Prototype test for LCTPC

Pre-prototype GEM panel for LP1

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What is Large Prototype

Why we need pre-prototype test

What we are going to make

GEM panel
100um GEM

Schedule

Large prototype TPC in LC TPC collab.

Mom. resolution
dead space
Large area MPGD
calibration

reconstruction efficeincy
under non-uniform field
low material TPC

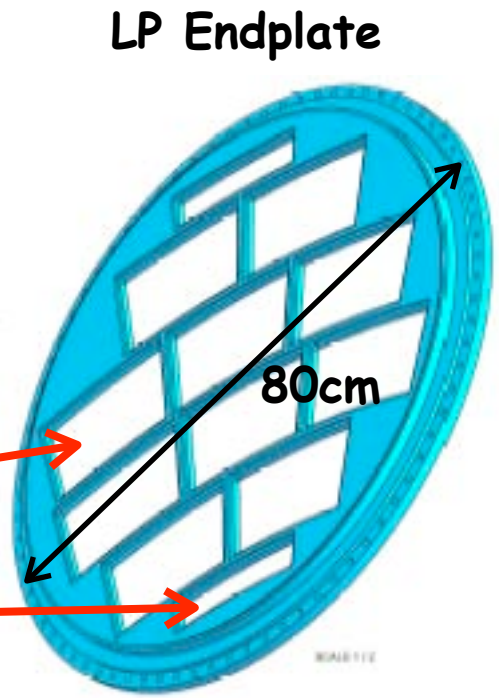
could be studied in LargePrototype in LC-TPC

Conceptual Design at moment

Endplate
+
small/medium size panel
1 MPGD/panel ??

Gas seal by endplate
stand for pressure
Size of panel ??

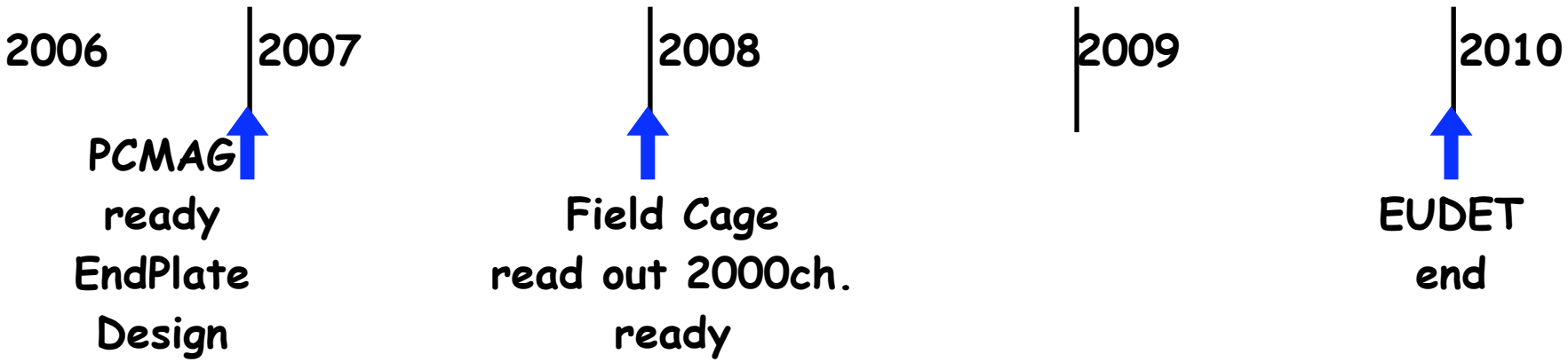
Readout electronics
——>std. RO @LP1



Alignment using tracks
Efficiency at boundary

LC-TPC prototype study schedule

EUDET



realistic electronics
realistic config.

Target date
of LP1
production

limited time for R&D !!

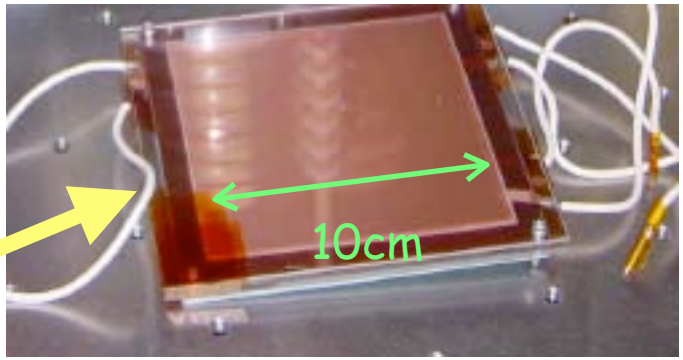
"Pre-PROTO"

though many issues are not fixed yet

What we want to do at Pre-proto

Production of GEM panel

minimize dead area due to GEM support frame
specially in radial direction
we hope to remove radial frame
to avoid loss of series of hit info.
can we mount GEM properly ?
how do we stretch GEM?



GEM we used
@Small prototype test

Readout Pad plane

Pad size
arrangement

readout connector

GEM structure on the pad plane

support structure
of GEM

HV supply

Larger
area GEM

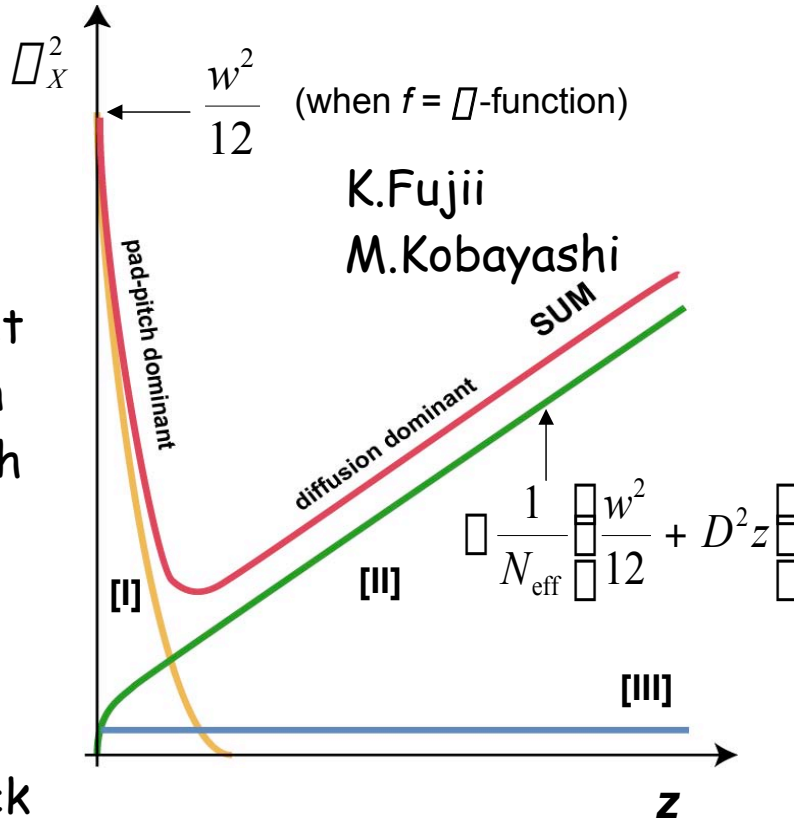
Gating structure

scheme

mount structure to EP

-> Dan Petersen
common system in LP

Readout Pad plane



Pad geometry

width: Analytic formula teach us max. pad width
in order to avoid hod-scope effect
diffusion in GEMs must be larger than
~0.3 of pad pitch
~300um w/ 5mm thick
for the most of gas
1mm pitch of pad width

length: angular dep. of
σ_0 ~30um @6mm for 50GeV track
related to number of connector we can put on the rear panel

arrangement :
staggered pad layer by layer
forget about loss of a half pad at edge (~0.5mm effect)

