Simulation of Track Distortion due to Inhomogeneity of Electric Field in Micromegas modules

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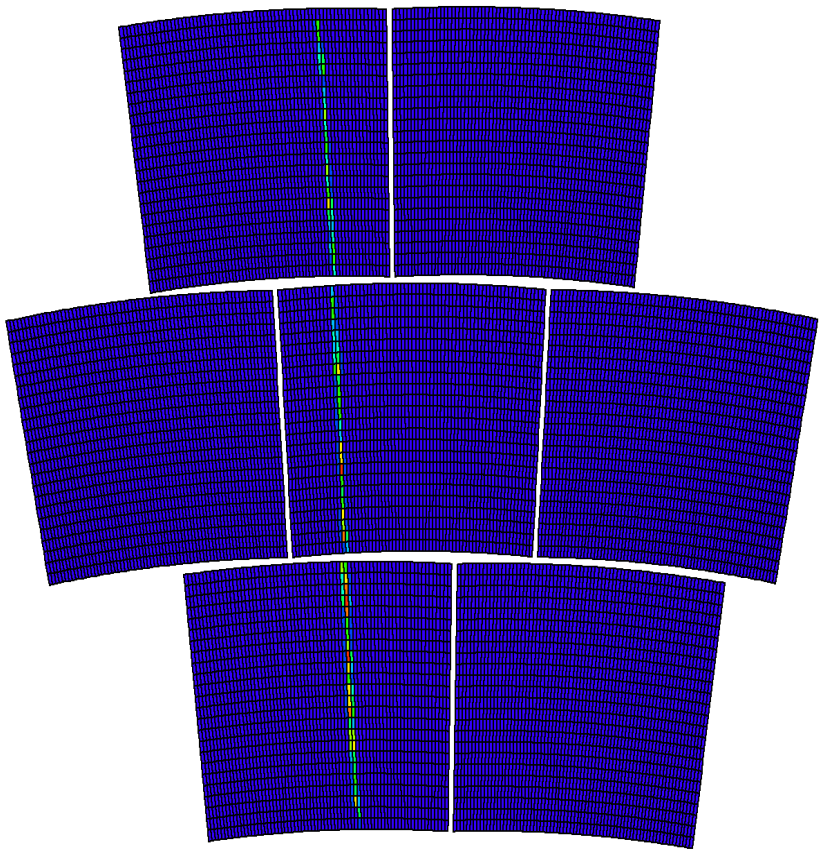
Motivation of the Study

- **Developing a better understanding on Distortion**
- **Understanding the mis-alignment.**
- **Exploring scope for improvement.**

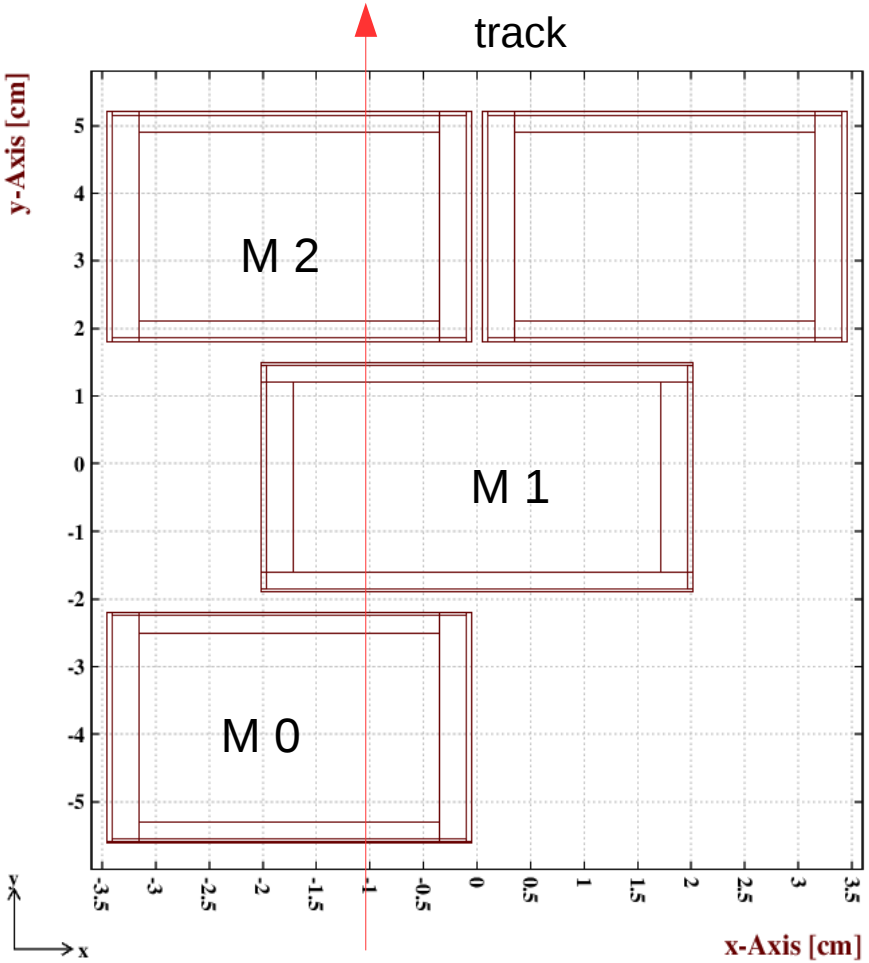
Simulation Tool:

- **Garfield Framework**
- **Field Solver → neBEM**
- **Gas Transport → Magboltz**
- **Primary Ionization → Heed**
- **Electron Drift → Monte Carlo**

The module arrangement



Micromegas modules
on the **LPTPC endplate.**

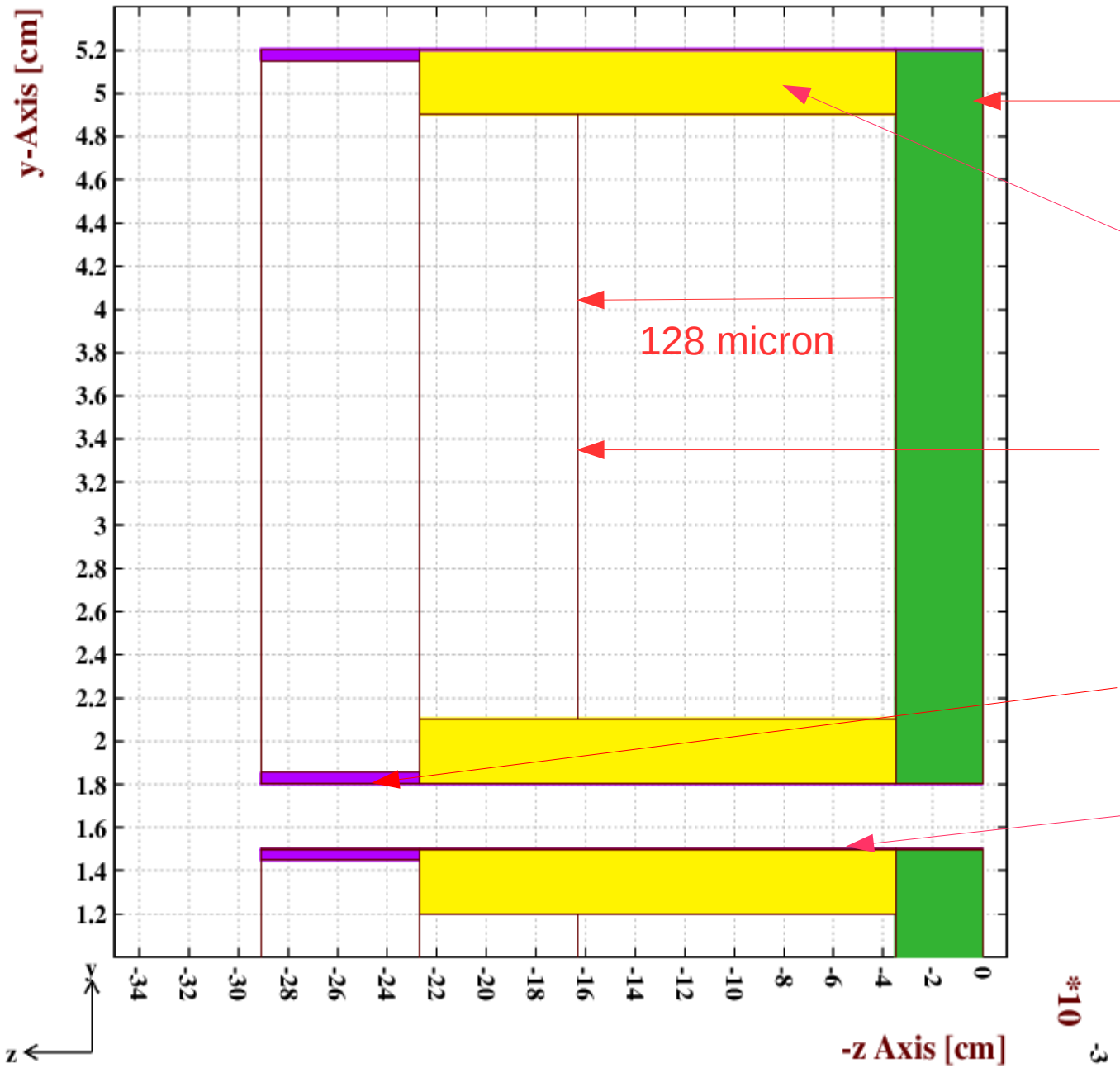


The **simulated** Micromegas modules

Module size:
17 cm × 22 cm.
reference frame is
in r-phi system.

Module size:
3.4 cm × 3.4 cm.
reference frame is
Cartesian.

