The GEM-TPC performance test with ultraviolet laser

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Purpose

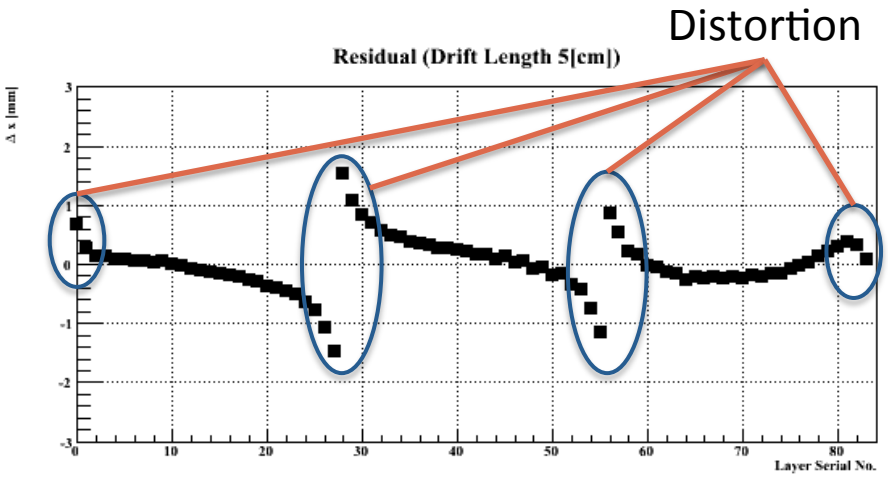
We had distortions around the module boundary in the previous beam test.

The electric field was distorted, because of the wrong voltage adjustment for the field shaper.

We should check the electric field in advance !!

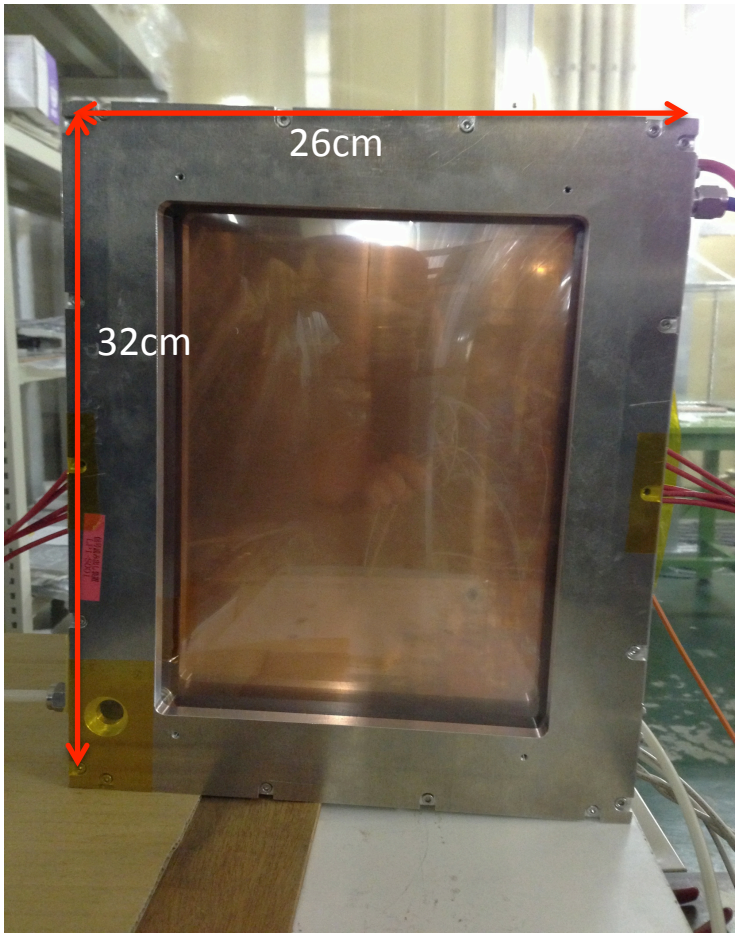
But, We did not have any system which checks.

The performance of GEM-TPC investigates by using ultraviolet laser.

