

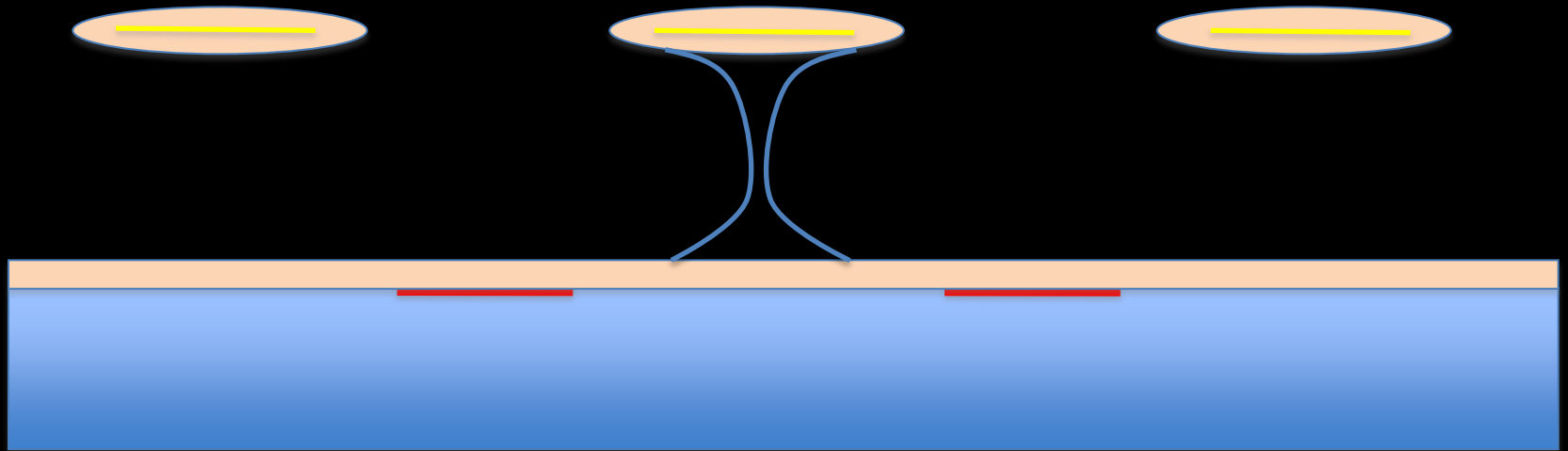
GridPix:

- the all-ceramic InGrid
- TimePix-3
- the Quad Focus chamber
- Q64

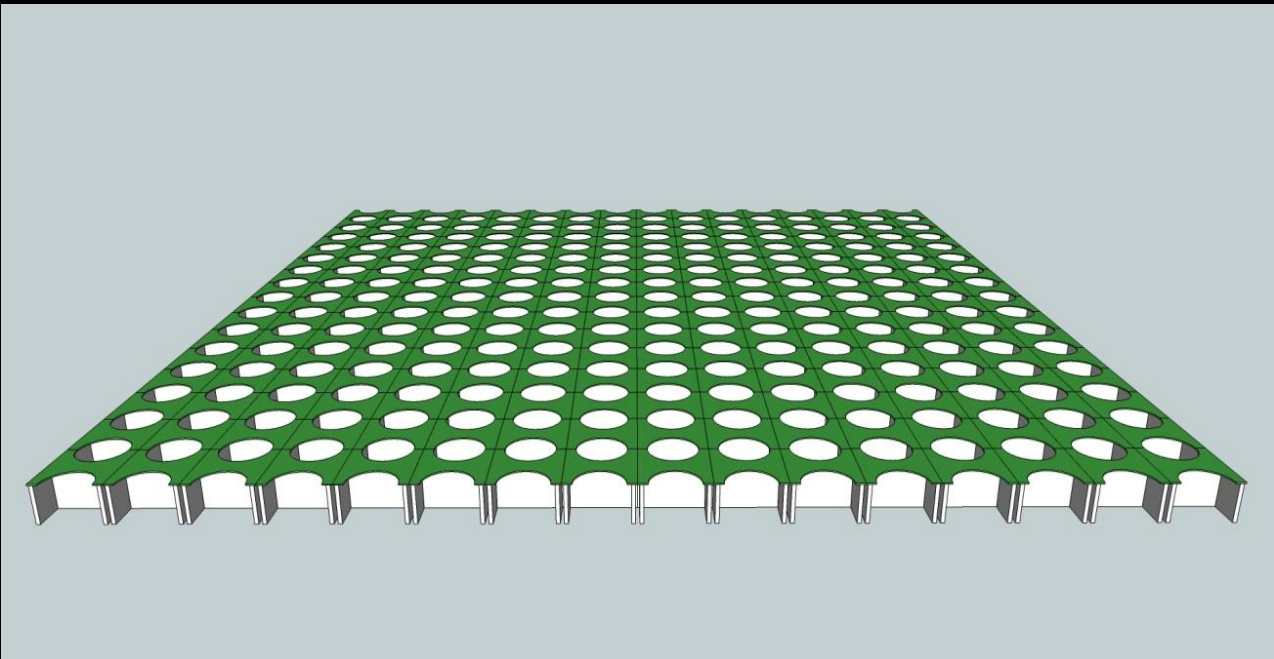
Harry van der Graaf
Nikhef/TU-Delft

RD51 Workshop
WG 1, CERN, Oct 16, 2013

The all-ceramic InGrid: Yevgen Bilevych & Hong Wah Chan @ IZM-Berlin



- Double Discharge Protection (like RPCs)
- thermal expansion coefficient as Si: cryogenic applications
- no outgassing (LAr & LXe TPCs)

