A field line focusing drifter for GridPix (tracking) TPCs

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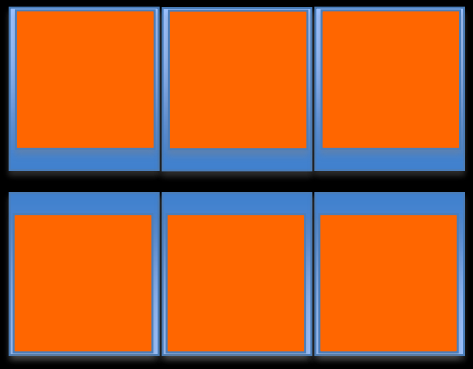
RD51 mini week

WG2

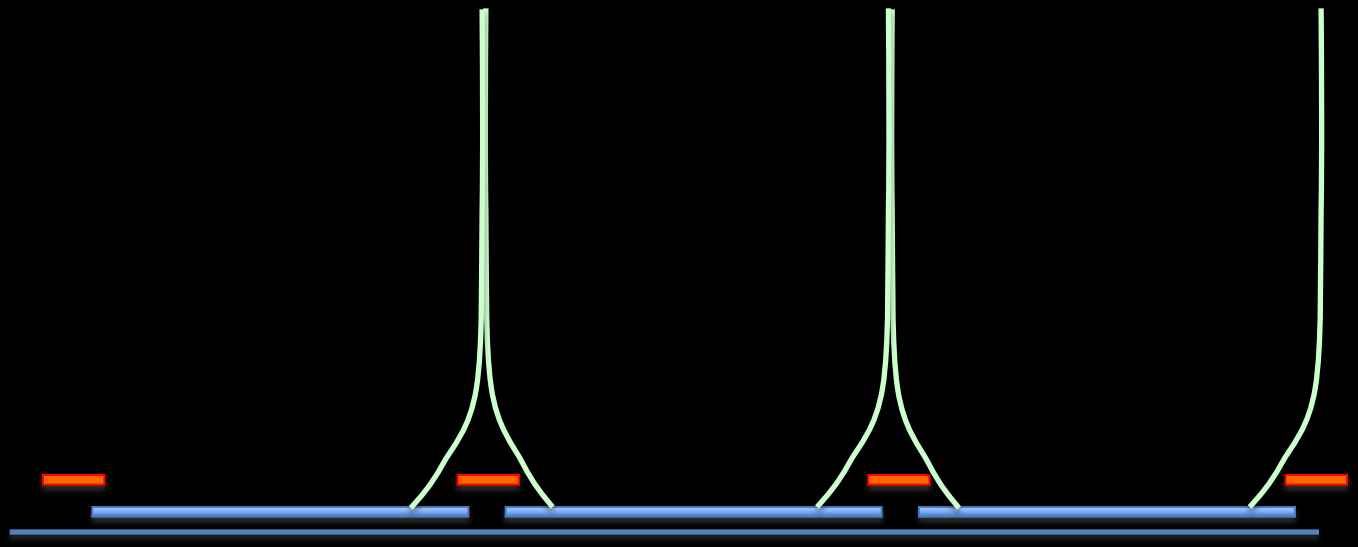
CERN, April 22, 2013



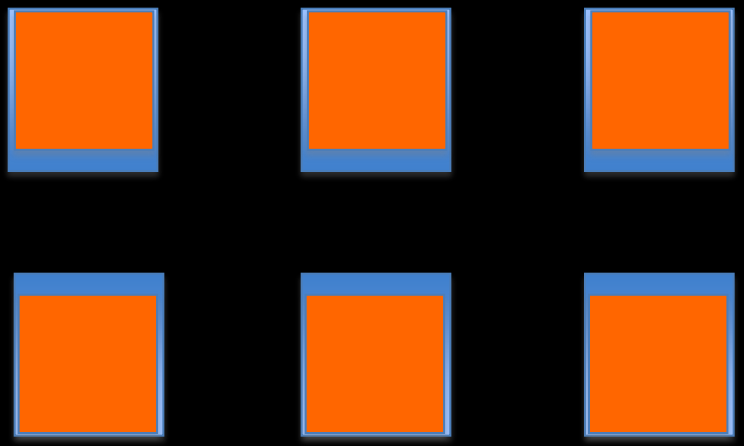
GridPix: best tiling now

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 tracking TPCs
- for ILC TPC: no urgency to minimize dead regions



