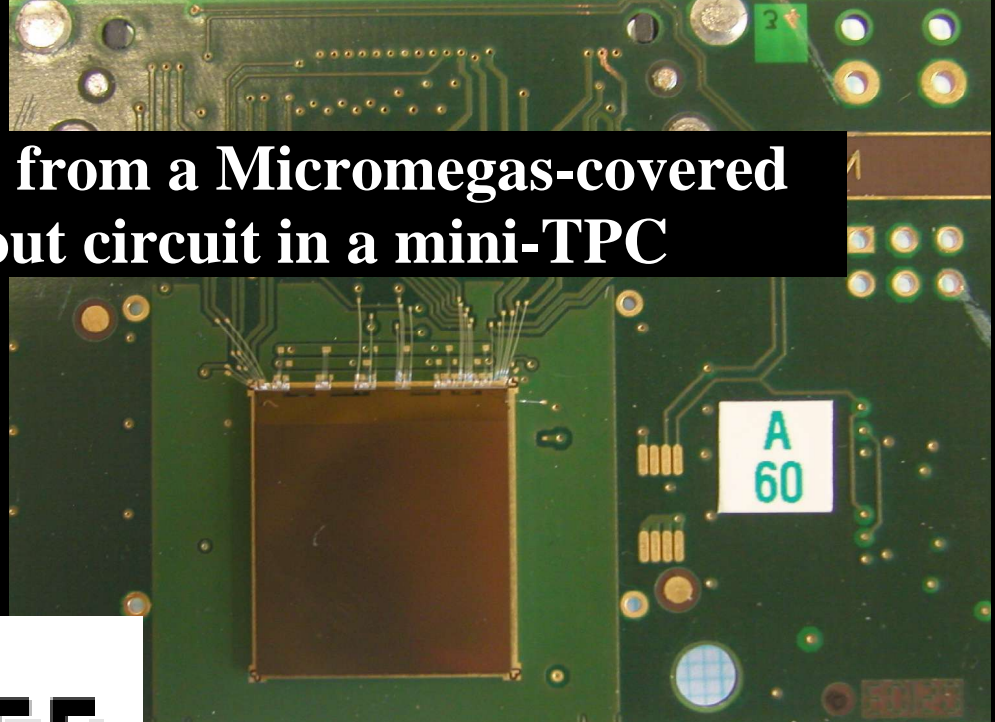
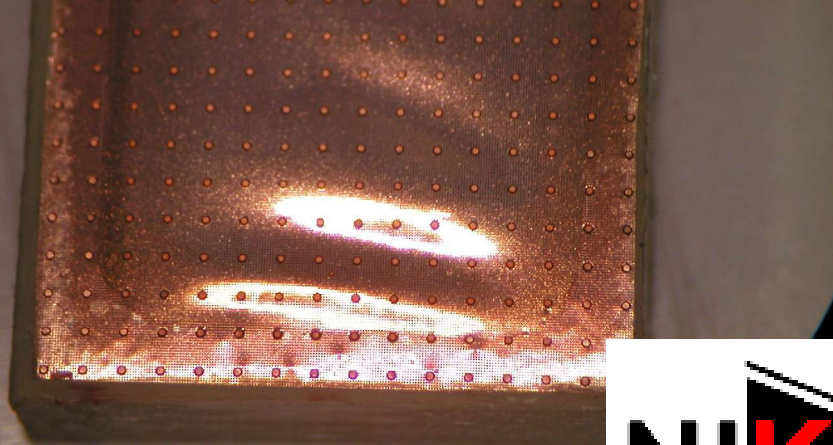
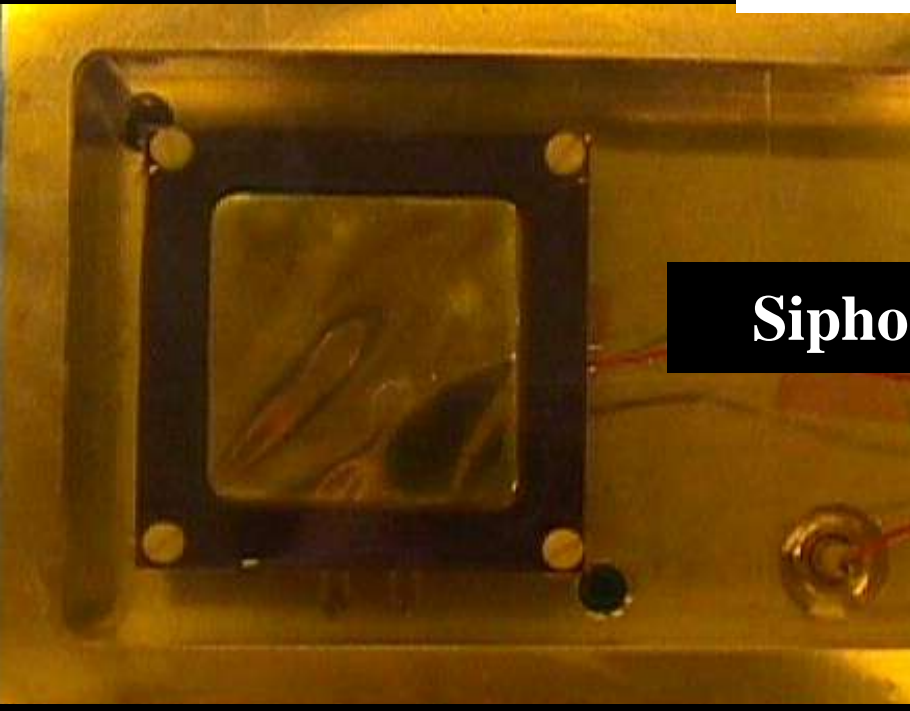


