Some results with NIKHEF Ingrids at DESY test beams

EUDET Annual meeting

29 September 2010

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NIKHEF/DESY

Full post-processing of a TimePix

· Timepix chip + SiProt + Ingrid:

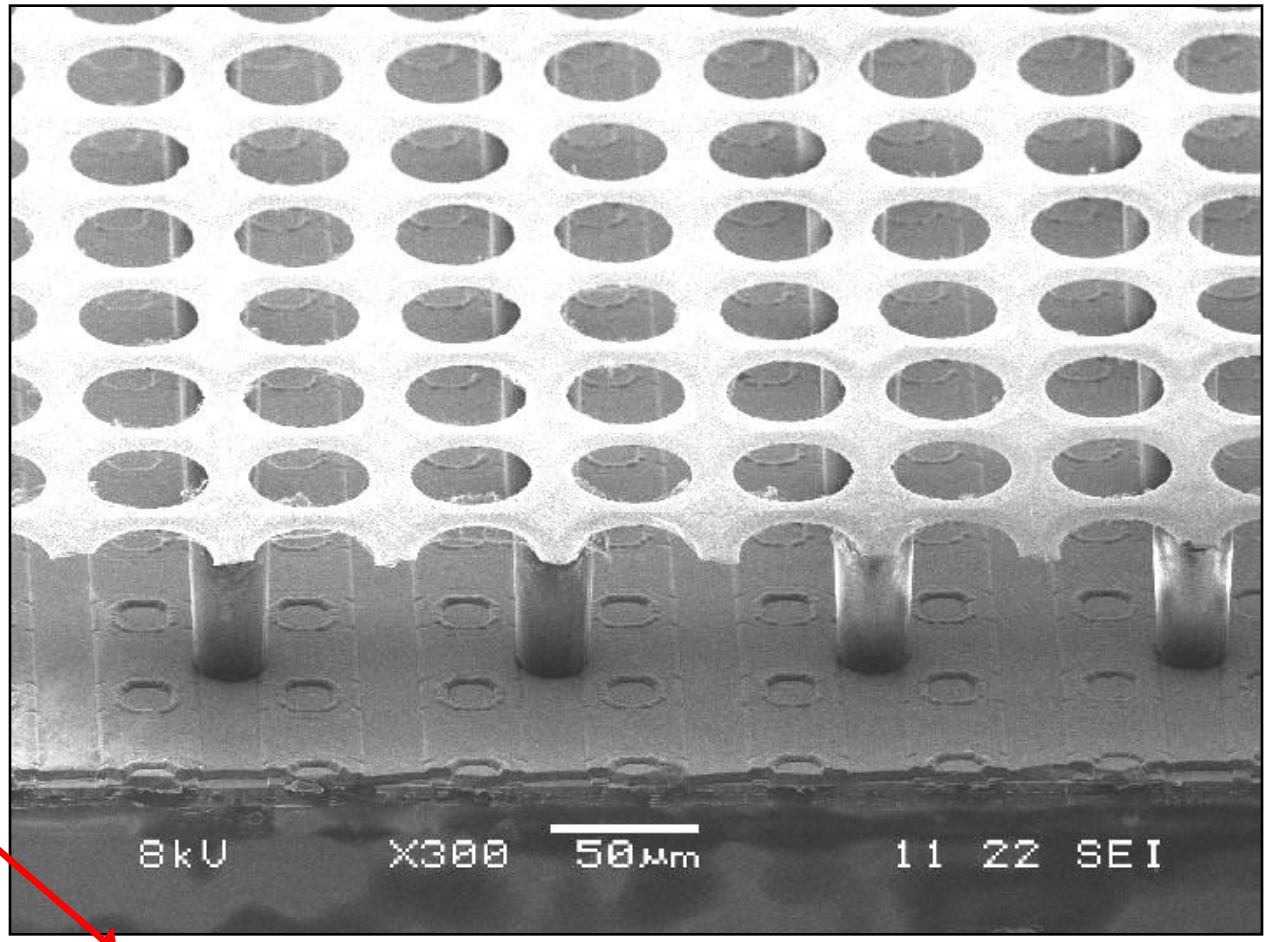
Timepix chip:

- 256x256 pixels
- pixel: 55x55 μm^2
- active surface: 14x14 mm^2

MESA+: Ingrid

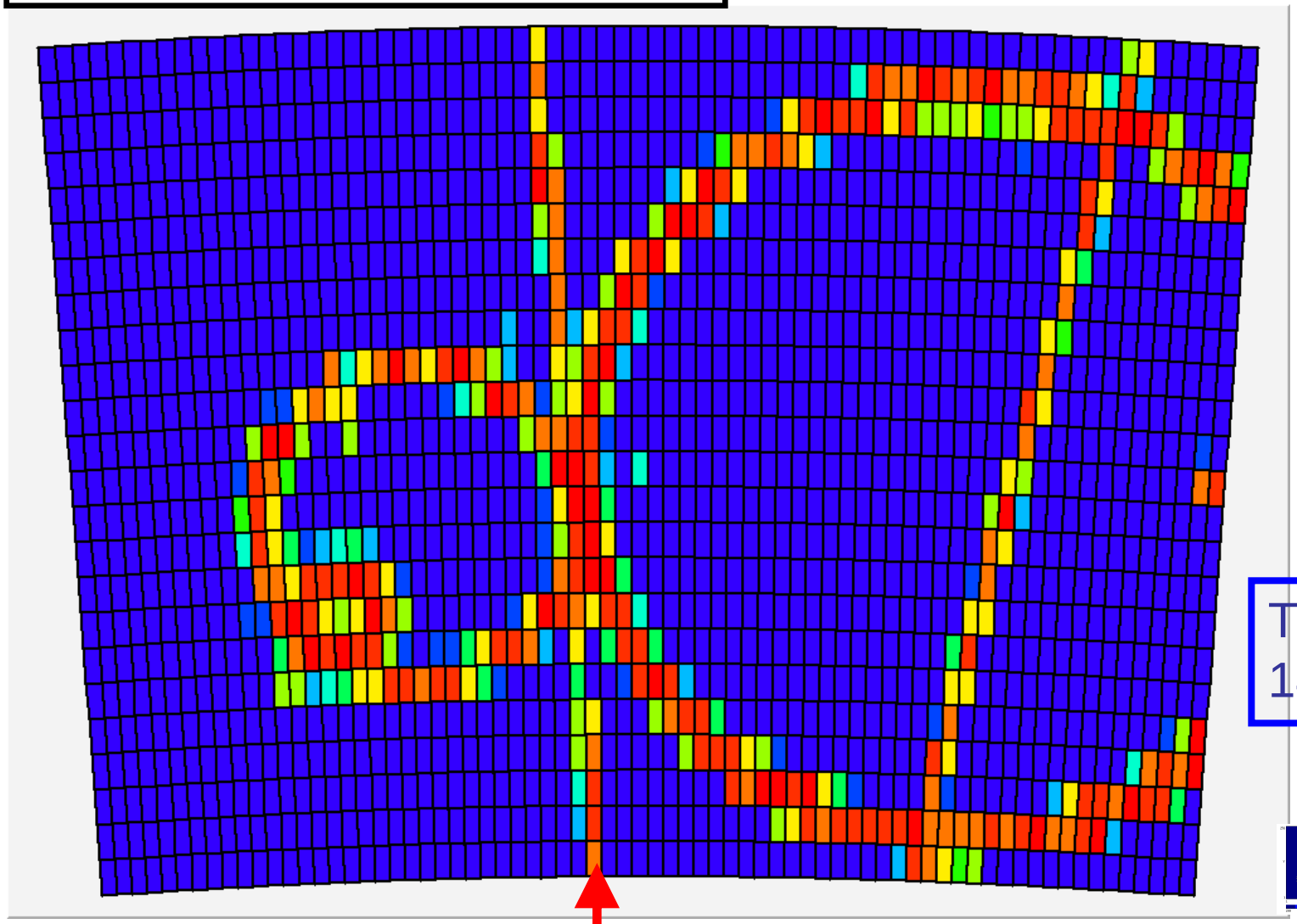
IMT Neuchatel:

