Simulation Results We Have

Shin-ichi Kawada
Hiroshima University

Current Status

1. Klaus Zenker's work
   - Simulation for distortion: module boundary and electrode gap
   - Track angle dependency of distortion
   - A slide for Asian GEM module can be found at ---> http://www.desy.de/~zenker/talks/asian_module.pdf
2. Philippe Gros's work
   - Simulation for gate

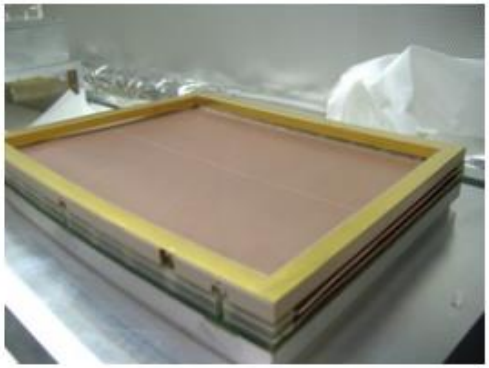
Klaus's work: Simulation Tools

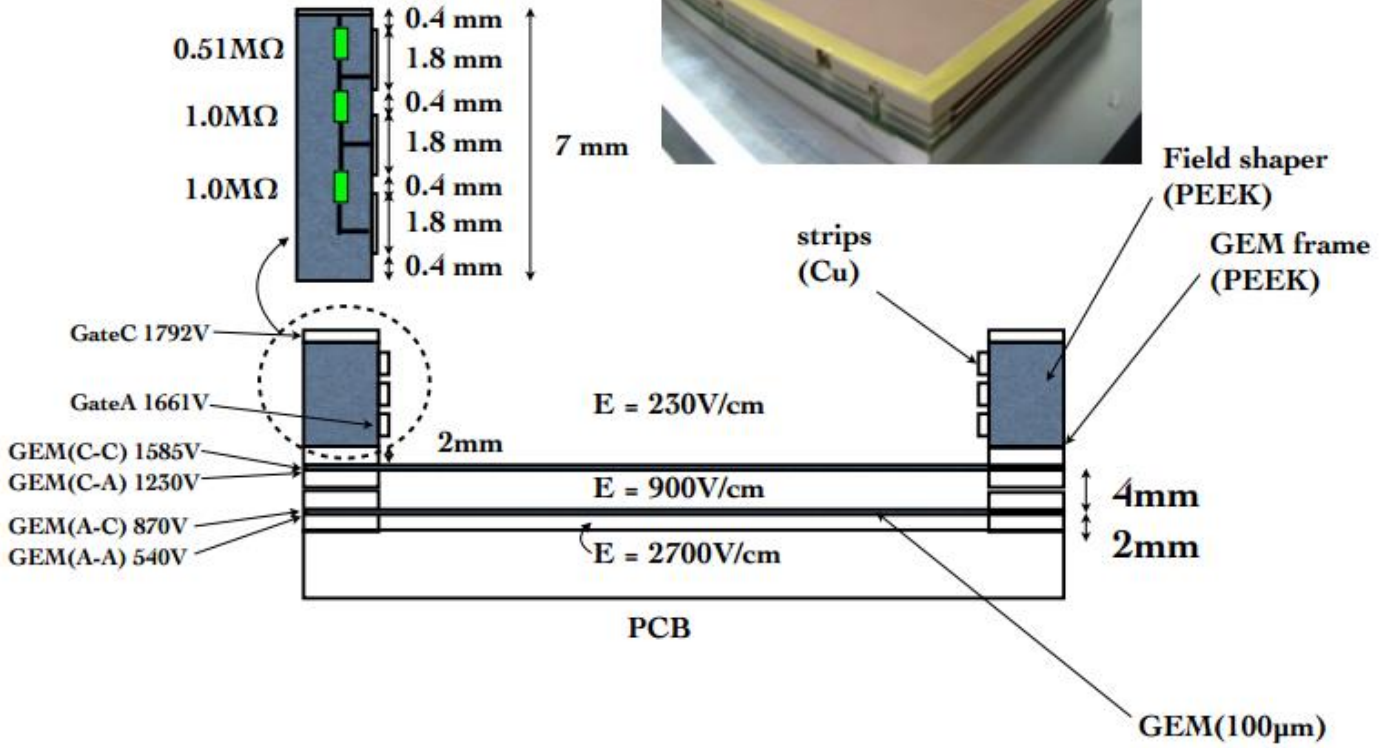
- Simulation with CST™ and GARFIELD++
  - CST™: finite element based program, for field simulations
  - GARFIELD++: detailed simulation of particle detectors

Setup for Simulation

Sketch of the Asian module (by Ryo)

