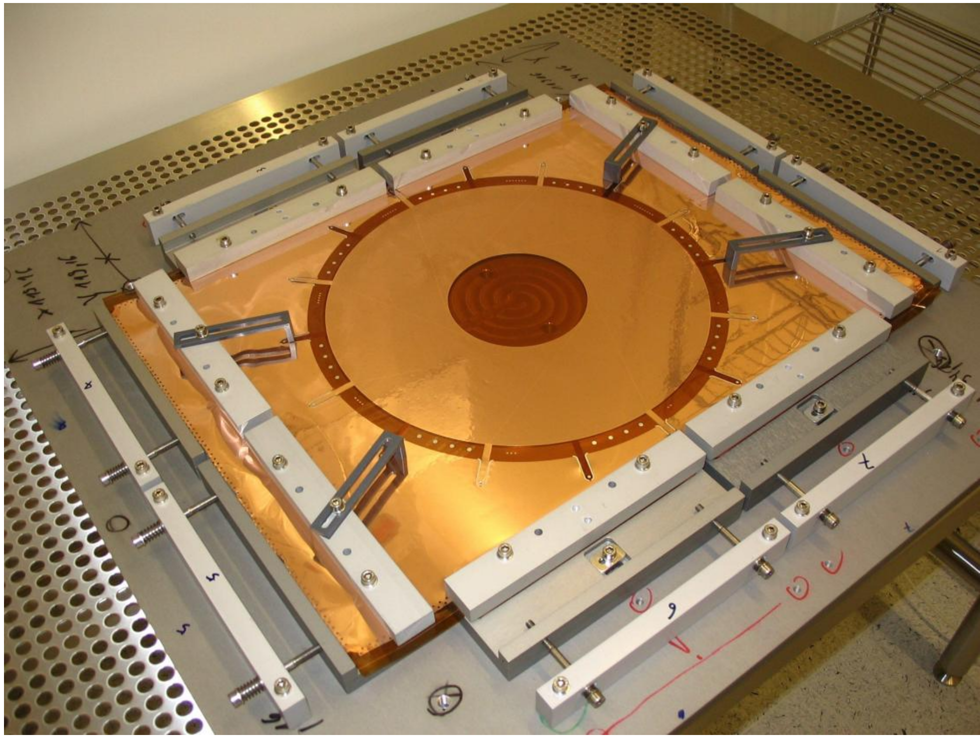
Readout PCB



- Padplane to be used in the TPC-prototype
- ~10000 pads
- Ø=40 cm

Glueing of GEM-Foils

