

LP1 study at Asia

Sugiyama

LC-TPC @Asia

KEK, TUAT, Kogakuin, Kinki, Saga

Tsinghua, Mindanao

GEM TPC panel

GEM gating

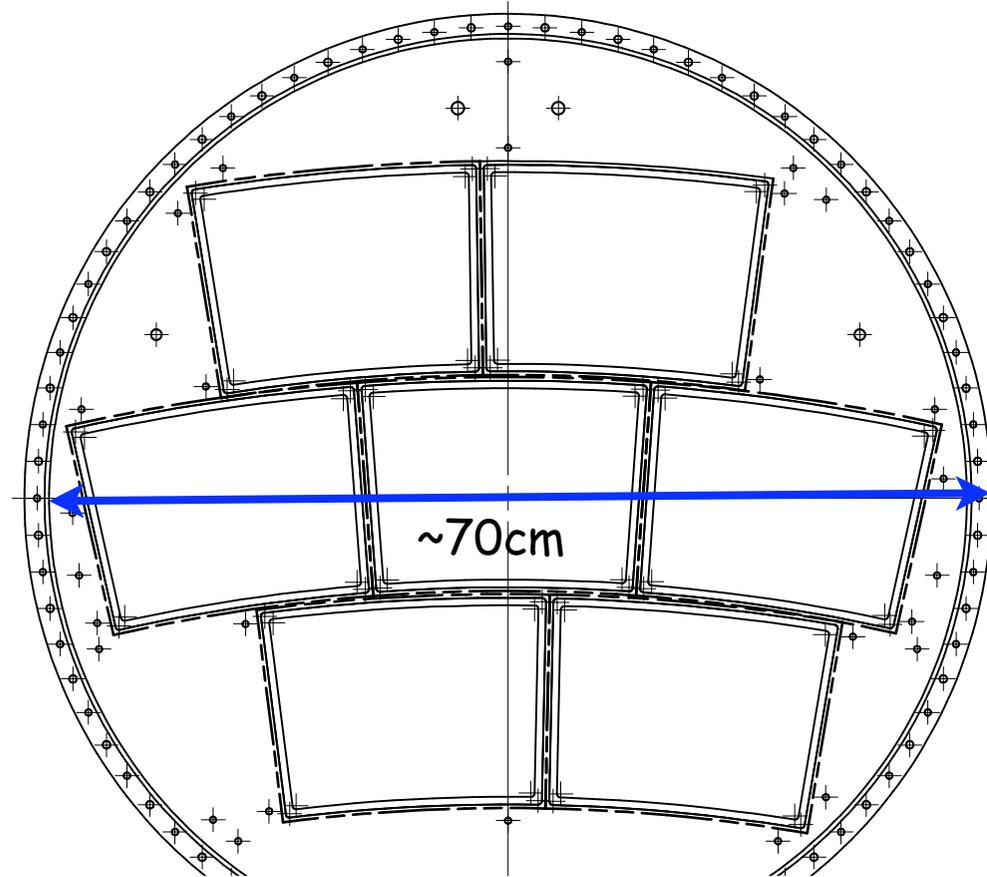
Large Prototype 1

GEM-TPC panel

fill 24 cm x 17 cm pieces

this size might be reasonable for GEM
price, replaceability

Pre-prototype study has been done
for LP1



LP1 EP design fixed

2006

2007

2008

2009

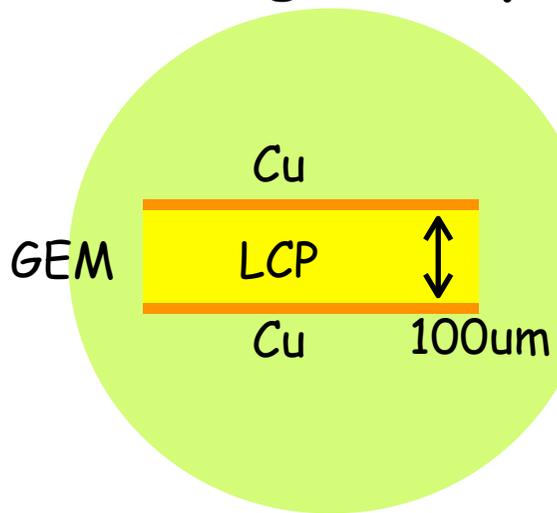
2010



Beam test

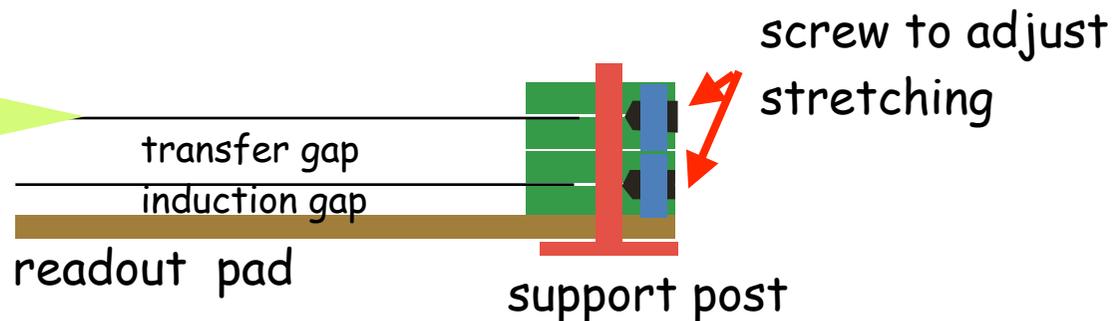


Conceptual design(Pre-prototype)



