



Update on Silicon Pixel Readout for a TPC at NIKHEF

ILC/ECFA - Warsaw

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NIKHEF

Full post-processing of a TimePix

· Timepix chip + SiProt + Ingrid:

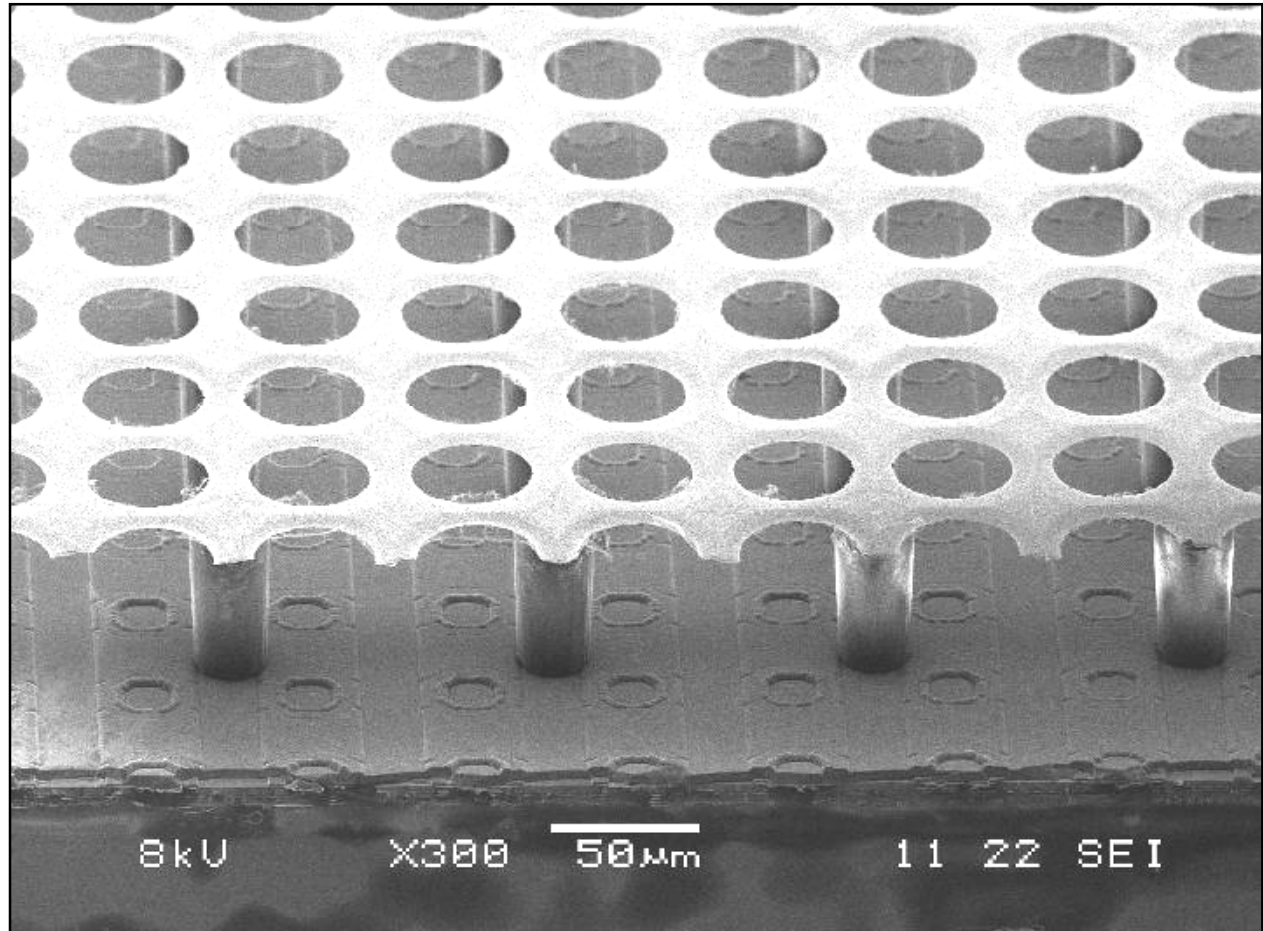
Timepix chip:

- 256x256 pixels
- pixel: $55 \times 55 \mu\text{m}^2$
- active surface: $14 \times 14 \text{ mm}^2$

MESA+: Ingrid

IMT Neuchatel:

15 or 20 μm highly resistive aSi:H protection layer



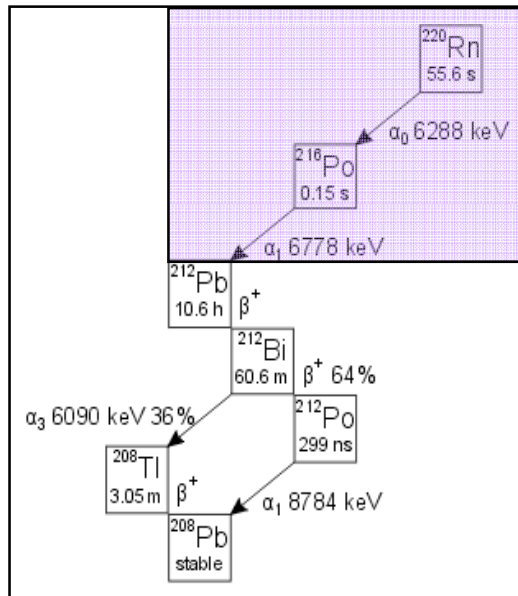
“lifetime” of Medipix2/Timepix chips

- “naked” Medipix chips:
up to few hours; sometimes very short!
(both in He and in Ar mixtures)
- With 4 μm amorphous Si:
 - in He/isobutane (80/20): > 3 months
 - In Ar/isobutane (80/20): ~ 1 day!
- With 20 μm protection layer ???