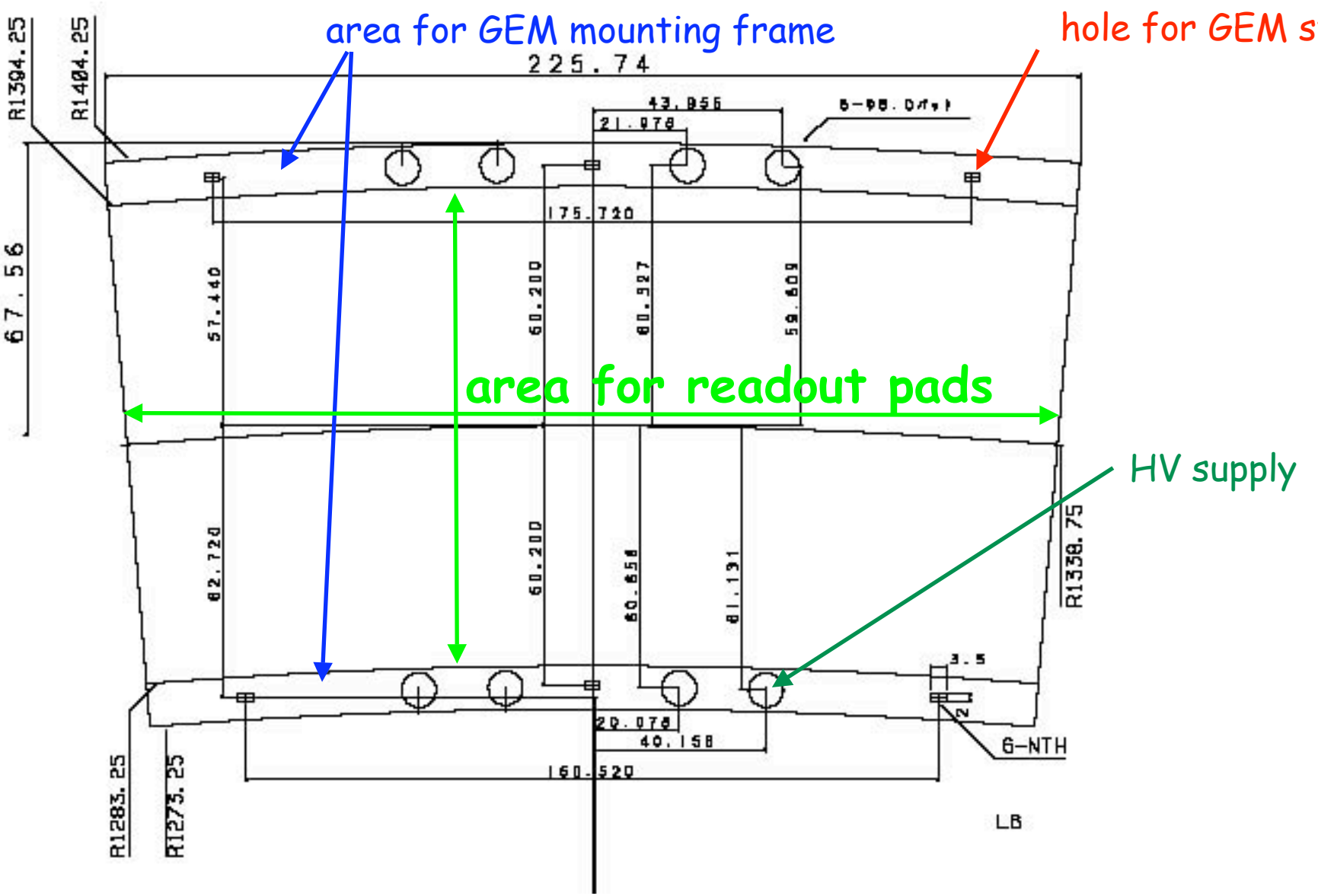
SIZE of panel for pre-proto
We chose Dan's early design
(Final panel size is under discussion)

Readout Pad plane

size ~ 22.6 x 13 cm2

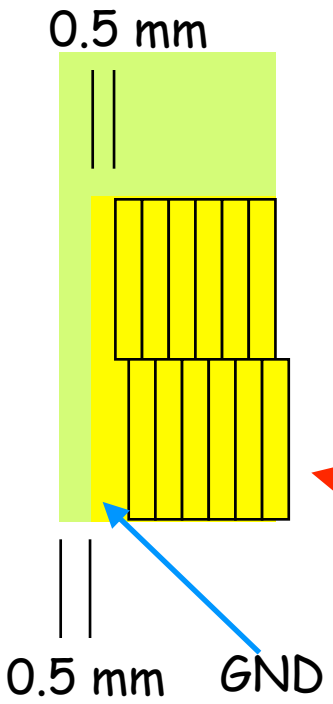
Outer/Inner edge (1cm) are spent for GEM mount/HV supply

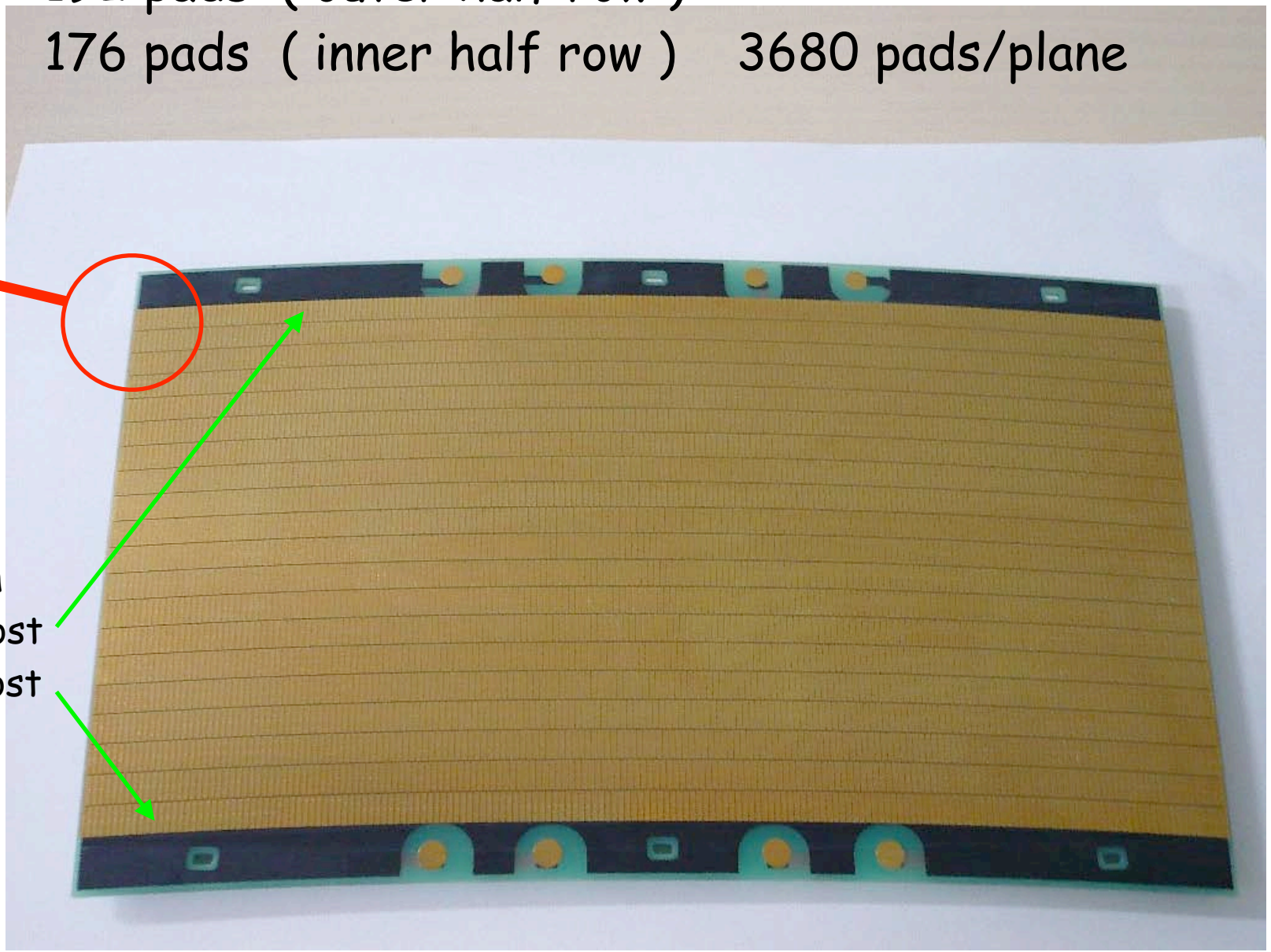
no obstacles at left/right edge (radial direction)