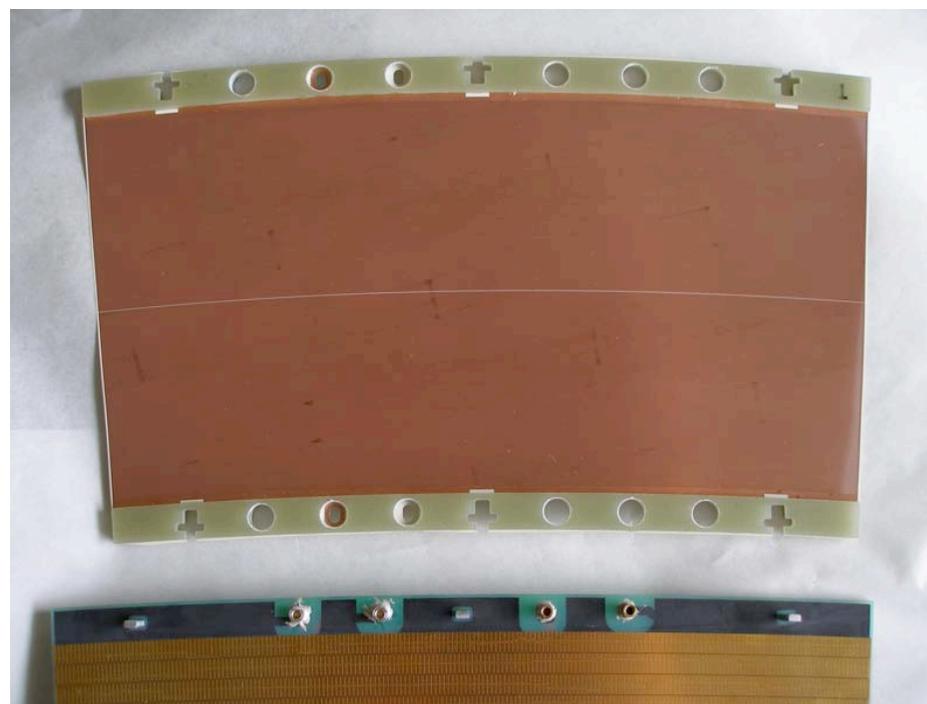
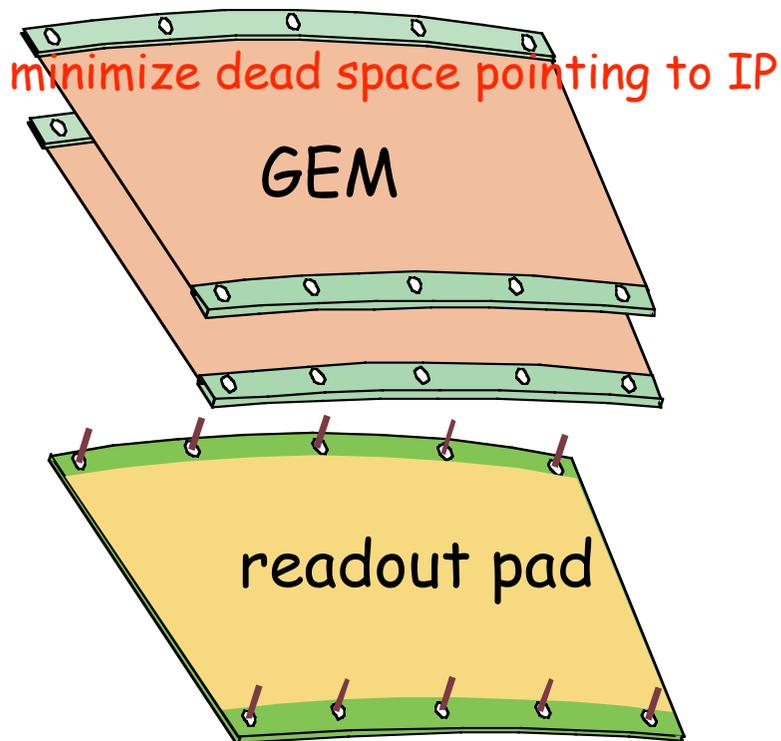
Can we stretch GEM ?

mounting(stretch) mechanism



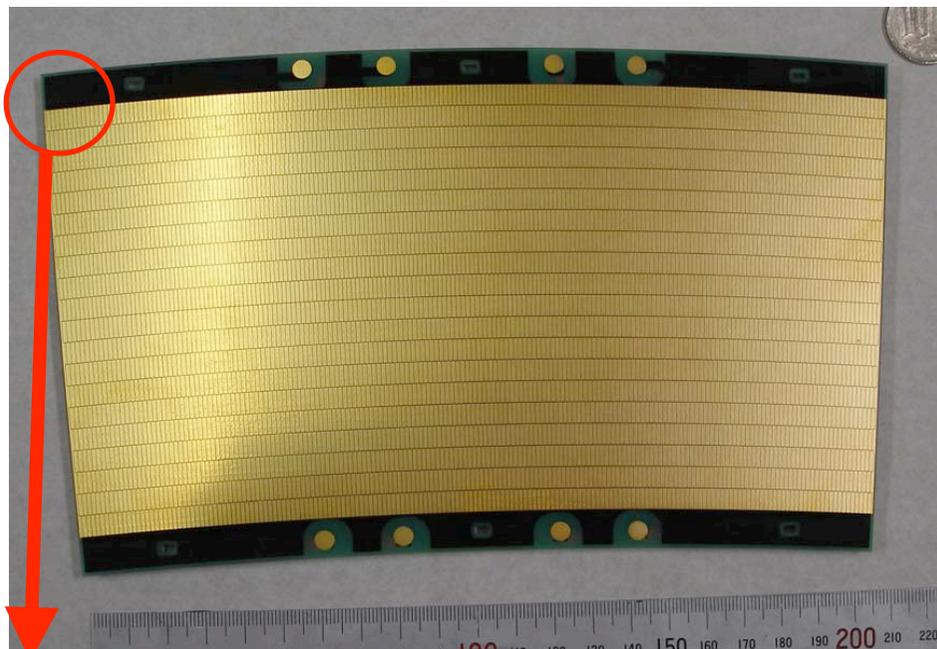
Transfer gap ~ 4mm : enlarge signal distribution
(+2mm) width > 0.3* pad pitch

frame : top & bottom frame.
no side frame



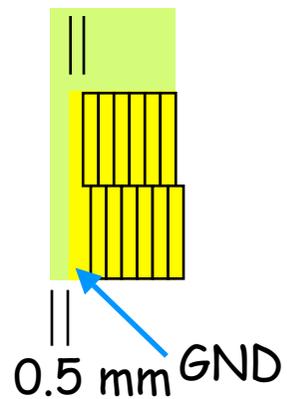
PC Board (Pads & connectors)@pre-prototype

pad size $\sim 1.1\text{mm} \times 5.6\text{mm}$
 ~ 3 times wider than diff@GEMs
20 pad rows (3680 pads)
staggered pad geom.