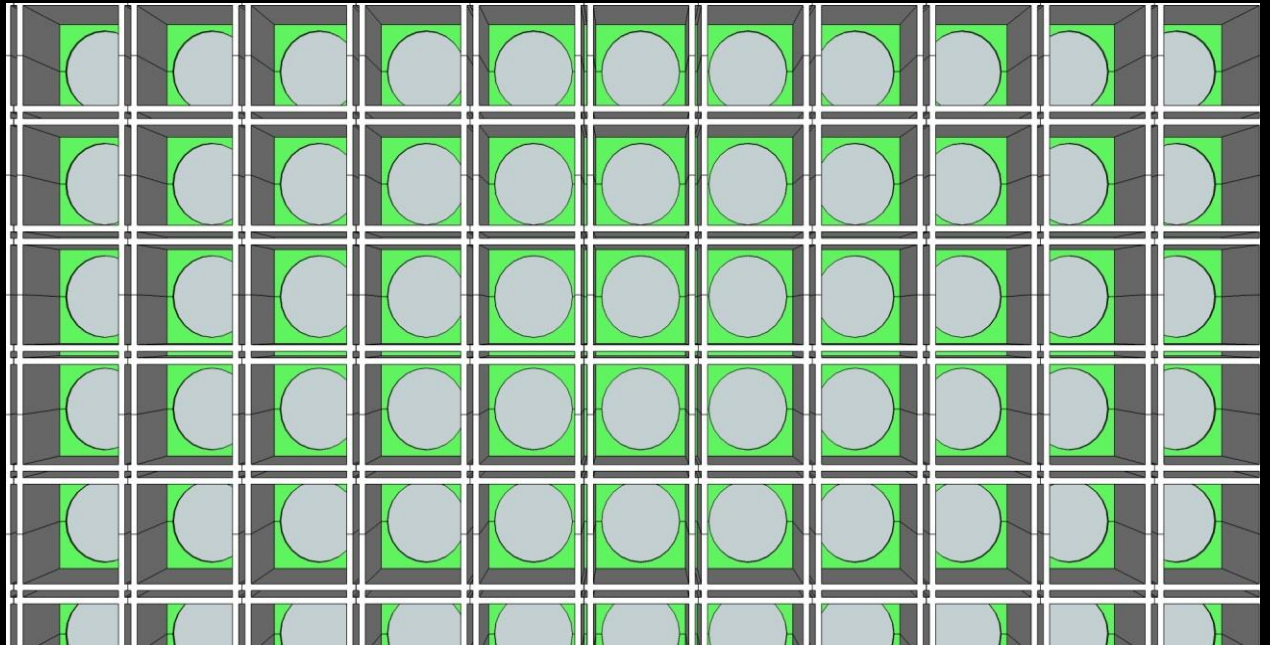


First:

all-ceramic Micromegas

Discrete component
to be mounted on
TimePix (-3!) chip

Later: intergration:
all-ceramic InGrid



Appendix A: Flow chart



Deep reactive-ion etching (DRIE). DRIE etching allows high aspect ratio structures to be etched. The width of the trenches will be 2-3 μm . In this design a double square wall will be formed.



Low pressure chemical vapor deposition Silicon Nitride (LPCVD SiN). LPCVD SiN has a high conformity, which will fill up the trenches nicely when a layer of 1.5 μm is deposited.



Aluminum deposition. A thin layer of aluminum is deposited for the lateral conductivity of the grid.



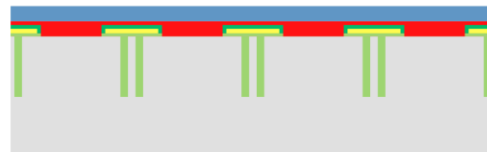
Aluminum patterning. The aluminum is patterned, so that no aluminum is exposed when the grid holes are opened.



Plasma-enhanced chemical vapor deposition (PECVD) SiN. The aluminum is covered by PECVD SiN. This layer will prevent sparks.



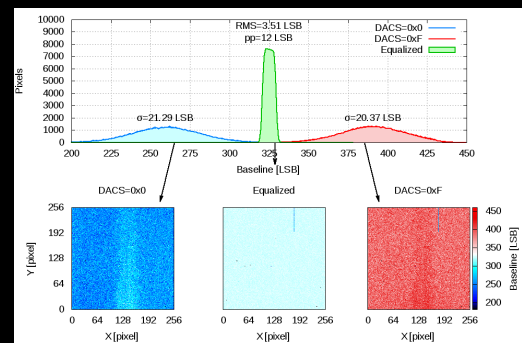
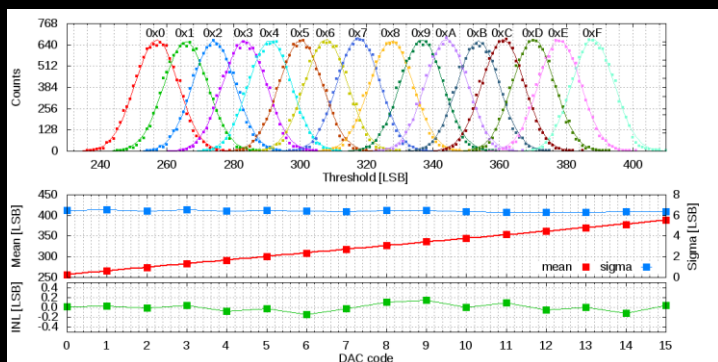
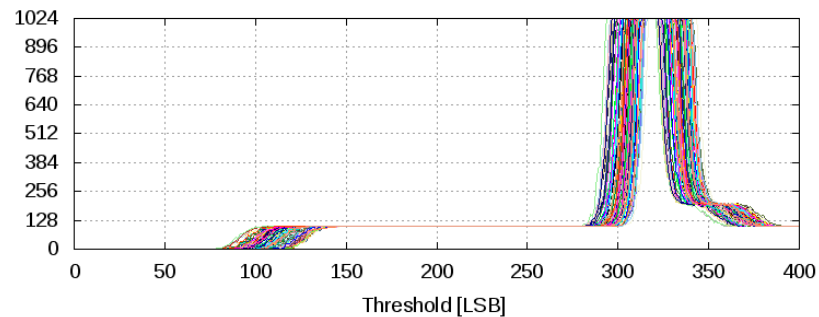
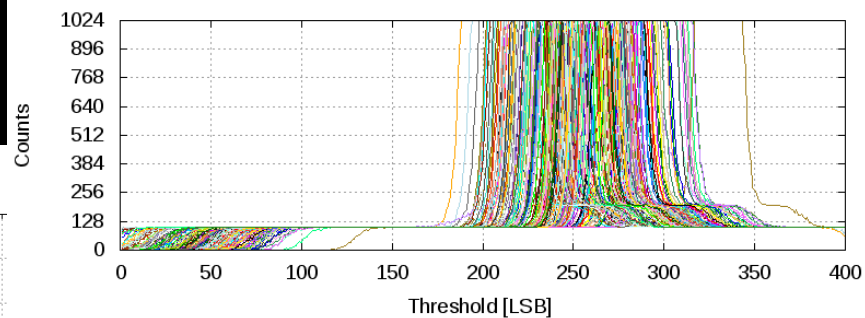
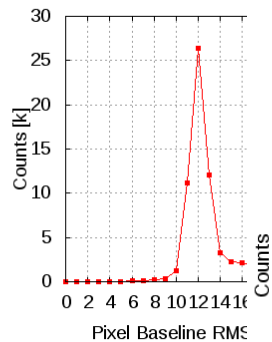
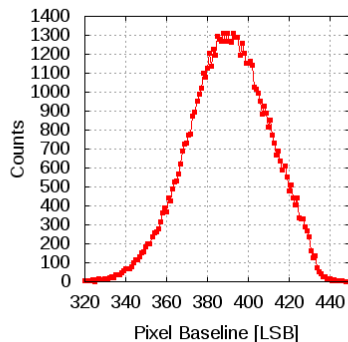
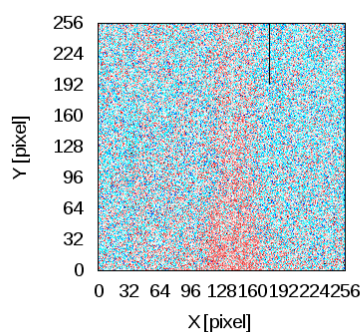
Grid patterning. The grid holes are opened by plasma etching.



