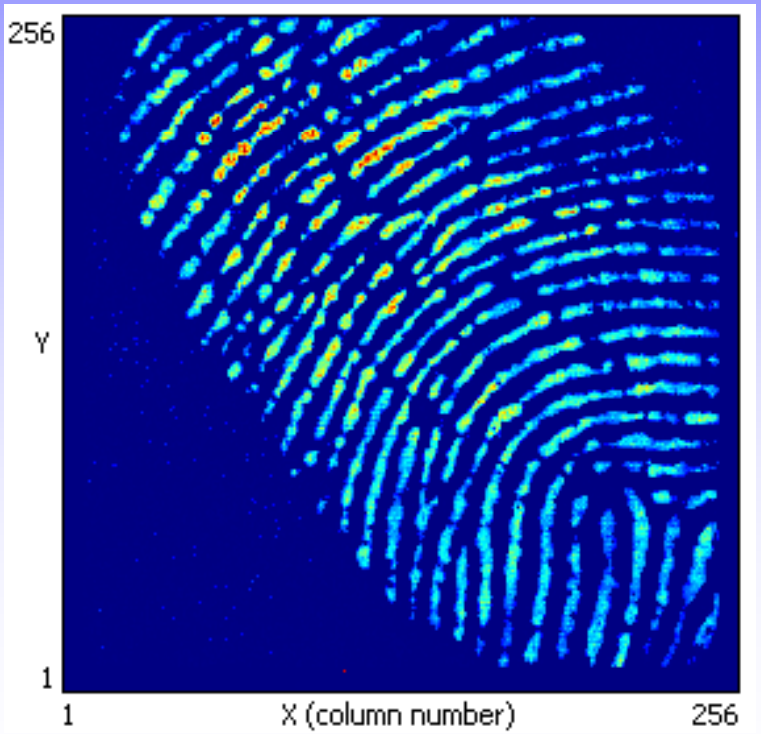
GridPix/Gossip MPGDs: test beam results

Martin Fransen, Nikhef

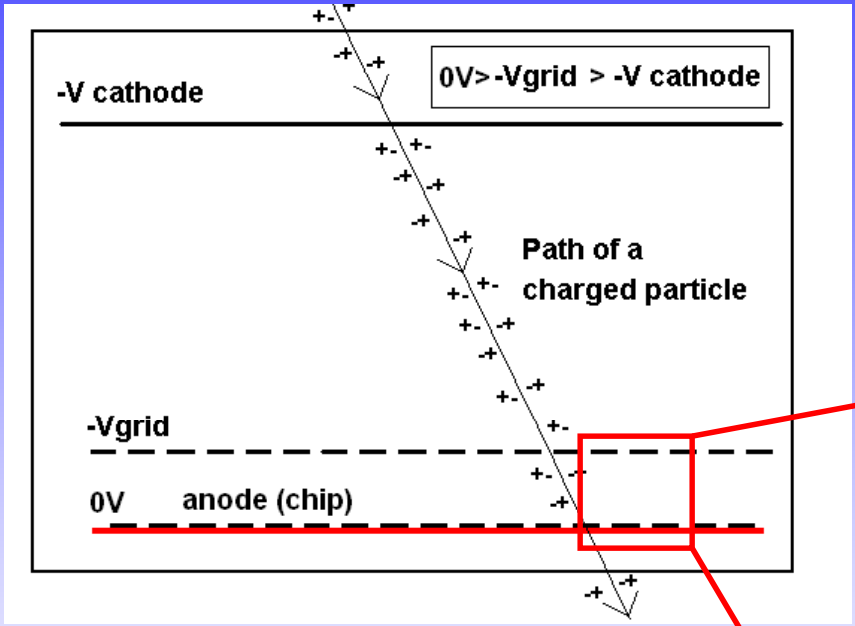


Outline

- Testing GridPix at DESY
- Testing Gossip at CERN

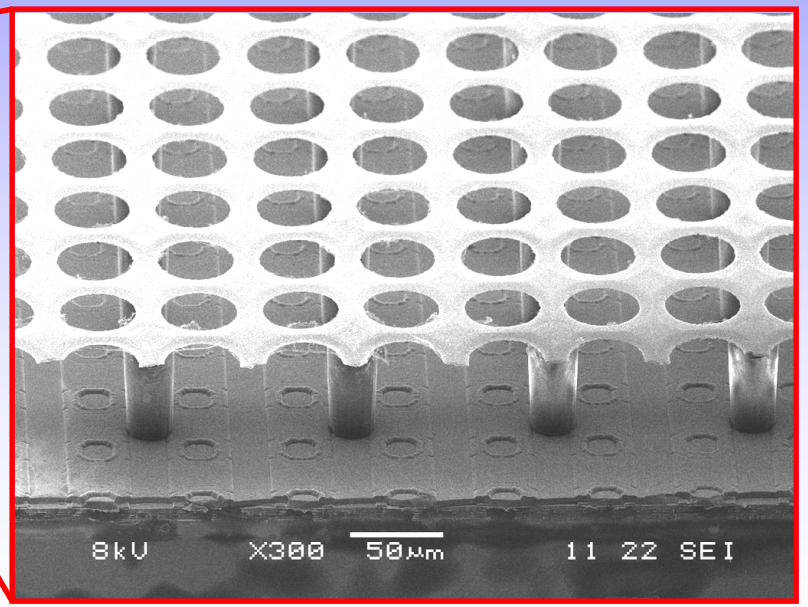
- And the 2nd part:
- Photon sensitive Gridpix

Gridpix detectors

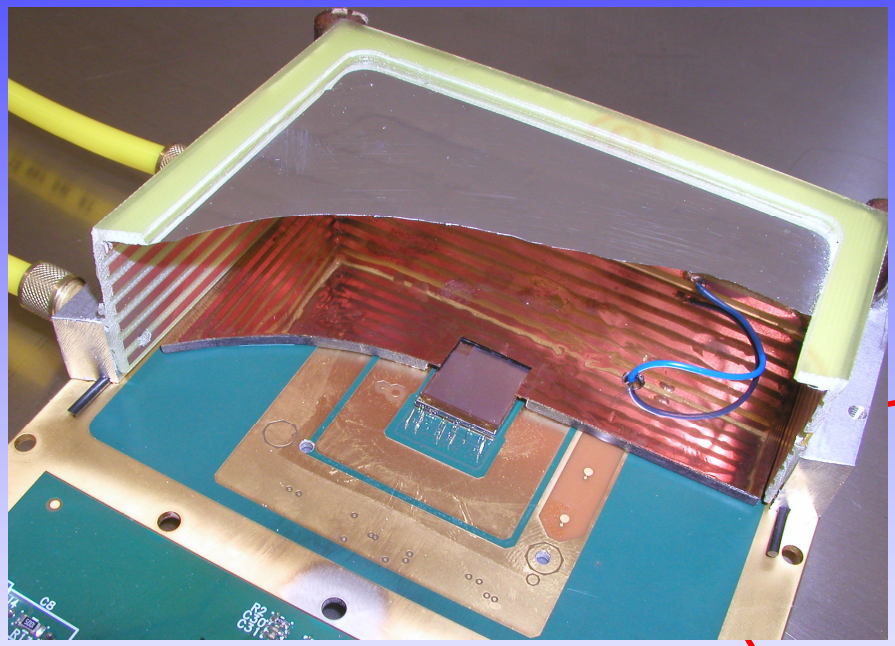


- Drift volume (1mm-1m).
- Grid.
- Gain region.
- Pixel readout chip.

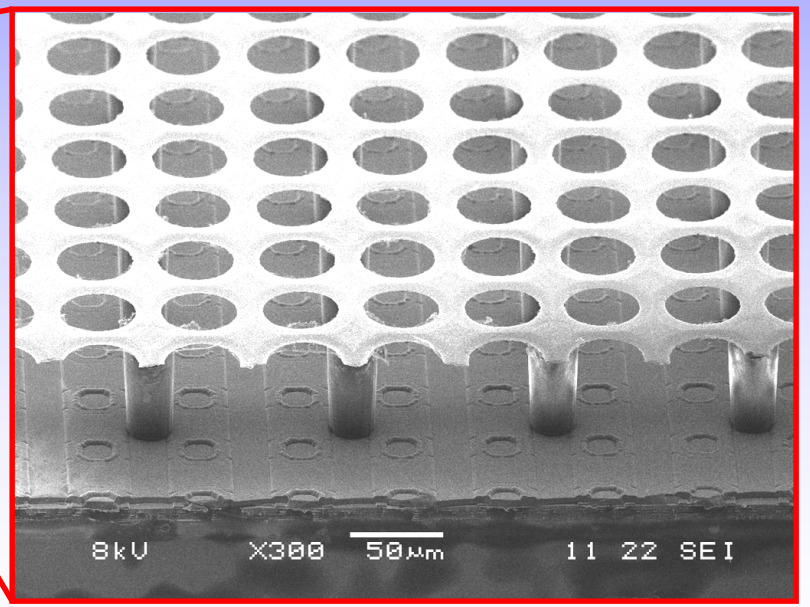
- Grid made by lithographic procedure. (University of Twente)



Gridpix detectors



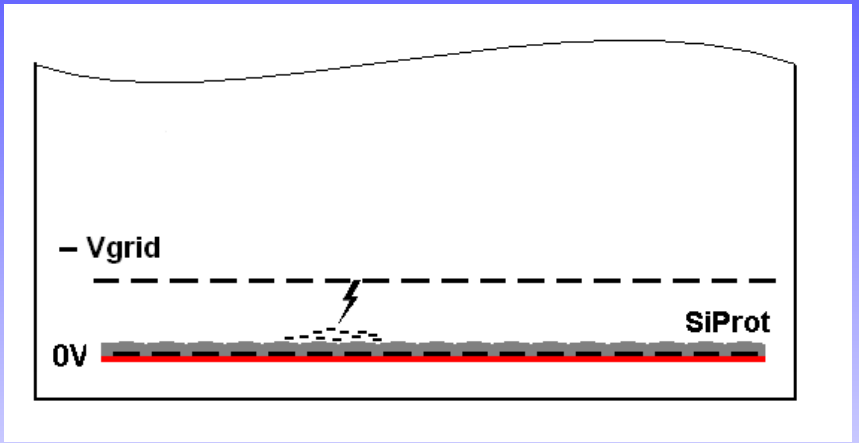
- Drift time gives z coordinate.

