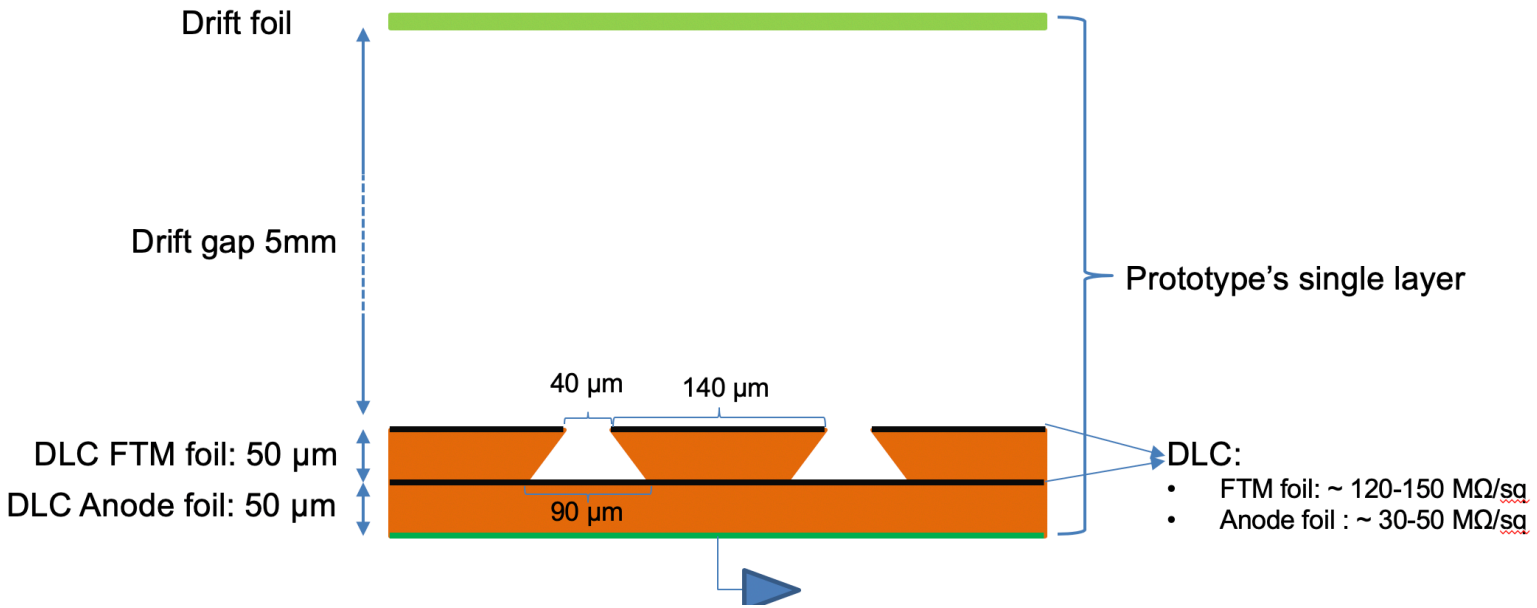
Progress on the FTM prototype

A small look in the past

- The past prototype
  - DLC FTM foil
    - 40/90 µm TOP/BOTTOM holes
    - 140 µm pitch
  - DLC Anode foil
    - Current measurement



Measurements - Setup

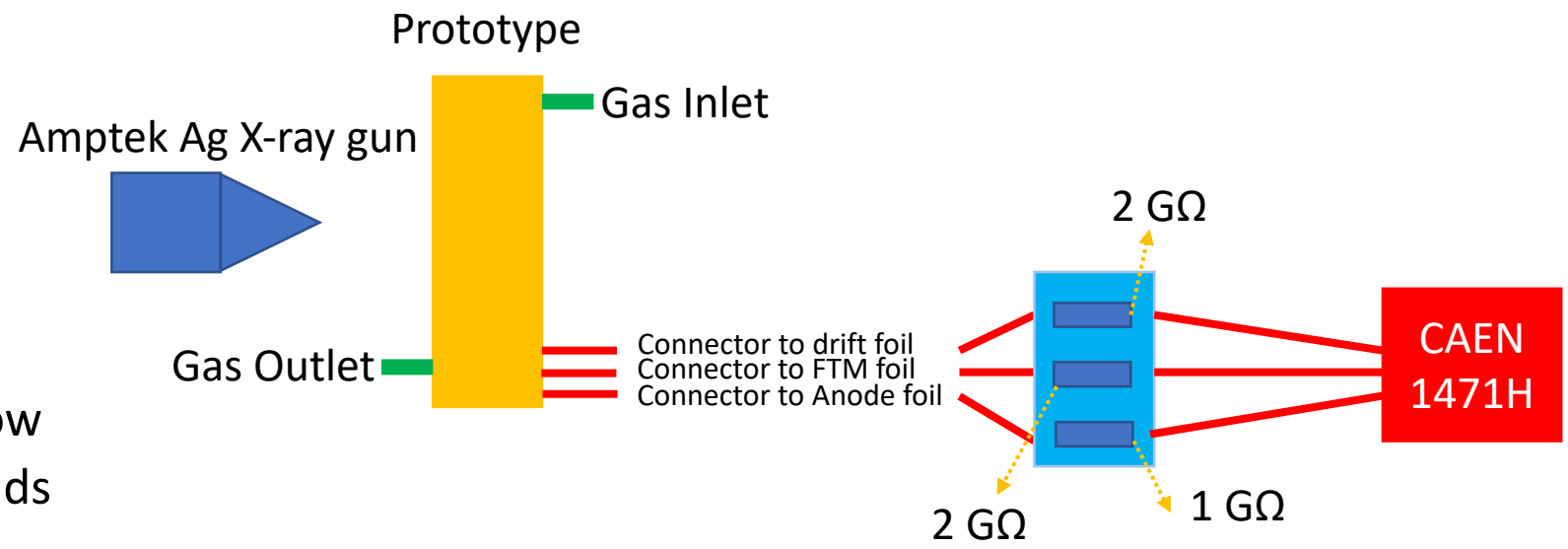
- Main goal to measure the effective gain
  - Estimation of the ionization current