15 or 20 µm highly resistive aSi:H protection layer



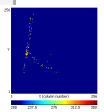
Now also Si_3N_4 protection layers (7 µm)

72x24 pads of ~3x7 mm^2

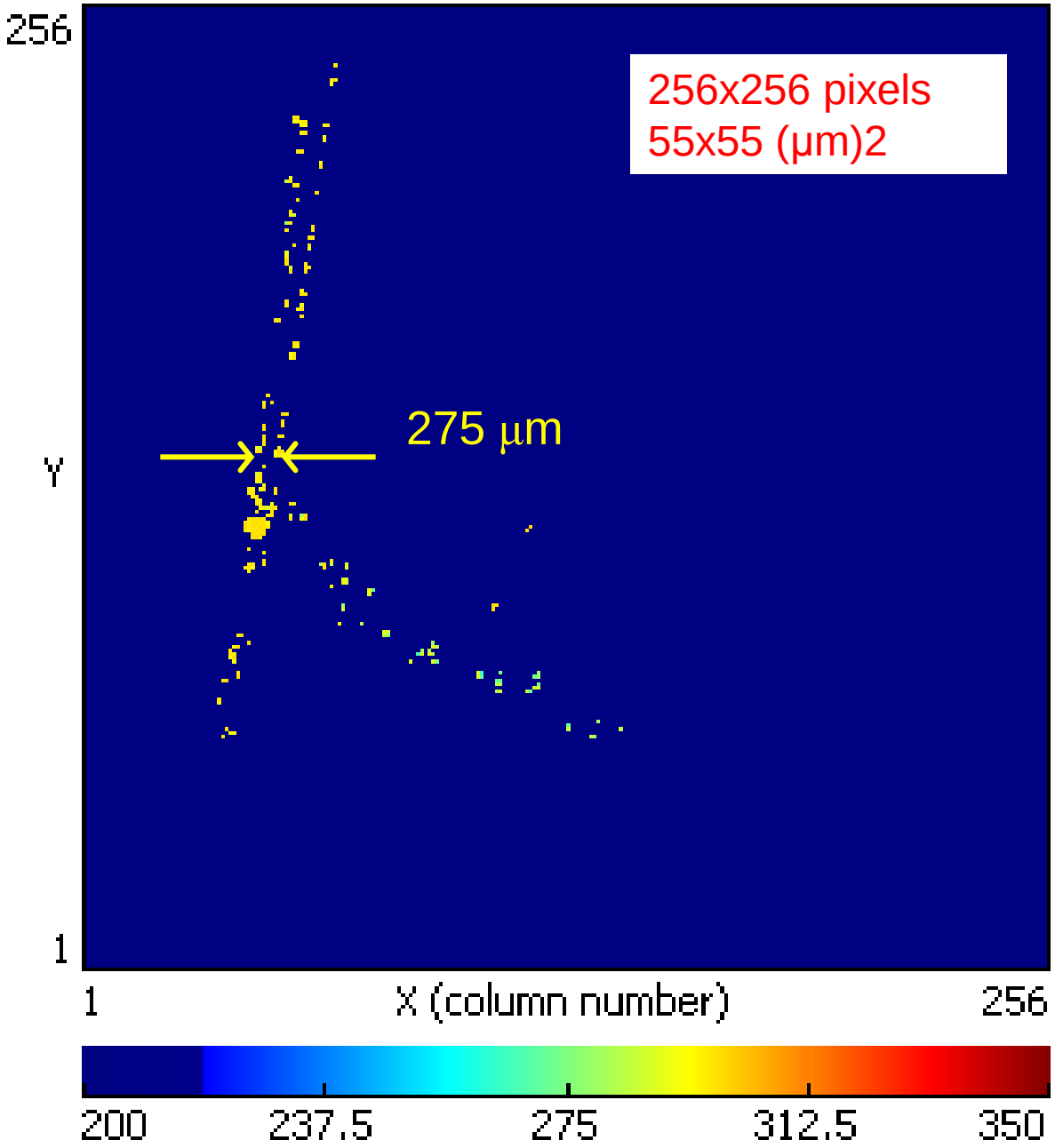


B = 1 T

TimePix chip
14x14 mm^2



5 GeV e^- beam



Two-track separation:

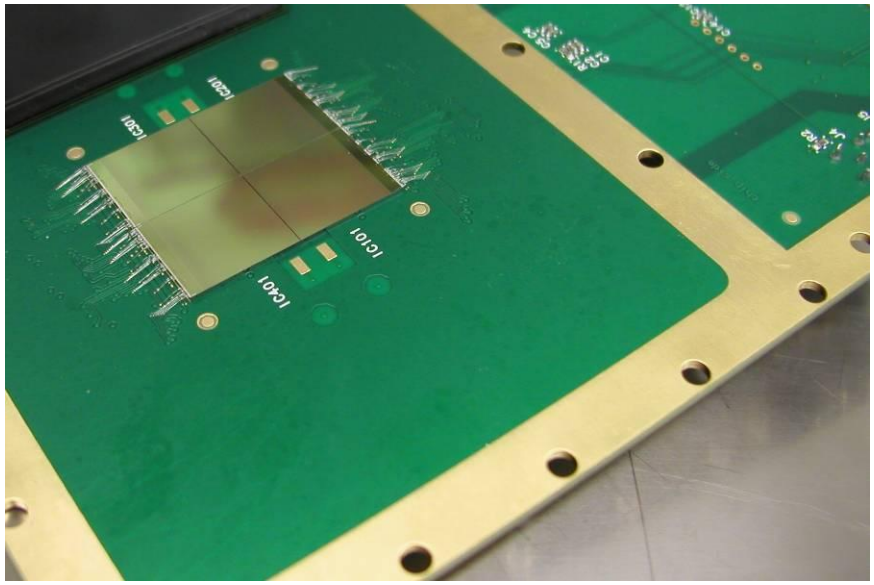
- Will be diffusion limited
- In this example:

5 pixels = 275 μm

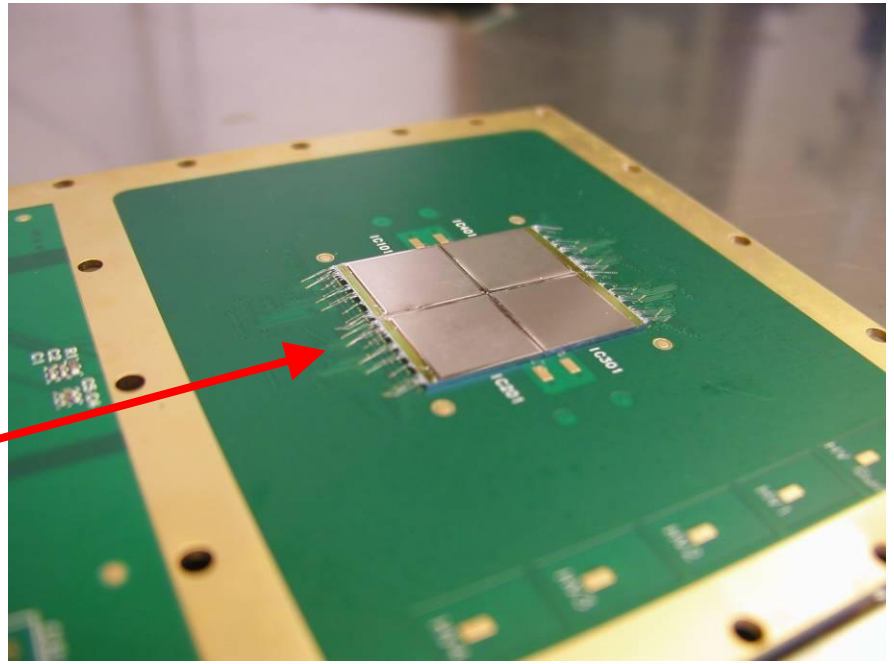
Diffusion at 4T in Ar/CF4/iC_4H_{10} is

~ $20\sqrt{200}$ = 300 μm

NIKHEF: emphasis on Ingrids



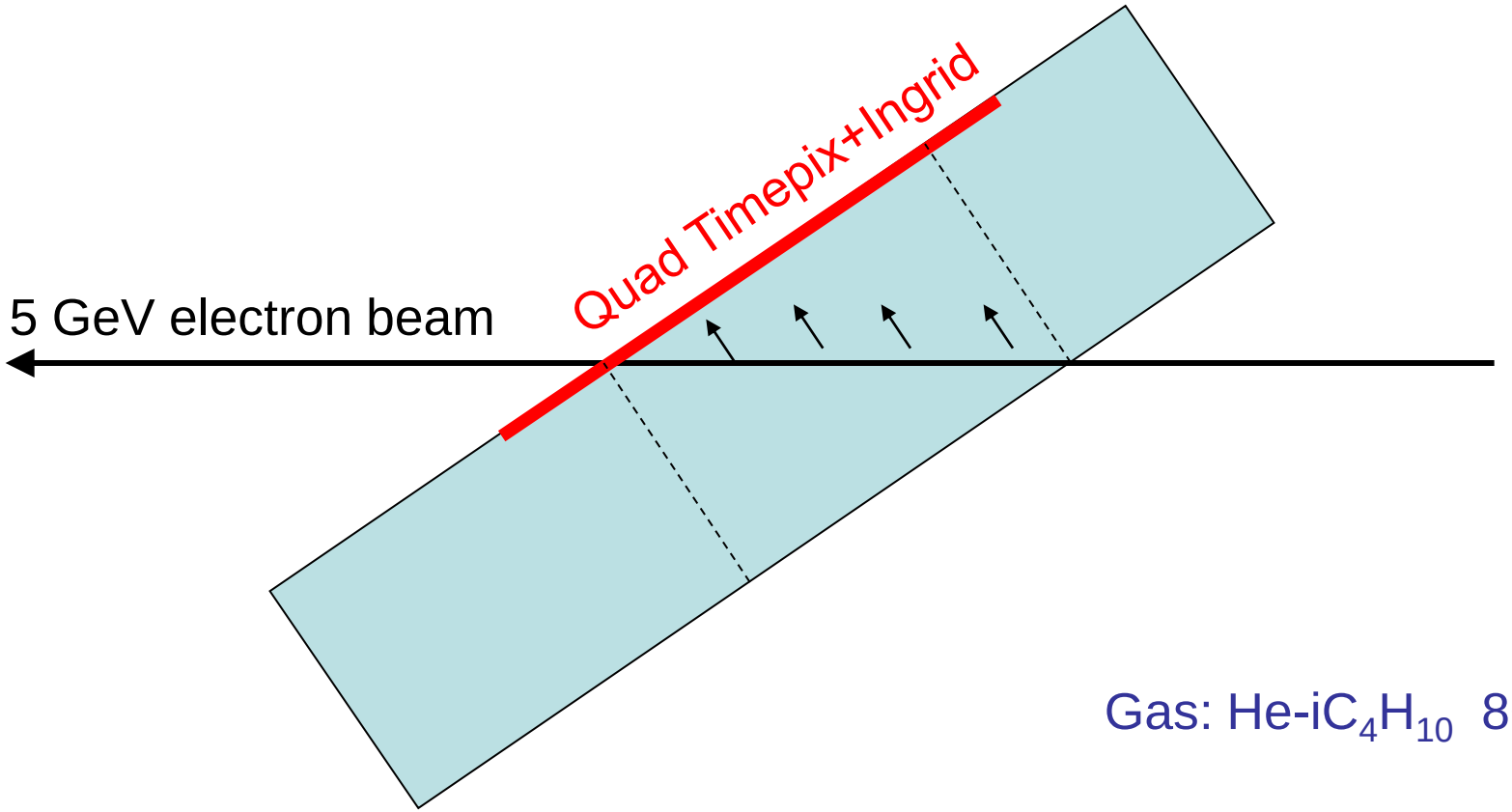
- within Relaxd project: 4x4 Medipix chips in compact mounting
- Will evolve in 8x8 Timepix chips for EUDET



- Works with source and cosmics at NIKHEF in Nov'09 – Feb'10
- Equiped with Ingrids in June '09
- QUAD chips board tested OK in 2008

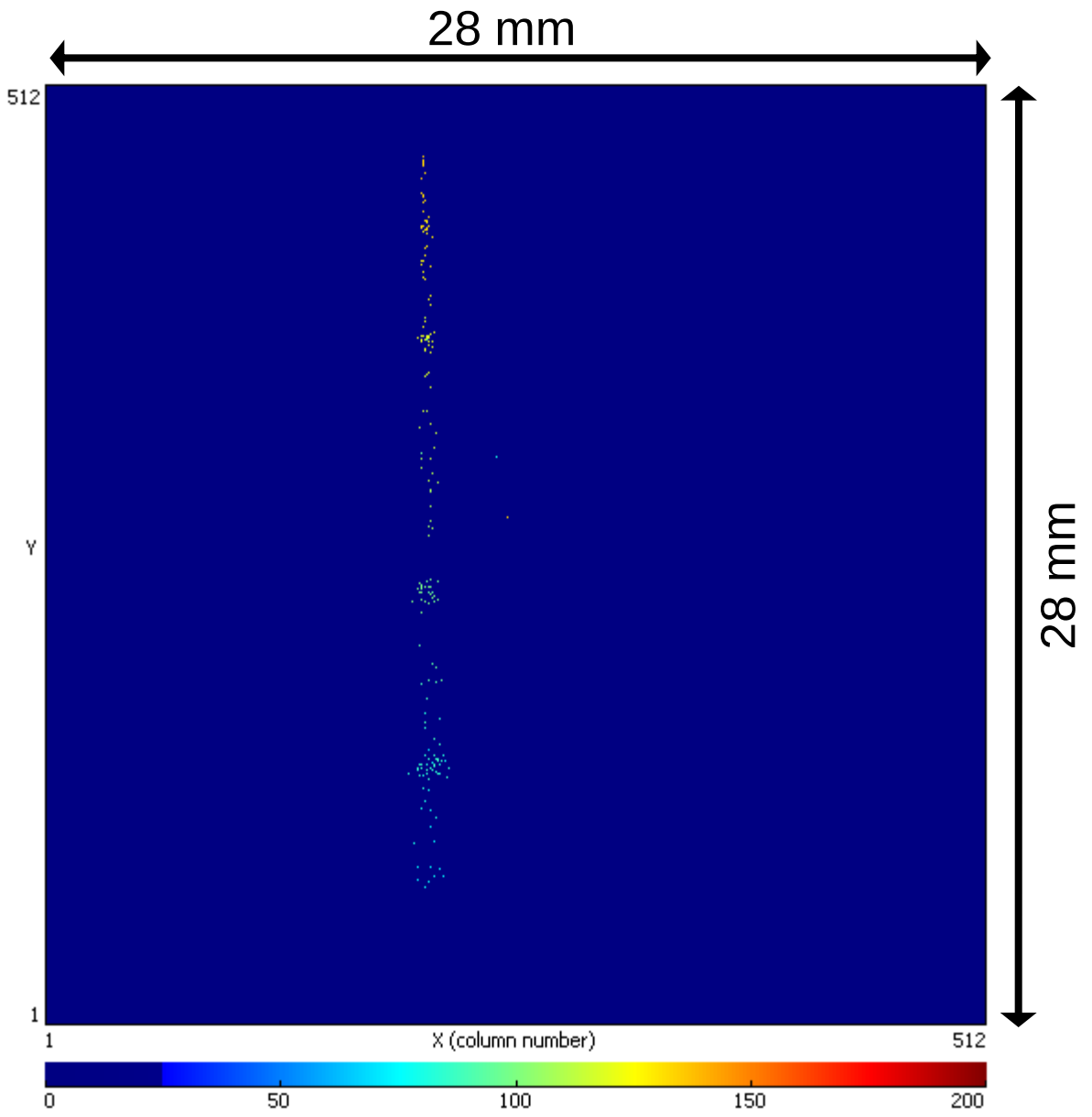
- Readout did NOT work at DESY (testbeam) in Dec'09 and Mar'10, except for 3 days in March'10