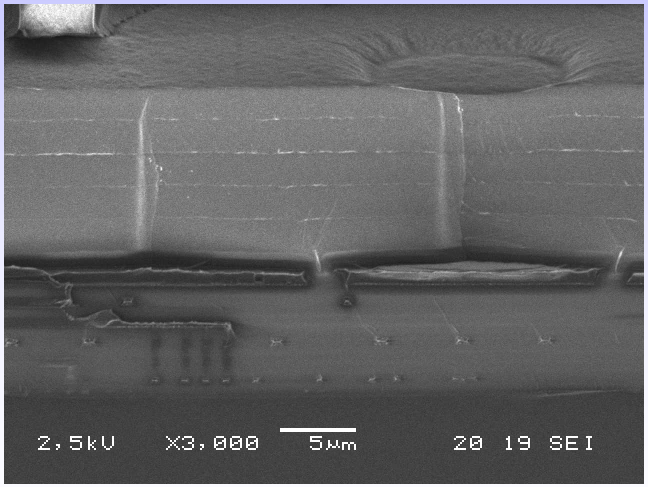


- Drift volume E= ~0.1-1kV/cm.
- Grid.
- Gain region E= ~80kV/cm
- Pixel readout chip.

Discharge protection

- Quenching of discharges.
- Some conductivity to prevent net charge build up.
- Si_3N_4 , silicon nitride (Twente), SiNProt.
- Affecting signal development?
- Put to the test at DESY.





Beamtests at DESY

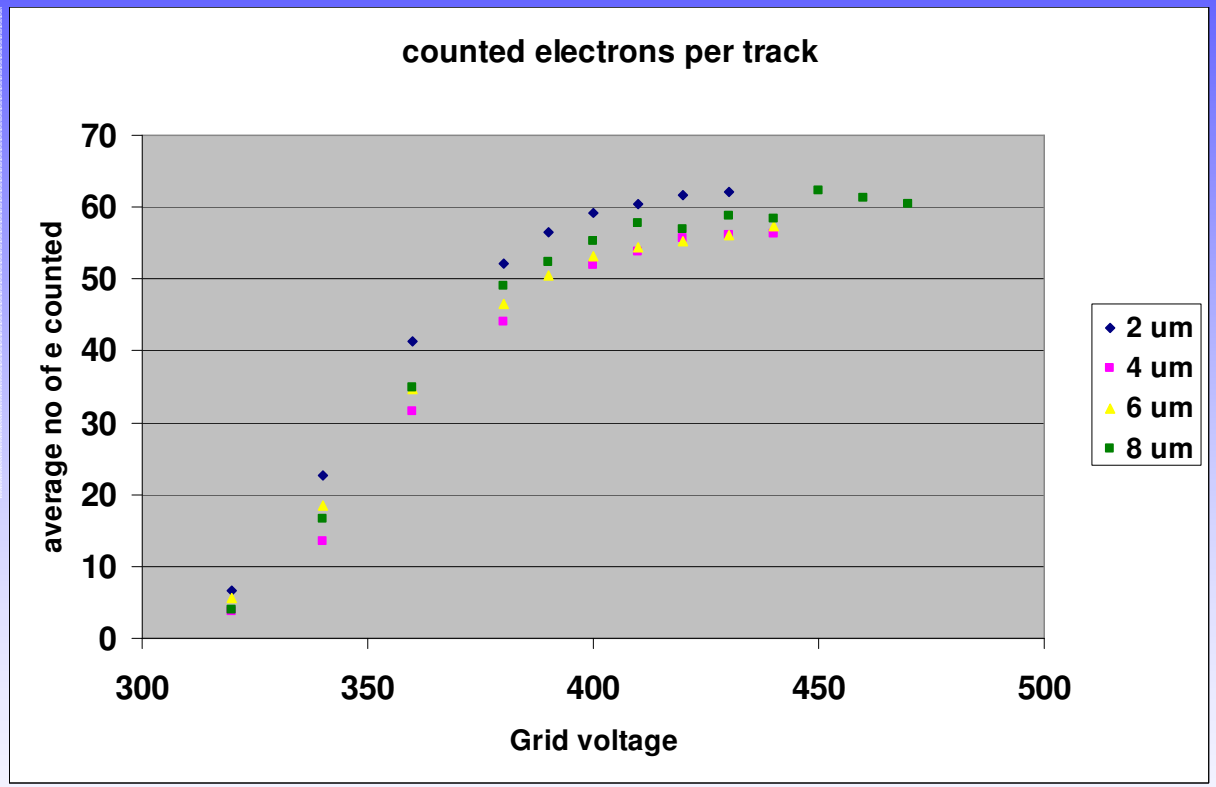
- Few GeV e
- TimePix chips
- SiNi layers of 2,4,6,and 8 um
- How do this affect signal development?
- When do the chips break down?

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

- The detectors:
- 11.5 mm drift gap
- Used gases:
  - Ar/ISO 80:20
  - He/ISO 80:20
  - T2K, Ar/CF4/ISO 95:3:2
  - Ar/CO2
  - He/CO2

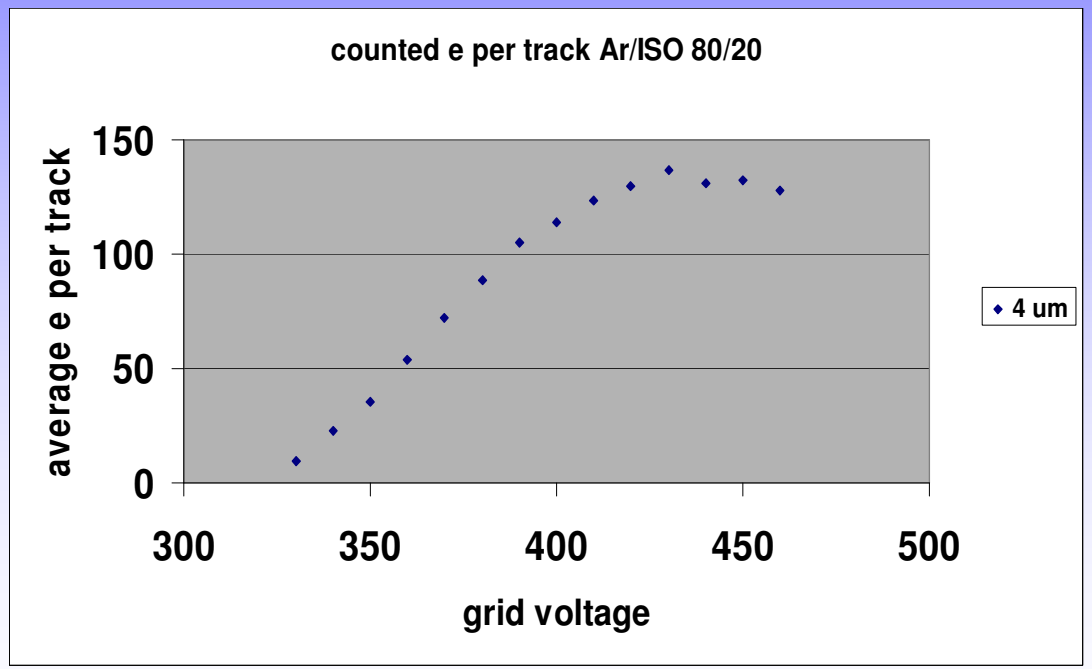
Beamtests at DESY

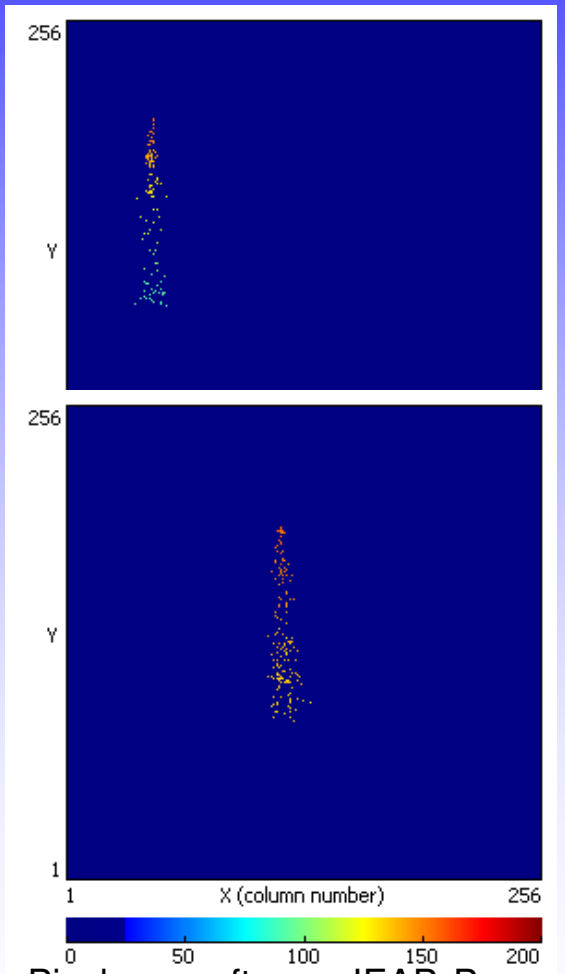
- counting electrons per track.
- compare this per chip.
- He/ISO 80:20
- E drift = 450V/cm



