MPGD - ECT

GEM-µRwell Test Beam 2024

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for

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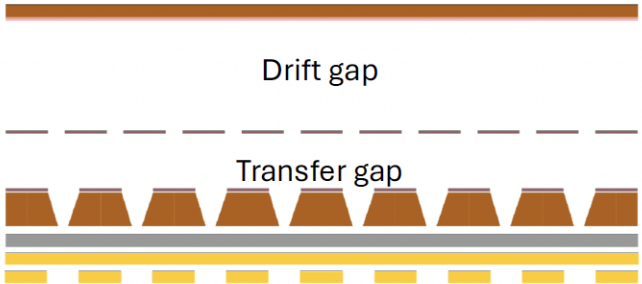
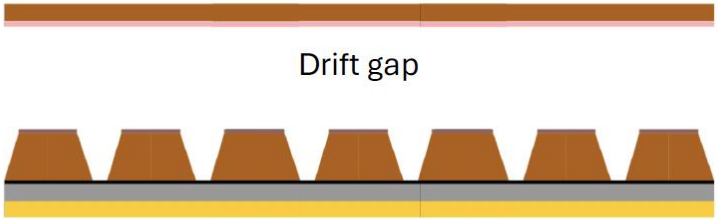
Test Beam 2024 Detectors

GEM- μRWELL

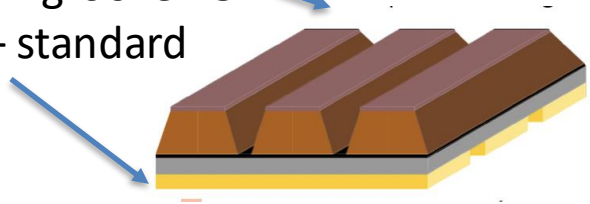


- 10 x 10 cm^2 active area
- 6 mm drift gap
- 3 mm transfer gap
- 400 μm strip pitch
- XY 2D readout COMPASS-like