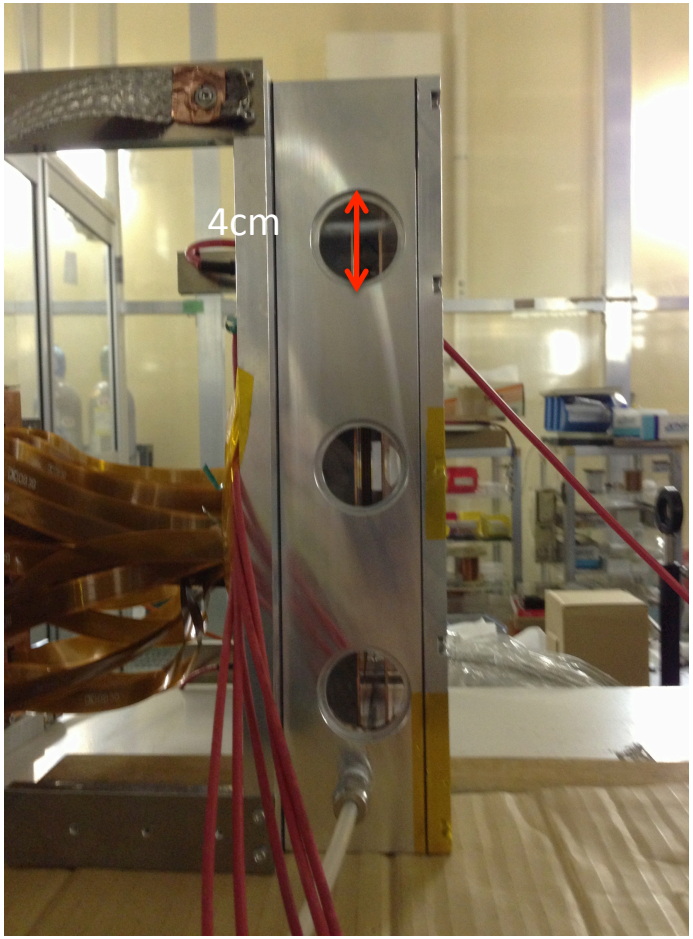


Residual

Using test Chamber



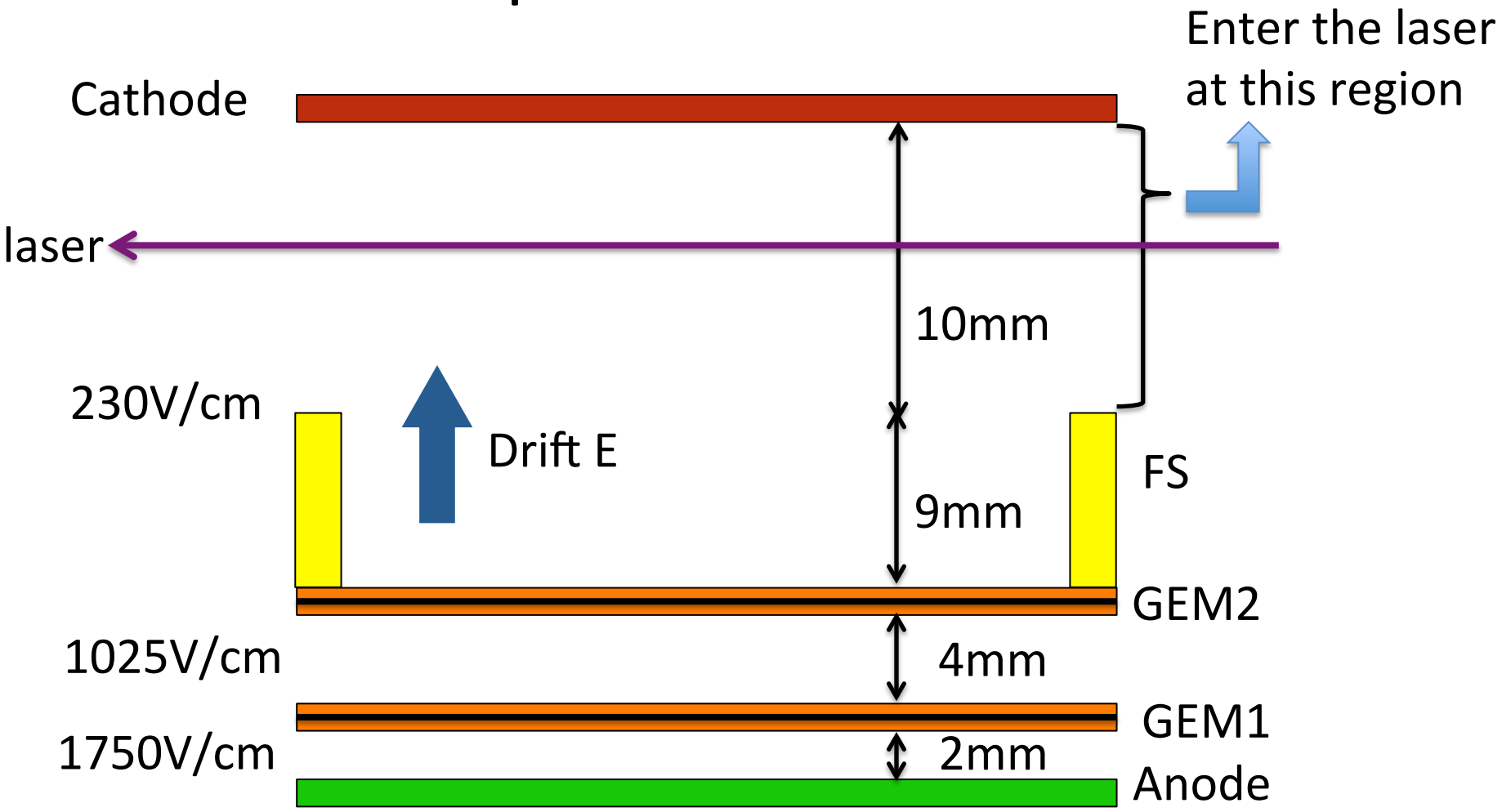
Chamber top