Beamtests at DESY

- Ar/ISO 80:20
- E drift = 900V/cm
- continue using the 4 um chip

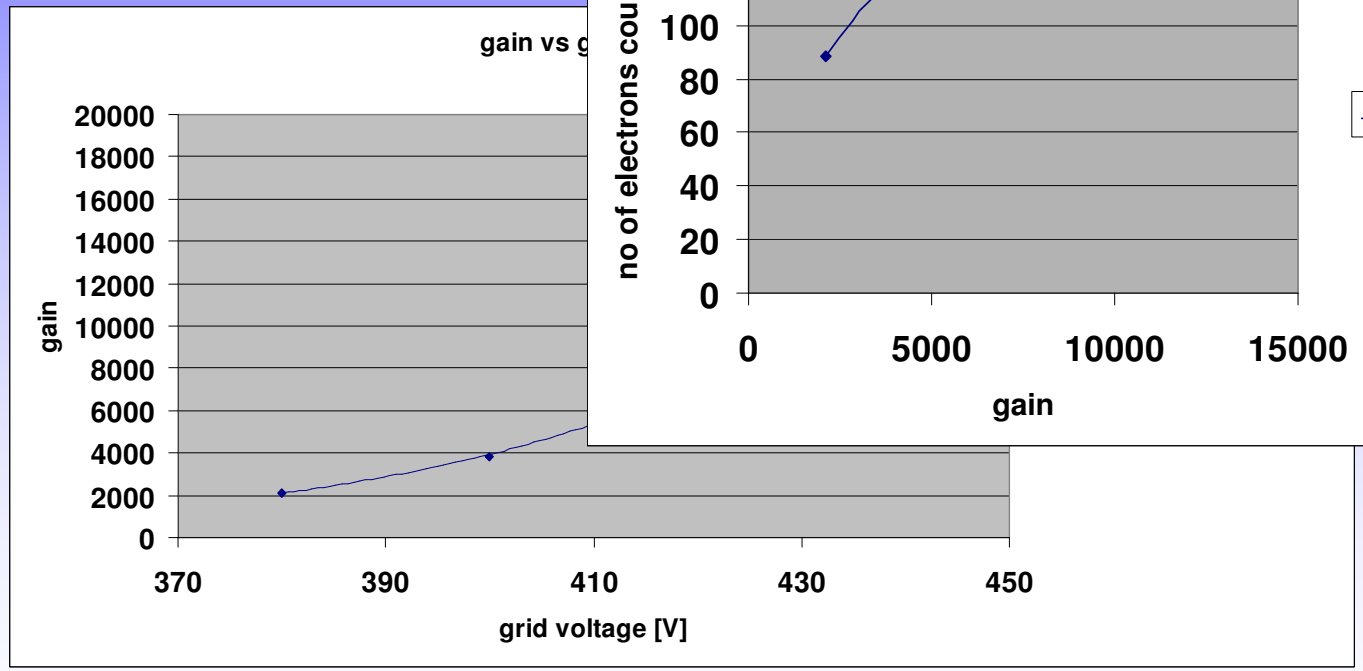


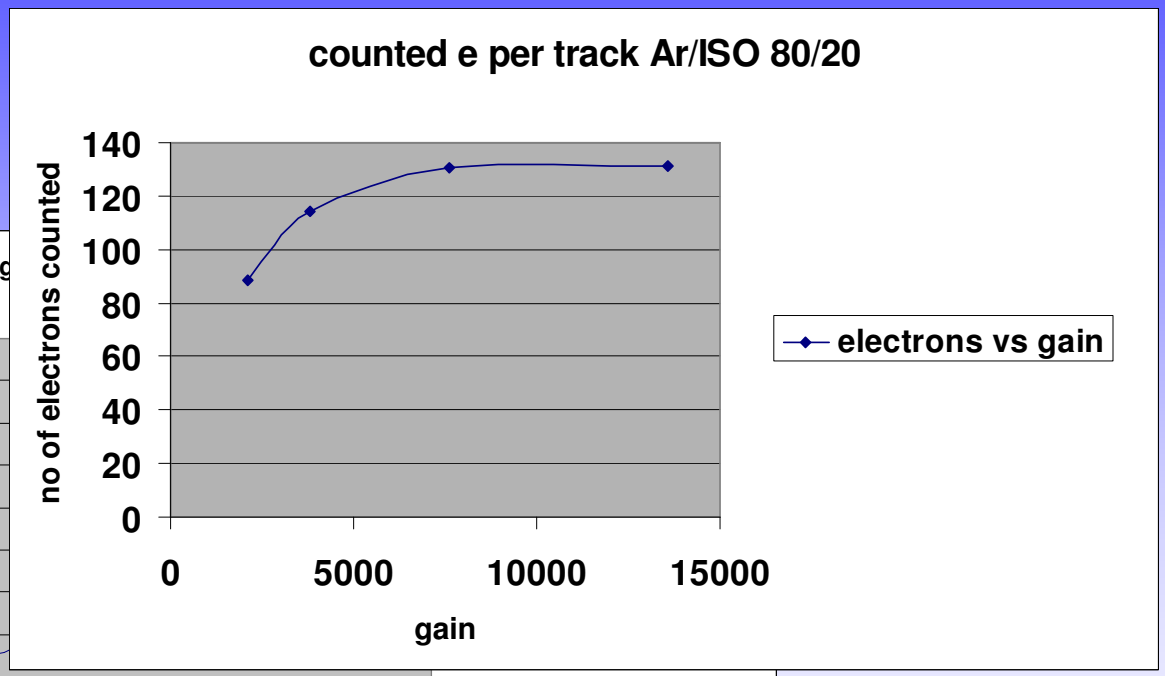


Pixelman software: IEAP, Prague

Beamtests at DESY

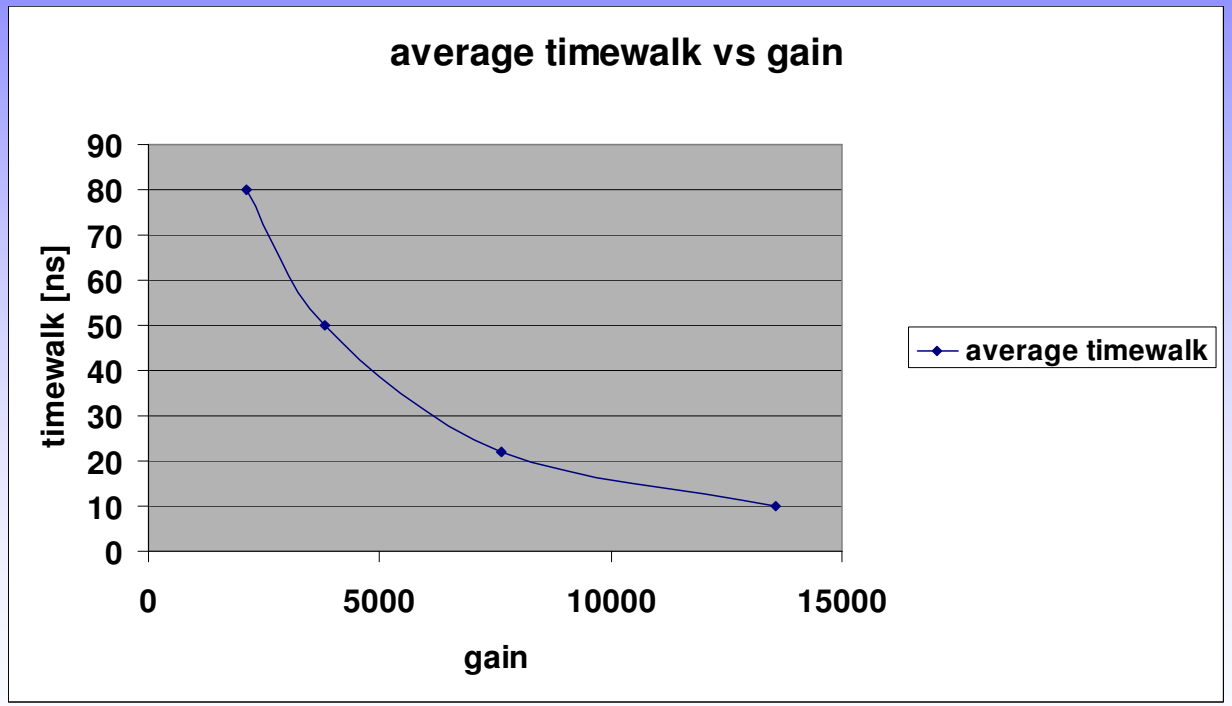
- Ar/ISO 80:20
- E drift = 900V/cm





Beamtests at DESY

- Ar/ISO 80:20
- E drift = 900V/cm

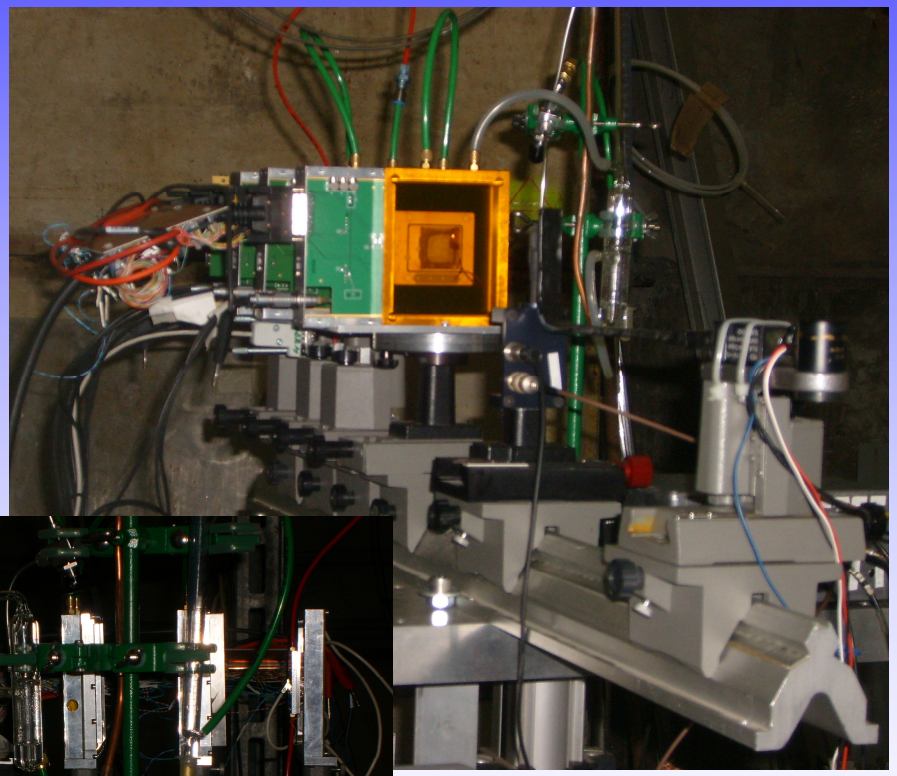


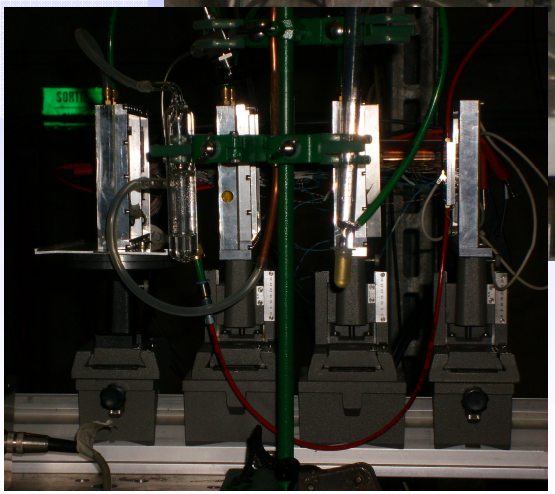
Beamtests at DESY

- And finally destruction…
- After hours of suffering >2 sparks/sec still no sign of problems BUT:
- After few more days, under normal operation:
  - The 6 um dies (Ar/ISO 80:20, Vgrid -430V)
  - Ten 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.