- Setup
  - CAEN 1471H

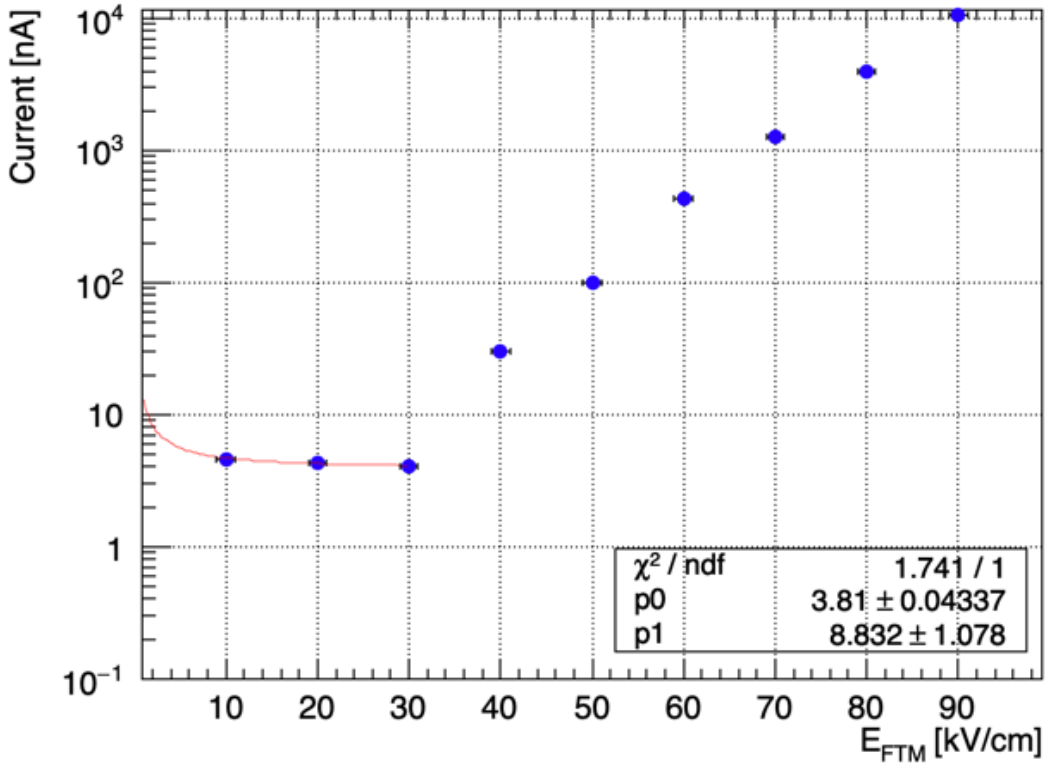
  has 50pA current

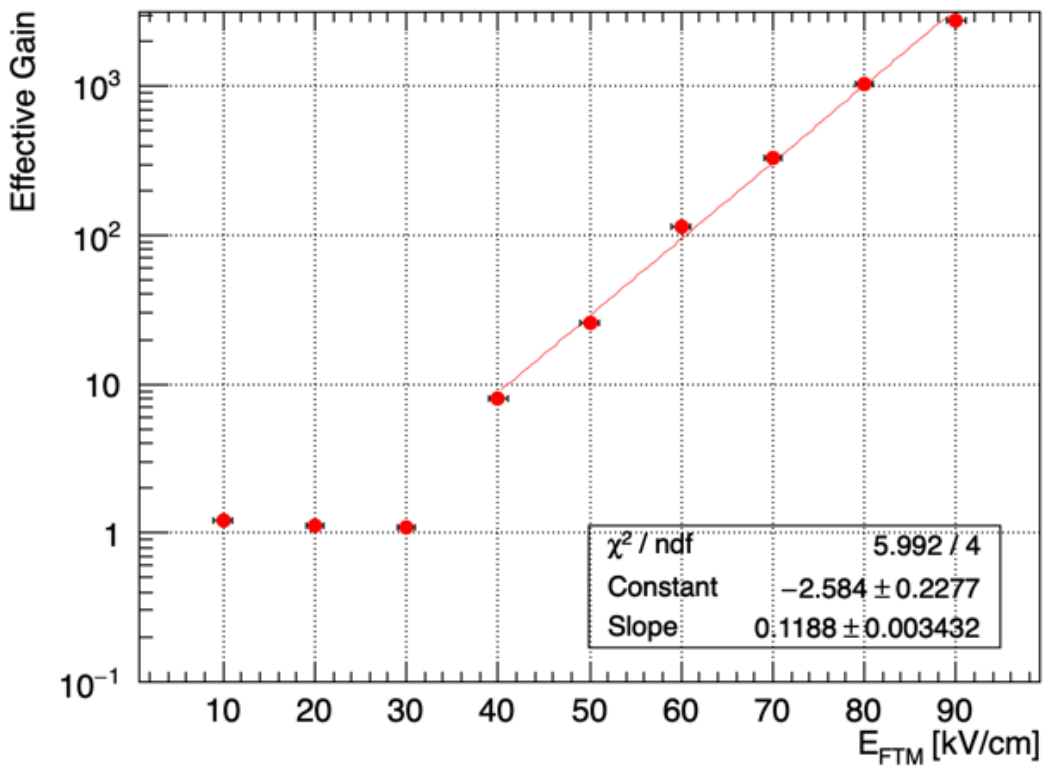
  Resolution
    - Able to scan low

    amplification fields

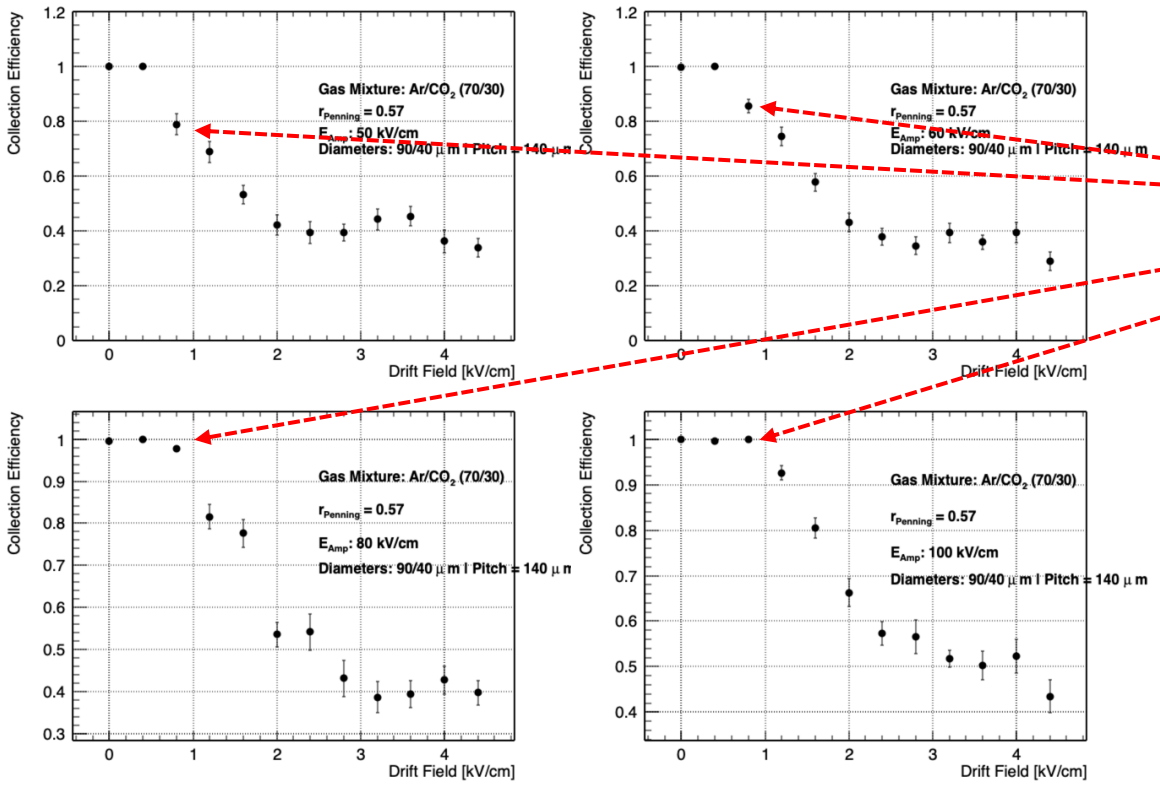


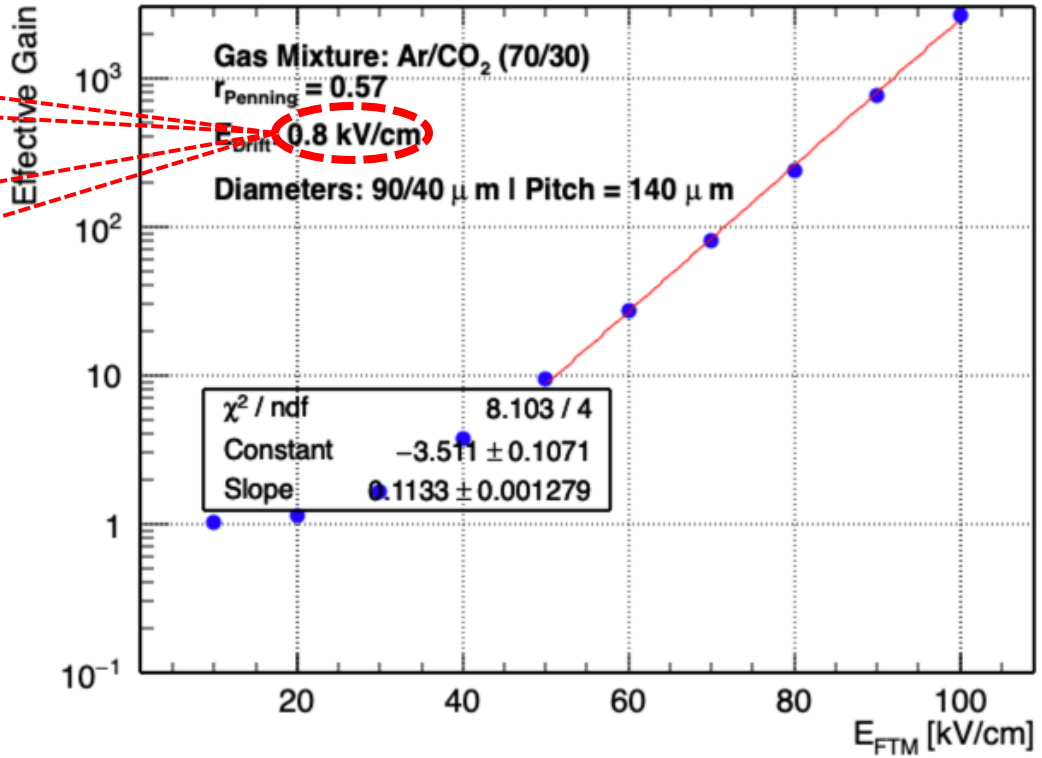
Measurements - Results





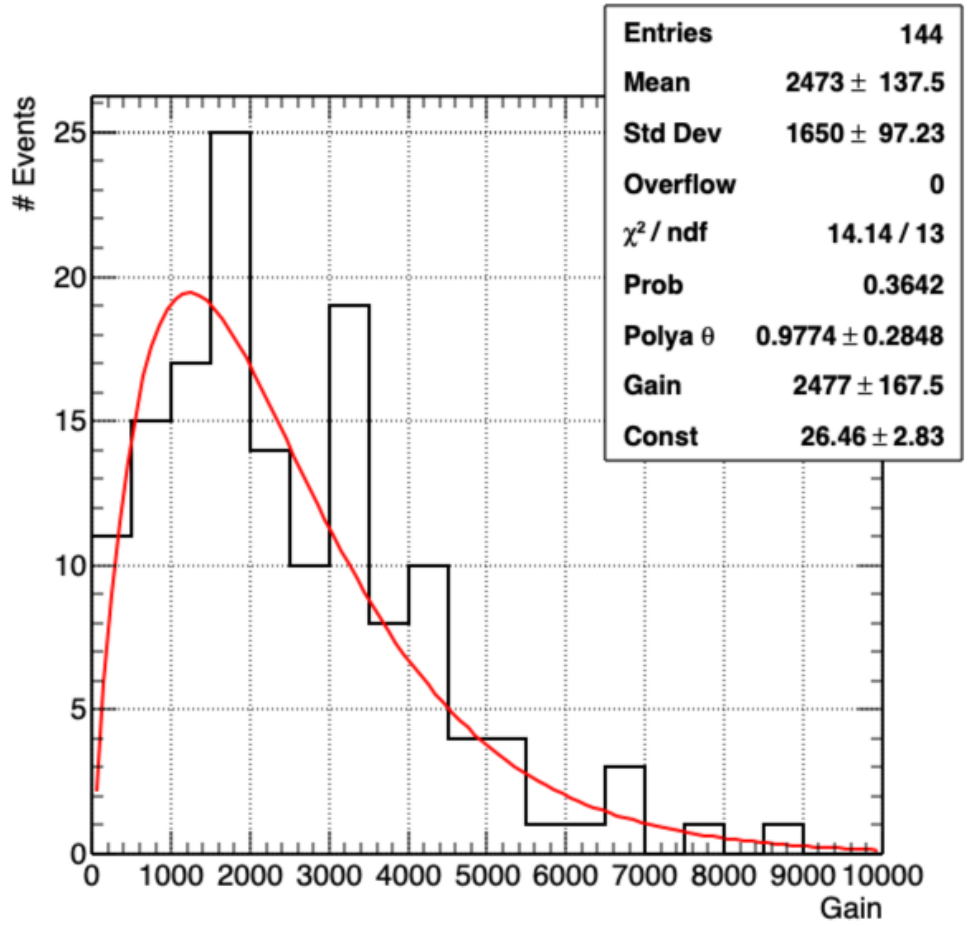
Simulations – ANSYS/GARFIELD++



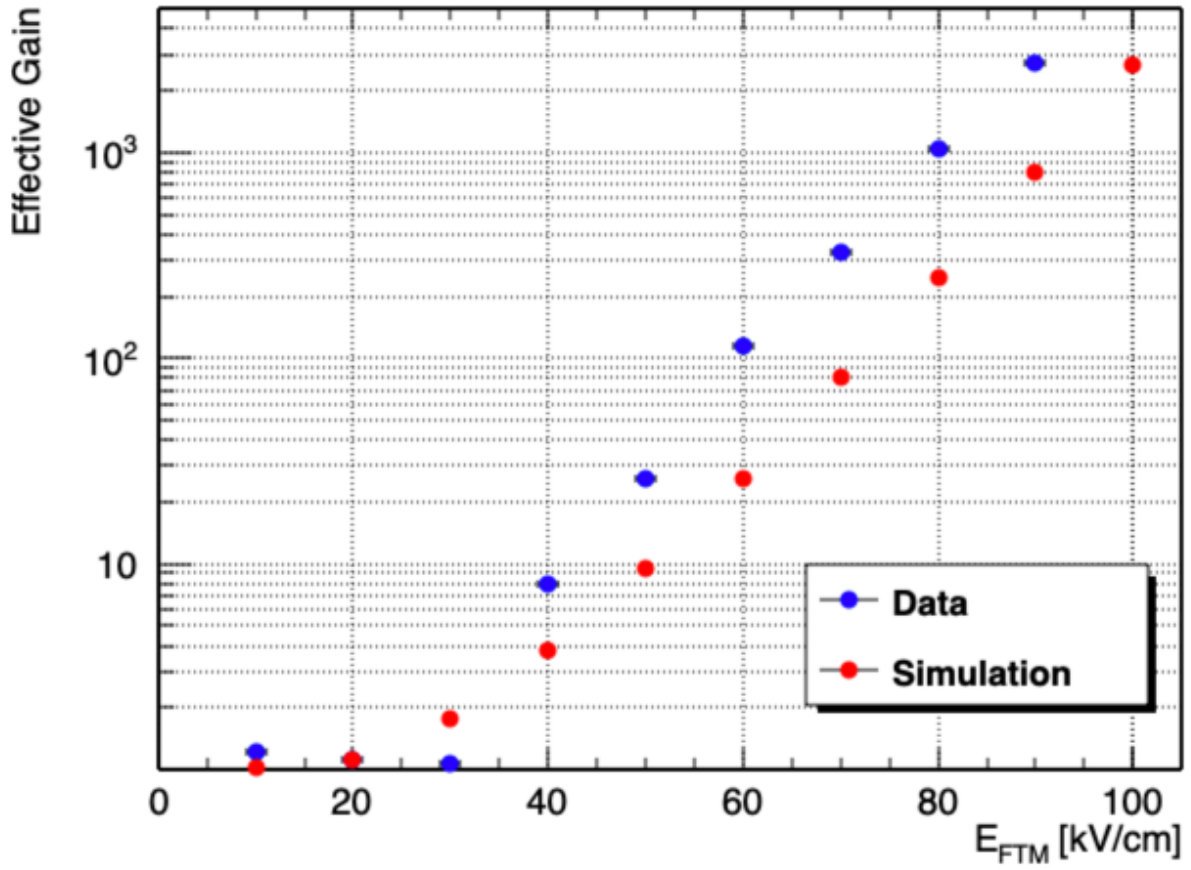


Simulations – ANSYS/GARFIELD++

- Polya Fit on the distribution
  - Better estimation of Gain
  - Gain shown for Amplification 100 kV/cm
    - Gain: 2477