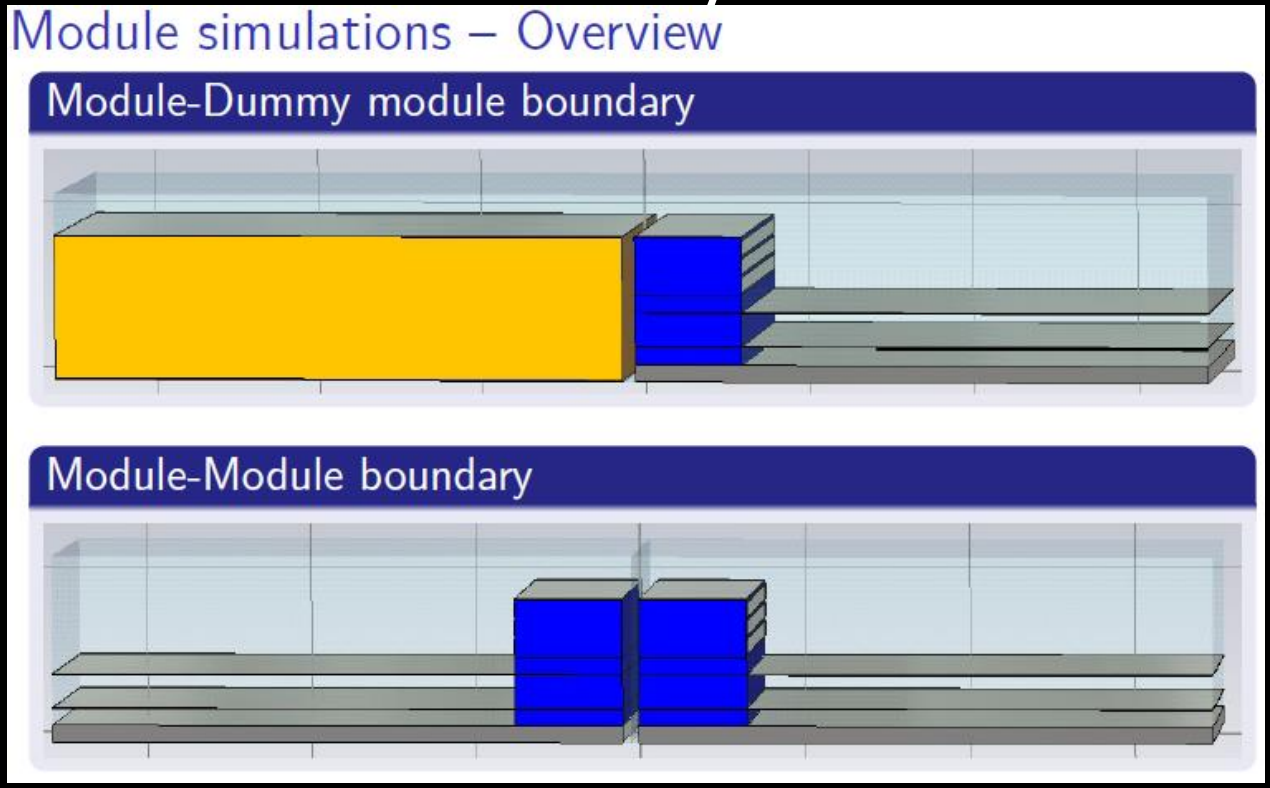
PEEK width is set to 13 mm.





Module Boundary Simulation

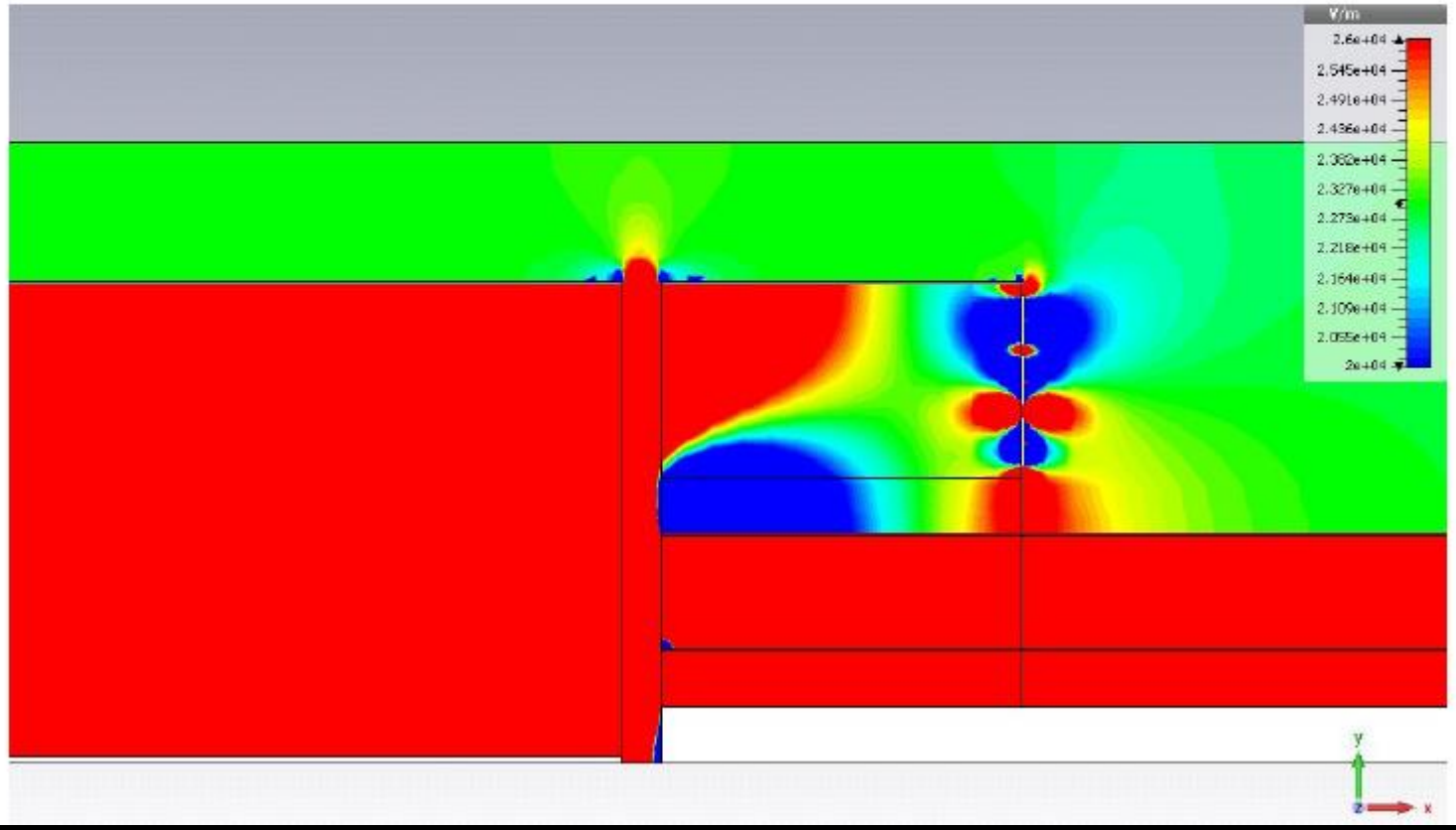
- Dummy module - Module boundary effect
- Module - Module boundary effect
- GEM electrode boundary effect



