Minutes of LCTPC Japan group face to face meeting

May 13(Sat.) 11:00 - 14(Sun.) 12:00, 2017

Room 425, Building No.3, KEK

Attendance:

[KEK/SOKENDAI] Keisuke Fujii, Tomohisa Ogawa, Yumi Aoki, Takeshi Matsuda

[Saga University] Akira Sugiyama, Takahiro Fusayasu

[Iwate University] Shinya Narita, Aiko Shoji

[Kindai University] Yukihiro Kato

[Kogakuin University] Takashi Watanabe

[University of Tokyo] Junping Tian

Agenda:

[1] Beam test analysis

Yumi and Aiko reported status of beam test analysis.

Report from Yumi:

・Yumi was evaluated for Pad response, spatial resolution, and electron transmission rate was obtained from Neff.

・The reason why diffusion coefficient Cd is different with or without gate is not clear. The cause may be caused by the gain different (gain is not uniform), but try to clarify the cause by comparing the results of other data sets.

・In module 0, good data could not be acquired because the gain was lowered. This cause has not been clarified. If we have time to check the gain before the beam test, we might have noticed that earlier.

・She will evaluate pad position dependence of position resolution and simulate gain uniformity of Amp GEM using Garfield.

Report from Aiko:

・Aiko calculated the electron transmission rate by fitting the charge distribution and using MPV.

・The drift distance dependence of the electron transmittance is almost constant.

・The influence of charge loss at the GEM boundary was conspicuous in the dependence of the charge on the pad row. This is one of the problems to be solved, but it will be a long-term task to solve.

・In the pad row dependency of the electron transmittance, the charge loss structure was slightly observed even in the electron transmittance. Since the transmittance is obtained by comparing without the presence or absence of a gate, the transmittance should be constant, and such a structure should not be seen theoretically. It is thought that this cause is caused by the fact that the electric field formed without the gate is different.

・She will calculate dE/dx from charge data.

[2] Simulation of electron transmission and new analysis of transmission

Report from Sugiyama:

【Simulation of electron transmission】

・Nagasaki(Saga student) made a new model of gate GEM and simulated the electron transmittance.
・Collection and extraction efficiency depend on structure of rim reasonably. Total transmission is mainly determined by global size and not affected by detail rim structure so much.
・The simulation result of the transmittance at the magnetic field 1 T has not been improved.
・How much electron is displaced from a starting point? Due to lack of time, he check it at only limited region. As far as up to B =1T displacement is acceptable. If $V_{gate} < 5V$, displacement and sigma increase seem to be acceptable as far as Garfield++ is correct.

【New analysis of transmission】

・Proposal on new method of calculation of an electron transmittance: Up to now, the transmittance was obtained by using two data, but the time to acquire these two data is different, taking into consideration the error due to the time change of the gain have to do. Proposing to obtain transmittance by trying single data. There are four peaks in single data, and the transmittance is obtained therefrom. Even when the peaks overlap, it becomes possible to calculate the transmittance by using parameters taking into consideration factors such as Auger effect ratio, main peak ratio and escape peak ratio etc...
・Stability of parameters will be show by Yamashita(Saga student) later.

[3] Measurement of ion back flow (IBF)

・It is unknown how much current generated when ions reach readout. Construction of a measurement method for IBF can be a long-term task.
・We would like to discuss measuring method with Paul and someone. Huirong may know the measuring method? Kobayashi also has something to think about? We will discuss building the measurement method at a meeting, later.

[4] Electron transmission of an "Amplification" GEM under 3.5 T or 4 T

Report from Ogawa:

・GEM has not been used under high magnetic fields with gas that $\omega\tau$ is large (transverse diffusion is very small).
・Ogawa simulated the loss of seed electrons. Simulation was performed by changing the magnetic field from 0 to 4 T. At 100 μm (GEM thick), seed electrons tend to be more easily lost than 50 μm (GEM thick). As the magnetic field increases, the electron loss increases. At GEM hole size φ=100 μm is better result thanφ=70 μm.
・Behavior of electron transportation (Garfield++) under a high B filed does not have sufficient reliability. (e.g. gating GEM with lower voltage under the B) Nevertheless, it gives us results being close to real data.(e.g. gating GEM with higher voltage) Some measurement seems to be necessary under high B (which should be > 3). To avoid the loss of seed electron a possible idea (in the case of GEM) is to enlarge the hole size, to use 50um GEM, to apply much higher voltage (gain get larger).
・We must consider whether there are experimental facilities that can conduct experiments under high magnetic field. We should consider making small chambers for that experiment. After realizing the agreement between the simulation result and actual measurement result at the present φ = 70 um, we think about φ = 100 um.