Photoresist + dicing foil. Photoresist and dicing foils are applied to the surface of the grid. The wafer can be diced at this stage.

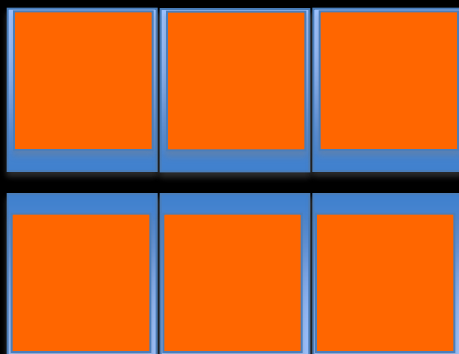
Engineering run: wafers received @ CERN in Sept 2013

Seems to work perfectly!



GridPix on Single TimePix-3 chip under construction!

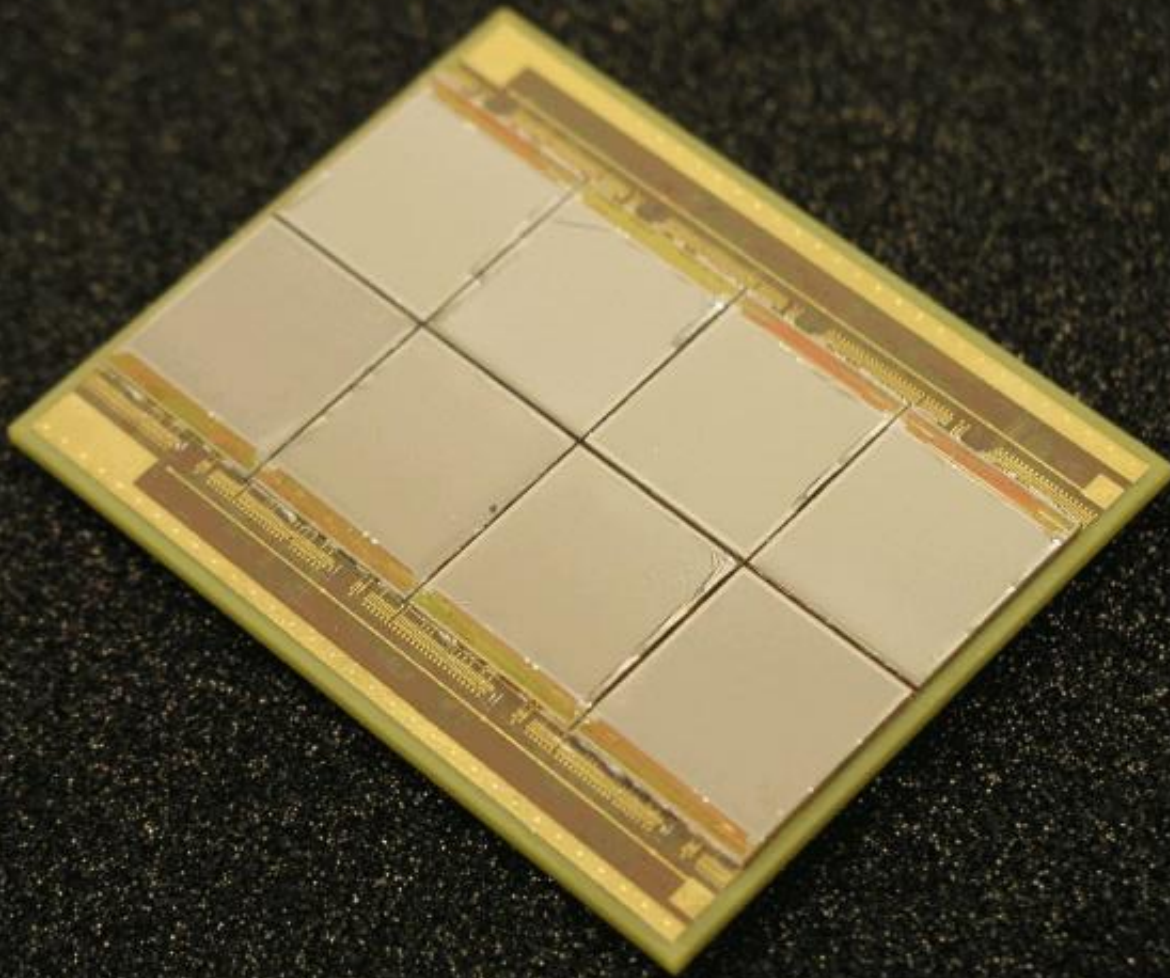
The QuadFocus chamber



GridPix: best tiling now

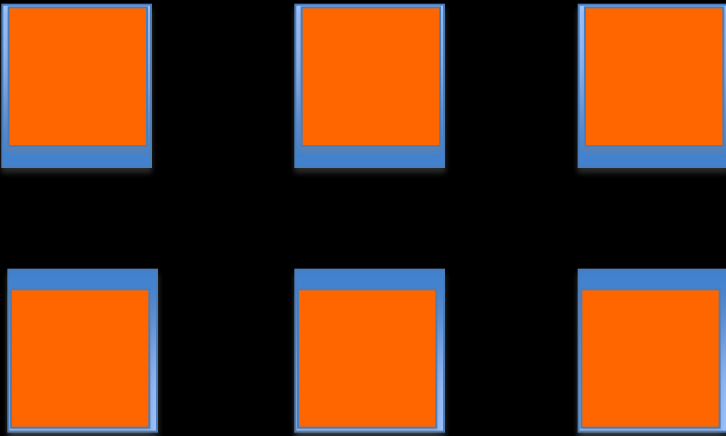
For TPC readout: dead regions due to non-perfect tiling