The geometry of the modules



Anode/ground/10 micron

Dielectric/3 mm

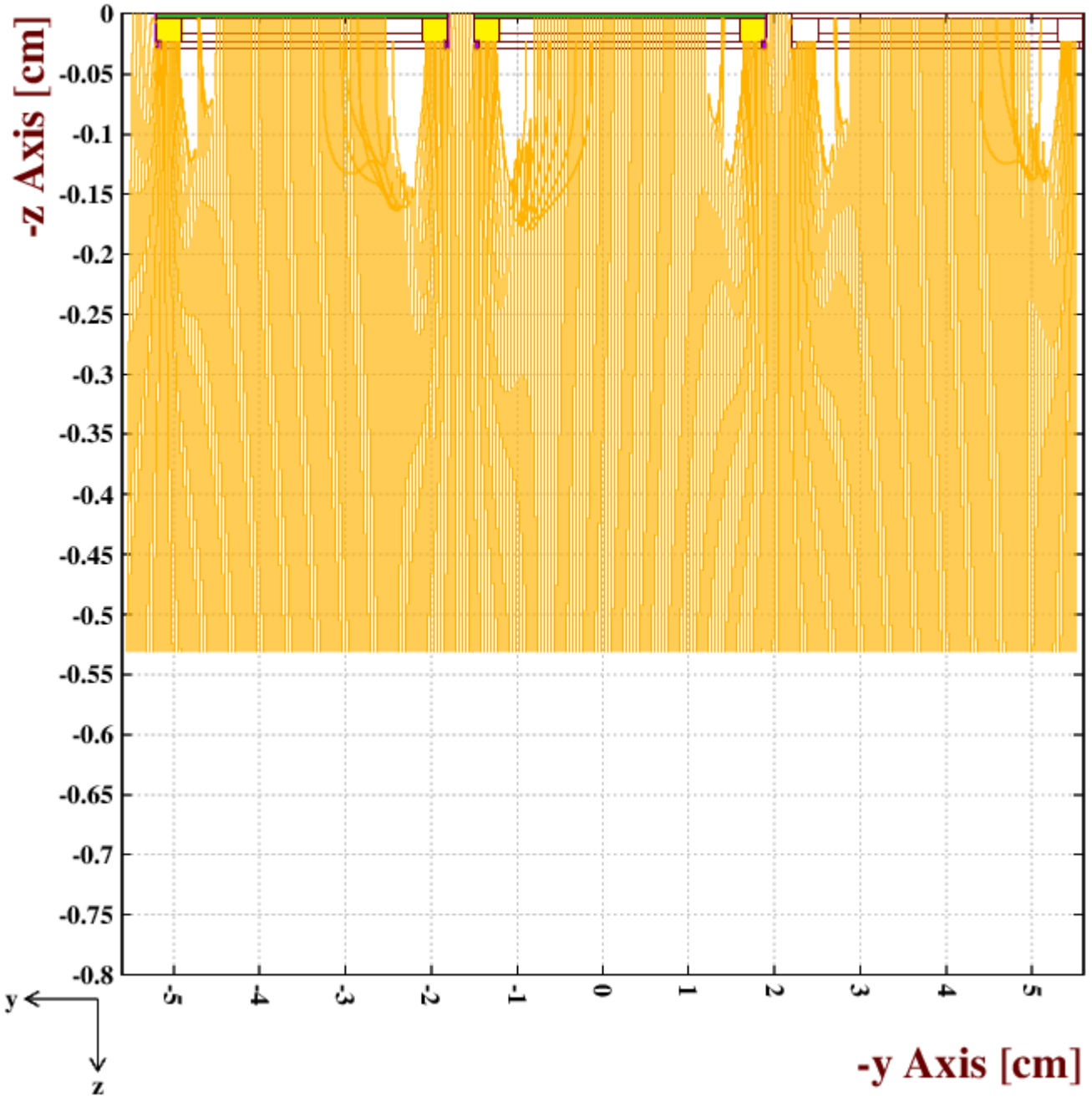
Zero thickness Mesh/(-350V)

