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18 - March - 2017

# ILC-TPC用高開口度GEM型ゲート装置のビーム試験における特性評価

## Characteristic evaluation of a GEM-type gating device with large aperture at beam test for the ILC-TPC

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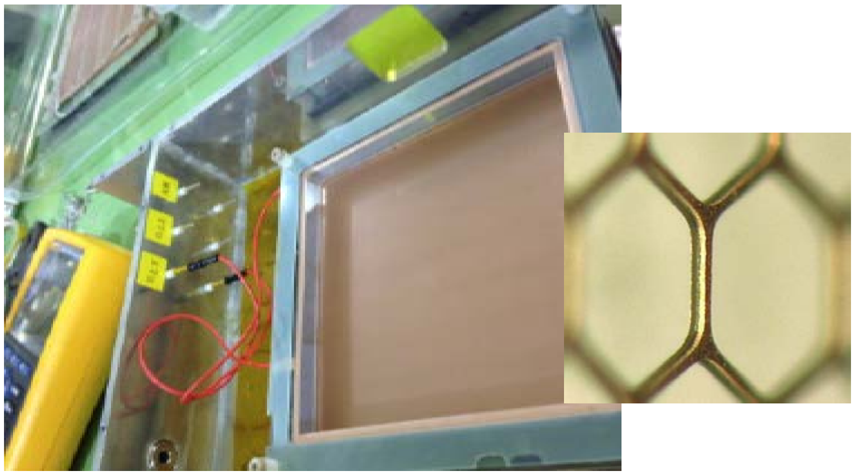
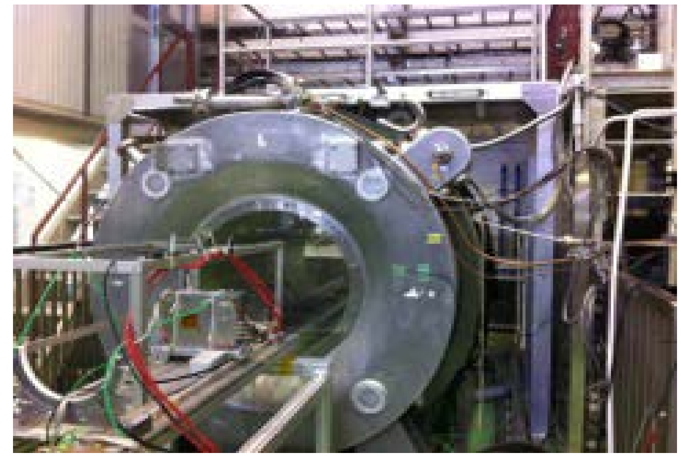
# *The past study of gating GEM*



We had measured the electron transmission rate by using $^{55}Fe$ and laser.

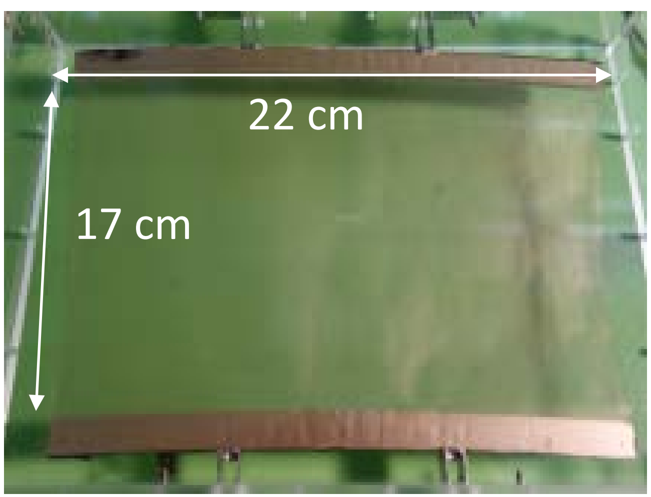
- Measurement using small gate device (10 cm × 10 cm) at B = 0, 1.0 T