Chamber side

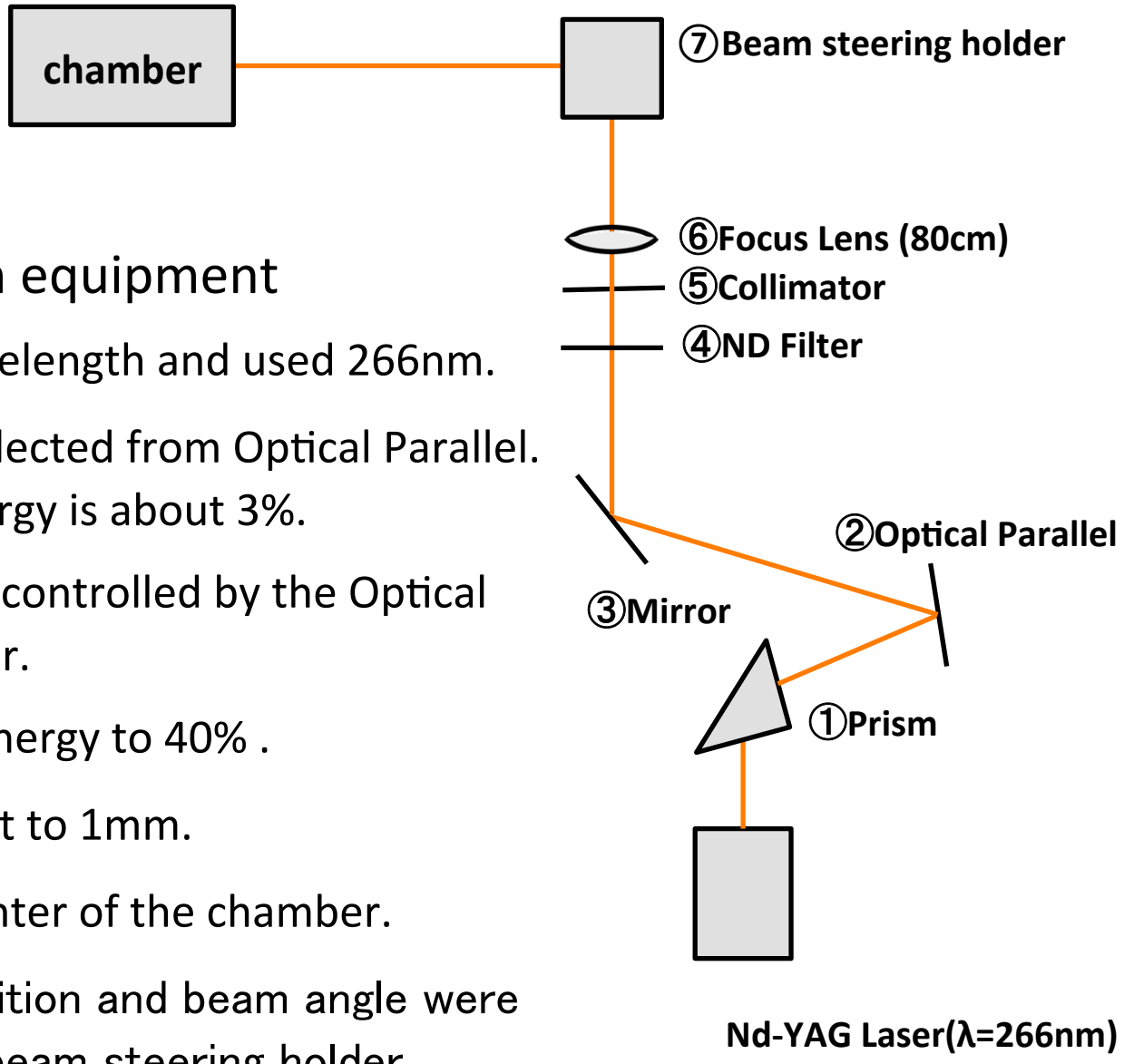
For LP1 module, we made a quartz window so that laser photon go through.