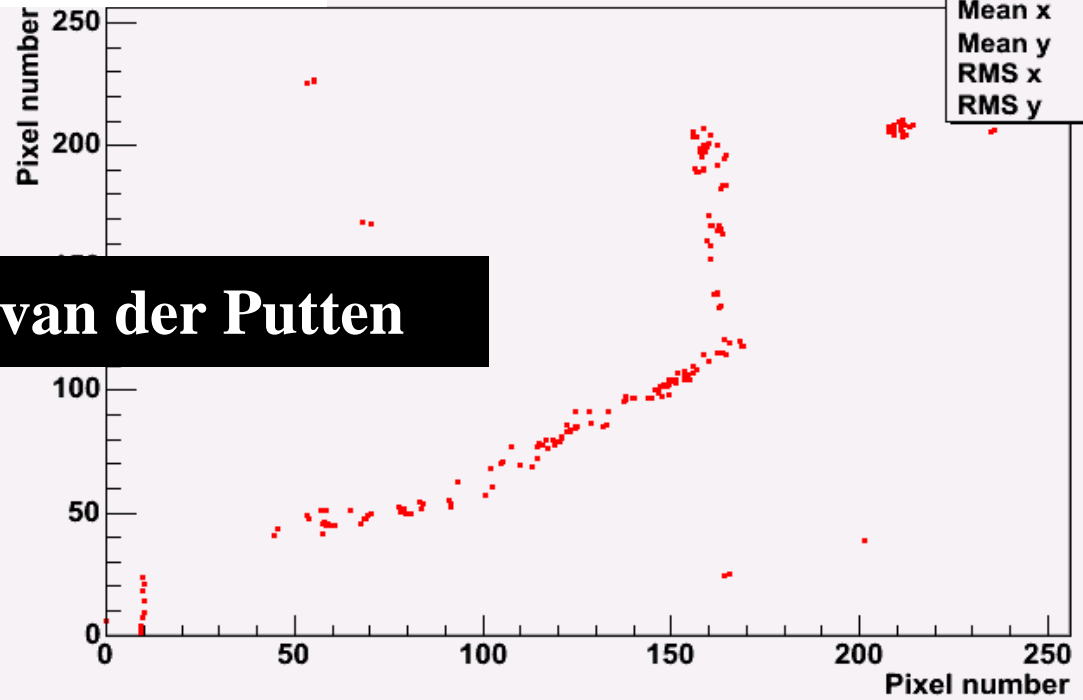
Tracking cosmics: Recent results from a Micromegas-covered MediPix2 pixel CMOS readout circuit in a mini-TPC



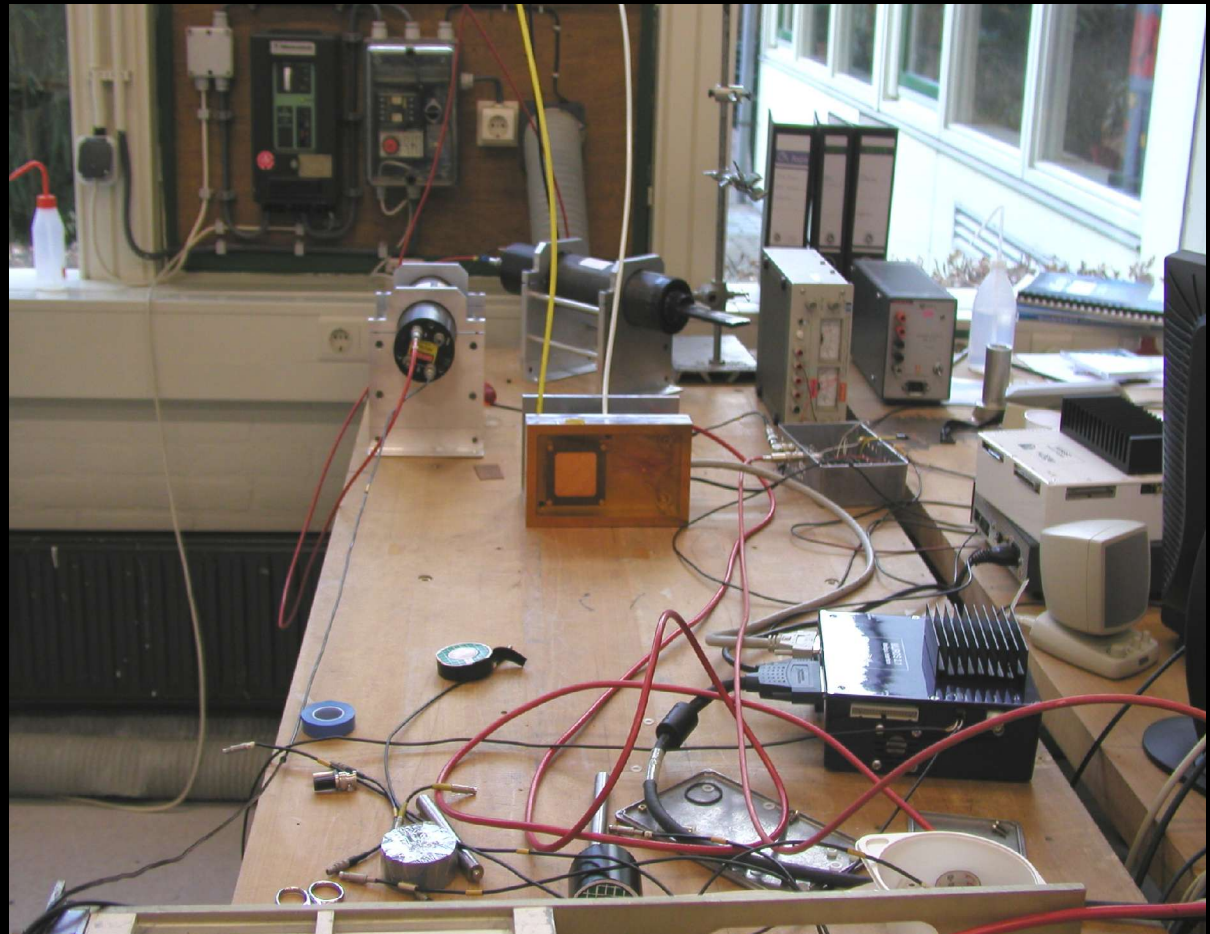
event_280.dat	
Entries	65536
Mean x	128.3
Mean y	118
RMS x	57.53
RMS y	62.82