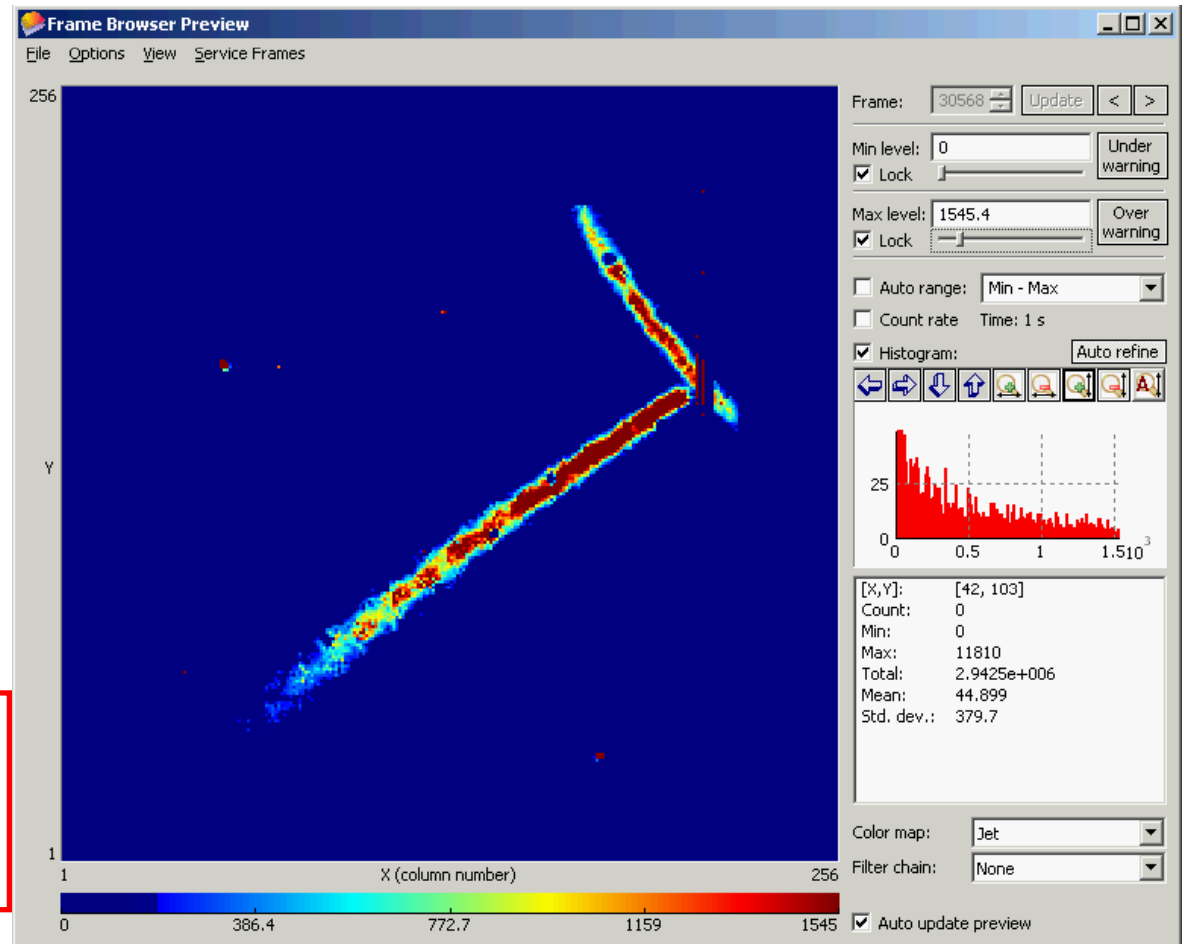
Final assessment: spark-proofness

- Provoke discharges by introducing small amount of Thorium in the Ar gas
 - Thorium decays to Radon 222 which emits **2 alphas of 6.3 & 6.8 MeV**
 - Depose on average $2.5 \cdot 10^5$ & $2.7 \cdot 10^5$ e- in Ar/iC₄H₁₀ 80/20 at -420 V on the grid, likely to trigger discharges

Charge mode



During ~3 days, some $5 \cdot 10^4$ alpha events recorded in 1% of which ...



... discharges are observed !

