

Detector Characterisation - THGEM

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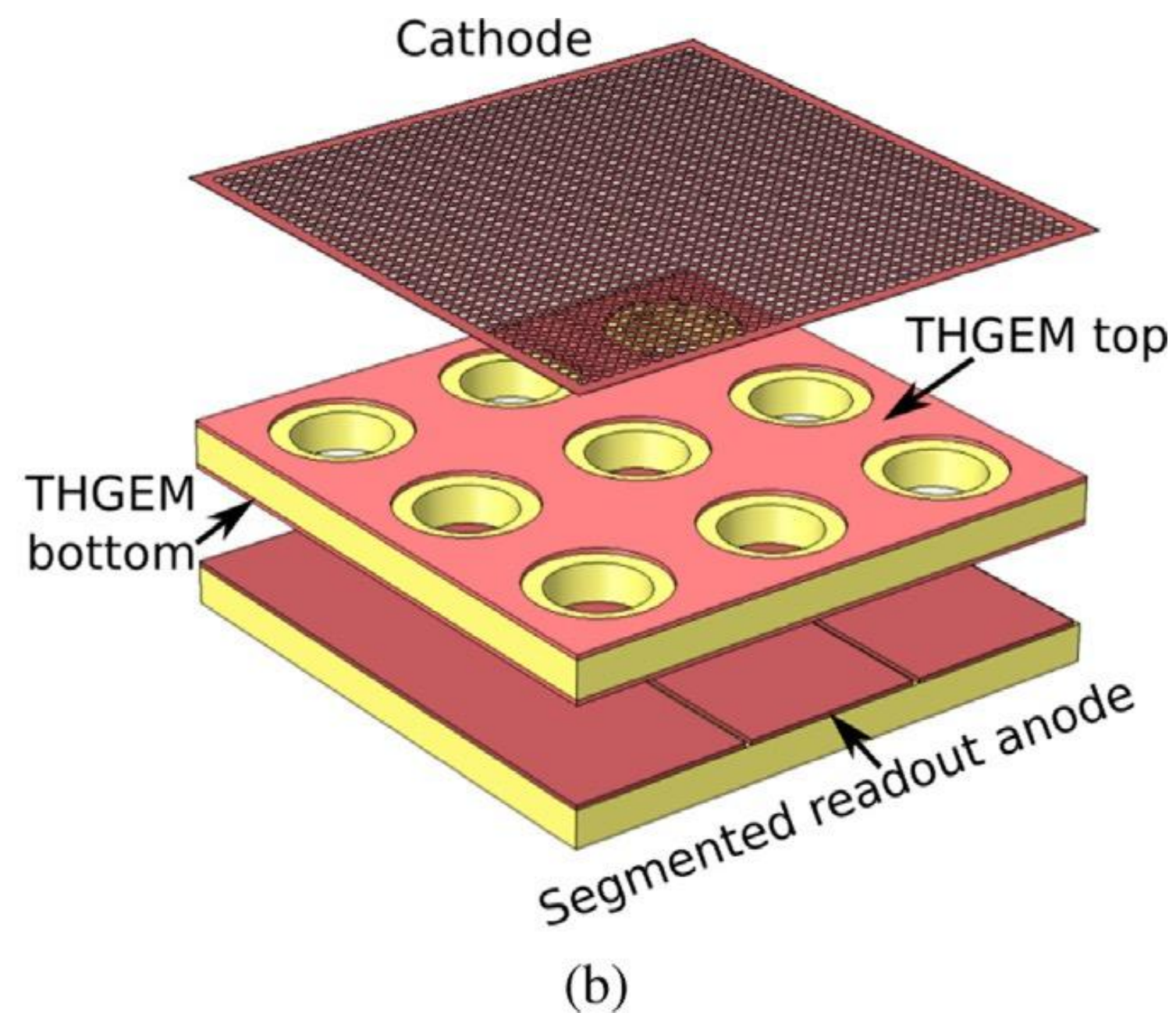
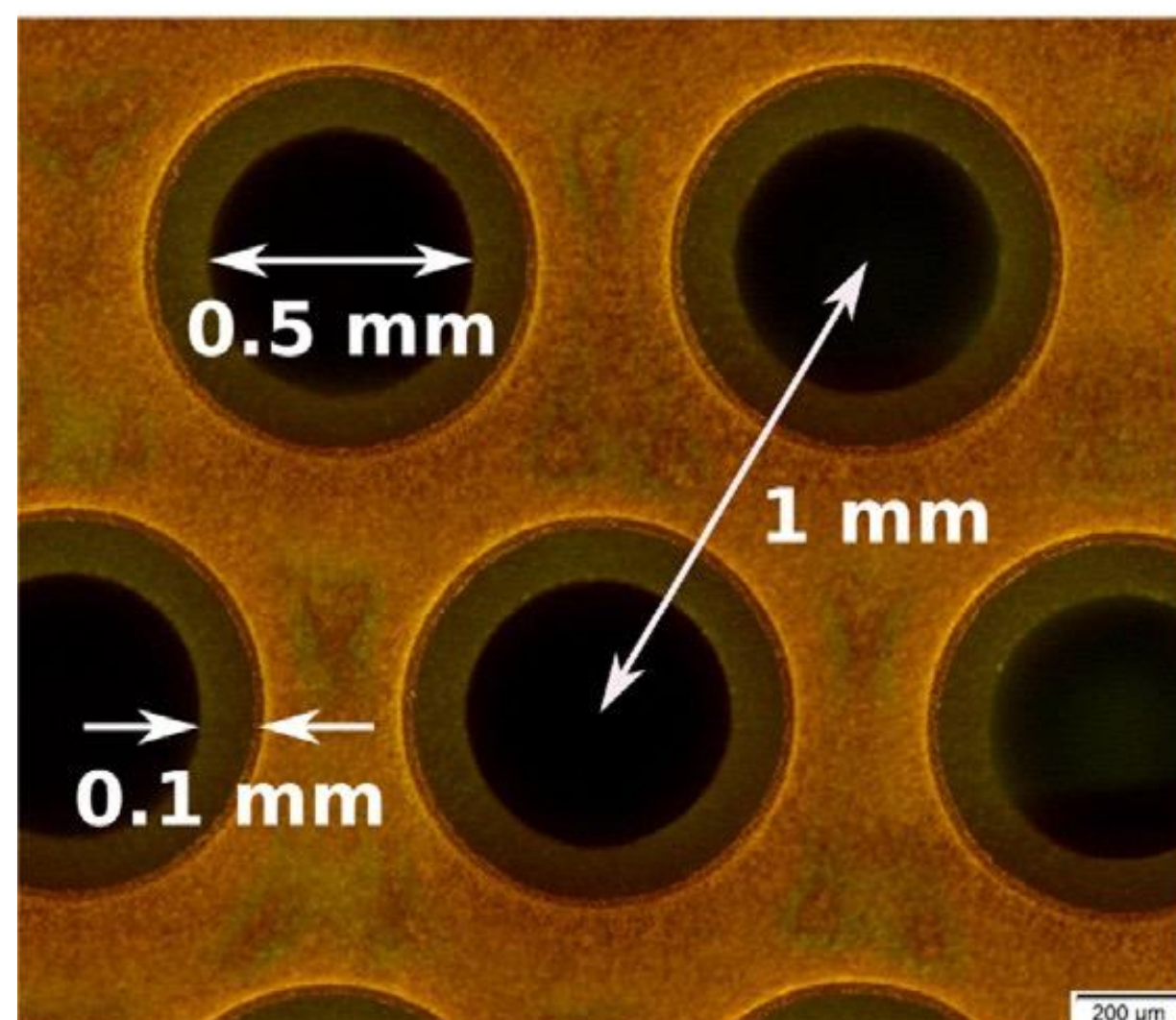
Outline