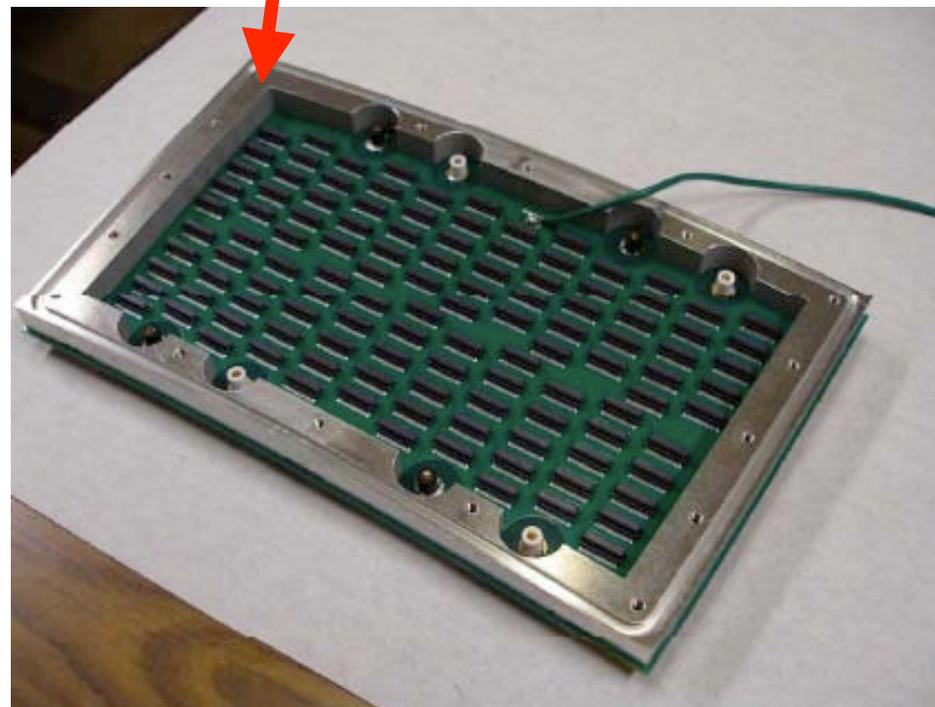
0.5 mm

6 layers PCB
one GND layer



connector space is reduced by
back frame (metal structure to EP lib)

HV connectors are also here

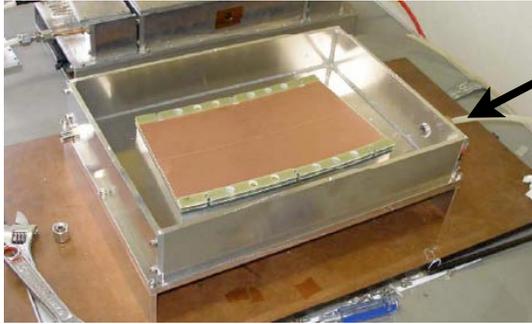


HV line shorts to GND !!

routing is important !!

This will be fixed in Prototype PCB

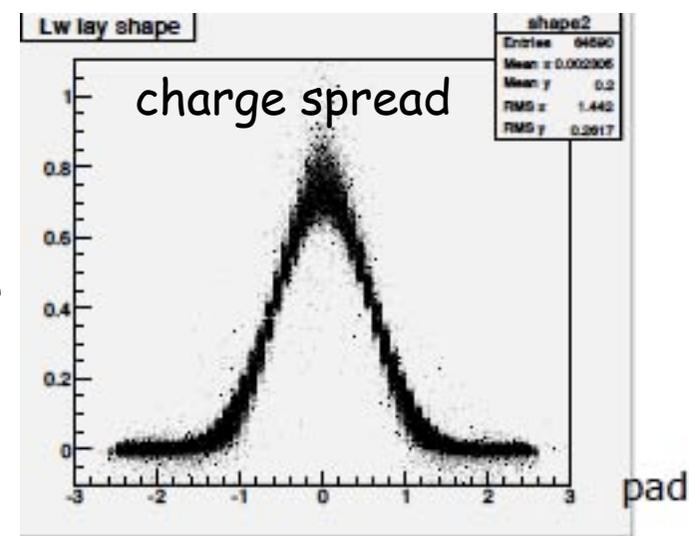
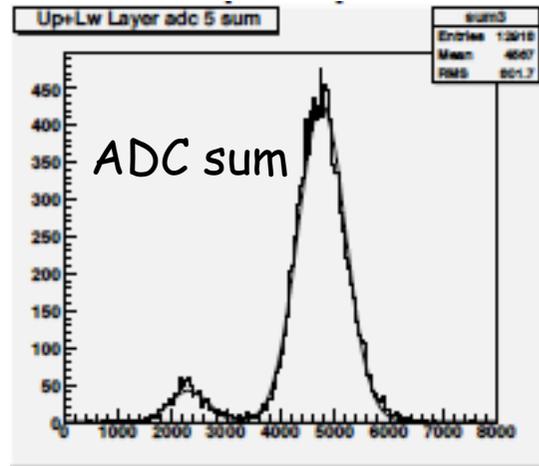
Test result of Pre-Prototype@LCWS07



Ar:isoC4H10(90:10)

Belle
pre/post-amp

CAMAC
ADC



Gain variation over panel ?
charge up on insulator ?

After LCWS07 we've tried to improve setup of test box
but.....

GEM was broken

after some modifications every time

Work under dirty condition cause in fatal damage to GEM
reported from the RIKEN group

Cleanness of working environment seems to be
important !!!

Clean booth was introduced



PC Board for LP1

PCB design/prod. at China (Tsinghua Univ.)

