Discharge Probability Studies with 3x3 cm^2 THGEM

Berkin Ulukutlu

RD51 Collaboration Meeting & MPGD Stability Workhshop

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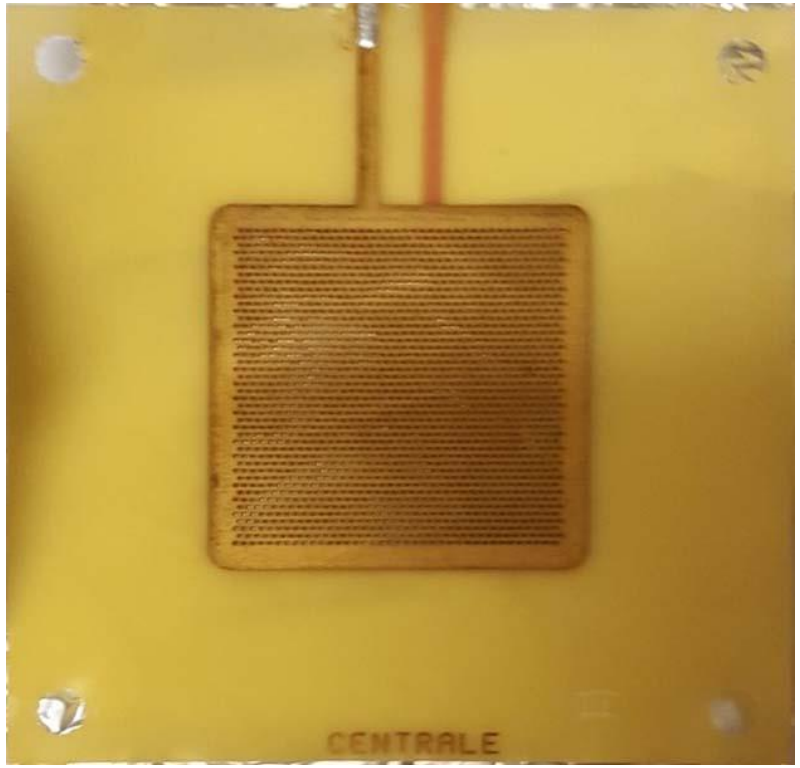
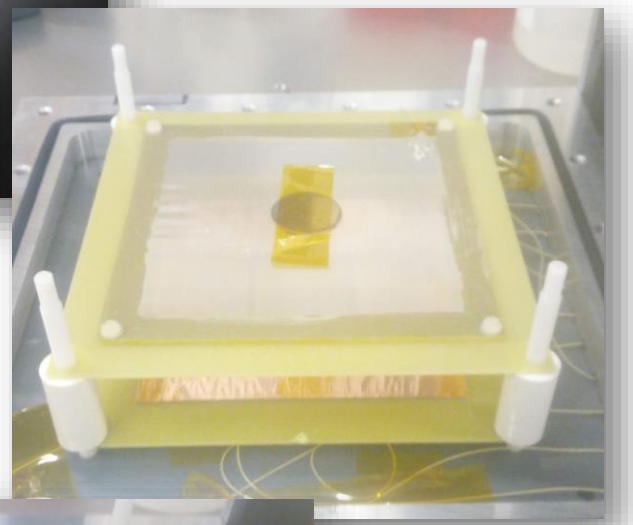
The Thick GEM

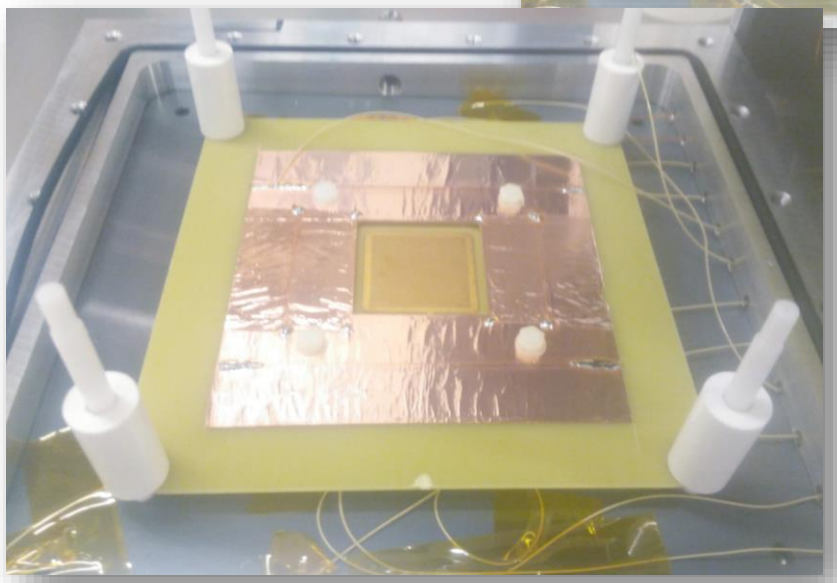
- 3x3 cm^2 THGEM from INFN Trieste
  (courtesy S. Dalla Torre, F. Tessarotto)
  - Thickness: 0.4 mm
  - Hole diameter: 0.4 mm
  - Rim: ≈20 µm
  - Hole pitch: 800 µm
- Goal: discharge probability studies for the future applications in photon detectors
- This work: comparison to single GEM measurements in Ar-CO_2 (90-10) and (70-30)