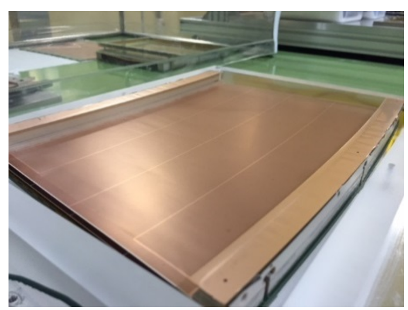


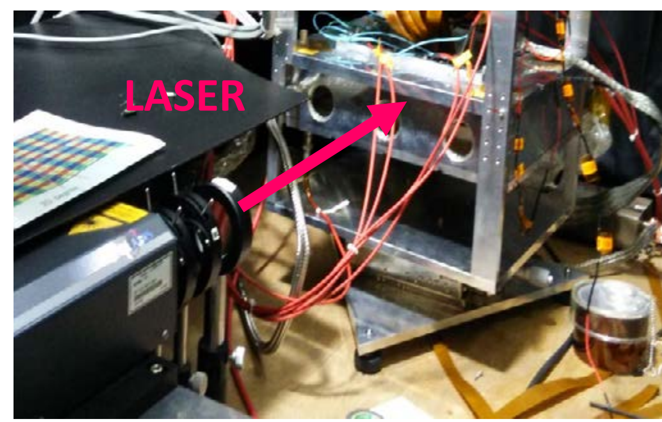


1 T electromagnet/KEK

- Measurement using full size gate device at B = 0 T





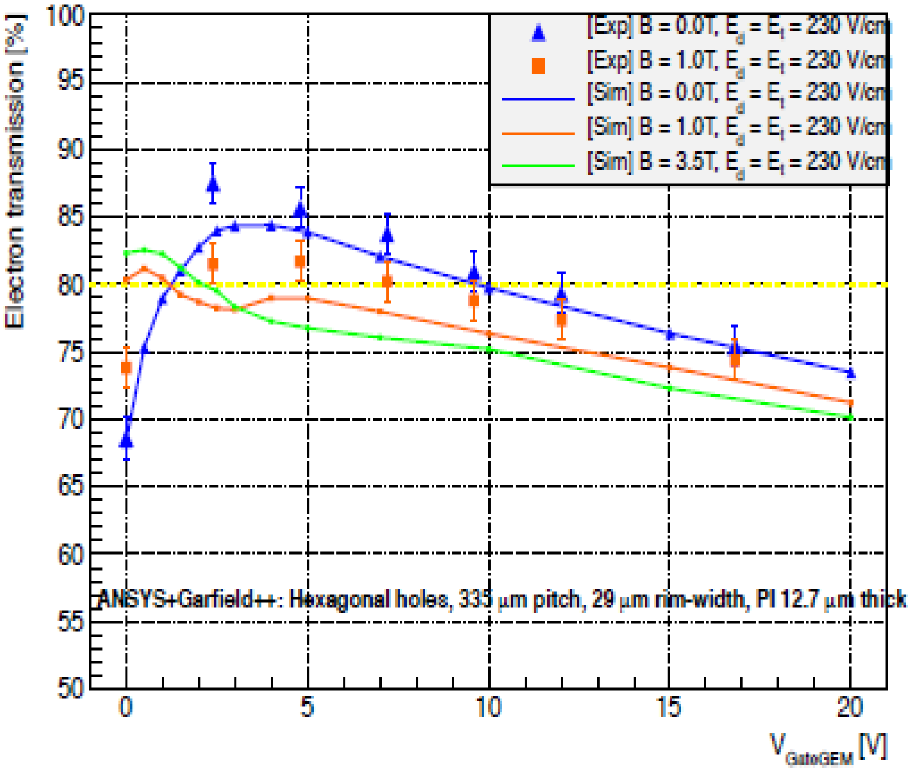

（Reported at the past JPS meeting）

# The past study of gating GEM (result)

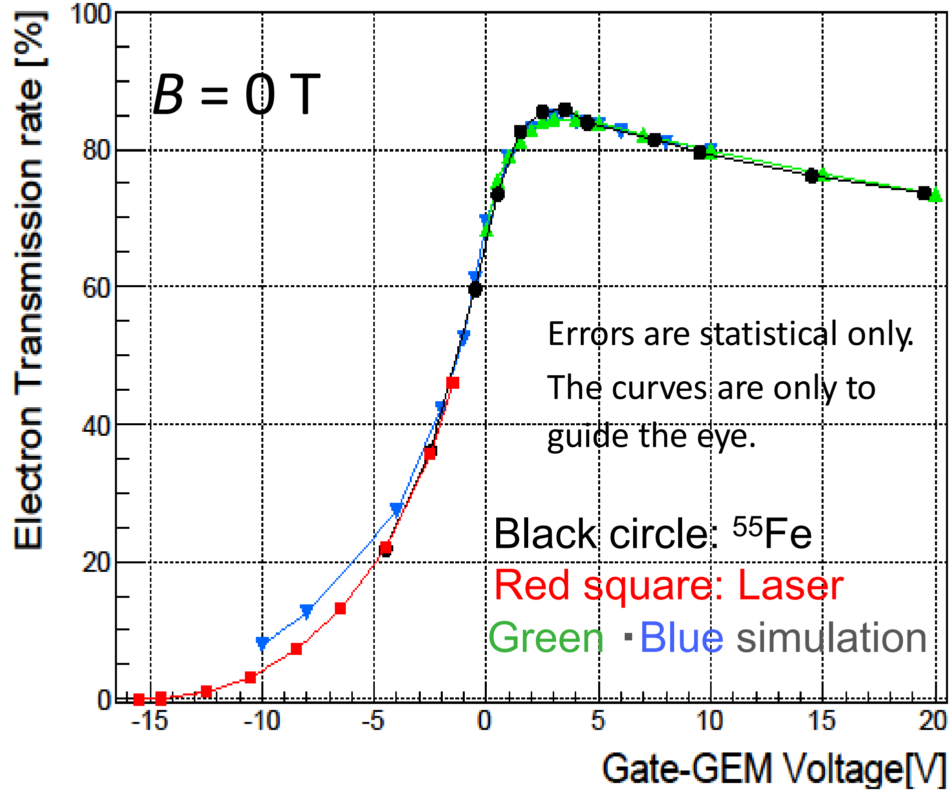


- Transmission rate as a function of the gate GEM voltage, ΔV.