28 pad-rows x 176(192) pads/raw for inner(outer) 14 rows

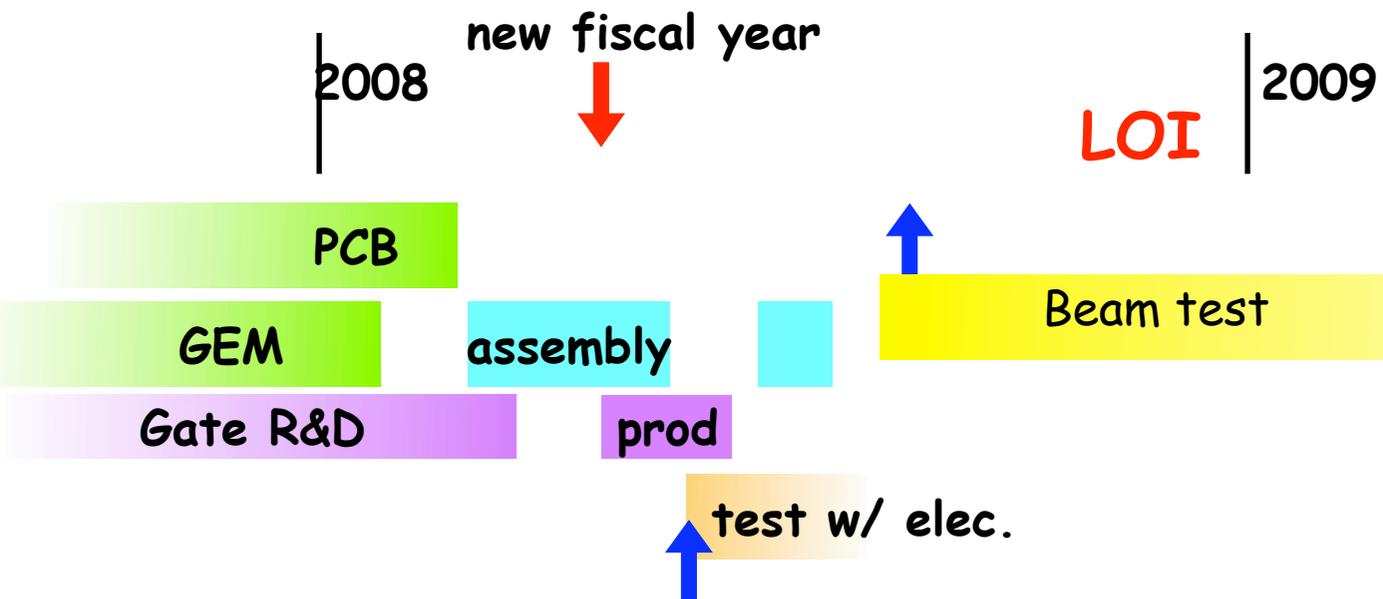
~1.2 x 5.4 mm² pads

routing design will be finished soon

Others designs are same as the pre-prototype

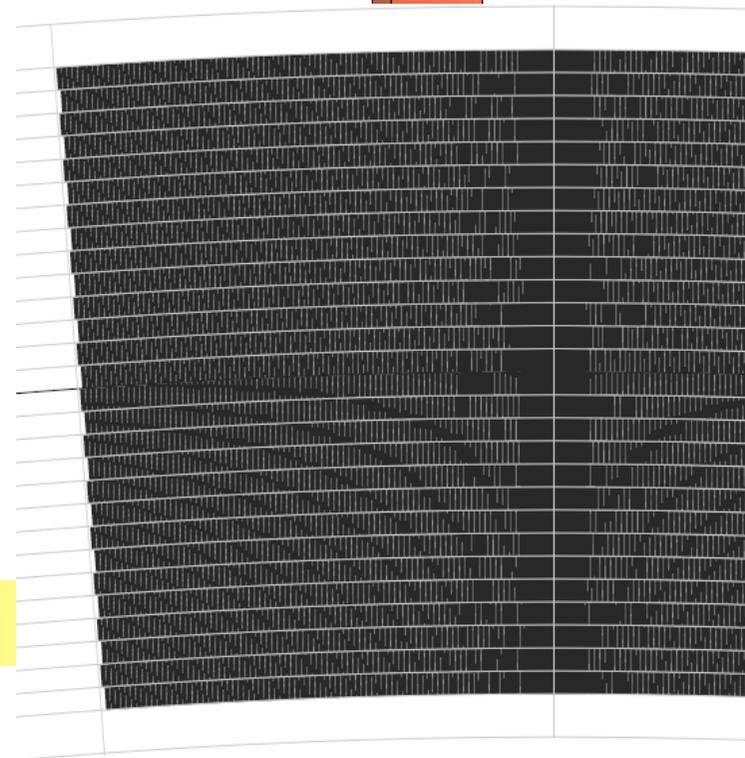
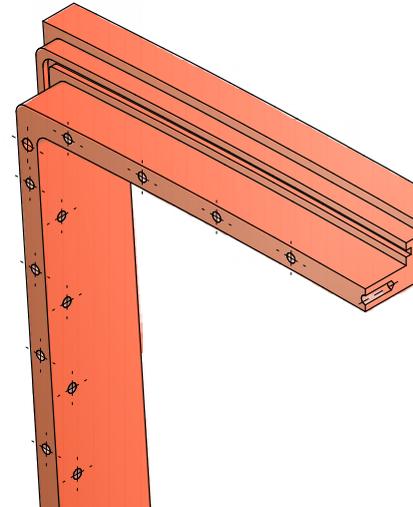
GEM + assembly parts : almost ready now

PCB will be ready @ February



Great ! if a few LP1 electronics is available @ remote site

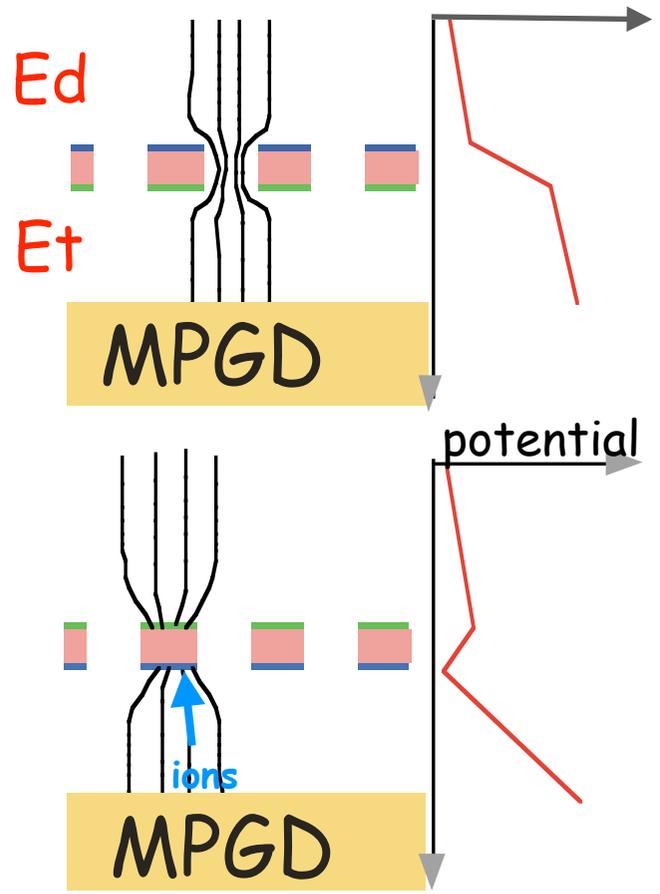
Gate system may not be available @ the beginning of beam test