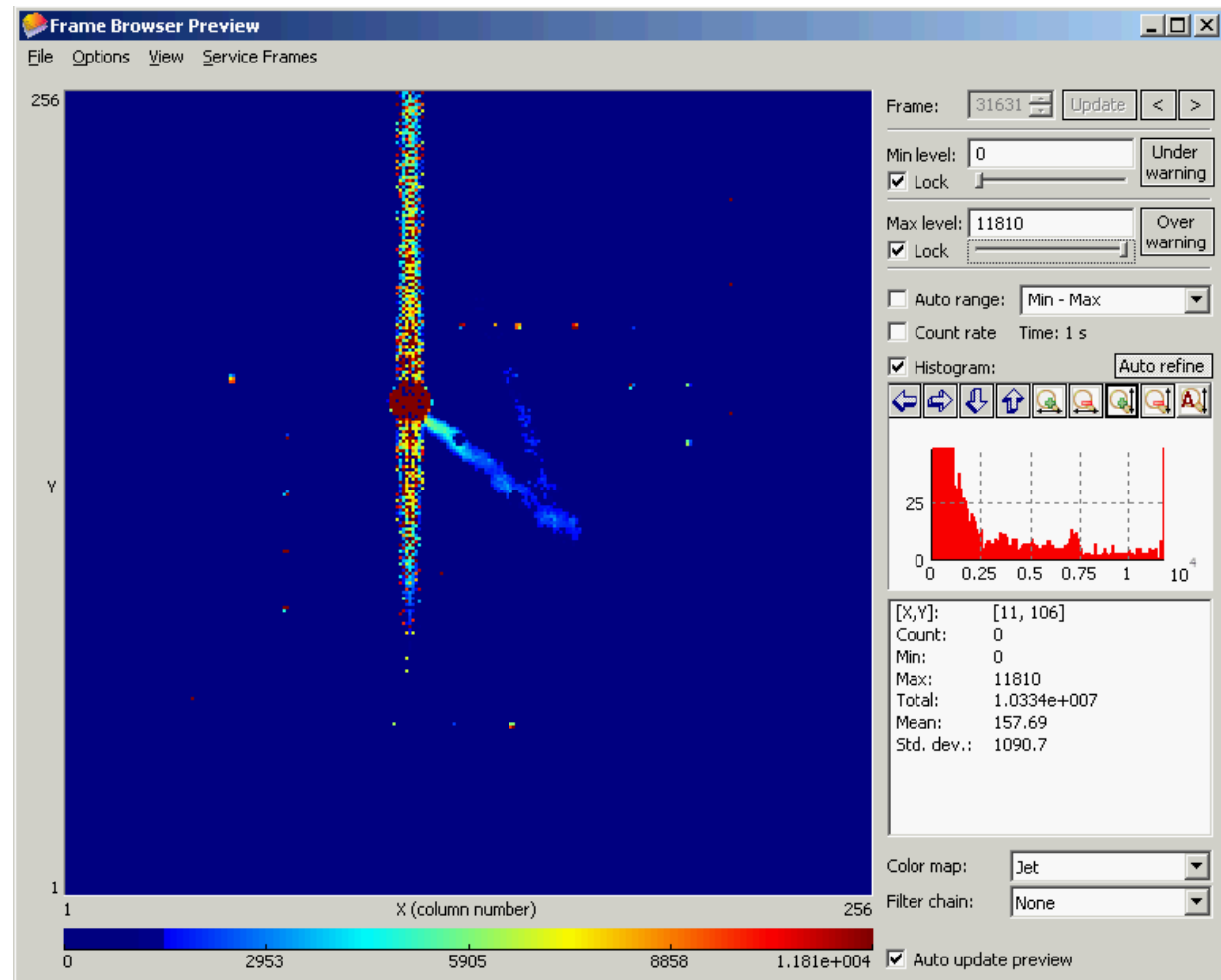
For the 1st time: image of discharges are being recorded

Round-shaped pattern of some 100 overflow pixels

Perturbations in the concerned column pixels

- Threshold?
- Power?

Chip keeps working !!



Until 3 weeks ago (with 20 μm SiProt):
no more Timepix chip damaged by
discharges

- On 21st May in CERN T9 testbeam:

Chip (with 15 μm SiProt) no longer
functioning after $\frac{3}{4}$ hour in Xe/CO₂ (70/30)
mixture at $V_{\text{grid}} = 490 \text{ V}$

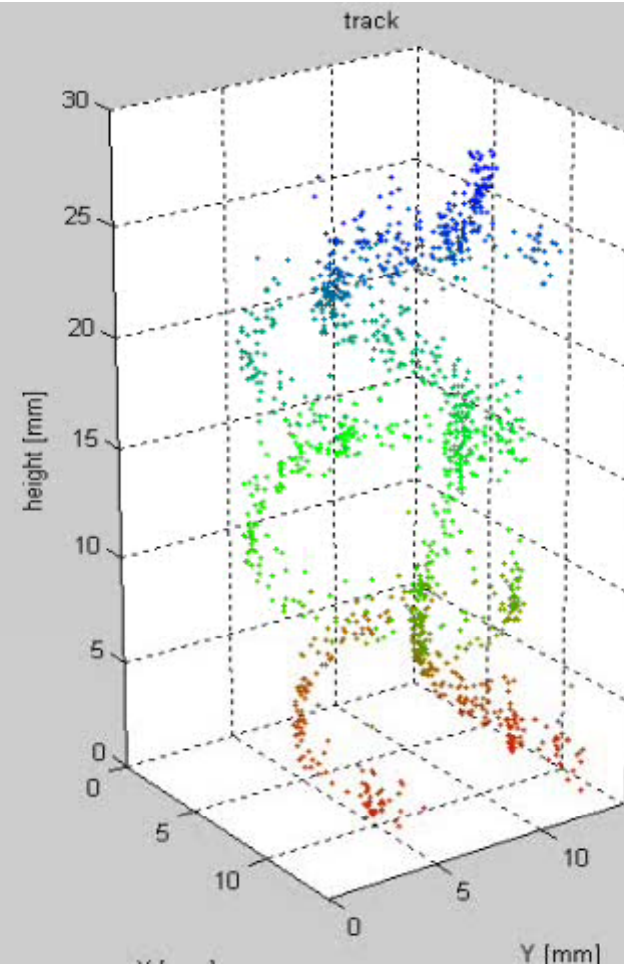
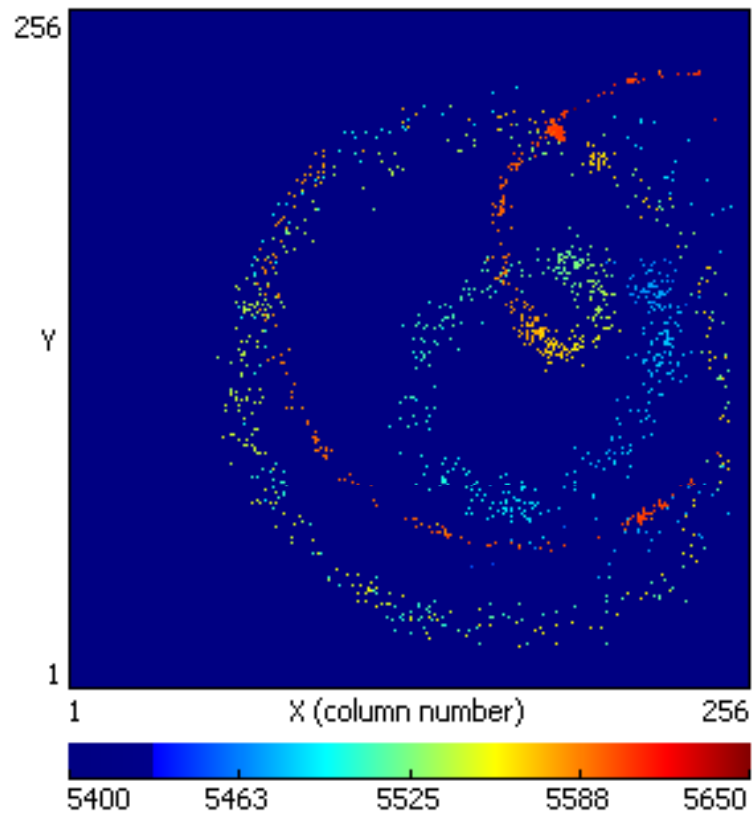
- Apart from that: lots of data collected;
analysis started