Charge production and transport mechanisms in a THGEM detector

- THGEM Overview
- Experimental Set-up
- Data Acquisition & Results
- Analysis and Discussions
- Summary

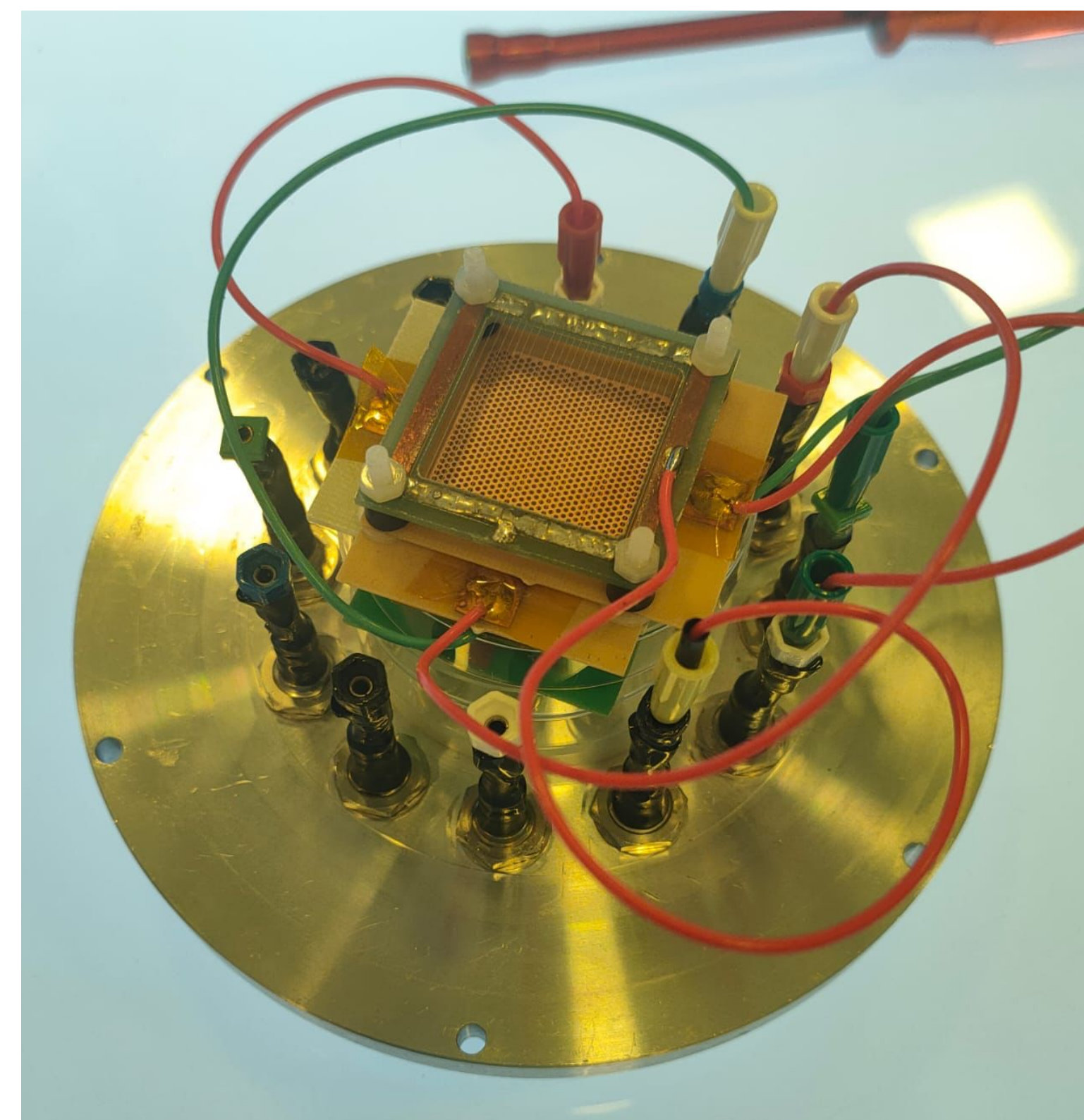
THickGem Detector Overview

Principle of Operation



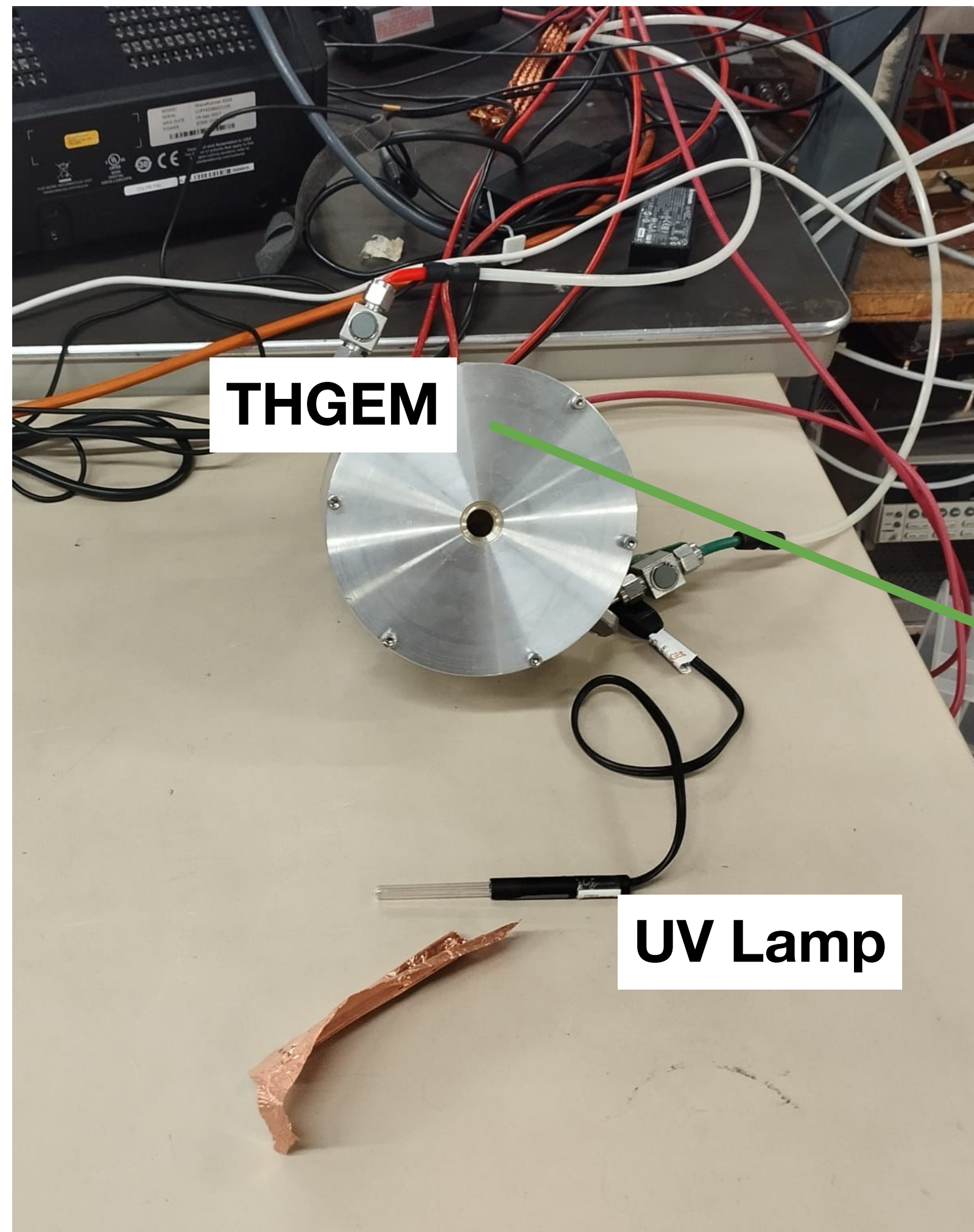
- THick GEM (THGEM) Detectors are geometrically scaled GEM detectors
- Can be cheaply produced in large scales