Measurements vs Simulation



Issues – Mistakes - Failures

- Issues
  - 100 kV/cm amplification (or higher) → not possible for current measurement
  - No signal observed at the maximum achievable amplification field (97.5 kV/cm)

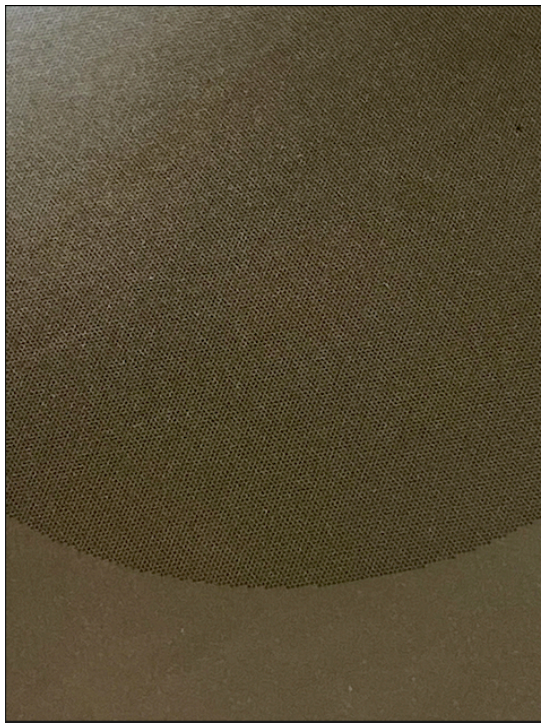
- Mistakes
  - Not proper training of the foil
    - CO_2 flushing at high field (lower than the Passchen limit)
  - Possibly the reason why 100 kV/cm could not be reached

- Opening of the prototype
  - Observed defects on the foil → with the digital zoom of a phone
  - A microscope could be useful for further inspection