Chamber Set Up



The schematic inside chamber

Laser Set Up



Description of each equipment

①Separated the wavelength and used 266nm.

②Used the beam reflected from Optical Parallel. Reflected light energy is about 3%.

③Laser position was controlled by the Optical parallel and a mirror.

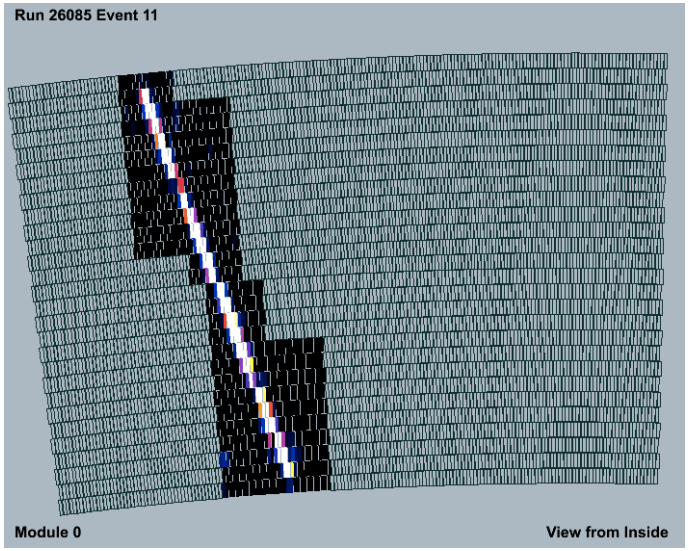
④Filtered the light energy to 40% .

⑤Collimated the light to 1mm.

⑥Focused on the center of the chamber.

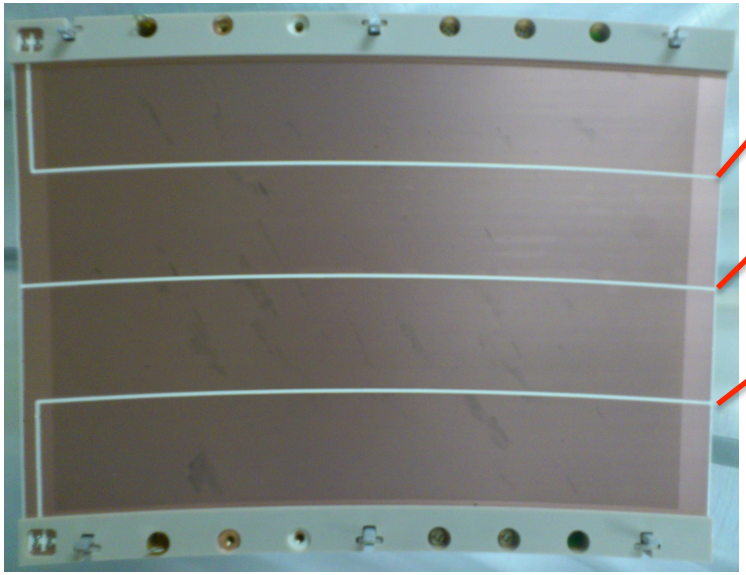
⑦The incidence position and beam angle were controlled by the beam steering holder.