Readout Pad plane what we made

Pad size ~ 1.1 x 5.6 mm
20 pad rows
192 pads (outer half row)
176 pads (inner half row) 3680 pads/plane

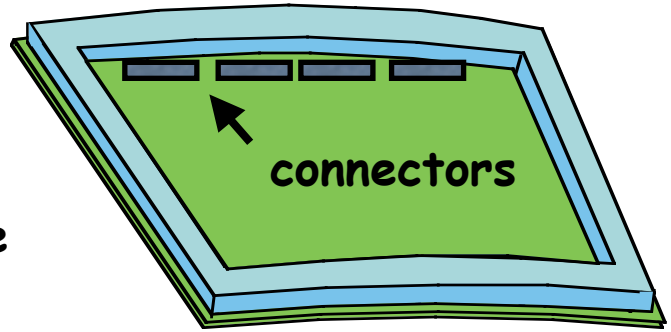


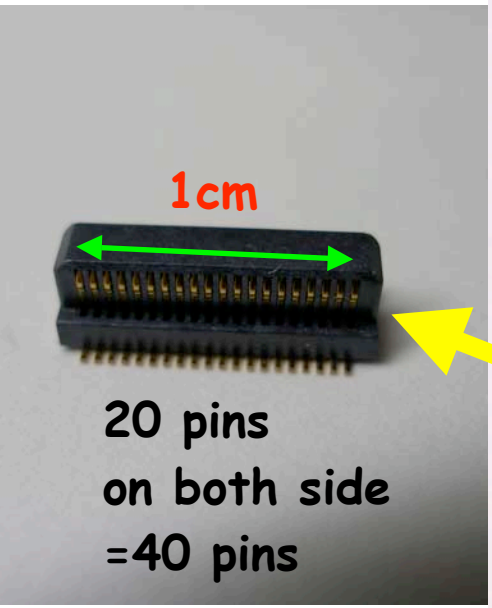