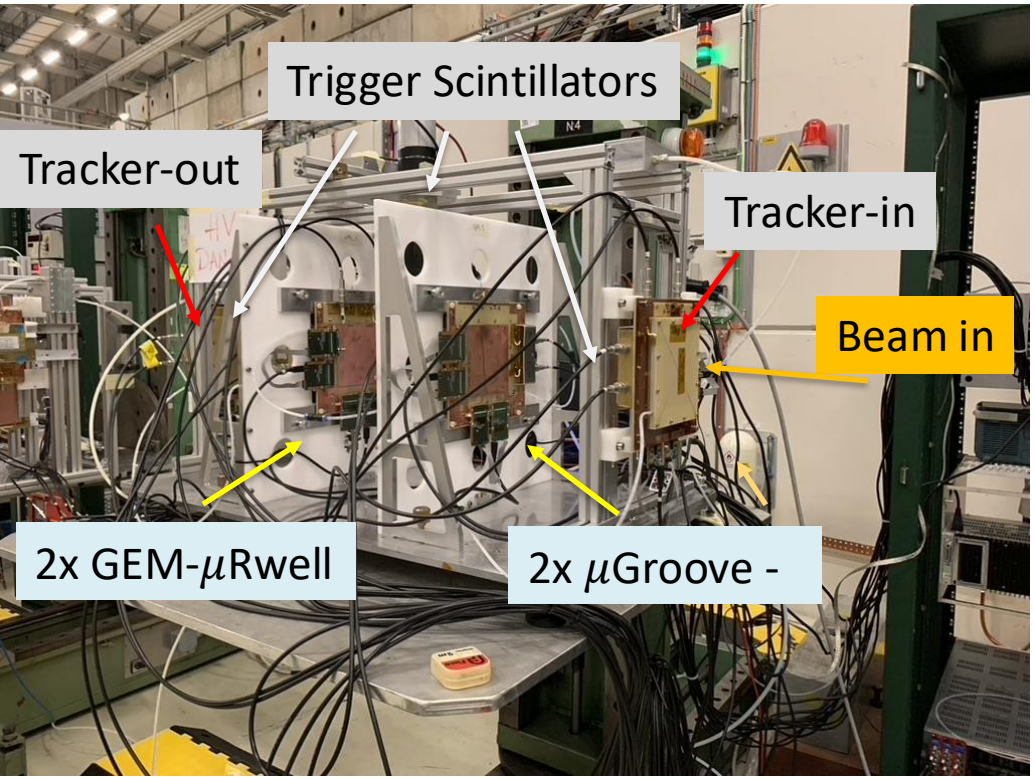
μGroove



- 10 x 10 cm^2 active area
- 6 mm drift gap
- 400 μm strip pitch (3x140 μm or 2x200 μm)
- Y coordinate on groove TOP
- X coordinate – standard



Test Beam Set-up



Tracker-In : μRwell – 3 mm drift
(a hybrid GEM- μRwell with GEM foil used as a cathode)

Tracker-Out : GEM-μRwell

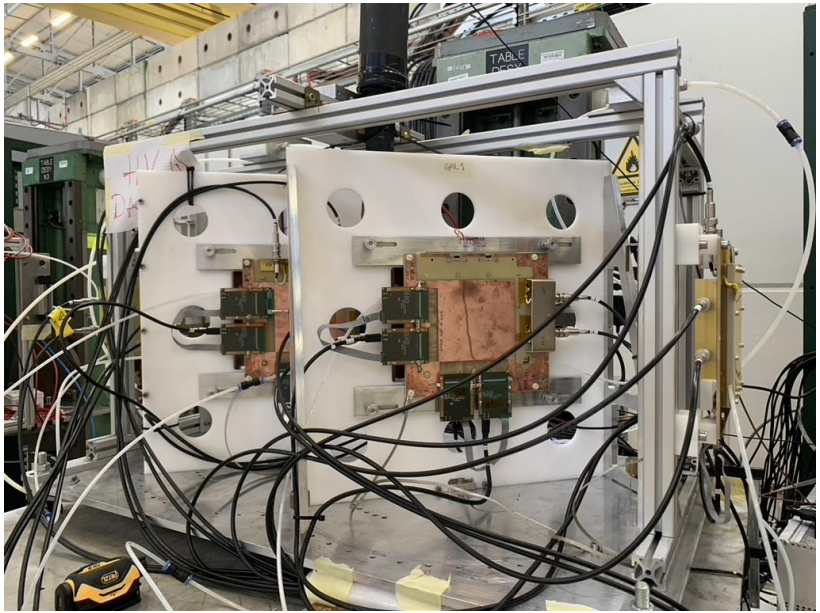
Detectors Under Study (DUT)

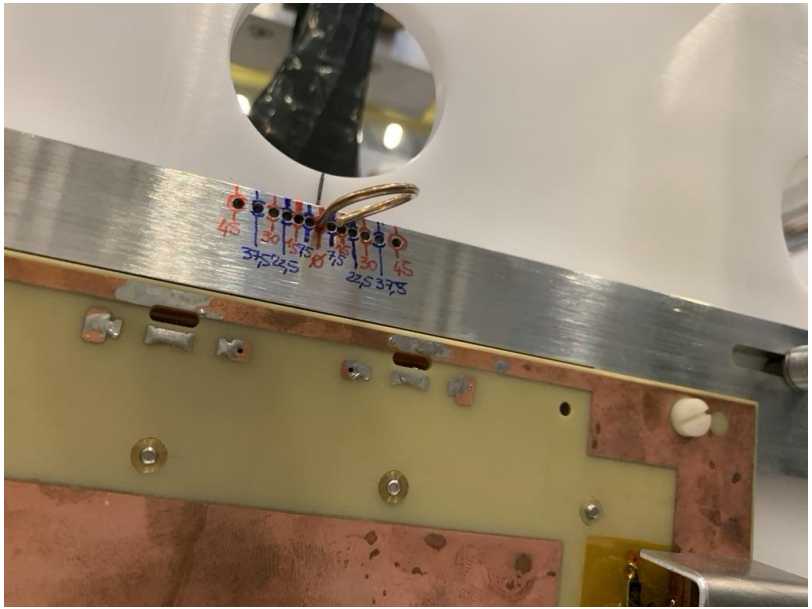
- in mirror configuration
  → "Enemy"