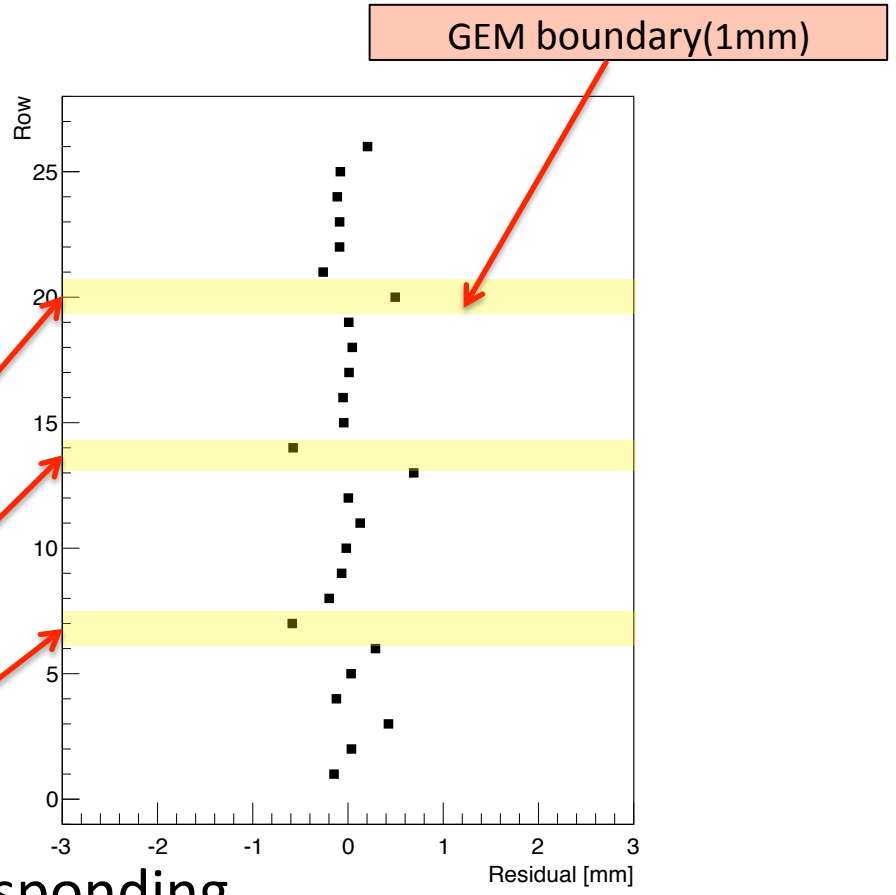
Result



Event display

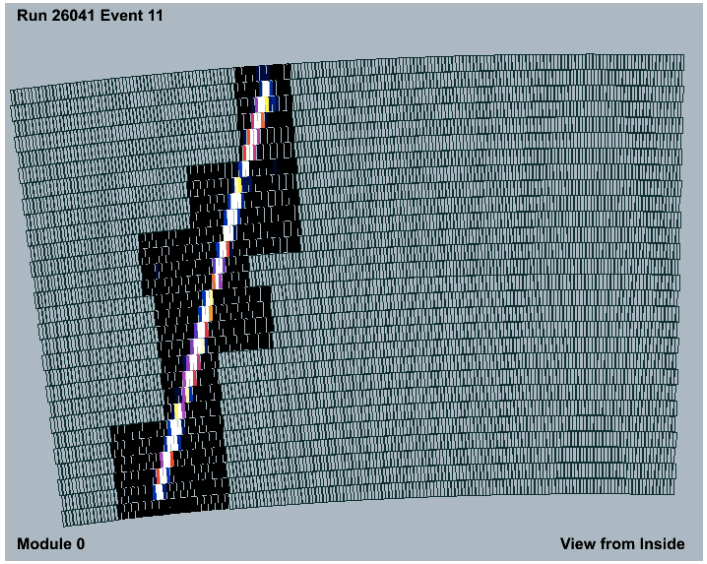
Since there was no magnetic field, laser beam was angled with GEM boundary.