Few tracks from ~3-day test at DESY with quad-Ingrid detector

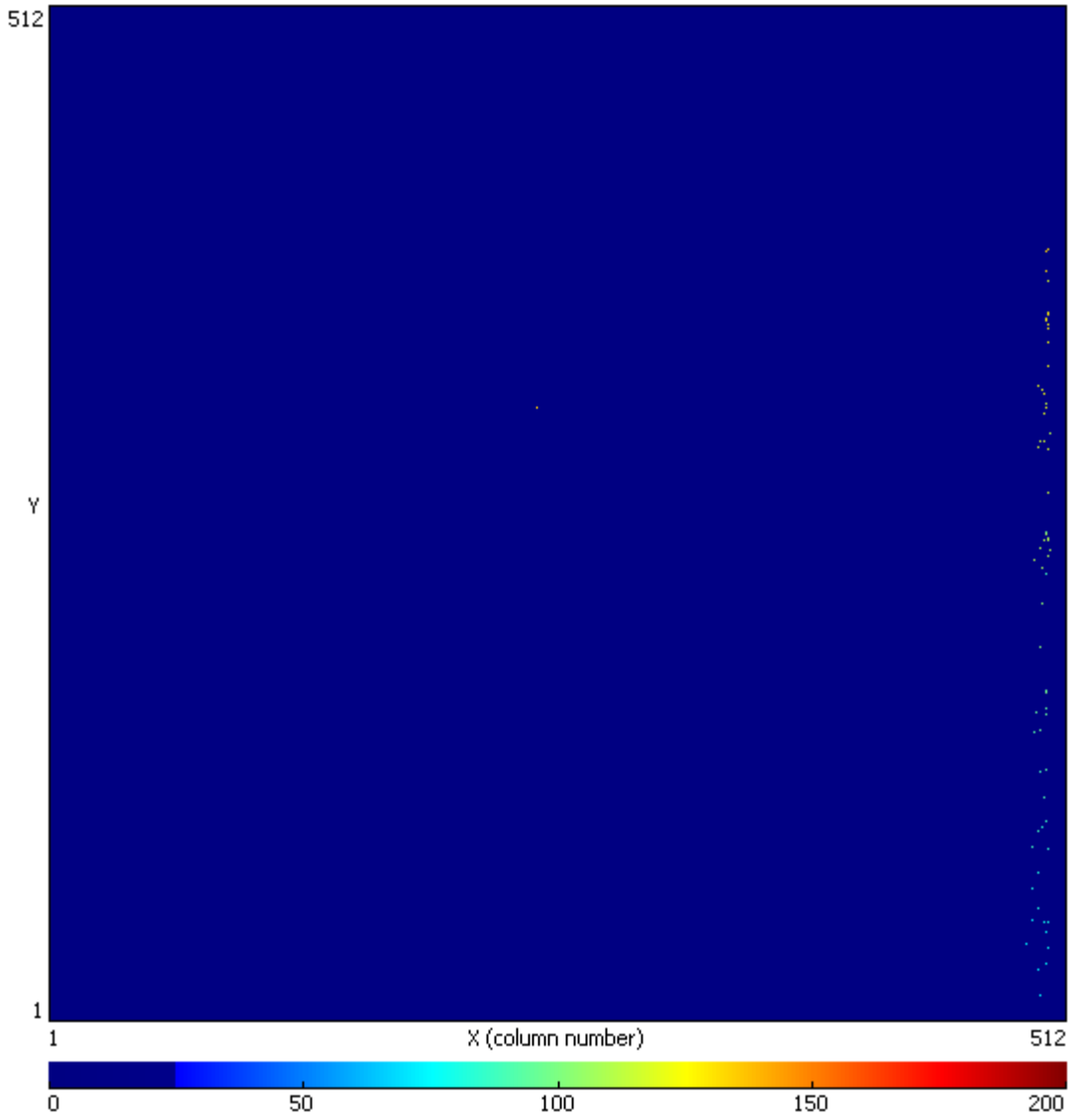


Gas: He-iC_4H_{10} 80/20