The Detector Setup

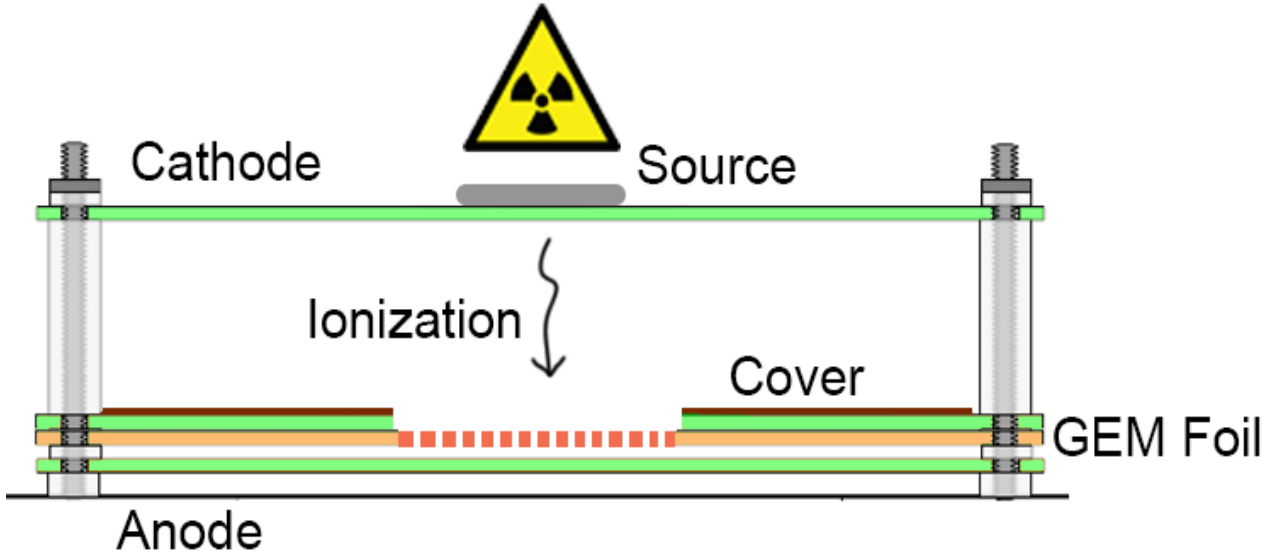
- Multi-independent-channel high voltage power supply from ISEG
- Keithley high precision ampere meter
- Scope and discriminator for counting discharges
- Cover electrode was added to avoid charging-up effects of large-area PCB material surrounding the active THGEM area