Sipho van der Putten

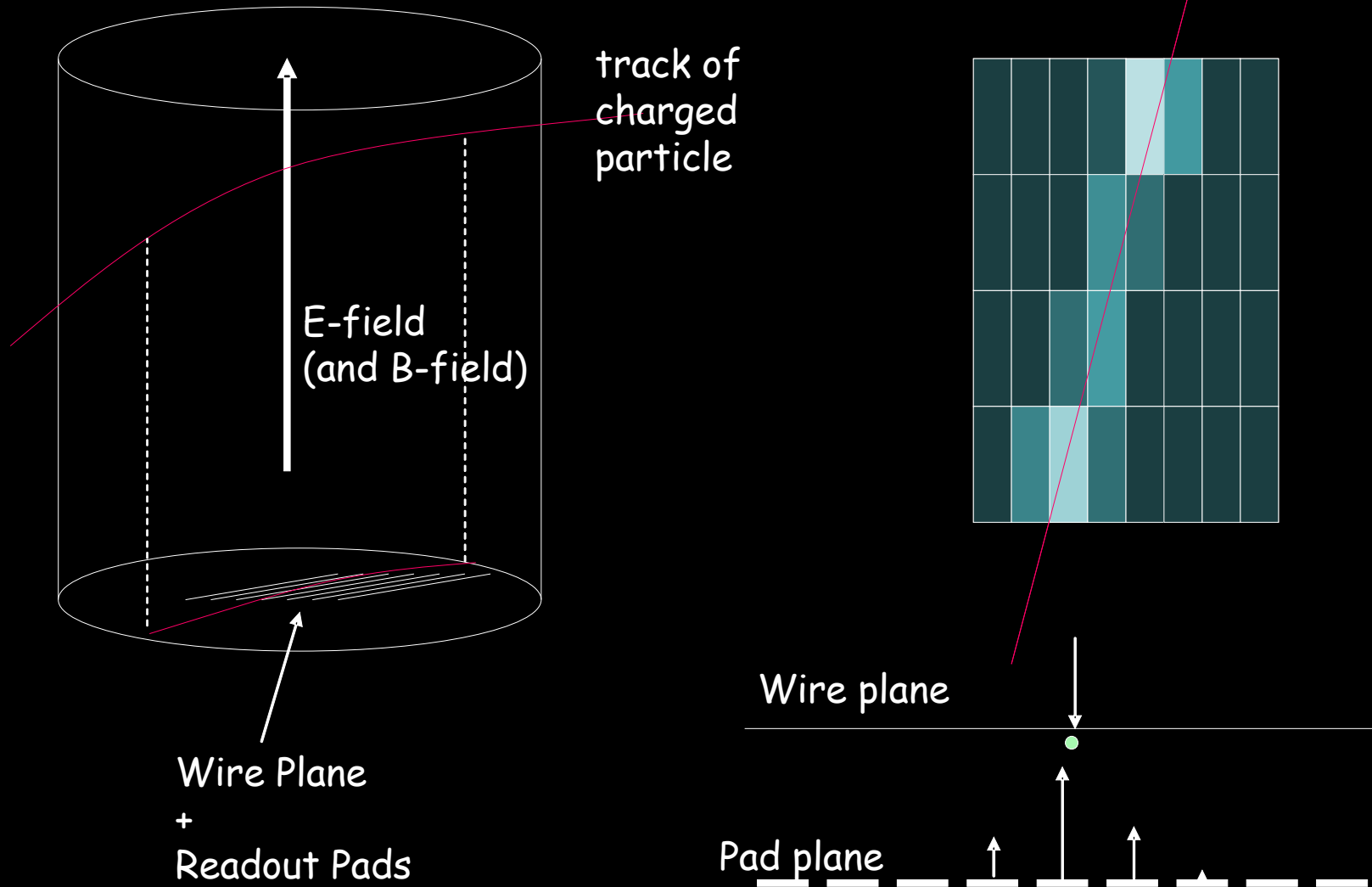


- Introduction
- Gridpix
 - Setup & Goals
 - Results
- Aging
 - Setup & Goals
 - Results
- InGrid



Principles of TPCs

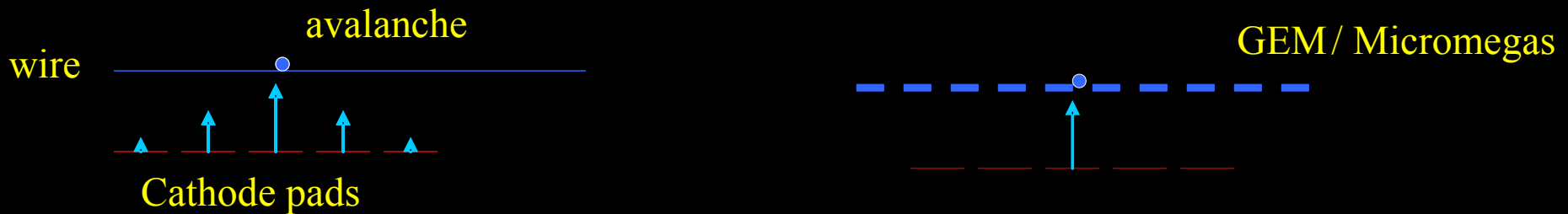
Time Projection Chamber (TPC): 2D/3D Drift Chamber
 The Ultimate Wire (drift) Chamber



TPC vs GEM & Micromegas

Wires: measure charge distribution over cathode pads: center of gravity is a good measure for track position

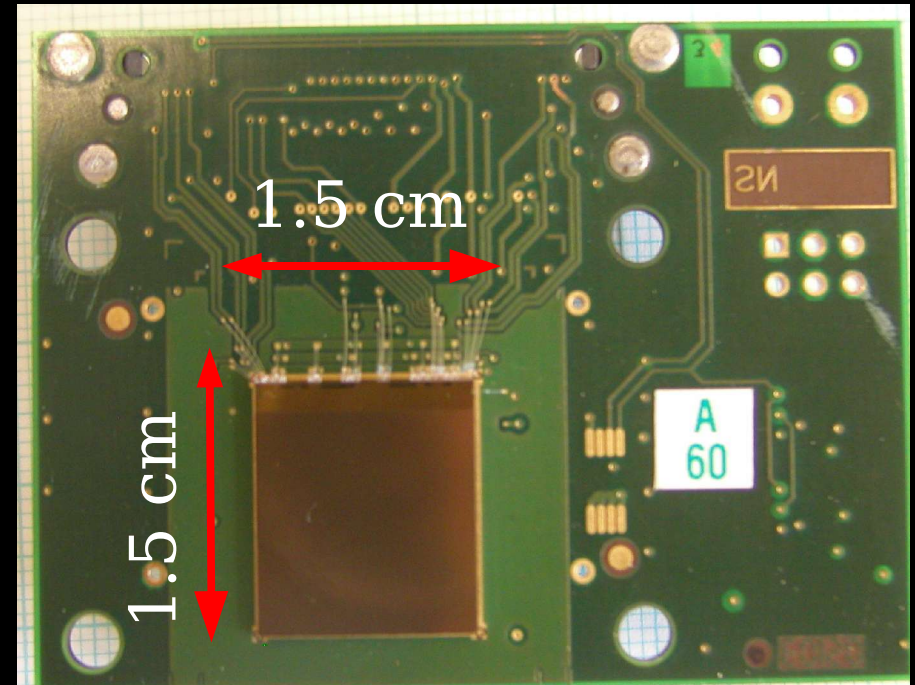
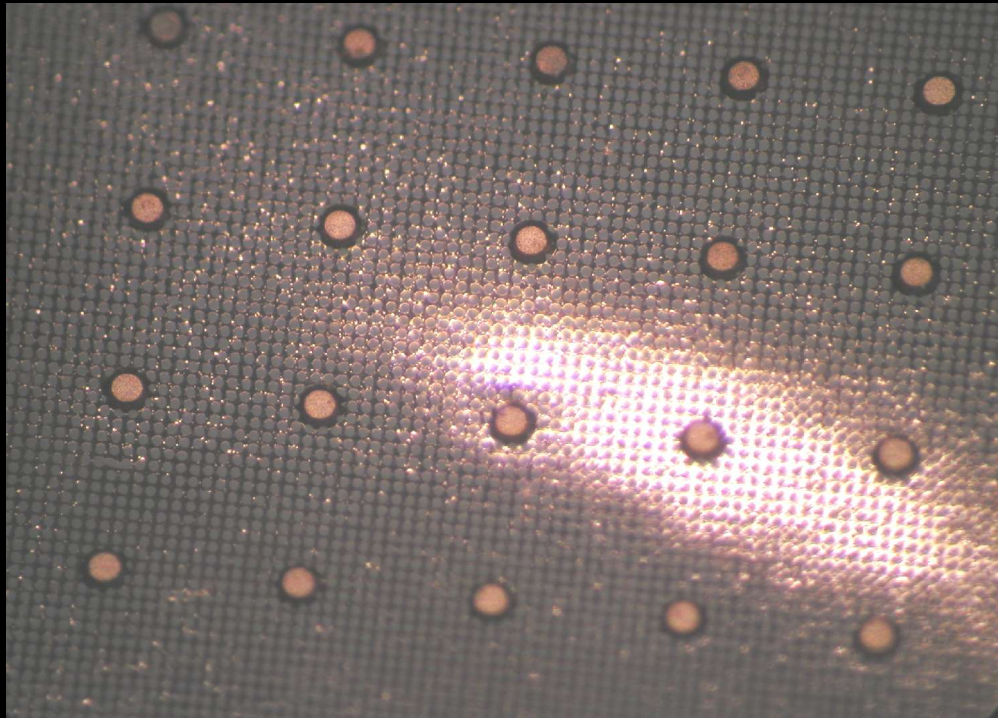
GEMs or Micromegas: narrow charge distribution (only electron movement)