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



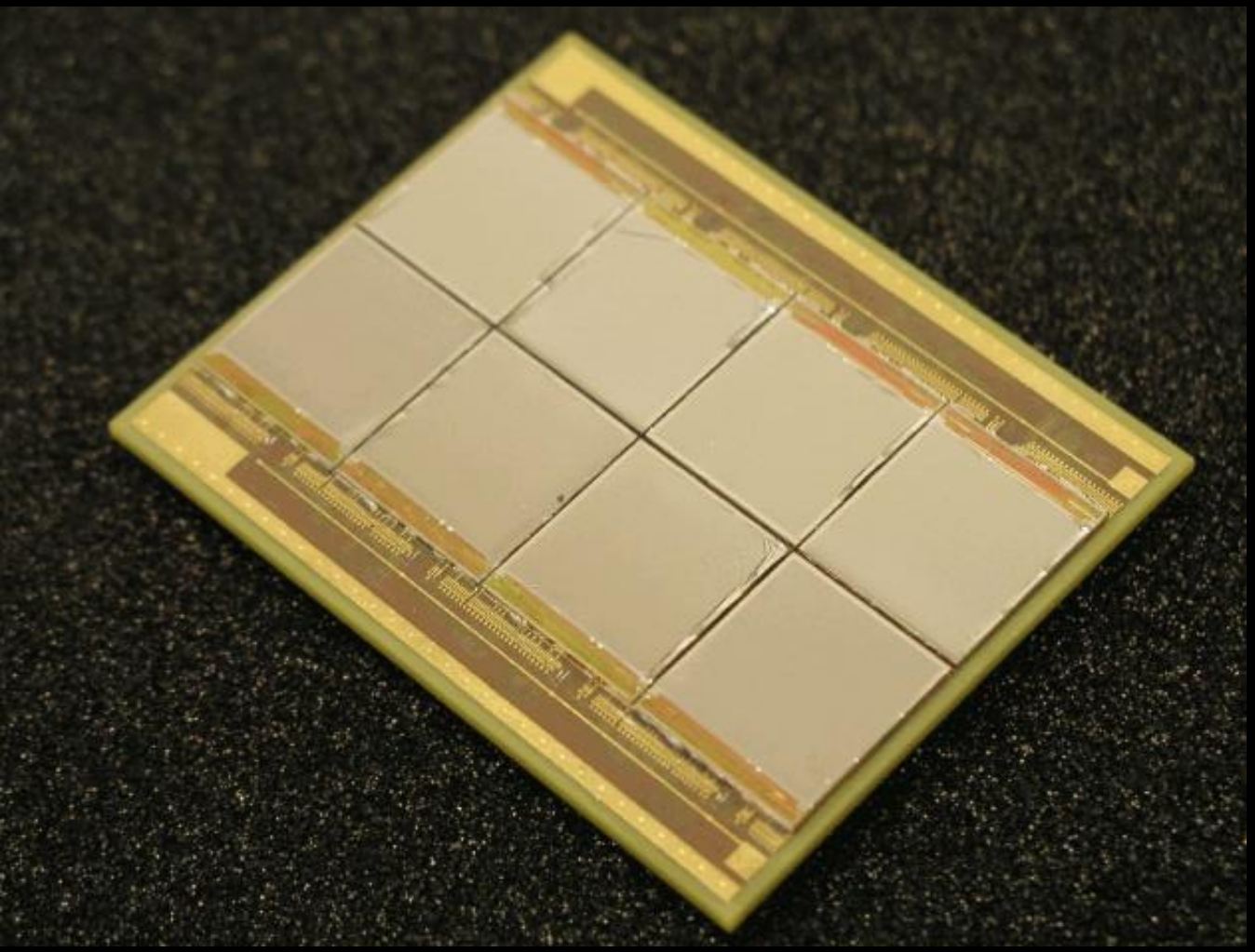
Strong focusing

-cover only 25 of fiducial surface with active pixel chip

- saves $$
- saves power, thus cooling, thus radiation length

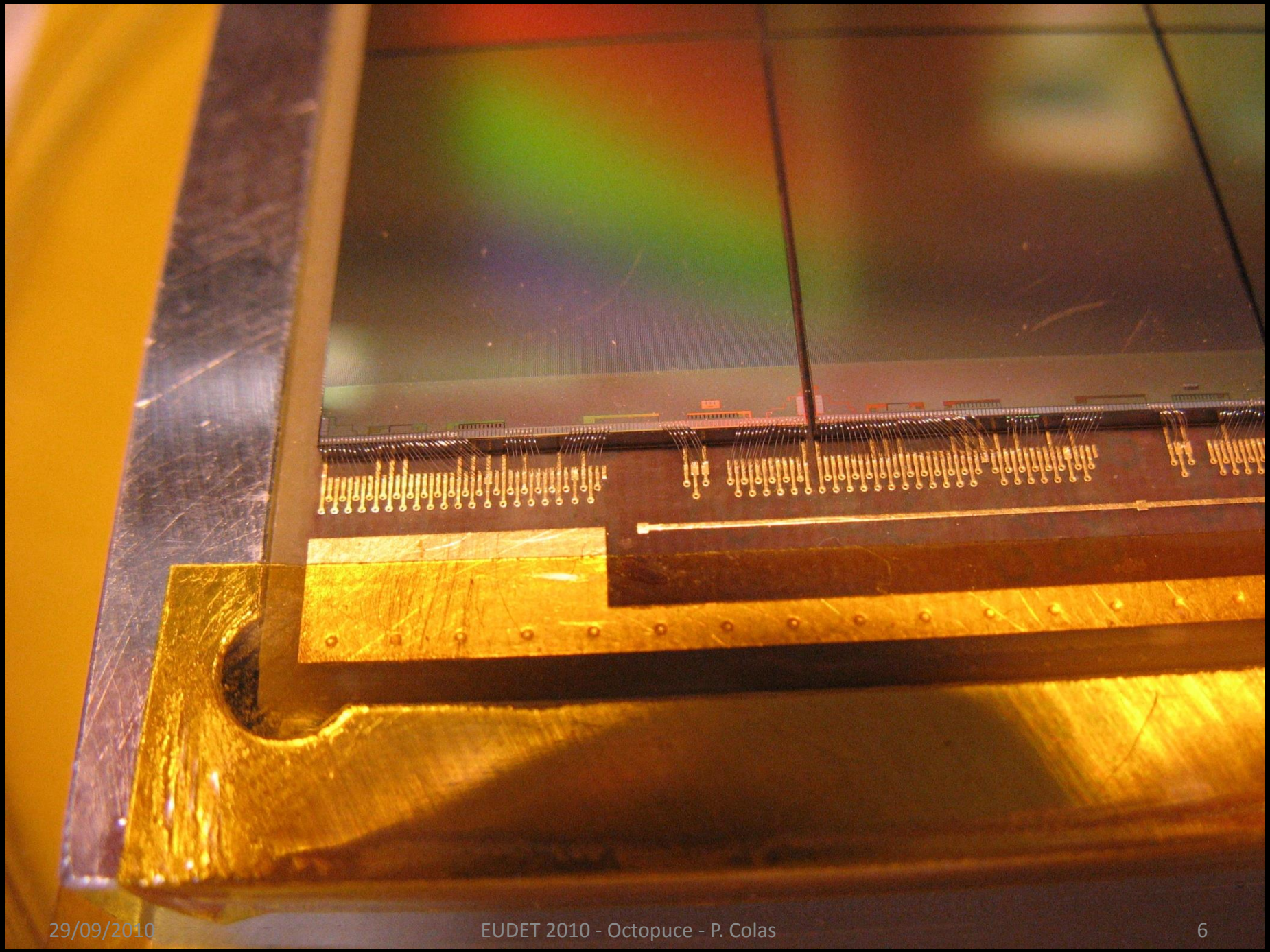
But: larger effective pixel pitch (256 x 256 pixels @ 55 µm x 55 µm)
➔110 µm x 110 µm