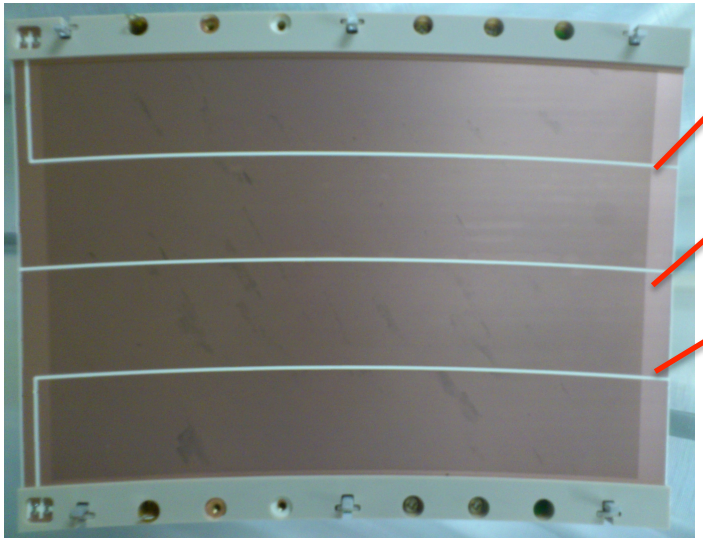


corresponding

Result

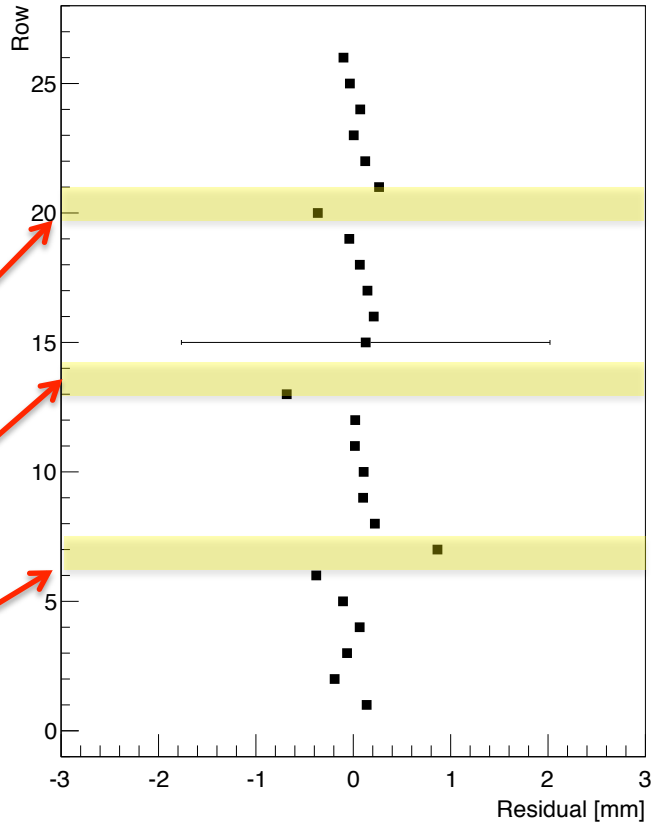


Event display



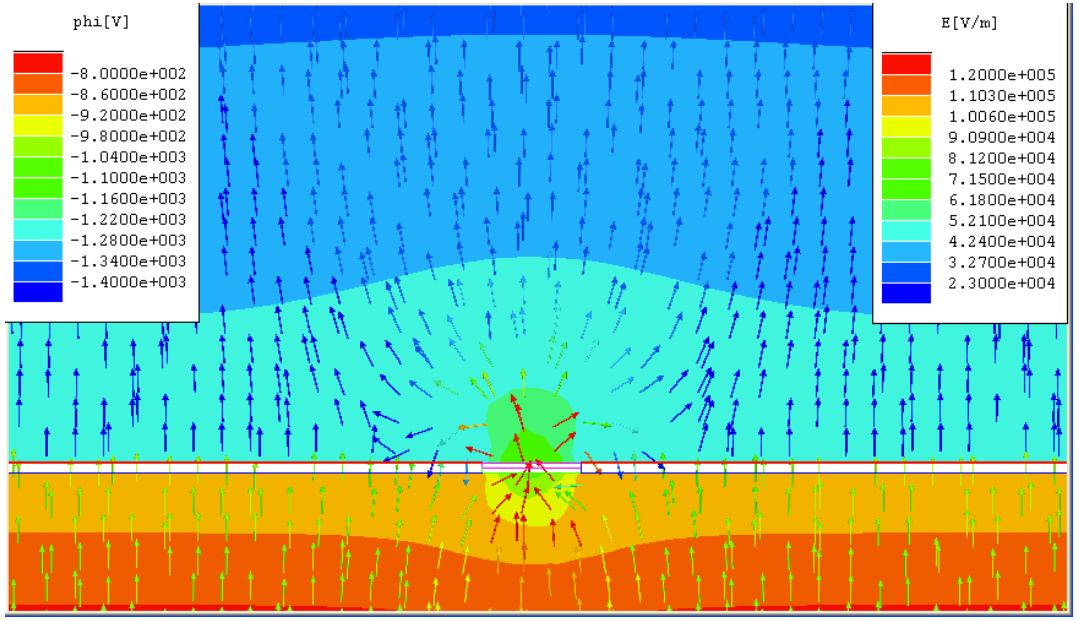
When entering angle was changed, the same result came out.