GEM Gating

Our GEM scheme is based on an existing of extra gating system

GEM



local change of E
electron transmission

Working gate system is necessary

good electron transmission is necessary

in order to achieve this requirement
we have studied GEM gating by the simulation
and

very thin GEM with wide holes

may provide a reasonable results @low VGEM operation

Required Gate GEM performance @LC-TPC

Effect of Ed @12.5 um thick GEM

drift Et 300V/cm

trans. Ed —+— 50 V/cm

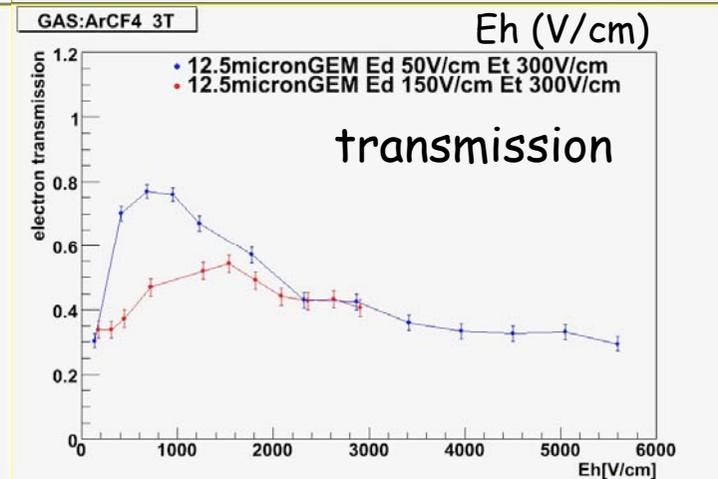
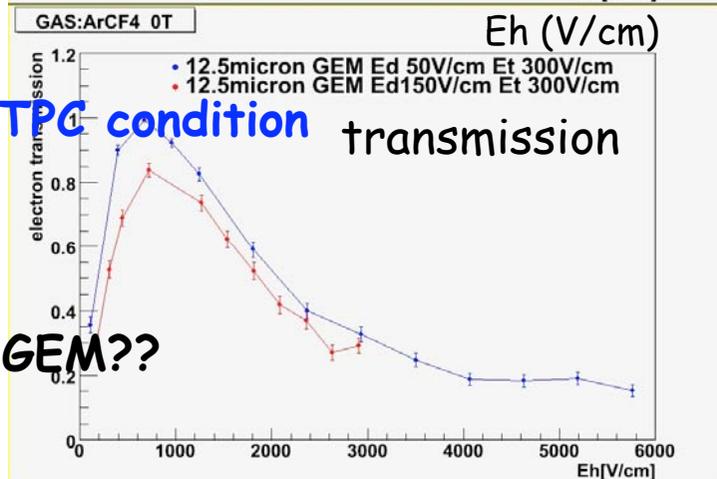
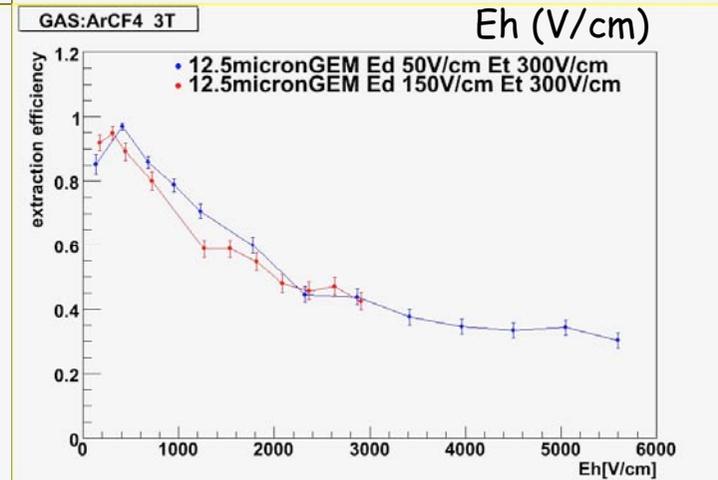
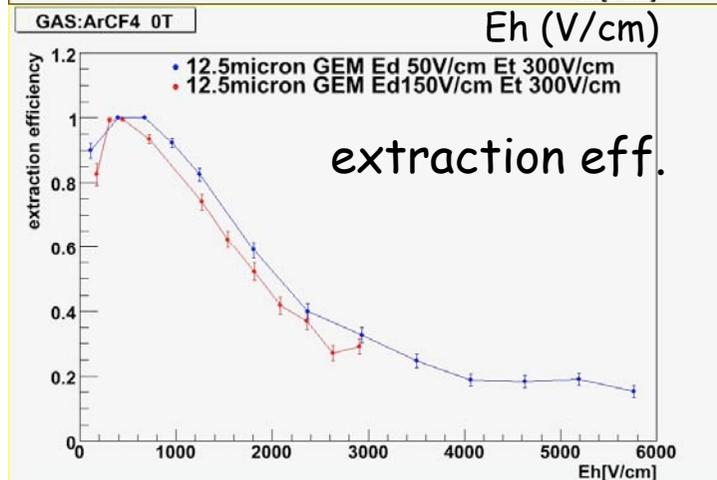
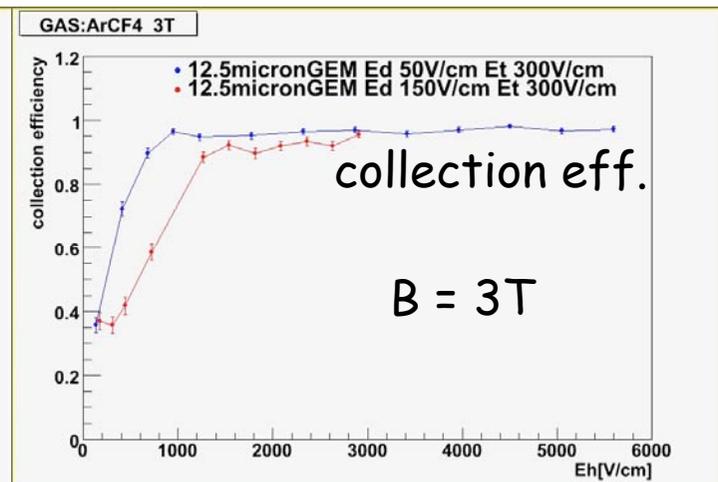
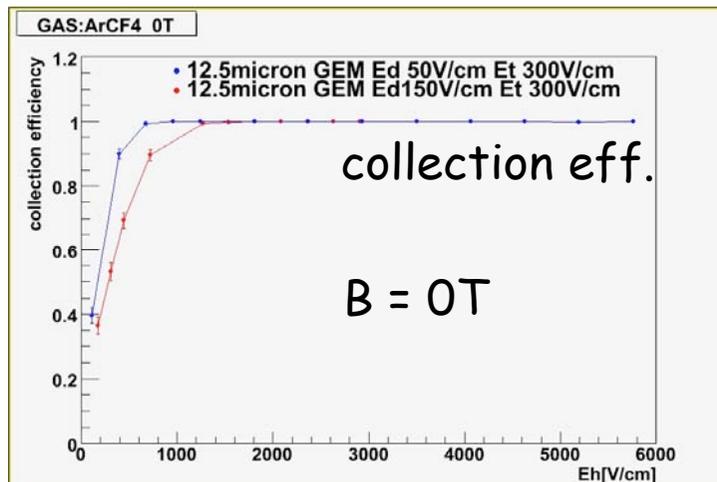
—+— 150 V/cm