Moore'sLaw: smaller pixels in future

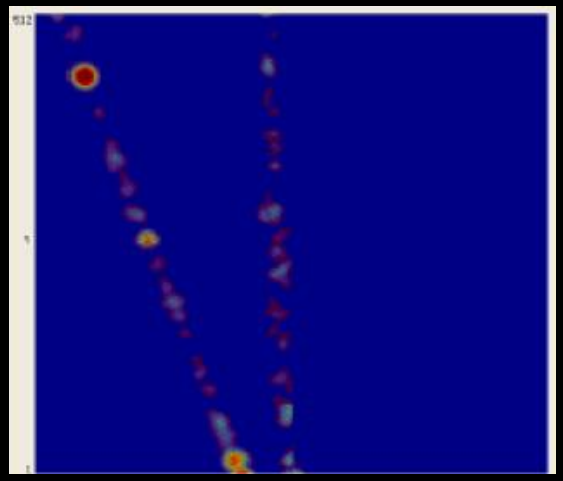


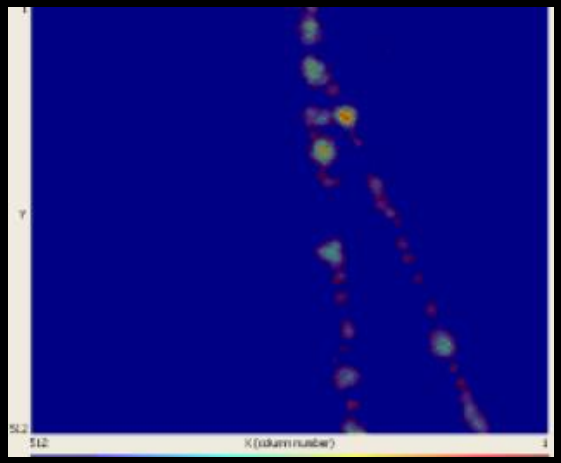
Octopuce: attempt to minimize dead regions

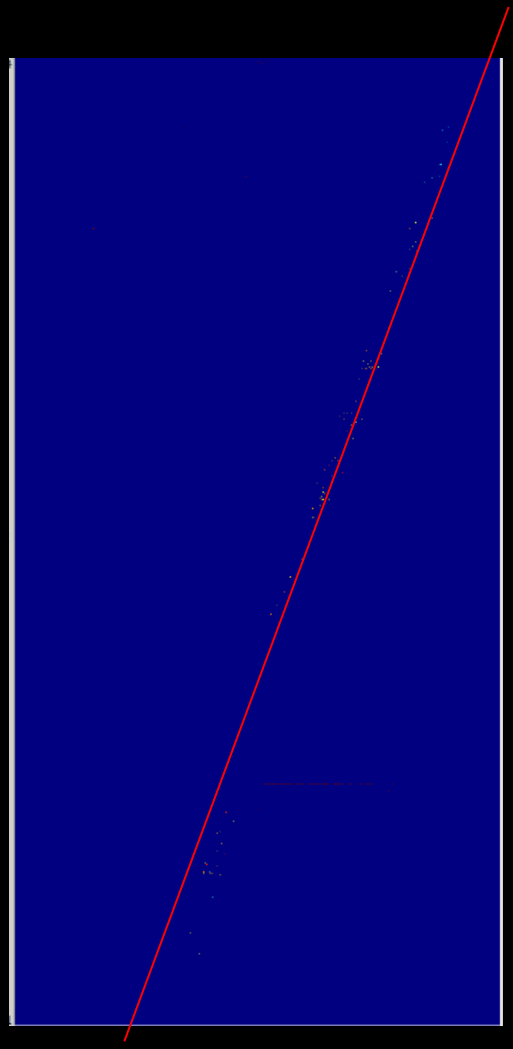
- very hard to exchange broken chips
- yield: skip GridPix dicing