- perfect tiling possible with Si-Medipix ReLaXd at the cost of through-vias
- dead regions acceptable for some tracking TPCs
- for ILC TPC: no urgency to minimize dead regions



Octopuce: attempt to minimize dead regions

- very hard to exchange broken chips (and we will have broken chips)
- uncontrolled distortion of drift field

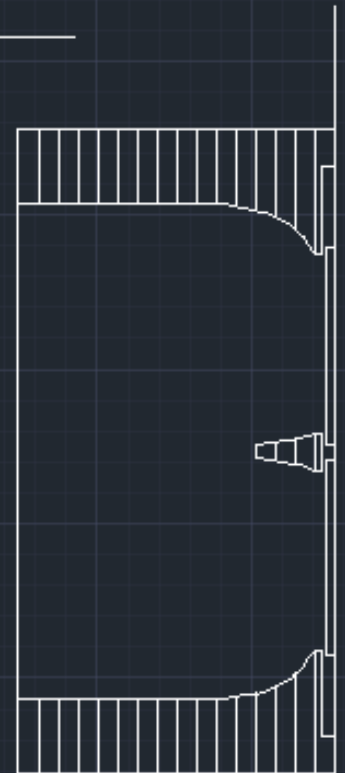
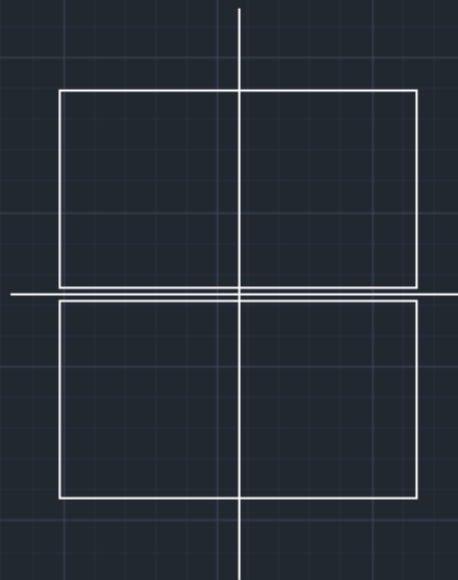
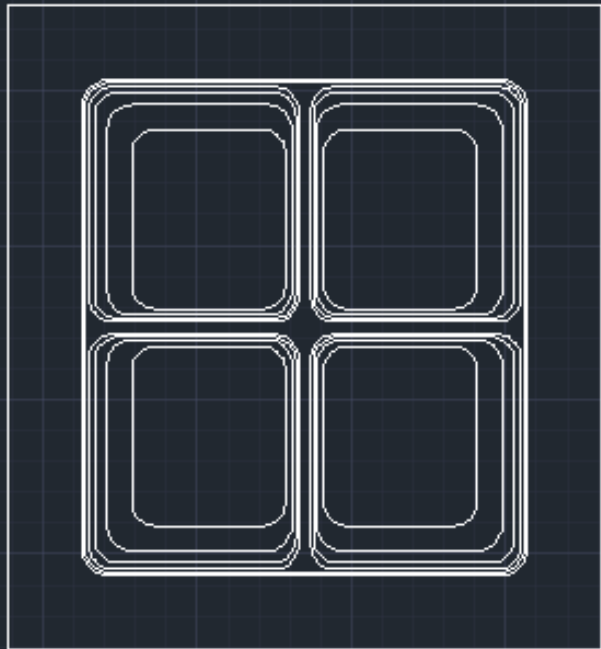
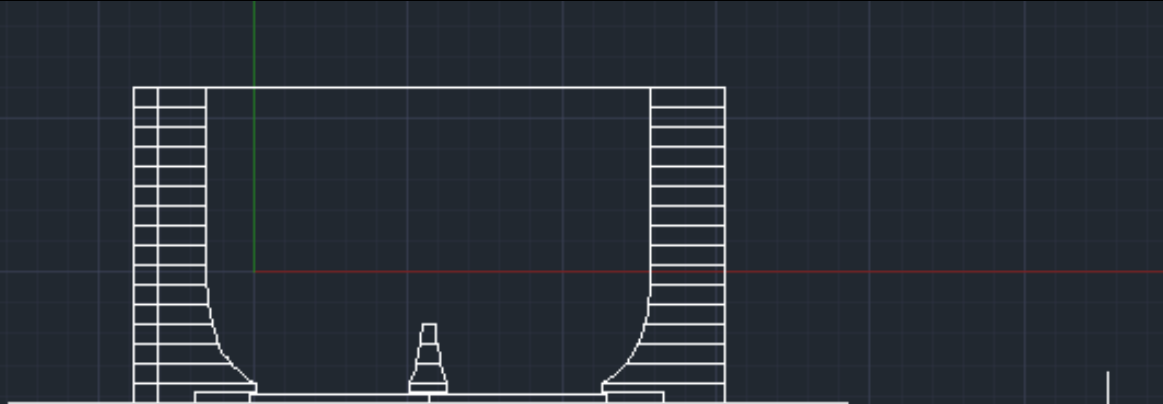
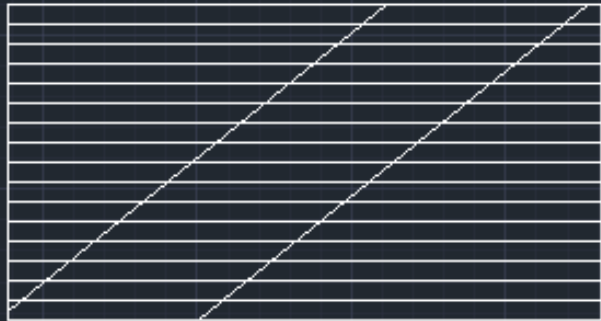