- 2 GEM- μRwell
- 2 μGroove

Detectors Set-up

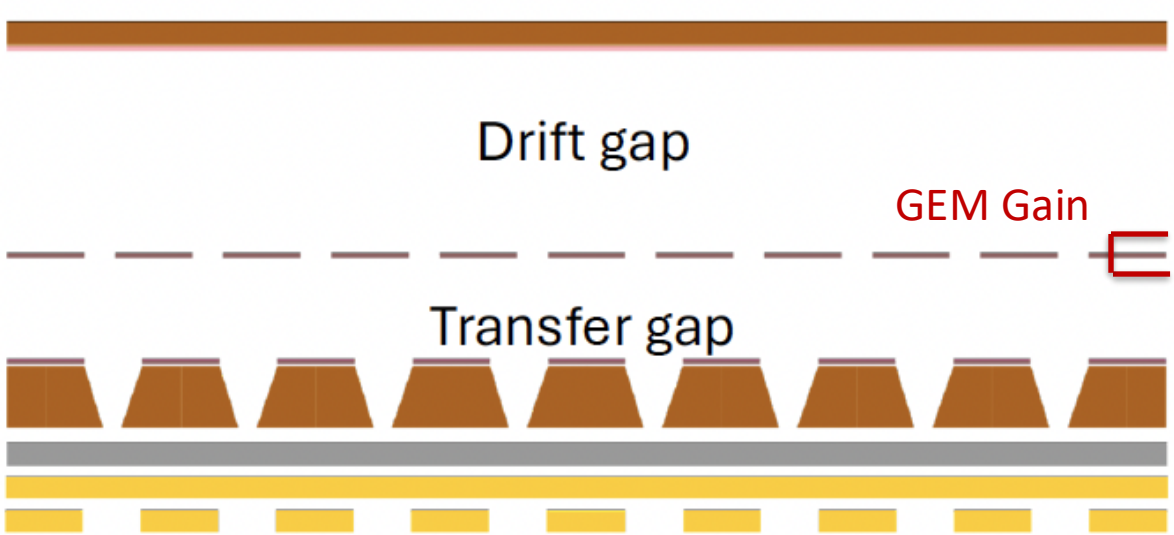
- DUT may be rotated to study their characteristics for inclined tracks.
- θ= 0°, 7.5°, 15°, 30°, 45°