Width of pad pitch
1.18 mm @outermost
1.08 mm @innermost

Rear view

supporting structure
to endplate
2cm wide

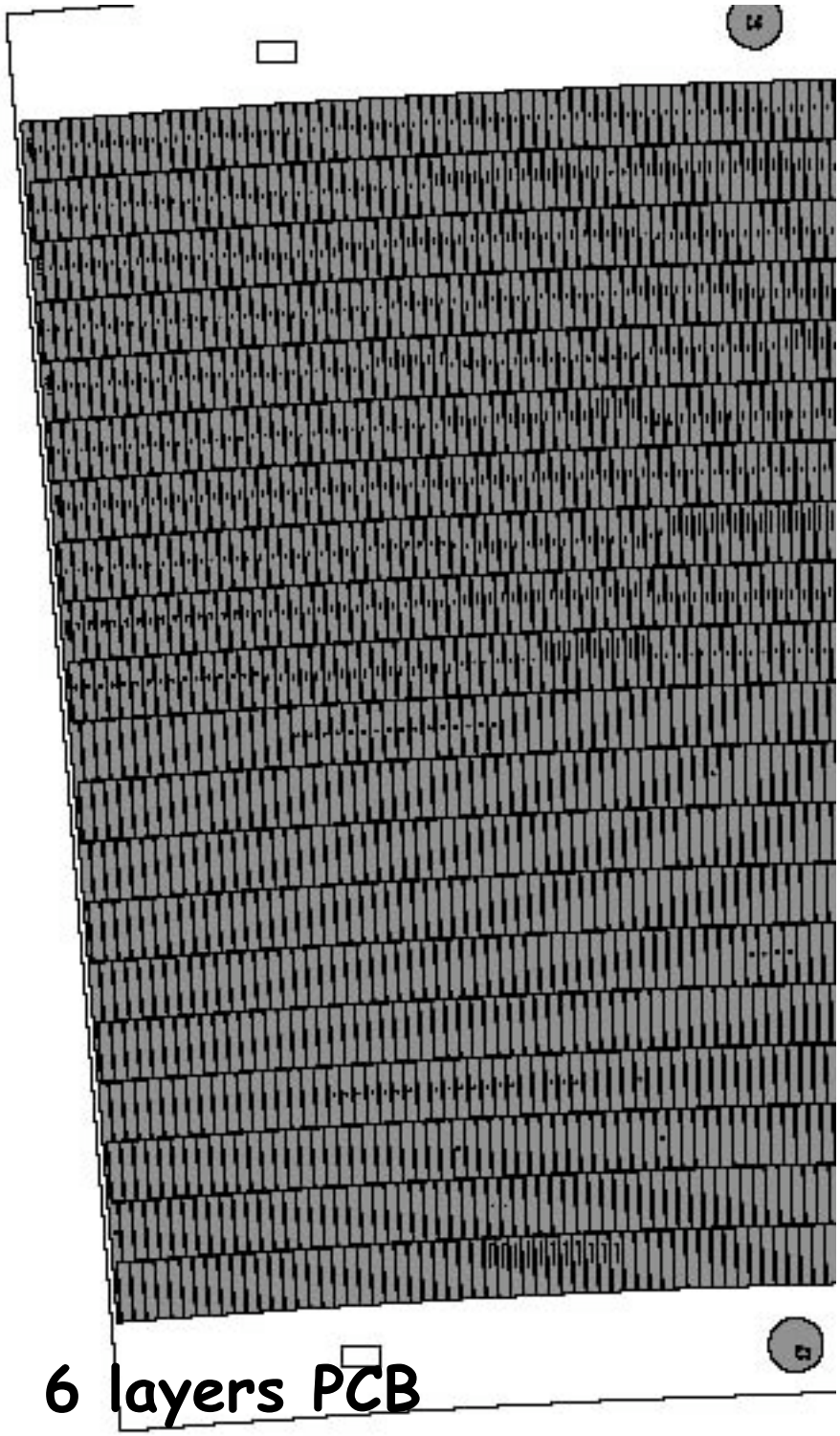


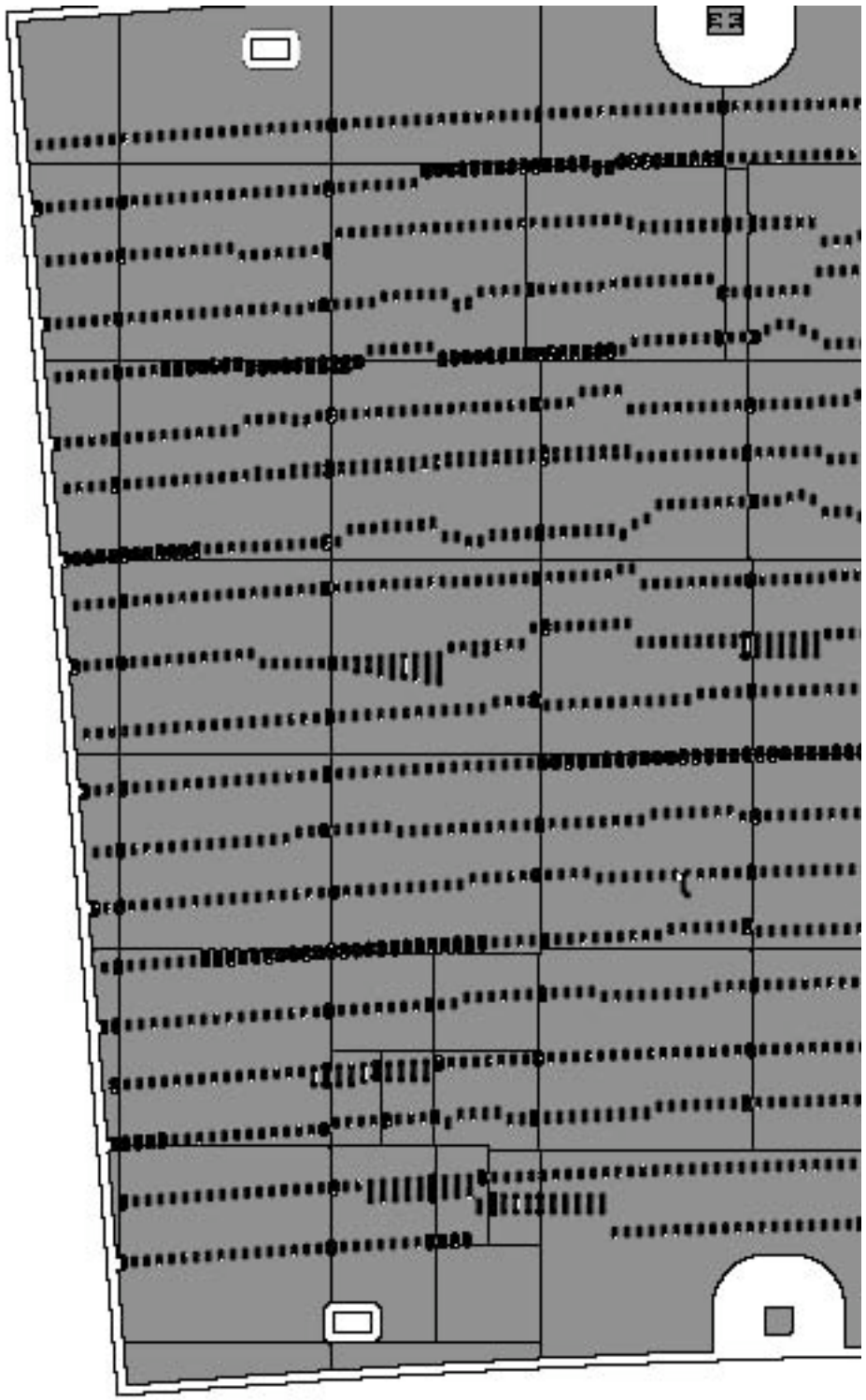


these are is saved for mounting structure to endplate