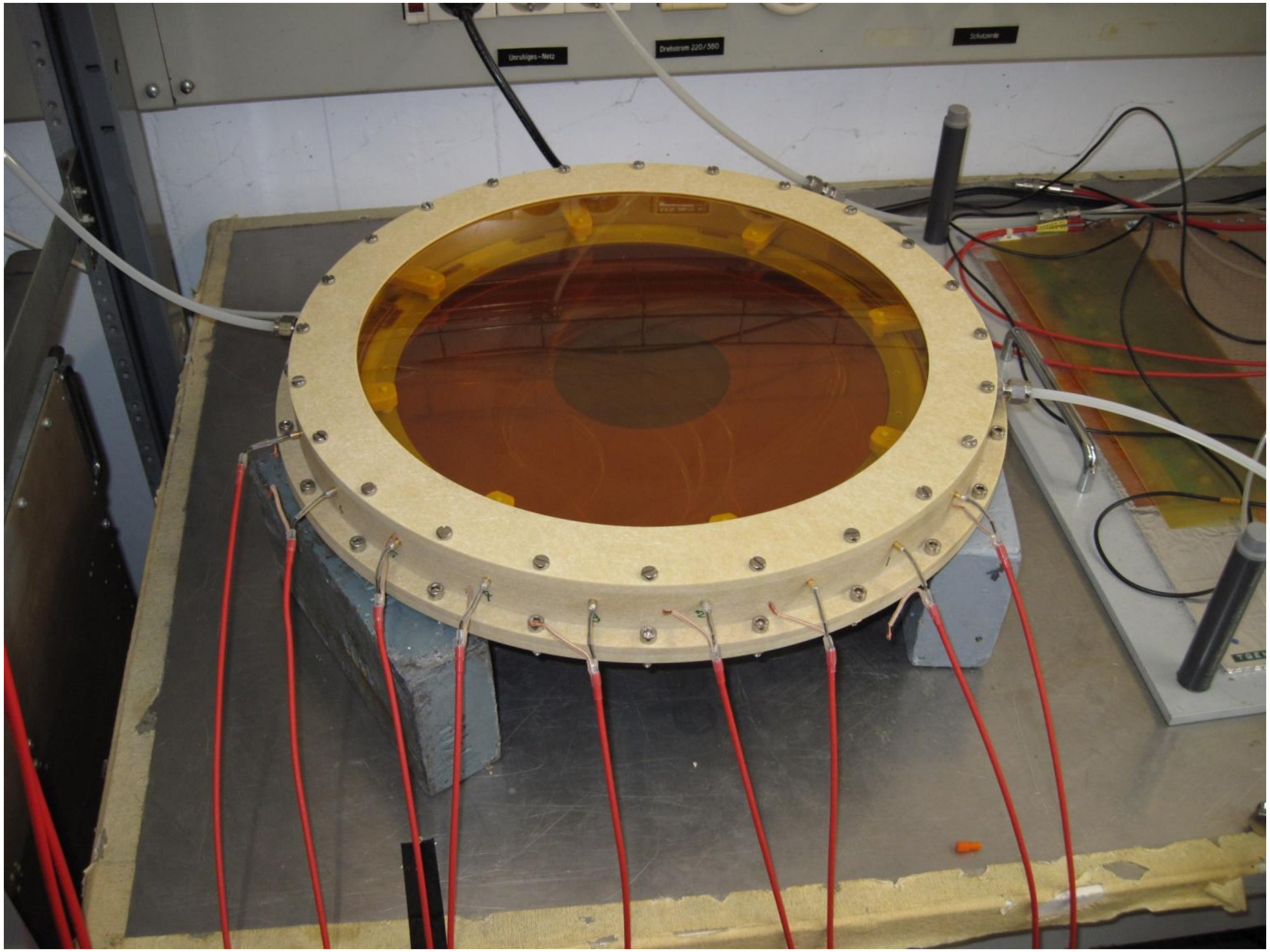




GEM foils:

- Standard double mask technique
- 8 diaphragm-like sectors
- Stretched and glued onto FR4 frame