Strong focusing

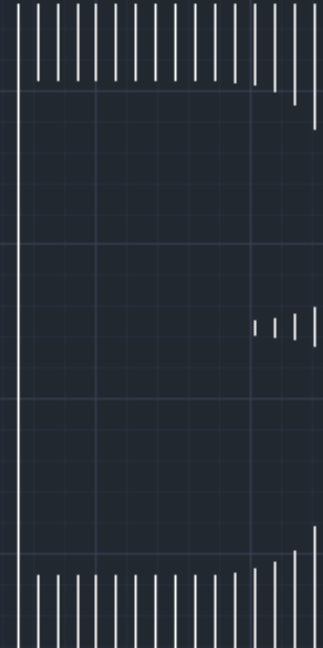
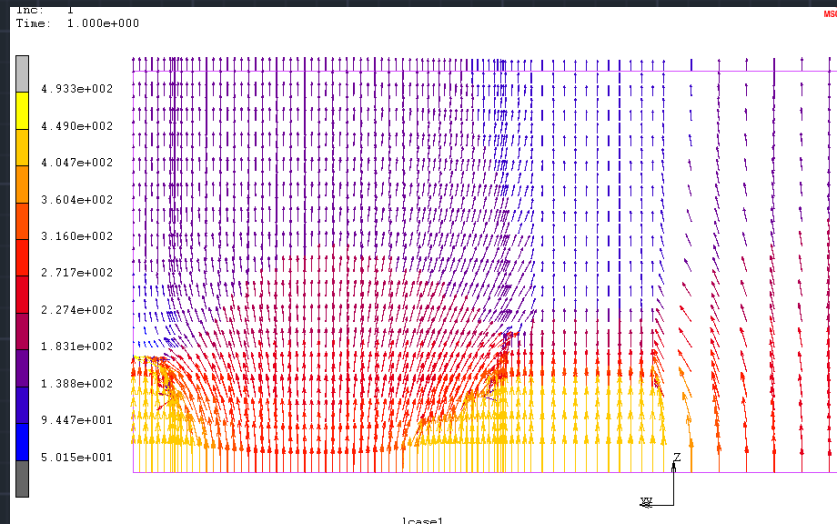
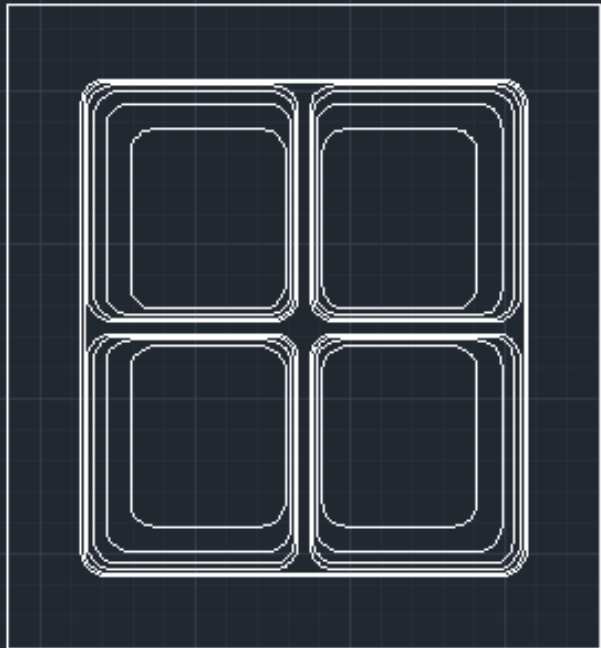
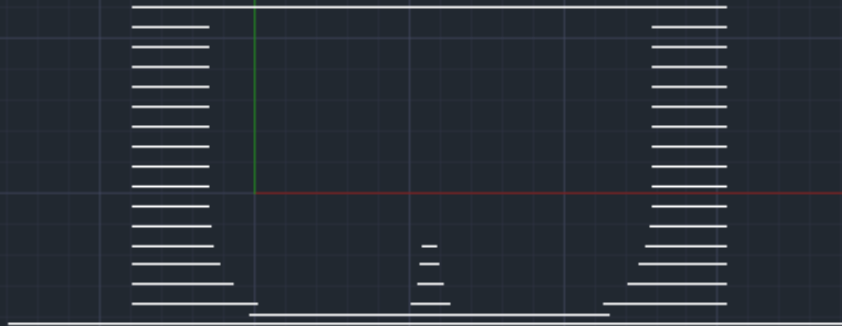
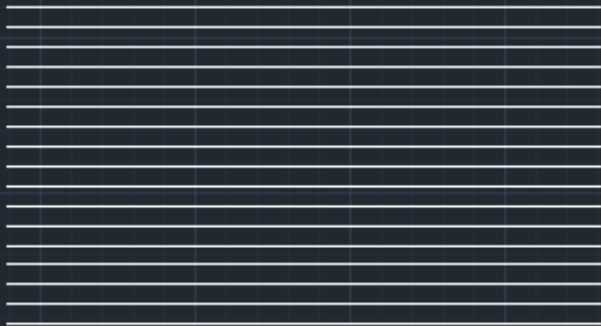
- cover only 25 of fiducial surface with active pixel chip
 - saves \$\$
 - saves power, thus cooling, thus radiation length

But:

- larger effective pixel pitch (256 x 256 pixels @ 55 μm x 55 μm)
→ 110 μm x 110 μm Moore's Law: smaller pixels in future
- region of amplified diffusion
- in B-field: E x B effect: amplified (coupled) diffusion