Beamtests at CERN

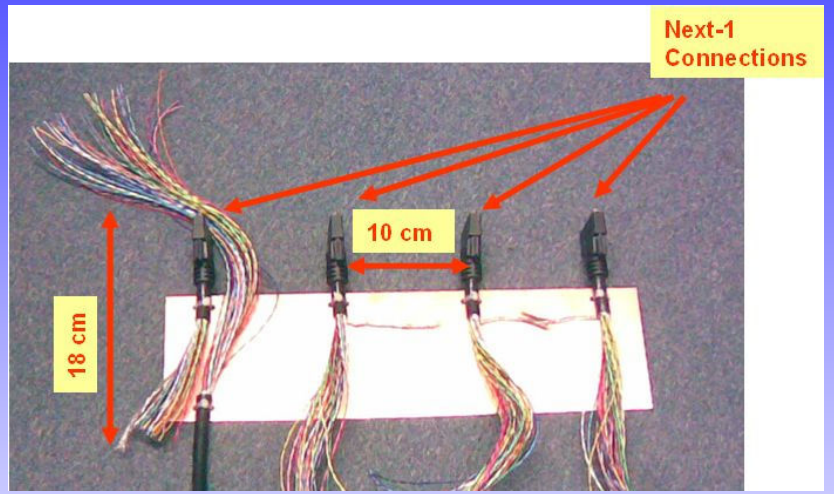
- TimePix chips
- 3 X Gossip and DICE in series
- DICE drift length 19.5 mm
- Gossips: 1, 1.4 and 1.5 mm drift
- Ar/ISO 80:20 and CO2/DME 50:50
- E drift = 900V/cm and 2kV/cm

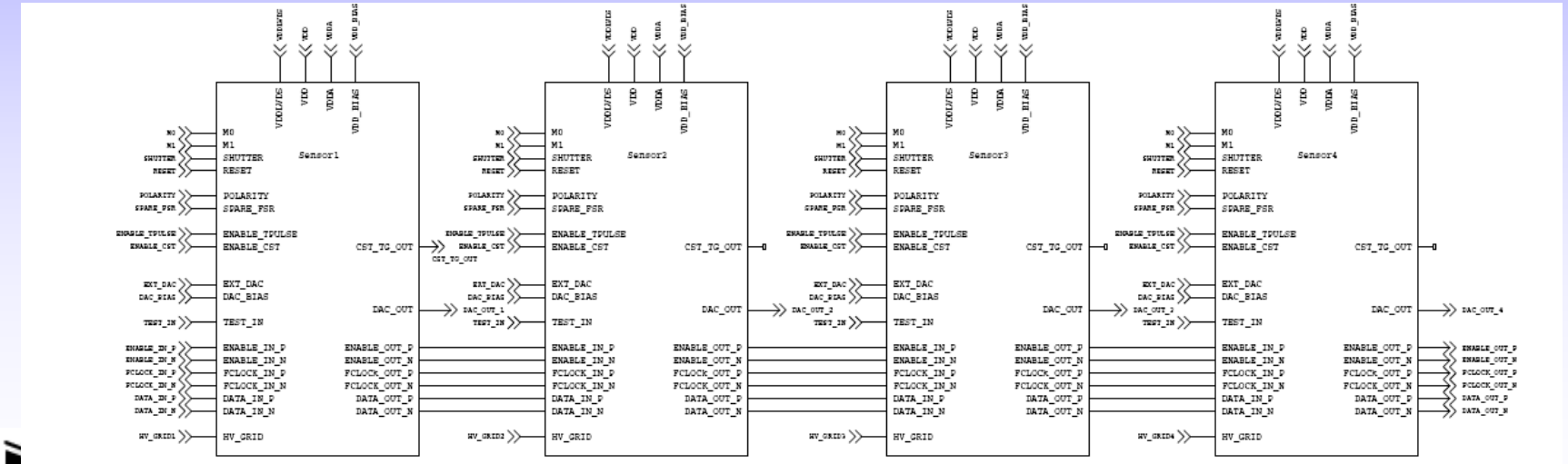




Beamtests at CERN

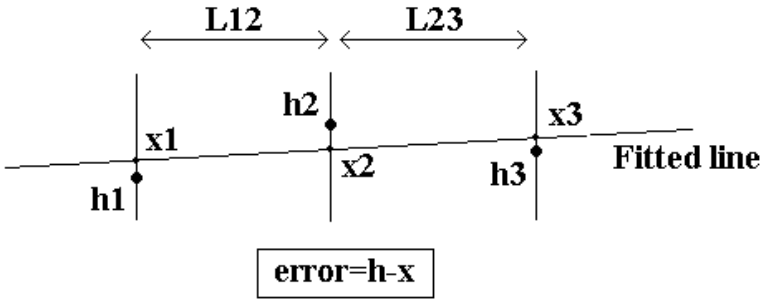
- Special cable to fake a single quad board. (thanks to Peter Jansweijer)
- read out four chips simultaneously
- needed 1.5 ns delay in dataline between chips to function properly

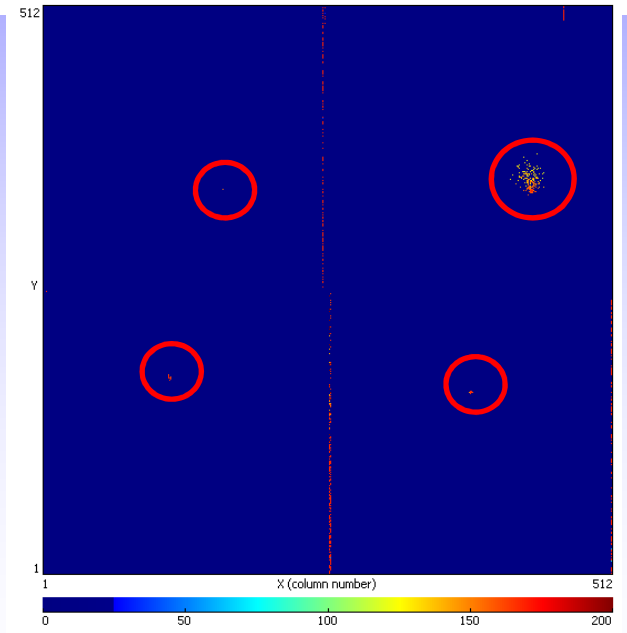




Beamtests at CERN

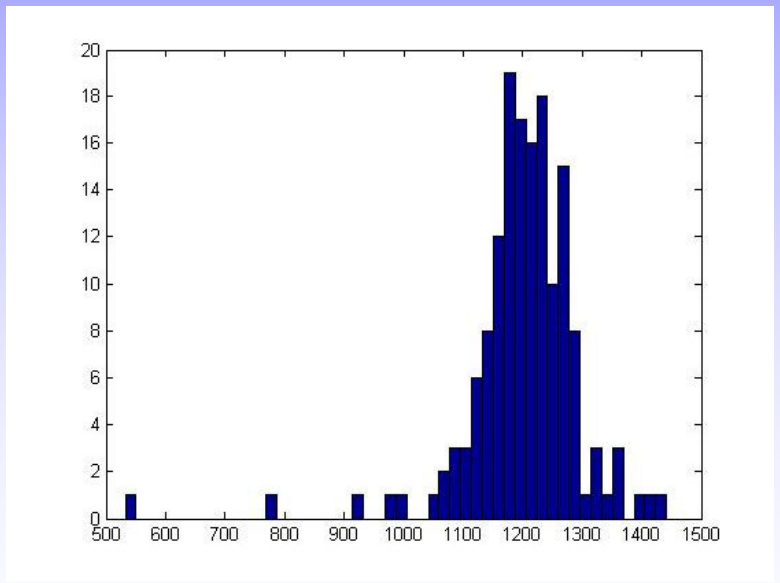
- DICE is reference detector
- Determine center of gravities in G1, G2 and G3 → h1,2,3
- No time information used (too much timewalk)
- Determine relative positions of chips
- L12, L23; distance between detectors
- X1,2,3; best fit

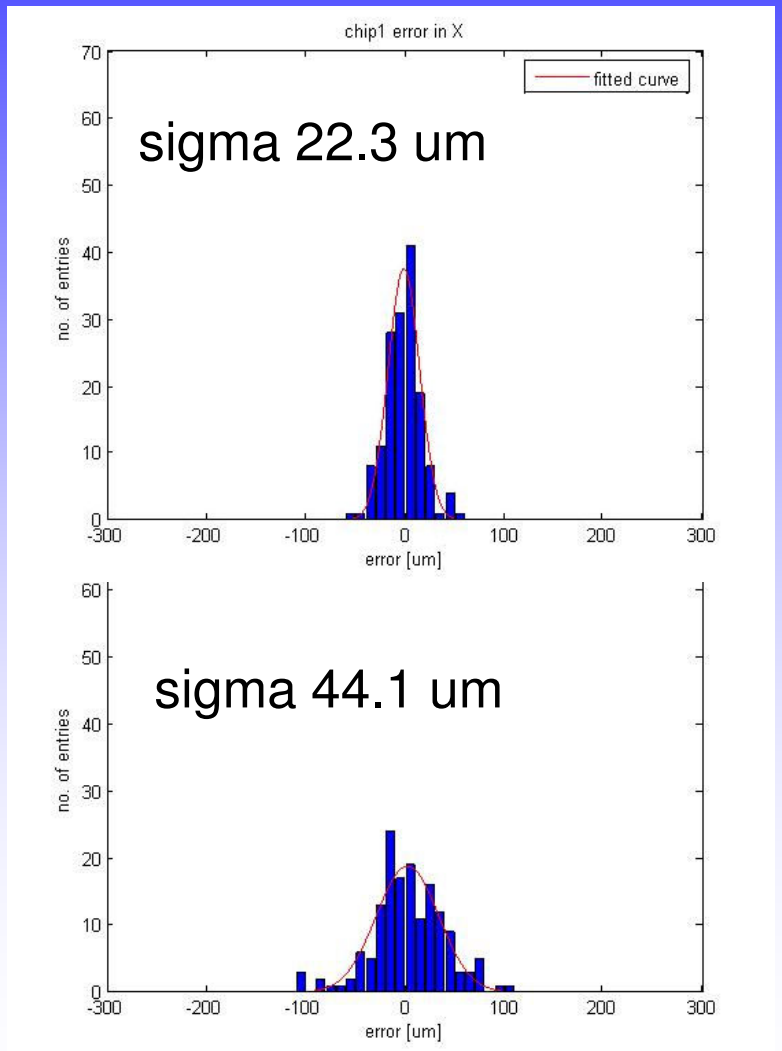




Beamtest H8 (SPS)