The Measurement Process

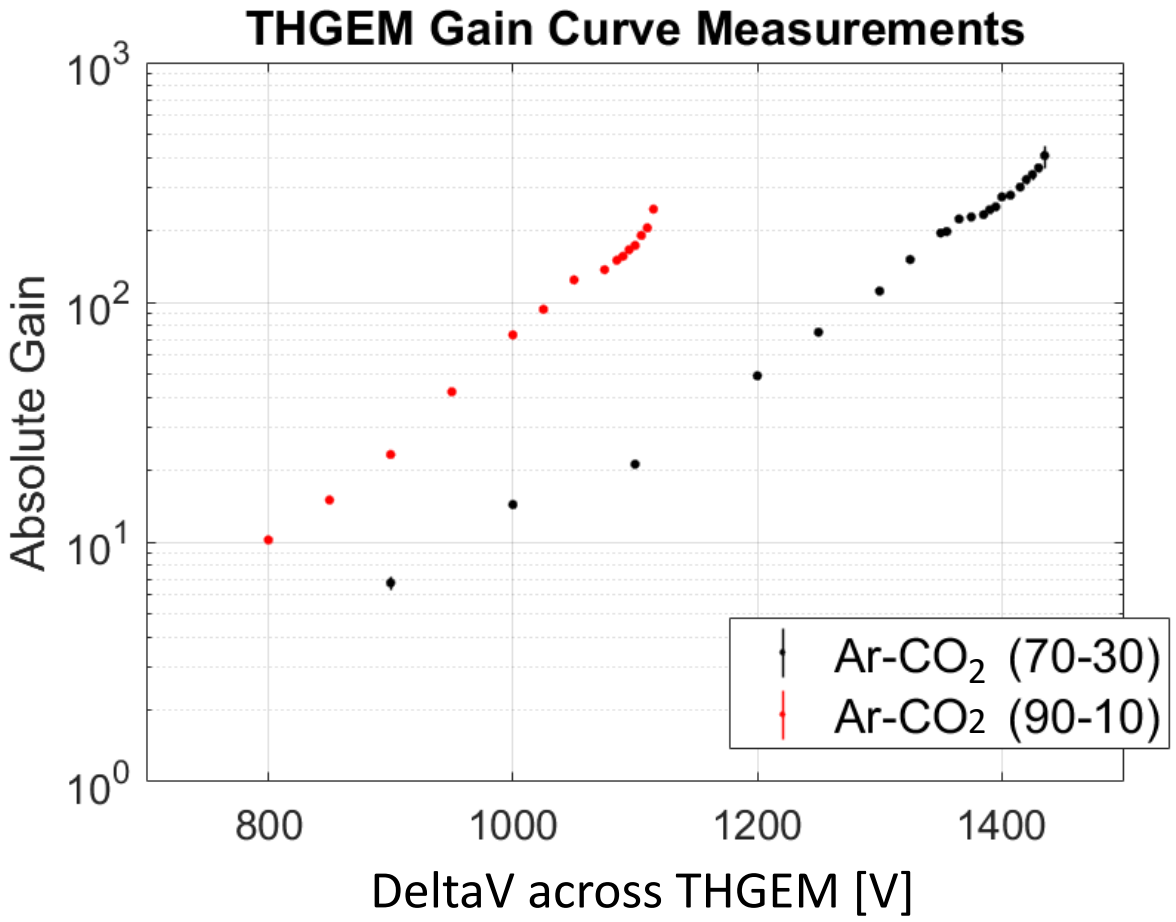
- Using alpha source (^{239}Pu+ ^{241}Am+ ^{244}Cm)
  - Rate: ~30 Hz
- E_{drift} = 400 V/cm, E_{ind} = 0 V/cm
- Absolute gain measurement:
  - Primary current (I_P) in the drift gap ~0.5 pA after offset subtraction
  - Amplification current (I_A) at GEM_{bot}
  - Gain = I_A / I_P