Some events

- From Nikhef in lab setup with magnet up to 1 T
- From CERN PS testbeam T9 (2 and 5 GeV pions and electrons)

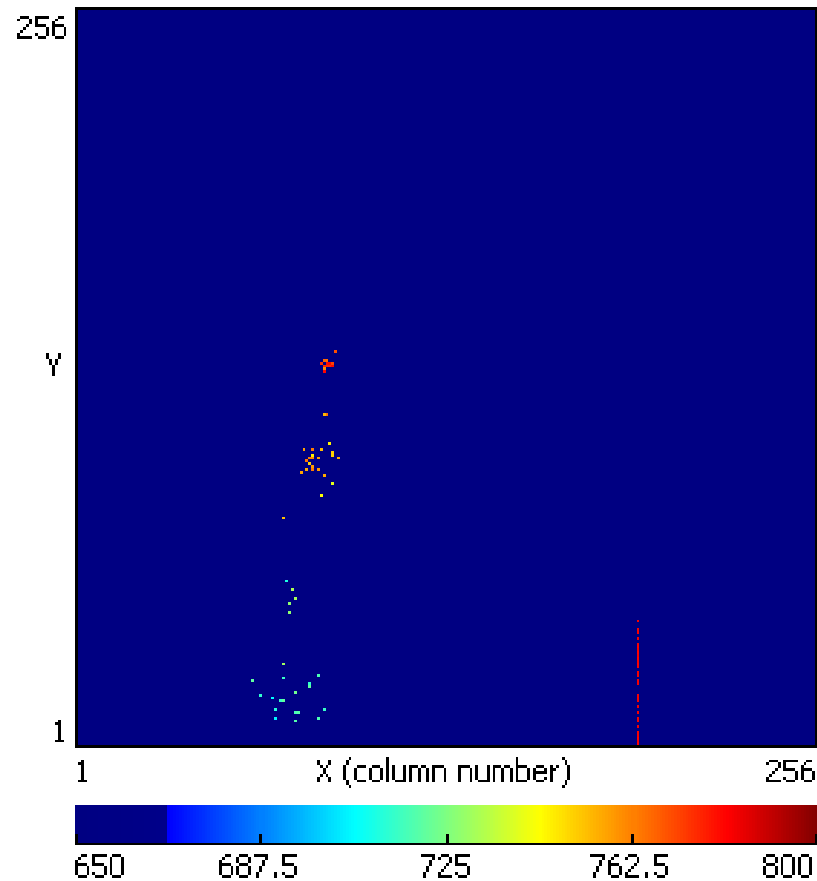
A 5 cm³ TPC (two electron tracks from ⁹⁰Sr source)