- THGEM assembled during Lab 1 of the RD51 MPGD School

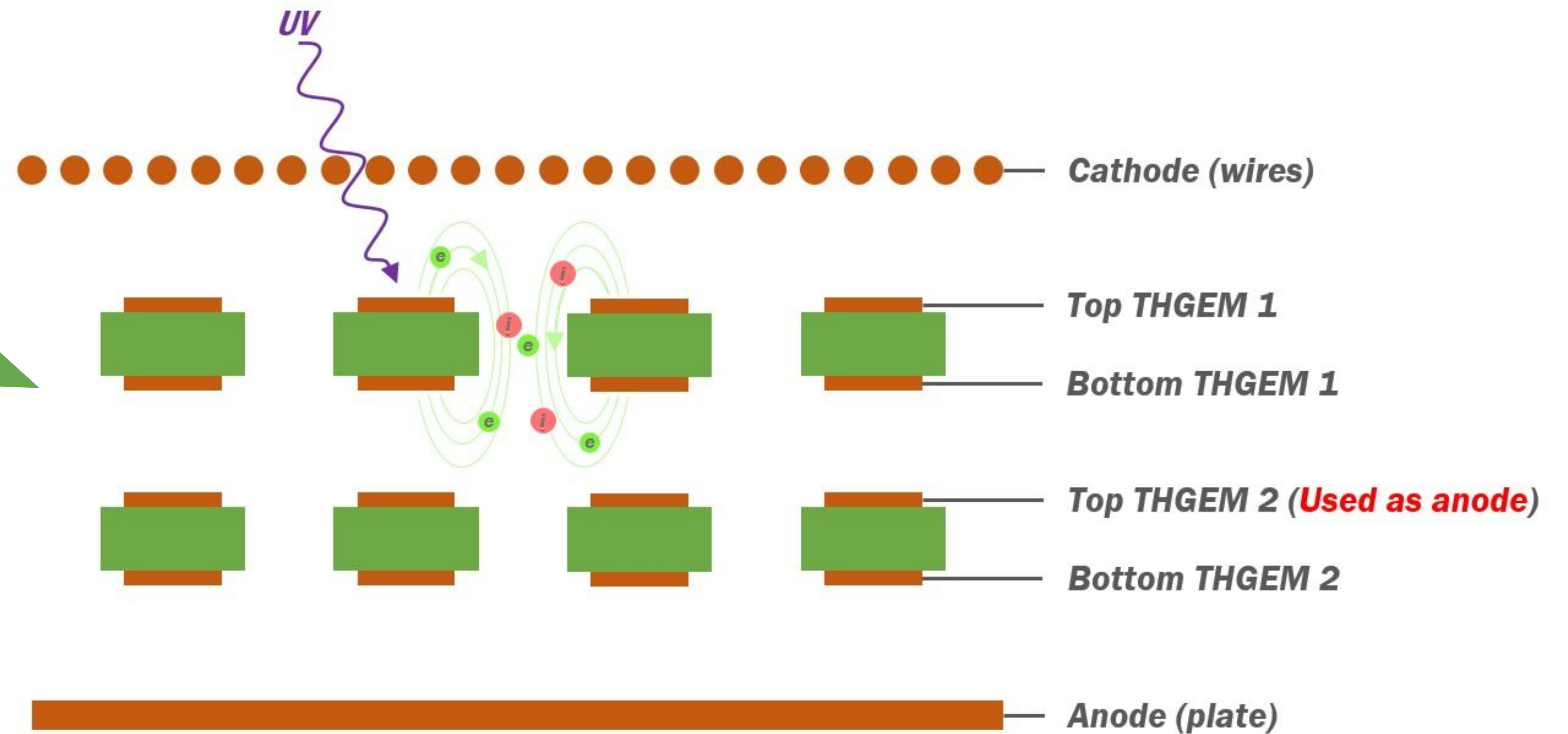


Experimental Set-up

THGEM Characterisation



- double THGEM structure using 93% Ar + 5% CO₂ + 2% iC₄H₁₀
- UV Lamp (Hg) with lines in the 200 - 600nm range



First experience

Establishing gain & working point

Object under study:

- double-THGEM filled with Ar:CO₂:iC₄H₁₀ (93:5:2).

Detector operation:

- Detector configured as a single-THGEM (ignoring anode and adjacent THGEM layer).
- Remaining 4 electrodes piloted in tension through a power supply.

Signal:

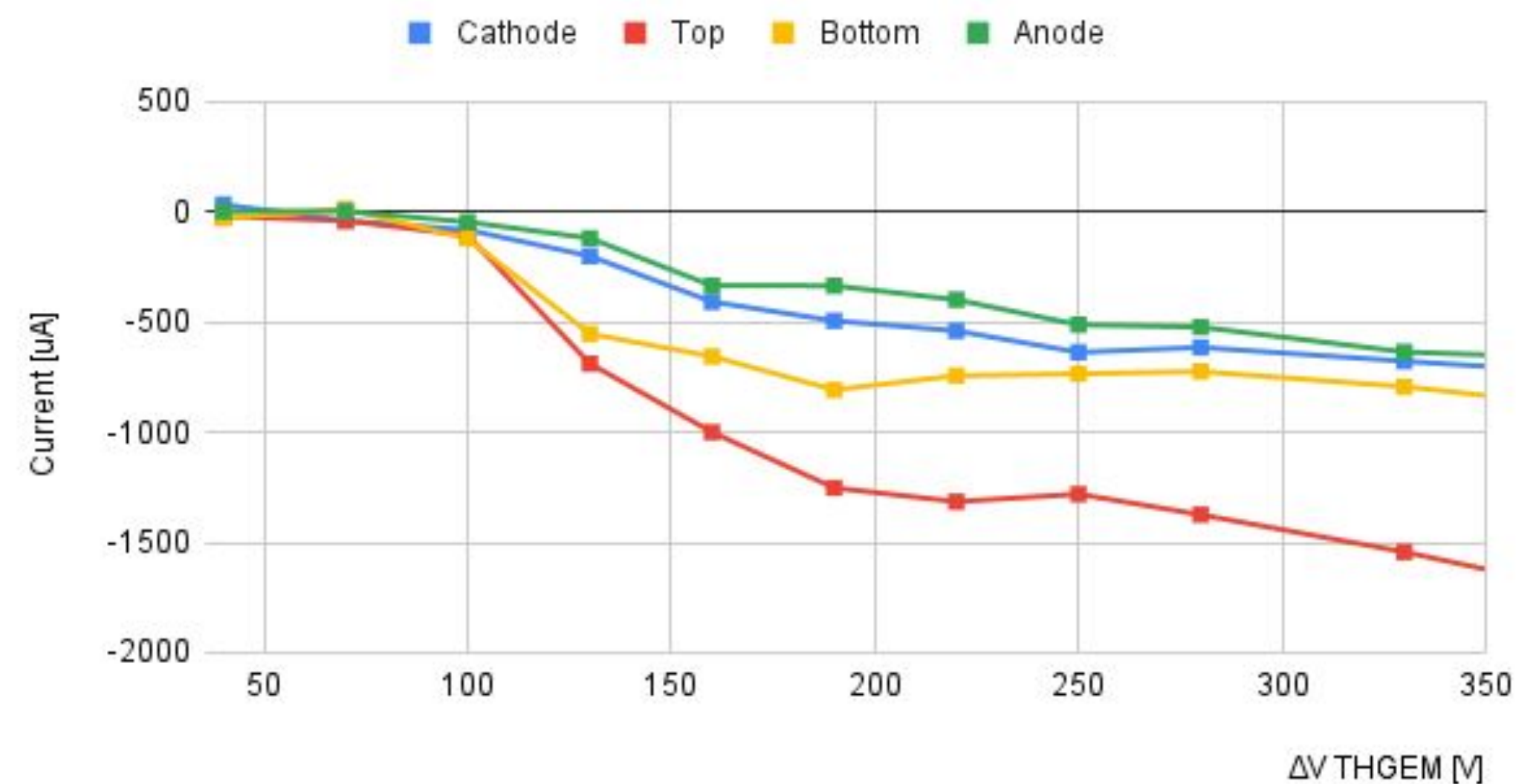
- Current measured on the 4 electrodes with an oscilloscope.