reverse

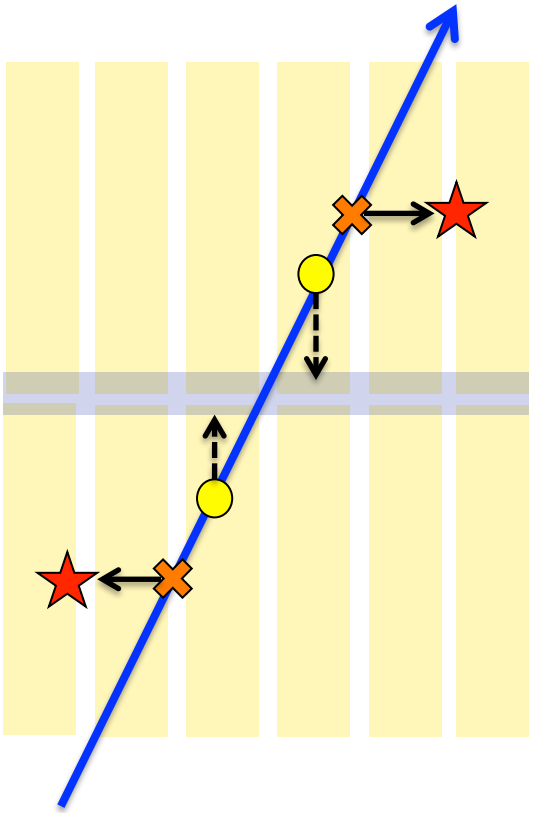


Consideration

Electron goes to the GEM boundary, because the transfer region's electric field is much higher than drift region.
Because electron charged up the boundary, and the C.O.G of electron is biased which led the distortion.



Electric field around GEM boundary



The schematic near the boundary

:electron

:correct hit

:real hit

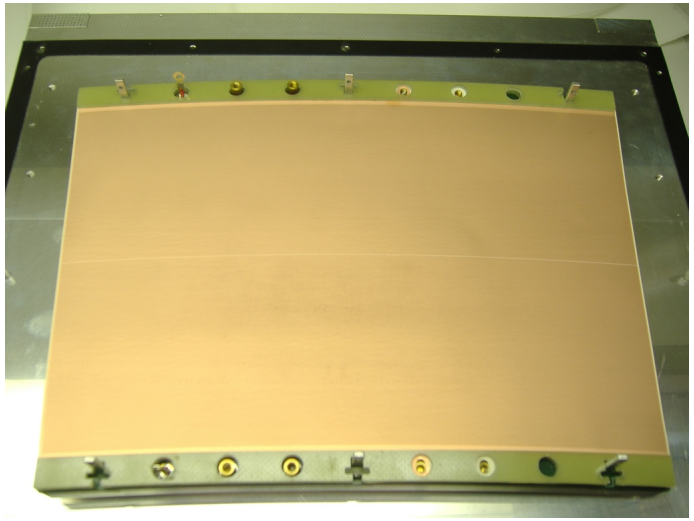
Why we need the GEM boundary ?

Previous beam test → 2 parts・200μmBoundaryGEM

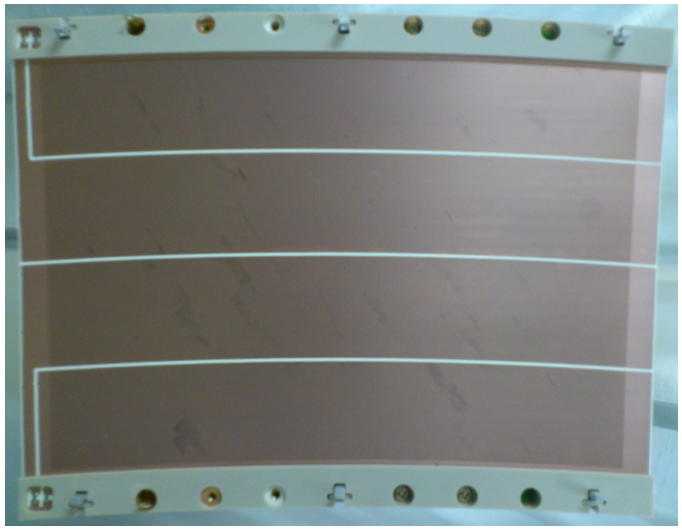
- When it discharges, the induced electric charge flows into electronics and breaks electronics.
- Discharge is jumped over GEM boundary.

4 parts GEM
- Increases division and reduce the induced electric charge.
- Discharge does not jumped 1mm boundary .