Ground/copper/500 micron

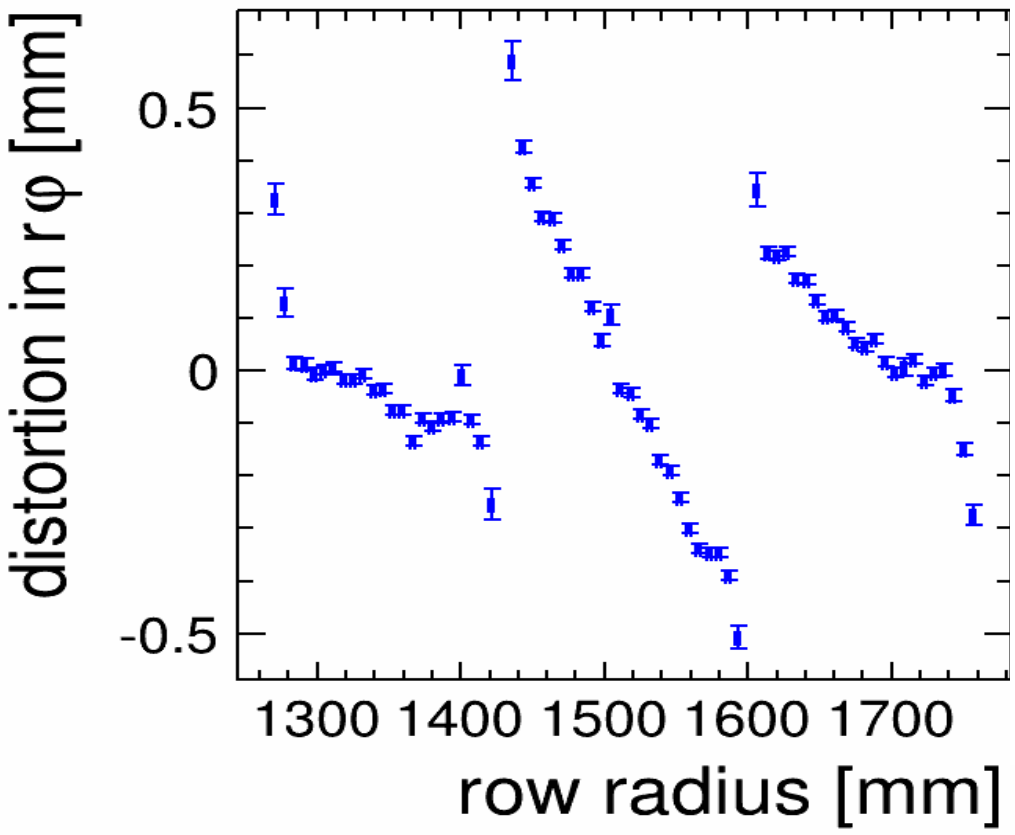
Ground /metal/30 micron

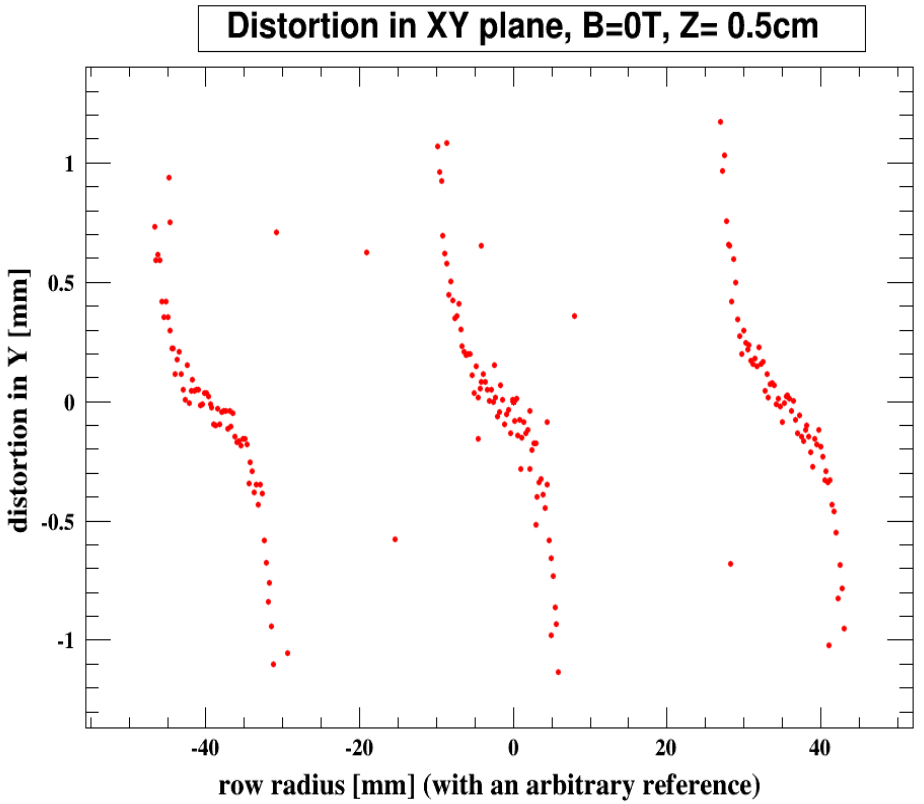
Cathode is at (-600V)
(not shown here)

Drift of electrons (Monte Carlo) at B = 1 T.