B = 0.2 T



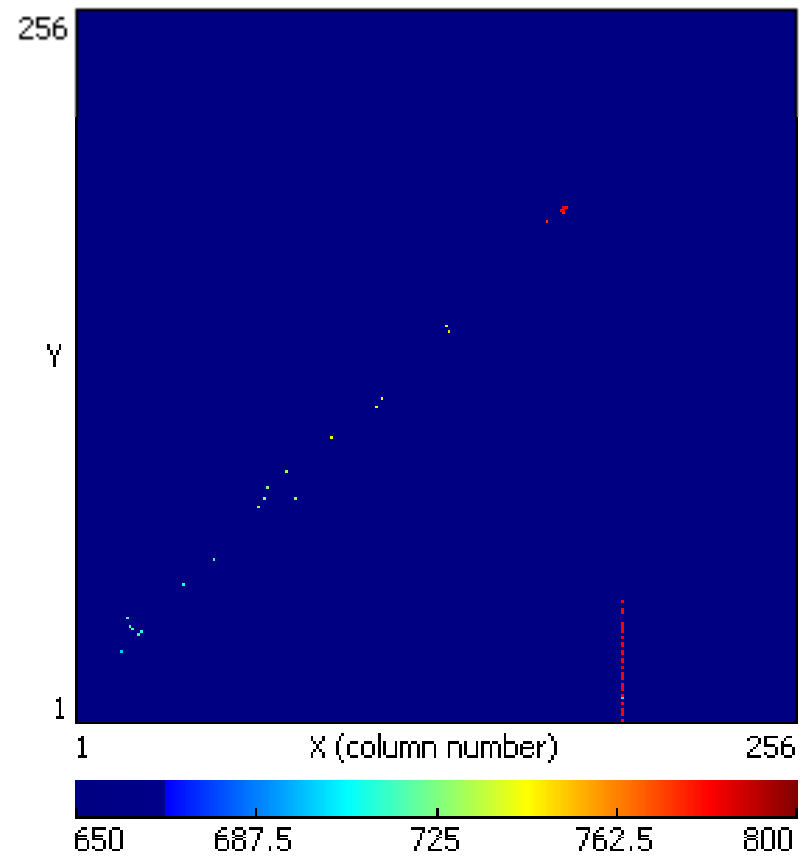
Cosmic tracks traversing ~ 30 mm drift space in Ar-CF4-iC4H10 (95/3/2%)

0 T



“large” diffusion

1 T



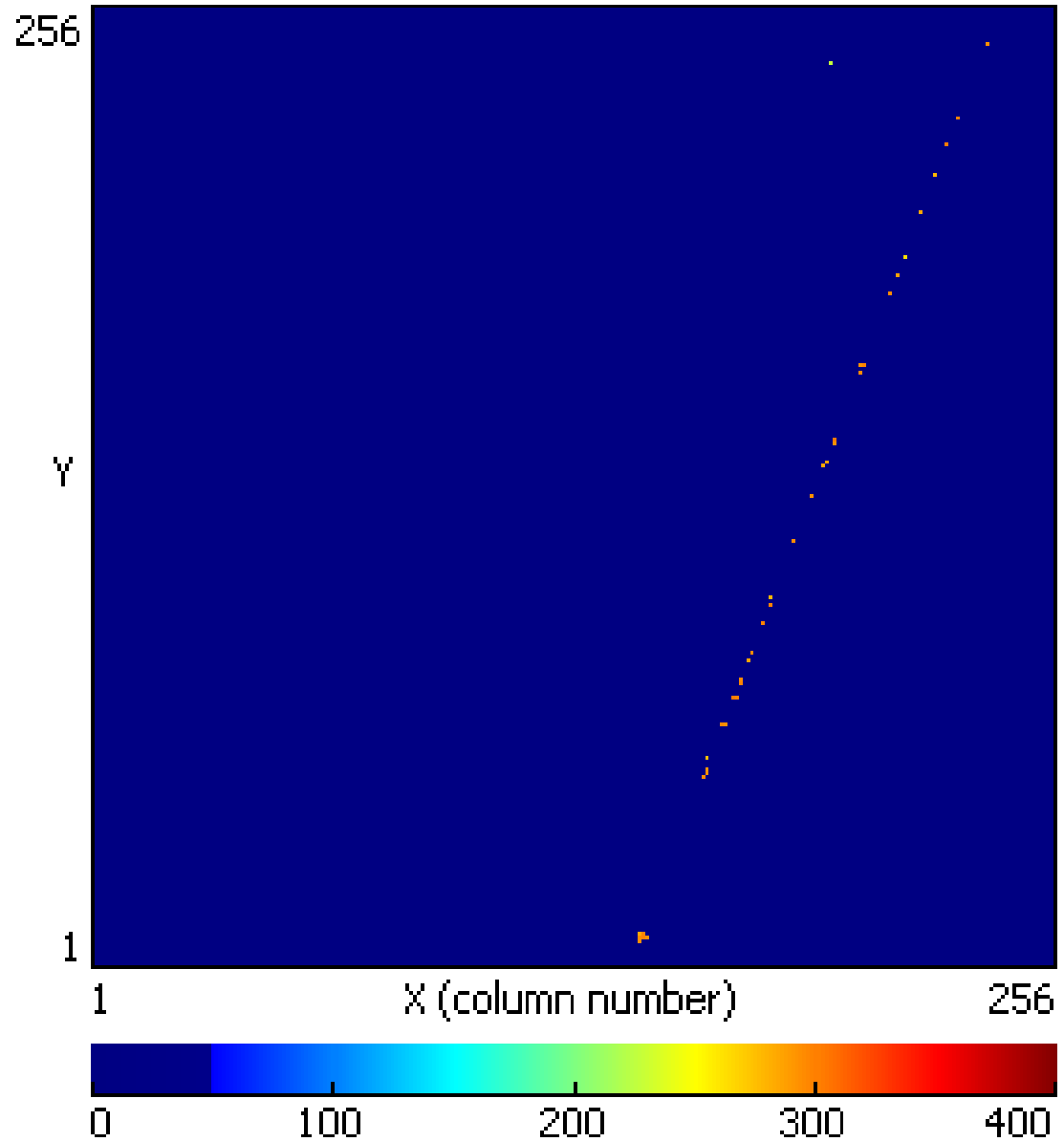
“little” diffusion

19 May 2008

5 GeV neg. beam

ArCO₂ (70/30)