Octopuce

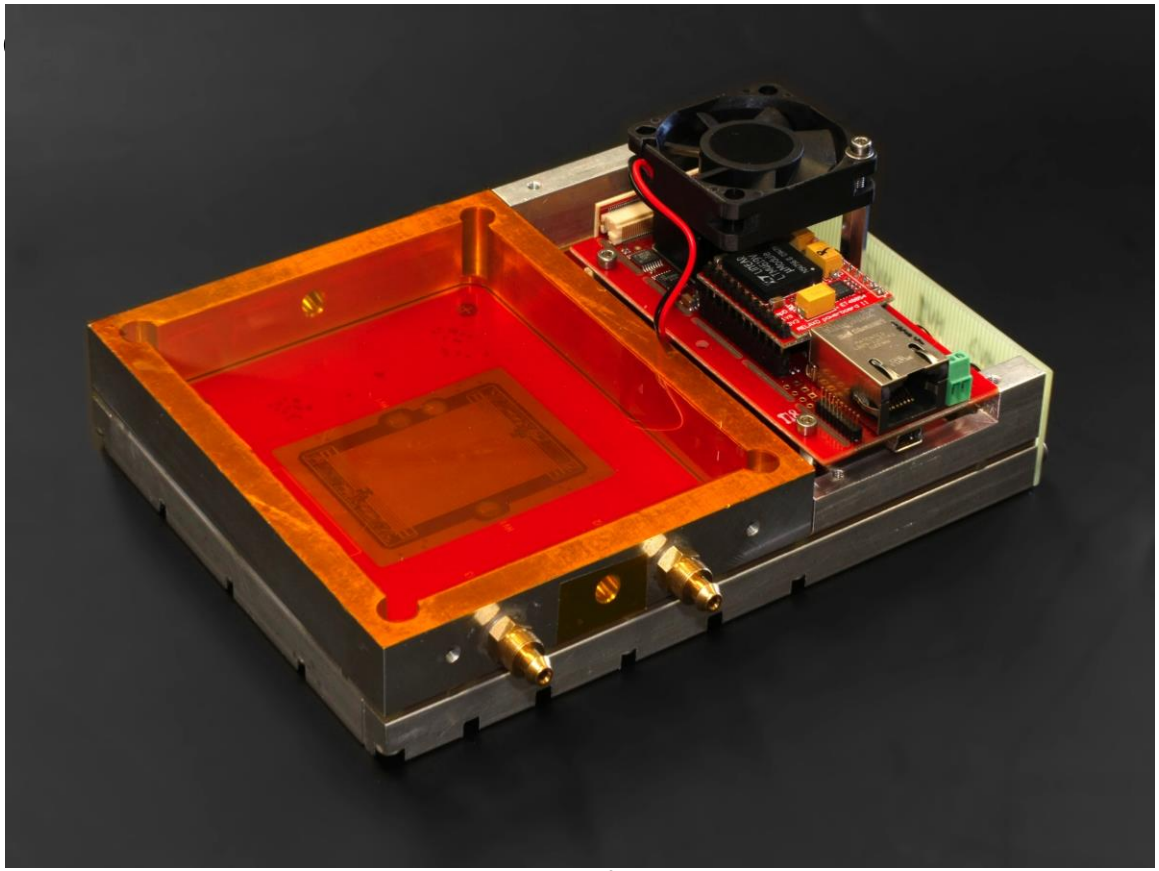




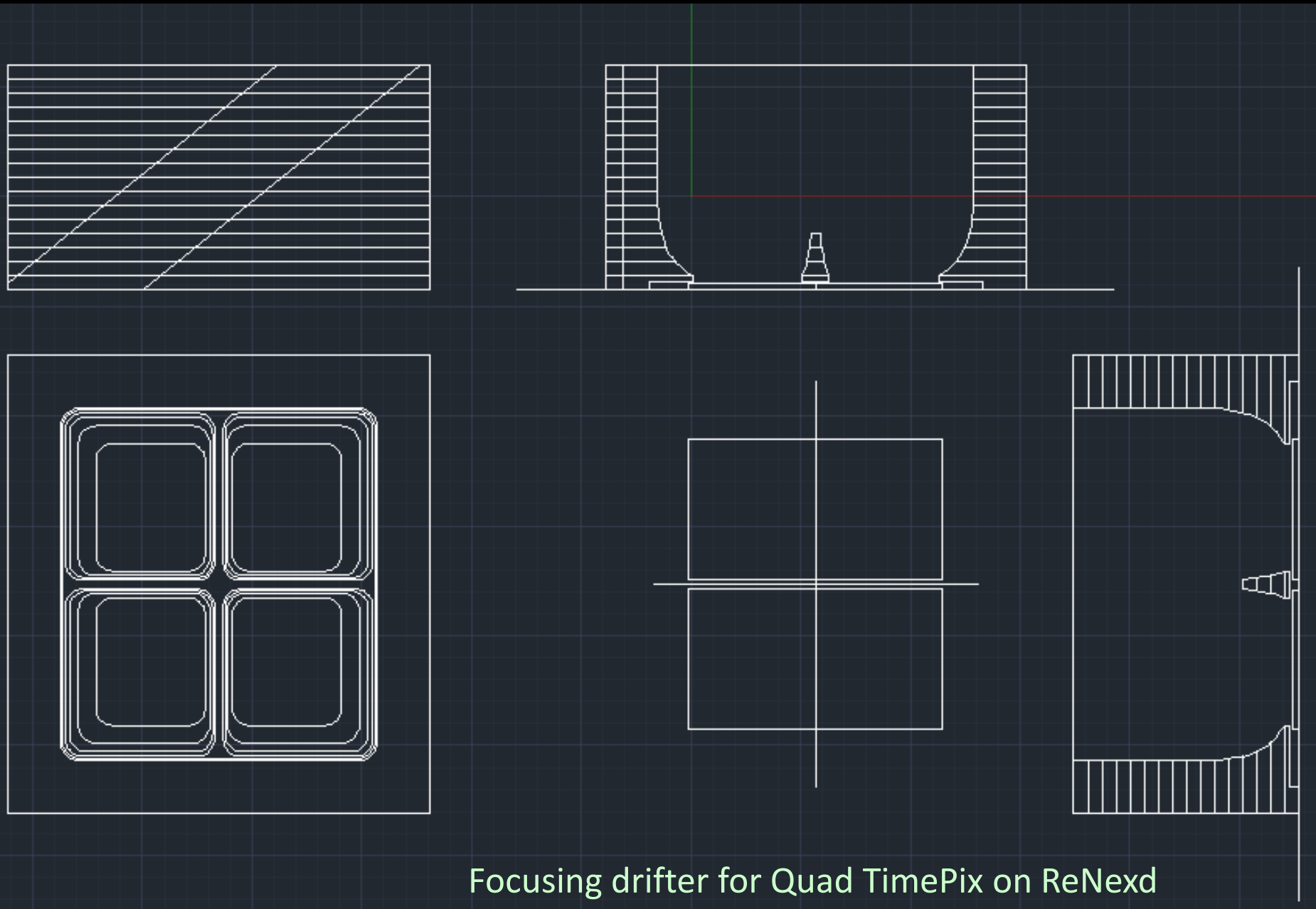


Renext: relaxd for gaseous detectors

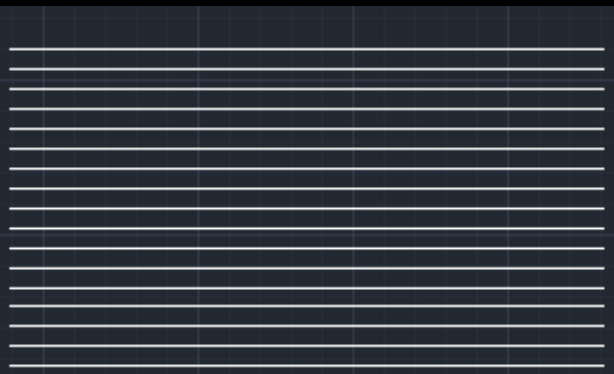
- Quad timepix carrier board for gaseous detectors
- Provides gas enclosure
- Relaxd read