Dummy Module - Module Boundary

Dummy module – Module boundary

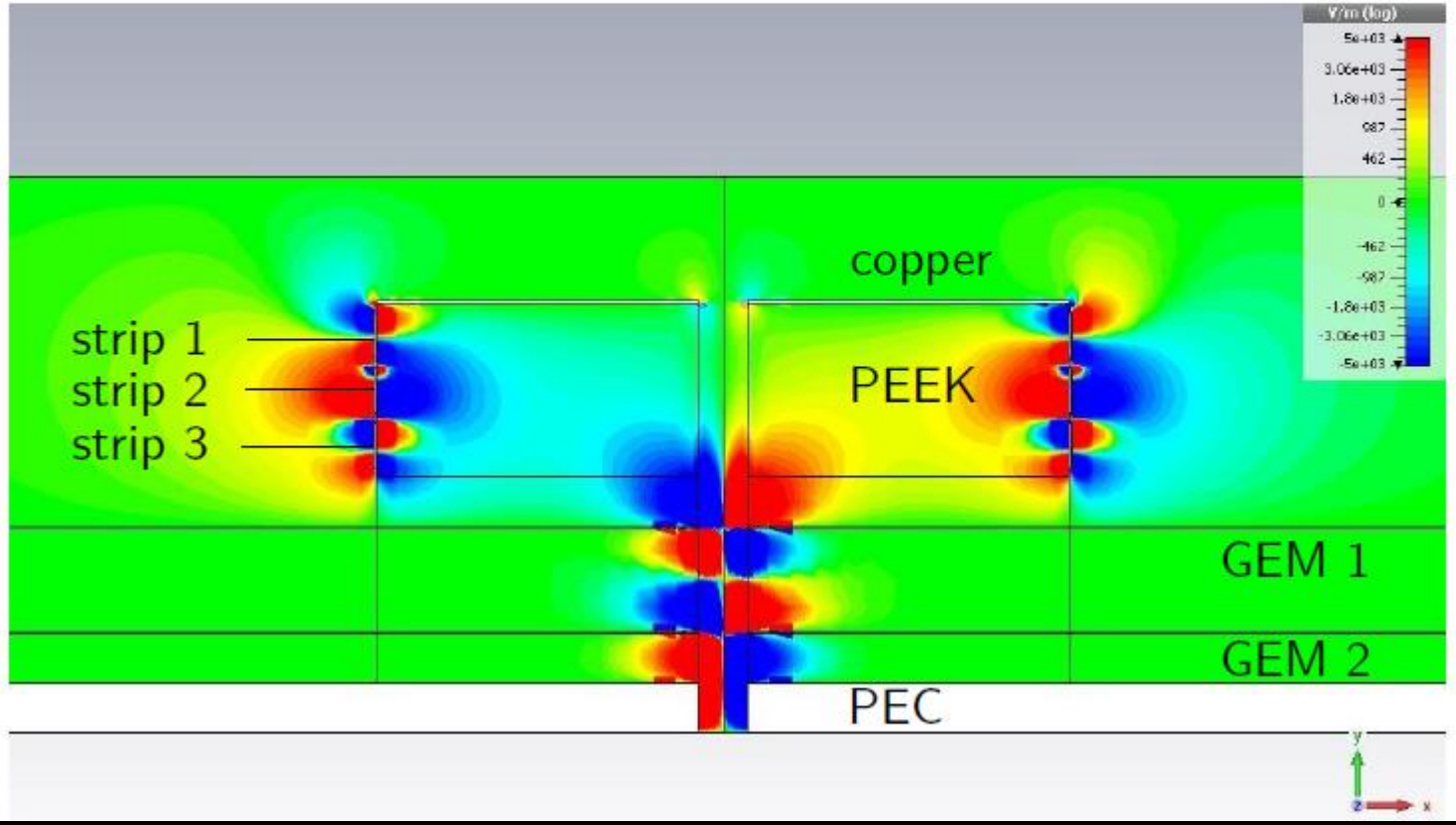
- Gap: 1.5 mm
- Field in drift direction
- Scale (linear): [200 V/cm, 260 V/cm]