for HV supply

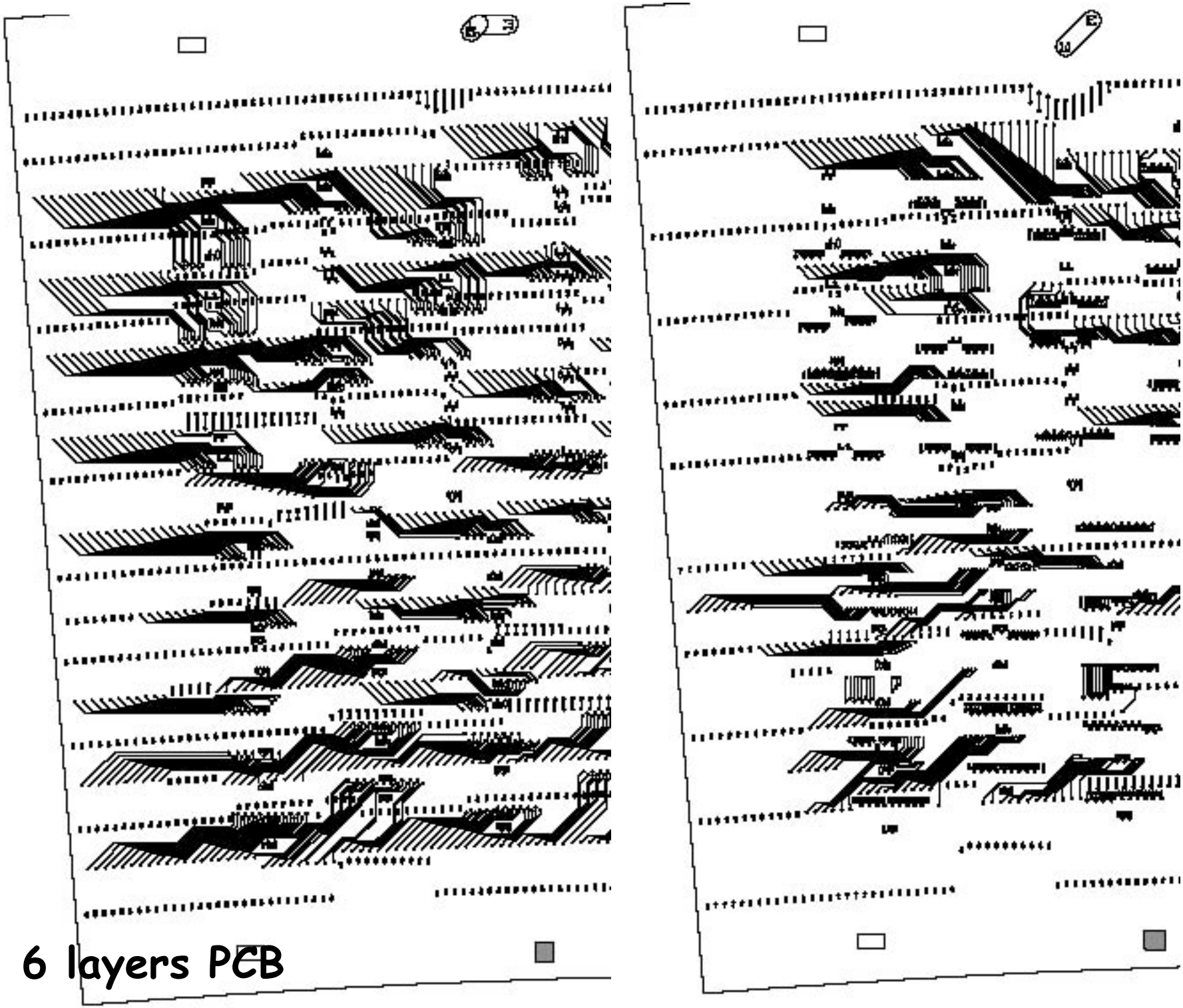
pad plane -> GND + through hole





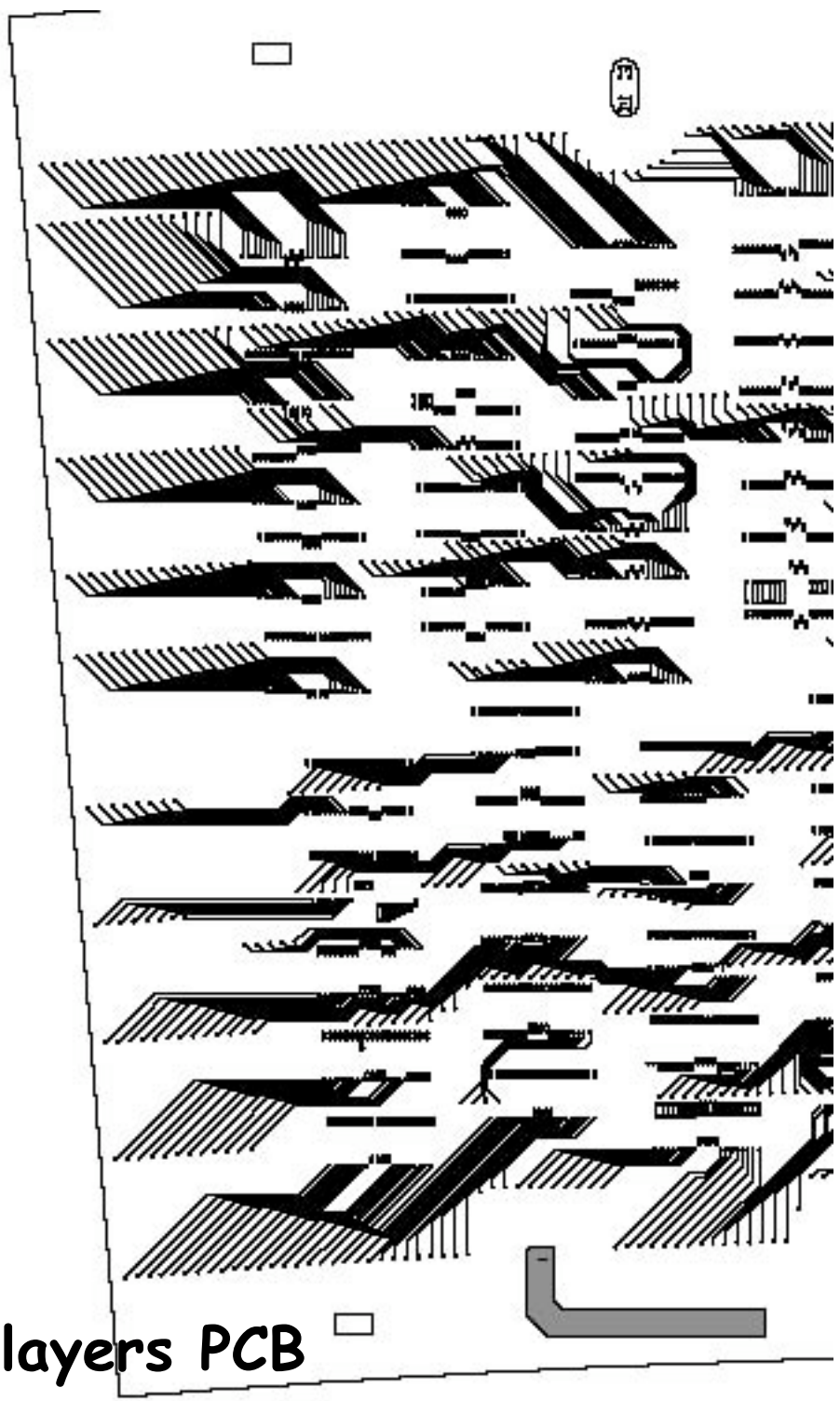
6 layers PCB

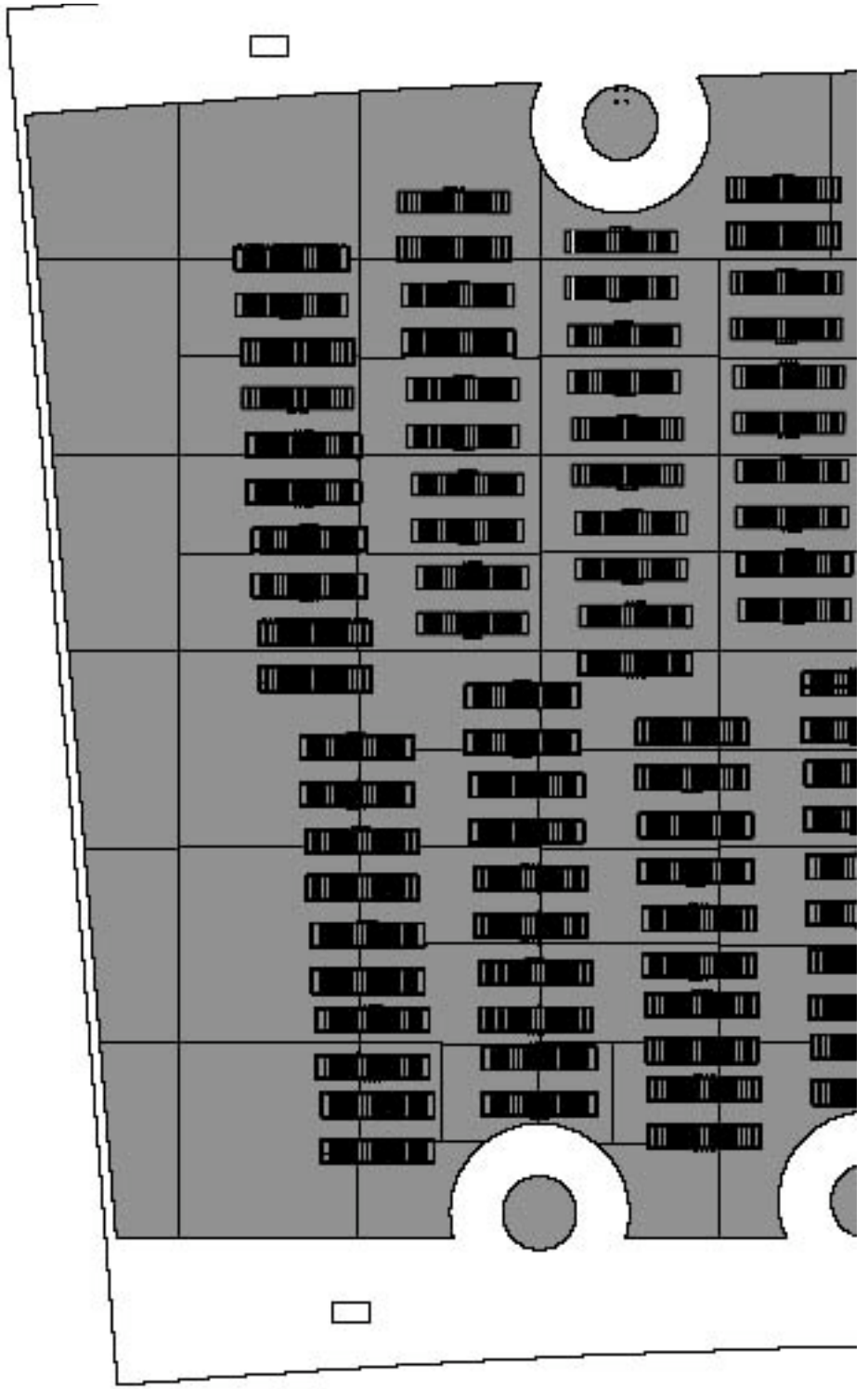
pattern (1/3) -> (2/3)