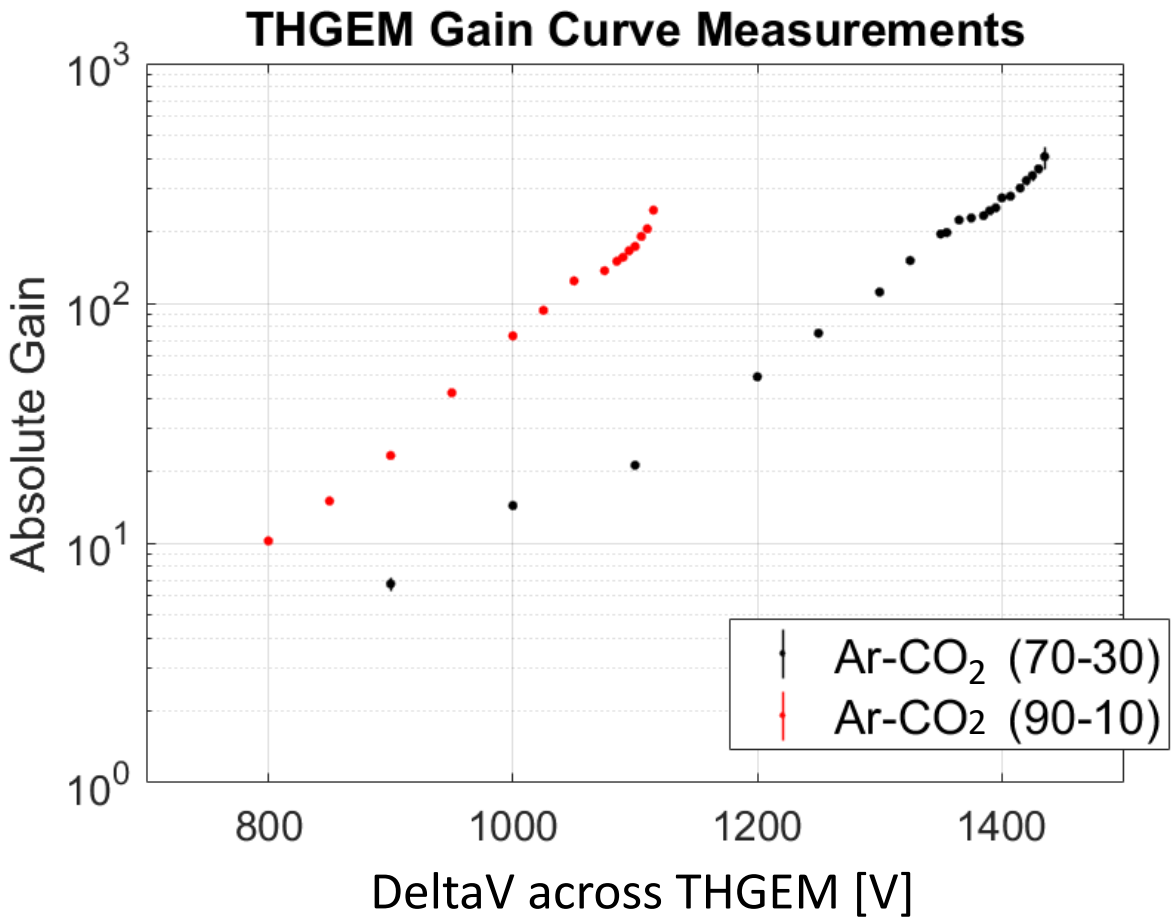
- Discharge probability:

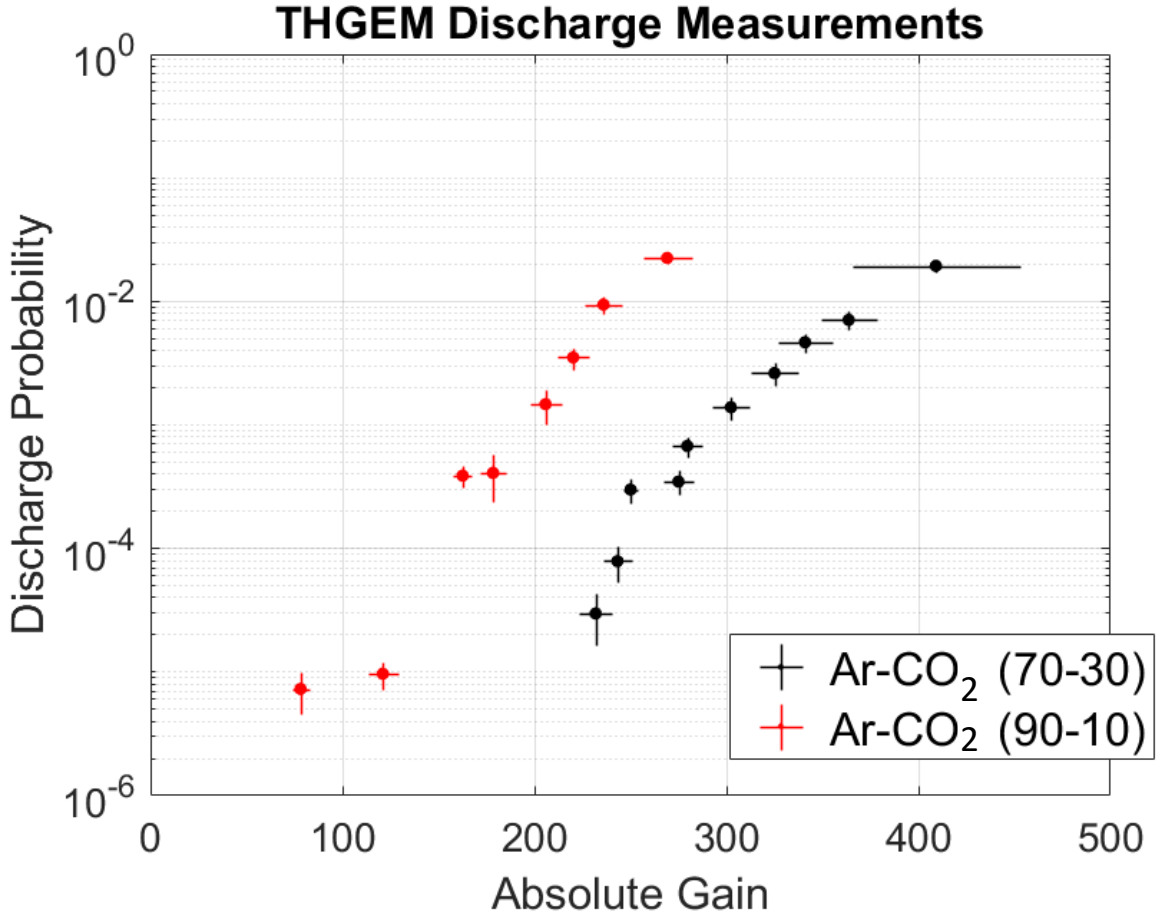
$$Discharge\ Probability = \frac{Discharge\ Rate}{Source\ Rate}$$