Module - Module Boundary

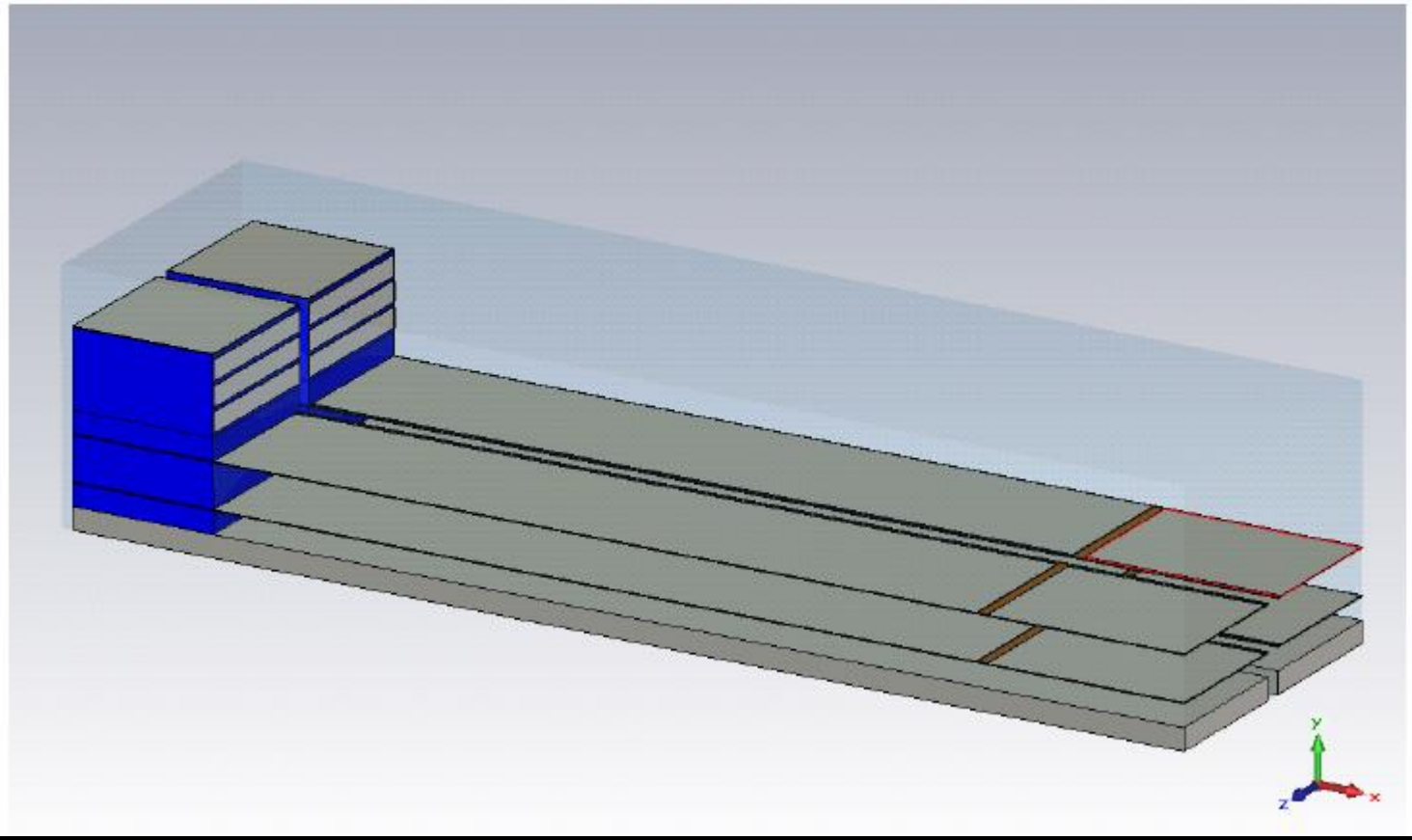
Module – Module boundary

- Gap: 2 mm
- Field transverse to the drift direction
- Scale (logarithmic): $[-50\,\mathrm{V/cm}, 50\,\mathrm{V/cm}]$



Simulation of GEM Electrode Boundary

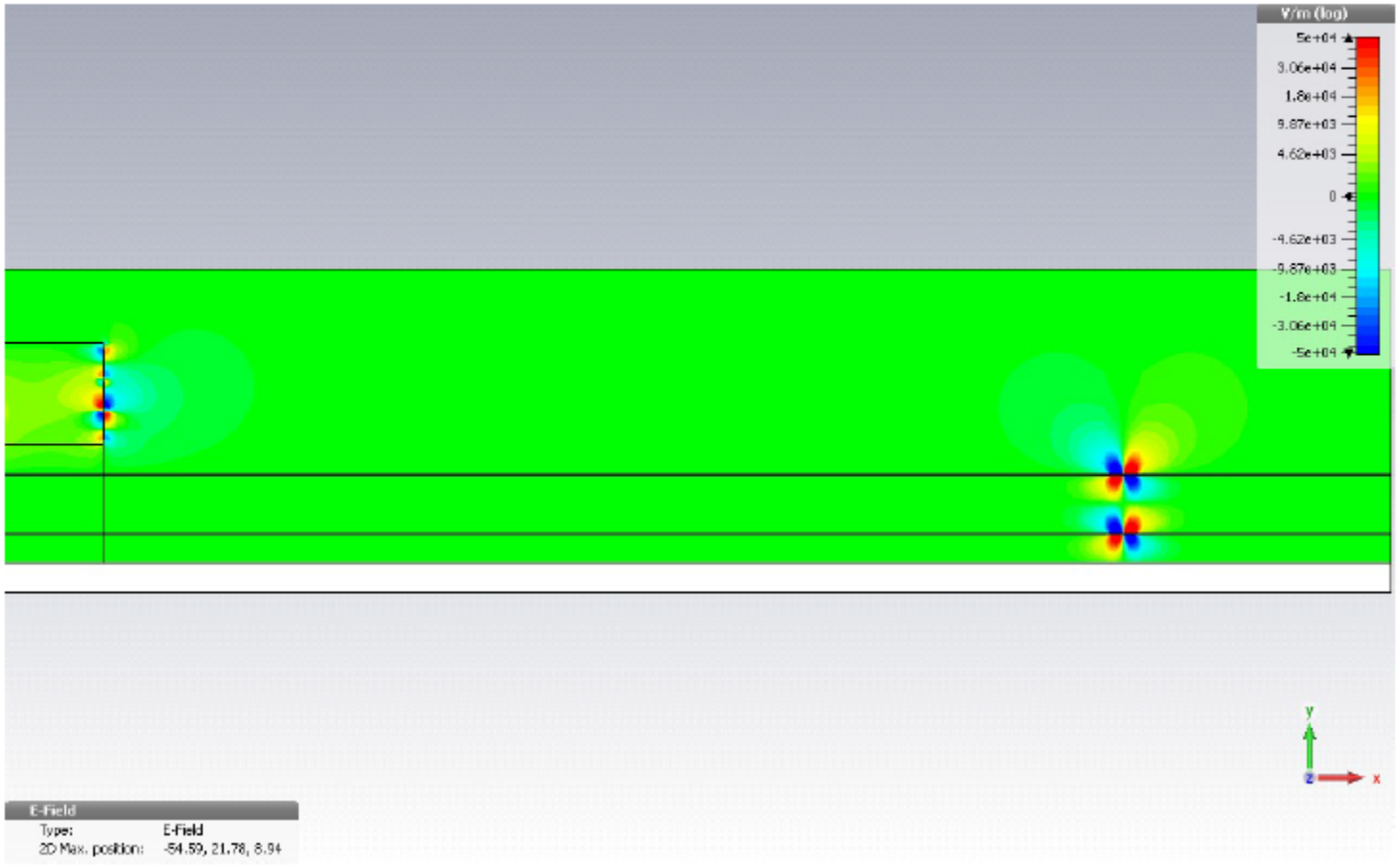
Sketch of the model including module-module and GEM electrode boundaries