6 layers PCB

pattern (3/3) -> connector plane



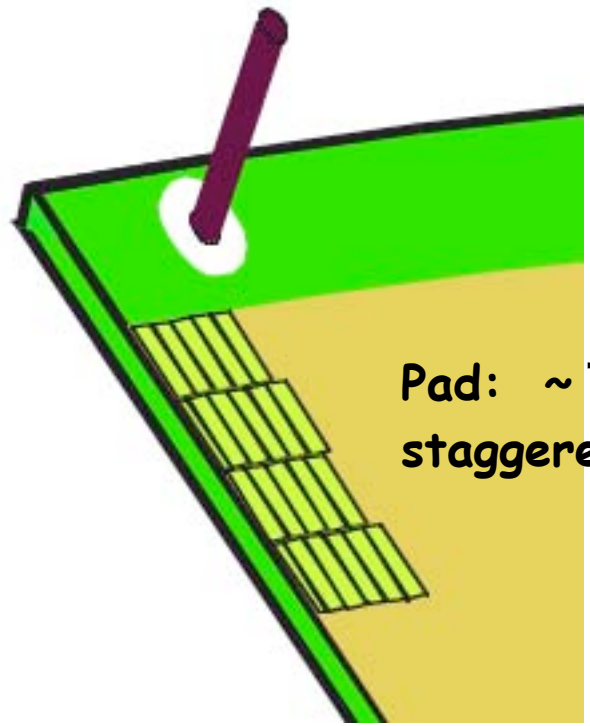


6 layers PCB

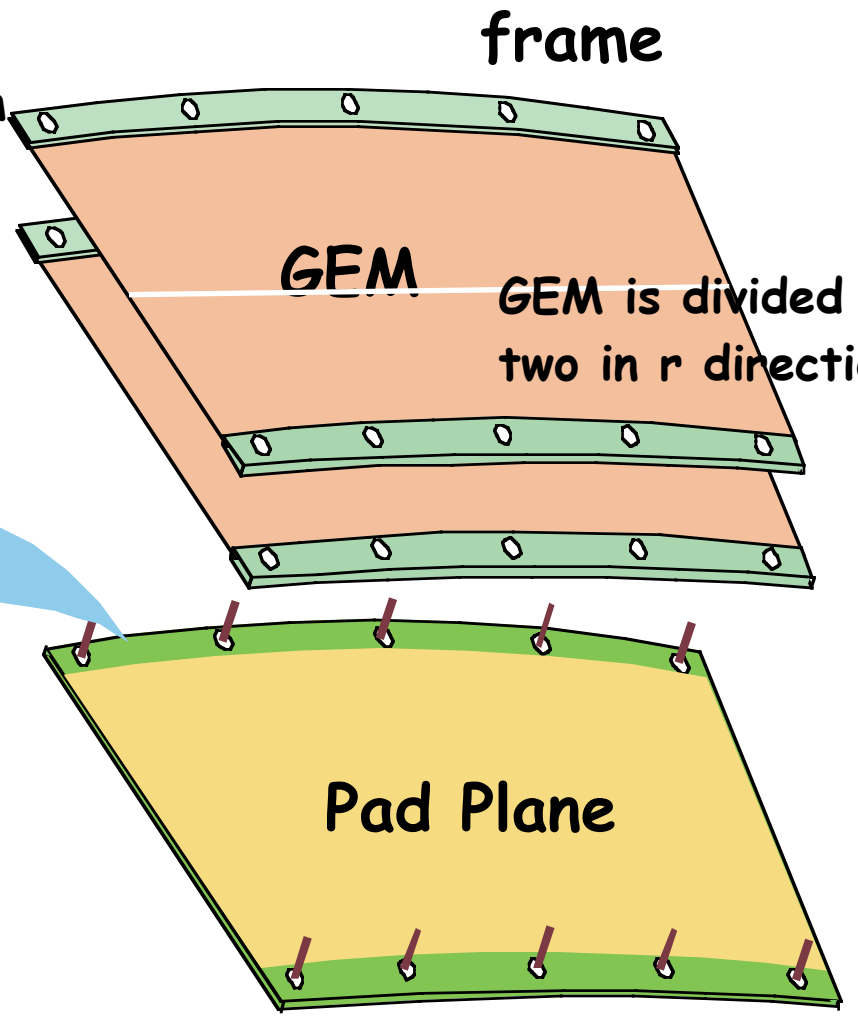
GEM structure

narrow frame (mount mechanism)
double GEM(100um thick) : high gain
simple strucuture
how to provide HV
low capacitance (division)
F.Sauli suggested < 70cm2 @50um
field shaping at frame

GEM is stretched by the post

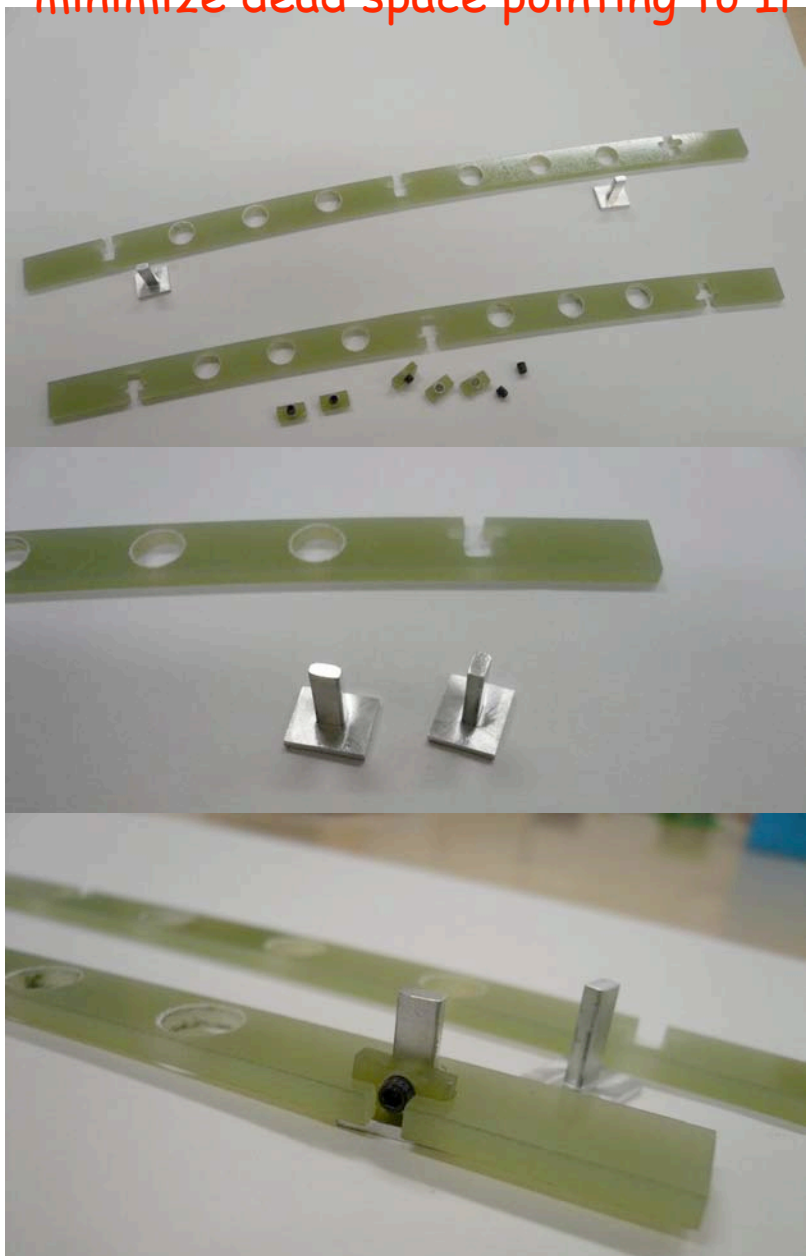


Pad: ~1 x 5.5 mm2
staggered a half pitch



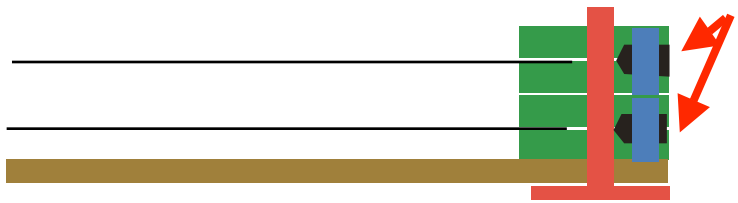
GEM mounting scheme

frame : top & bottom frame.
no side frame
minimize dead space pointing to IP

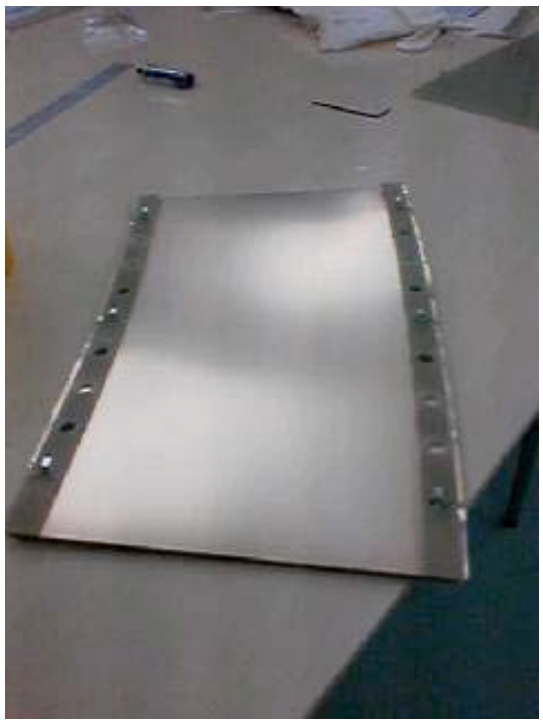


Can we stretch GEM ?