Narrow charge distribution: Lose precision

- Solutions:
- Cover pads with resistive layer
 - “Chevron pads”
 - Many small pads: pixels → **GRIDPIX**

- Gridpix: A TPC using a micromegas with a CMOS pixel detector (Bare medipix2)

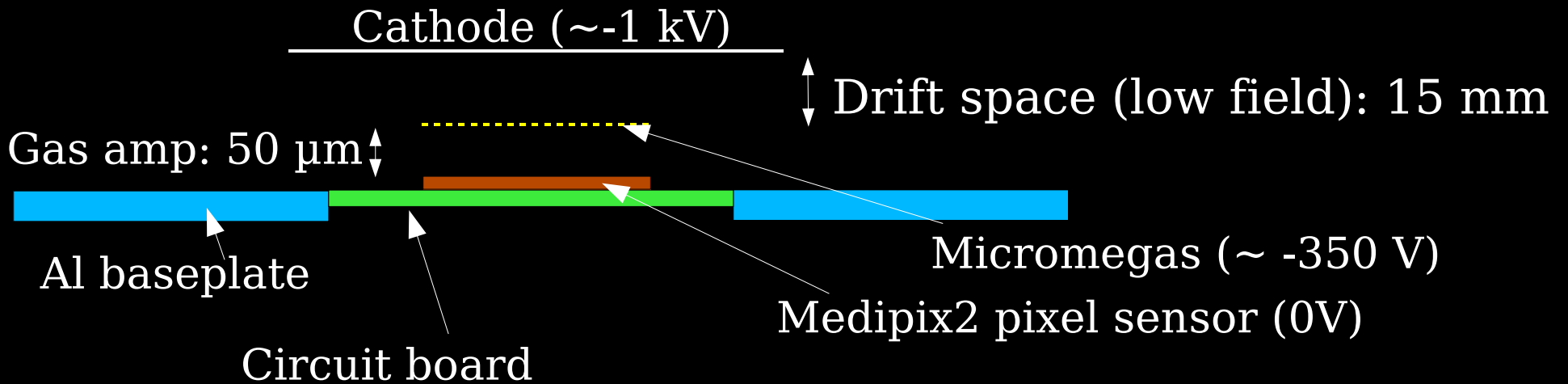
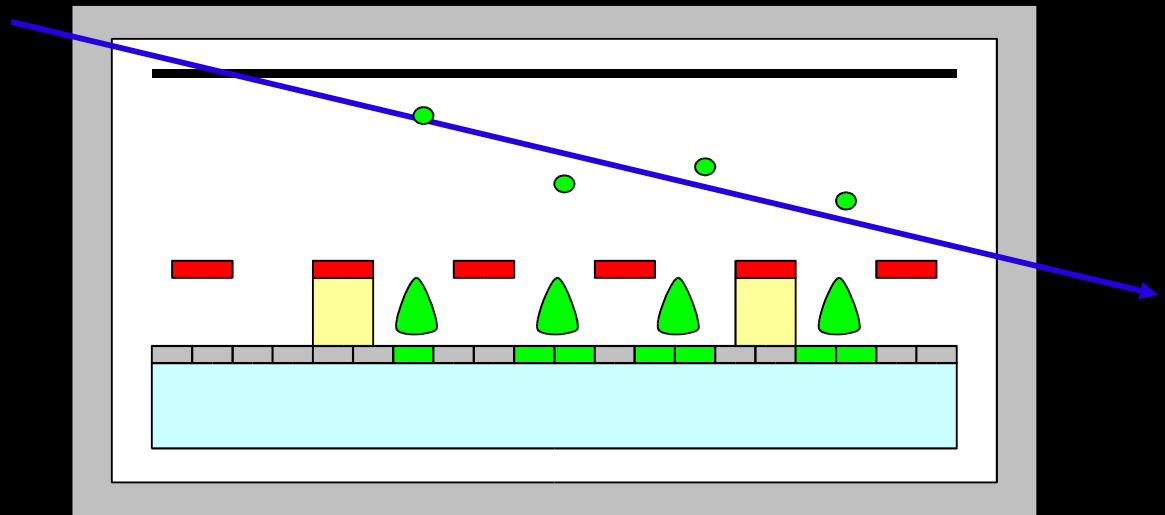