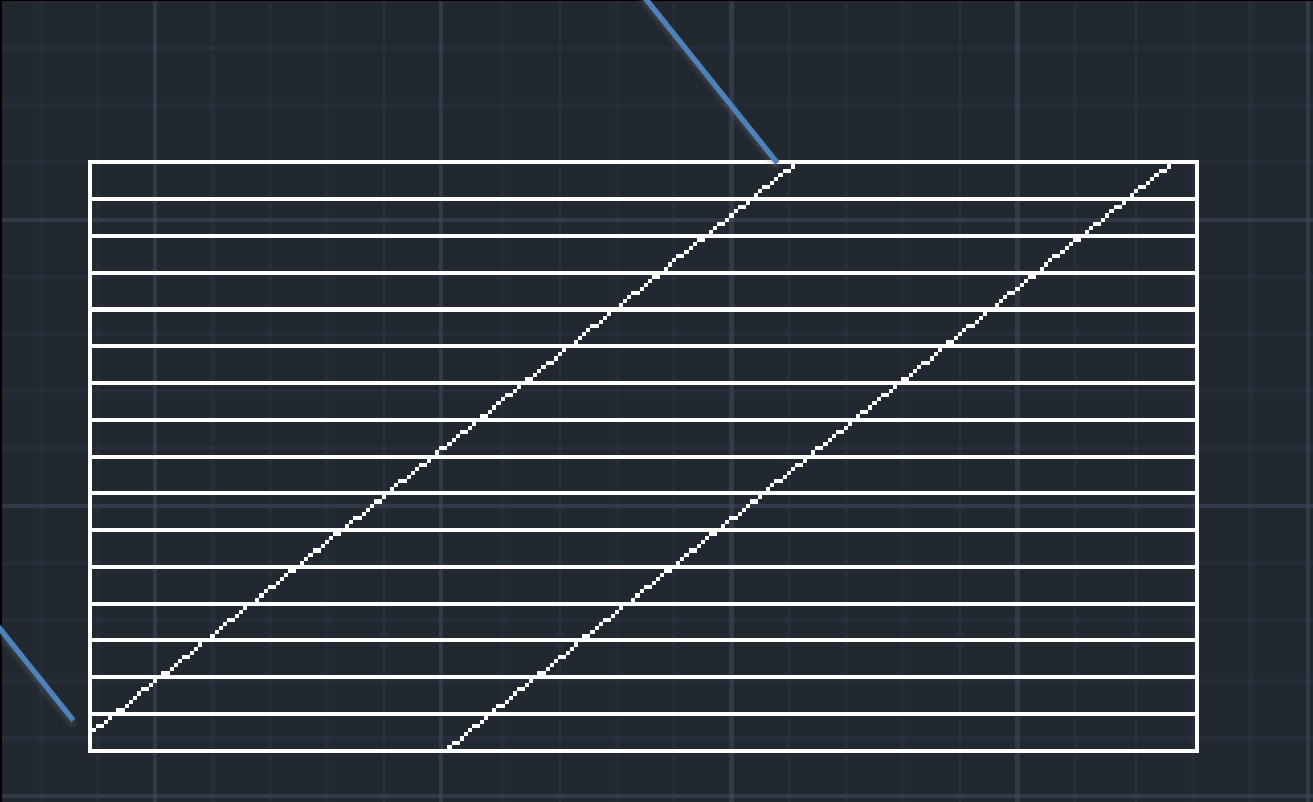


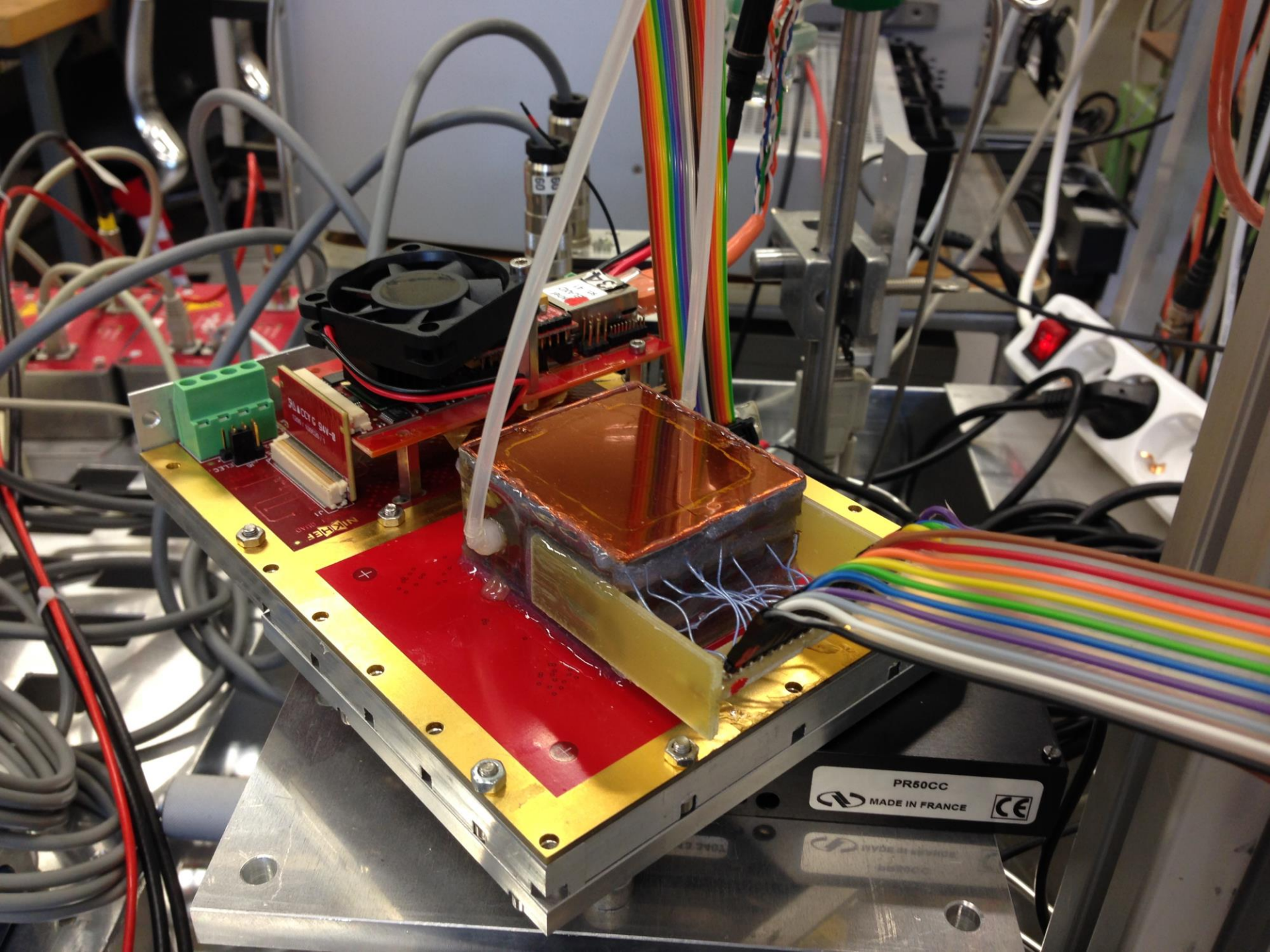
Focusing drifter for Quad TimePix on ReNexd