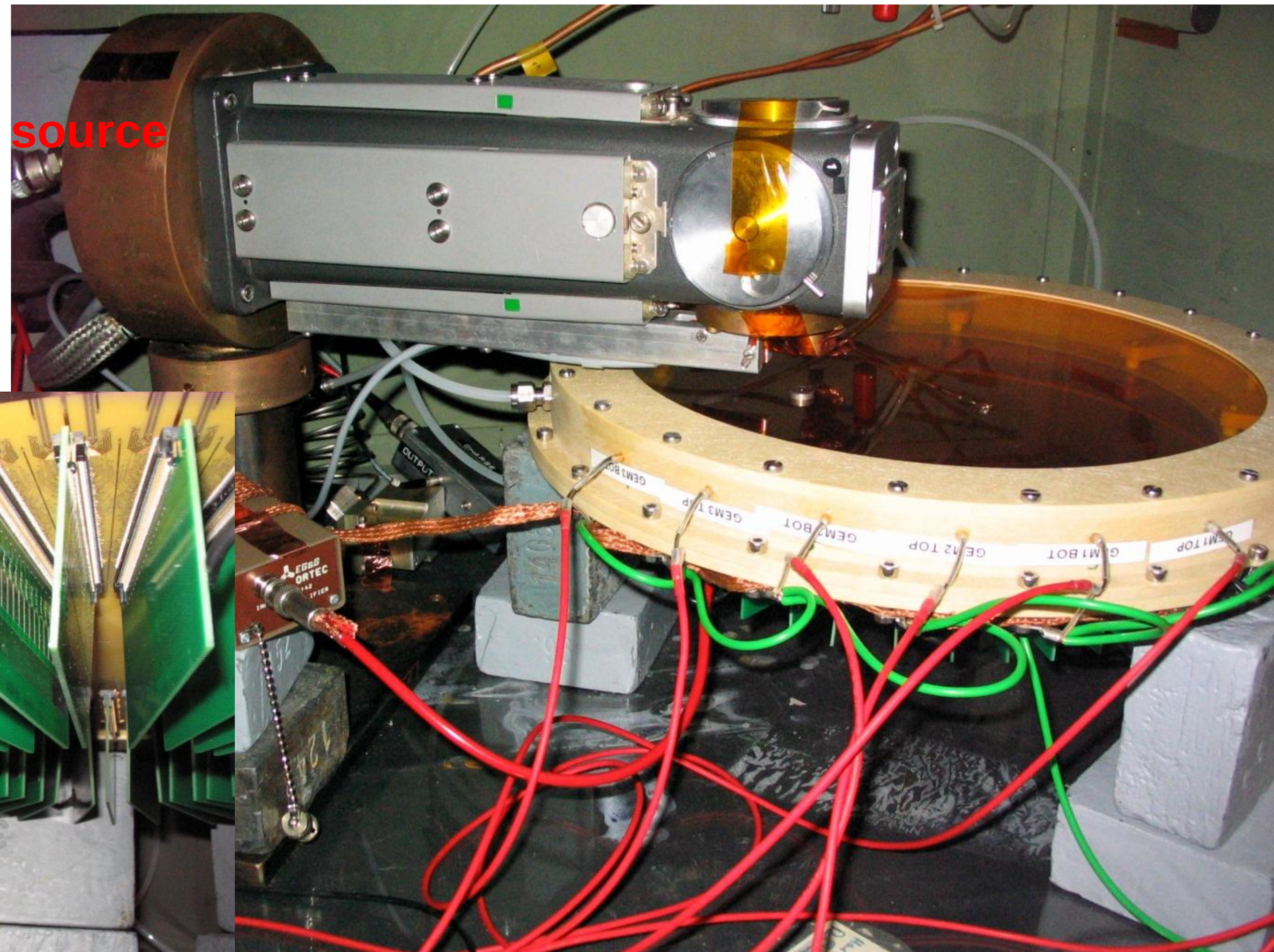
The Detector in the Lab

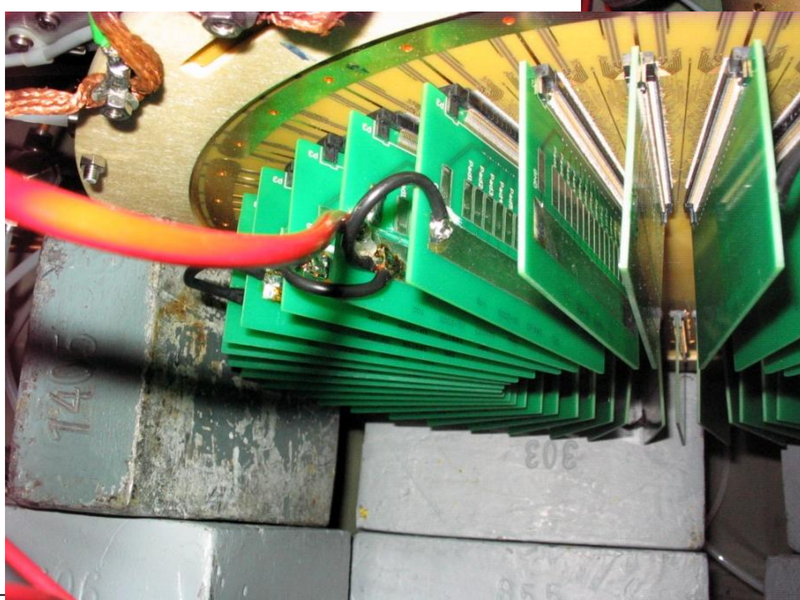


Gain measurements

Two main methods used:

- Pulse height method
  - Cu X-ray Tube
  - Fe^{55} Radioactive source
- Current method
  - Cu X-ray Tube





Pulse Height Heasurements

Fe^{55}-spectrum:

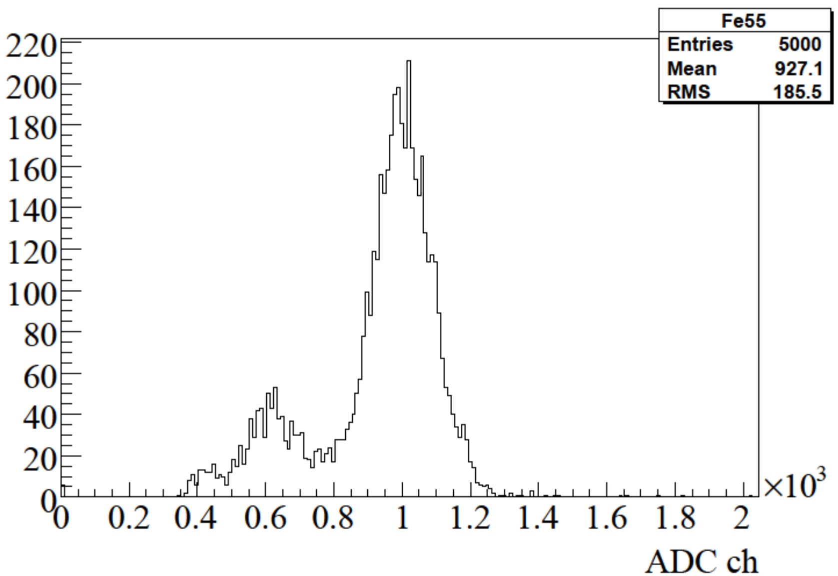
K $_{\alpha}$ 5.9 keV

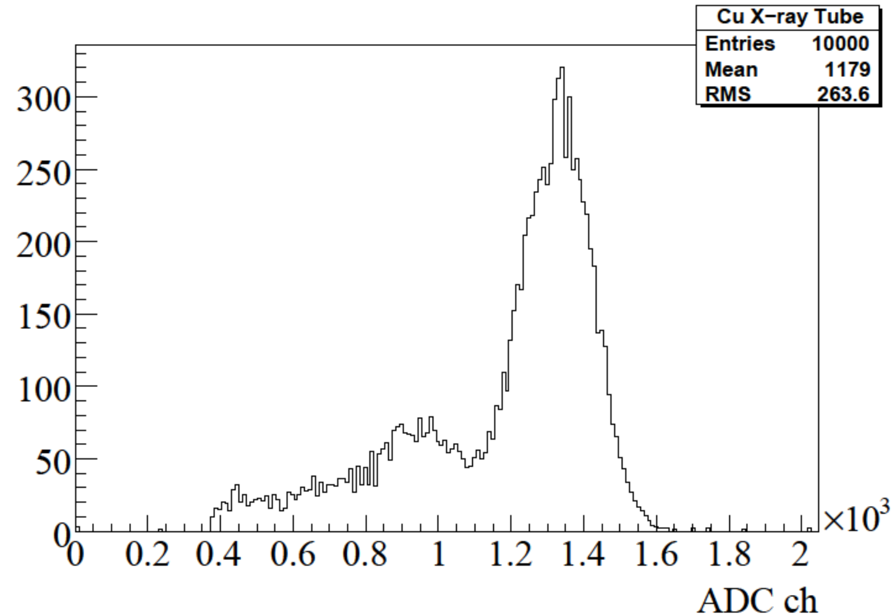
100% HV-settings

Cu-Spectrum:

K_{α} (80 %):8 keV

K_{β} (20 %):8.9 keV





Pulser Spectrum

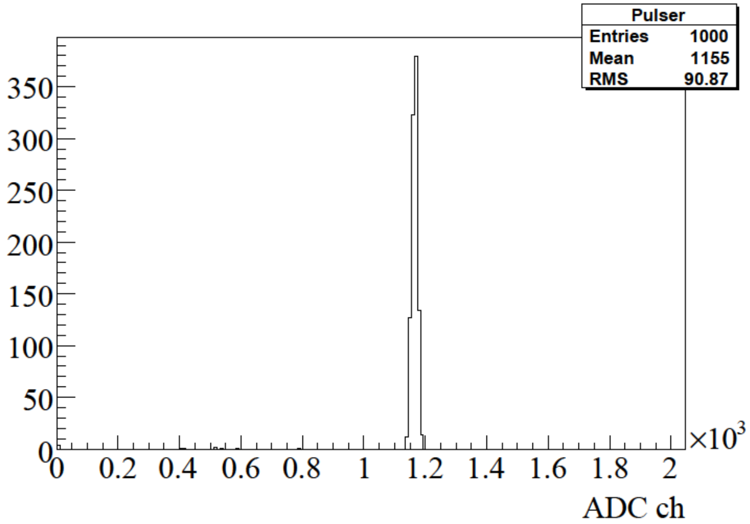
Inject known charges to the preamplifier

Make a linear fit for charge as a function of ADC-channels

$$G_{eff} = \frac{Q(ADC\,ch)}{n_e \cdot e} \qquad n_e = \frac{\Delta E}{W_i}$$

Disadvantage:

- Always need to be recalibrated



Current/Rate Method

Gain calculated according to this formula:

$$G_{\text{eff}} = \frac{I}{n_e \cdot e \cdot \varphi}, \varphi = \text{Rate}$$

Advantages

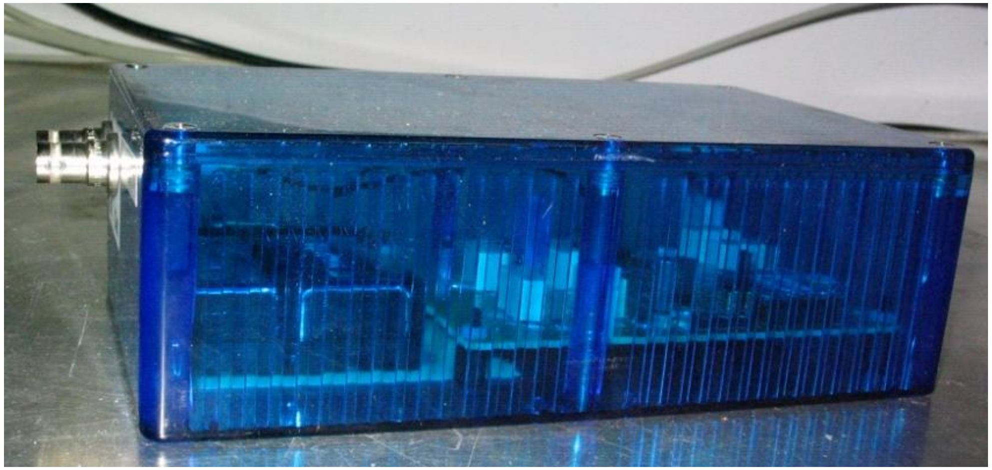
- A more direct measurement
- Simpler

Limitations:

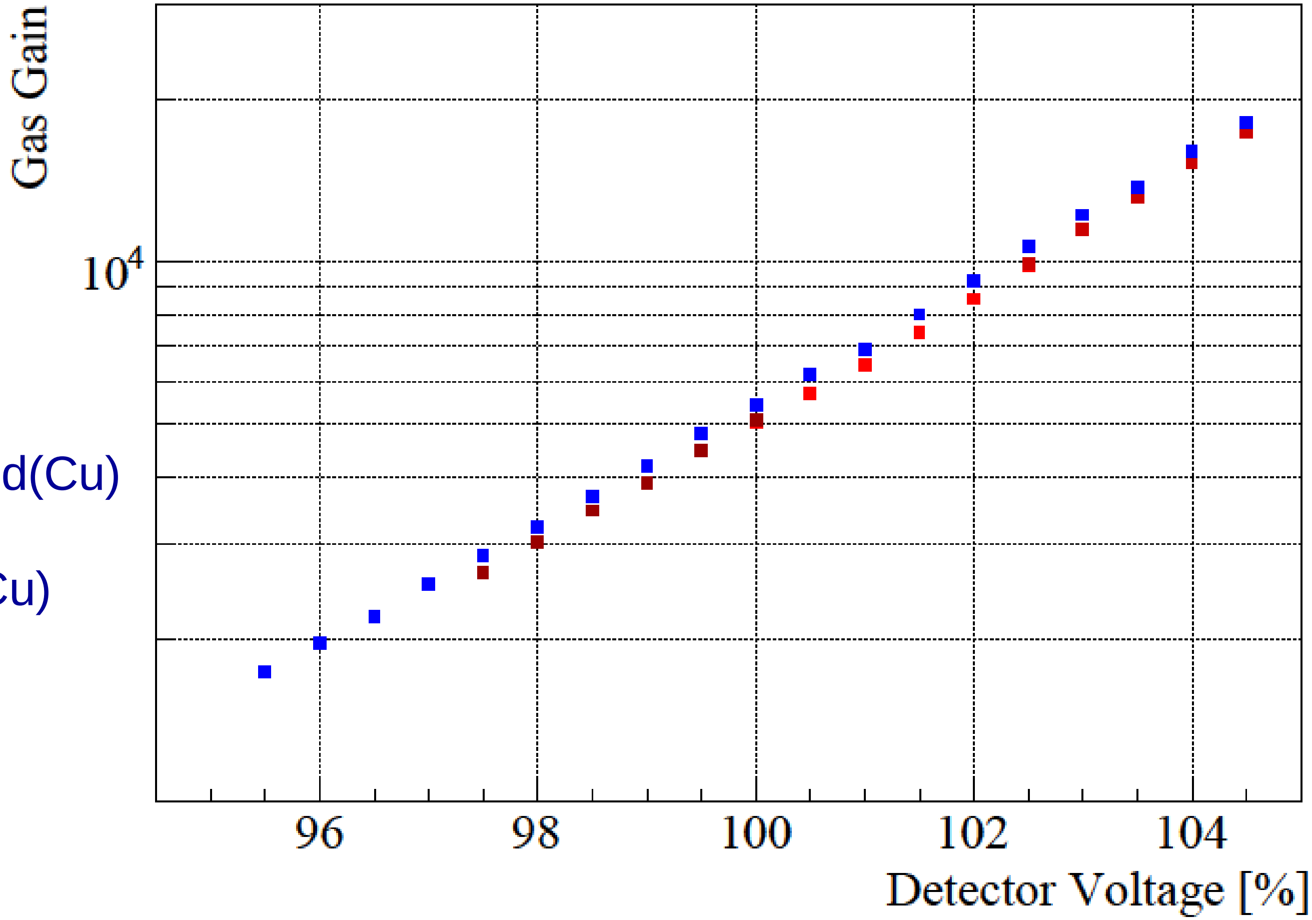
- Rate fluctuations

NanoAmpermeters

- Wireless (Xbee)
  - Tested using 8 modules simultaneously
- Floating on HV of up to 7 kV
- Controlled by a microcontroller
- 4 ranges auto switched
- Finest range $|I| < 10\,\mathrm{nA}$
  - 100 MΩ shunt
  - ±1 V
  - Resolution: ~5 pA



Gain Curve



- **Blue** points:
  - Current method(Cu)
- **Red** points:
  - Pulse height(Cu)

Conclusion and Outlook

Conclusion

- Detector working
- Padplane and GEM-foils working
- Absolute gain of the detector well understood

Outlook

- Uniformity tests
- Test with new AFTER/T2K front end cards