Colour code =
drifttime



20 May 2008

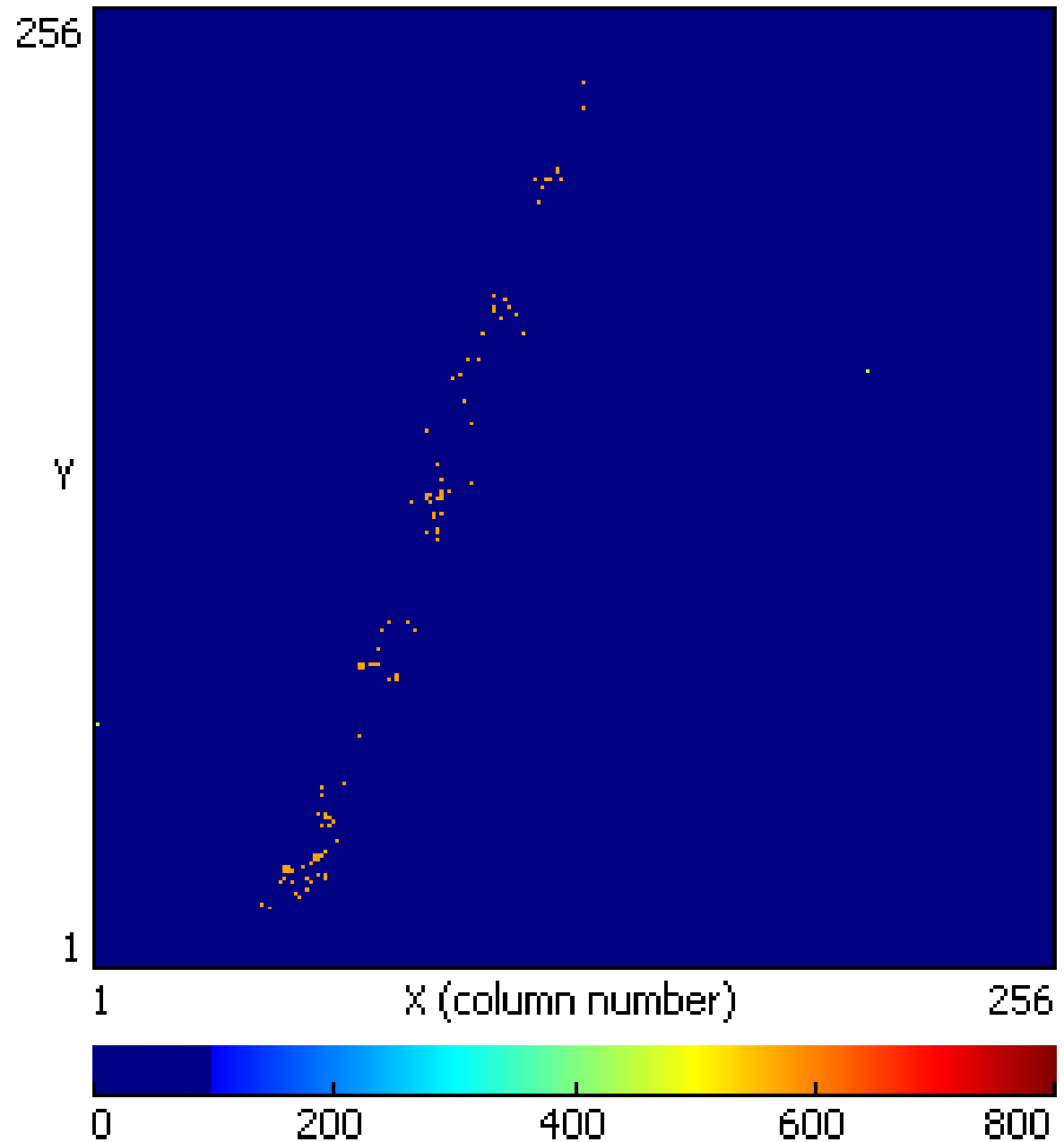
(early morning)

2 GeV neg. beam

“electron” trigger

ArCF₄isoB
(90/3/2)