Extract copper pattern for 3D field calculations

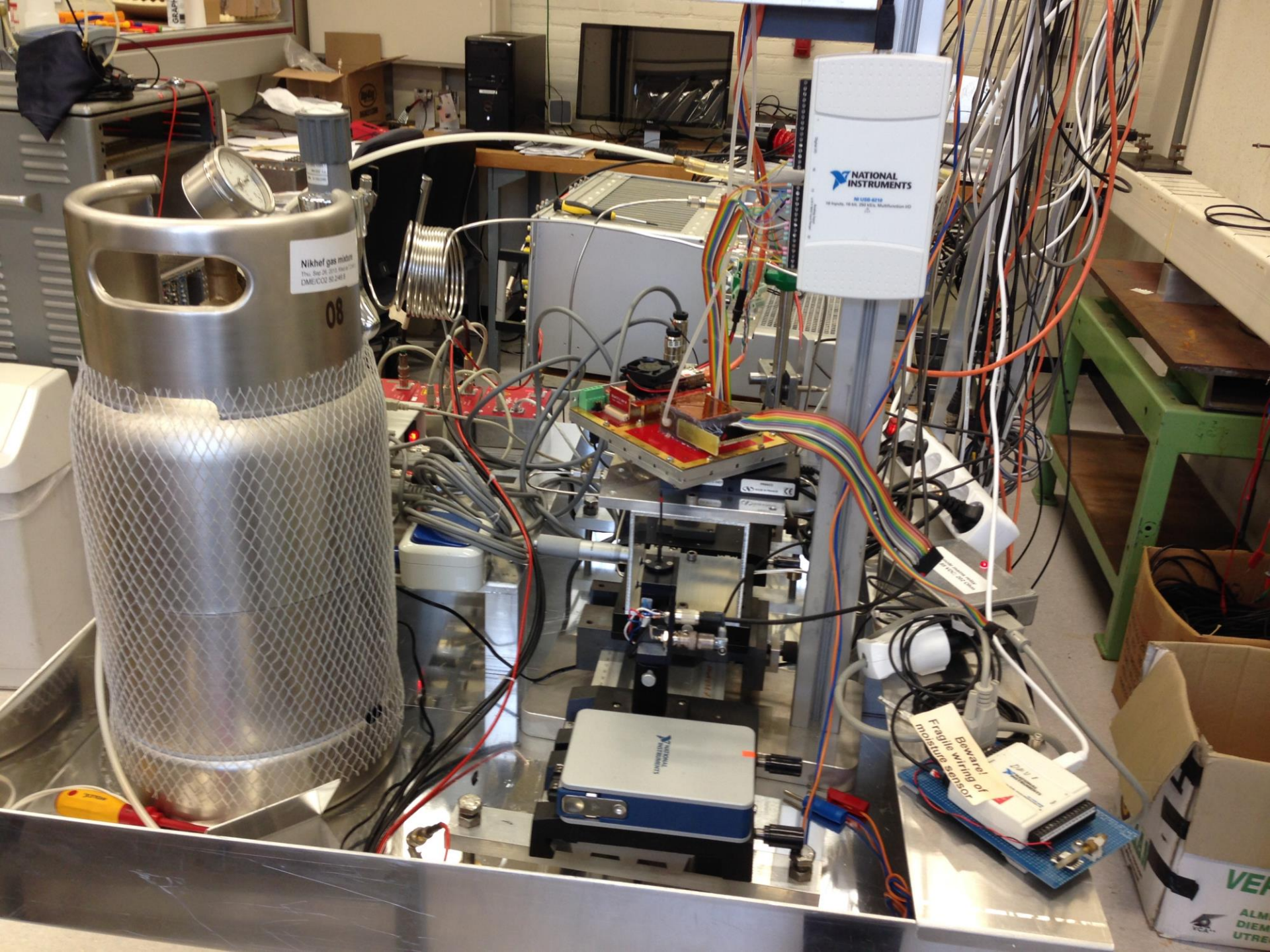
Flat Cable with 16 leads: external potential settings