  - Small gate device (10 cm × 10 cm)




  - Full size gate device

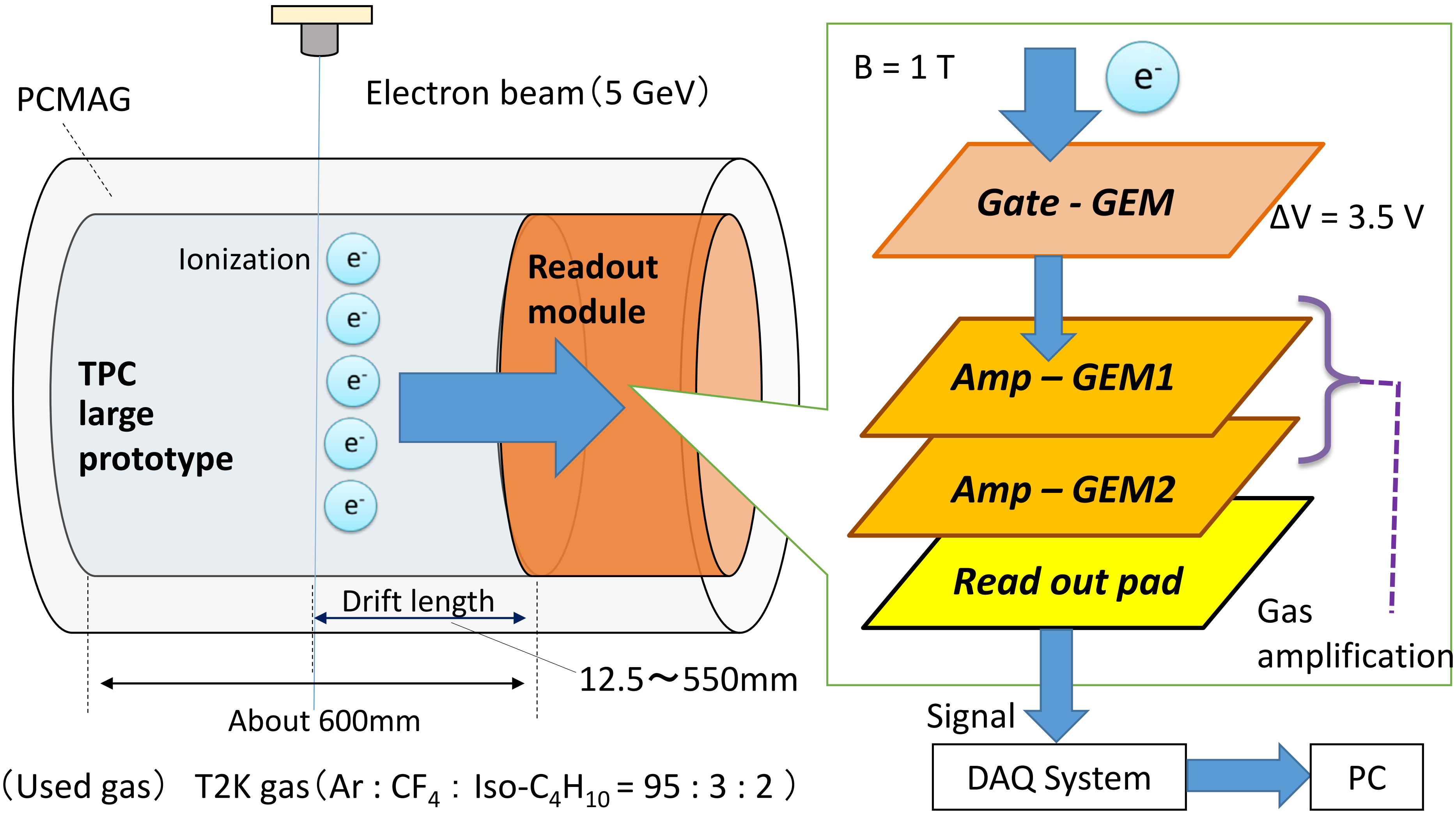



- The transmission rate was found to be ~85 % at ΔV=3.5 V.
- The measurement using a small gate device with B field (B=1.0 T), sufficient electron transmission rate was obtained.

# *Measurement of transmittance using e⁻ beam*



We measured the electron transmission rate using the electron beam with B field of 1.0 T.




（Used gas） T2K gas（Ar : $CF_4$ : Iso-$C_4H_{10}$ = 95 : 3 : 2 ）

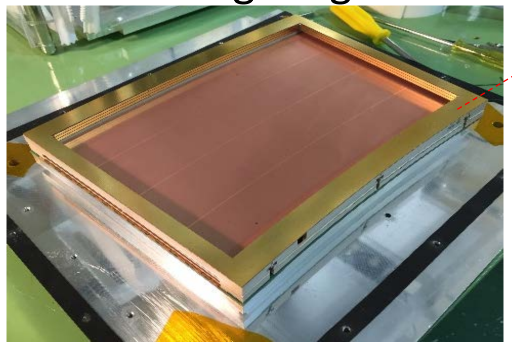
The pressure and the temperature in the TPC were monitored during the experiment.