Colour code =
drifttime



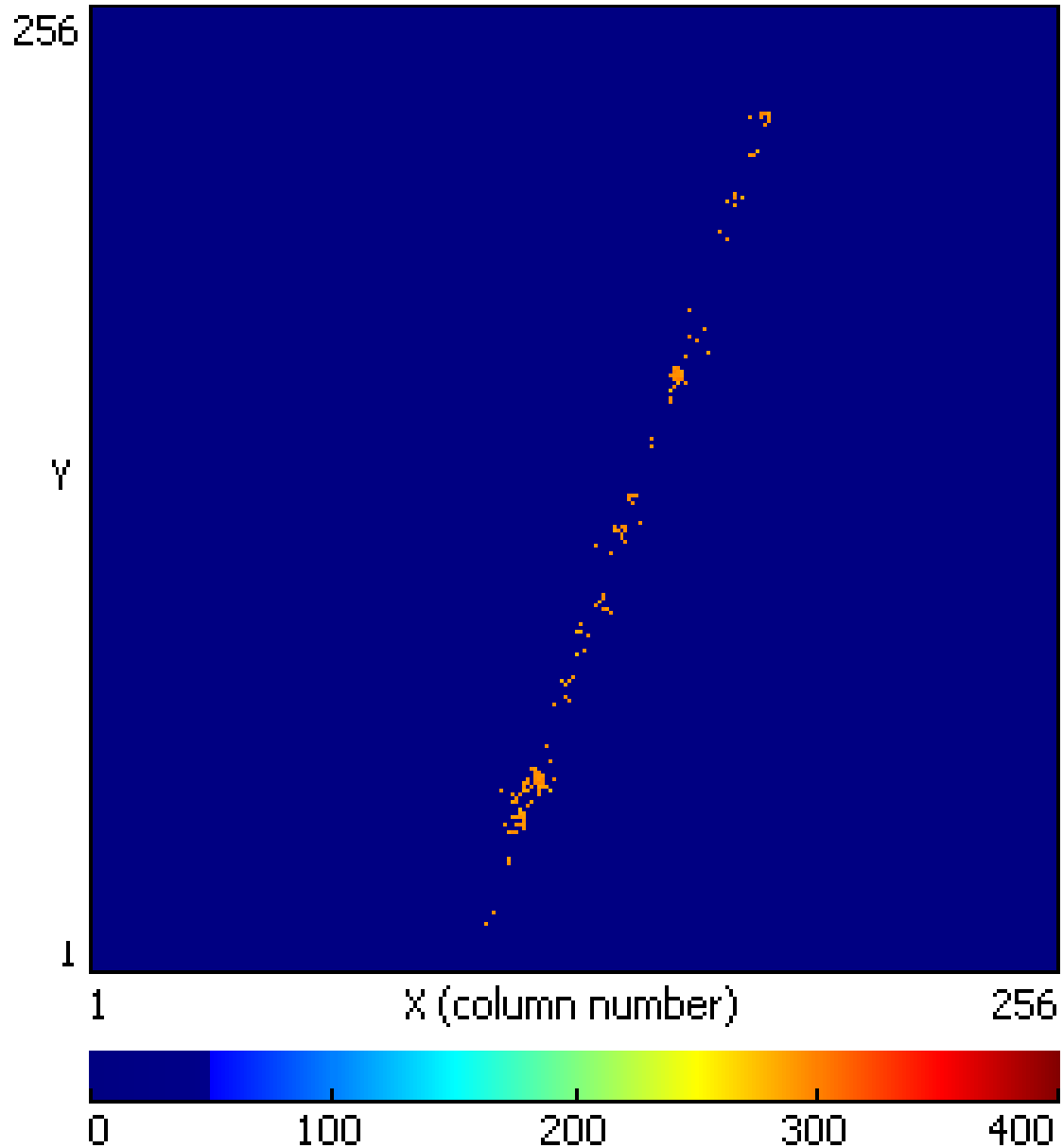
20 May 2008

(early morning)

2 GeV neg. beam

ArCF₄isoB
(90/3/2)

Colour code =
drifttime

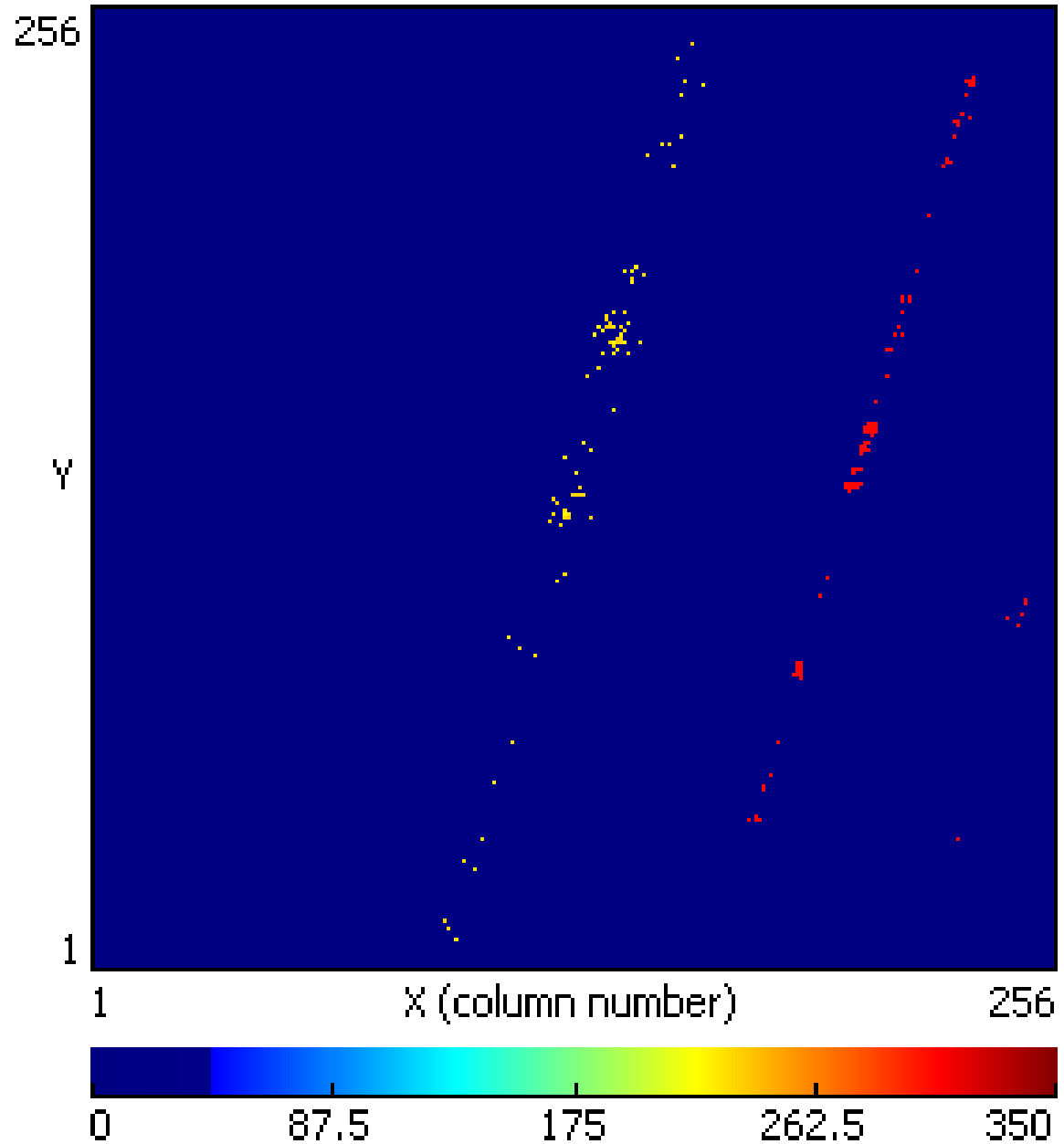


21 May 2008

5 GeV neg. beam

XeCO₂ (70/30)