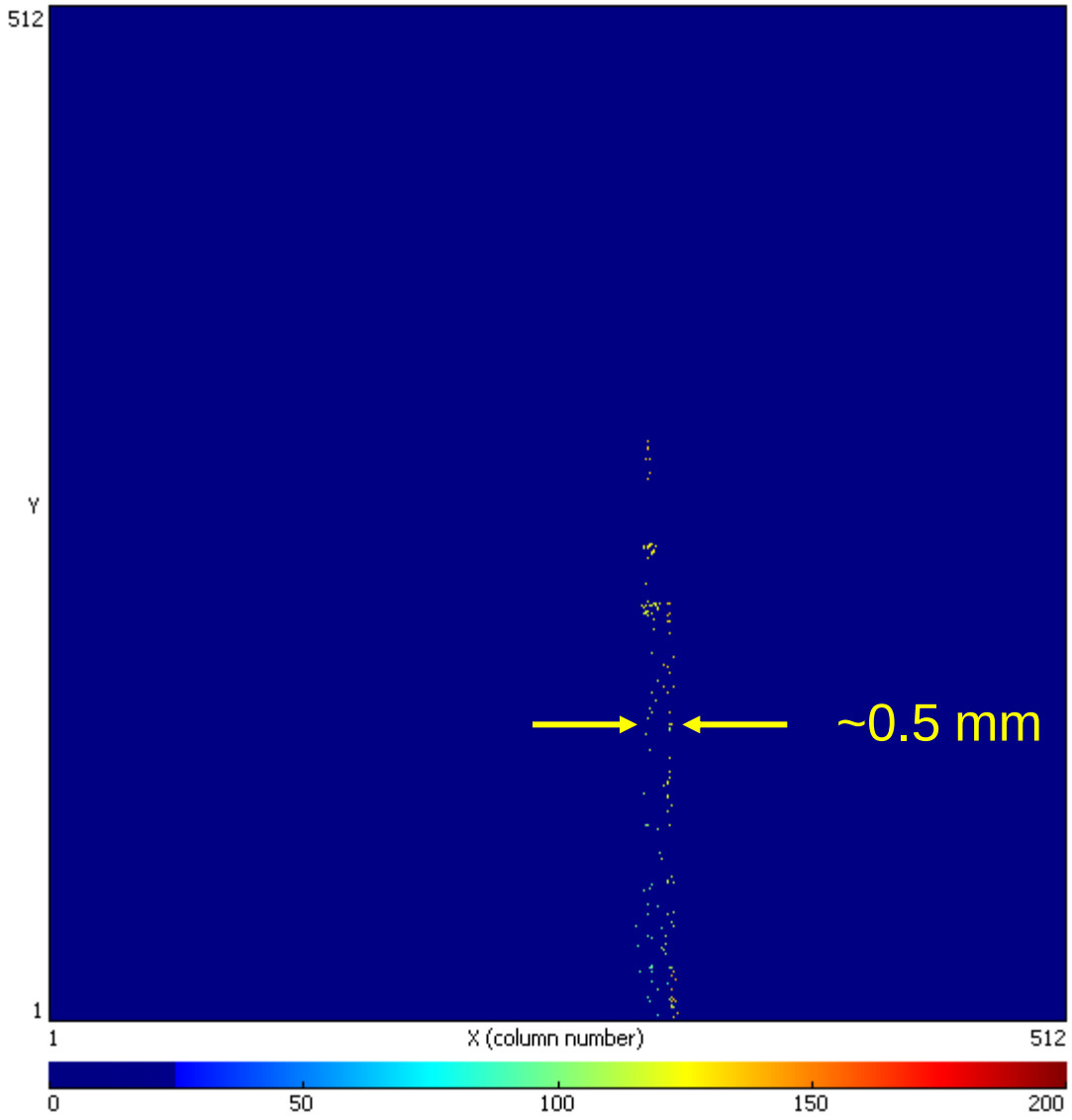
A normal track



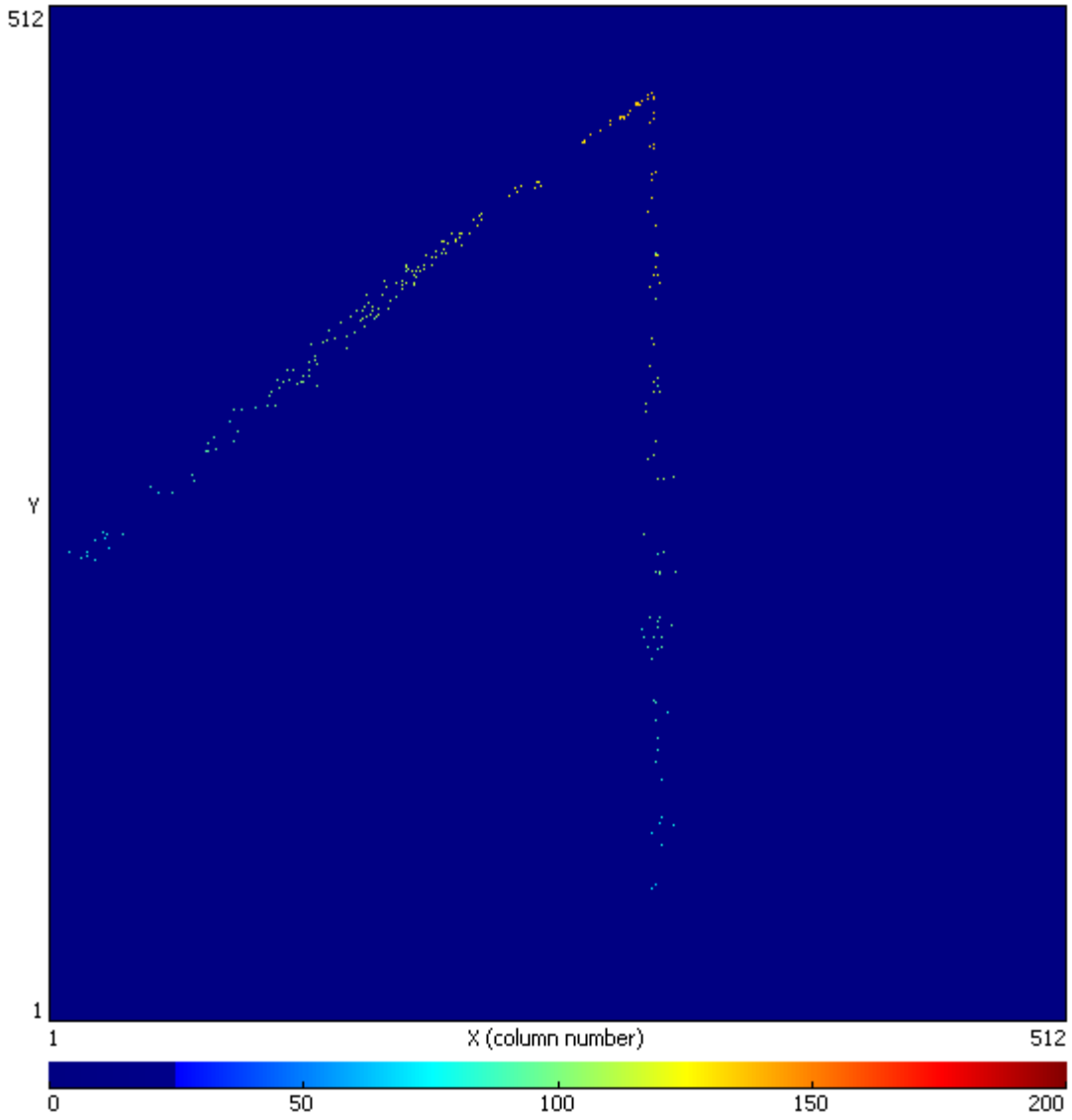
Track very close to border; there is 0.5mm ‘dyke’