Simulation of GEM Electrode Boundary

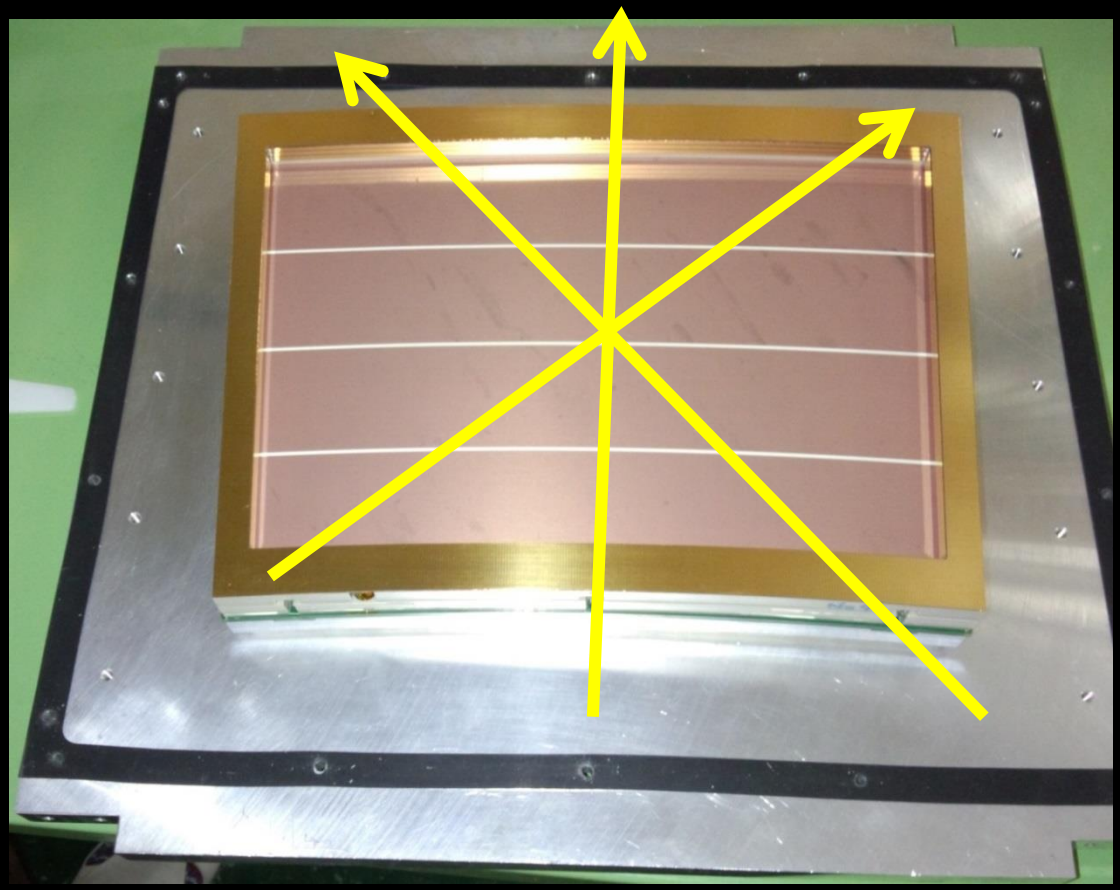
Distortion from GEM electrodes

- Field transverse to the drift direction
- Scale (logarithmic): $[-500\,\mathrm{V/cm}, 500\,\mathrm{V/cm}]$