Distortion comparison at B = 0 T

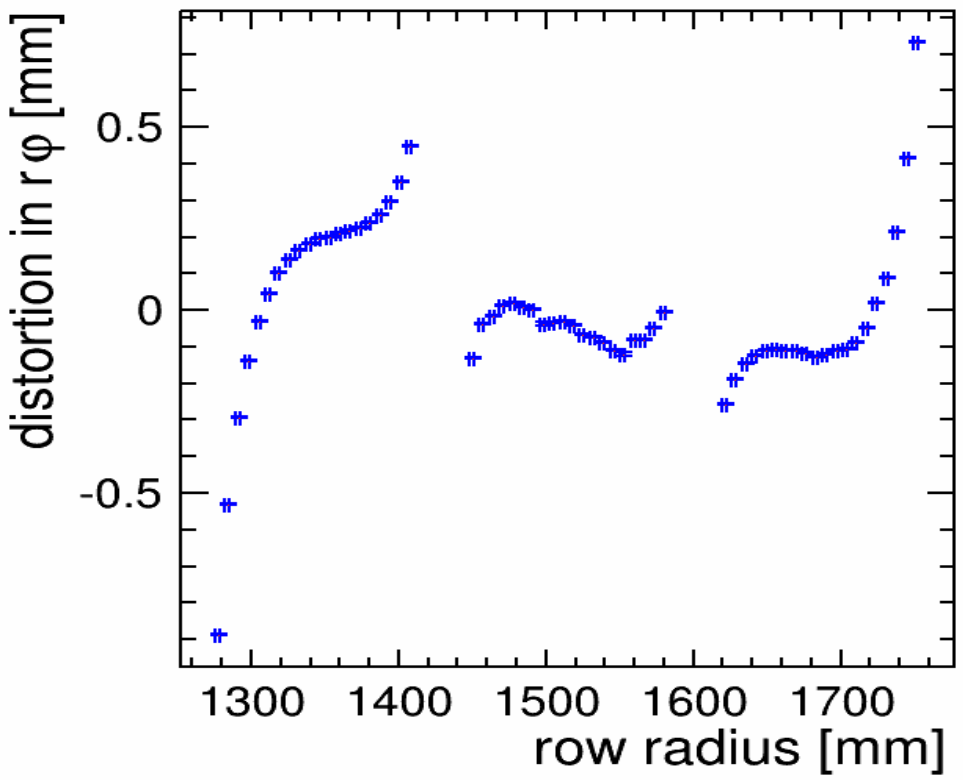


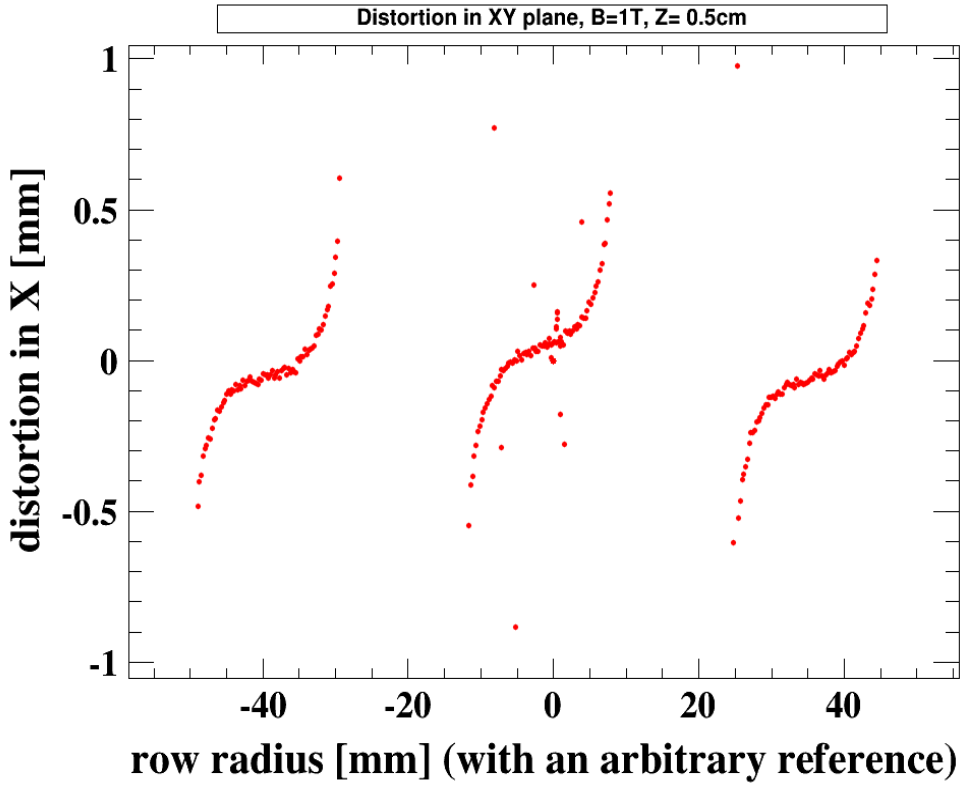


Experimental observation (Thesis W. Wang)