First Results

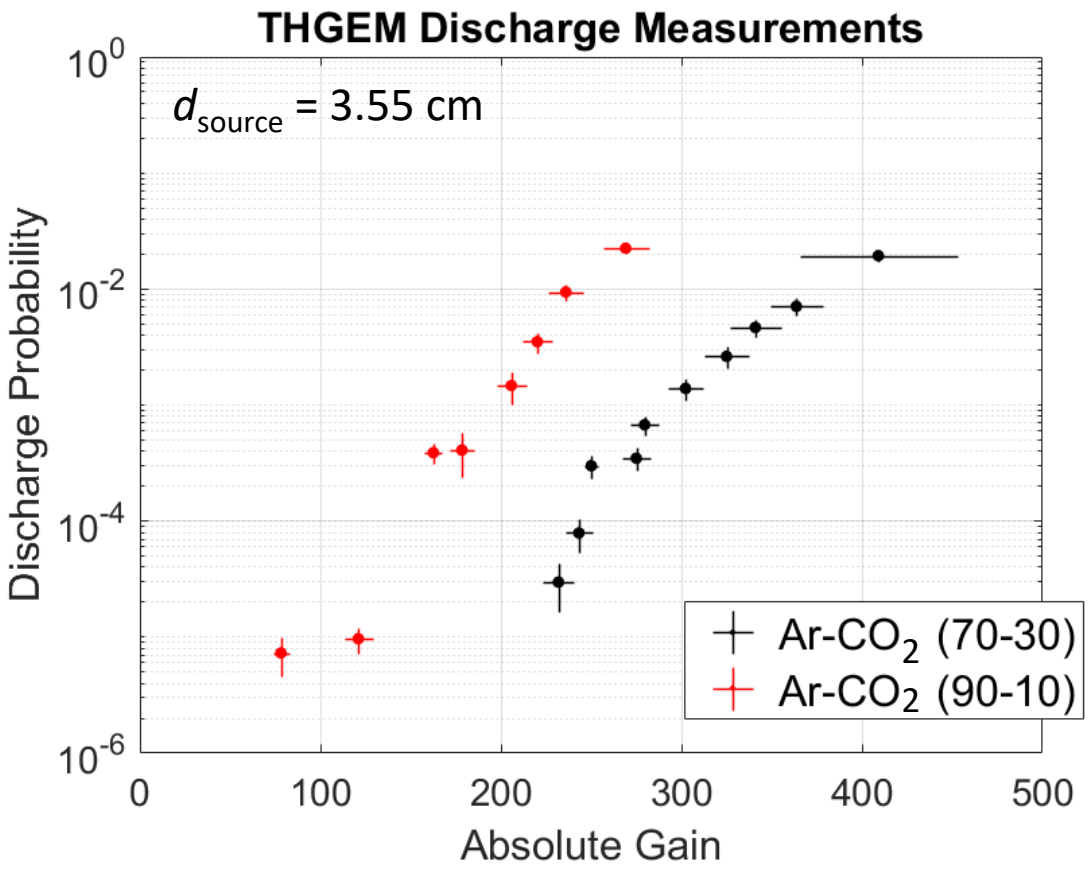


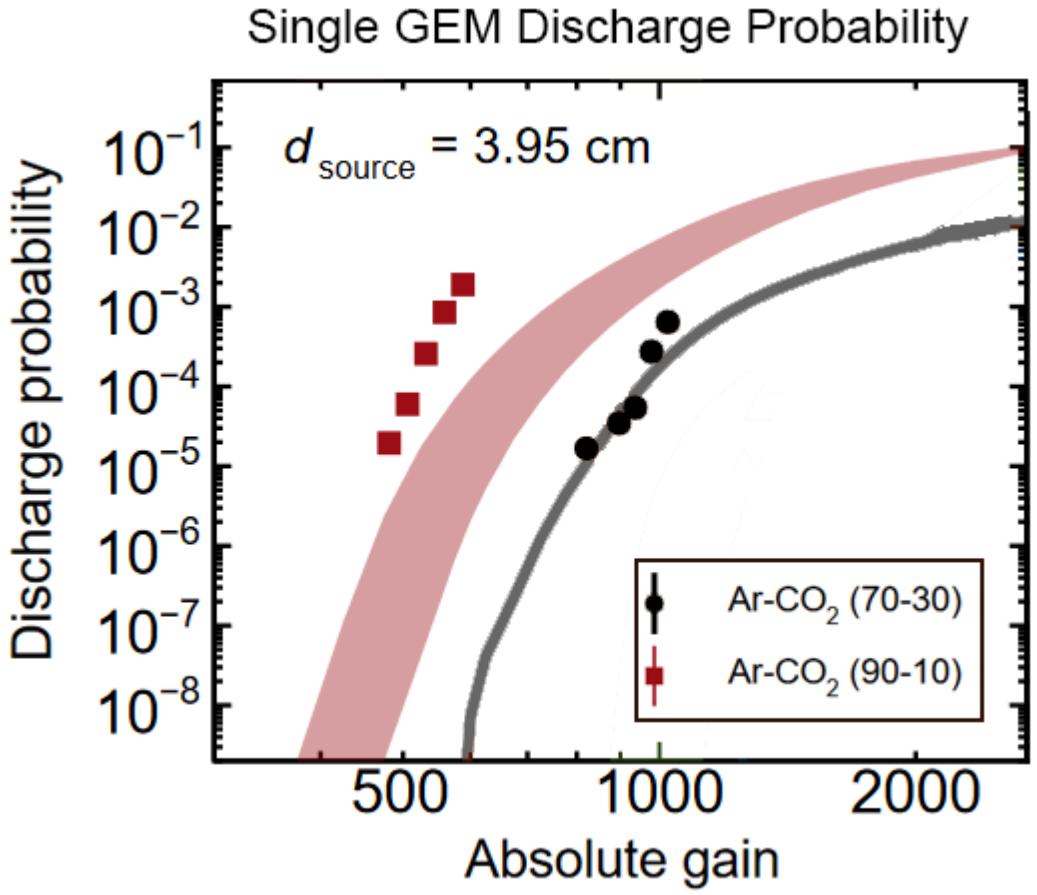
First Results





Comparison: THGEM & single GEM





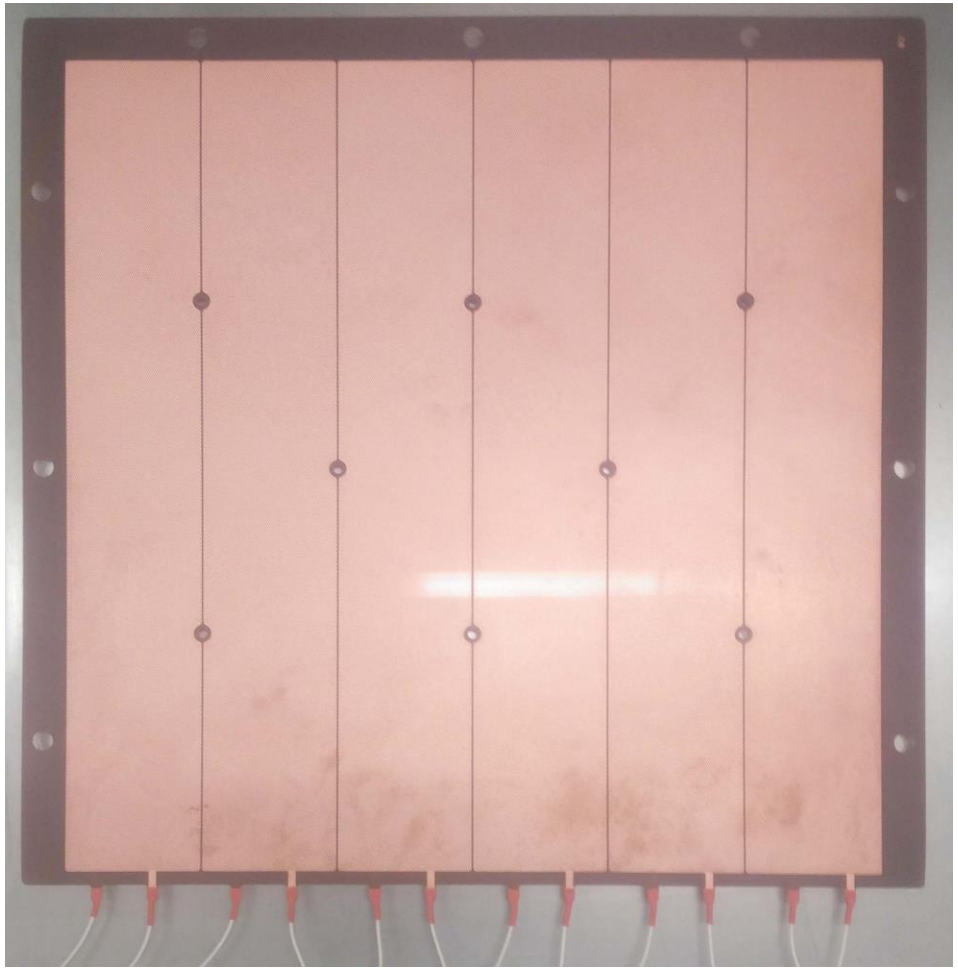
from "Charge density as a driving factor of discharge formation in GEM-based detectors"
P. Gasik, A. Mathis, L. Fabbietti, J. Margutti, NIM A 870 (2017) 116