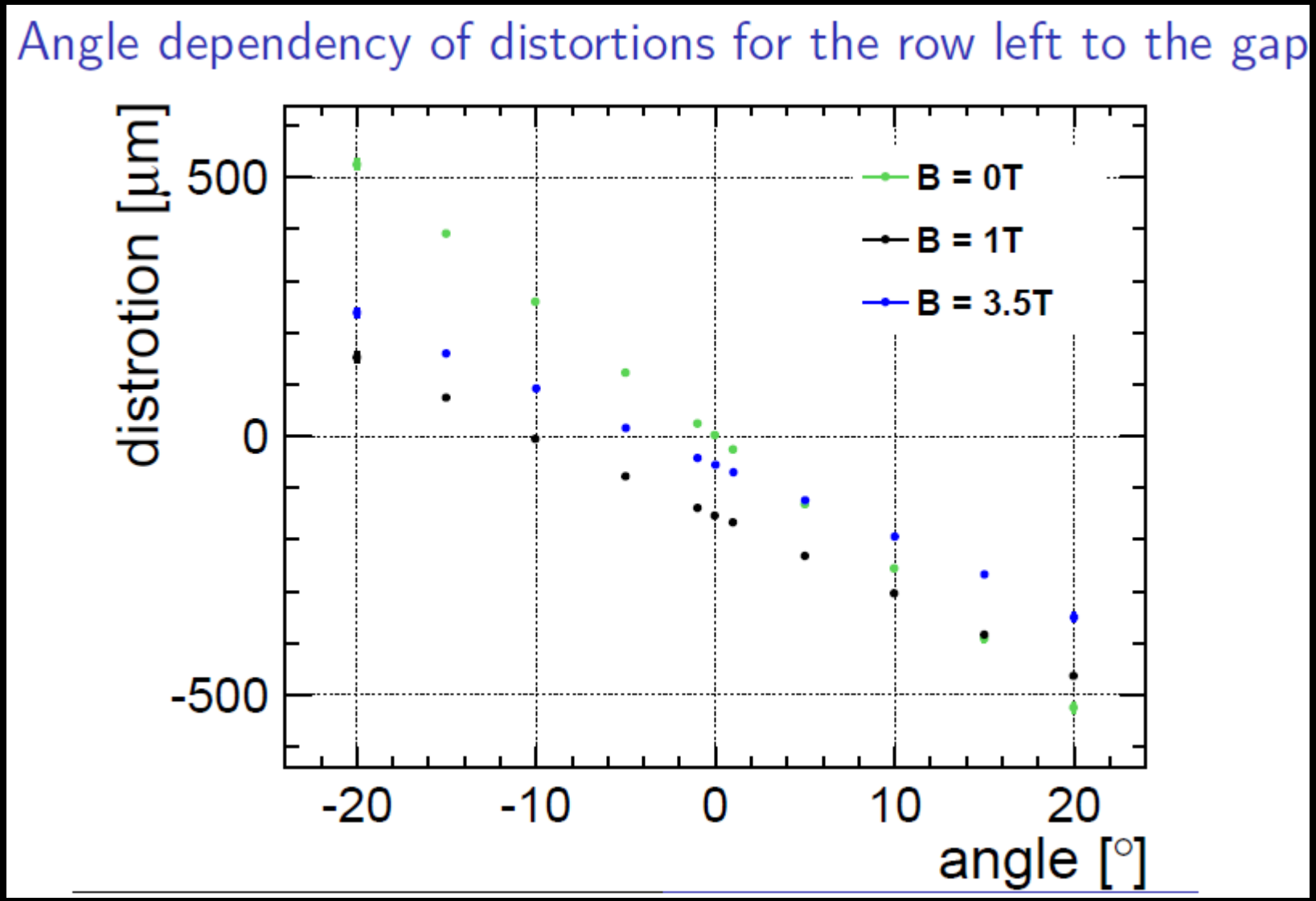


Distortion Check with Track

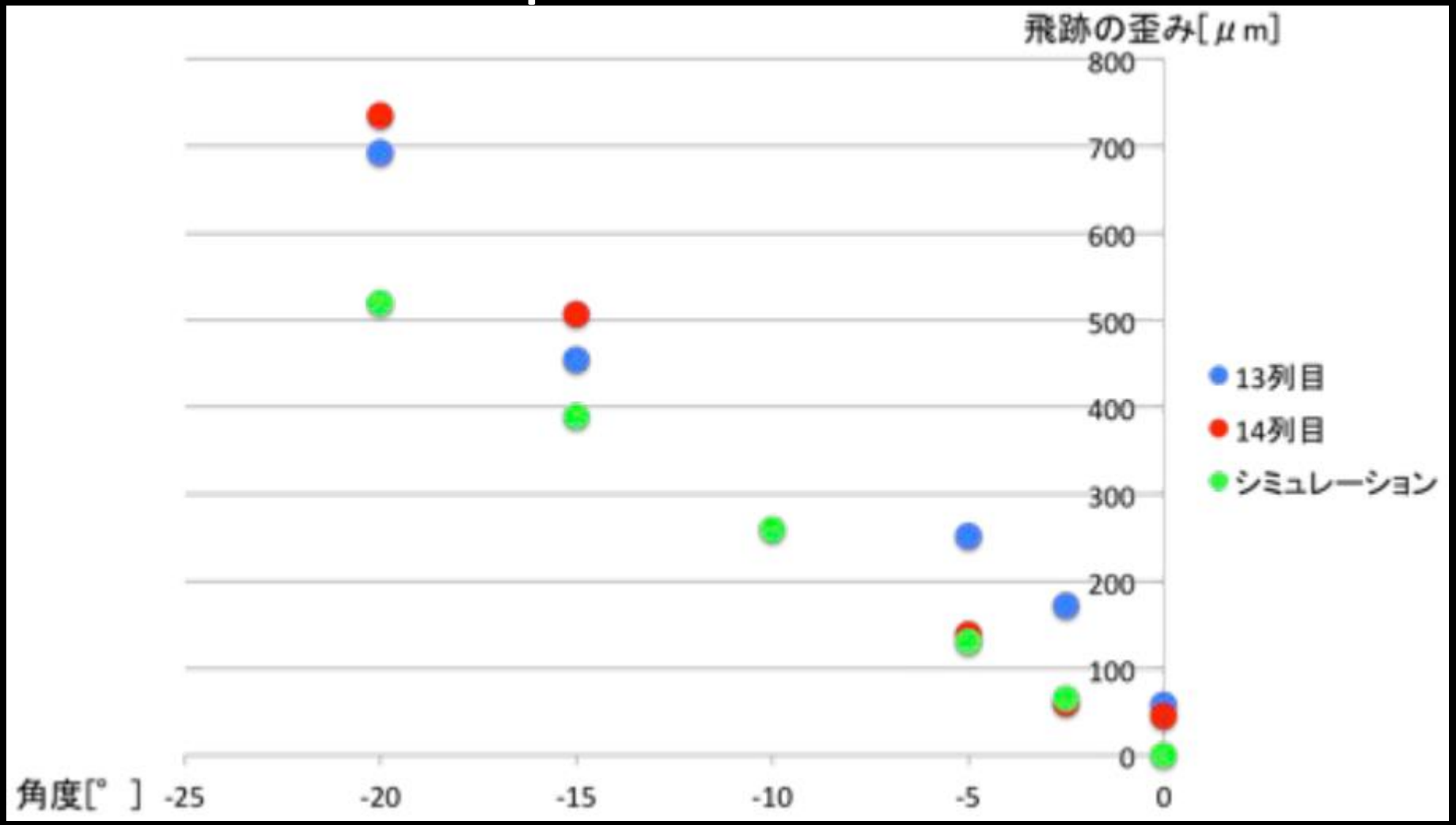
- Check the track angle dependency of distortion with simulation