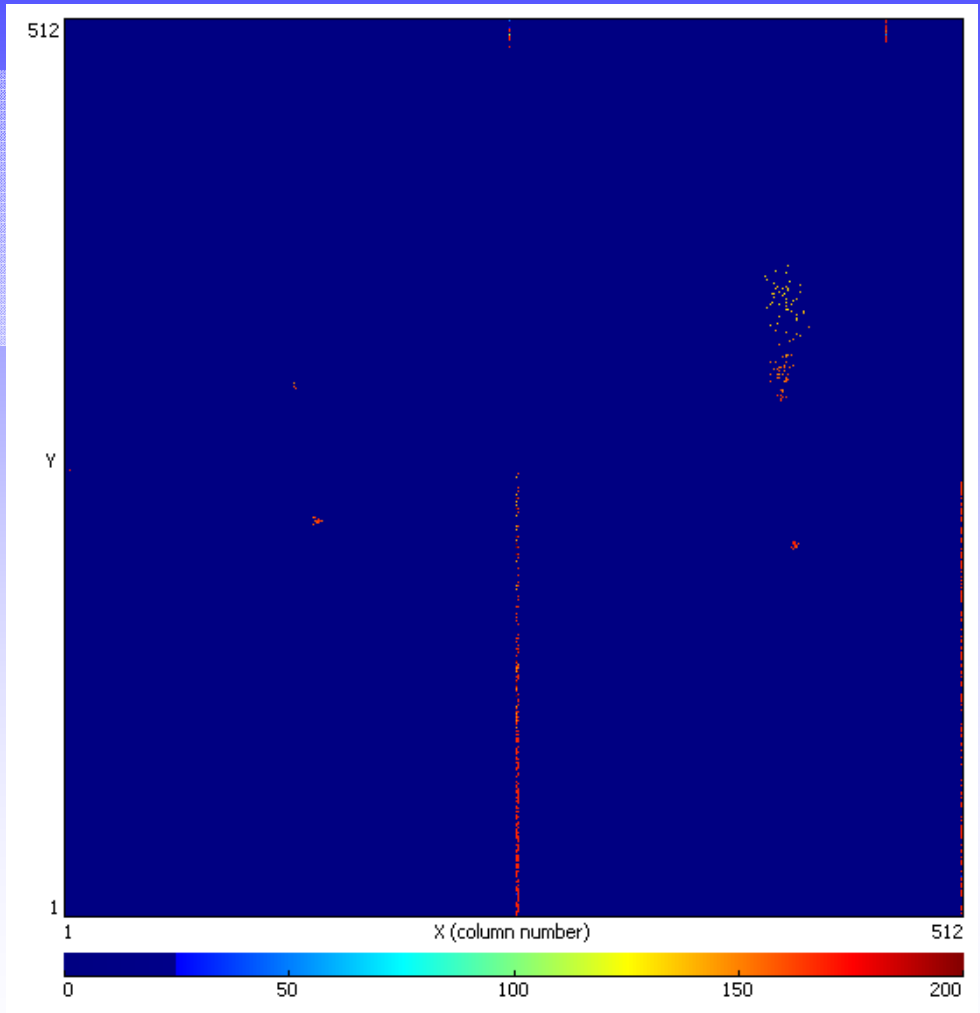
- 150 GeV “stuff”
- Ar/ISO 80:20





Beamtest H8 (SPS)

- 150 GeV “stuff”
- negligible multiple scattering
- Ar/ISO 80:20



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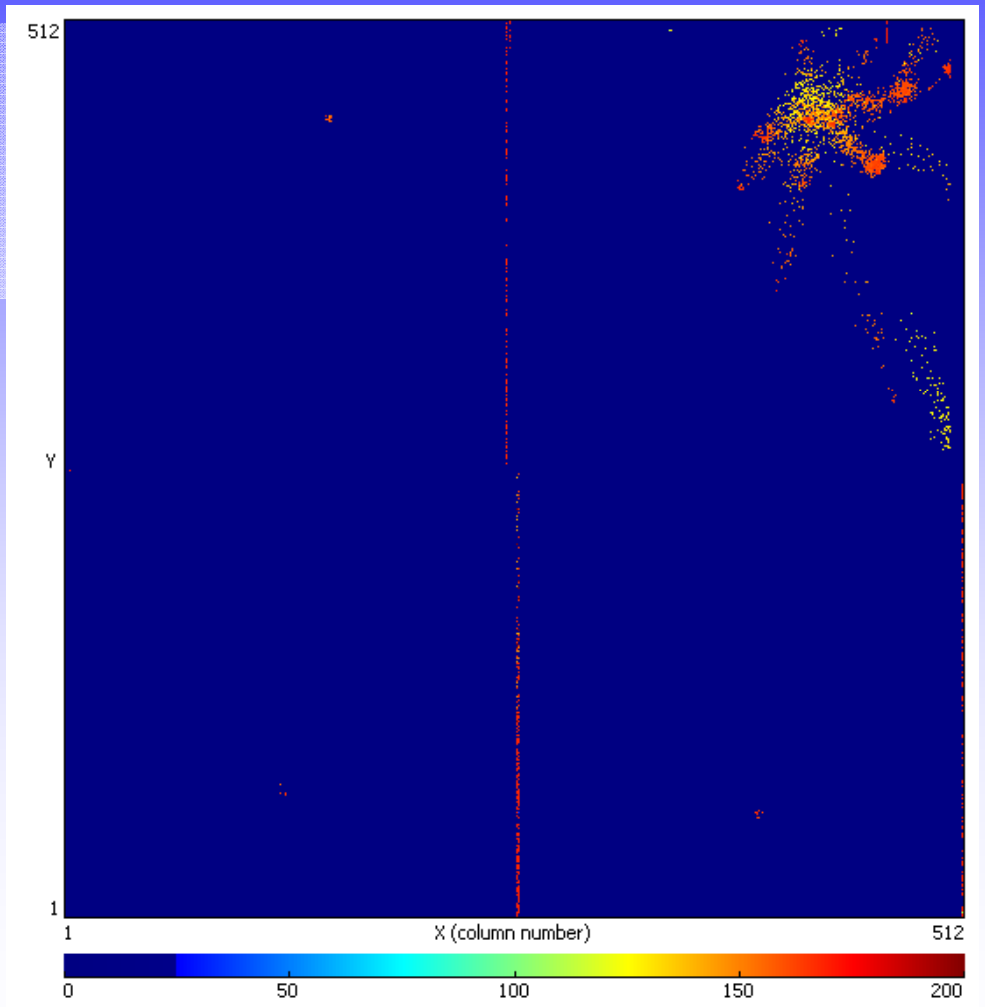
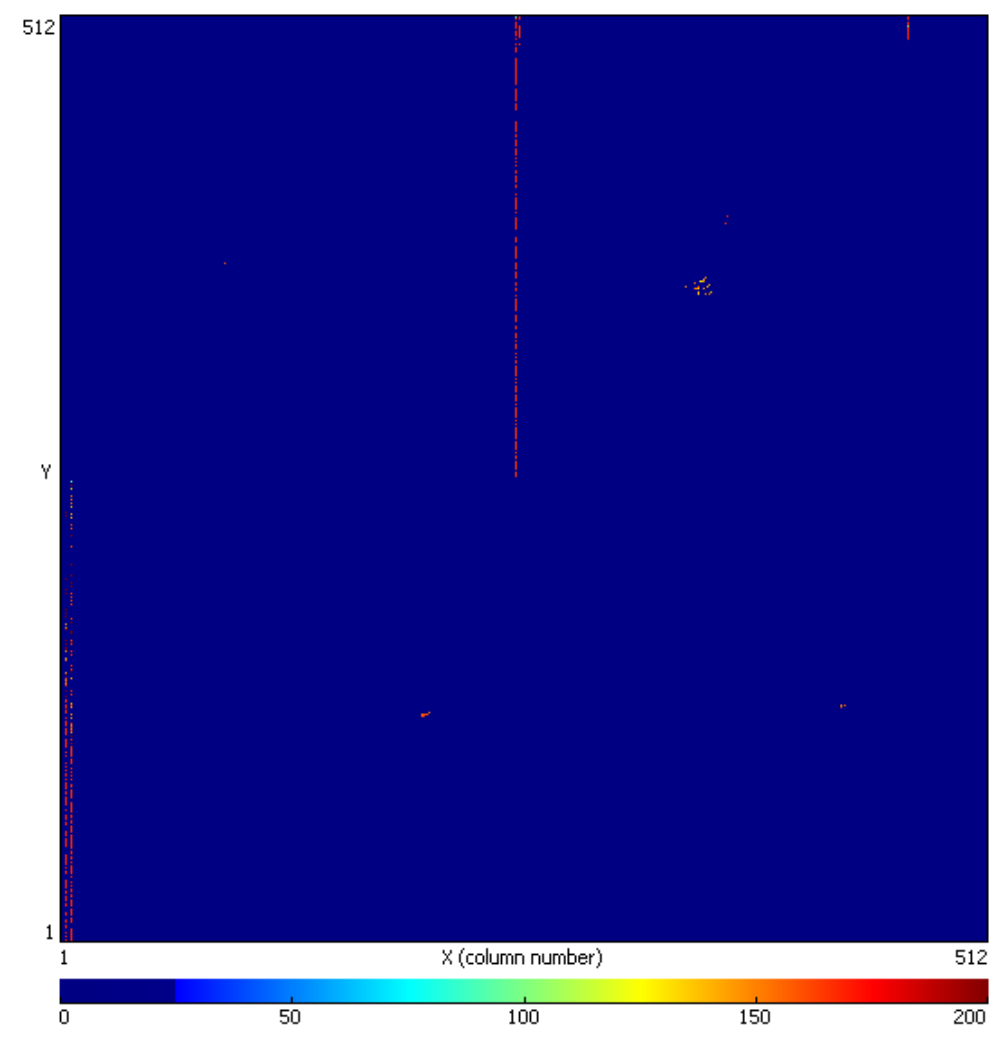


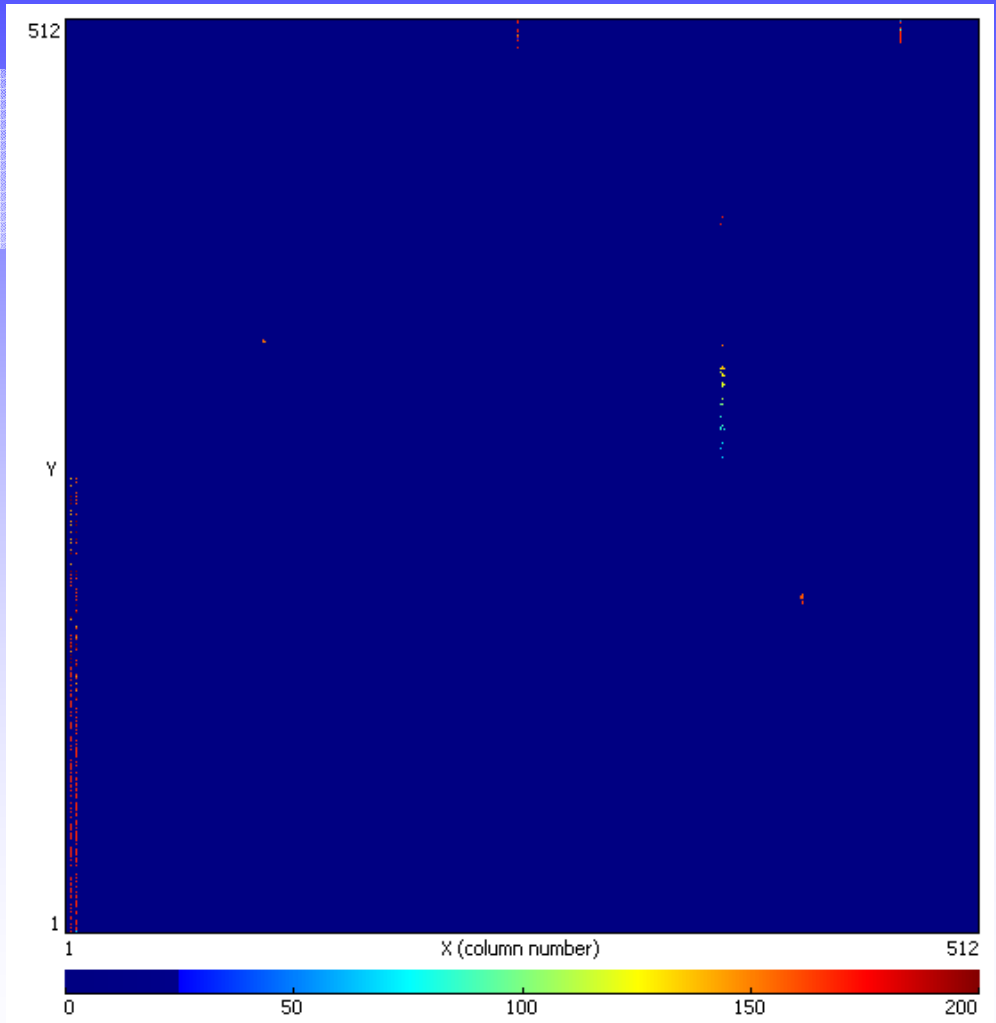
Beamtest T10 (PS)