Improvement comes from Ed/Eh ratio!

Large hole aperture
Thin foil(insulator + metal)
Straight hole(n.c.)

will achieve
70% transmission @LC-TPC condition

Can we make this kind of GEM??



However simulation must be justified !

Sauli's results are reproduced by simulation

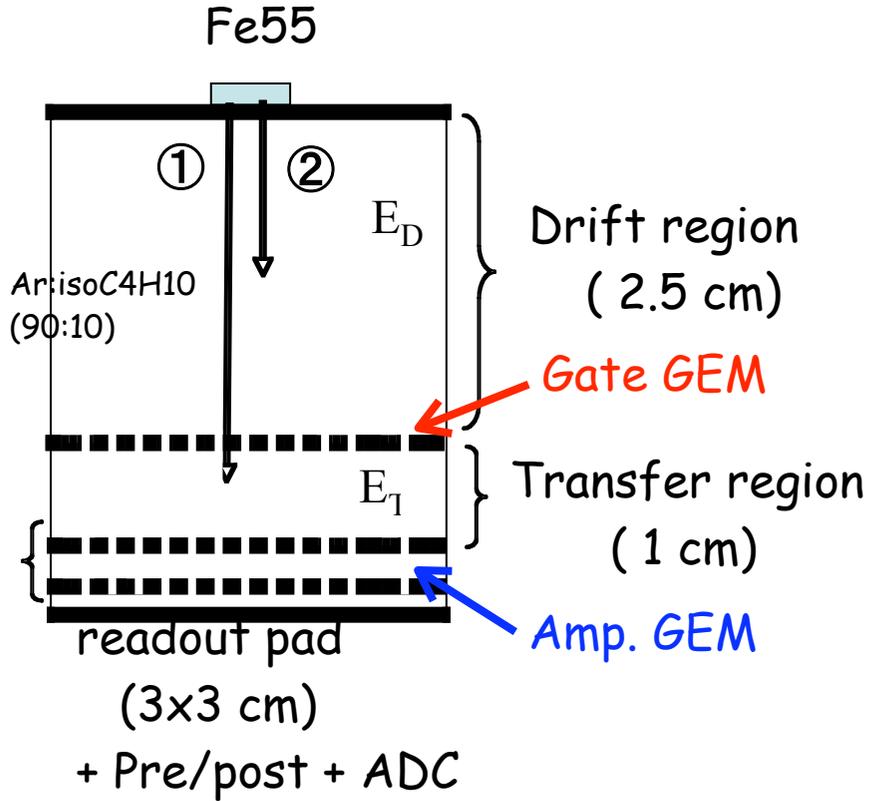
But we are not sure all behavior can be evaluated by the simulation.

We need to compare measurements and simulations under various conditions in order to believe sim. results.

Measurement of electron Transmission

Systematic study of electron transmission:

Method to measure transmission



The most of X-ray convert at drift region due to low att. length

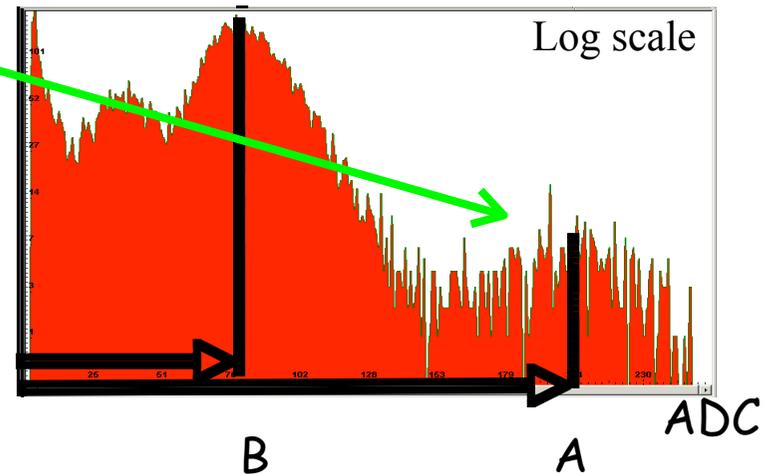
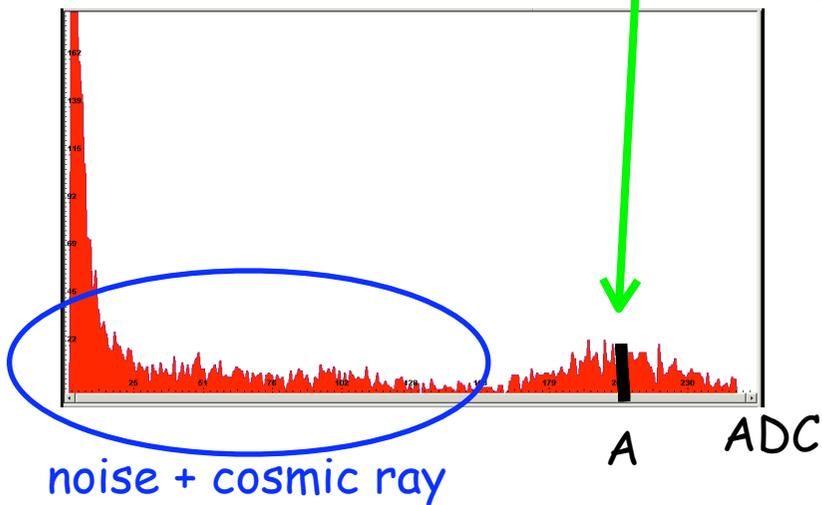
$$N_{pi} \times \text{eff. (transmission)} = B$$