mounting(stretch) mechanism



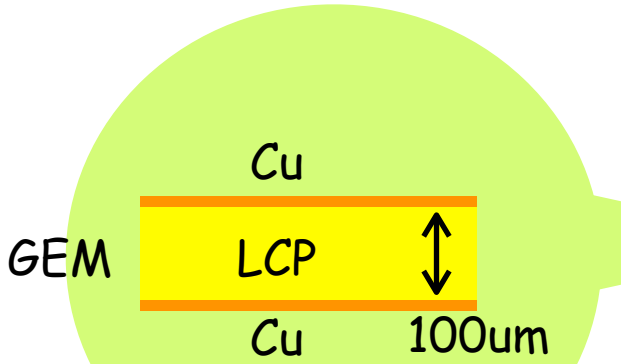
scheme test using dummy GEM



test was successful ! @Dec.14
this method seems to be OK

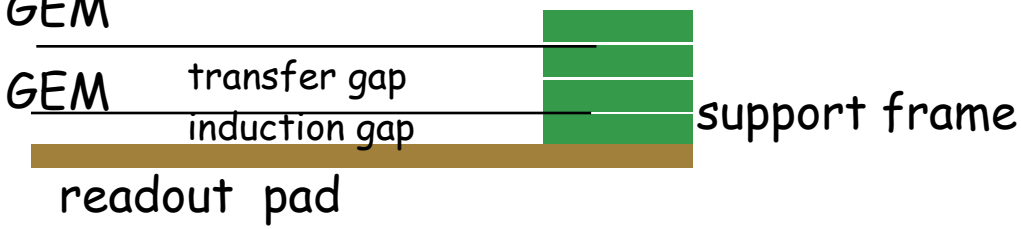
GEM we will use 100um thick GEMs due to simpler structure

produced by SCIENERGY co.(Japan)



LCP:Liquid Crystal Polymer

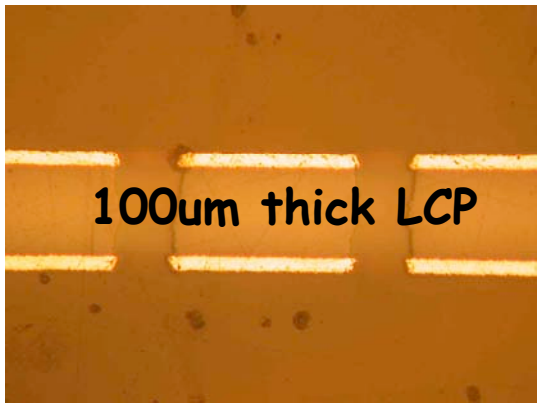
Double GEM stuck can provide enough gain



Transfer gap ~ 4mm : enlarge signal distribution

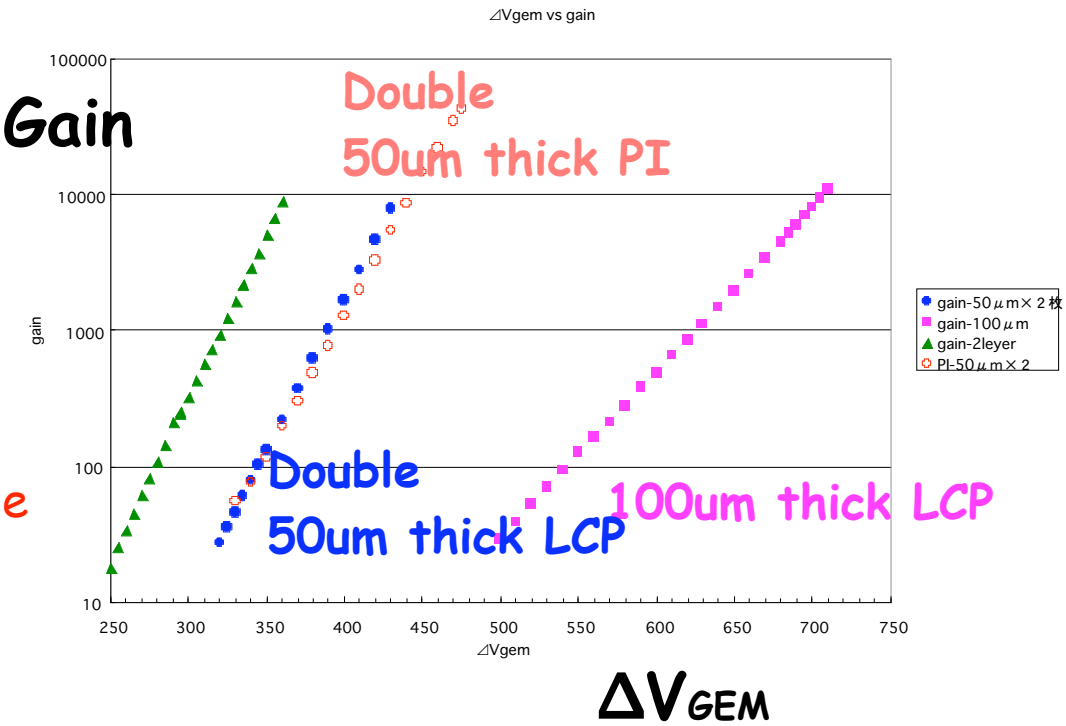
(+2mm) width > 0.3* pad pitch

Why we use 100um GEM



Enough gain for two GEM structure simple

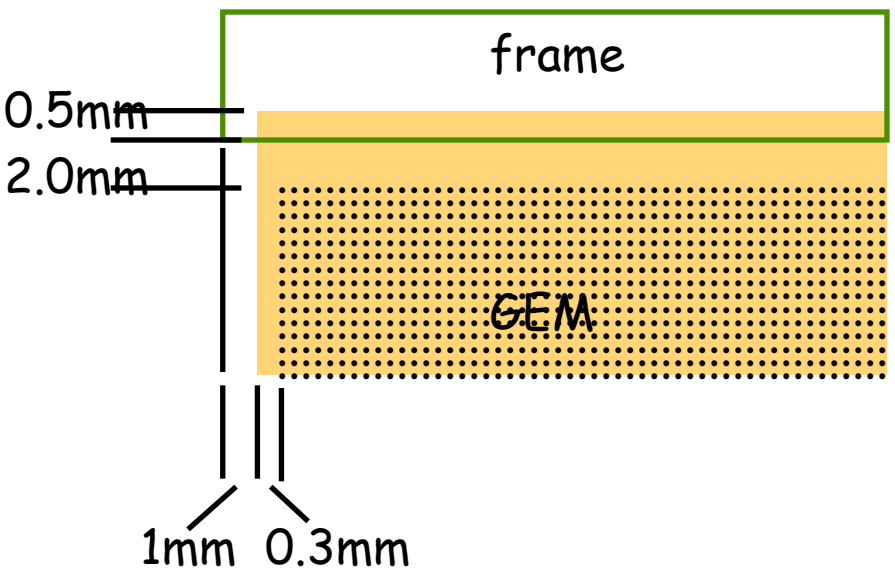
stiff easy to mount ?