# Configuration of the GEM module



With gating GEM

Without gating GEM

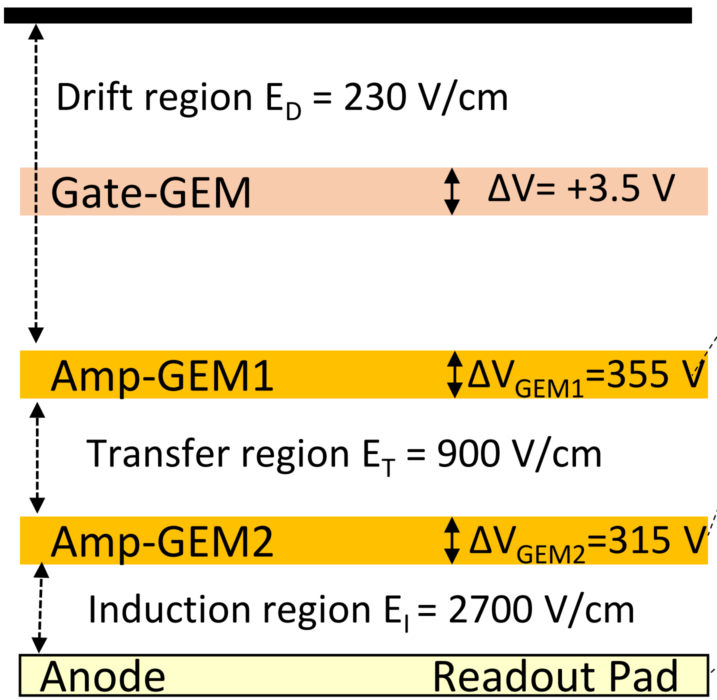


Field Shaper

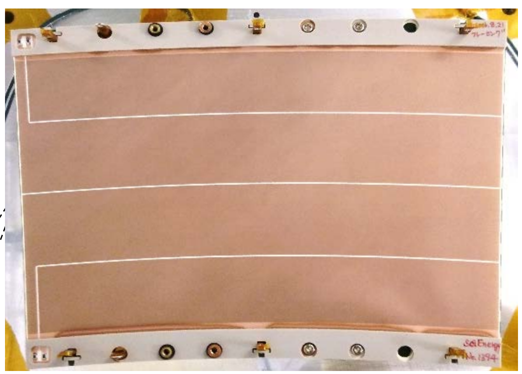
Electron transmission rate
is obtained by comparing
the signal charges for both conditions

(Voltage, Electric field)

Cathode




GEM

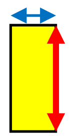


100 μm thick (LCP)

The electrode is divided on one side into four parts to prevent the discharge from affecting whole anode plane.