Some of X-ray can go into the transfer region through GEM holes

$$N_{pi} = A$$

② conversion @ drift region

① conversion @ transfer region



$$\text{Transmission} = B/A$$

Measured Transmission

3 kinds of GEM

	foil thickness	hole size
standard:	50um	70um
thin :	25um	70um
thin-wide:	25um	90um

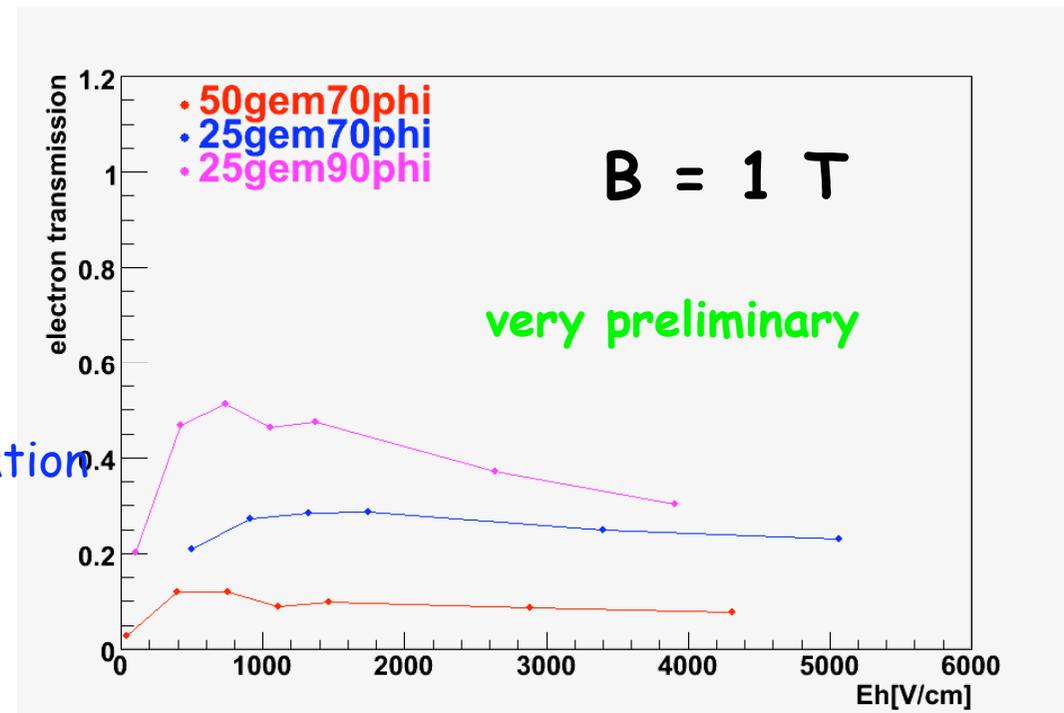
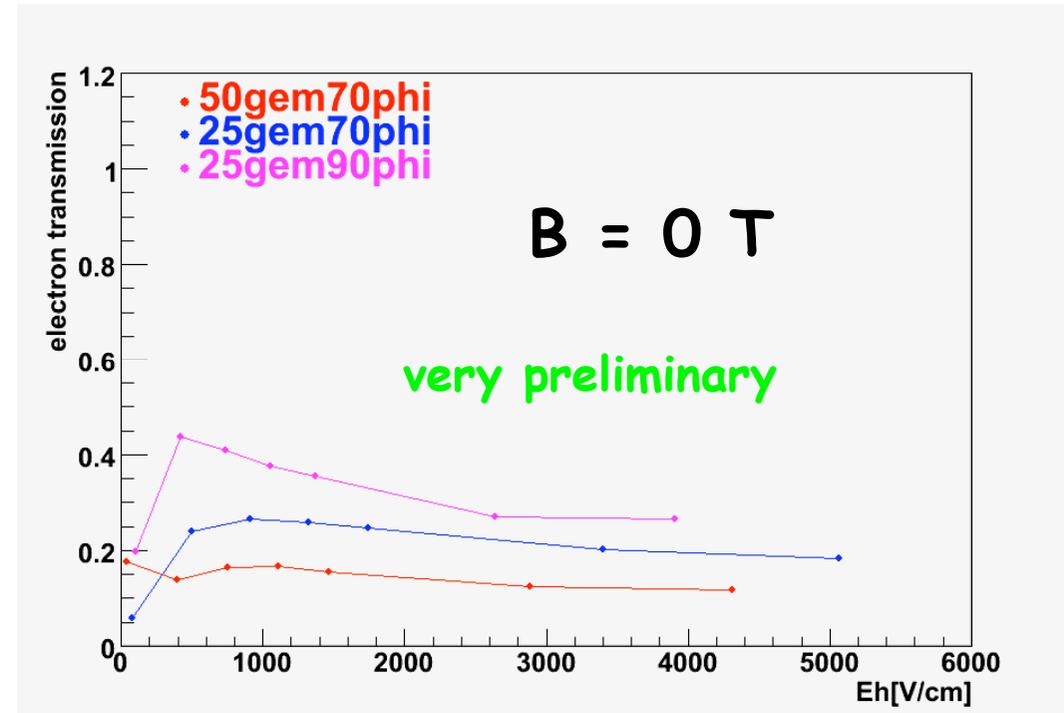
Magnetic field

0 Tesla

1 Tesla @ KEK cryo. center

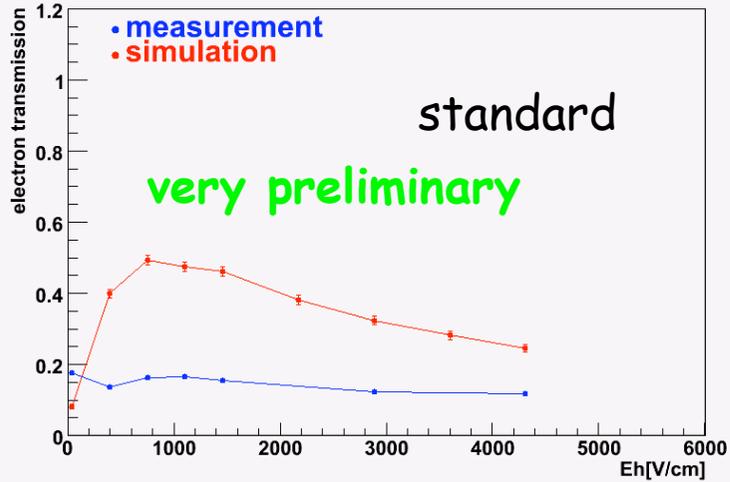
transmission is getting better
as foil thickness becomes thin
as hole size becomes larger
w/wo B field