- Micromegas:
 - Cu mesh (5 μm thick)
 - Hole: 35 μm^2 Pitch: 60 μm

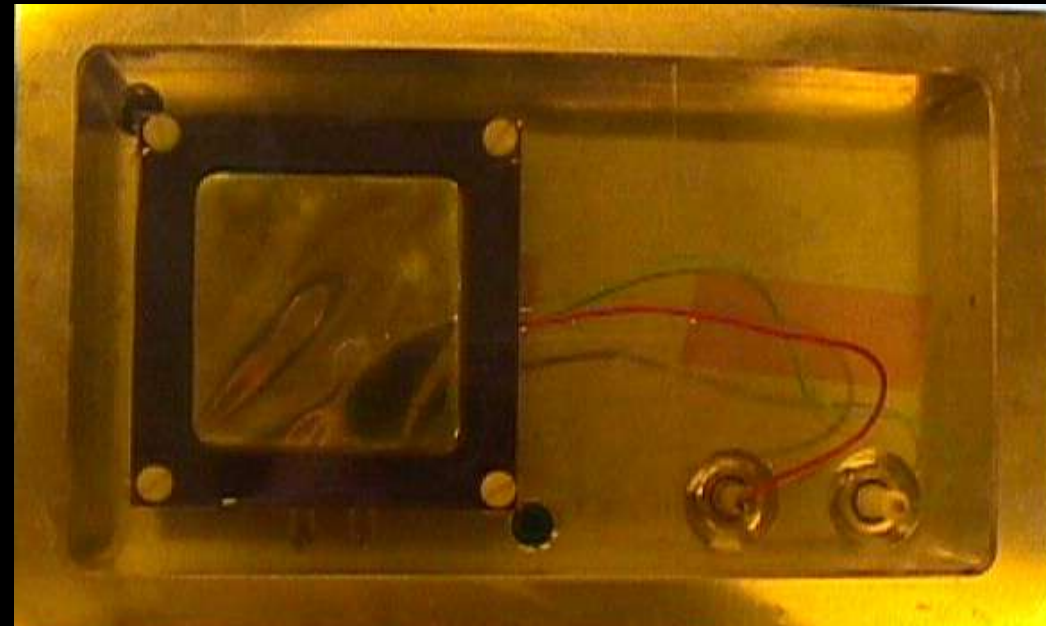
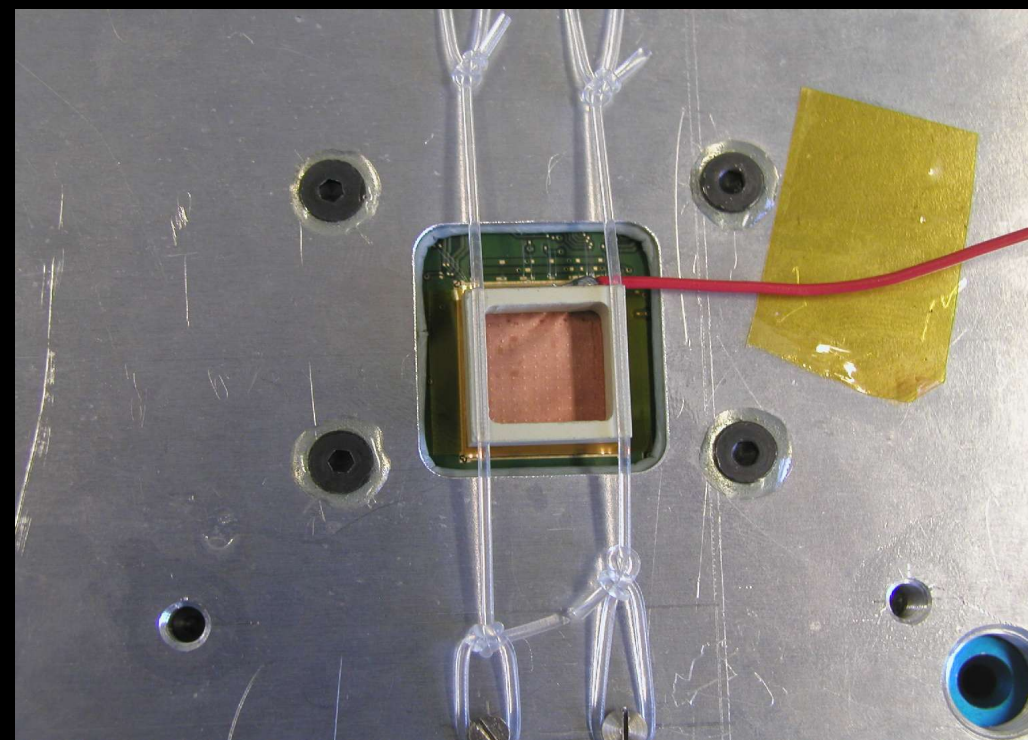
- Medipix2:
 - 256x256 pixels
 - 55x55 μm pixels

Electron collection & Setup

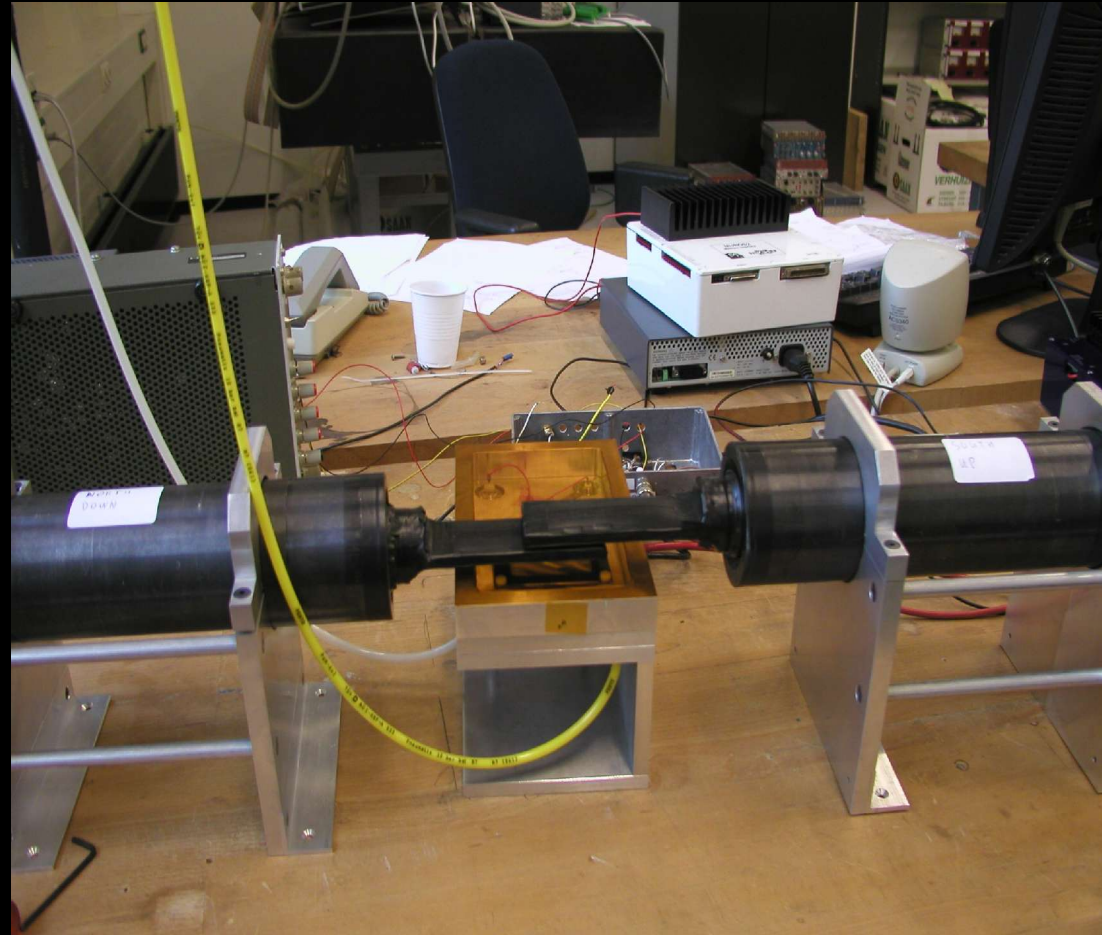
- 1 Clusters (depends on gas mixture)
- 2 Drifting
- 3 Amplification
- 4 Collection on pixel