Simulation Results

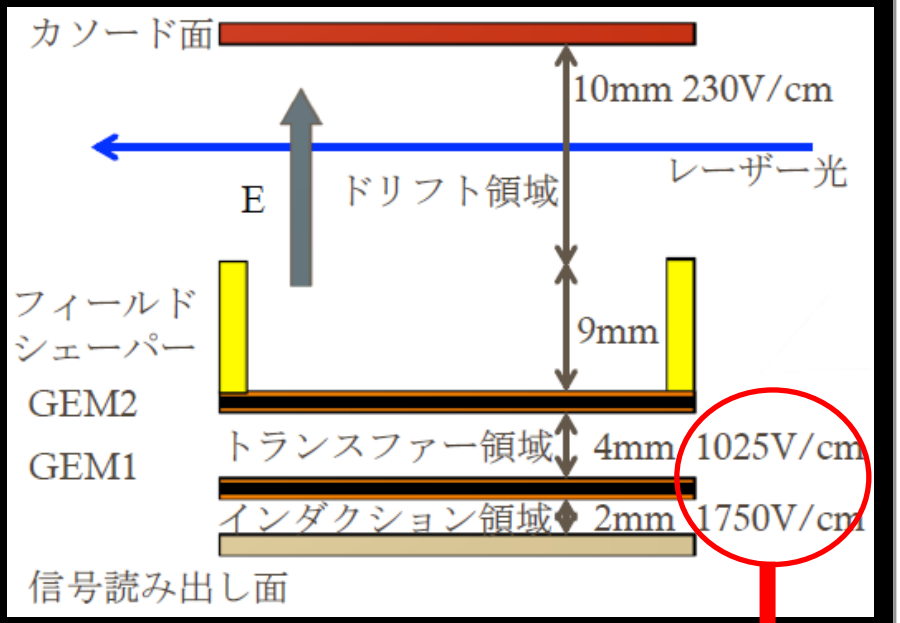


Comparison between Simulation and Experimental Results

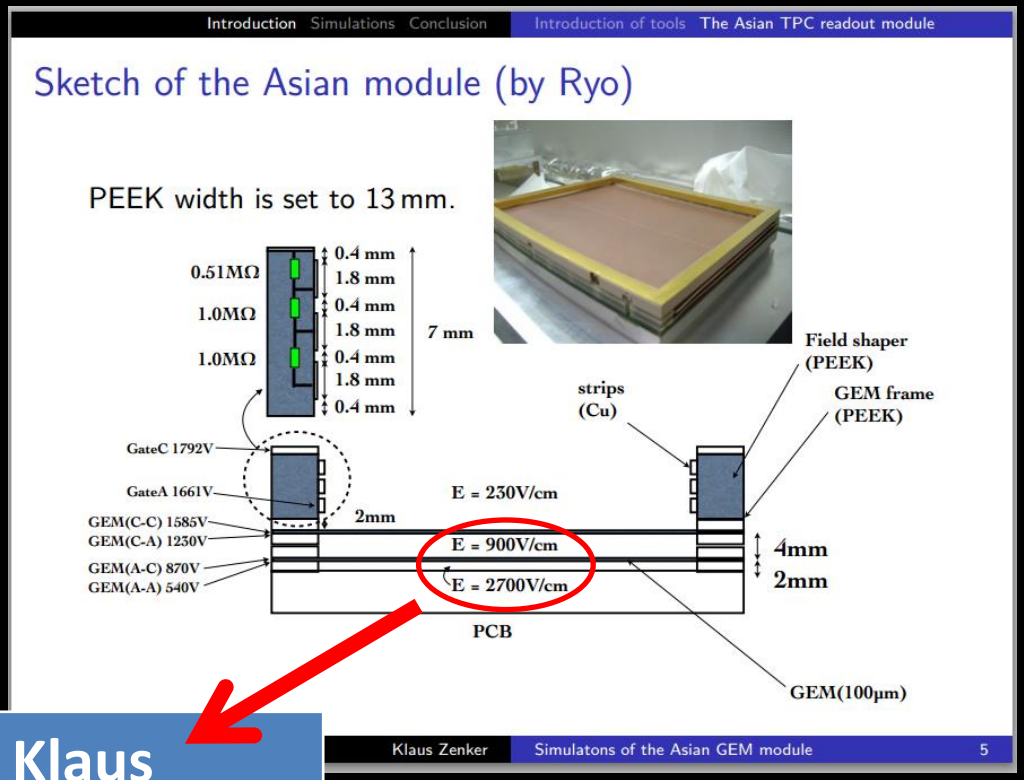


But... Again...

Yatsukawa-kun's master thesis



Klaus Zenkar's work



electric field	Yatsukawa	Klaus
transfer	1025 V/cm	900 V/cm
induction	1750 V/cm	2700 V/cm

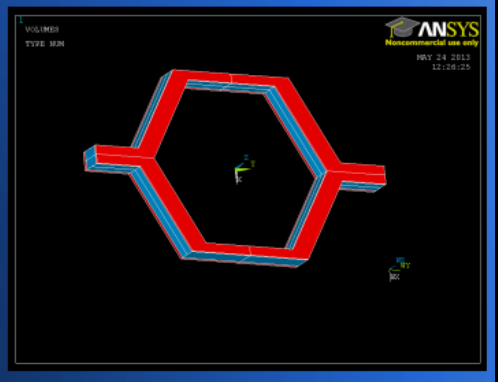
!?

Philippe's work: Simulation for Gate

- Tools: GARFIELD++ and ANSYS
- To make a gate design
  - electron transparency
  - ion feedback
  - distortion with gate