Pad

1.15~1.25 mm



5.26 mm

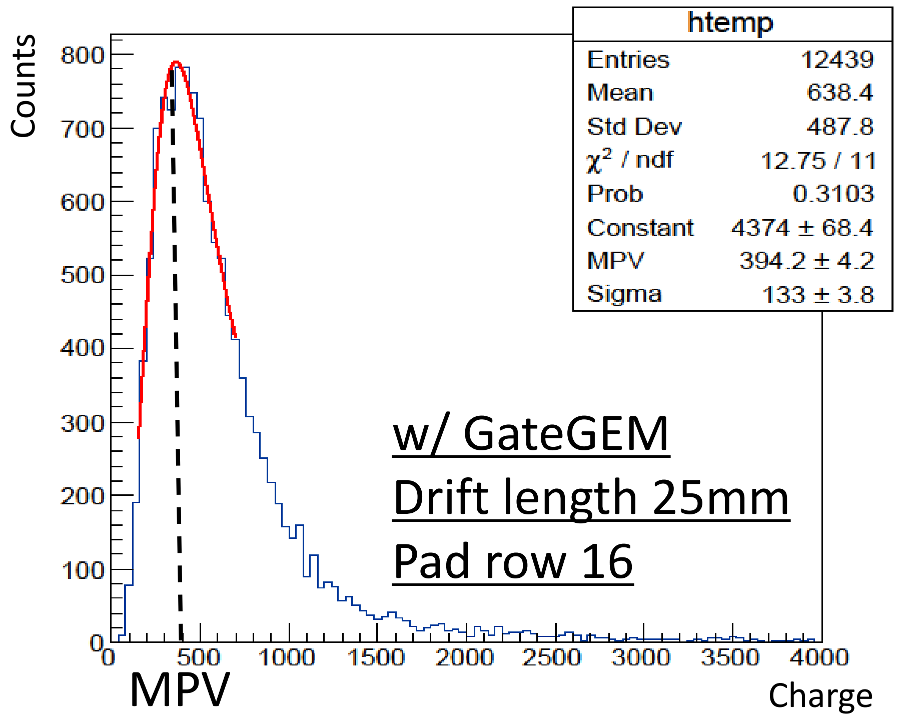
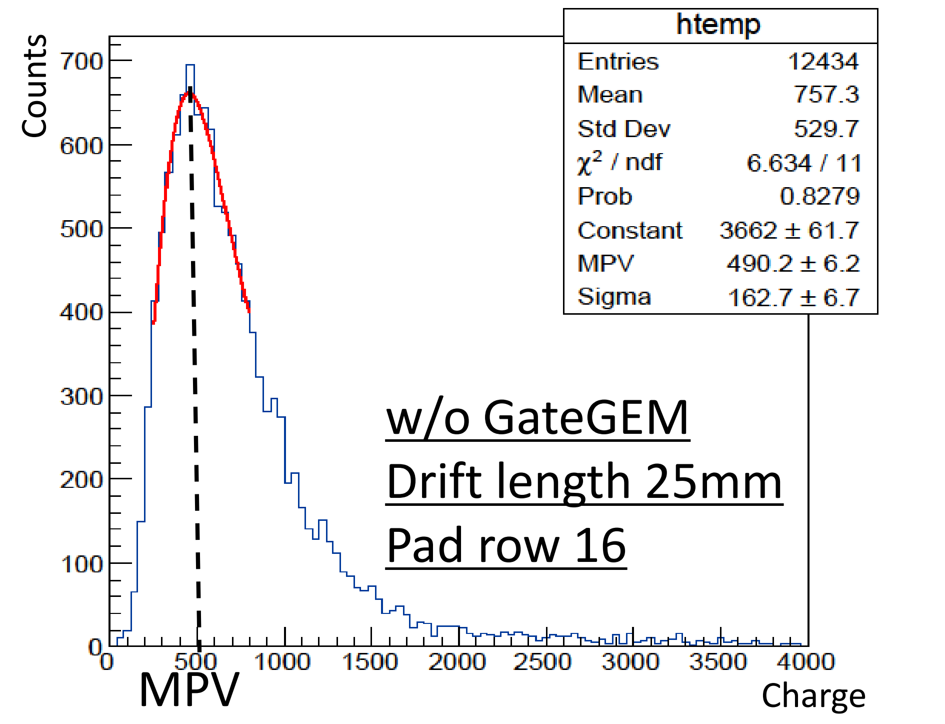
× 5152 pads

28 rows

# How to calculate the transmission rate



The peak value was obtained by fitting with Landau function to the distribution.

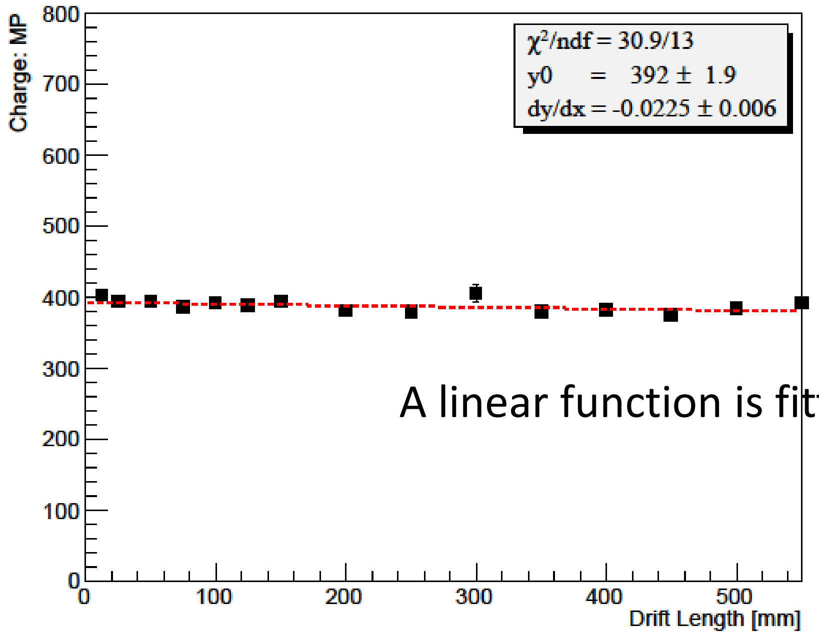
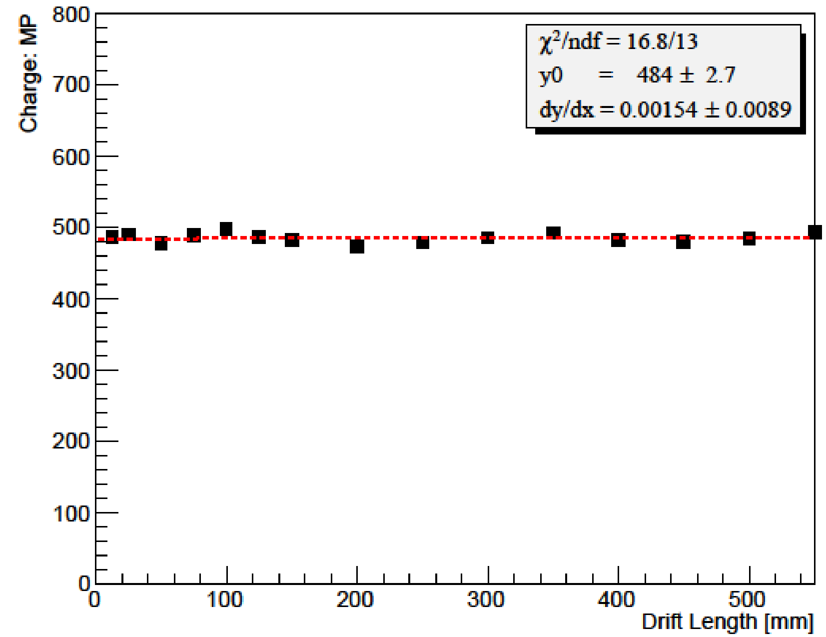
| With gating GEM | Without gating GEM (w/Field shaper) |
|---|---|
|  |  |