- 6 GeV p and pi +
- multiple scattering ~ 15-50 um
- Ar/ISO 80:20



Beamtest T10 (PS)

- Now go to CO2/DME 50:50
- E drift 2kV/cm



Beamtest T10 (PS)

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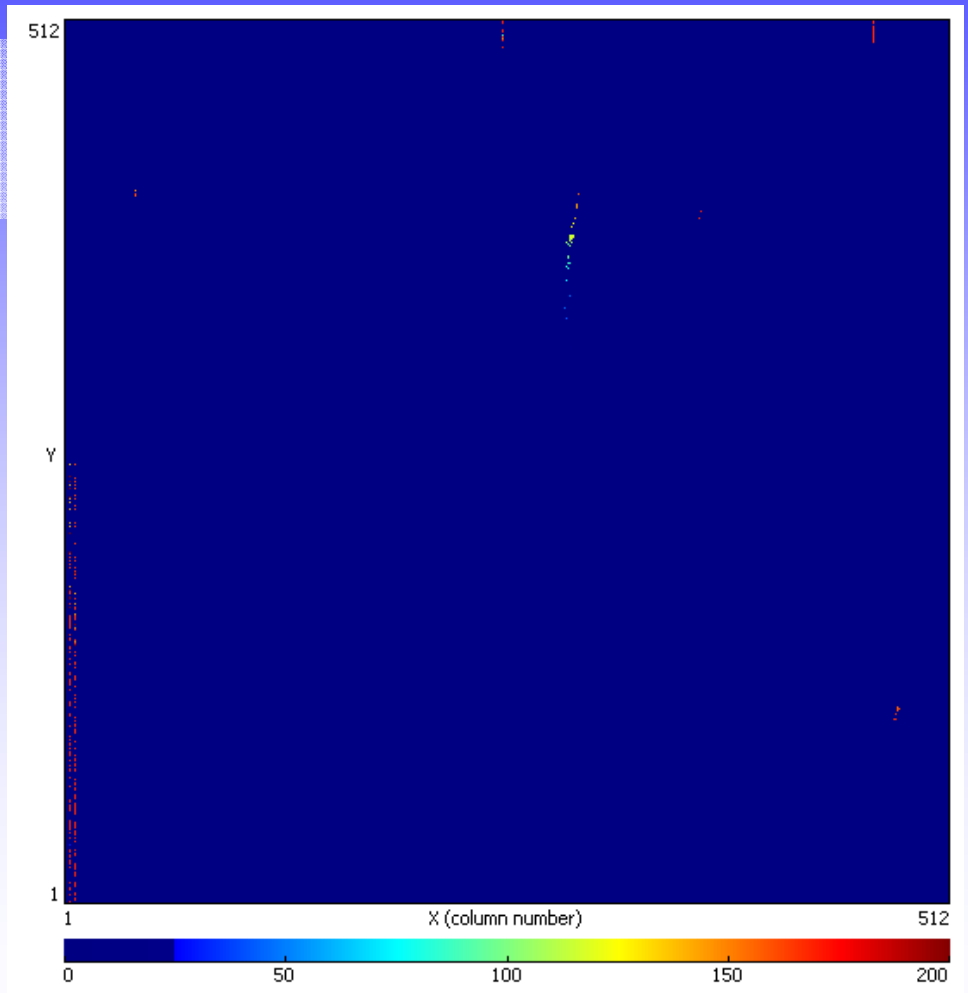
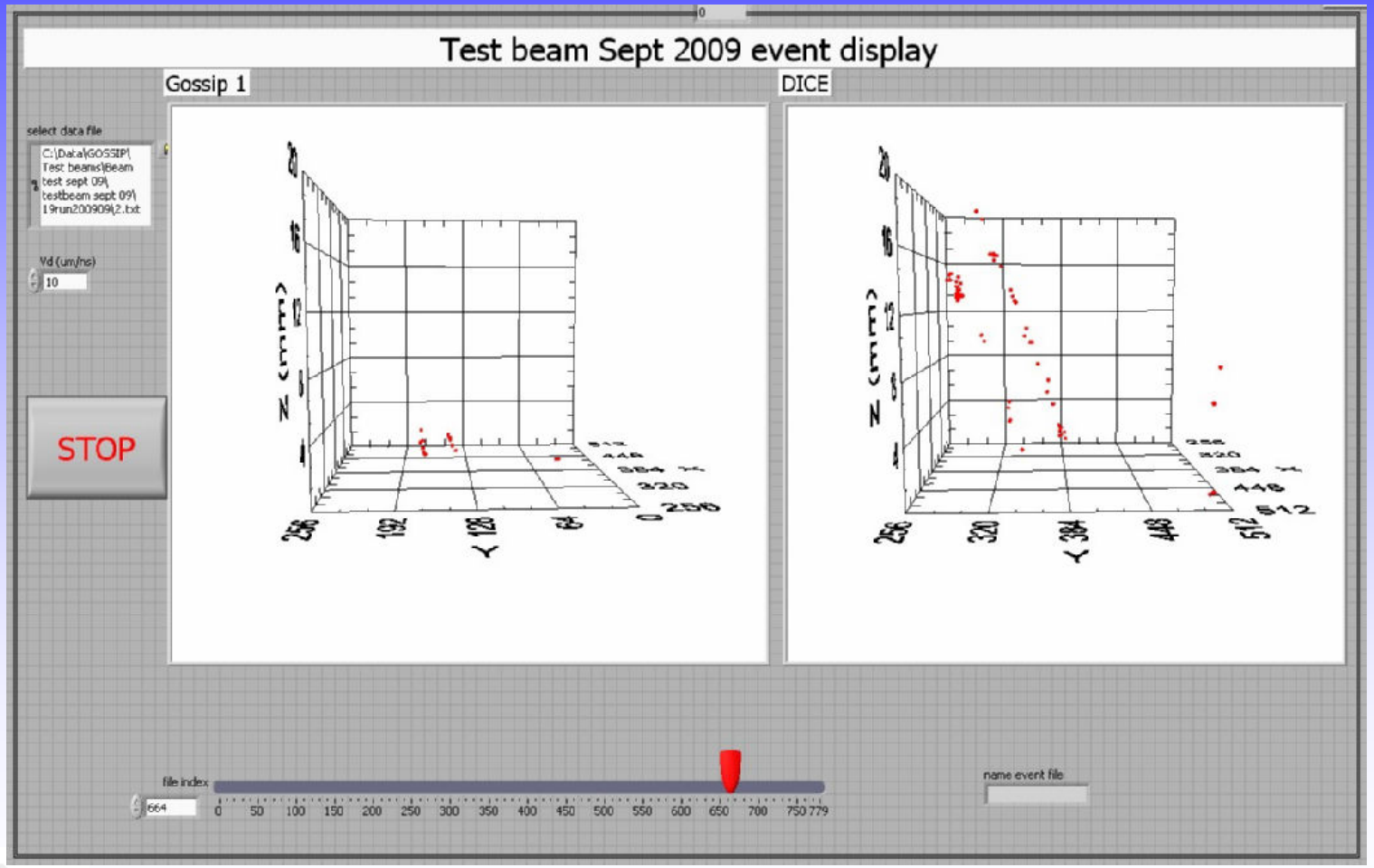


Beamtest T10 (PS)



Conclusions for part1

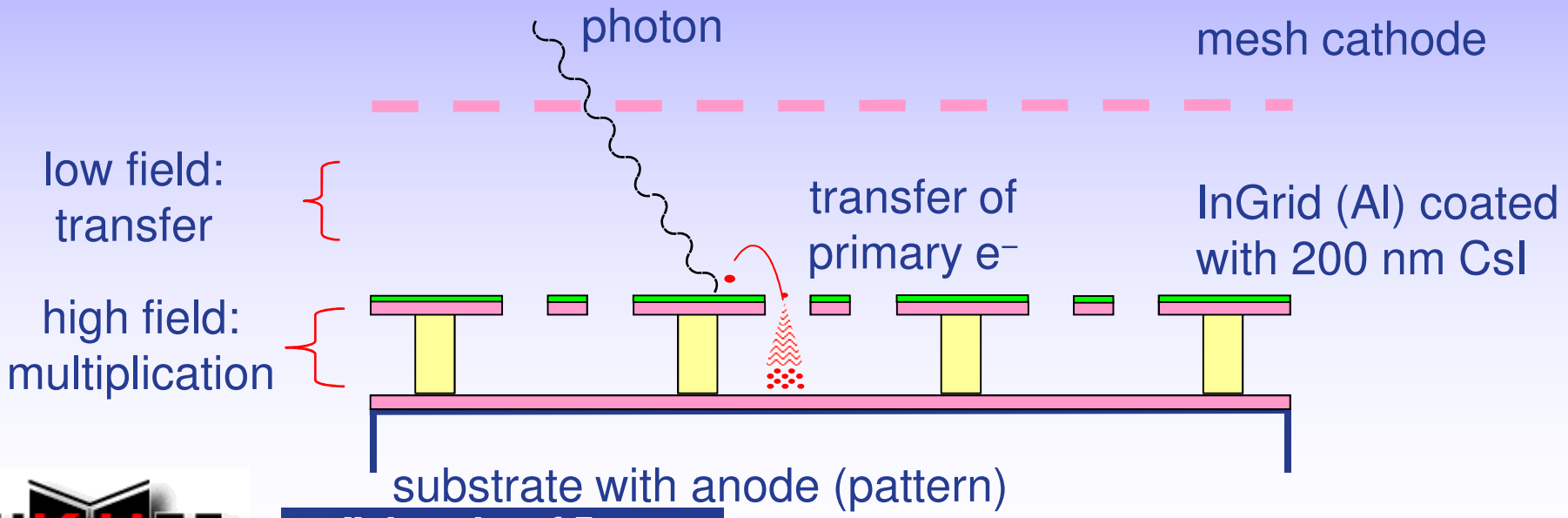
- a good 4 um SiNi layer is sufficient spark protection
- But what causes that still sometimes a chip dies?
- for gains>5k single e eff>90%
- need gains>15k to keep average timewalk within 1 timebin (10 ns).
- CO2/DME significantly better resolution than Ar/ISO mix
- Still have to look at track efficiency
- Use this data to verify simulations