Change the foil of the prototype

- In January received a new foil
  - Similar production process with the previous foil
  - No DLC attached on the TOP side BUT Cu
  - Slightly bigger holes → 50/100 μm holes, 140 μm pitch

DLC



Cu

Correcting the past mistakes

- Cu foil underwent a 3-day training by flushing with CO2 and applying

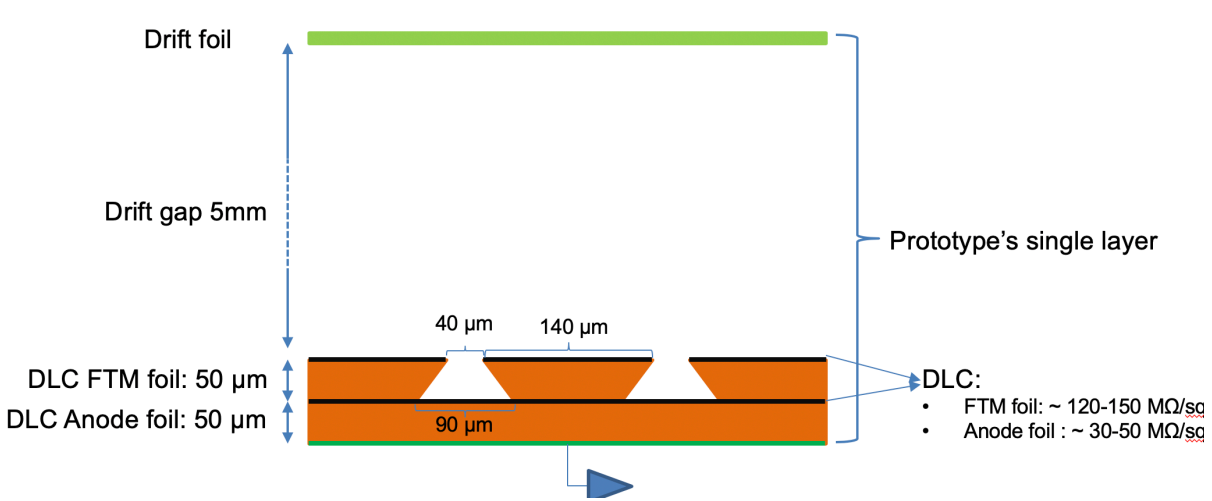
Very high amplification field > 140 kV/cm

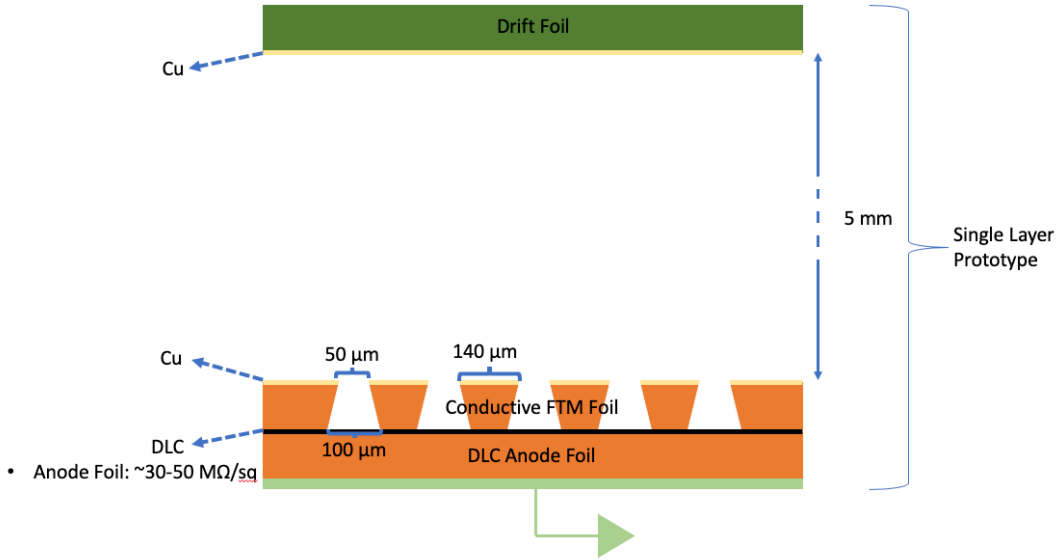
- Eventually the foil was able to operate in the ”nominal” for a FTM foil field of 120 kV/cm without any problem