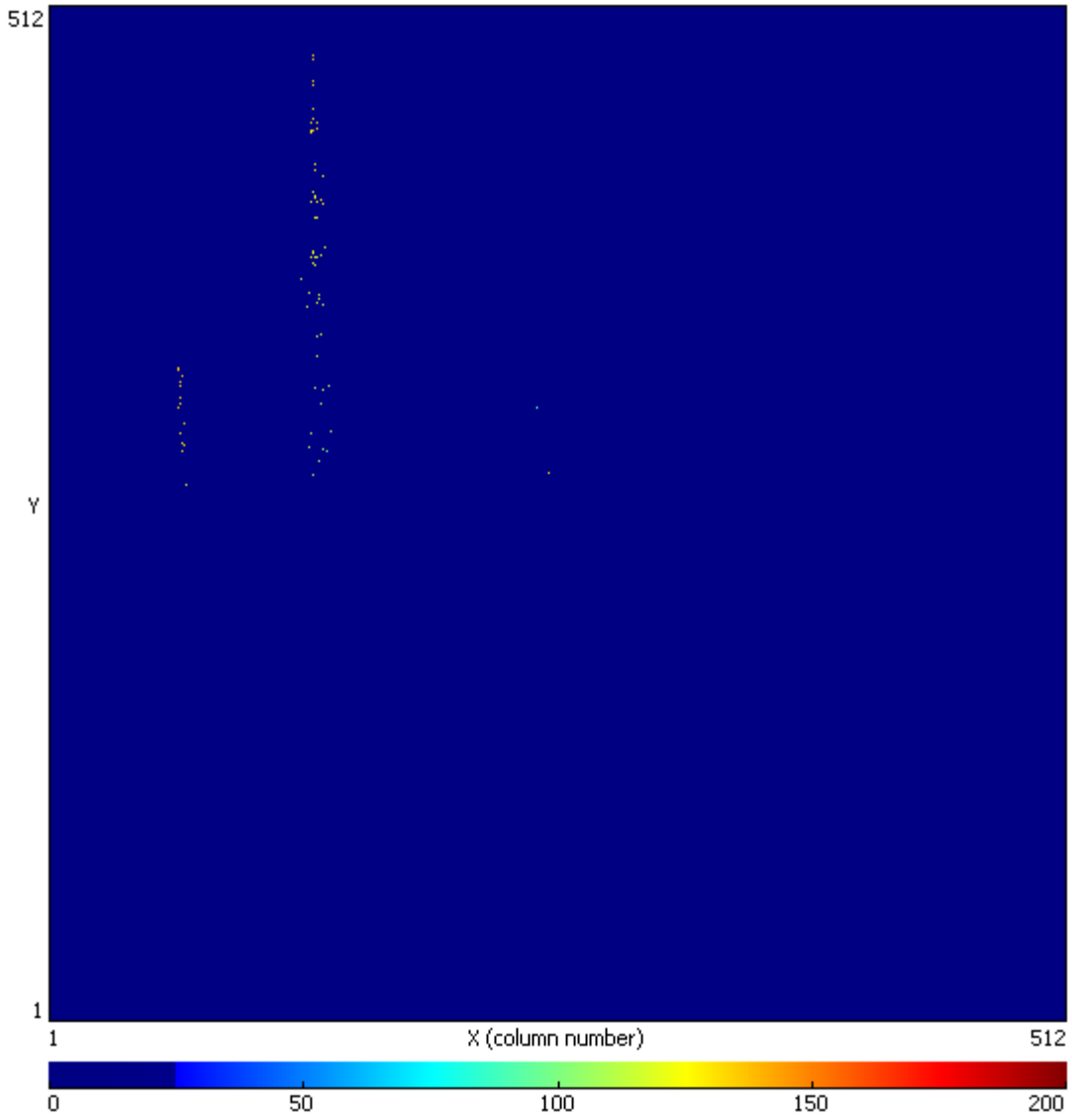
Two tracks about 0.5 mm apart in x



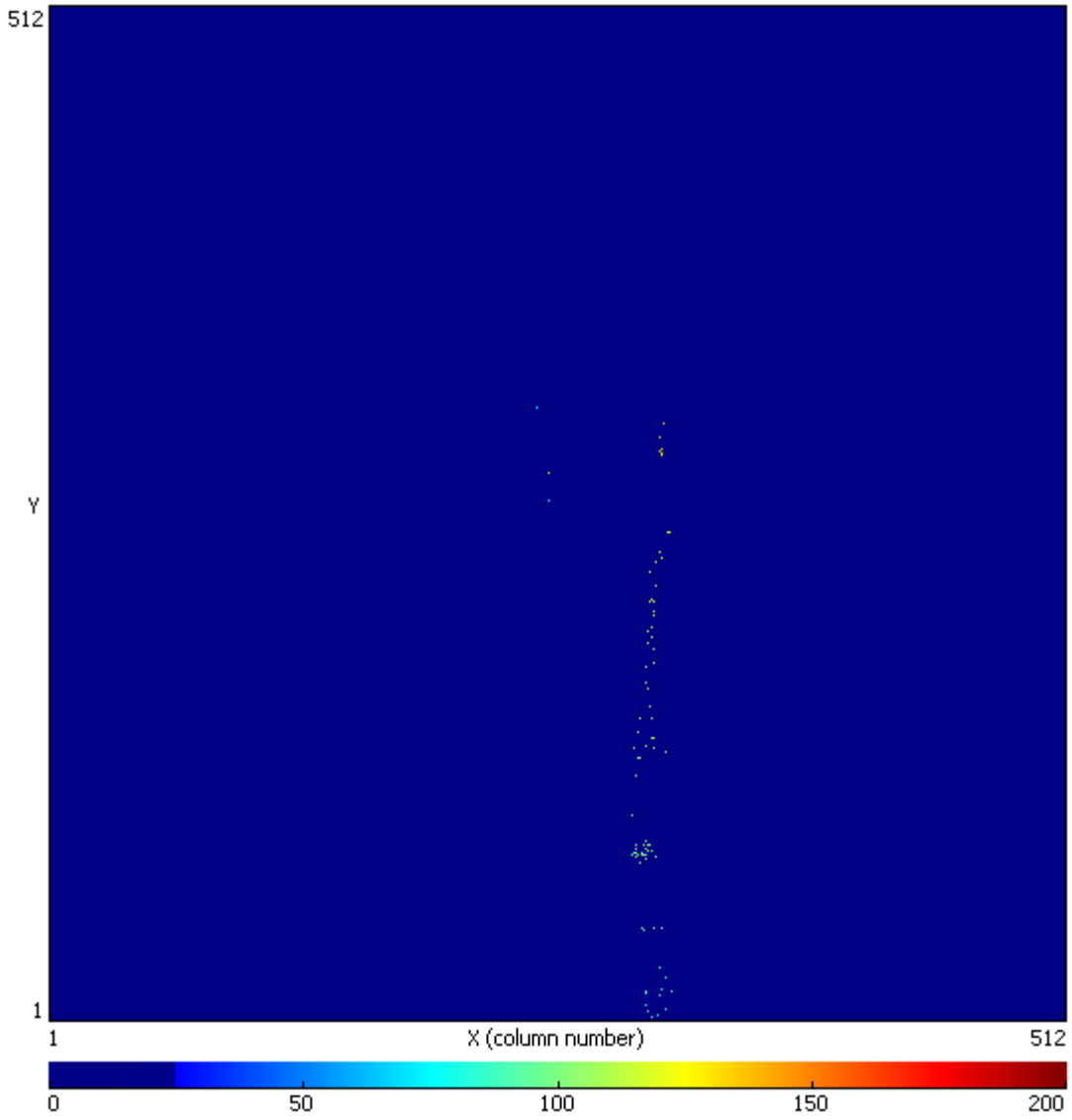
Track backscattering from chip (=anode)



Two tracks; last day lower-left Ingrid lost HV connection



Track distorted by HV disconnected from lower-left Ingrid



A little reminder of last year's DESY beam test with several Ingrids

2009 Beamtests at DESY

- Few GeV e to test;
- Signal development
- When do the chips break down?

  (this is, of course, the last test to be performed)

Martin Fransen

- The Gridpix detectors:
- TimePix chips with 2,4,6,and 8 um silicon nitride
- 11.5 mm drift gaps
- Used gases:
  - Ar/ISO 80:20
  - He/ISO 80:20
  - T2K, Ar/CF4/ISO 95:3:2
  - Ar/CO2 70:30
  - He/CO2 70:30

NIKHEF

2009 Beamtests at DESY

Martin Fransen

- And finally destruction…
- After hours of suffering >2 sparks/sec, the 4 um chip is still doing fine BUT:
- After few more days, under normal operation:
  - The 6 um dies (Ar/ISO 80:20, Vgrid -430V)
  - 10 days later the 2 um dies (He/CO2 70:30, Vgrid -520V)
  - Another 6 days, the 4 um (T2K, Vgrid -360V)
- All breakdowns are similar, regardless of thickness of SiNi Layer.

The 8 um Ingrid is still in use in 2010, even after suffering many discharges

Handshaked Pixelman operation

based on Uwe Renz Pixelman plugin

Work performed with Uwe Renz (and Martin Killenberg support) and with DESY summerstudent Bonnie Chow

Detector used is the (2009) “8 um” Ingrid

A little history

- sofar at Nikhef we operated Pixelman in free running acquisition mode (PC timer) with external shutter provided to Muros (Pixelman version of 24-07-2007 (!)) derived from trigger
- external trigger was used to generate shutter signal and veto was applied to external trigger over length that was somewhat longer than (PC timed) acquisition time
- this inherently leads to loss of some (very) short drift distance hits. Furthermore, many acquisitions could have no accompanying shutter signal, thus “empty events”. This was recovered by appropriate “output filter” selections