These are what we expected from the simulation
BUT



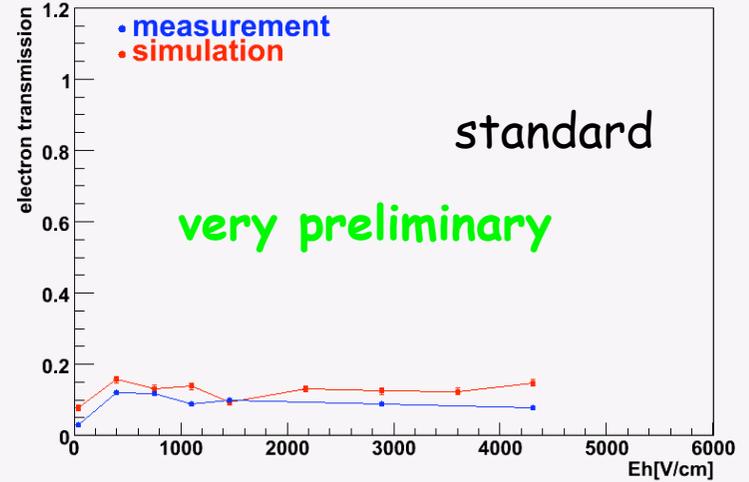
Comparison to simulation

B = 0 T

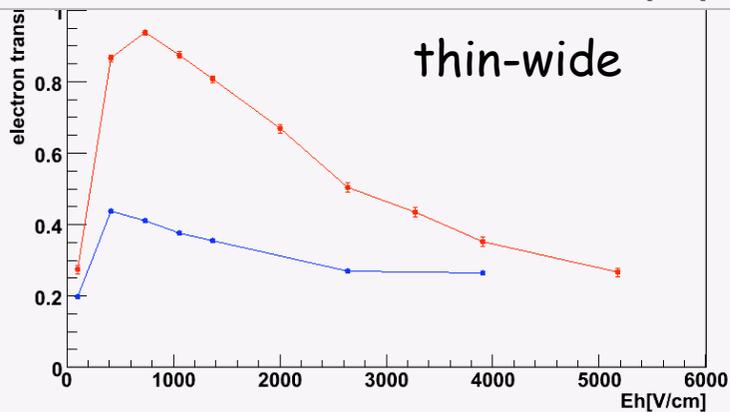
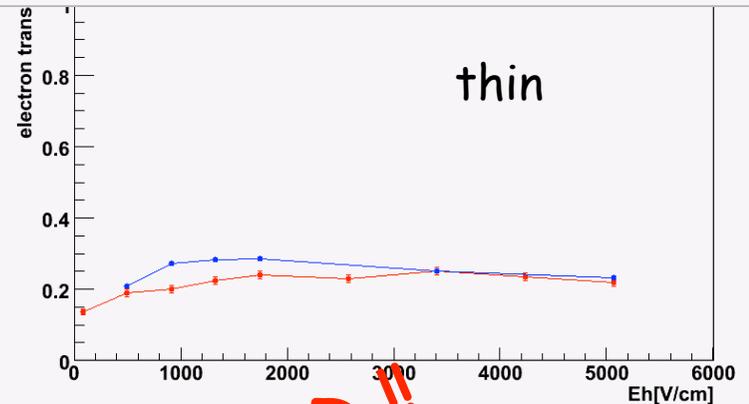
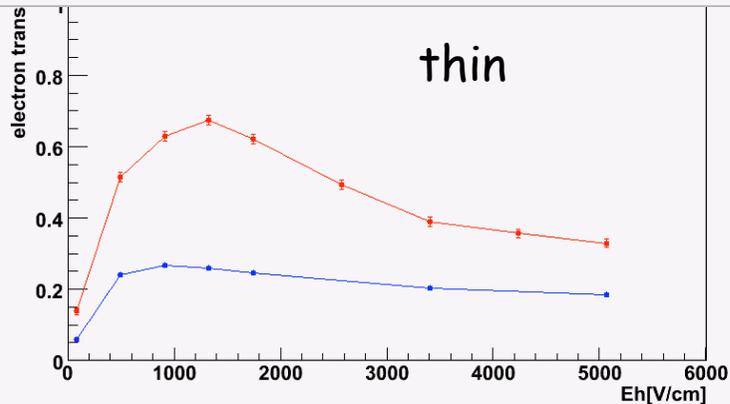


0T case
Large discrepancy
even in behavior

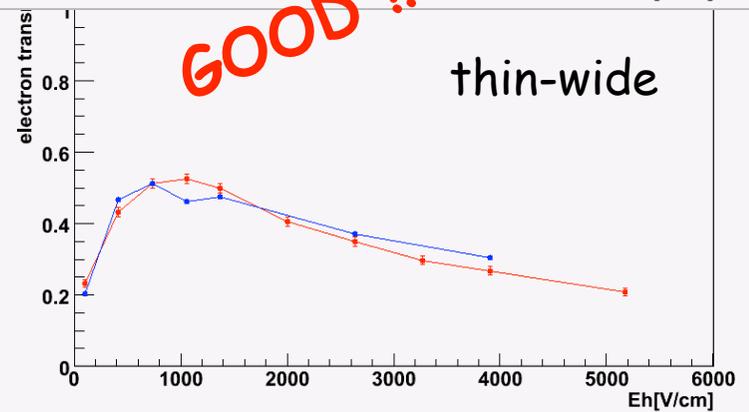
B = 1 T



1T case
results are similar
each other



B filed doesn't change
transmission in measurements



SUMMARY

GEM panel production is on going

GATE GEM study has been started

Gate behavior was reproduced by measurements@B=1T
but not for B=0T
Why ??? under study

Ar:CO₂ data is necessary to confirm Sauli's result
(not done yet)

If someone will measure transmission under B=5T@DESY
using our GATE GEM, it would be great

Also studying possibilities to produce 12.5um-thick wide-hole GEM