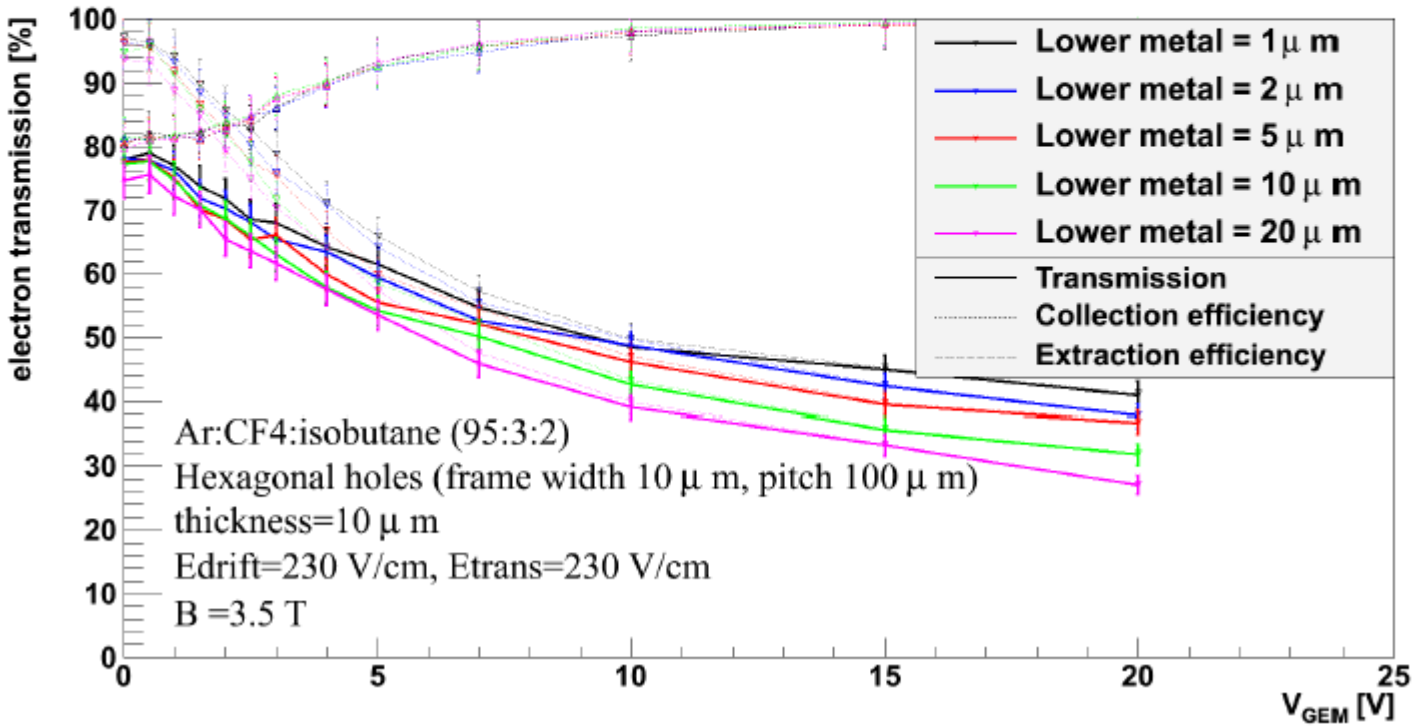
Large aperture

- Maximize the aperture
- Honeycomb structure
- 10μm wide, 100μm pitch
  - 81% aperture
  - difficult to build



Simulation Example

Influence of thicker metal

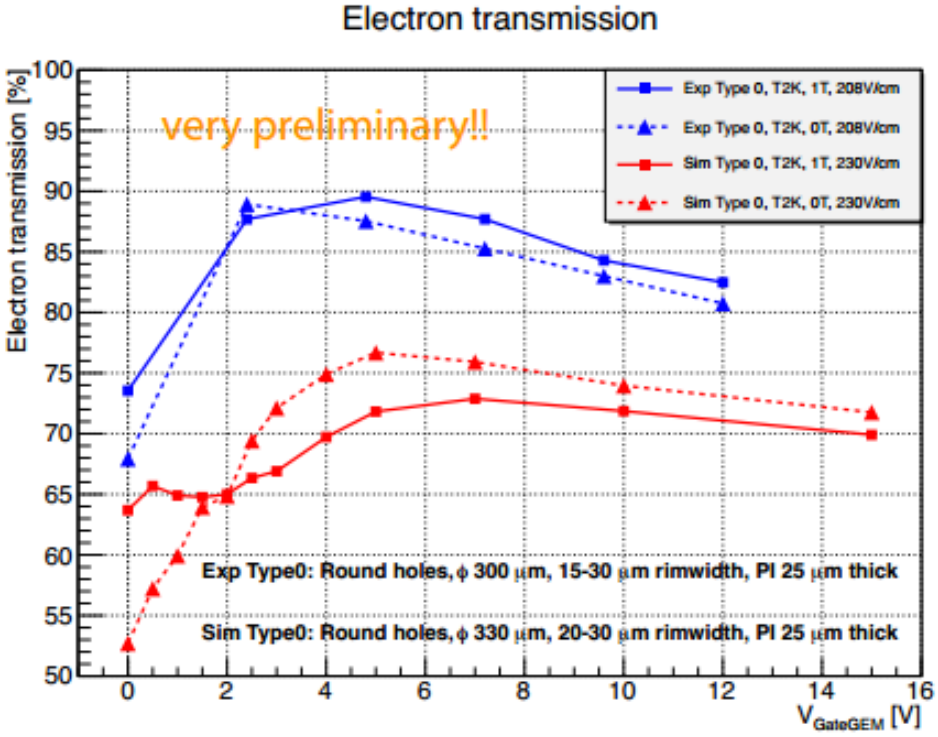


Now Working for Gate Simulation

- Ikematsu-san took over Philippe's work and codes.
- Reproduced Fujikura Type 0 simulation
- Fujikura Type 2 simulation: ongoing

Status of comparison with simulation

- **Data analysis for Fujikura Gate-GEM Type 0 sample**
  - Suspicious energy spectra obtained (= too high electron transmission for 208 V/cm?)
  - Require careful comparison of experiment with simulation (ANSYS/Garfield++ based)
- **Simulation framework**
  - Nice self-learning materials: "RD51 Simulation School (Jan. 19-21, 2011)"
    - useful example codes to simulate the CERN standard GEM by using ANSYS and Garfield++
    - http://indico.cern.ch/event/110634/
  - Legacy codes from Philippe: started to hold frank exchanges from 2 May (just after I showed my preliminary results for data obtained in April)
  - Reproduced Type 0 simulation (coll. & extr. eff.) for 0, 1 and 3.5 T (T2K gas)
  - Integrate them and rewrite all by myself from scratch to avoid programs from unknown sources
  - Understand how to implement hexagonal holes (for Type 2)



Summary & Future Plans

- Simulation for distortions by Klaus
  - for old GEM only
  - dummy module - module boundary, module - module boundary, angle dependency of distortion
  - But configuration between simulation and experiment is different
- Gate simulation by Philippe ---> Ikematsu-san
  - reproduced Fujikura Type 0 simulation
  - now working on Fujikura Type 2
- Any other issues to be simulated?
  - Non-uniform magnetic field
  - Neutron background from accelerator
  - etc...