Data Acquisition & Results

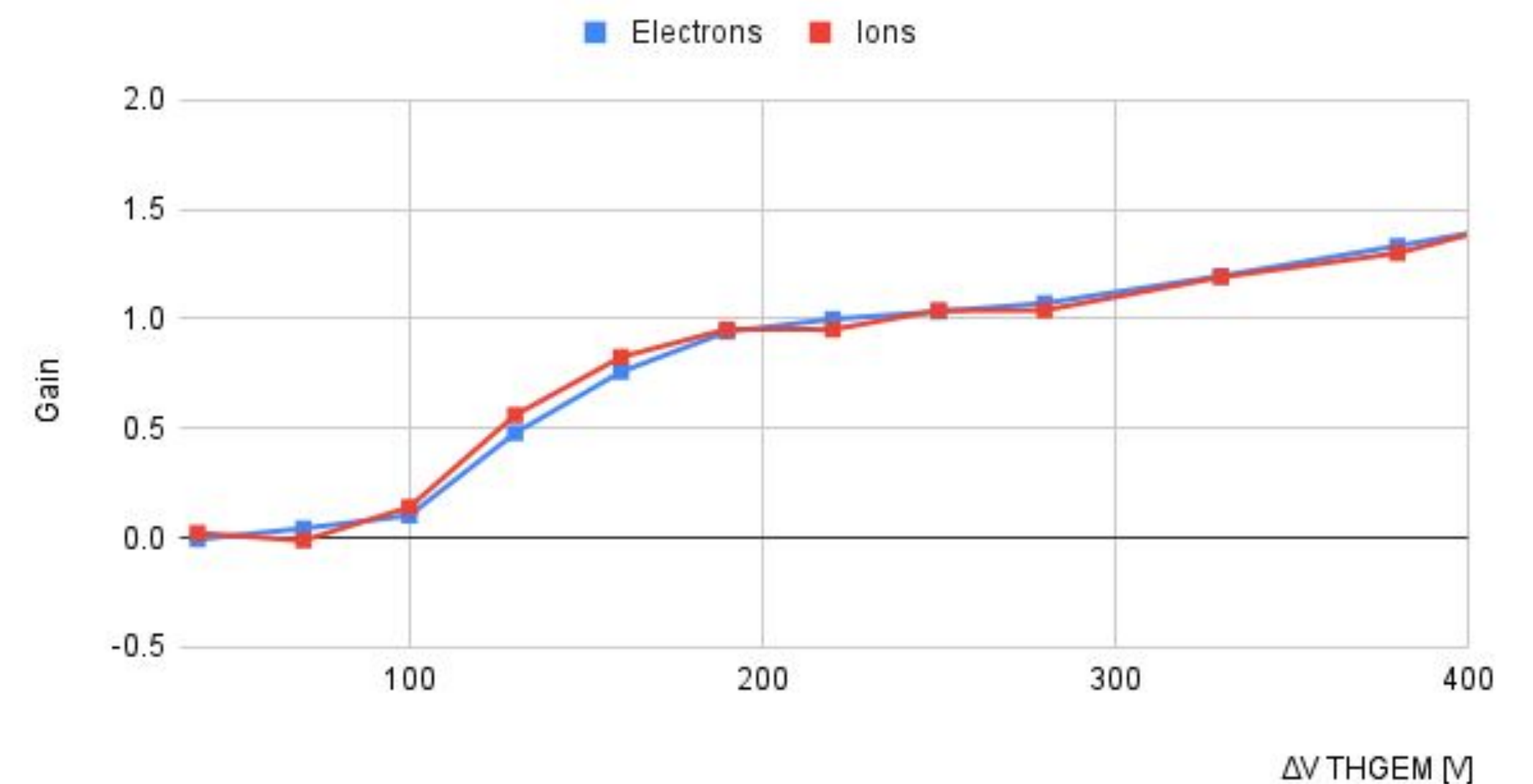
THGEM Characterisation

- Read-out **current plateau** observed at low amplification (corresponding to the charges freed by the UV radiation only).
- Electron/Ions curves (identified respectively by the sum of currents on anode/bottom THGEM and cathode/top THGEM) show analogous gain behaviour.

Readout currents (low amplification)



Gain (low amplification)



Notes:

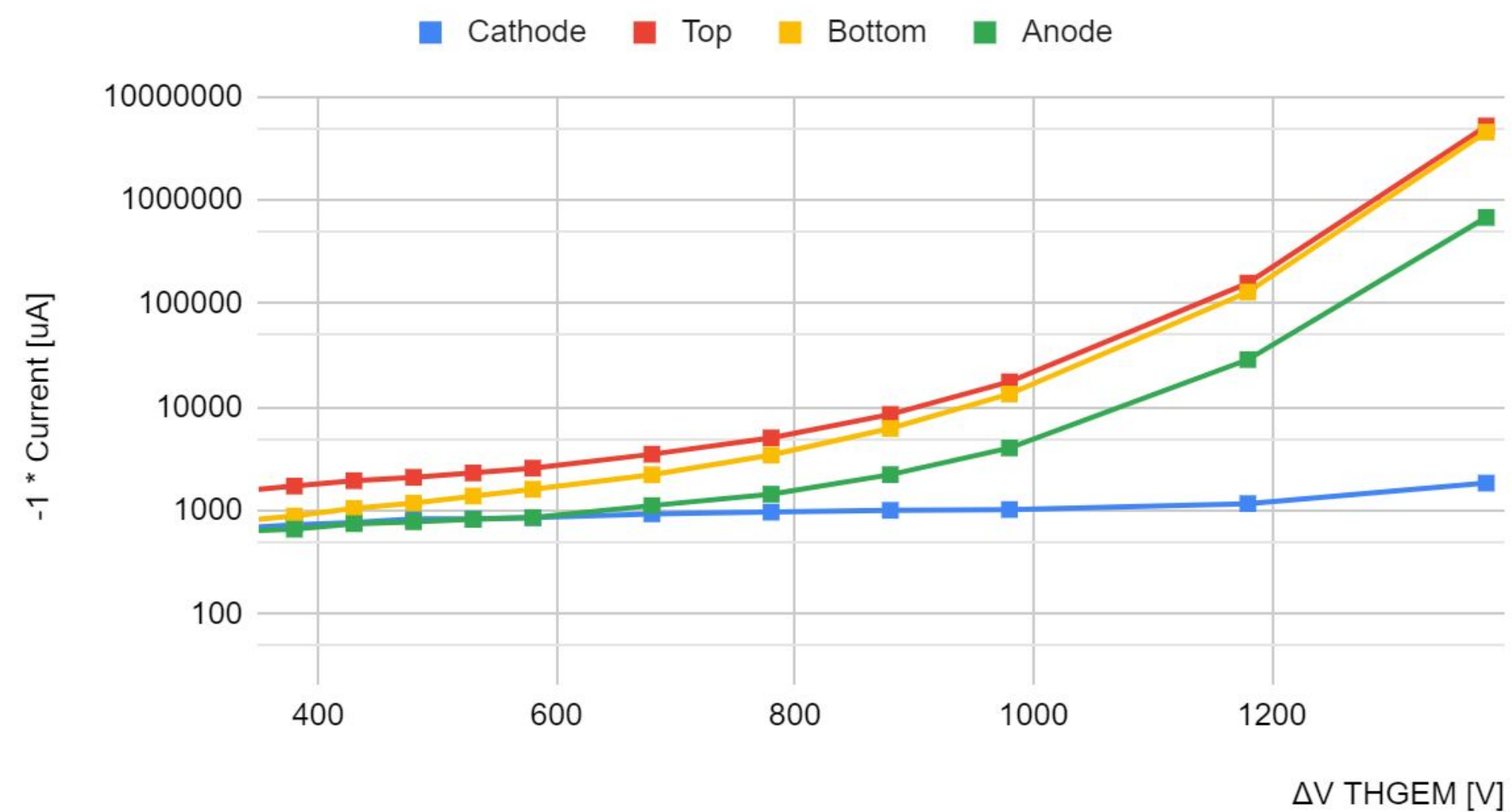
- Current measurements are taken after offset removal.
- Gain measurements are taken relatively to the plateau current.