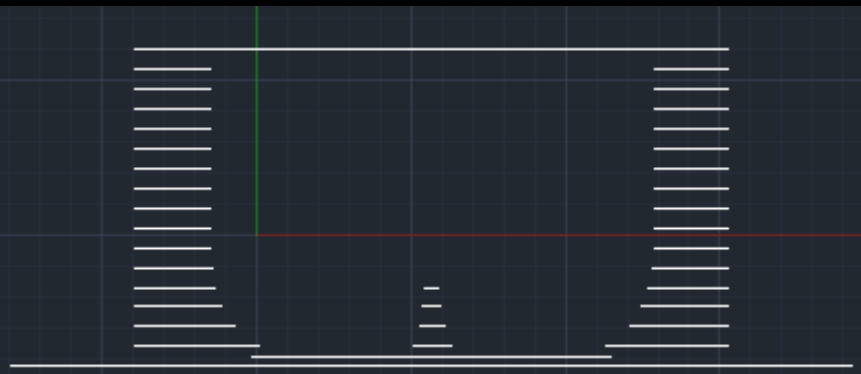


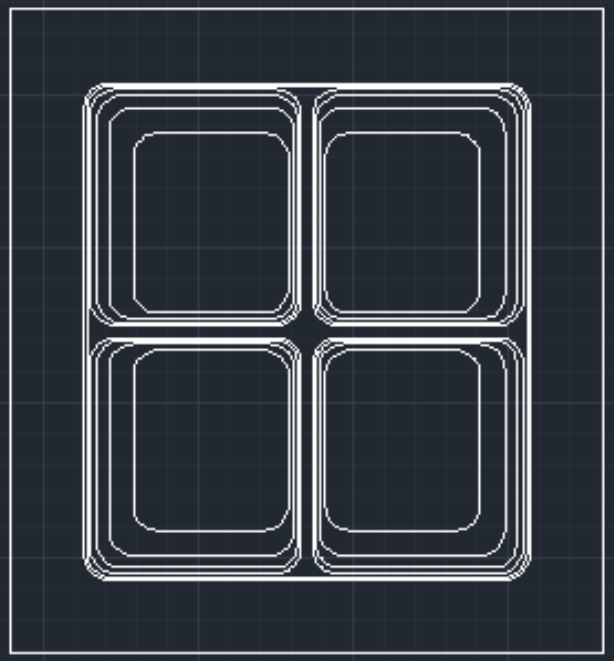

cathode foil
field cage
guard electrode

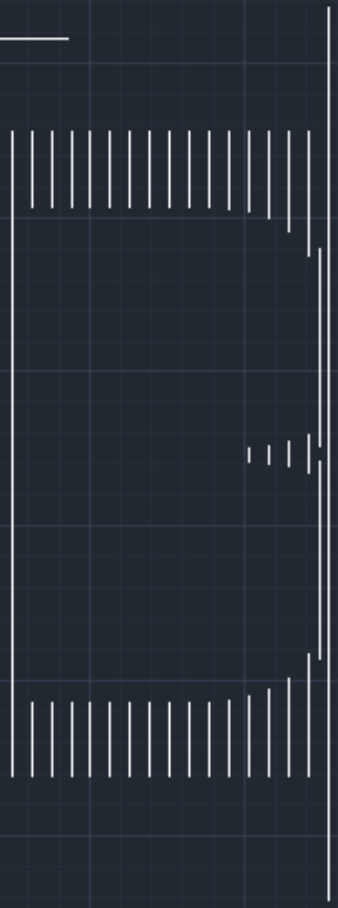


Focusing drifter for Quad TimePix on ReNexd



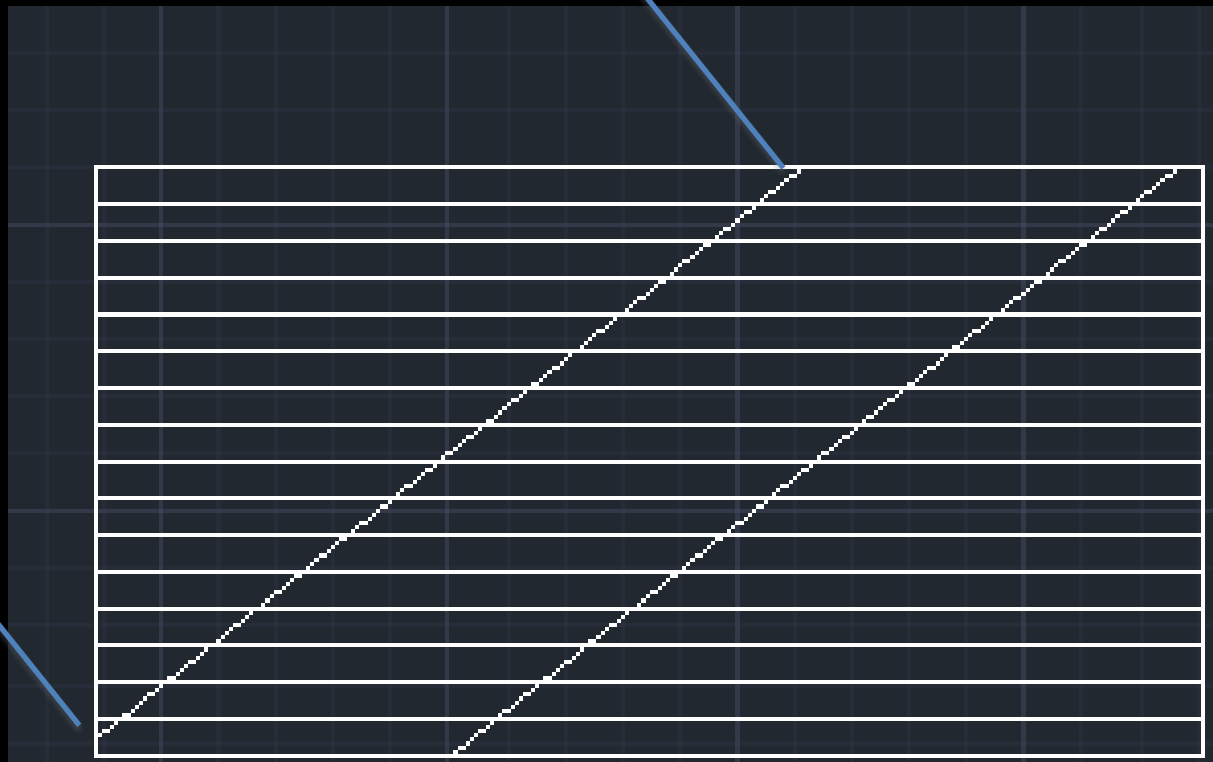


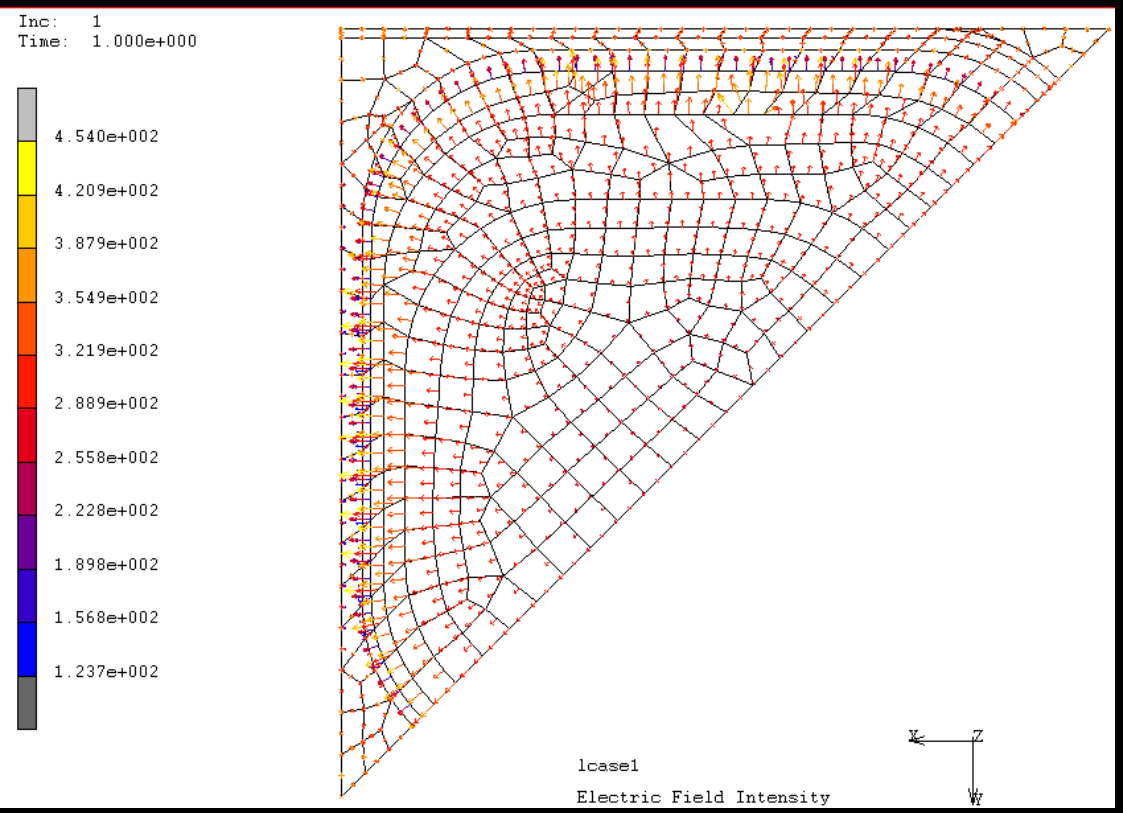




Extract copper pattern for 3D field calculations