Detectors parameters

GEM- μRWELL



Cathode HV

Drift Field

GEM Gain

Top GEM HV

Bottom GEM HV

Transfer Field

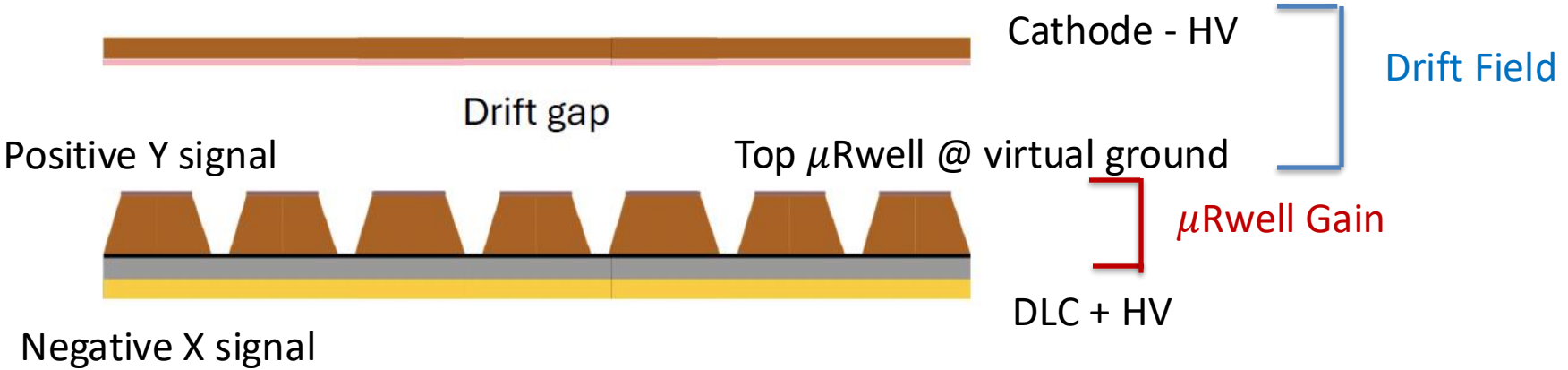
Top μRwell HV

μRwell Gain

DLC @ Ground

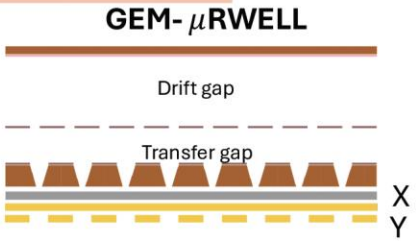
4 independent parameters to study: GEM gain, μRwell Gain, Drift Field, Transfer Field