Colour code =
drifttime



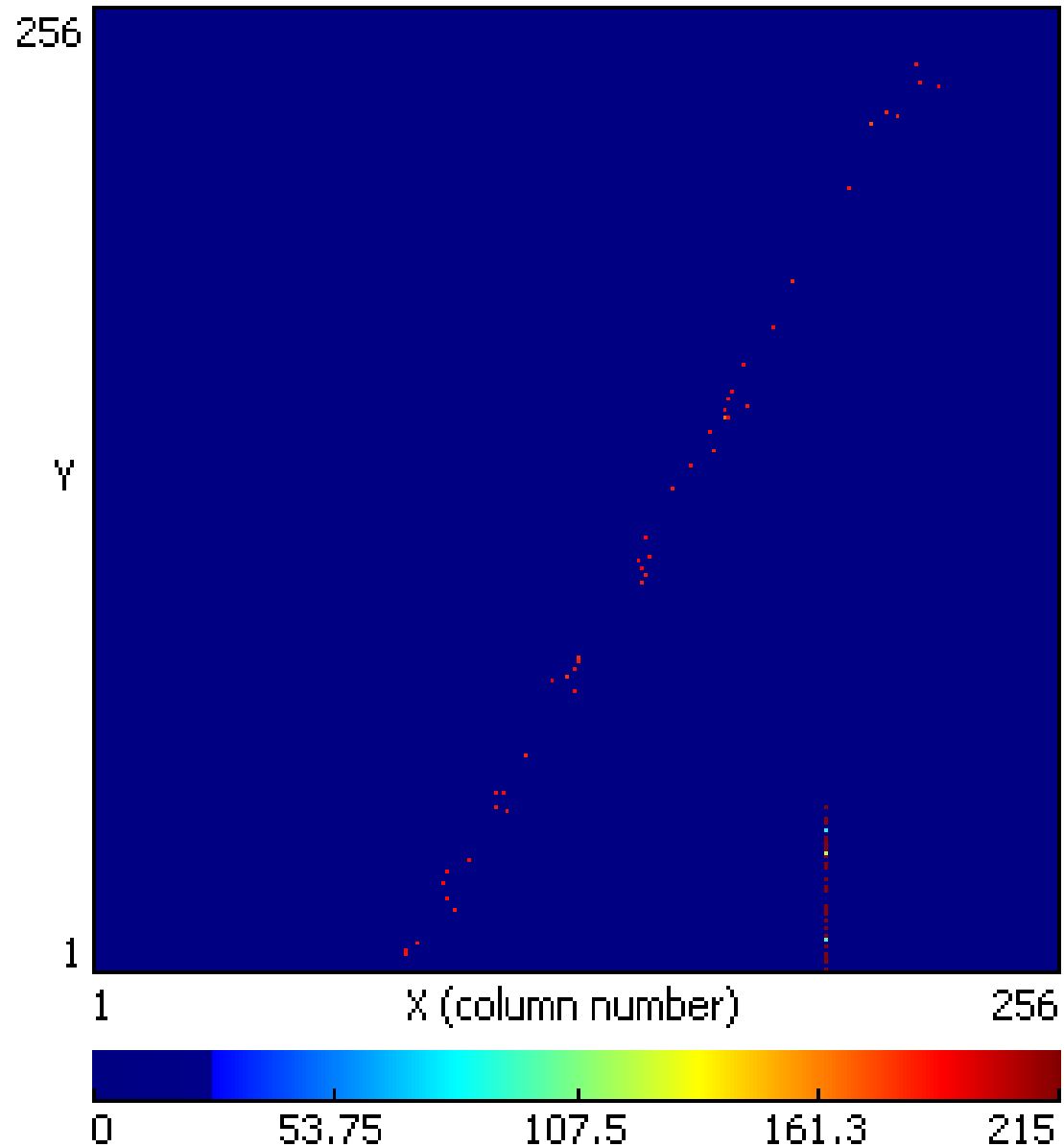
23 May 2008

5 GeV neg. beam

He-isoB (80/20)

$V_{\text{grid}} = 420 \text{ V}$

Colour code =
drifttime



- **Sofar** single-chip systems used
- **Soon** (Eudet deliverable) small multi-chip systems:
 - Bonn: two 4-chip boards → on endplate module
 - Saclay: one 8-chip board → on endplate module
 - NIKHEF: 4-chip board, fitting single-chip detector mechanics and drifter (could become endplate module)
- **Later (~3/2009)**: aim for a 64-chip system (NIKHEF; may be too ambitious; bottleneck could be production of sufficient # Ingrids)

Summary

- A lot of progress made in last 'year'; not mentioned many details on track resolution studies and on signal development
- Part of the technology is ready:
 - Very good energy resolution for Ingrid devices
 - Ion backflow at the few per-mil level at high field ratio
- Discharge protection seems working for Ingrid (and Micromegas) devices under “normal” conditions
- Robust operation with GEM devices (without protection)

Next:

- Build larger multi-chip detector systems with fast readout