- Signal observed
- Spectrum observed

Change of the foil - differences

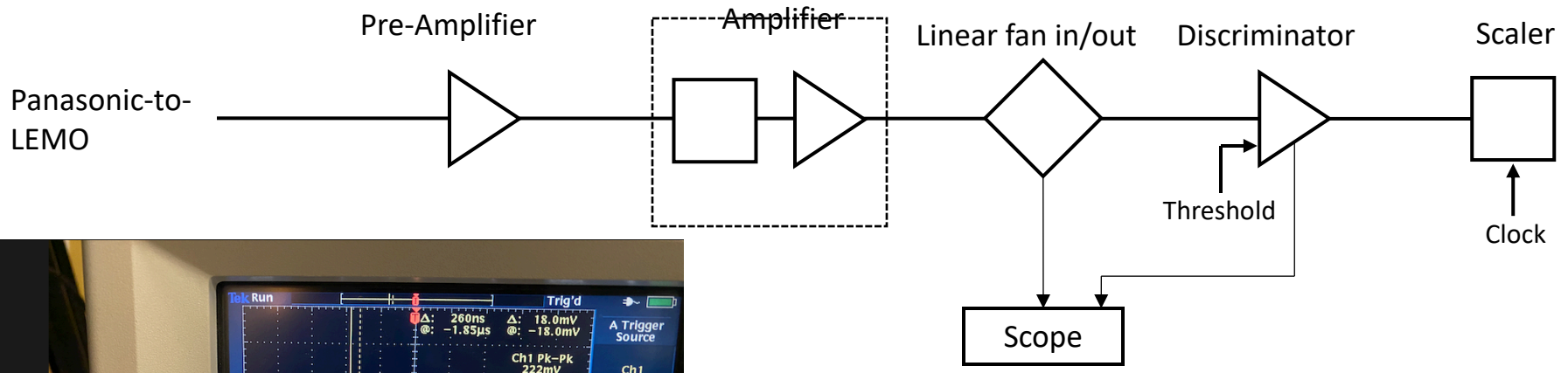
DLC Foil	Cu Foil
DLC on the top surface	Cu on top surface
Hole diameters 40/90 µm	Hole diameters 50/100 µm
Max. achievable operation Amp. Field == 97.5 kV/cm	Max. achievable operation Amp. Field == 135 kV/cm (for short period)

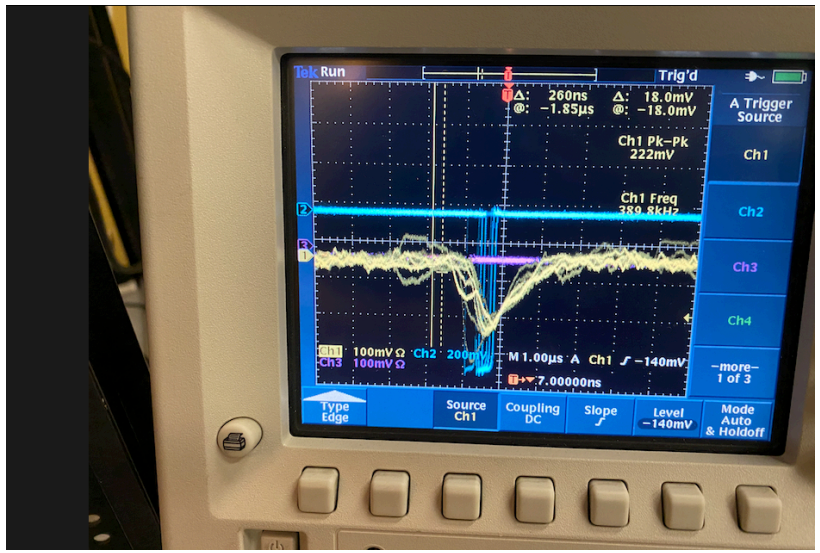




Measurements performed

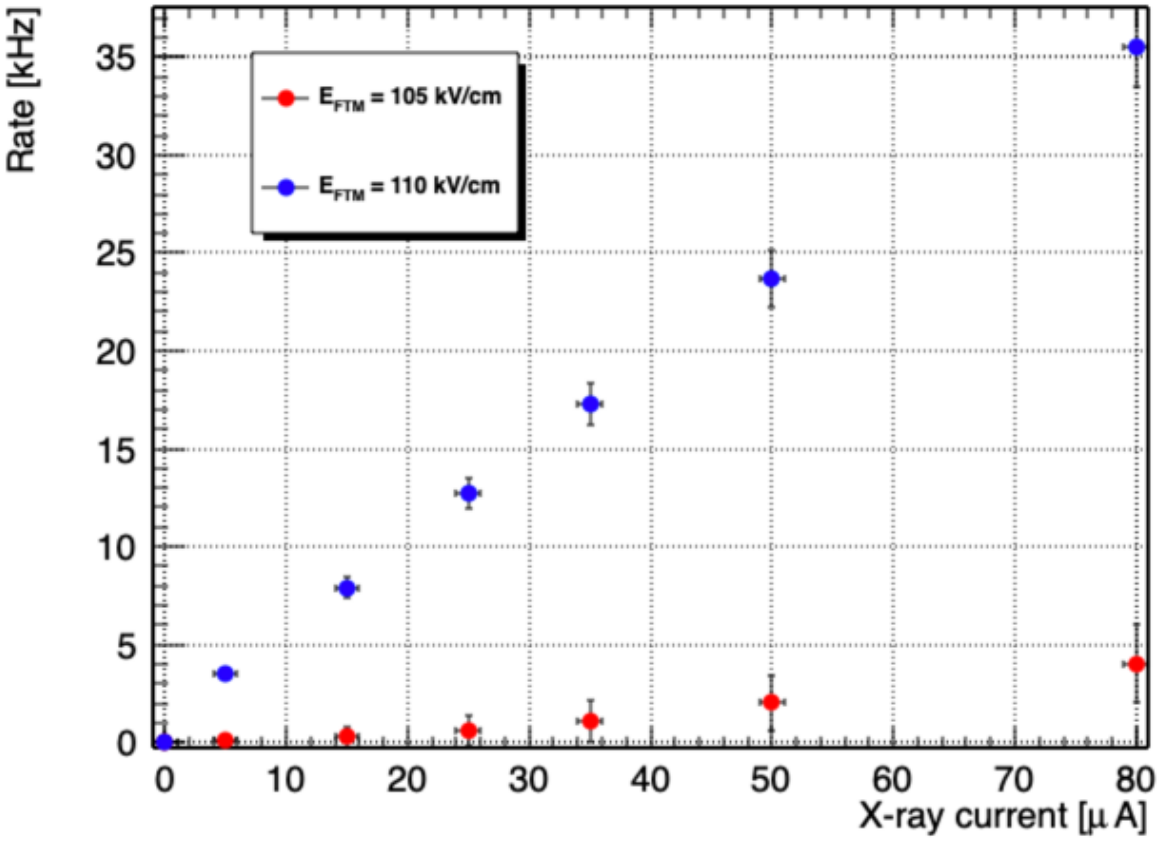
- Success in observing signal
  - The readout chain:





Rate measurement

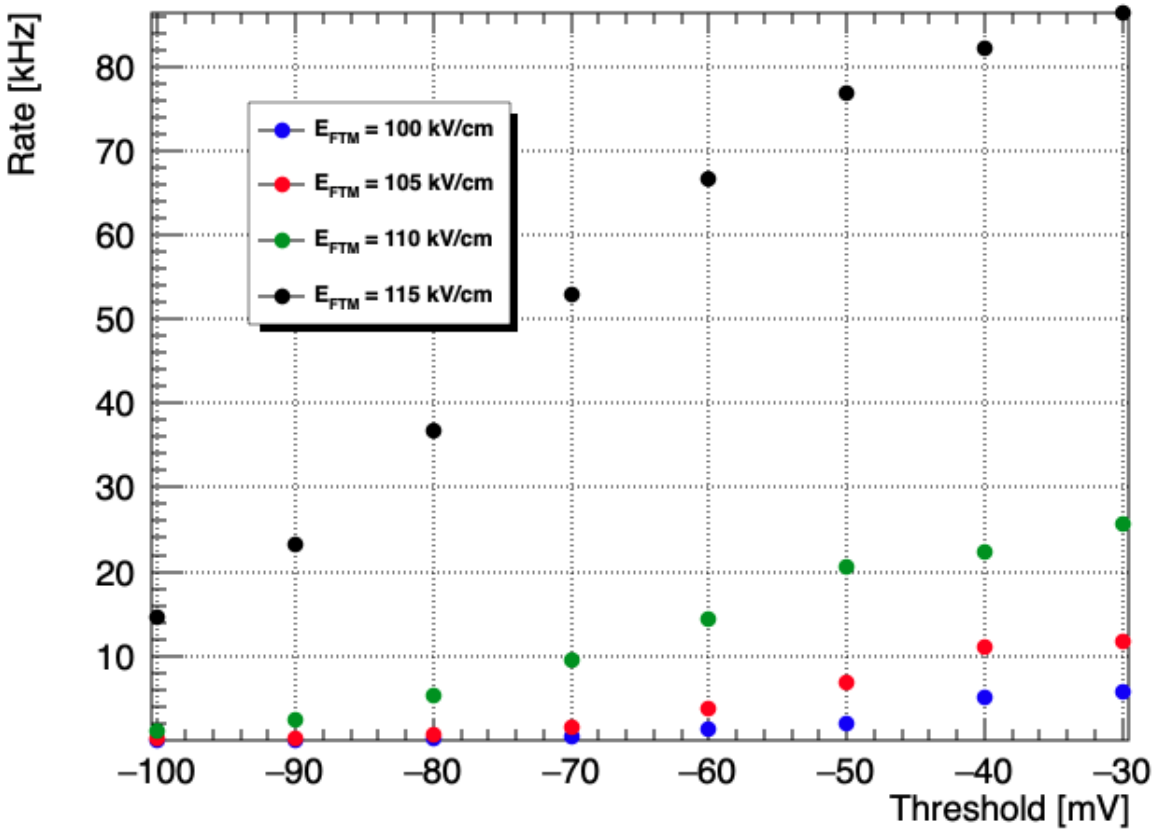
- Setup is the one of the previous slide
  - X-ray gun settings:
    - I = (5-80)μA, V = 50kV
    - No filter, no collimator
    - Distance from the detector – minimum (almost touching the Kapton window)
  - Amplifier settings as in GEM QC5
  - Discr. Threshold : -90 mV



Threshold Scan

- From the Rate values, huge bump for only 5 kV/cm amplification field difference
- Threshold scan to use an optimal threshold setting
- From the plot seems that

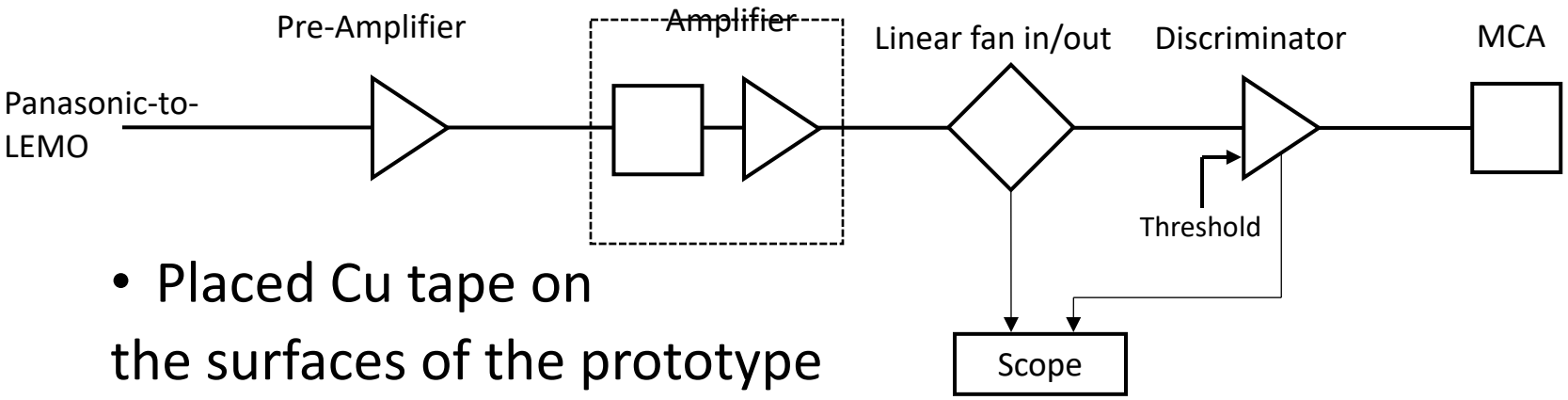
-50 mV is the most optimal



Effective gain

- Since we observe signal
  - Observe spectrum and calculate #primaries → primary current