Observation from Simulation

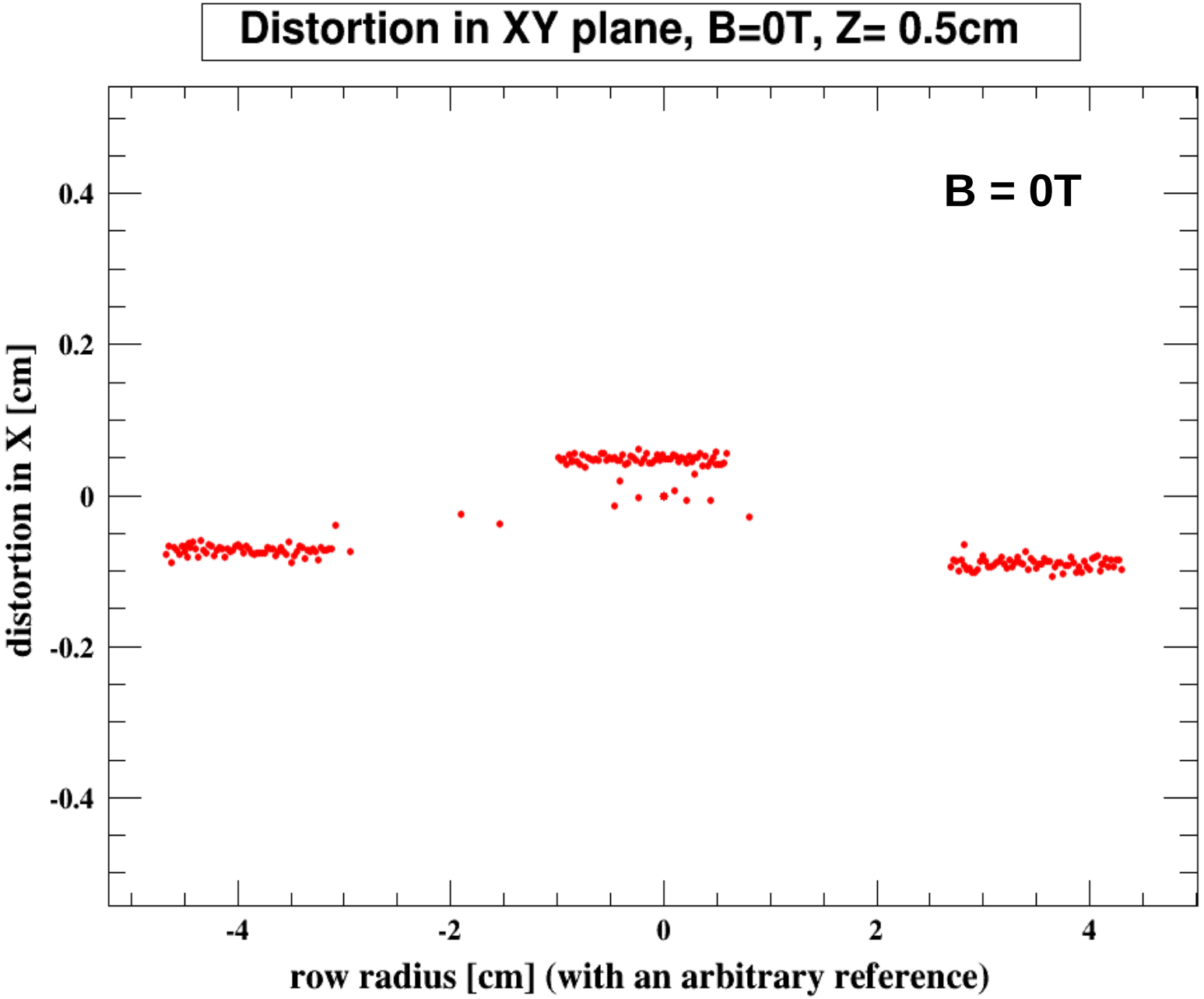
Comparison of Distortion at B = 1 T



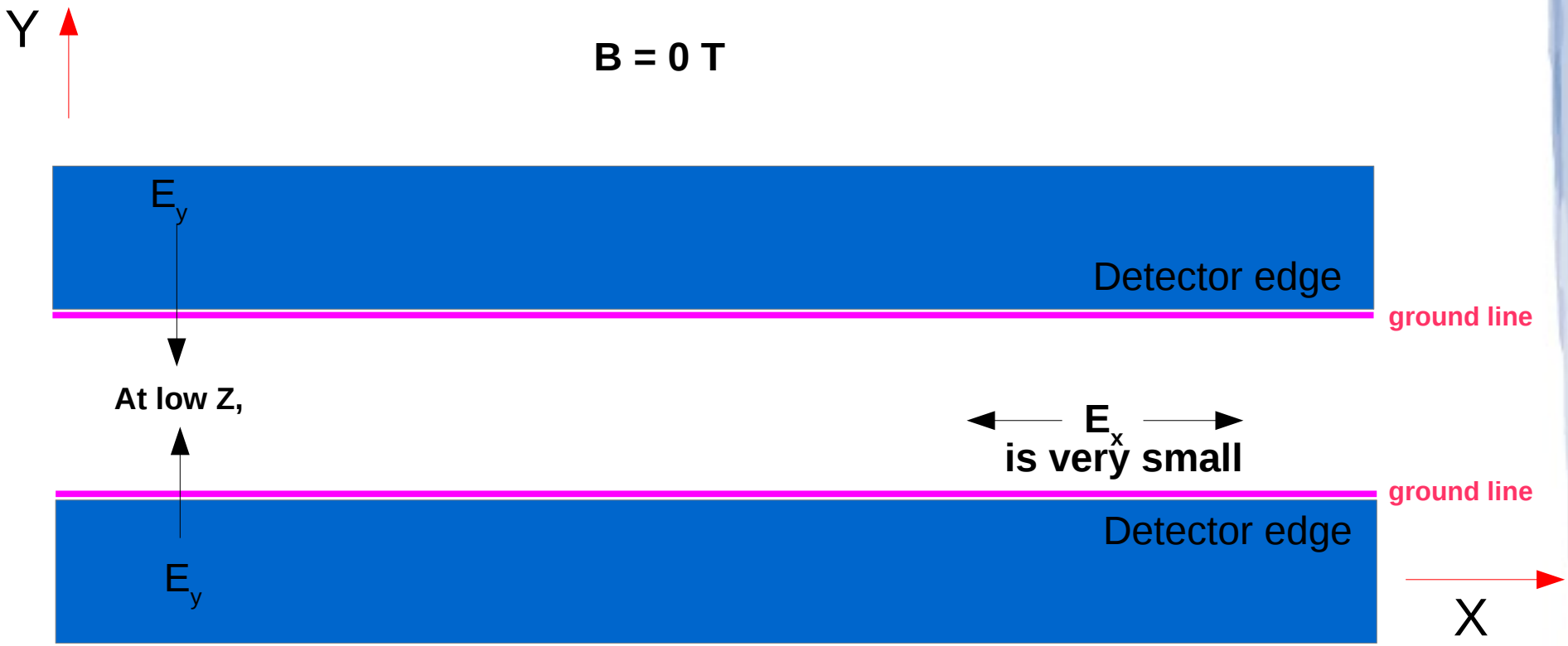


Experimental observation

Observation from Simulation

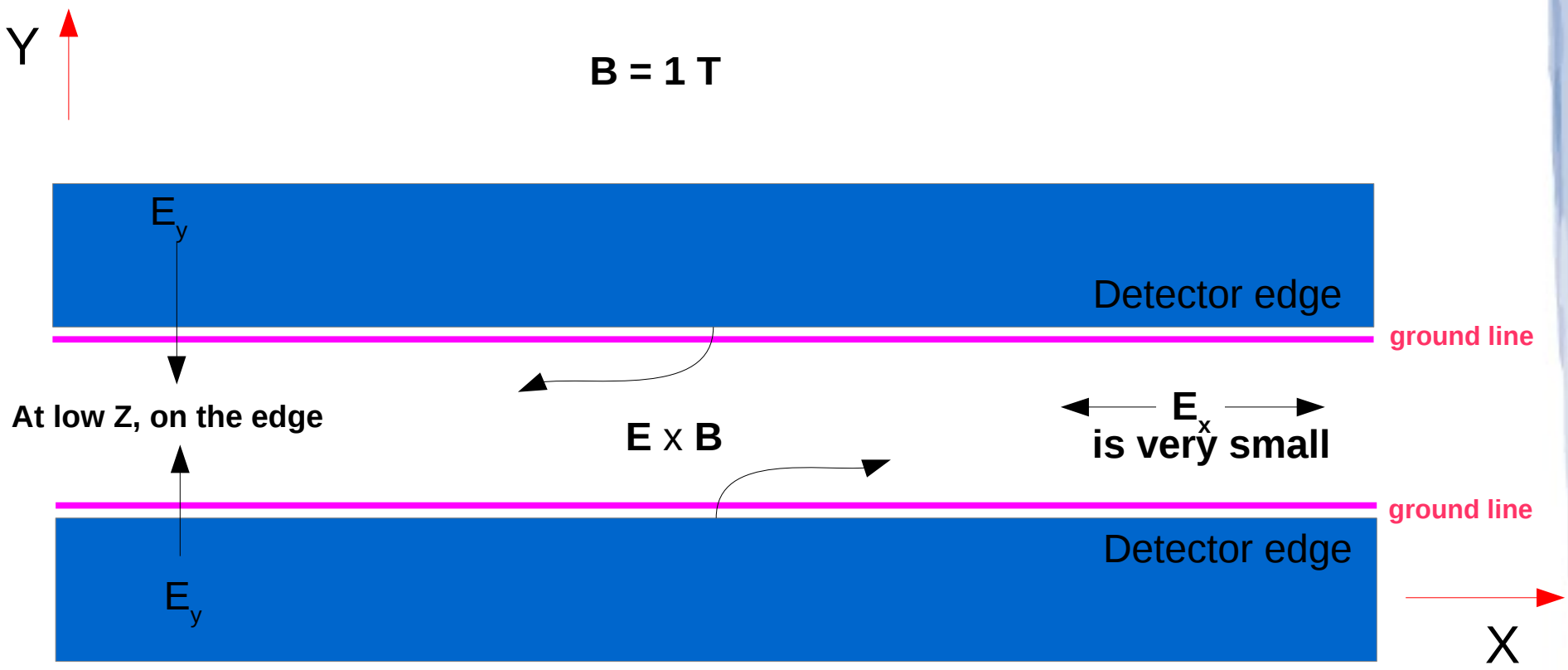

Distortion in XY plane, B=0T, Z= 0.5cm