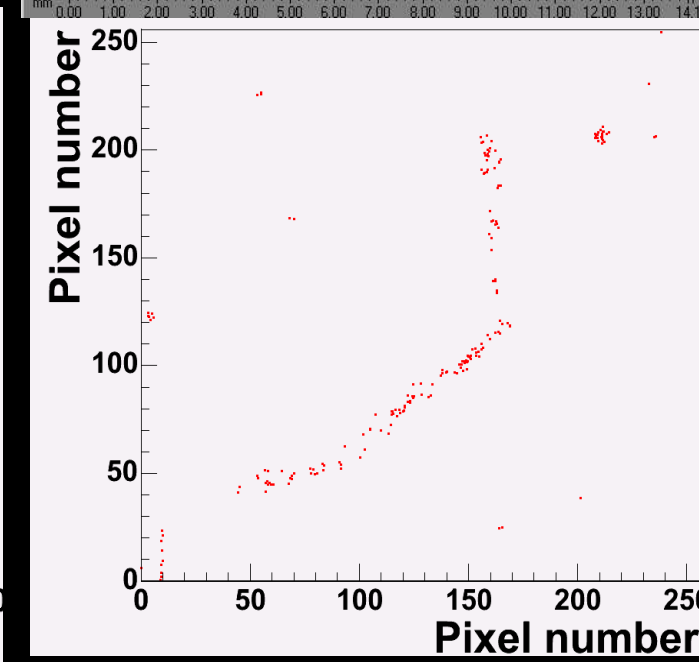
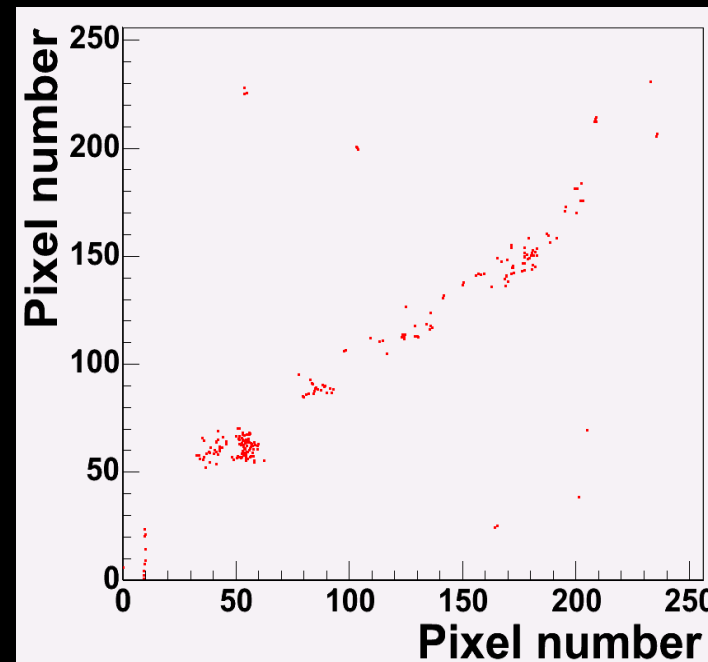
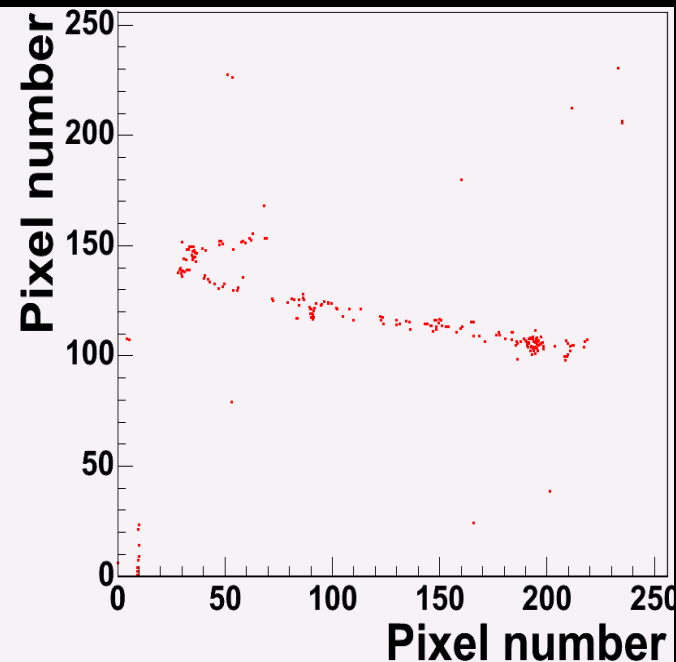
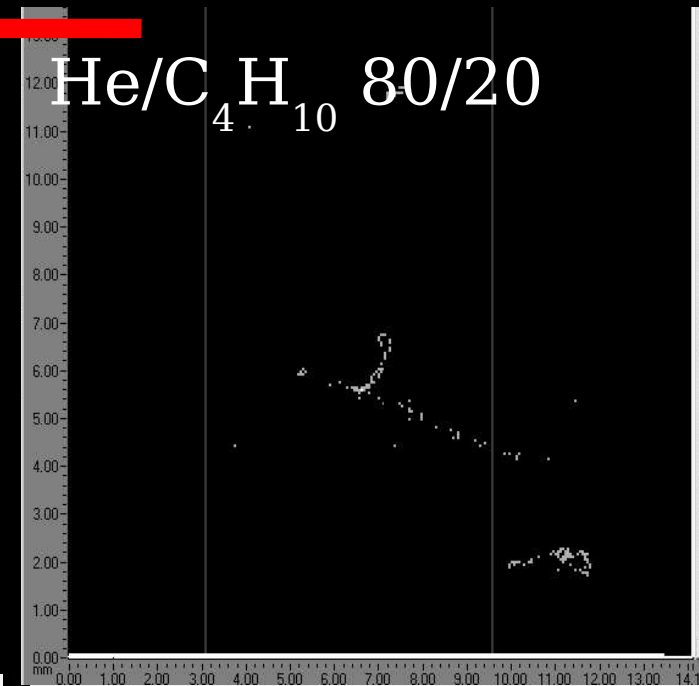
- Bare chip (Without Si sensor)
- Front end electronics all on chip