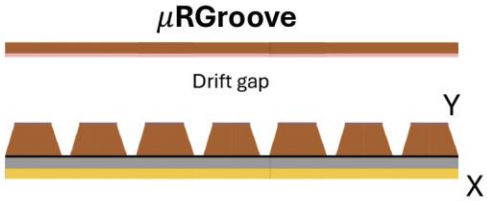
μGroove



2 independent parameters to study: μRwell Gain, Drift Field

Parameters under study





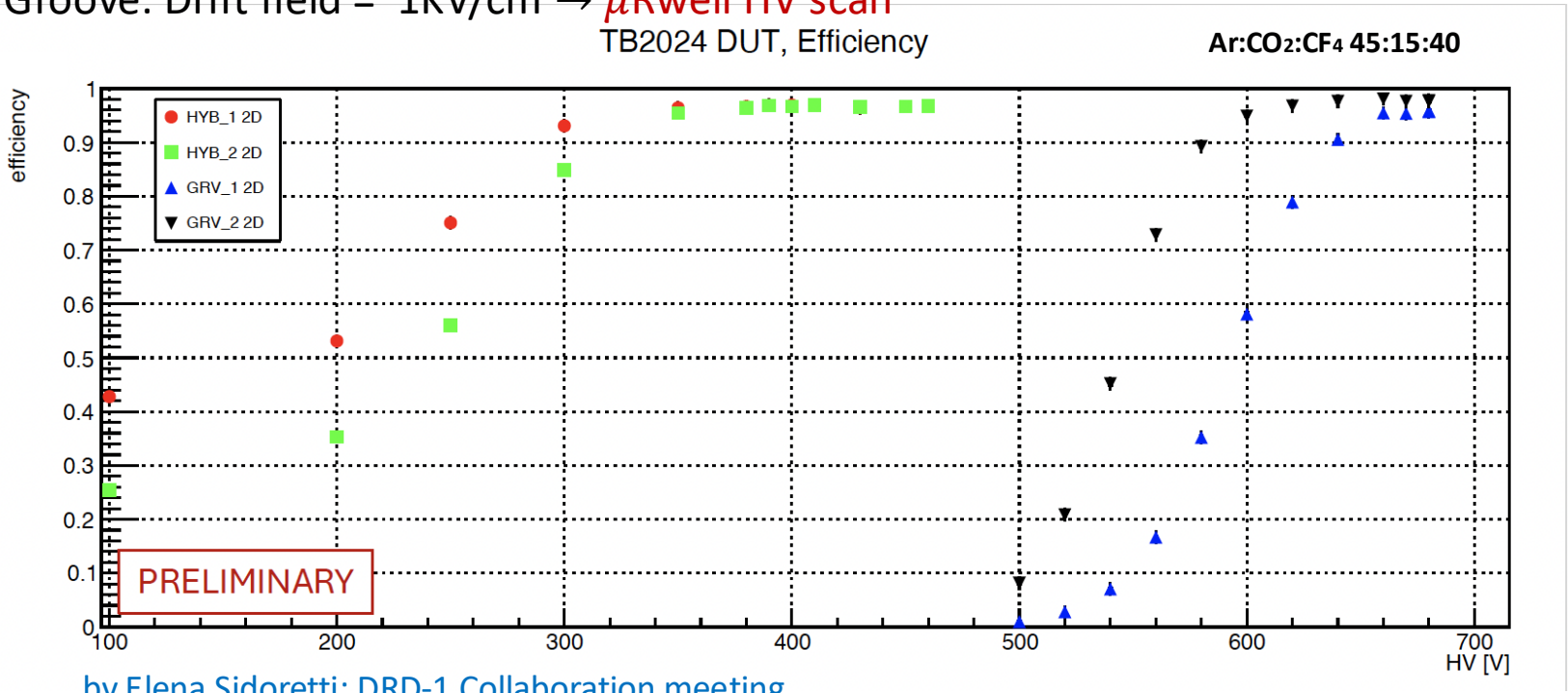
	GEM-μRWELL	μRGroove
SCAN HV 0°	ΔV_{GEM} scan ΔV_{WELL}= 550 V, E_{drift}= 1 kV/cm, $E_{transfer}$= 4 kV/cm	ΔV_{WELL} scan E_{drift}= 1 kV/cm
SCAN HV 30°	ΔV_{GEM} scan ΔV_{WELL}= 550, V E_{drift}= 1 kV/cm, $E_{transfer}$= 4 kV/cm	ΔV_{WELL} scan E_{drift}= 1 kV/cm
SCAN gap field 30°	E_{drift} and $E_{transfer}$ scan ΔV_{WELL}= 550 V, ΔV_{GEM} = 440 V	E_{drift} scan ΔV_{WELL}= 670 - 720 V
SCAN θ	θ scan ΔV_{WELL}= 550 V, ΔV_{GEM} = 440 V, E_D= 1 kV/cm, E_T= 4 kV/cm	θ scan ΔV_{WELL}= 670 - 720 V, E_{drift}= 1 kV/cm

We studied the performance of the μRWELL when the GEM is turned off at different angles to check if it is possible to still perform μTPC calculations with 3 mm gas gap.

First preliminary results

GEM-μRwell: Drift field = 1KV/cm, Transfer Field=4 KV/cm, μRwell Gain = 1500 → GEM HV scan