Data Acquisition & Results

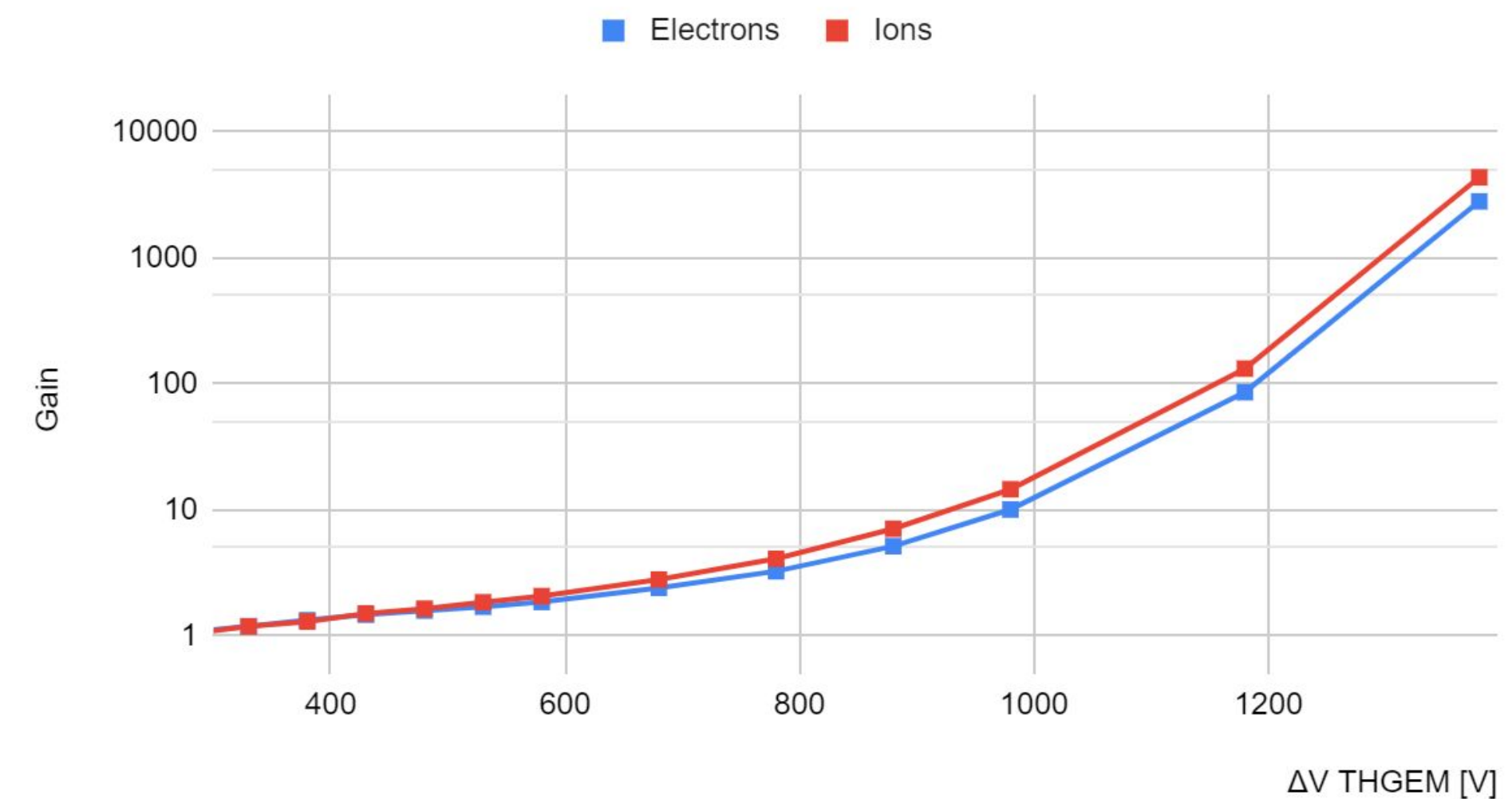
THGEM Characterisation

- Electrons/ions multiplication (i.e. production of additional charges in the THGEM holes due to the interaction of high energy electrons with the gas) is correctly observed at higher values of amplification tension as an increase of the electrode currents.