- Gas gain; single electron efficiency
- Aging
- MIPS (Atmospheric Muons):
 - Trigger
 - Diffusion
 - dE/dx
 - Tracking resolution

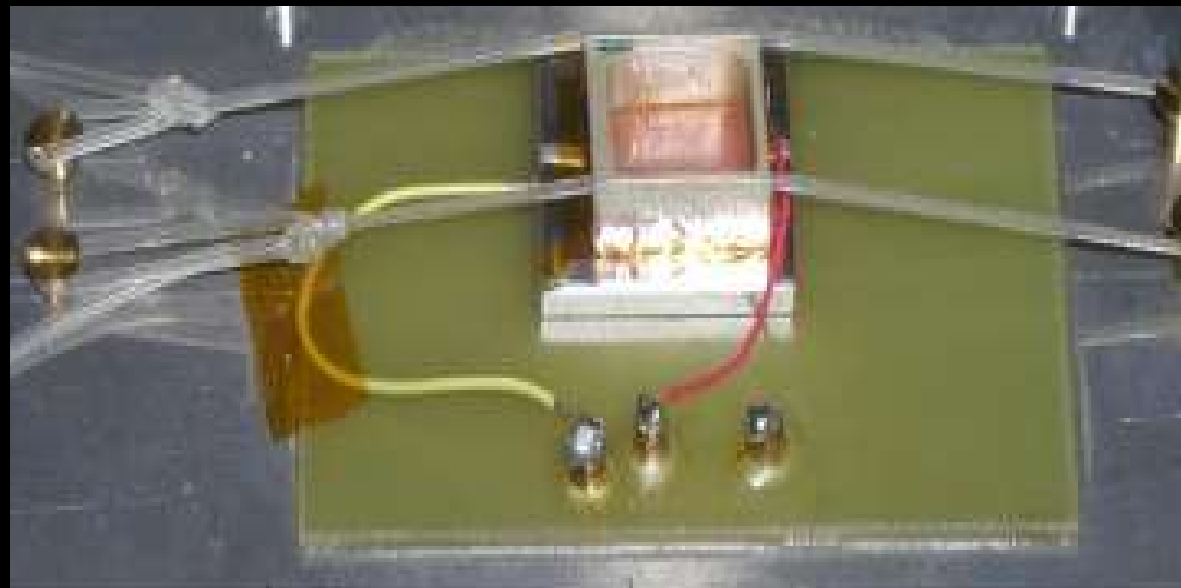


- Triggered Images
- Projections MIPS 3D → 2D
- Ar/C₄H₁₀ 95/5
- Gain ~ 10 000
- Predicted efficiency: 90% (s.e.)



- Effects of high radiation environment on GridPix project
 - Rate
 - Current
 - Deposit

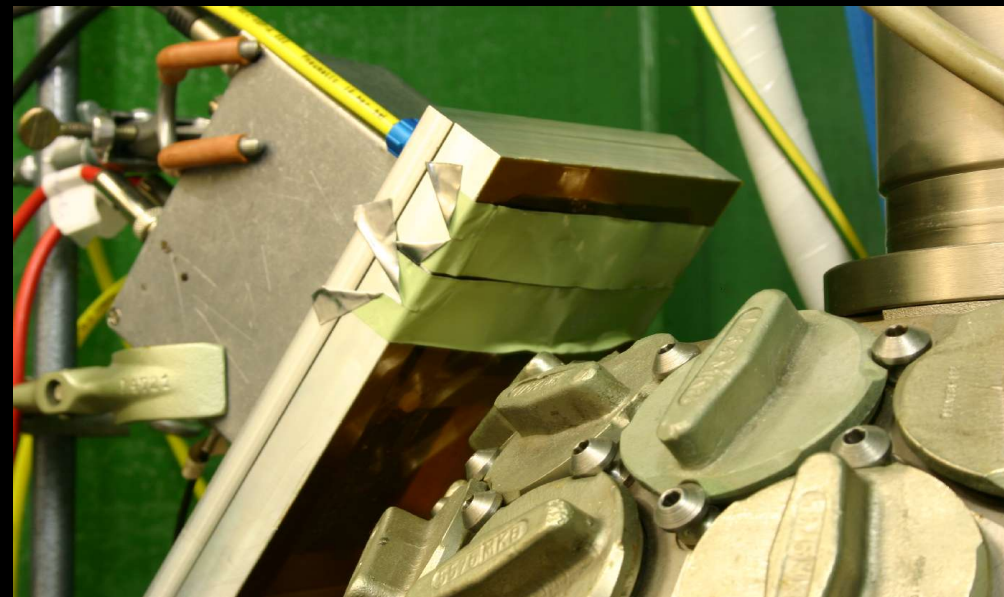
Method: Same as GridPix, but with polished Al plate as anode instead of MediPix