$$(Electron\ transmission\ rate) = \frac{Signal\ charge\ (MPV)\ with\ gating\ GEM}{Signal\ charge\ (MPV)\ without\ gating\ GEM} \times 100\ [\%]$$

# *Drift length dependence of signal charge*

| With gating GEM | Without gating GEM (w/Field shaper) |
|---|---|
|  |  |





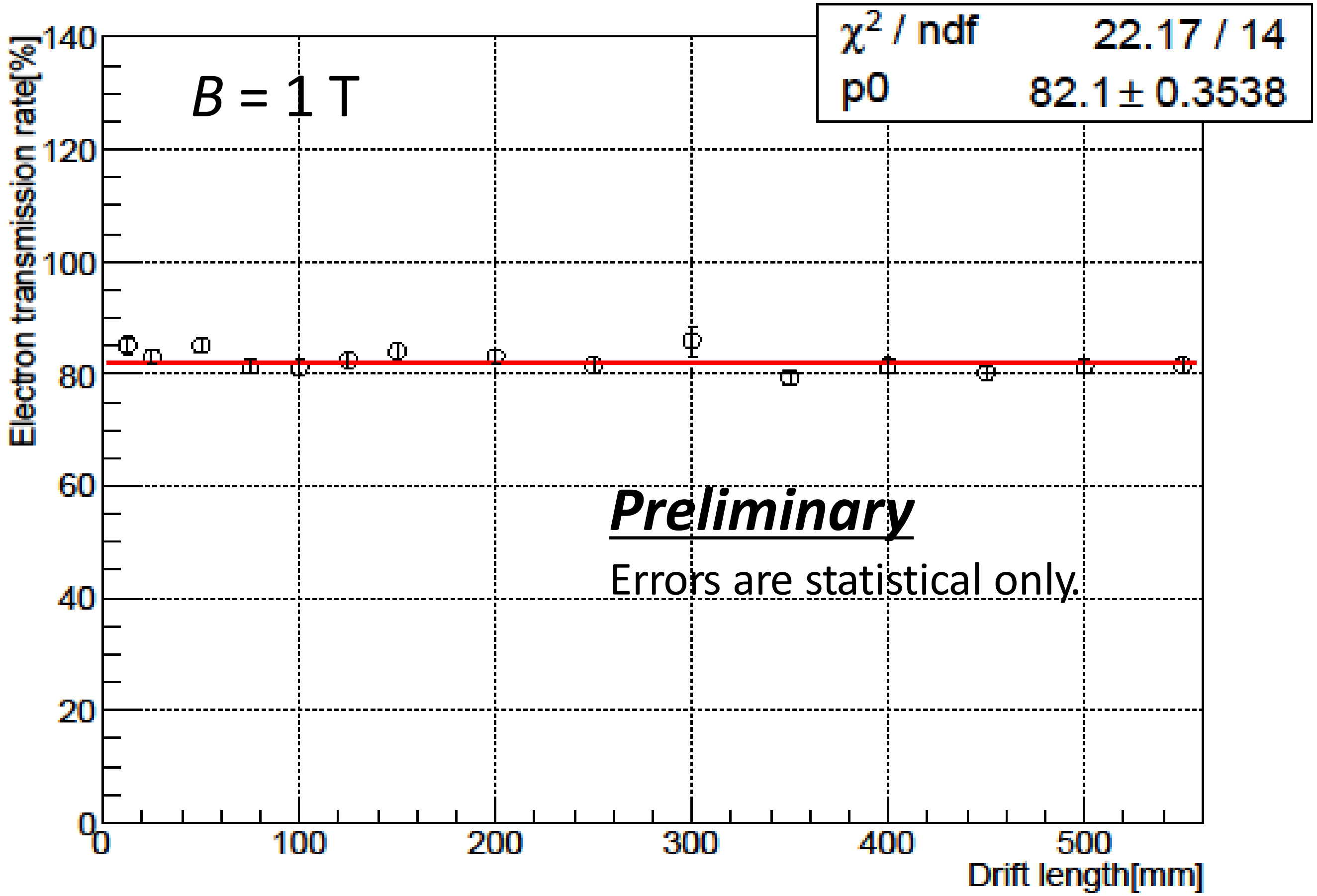
A linear function is fitted.