Photon-sensitive InGrid detectors

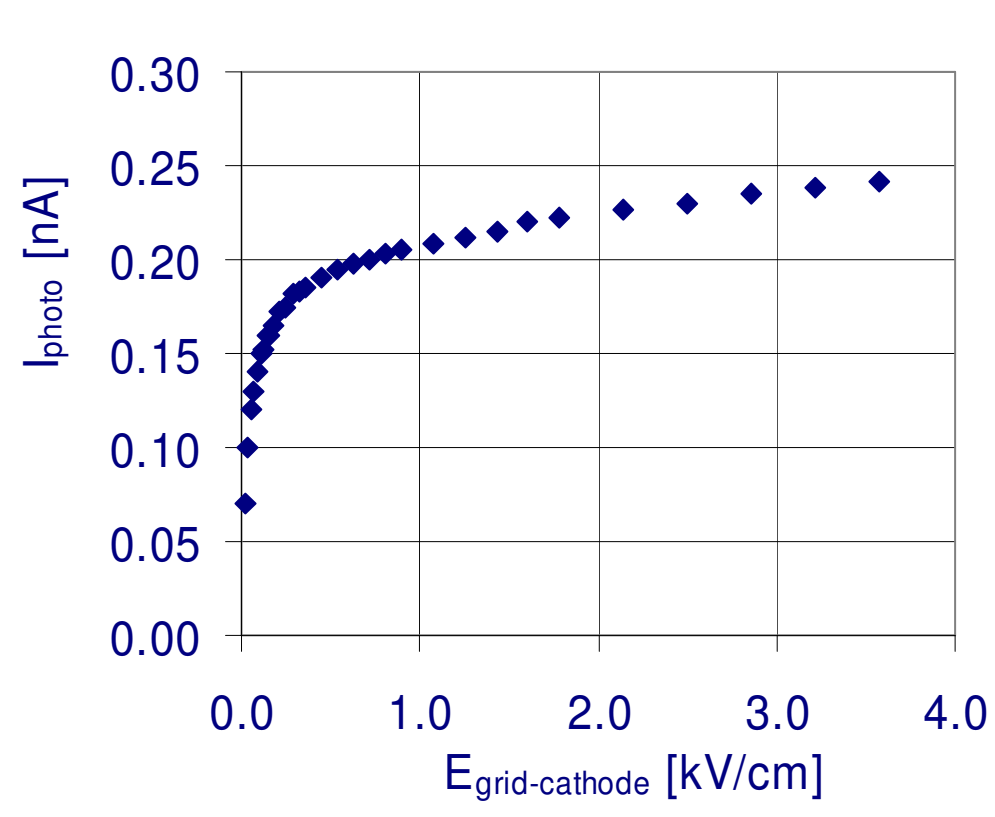
- University of Twente: Joost Melai, Victor Blanco Carballo, Cora Salm, Jurriaan Schmitz
- NIKHEF: Martin Fransen, Yevgen Bilevych, Joop Rövekamp, Harry van der Graaf, Jan Timmermans, Jan Visschers
- Weizmann (Israel): Amos Breskin, Alexey Lyashenko, Moshe Klin
- First experiments presented at IWORID 2009 (see proceedings in NIM-A)

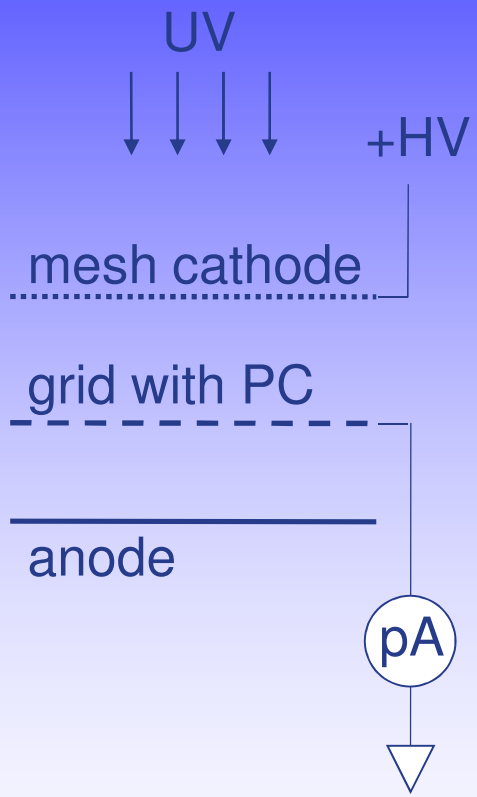
CsI photocathodes

- Photon-sensitive InGrid by deposition of reflective CsI Photo-Cathode
- Reflective PC is durable and easy to deposit (blanket thermal evaporation)