Readout currents (high amplification) - log scale



Gain (high amplification) - log scale



Second experience

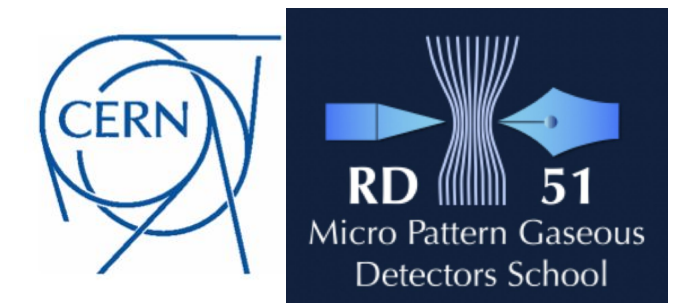
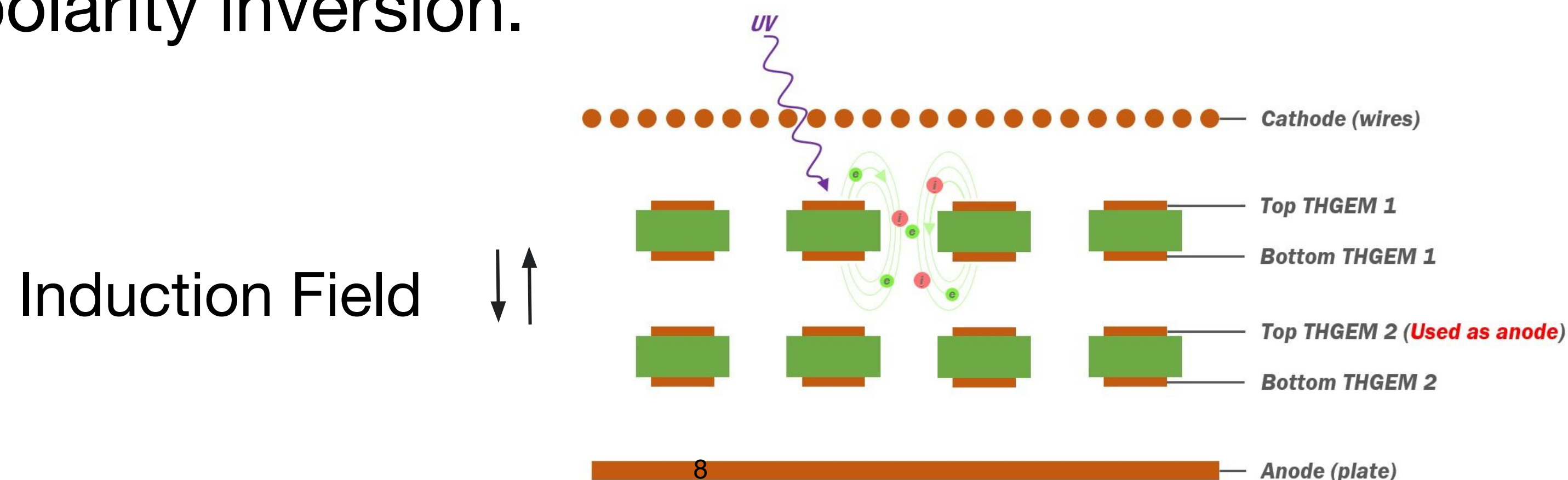
Effects of varying induction field

Induction field:

- (in a THGEM or GEM) typically the electric field generated between the *anode* and the adjacent *amplification layer*.

Interest of the experience:

- Observe the changes in read-out current due to the varying induction tension differences (ranging from $-600V$ up to $+600V$) and focus on the effects brought on by polarity inversion.