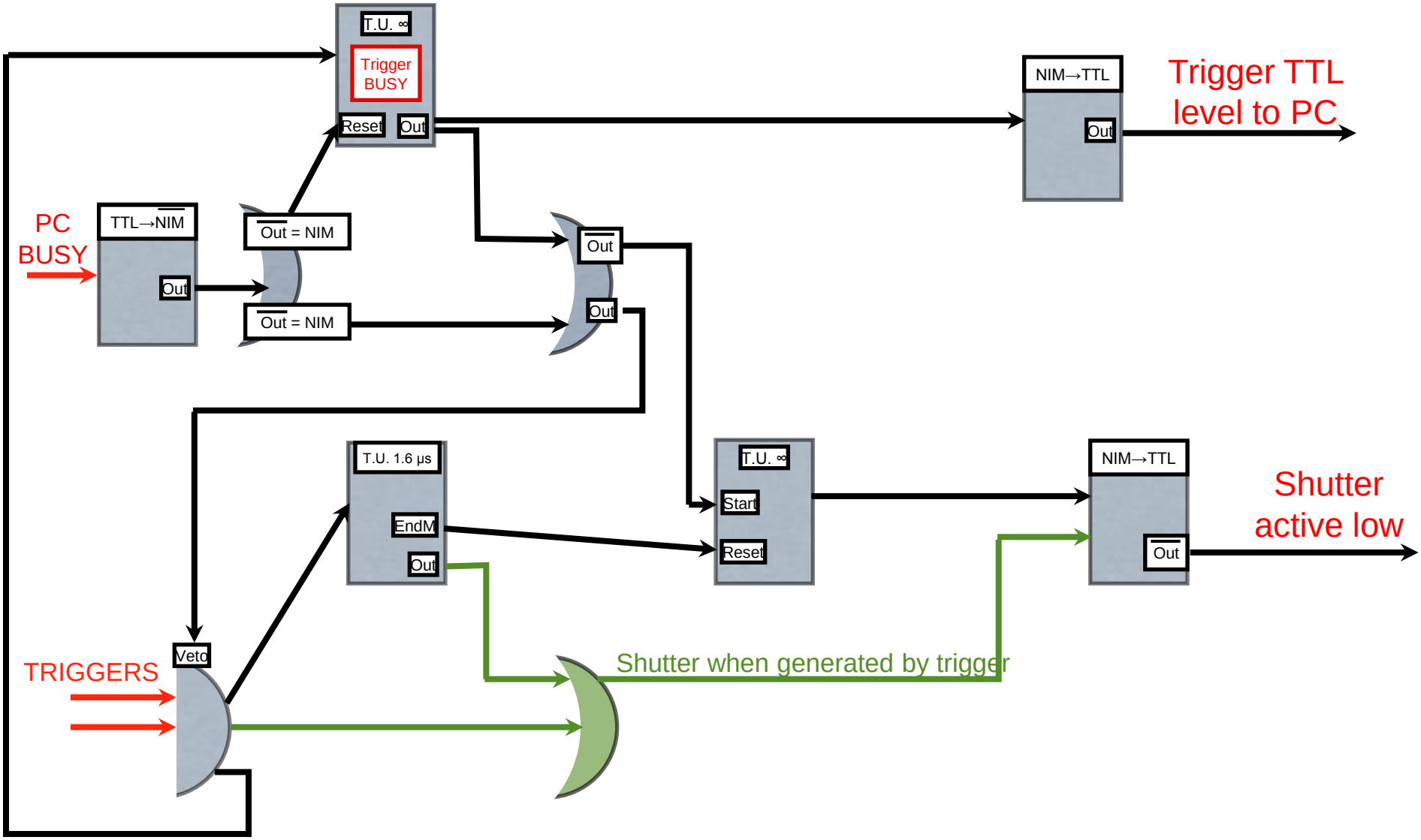
Uwe’s handshake plugin

- handshake communication via PC parallel port
  - pin 1 for TRIGGER input
  - pin 11 for BUSY
- user provides input TRIGGER level (TTL) and should VETO further triggers until PC has indicated to be ready for a new trigger
- BUSY (TTL, but needs ‘reinforcement’ for driving external TTL/NIM electronics) will be raised by PC upon receipt of TRIGGER
- device will be readout, after which BUSY will be lowered
- after BUSY becoming low (again), user should lower TRIGGER level and free VETO on trigger

implementation

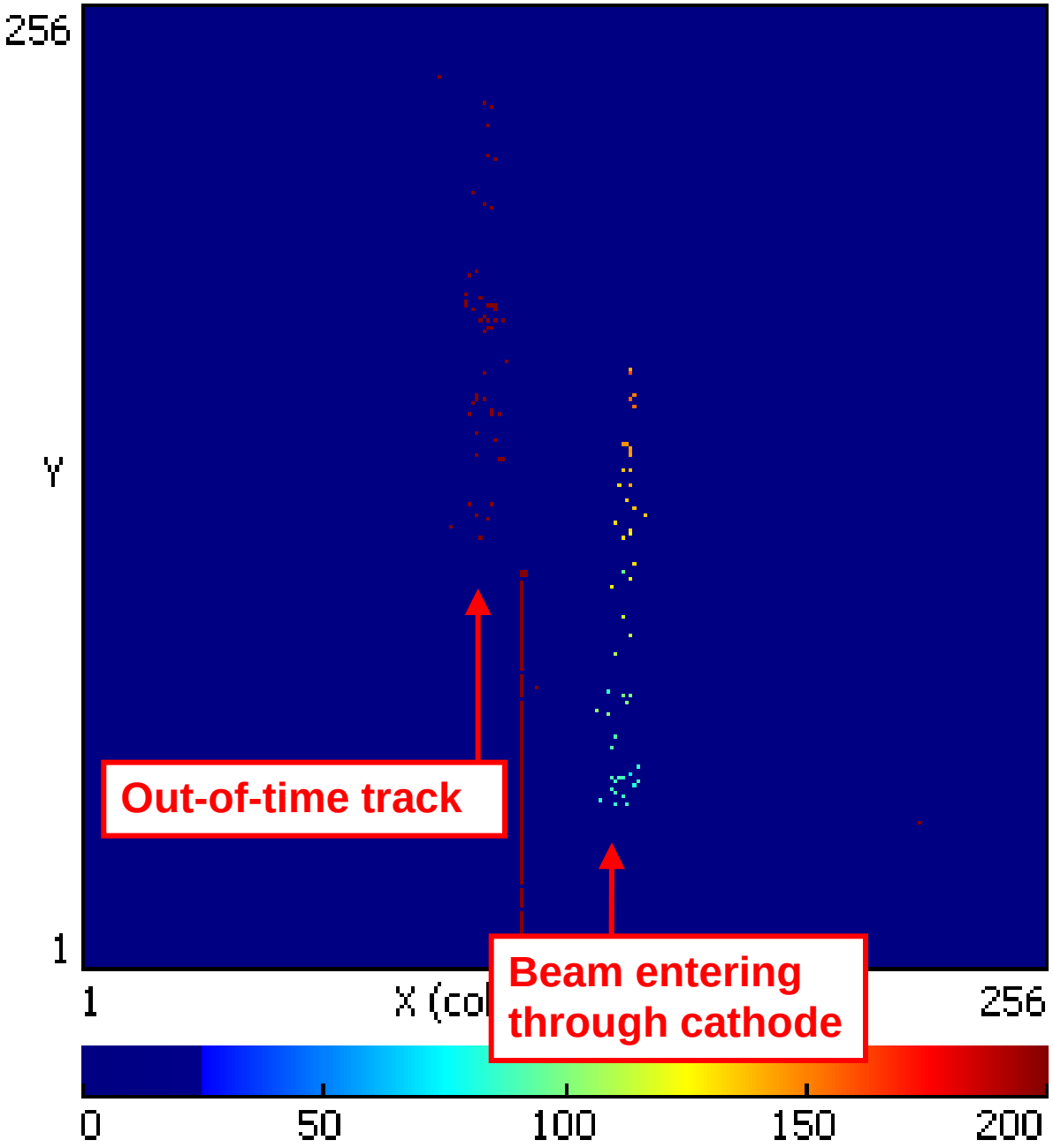
- this worked on Thursday 5 August, with just ONE track per acquired trigger, using a fixed length (1.6 us) SHUTTER generated from external trigger
- however, this way one looses short-drift hits, because SHUTTER starts too late
- next step is to start SHUTTER with end of PC BUSY and stop SHUTTER with appropriately delayed (say 1.6 us) signal
- this worked on Tuesday 10 August, however we observed some far out-of-time tracks in addition to the triggered track. The frequency seems to be compatible with beam intensity, but particles not always leading to coincidence trigger of two small scintillators.