B = 0T
distortion in X [cm]
0.4
0.2
0
-0.2
-0.4
-4
-2
0
2
4
row radius [cm] (with an arbitrary reference)

The detector edges on the left and on the right are far away



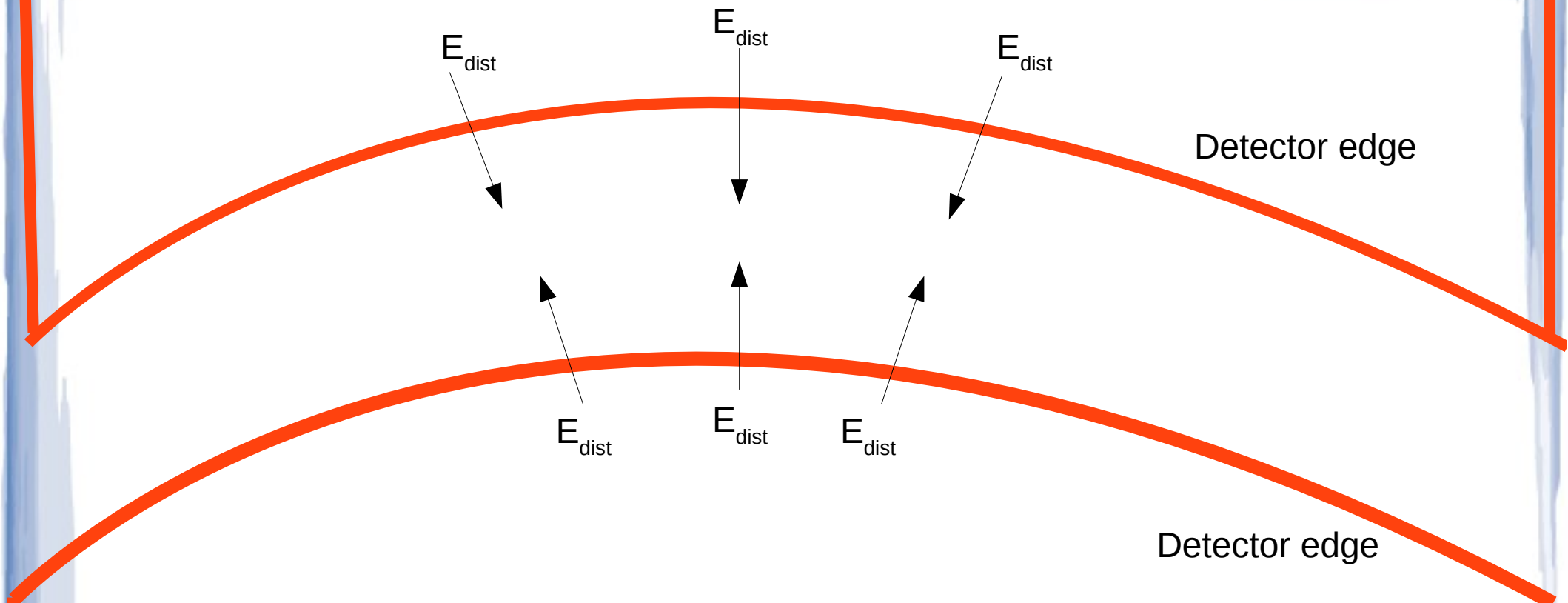
At the middle of the modules, E field is perpendicular to this plane