Conclusions

- New setup for discharge probability studies with THGEMs
- First measurements in Ar-CO_2 mixtures
  - Discharge probability in (70-30) lower than in (90-10), as expected
- Discharge probability in THGEM is higher than in normal single GEM

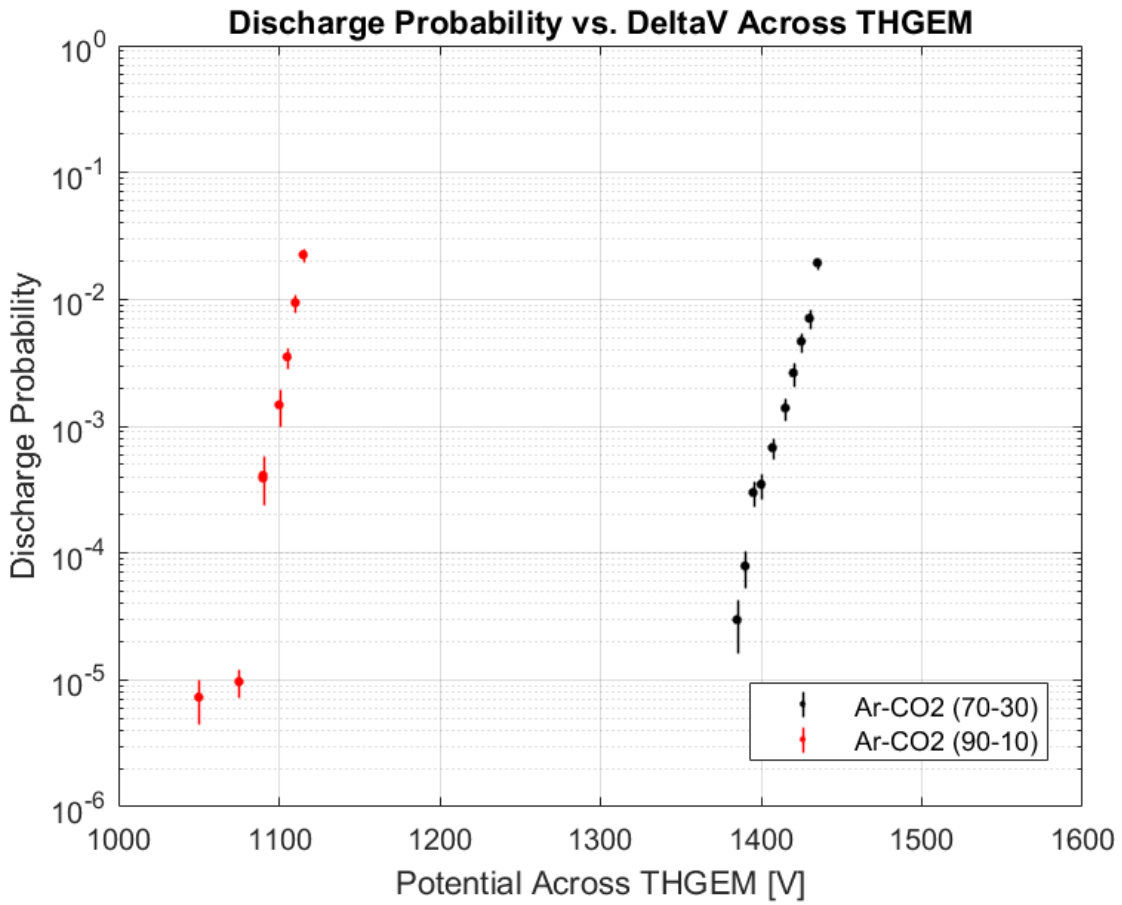
Outlook

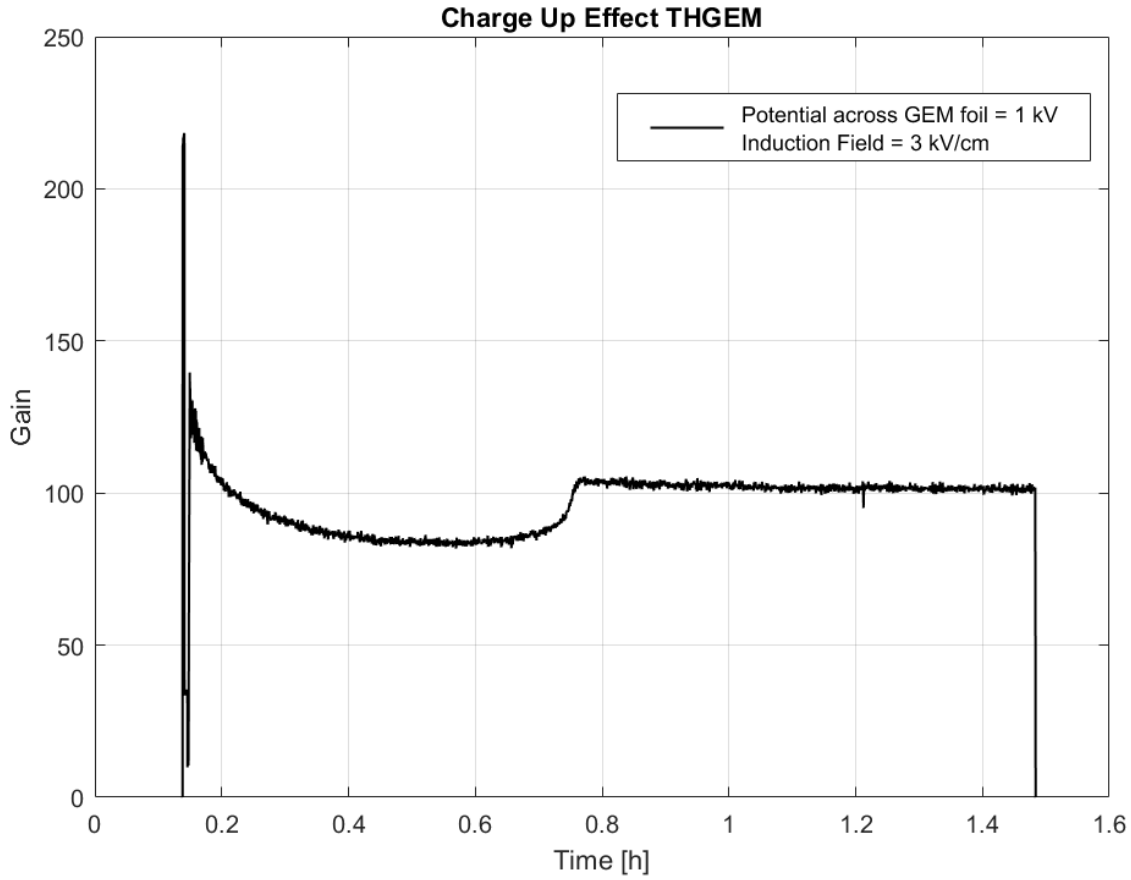
- Comparison with Geant4 simulations (see A. Mathis' talk in WG4)
  - Charge density hypothesis?
  - More charges per THGEM hole
- Continue measurements with other gas mixtures (Ne-CO_2, Ar-CH_4)
- Measurements with 30x30 cm^2 THGEM (courtesy of INFN Trieste)



Thank you for your attention!

Encore


Discharge Probability vs. DeltaV Across THGEM
Discharge Probability
Potential Across THGEM [V]
Ar-CO2 (70-30)
Ar-CO2 (90-10)


Charge Up Effect THGEM
Gain
Time [h]
Potential across GEM foil = 1 kV
Induction Field = 3 kV/cm