  →Effective Gain



  - Placed Cu tape on

  the surfaces of the prototype

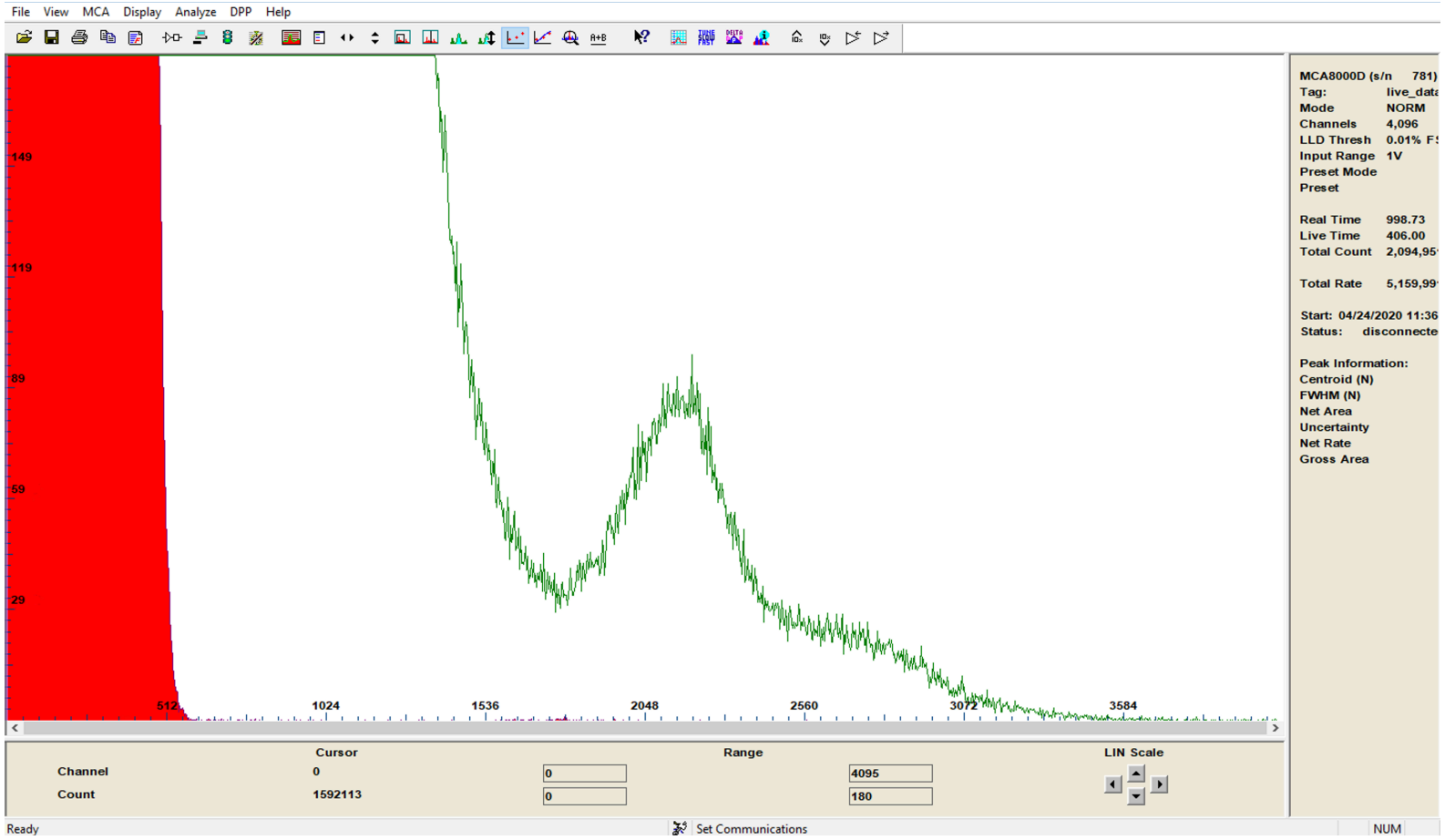
Spectrum

- Cu photopeak observed
  - X-ray gun: 5uA, 40kV
    - Filter applied
      3 cu filter (from amptek kit)
    - 2 mm collimator

- Issue in the calibration as we
Need to subtract the background

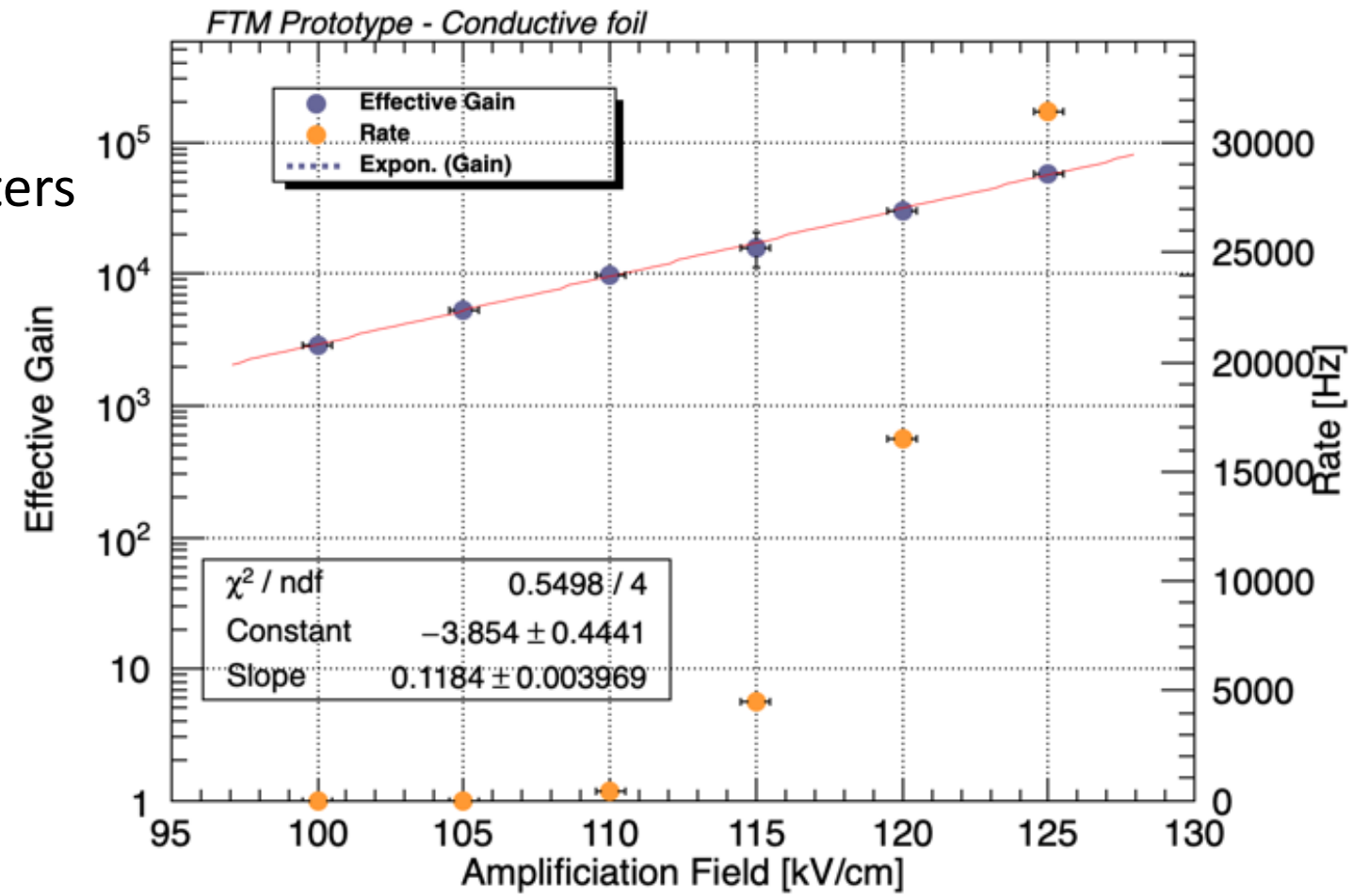
- No other source apart from the
X-ray gun is available at the moment