But 1mm boundary is too wide

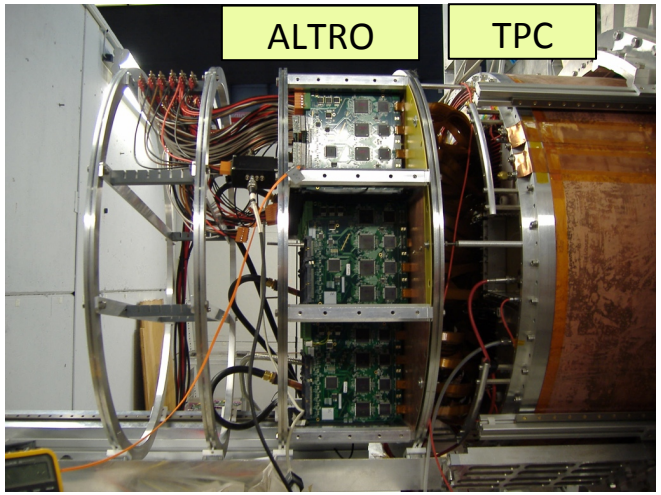


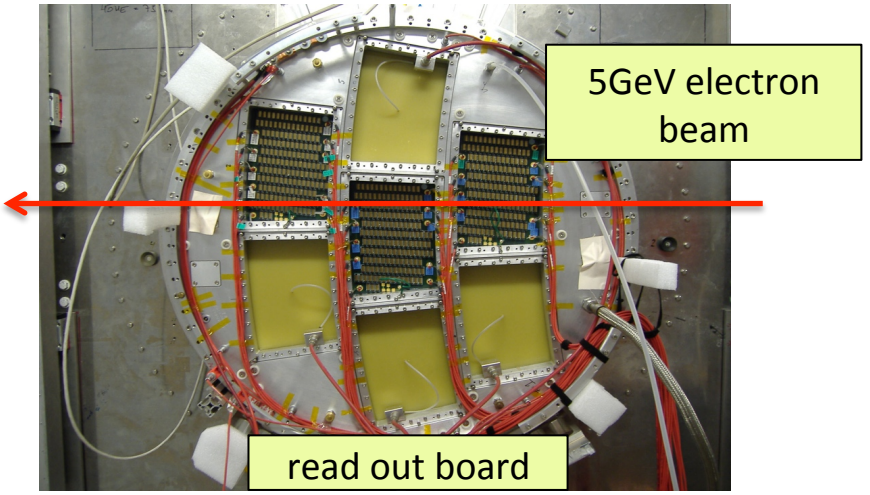
2 parts GEM

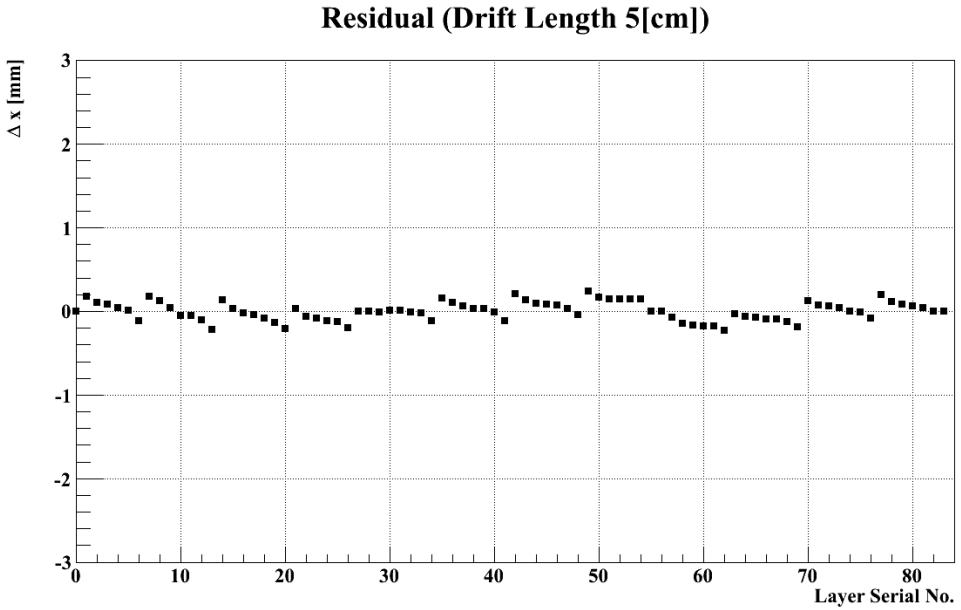


4 parts GEM

2012 DESY beam test







The result of this beam test is also identical with laser test.

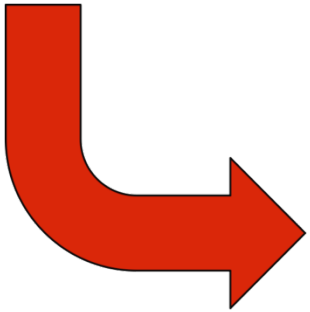
Summary

・We checked distortion of the electric field around GEM boundary, and it becomes clear that 1mm boundary is too wide.

・Although there was no time to improve the GEMs, we analyzes the electric field inside the chamber by using the ultraviolet laser.

Future

TPC-GEM optimization



・Simulation of the electric field around the GEM boundary and calculation of the influence from charged up boundary, are needed.

Then we should find the best boundary width.

・We will make new GEM and it will be tested with UV laser whether electric field is right.