Top Groove: Drift field = 1KV/cm → μRwell HV scan



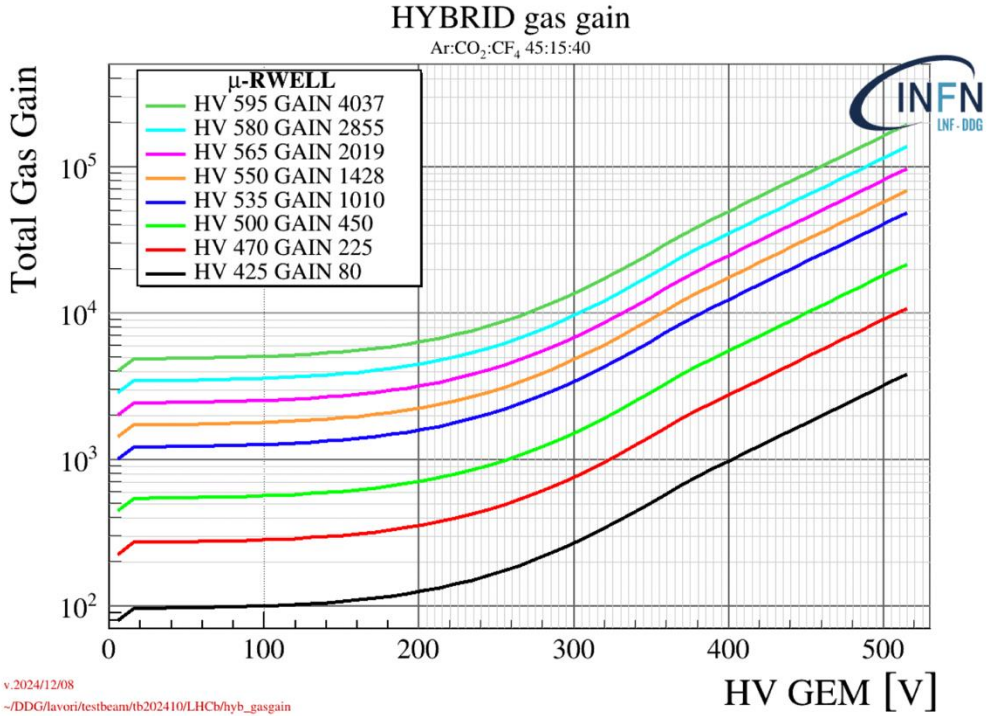
by Elena Sidoretti: DRD-1 Collaboration meeting