（Pad Row 16）

- Charge is smaller with gating GEM than without gating GEM
  ⇒ Calculate electron transmission rate from the ratio of these.

# *Drift length dependence of the transmittance*



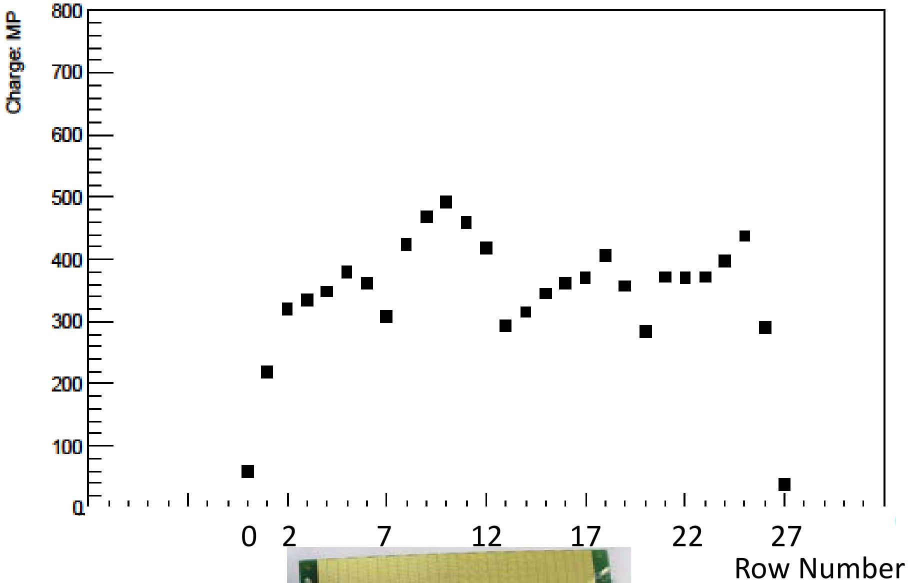


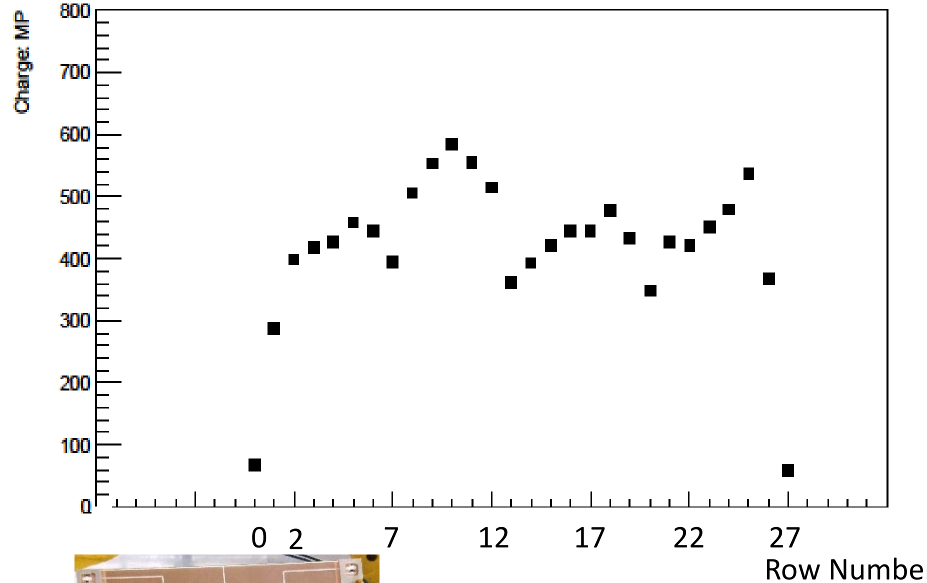

In the calculation of the transmission rate, we used the corrected charge values considering the fluctuation of the pressure / temperature during the experiment.

- Electron transmission rate does not seem to depend on the drift length.

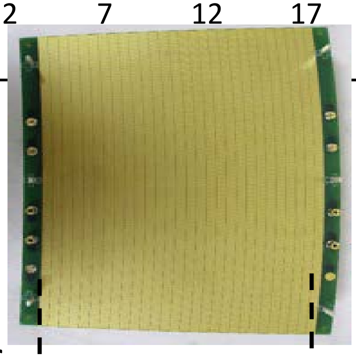
# *The signal charge for each pad raw*

| With gating GEM | Without gating GEM (w/Field shaper) |
| --- | --- |



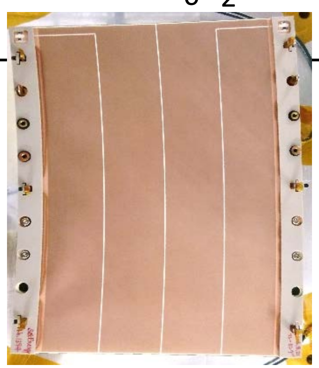




(Drift length 25 mm)