Flat Cable with 16 leads: external potential settings

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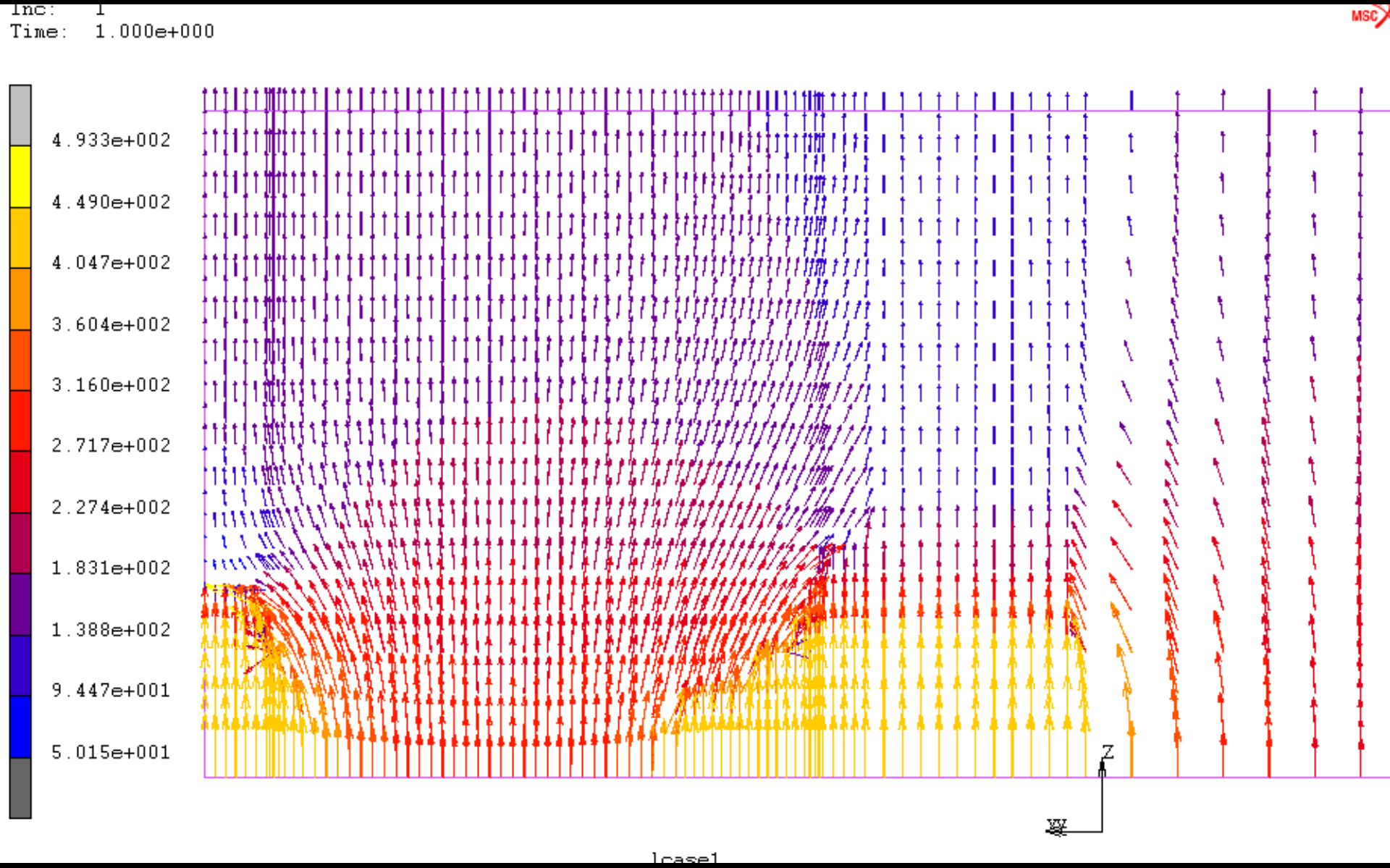
Time: 1.000e+000
4.540e+002
4.209e+002
3.879e+002
3.549e+002
3.219e+002
2.889e+002
2.558e+002
2.228e+002
1.898e+002
1.568e+002
1.237e+002
lcase1
Electric Field Intensity
X
Z
Y