Gas Gain – X Ray gun study

Ar:CO_2:CF_4 45:15:40

Gas Gain plot for GEM- μRWELL
- high gain is reached even for low WELL HV

Gas Gain plot for μRGroove was not performed before the test beam

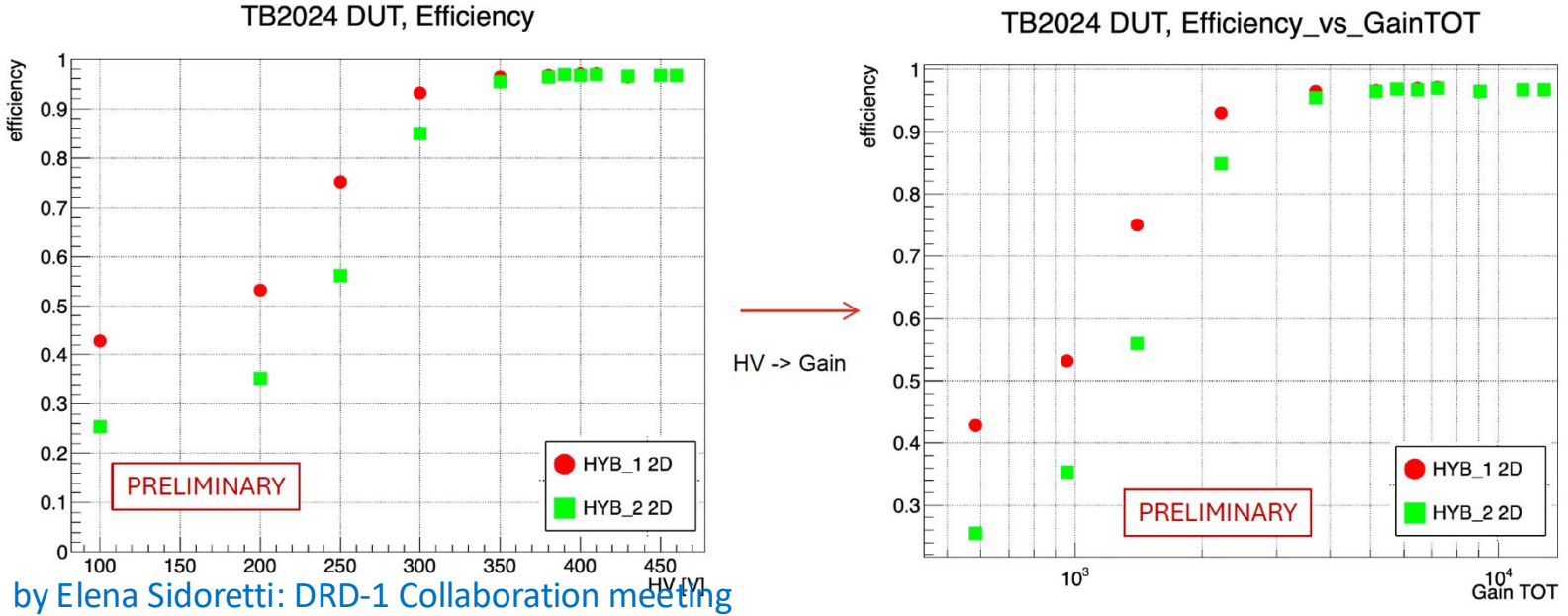


First preliminary results

Preliminary results HV scan at 0°

GEM-μRWELL

- ΔV_{WELL}= 550 V corresponding to ~1500 gas gain in the WELL
- high efficiency are reached for ΔV_{GEM} ~380 V (eff 97%) corresponding to ~5200 gas gain in total



by Elena Sidoretti: DRD-1 Collaboration meeting

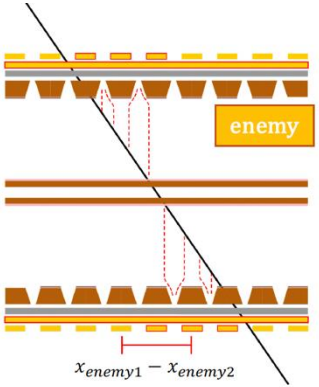
First preliminary results

Analysis ongoing

Charge Centroid method is currently used as the first step of spatial resolution study. On-going data analysis implementations:

Implementation to study **inclined tracks:**

1. The "**enemy**" method
   - calculates the distance between the clusters' centre on each readout as residual



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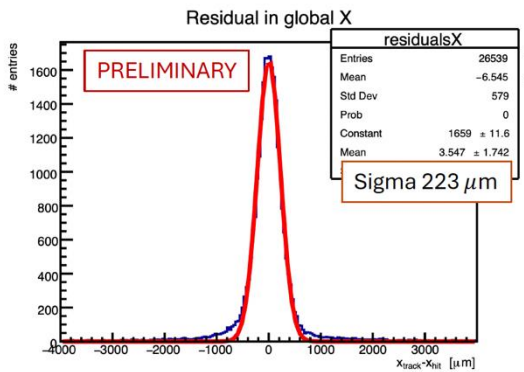
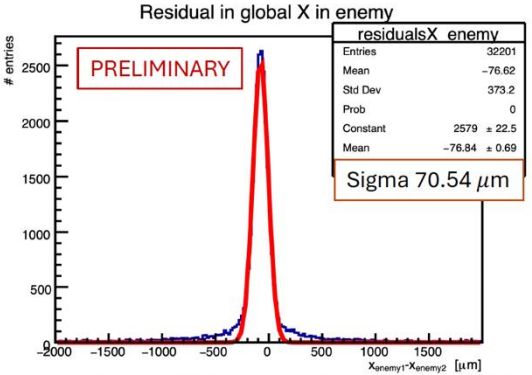
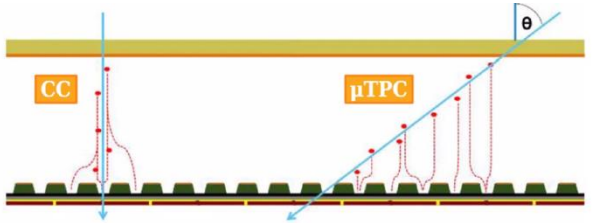




First preliminary results

Analysis ongoing



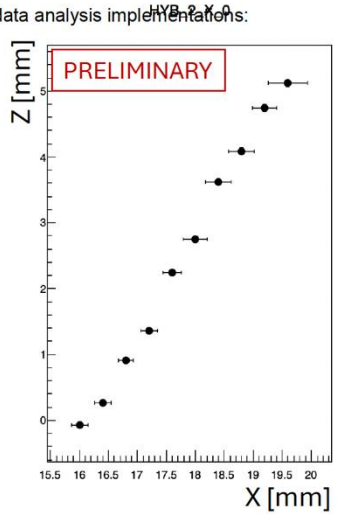
Thanks to Riccardo Farinelli (INFN Bologna)