Pad row number 0 ------------------------ 27

Amp GEM



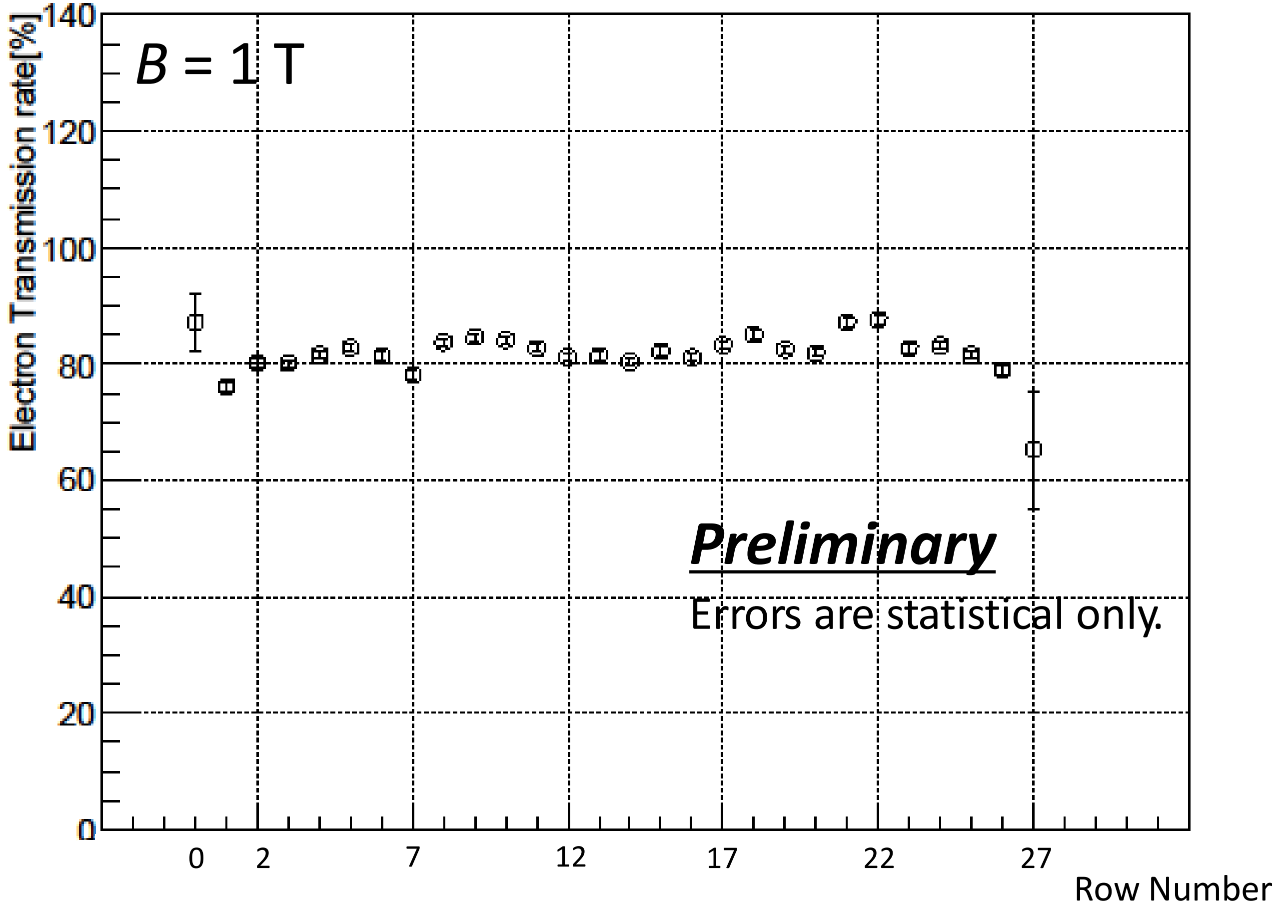
- The influence of charge loss due to the electrode gap of GEM can be seen.

⇒ Calculate electron transmission rate from the ratio of these.

# *Pad row dependence of the transmittance*



（Drift length 25 mm）




- The electron transmittance was almost constant (average 82.1 ± 0.14%)
- But structure in the plot can been seen ⇒ not understood yet

# Summary



- We have investigated the performance of the full-size gating GEM using the electron beam with B=1.0 T.
- The electron transmission rate was measured from signal charge distributions obtained with and without gating GEM.

- The transmission rate was found to be reasonably high (>80%), and it does not have dependence of the drift length or the readout pad position.
- The values obtained in this study are consistent with that calculated from Neff and results for the small sample in the past study.

**Future plan**

- Considering deriving stopping ratio to positive ions.
- Investigating the electron transmittance with higher magnetic field, such as 3.5 T.
- Optimizing the parameters in the simulation to get good consistency with the experimental data.

***Thank you for your attention !***

***Fin.***