PR50CC
MADE IN FRANCE





Nikhef gas mixer
Thu. Sep 26, 2013 14:00
DME/CO2 90-240-8

08

NATIONAL INSTRUMENTS

NI USB-6010

16 Ports, 16 Bit, 250 kS/s, Multifunction I/O

NATIONAL INSTRUMENTS

Fragile wiring of
moisture sensor

Beware!
wiring of
moisture sensor

VER
ALM
DIEM
UTRE

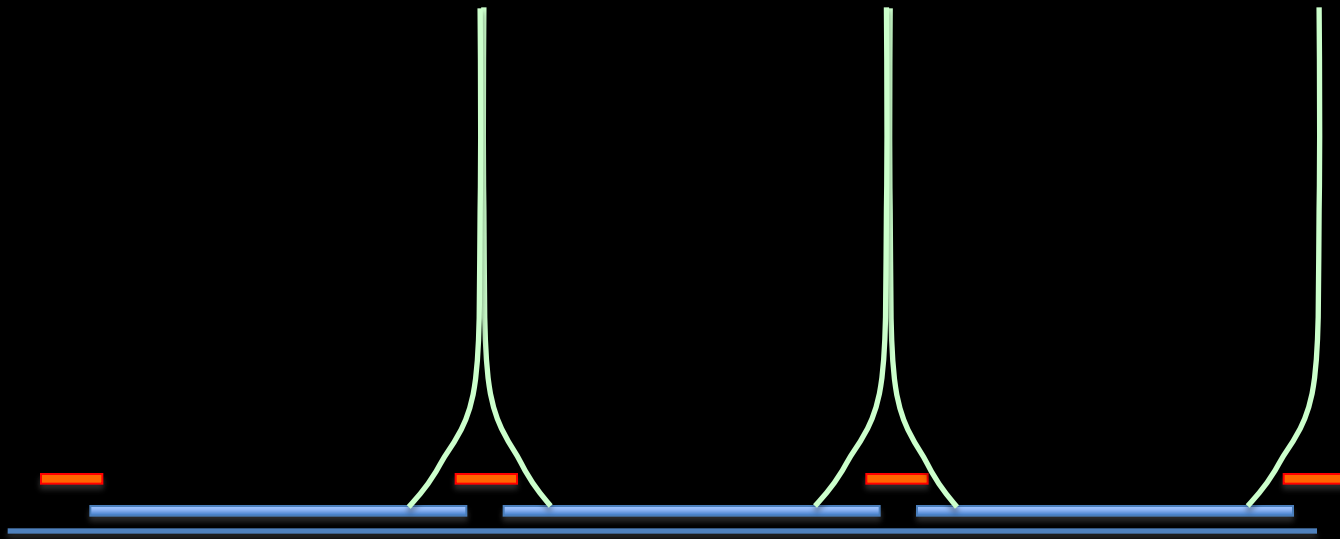
The Q64 chamber

cathode foil

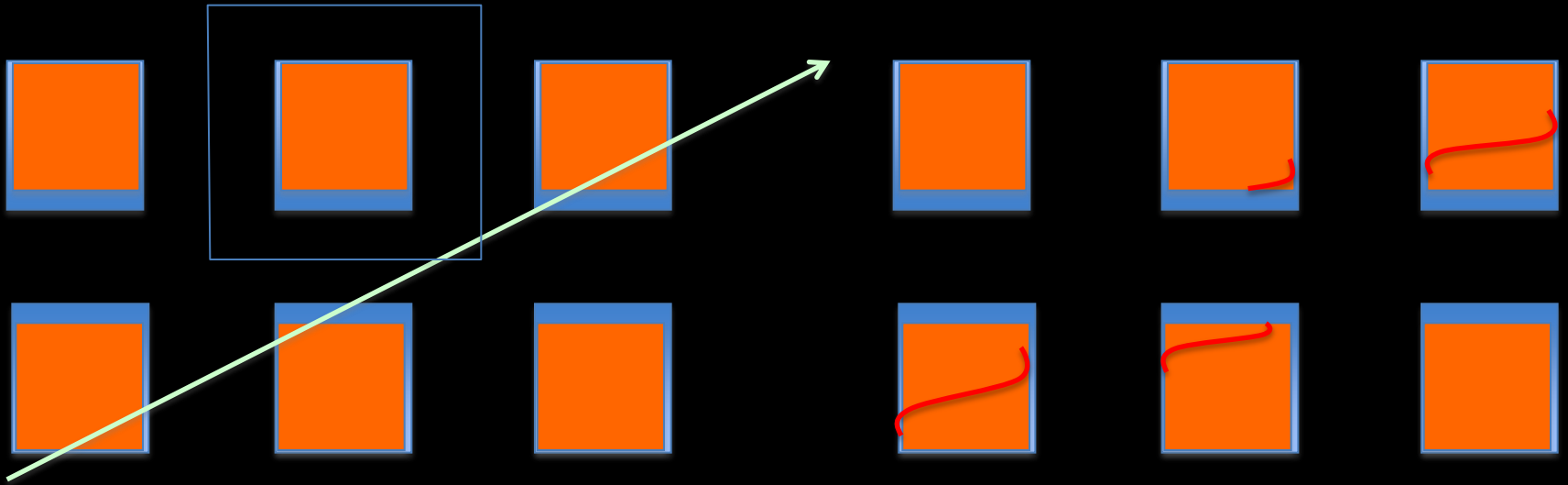
field cage

guard electrode





Focus drift field by means of guard electrode to avoid dead regions



Autocalibration

- get initial $f(X,Y) \rightarrow (X',Y')$ from 3D e-field
- make scatter plots of residuals
- modify $f(X,Y)$ until residuals are minimized

Basic correction: $X' = C X, Y' = C Y$
+ $E \times B$ effect

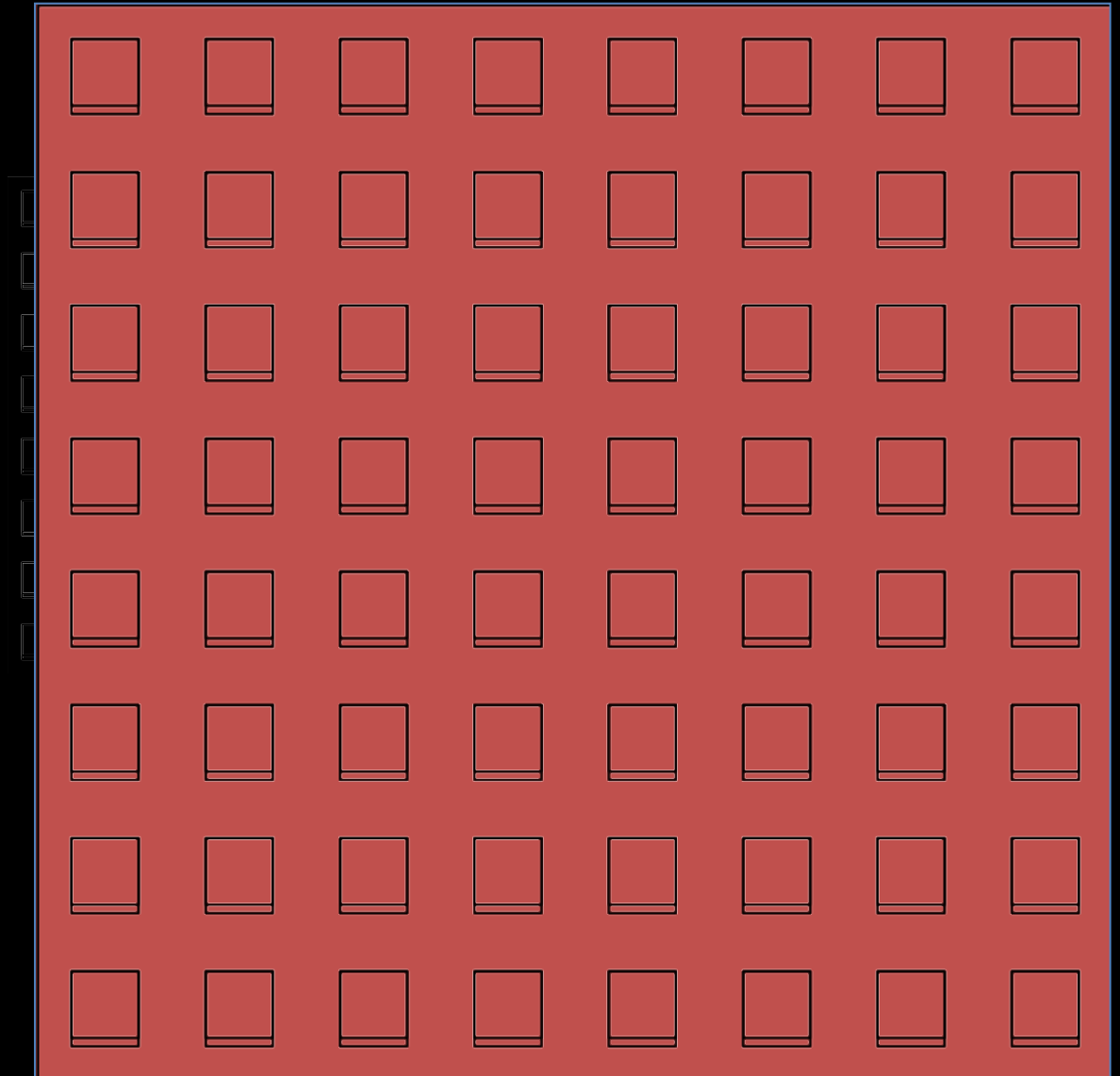
Performance

- requires knowledge of local vectors E , B
- effective pixel size related to electron diffusion
- $E \times B$ effect, although correctable, may worsen resolution

Plans

- Quad Focus Drifter under construction (finished)
- 2x Sci 30 mm x 40 mm to be constructed
- Chamber support + rotator (around Z axis) ready
- HV distribution box (16 channels!) ready
- Testbeam @ DESY in Oct 2013
 - Data analysis, Monte Carlo simulation, correction procedure

Q64: an assembly of 16 Quads



work:

- pcb
- focusing electrode
- cooling (ReLaXd)