- For the rest of the measurements
  I use #Primaries = 346 (like in GEM)



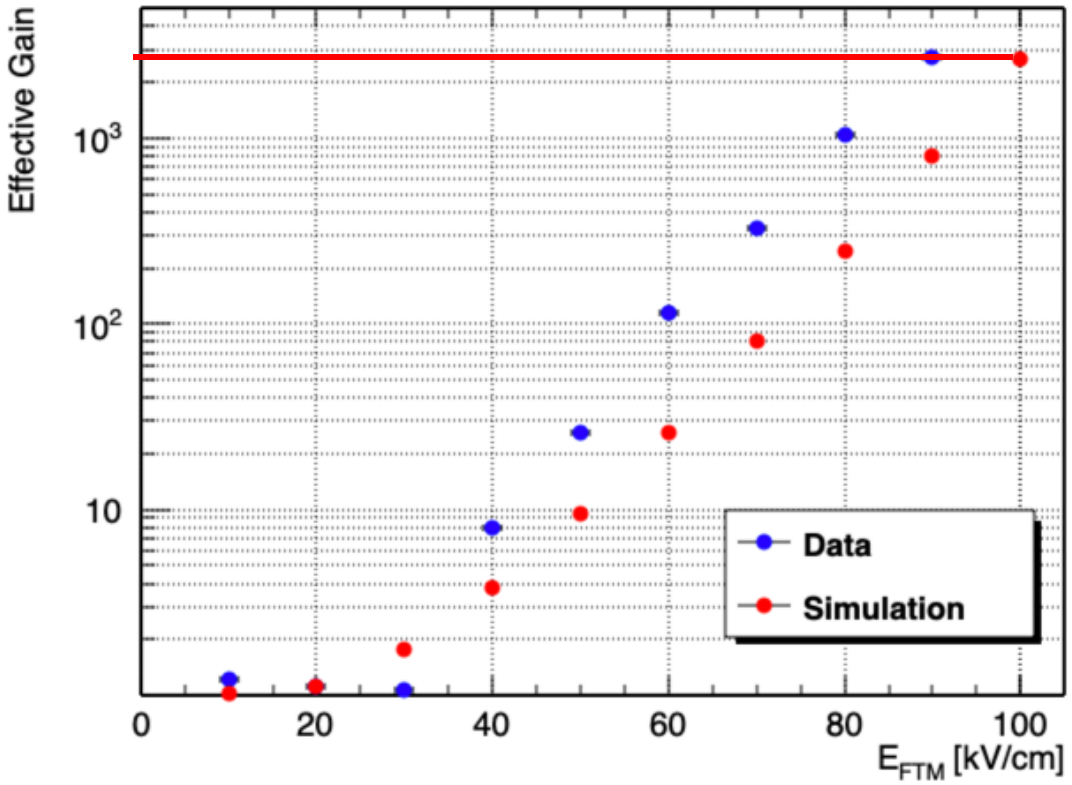
Effective Gain

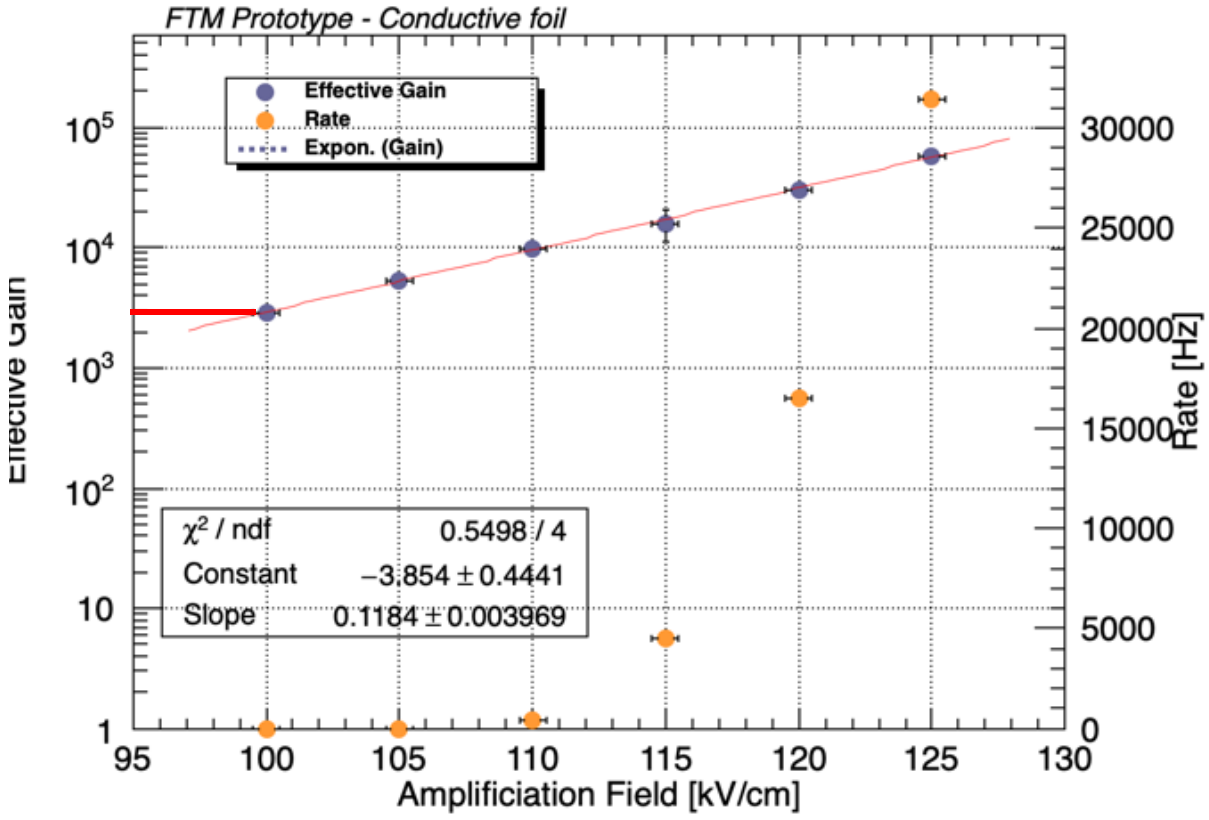
- Xray gun settings
  - I = 5 µA, V = 40kV
  - 2 mm collimator + 3 cu foil filters
- Threshold at -50mV
- Drift field = 3 kV/cm



A small comparison

Resistive foil





If indeed the #primaries is around 346 (to be confirmed) then we are in a good agreement to what have been measured
Also for the resistive foil and the simulation

Remarks

- From what we have performed and measured
  - A resistive foil which needs to operate at 120kV/cm is necessary
    - We now know that the first to do after placing it to the prototype is to train it (~3 days)
    - Operation at 120 kV/cm
  - Investigate the reason why no signal is observe to the already high amplification of 80 - 90 kV/cm (maybe due to the small active area?)
  - Still need to extract the correct number of primaries in order to accurately estimate the primary current (Rate*$N_{primaries}$*e)

Something for the future

- What do you think should be done now?
  - Re-do measurements to cross-check and validate the results?
  - Measure the effective gain with the second way (in which we measured for the resistive)?
  - Is a rate capability measurement meaningful ?