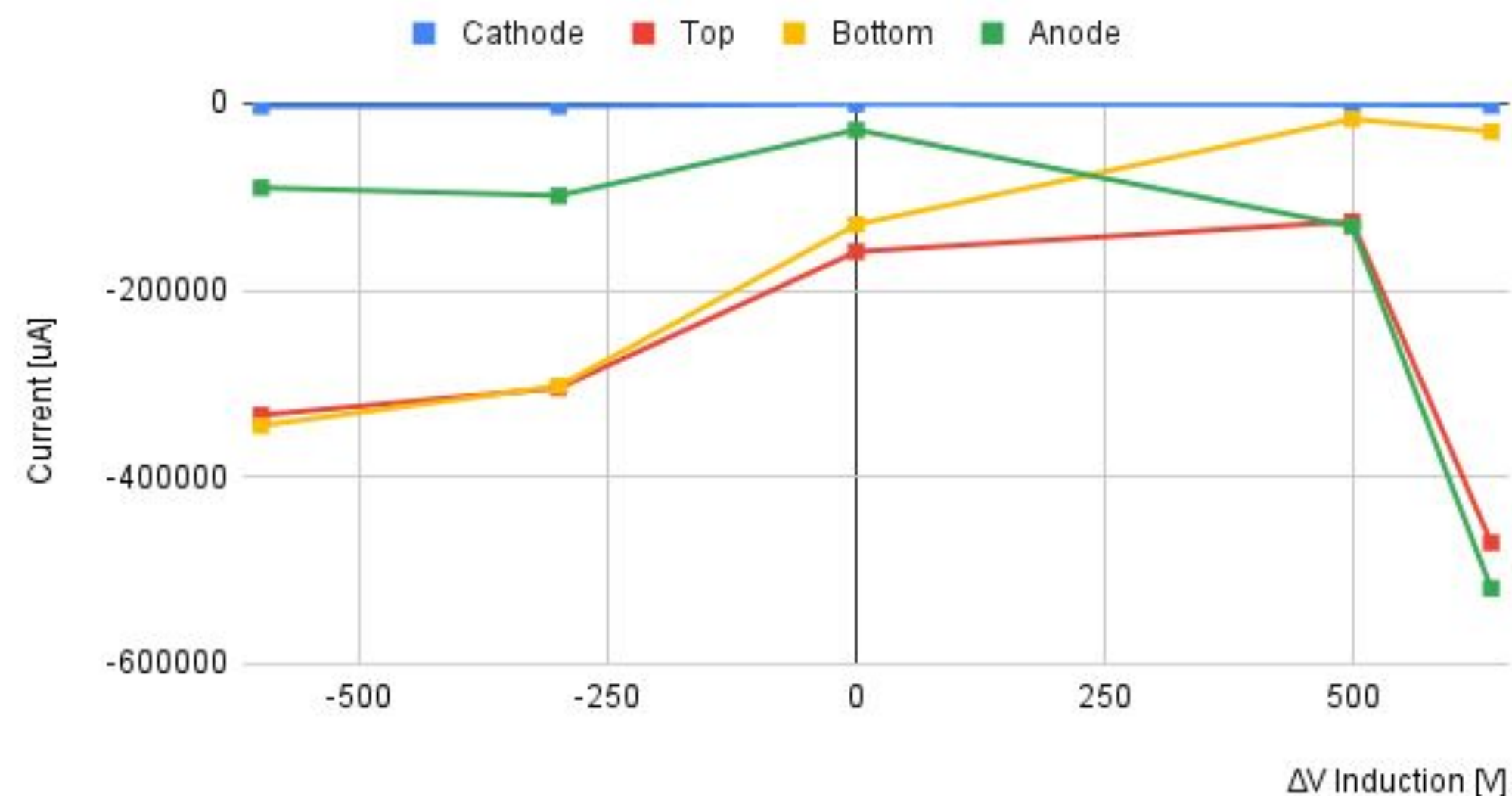


Data Acquisition & Results

THGEM Characterisation

- **Reversed polarity:** As expected, more electrons are collected on the bottom plate while the anode current also increases because it now can collect ions.
- **Matching polarity:** In this configuration the detector works more closely to its intended use and thus the most charge is collected on anode and top THGEM layer.

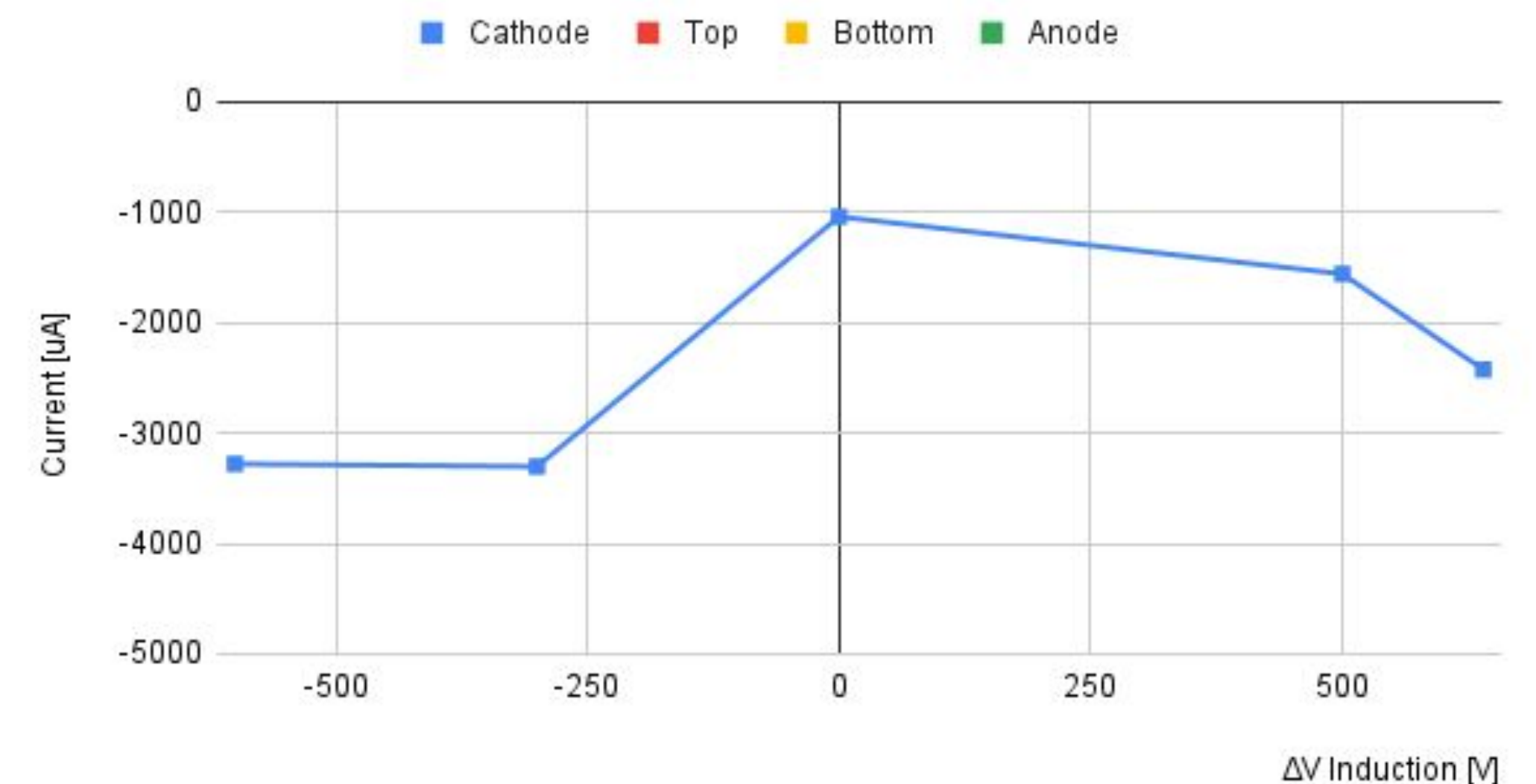
Current Vs Induction amplification



Reversed

Matching

Current Vs Induction amplification (Cathode only)



Summary

THGEM Characterisation

- Two charge multiplication sectors:
 - Plateau (almost no multiplication) below 350 V
 - Increasing charge multiplication above 350 V
- Polarity inversion:
 - Reversed induction Field: higher current in Bottom and Top
 - Matching induction Field: higher current in Anode and Top