The detector edges on the left and on the right are far away

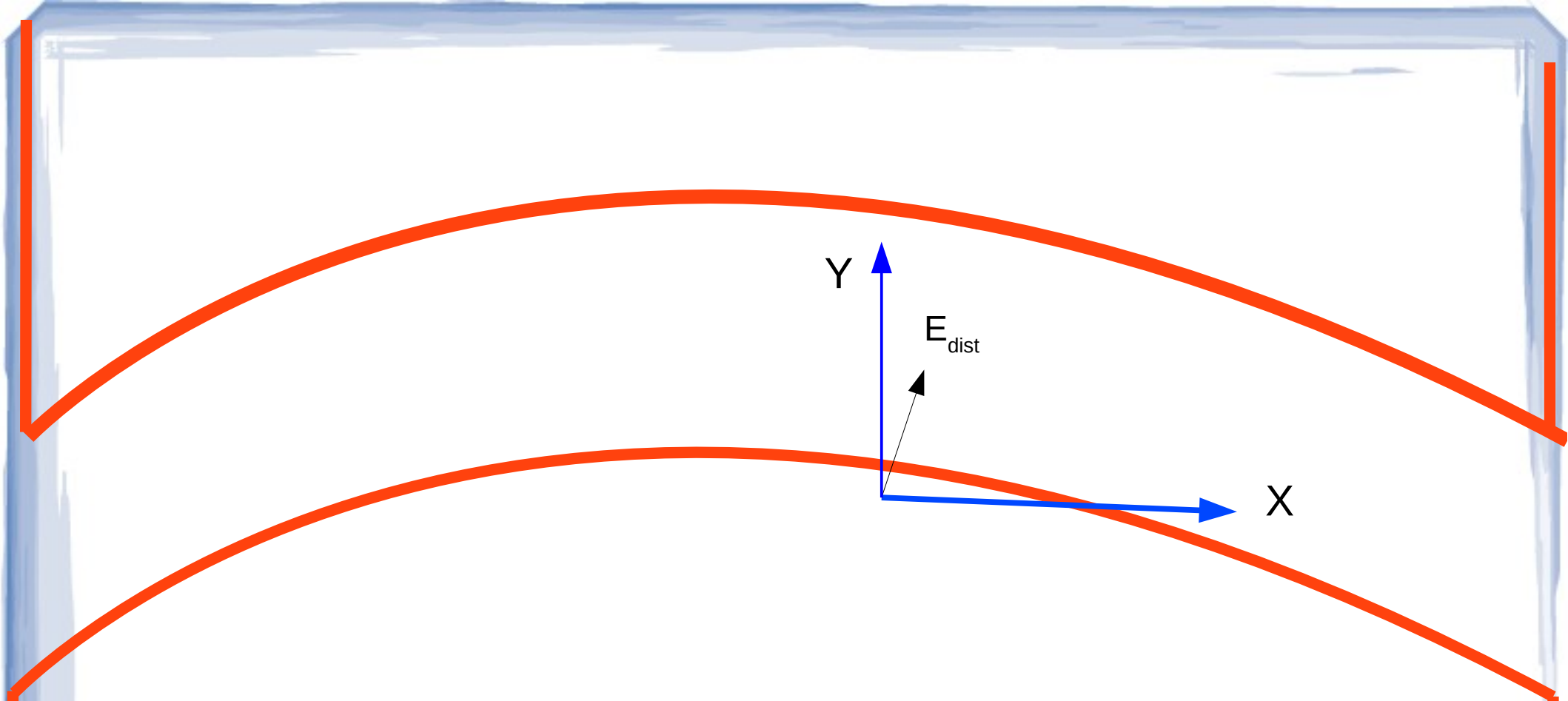


At the middle of the modules, E field and B field are perpendicular to this plane

For a Keystone shaped module



Because of the curve edge,
the distorted field components are distributed in 'phi' .



Due to the curve edge, there exist both Y and X component
Of (distorted) electric field.

Non zero E_x gives rise residuals in X at B = 0T.

System used:

(1) DELL Precision T7500 Work Station/12 cores/ 72 GB RAM.

(2)Xeon cluster @ 1.2 GHz/6 cores/ 16 GB RAM.

Thank You

Backup Slides

At the vicinity of the Module edges,

The three components of the Electric Fields are plotted in X, Y and Z