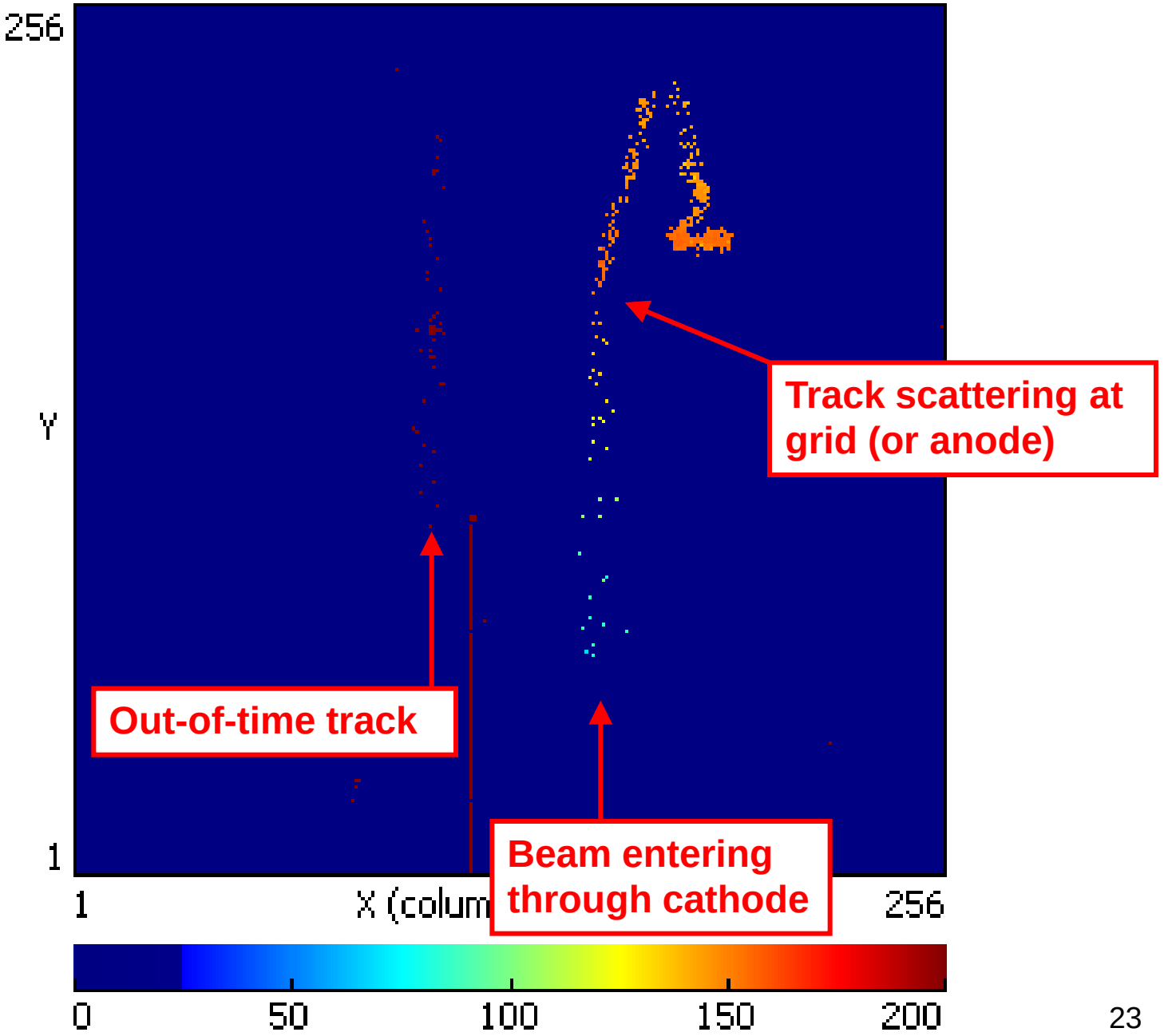
Trigger/shutter and handshake schematics



Some events …

- Handshaked mode
- Early shutter opening, so you will see “out-of-time” tracks
- He/iC_4H_{10} 80/20
- E_{drift} = 450 V/cm
- V_{grid} = 420 V


256
Y
1
1
X (co
256
Out-of-time track
Beam entering
through cathode
0
50
100
150
200


256
Y
1
1
X (colum
256
0
50
100
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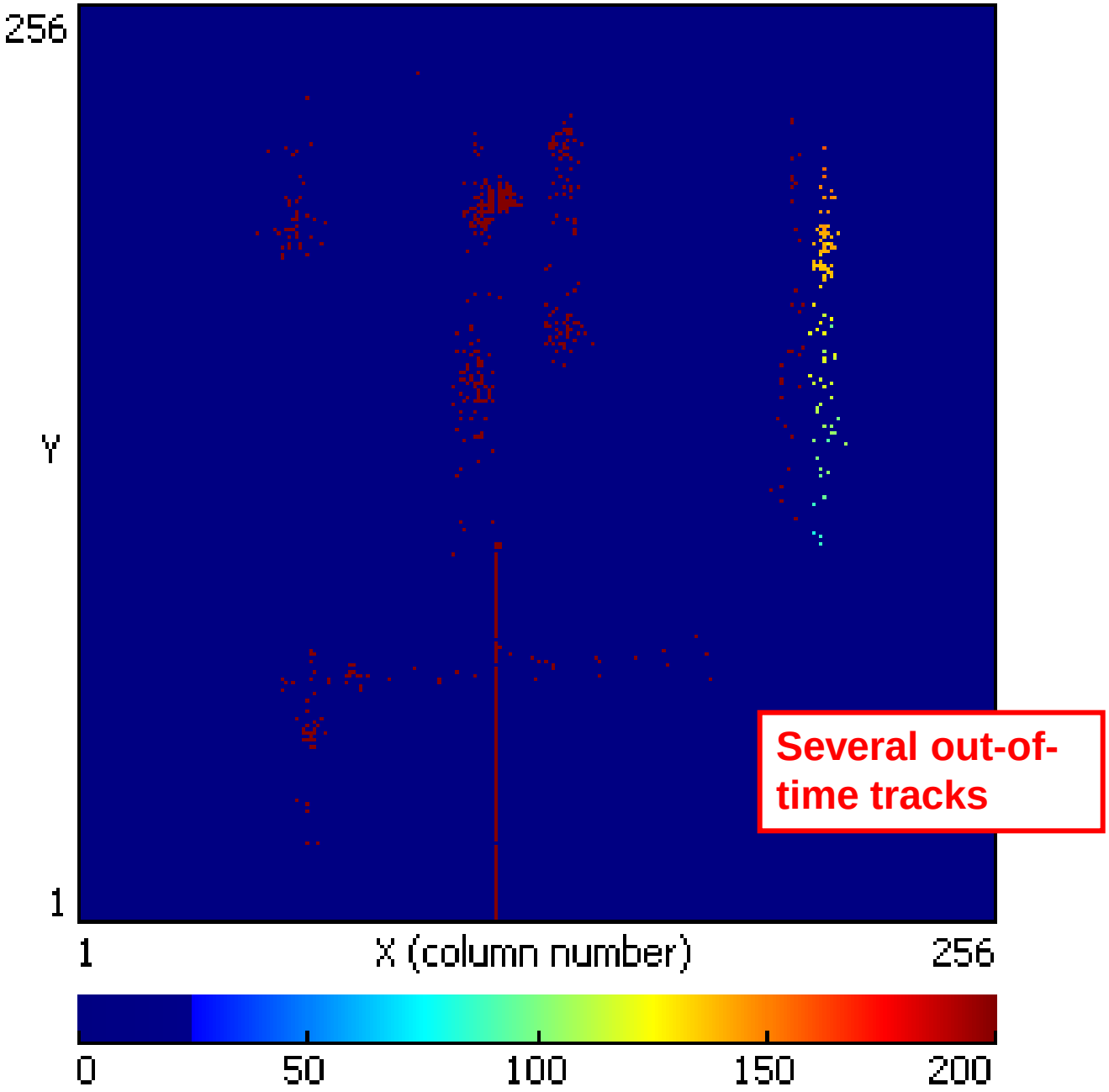
200
Track scattering at grid (or anode)
Out-of-time track
Beam entering through cathode


256
Y
1
1
X (column number)
256
0
50
100
150
200
Several out-of-time tracks

Common data taking with Zeus MVD telescope on 8 Sept. 2010

- Using TLU for TRIGGER and BUSY synchronisation
- Writing of data using EUDAQ with Pixelman Timepix Data Producer plugin and Timepix collector in EUDAQ computer
- Data transfer via TCP-IP
- ~ 4000 triggers written
- Possible problem still with “Endianness”
- Analysis awaiting

Summary

- 8 μm thick Si_3N_4 protection layers seem sufficient
- Problems with readout of 4-fold Timepix/Ingrid (still) being investigated
- Successful standalone “handshaked” operation with early shutter opening
- Common data acquisition with Zeus telescope, running EUDAQ, succeeded