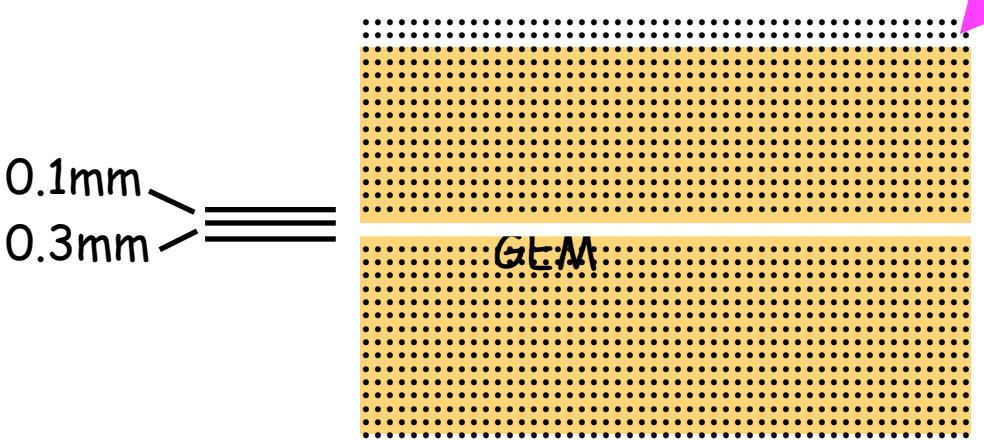


ΔV_{GEM}

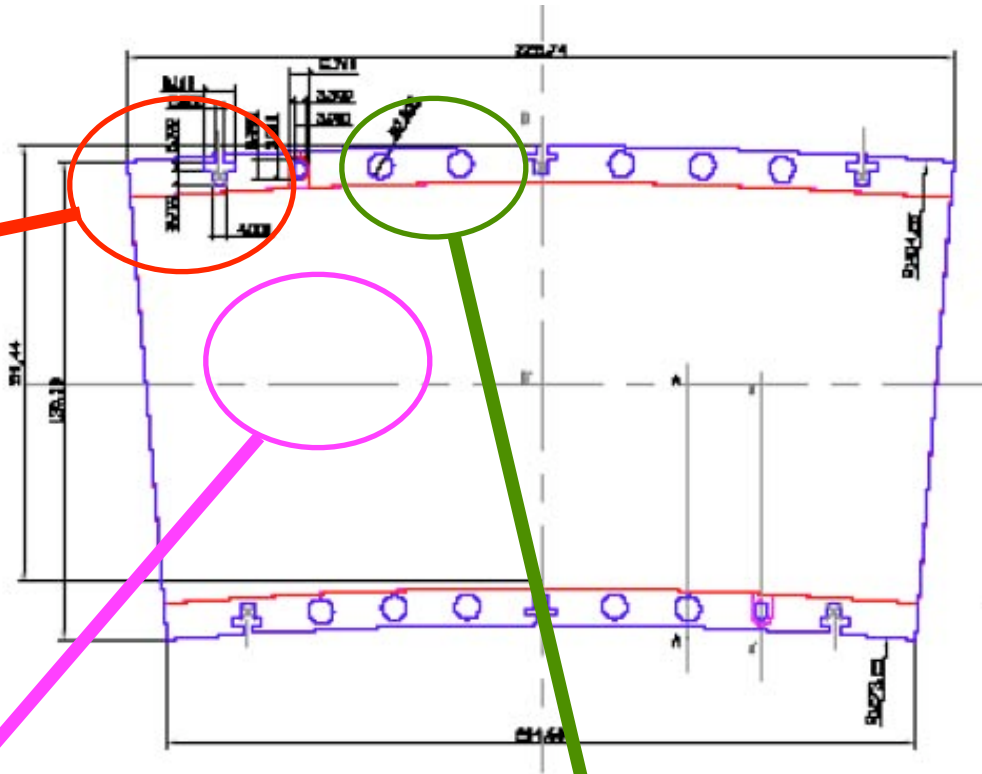
GEM design

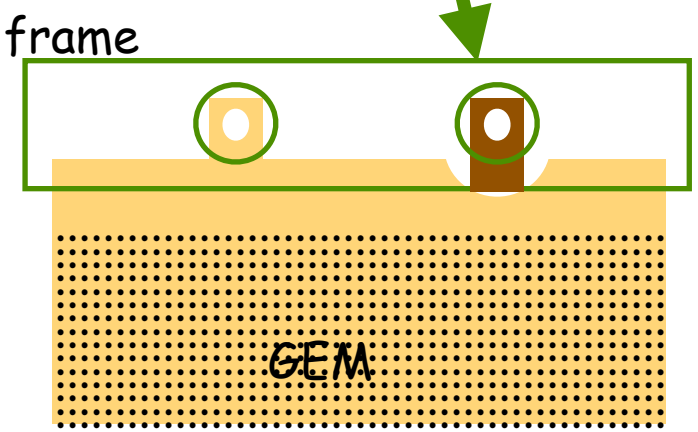
Edge





segmentation





HV supply

Schedule

Parts for GEM panel are almost ready now

Nov. Dec. Jan. Feb. Mar. Apr. May

test of Mount mechanism

GEM production

Pad Plane production

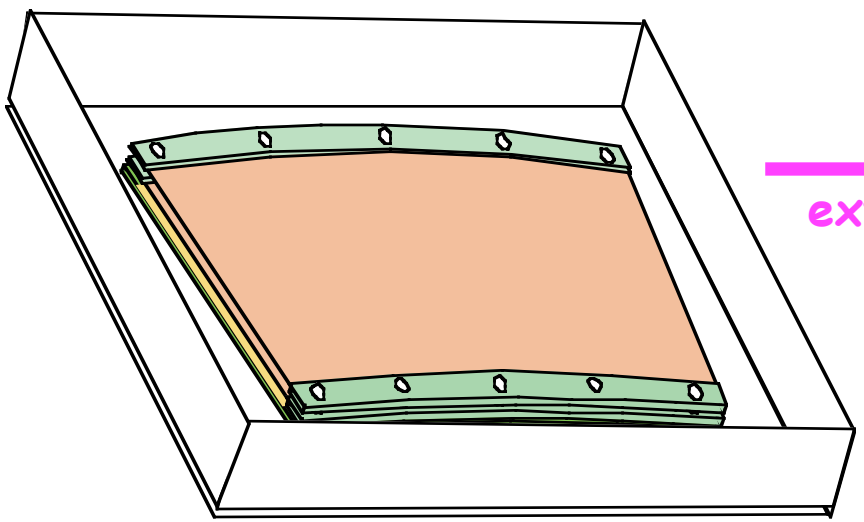
Assembly

TEST

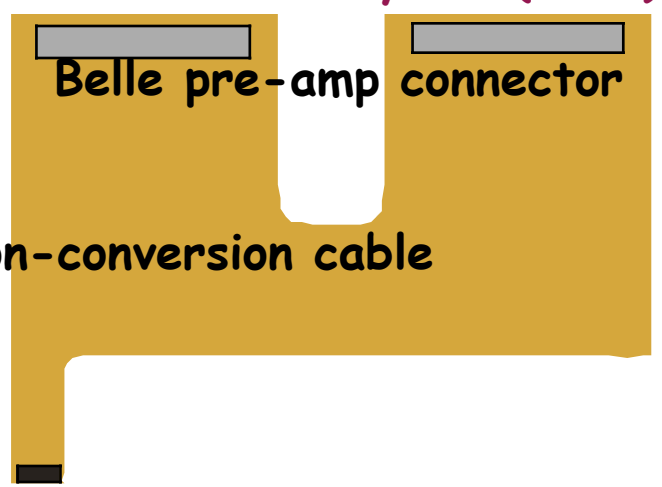
Gain check over the panel with Fe source

container box

ext. cable



using conventional readout system(Belle)



Gating structure is not considered in this test.

It should be equipped if necessary.

But we don't know what is good for gating yet.

-> Aoza's talk

Field adjusting frame is not considered in this test.

anything facing to drift volume should be kept as certain voltage in order to minimize field distortion near GEM

-> Home work for LP1

We may have many missing items .....

we want to realize what is missing for LP1 during this study.

Summary

We started to make pre-prototype
as engineering R&D for LP1

how to minimize dead region due to GEM support
is the most important issue

Parts for pre-prototype are ready,
fabrication/source test is schedule during next months.
we hope this test to be a good information
to LP1 GEM panel design.

any suggestions/idea are welcome and
we hope to work LP1 GEM panel with you