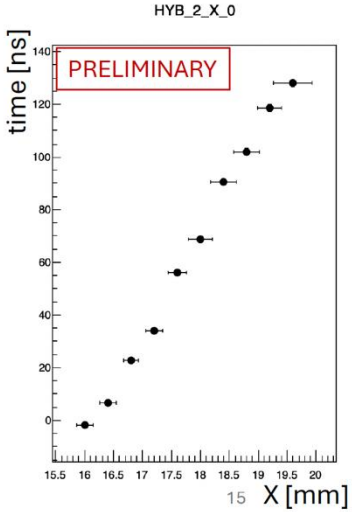
Charge Centroid method is currently used as the first step of spatial resolution study.

Implementation to study **inclined tracks:**

1. The "**enemy**" method
   - calculates the distance between the clusters' centre on each readout as residual
2. The "***μ*TPC**" method for inclined tracks
   - time of the hit on the strip is used with the drift velocity in the gap, to perform μTPC and select the position along z in the gas gap in which the particle passed

On-going data analysis implementations:





by Elena Sidoretti: DRD-1 Collaboration meeting

First preliminary results

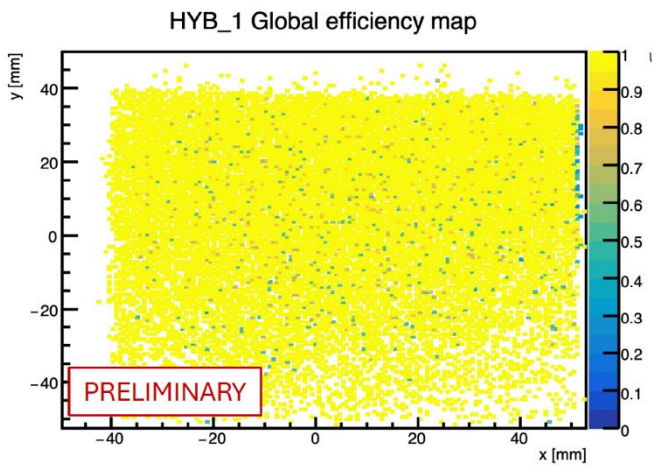
Effects under study

by Elena Sidoretti: DRD-1 Collaboration meeting

Efficiency 2D map:

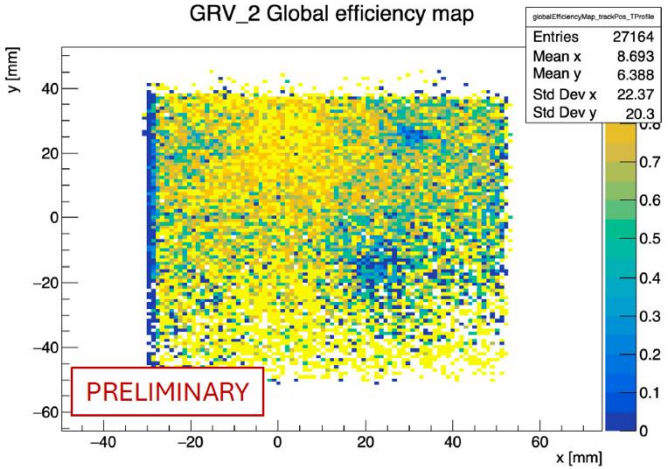
- after a few days of data taking, for one of the two μRGroove the current on DLC reached ~800 nA (HV filter on the TOP with resistivity of 2 MΩ)
- The detector is still operational with only a relatively small inefficient region in the efficiency map (an effect also reported by Kondo Gnanvo with μRWELL)

GEM-μRWELL in HV plateau (ΔV_{GEM} = 420 V)



Average efficiency = 97%

μRGroove in HV plateau (ΔV_{WELL} = 590 V)



Average efficiency = 71%