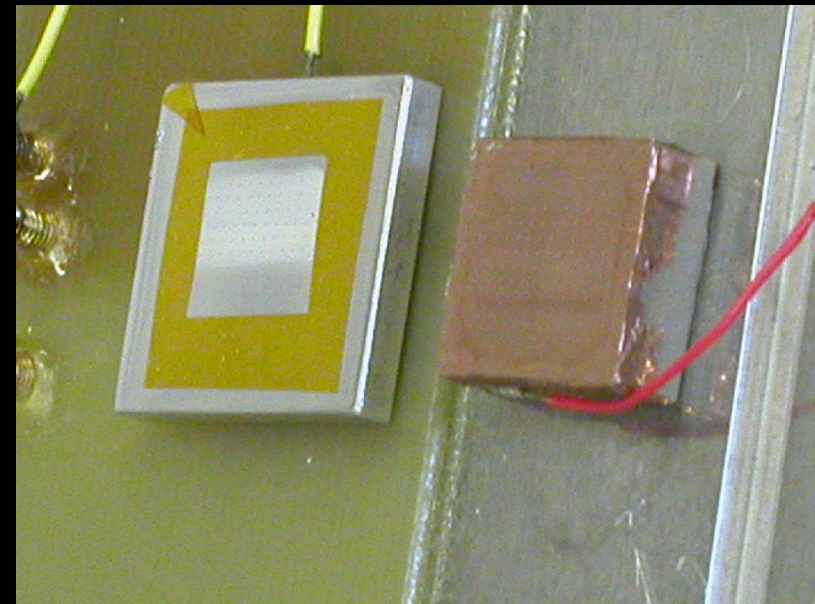
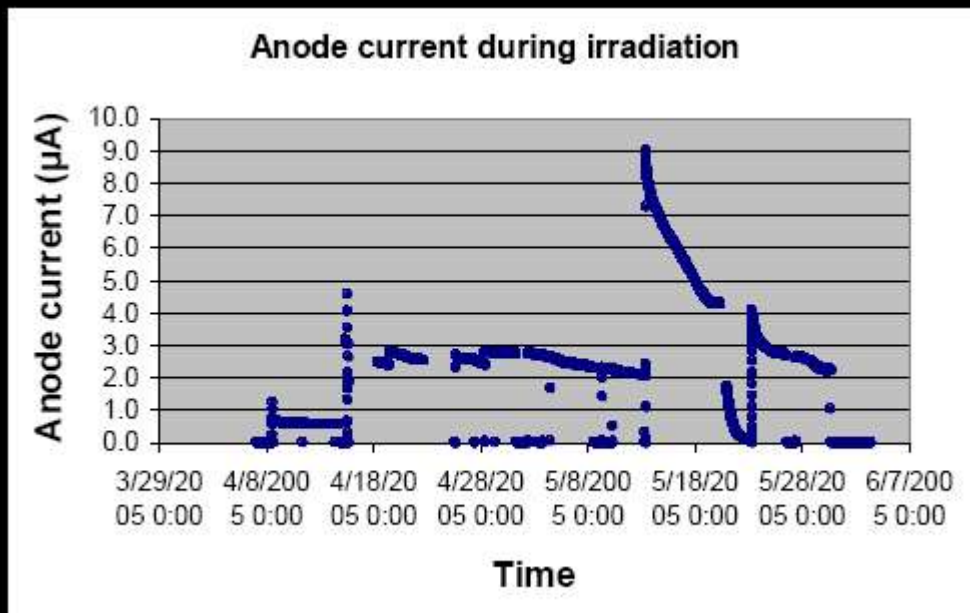
Anode current (gas gain) due to ^{55}Fe quanta calibrated with gas gain G and X-ray intensity N_x :

$$I_{\text{anode}} = G \cdot N_x \cdot 220 \text{ e}^- \cdot q_e$$

Irradiation with X-ray tube:
 No deviation from current proportionality was observed up to 44 MHz of 8 keV X-ray quanta on a detector surface of 100 mm^2 .



Half the GridPix was irradiated with 8 keV X-rays. Gas: Ar/Methane 90/10
 After 0.3 Coulomb/mm², deposit of carbon polymer on anode is clearly visible



Reduced aging of a GridPix detector versus wire chambers:

- ratio of anode surface: thin wire surface versus anode plane (~20x)
- low gas gain due to fast signal and low source capacity (~20x)

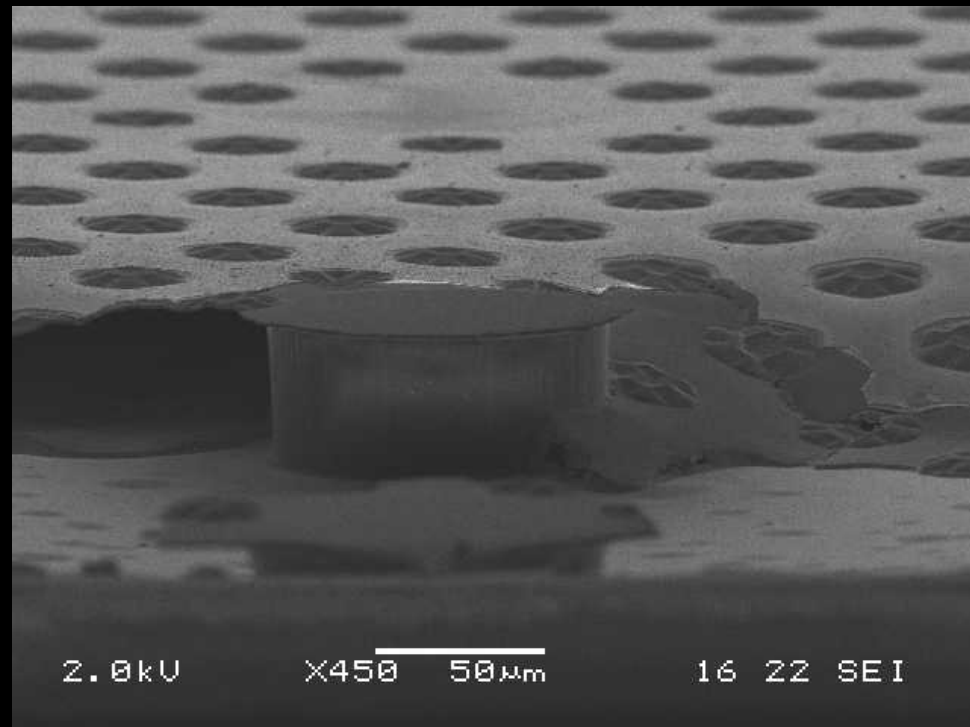
Aging: - no issue for ILC-TPC

- application as GOSSIP vertex detector in Super LHC seems feasible

- Goal: “medipix-micromegas combination in an integrated form using wafer scale post-processing”

Work in progress!!

Suspended metal grid on insulating supporting structures



Summary

- Triggered acquisition of cosmic rays can be obtained & analysis in progress
- Aging compared to wire chambers:
 - ~20x less charge collected per unit area
 - Gain needed ~20x less than wire chambers
 - Application SLHC/ILC feasible
- Work in progress on the InGrid project

Thanks to!

- Univ. Twente/MESA+
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