Inc: 1
Time: 1.000e+000
4.933e+002
4.490e+002
4.047e+002
3.604e+002
3.160e+002
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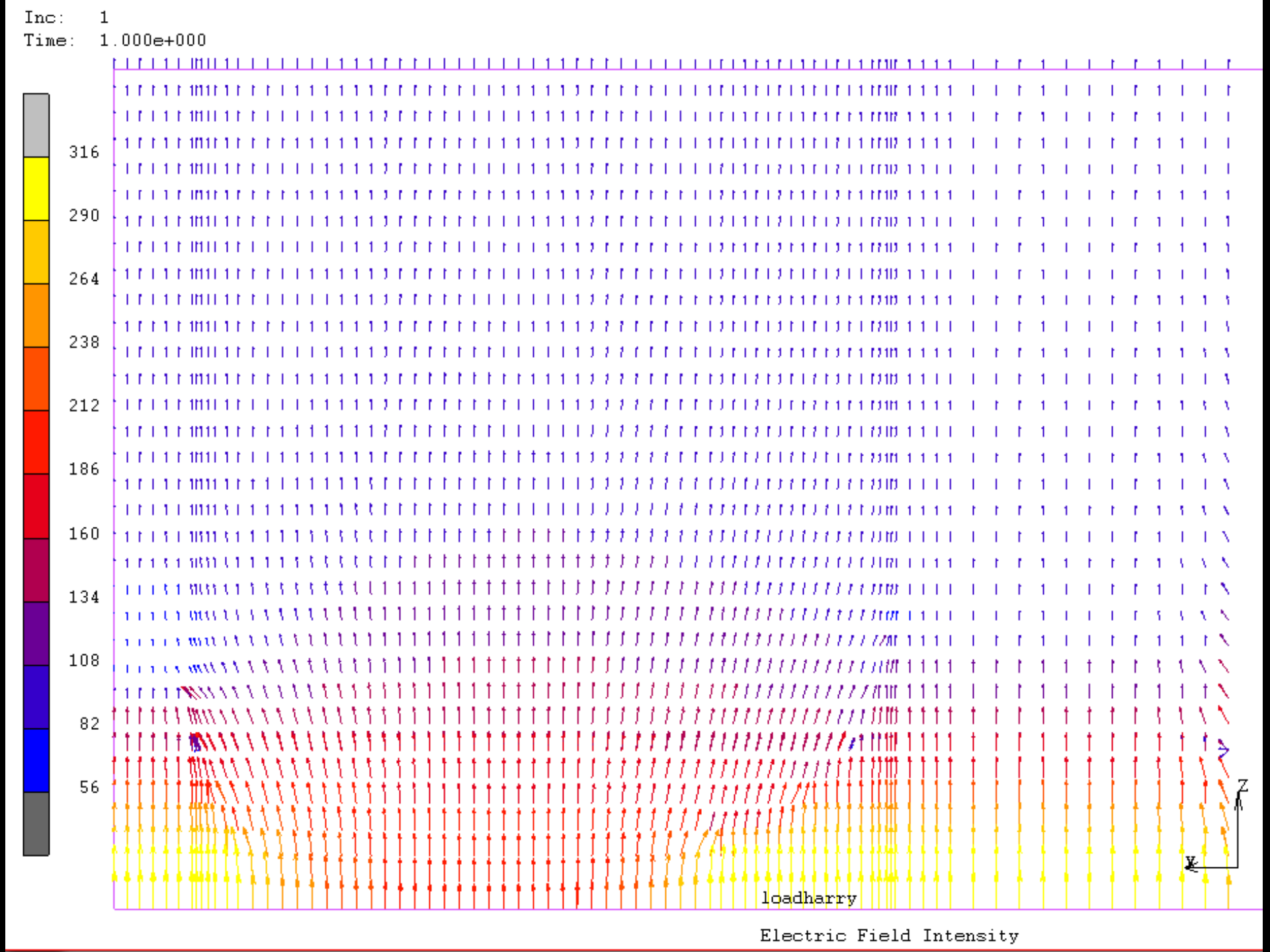
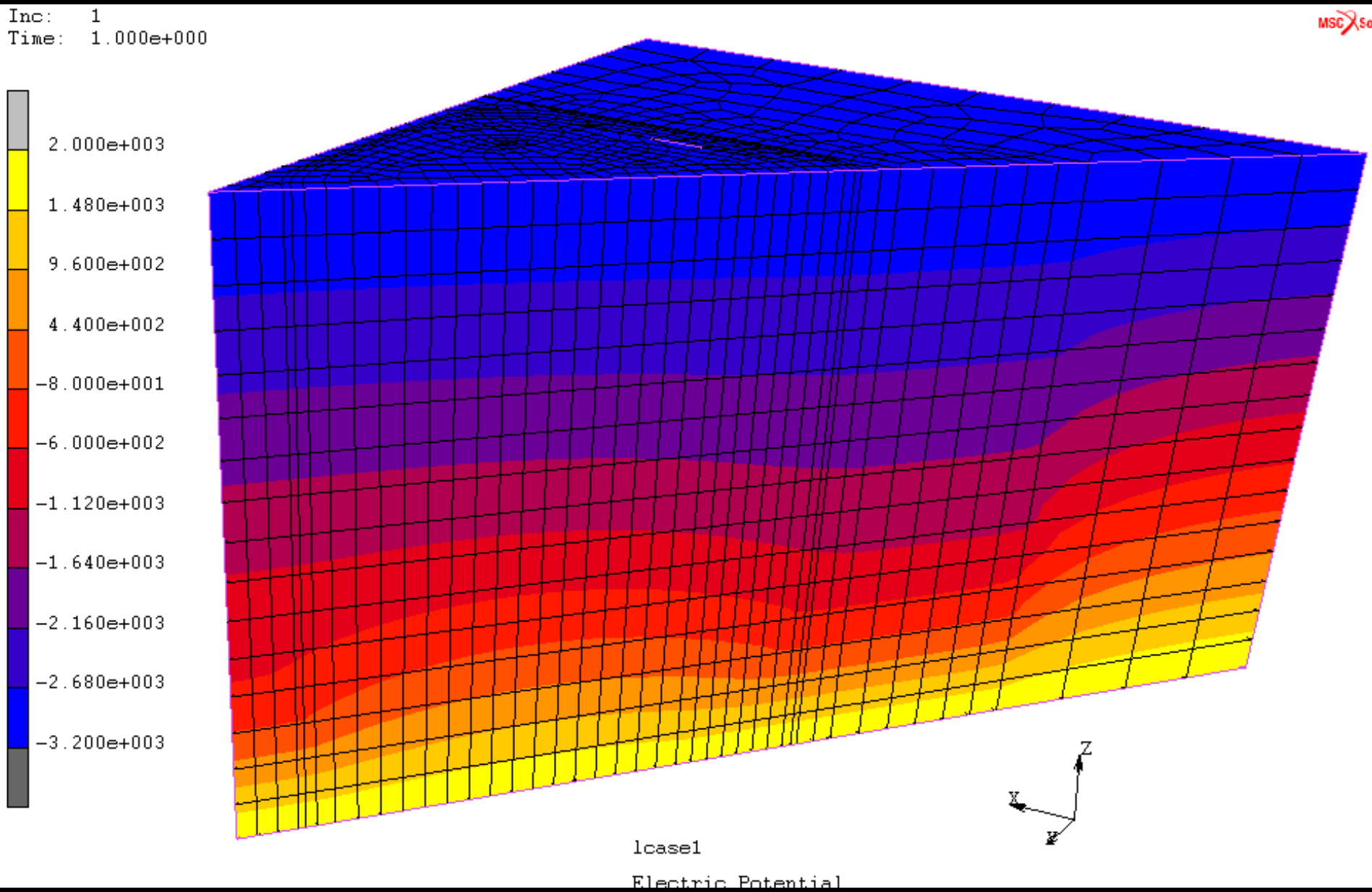
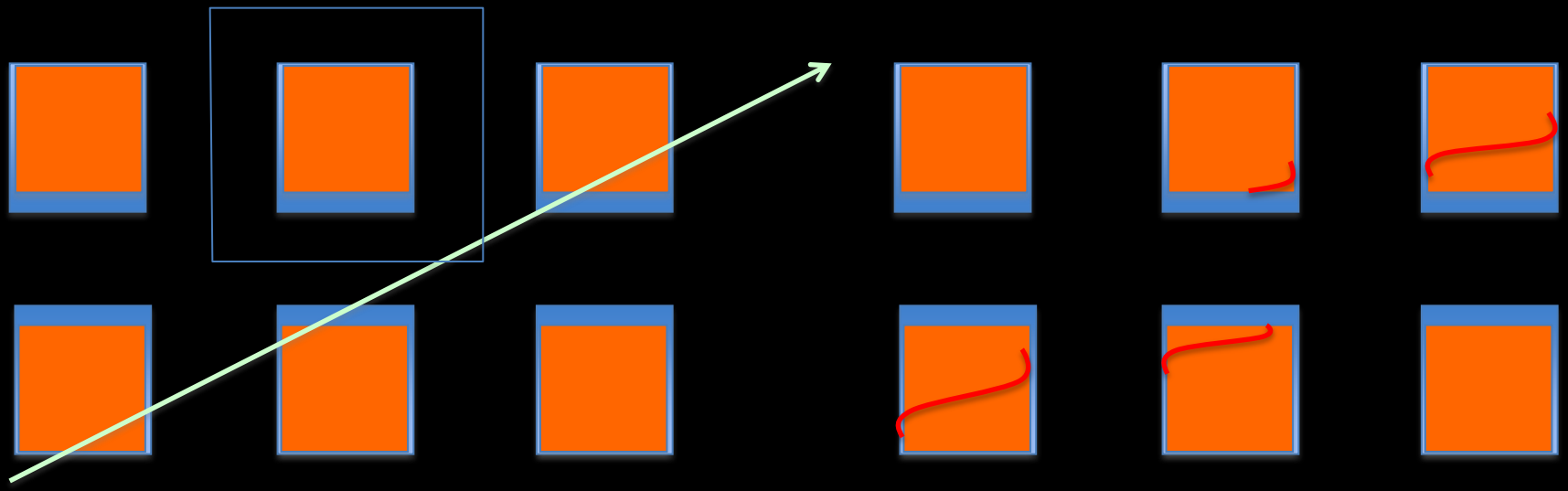
2.274e+002
1.831e+002
1.388e+002
9.447e+001
5.015e+001
Z
lcase1


Inc: 1
Time: 1.000e+000
316
290
264
238
212
186
160
134
108
82
56
Z
Y
loadharry
Electric Field Intensity


Inc: 1
Time: 1.000e+000
2.000e+003
1.480e+003
9.600e+002
4.400e+002
-8.000e+001
-6.000e+002
-1.120e+003
-1.640e+003
-2.160e+003
-2.680e+003
-3.200e+003
Z
Y
X
lcase1
Electric Potential



Autocalibration

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

Basic correction: X' = C X, Y' = C Y
+ E x B effect

Performance

- requires knowledge of local vectors E, B
- effective pixel size related to electron diffusion
- E x B effect, allthough correctable, may worsen resolution

Plans

- Quad Focus Drifter under construction
- Testbeam @ DESY in August 2013
  - Data analysis, Monte Carlo simulation, correction procedure