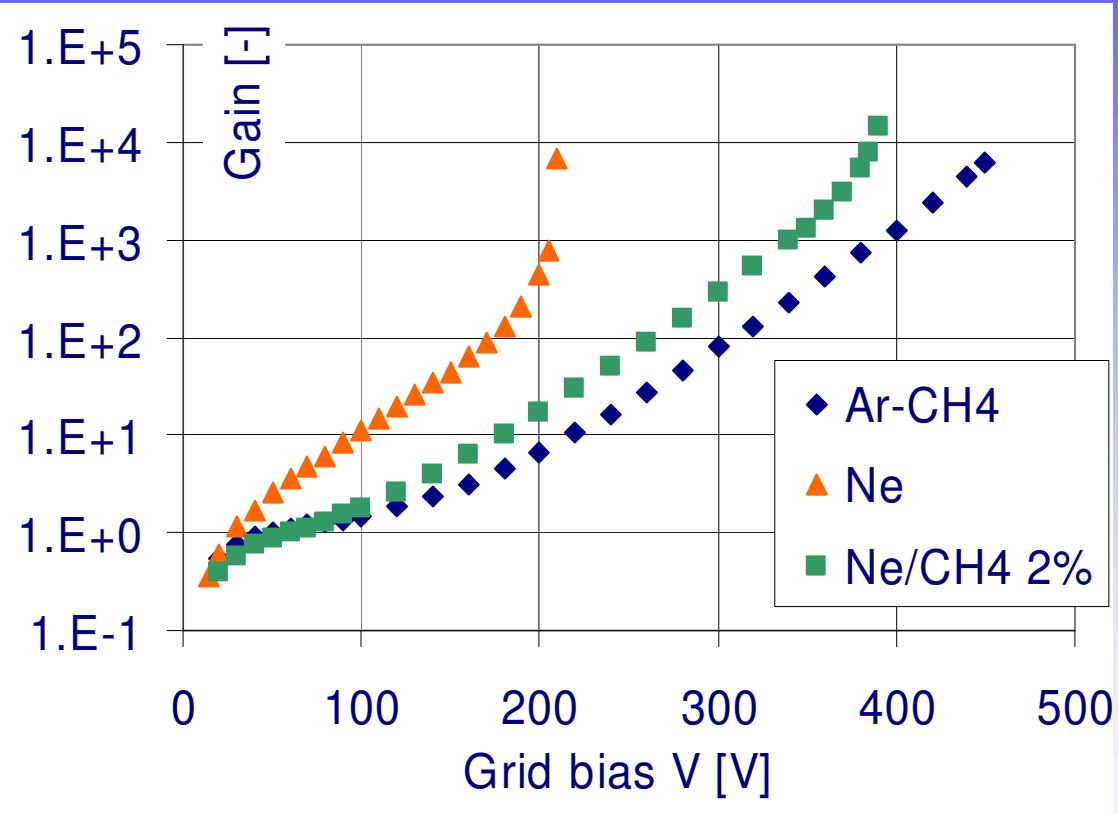


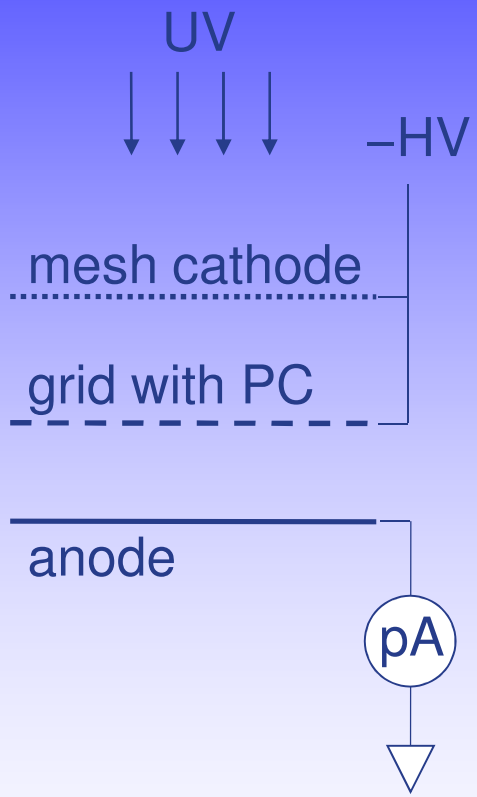
Photocurrent extraction from CsI





Gain of 75 µm device in different gases



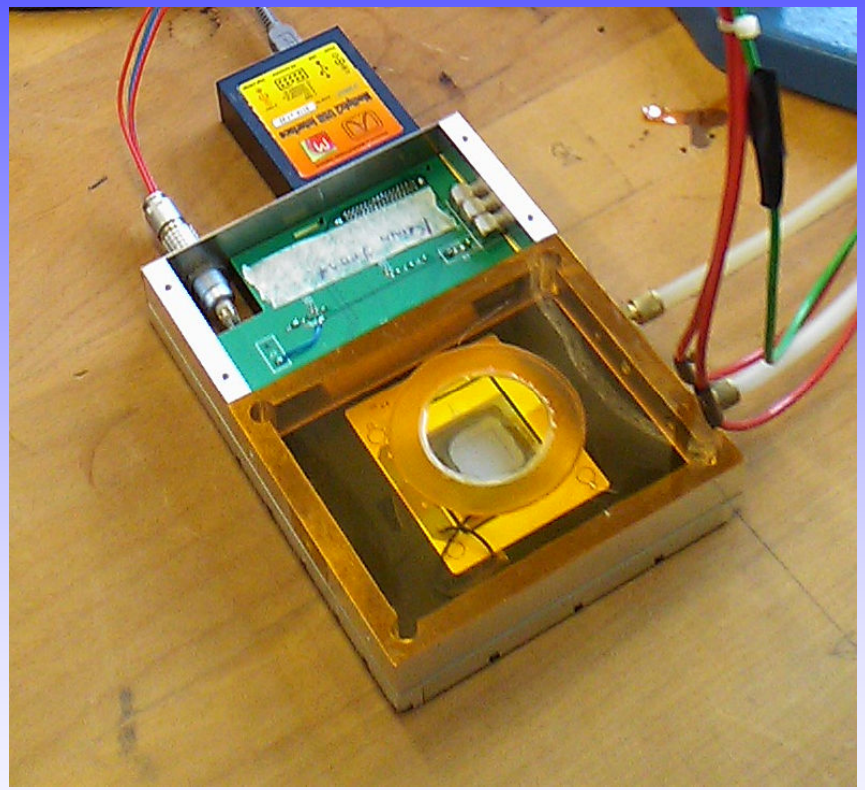


Conclusions

- CsI deposition on InGrid is easy, CsI PC works succesfully
- Photocurrent can be multiplied, max gain ~ 5000
- Transfer efficiency of primaries *appears* to be very good (I_{photo} (from PC) ≈ I_{anode} (at 0 gain))
- IBF currently ~2% (earlier InGrid record 1/1000)
- Single photon pulses could not be recorded (with external amplifiers)
- Read-out needs to be improved: Timepix

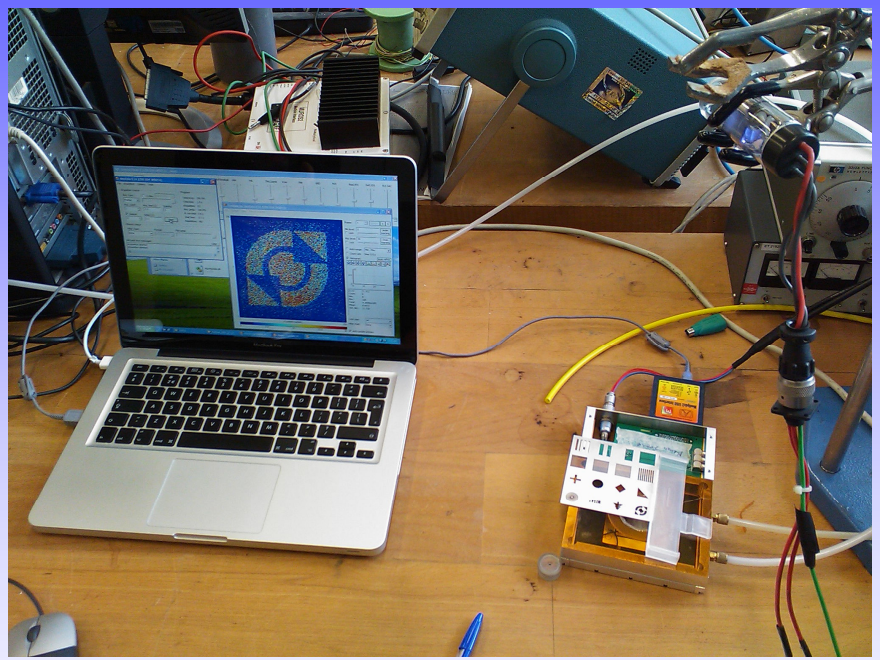
InGrid on Timepix

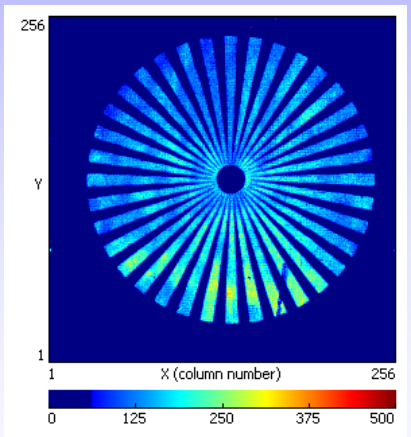
- Univ. Twente and Weizmann institute
- Timepix with 80 µm InGrid
- Gossip detector set up
- Read out with USB interface and pixelman
- UV light source D_2 lamp
- No dedicated PC, just Al grid (with native oxide)

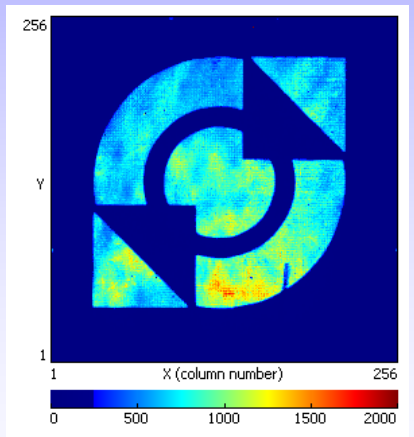


The set up

- Chip in medipix mode
- Gas He/ISO 80:20
- Try to find plateau
- Count hits in certain area

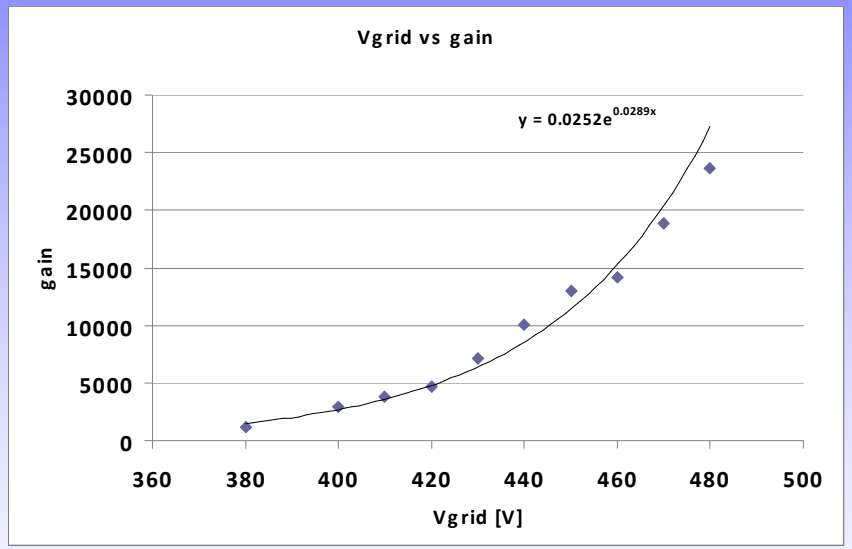


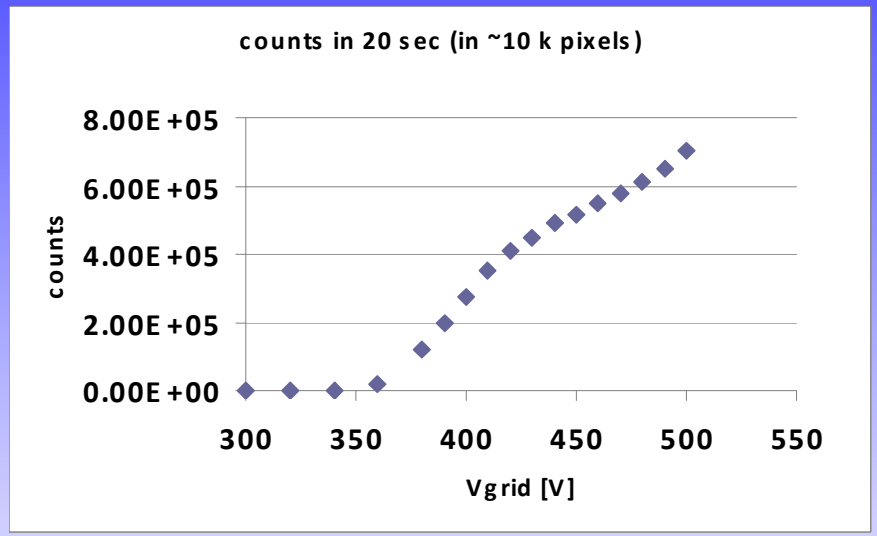




Determine working point

- Increase Vgrid
- Keep Vdrift=0



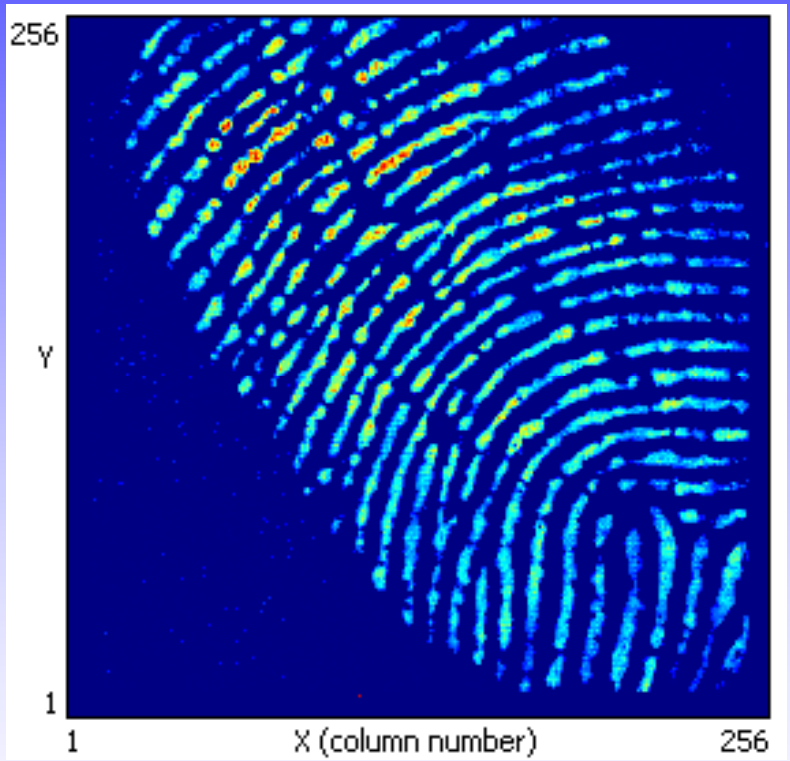


- No plateau
- Charge spread over multiple pixels?

What can we do with a photosensitive MPGD?

- Don't touch the UV window! They'll know it was you!
- A whole range of PC can be applied.
- Sensitivity can be ~ q eff.

- Add ns time resolution and a flash bulb (Timepix2?)



Questions? (or remarks)