[5] Module boundary

・There is no progress. Manpower required. Simulation is needed.

[6] Gating GEM's side frame problem

・Tomohisa attached one simulated plot showing the transmission of the ions w/ and w/o diffusion on e-mail.

・The ion "almost" follows electronic force lines. This means if there is no a side frame of the gating GEM, some ions might leak from the side to some extent and make square ion discs which might affect the spatial resolution. This should be simulated, and measured in the future if the fact is real.

・By some appropriate design Keisuke think we could in principle prevent all the E-field lines from the region of the amp GEM (with holes)from leaking into the module-to-module gaps so if the ions exactly follow the field lines the side cover might be unnecessary.

・However, in the region with very weak E-field positive ions stray there for a long time and could eventually leak through the gaps into the drift volume, he guess.

[7] Other possible candidate of a GEM

Report from Kato:

・Three GEM candidates (below)

(1) Glass GEM (FOTURAN II):

Low discharge and high gain. The price is about 1 million yen at 30×30 cm^2 size. The applied voltage needs about 1 kV. There are many studies on glass GEM as imaging and parameters such as resolution required for tracking detection may not be studied. The need for such a study.

(2) Metal free GEM (PEDOT/PSS):

GEM of conductive polymer coating. The electrode is not metal. Dead region is few and has high rate tolerance. This GEM can be achieved to V_{GEM} = 600V. The gain of double GEM is 4000～10000. KEK group (Nakamura and Haba) study metal free GEM.

(3) Ceramic GEM:

There are two types of ceramic GEM, LTCC(Low Temperature Co-fired Ceramics)-GEM and HTCC(High Temperature Co-Fired Ceramic)-GEM. There is time stability. Kindai University has started R&D of ceramic GEM(from Hirai Seimitsu Kogyo?) since 2016. There are many problems to stable operation without discharge and with sufficient gain (over 5000). The Siegen University is also studying the ceramic GEM (from KOA).

・Kato will continue to investigate and study new GEM candidates.

[8] CO_2-cooling system (& electronics)

Report from Fusayasu:

・Toda (Saga student) made a mock up of the CO_2 cooling system, conducted a test and simulation.

・The cooling test results exceeded the substrate temperature of 100 ℃, but the problem was clarified from the simulation reproducibility. It is known that there is a problem with the pipe of the cooling device, the SUS block structure, and the thermal conductivity of SUS. Power pulsing is very important in the current structure, and it can be expected to be put into practical use by performing advanced surface finishing or TIM insertion of Ra 0.4 or less for device improvement.

・Lund University is developing S-ALTRO16 as signal readout electronics and aims to flatten so that it can be connected to the back of the readout pad. Lund considers micro channel cooling. The method of cooling, or electronics such as ASIC etc…, needs to be discussed in the LCTPC group.

[9] Future plan of LCTPC Japan group

① 【Analysis of beam test】

Yumi

・Analysis of Pad response, GM resolution at different angular
・3.5 T extrapolation of resolution
・Transmittance estimated from Neff.
・Write paper about resolution at beam test

Aiko

・Analysis of charge, Z-resolution at different angular
・Calculation of dE/dx
・Make of environmental data sheet
・Write paper about transmission at beam test

② 【Optimization of geometrical parameters of the gating GEM】

Sugiyama (Saga Univ.), Ogawa, Aiko

・Consideration toward mass production with Fujikura
・Make new geometry model of gating GEM
・Simulation of leakage of ions and electric field, transmission etc…

③ 【10×10cm^2 gating GEM experiment and new method of calculation of electron transmission】

Sugiyama (Saga Univ.)

・Consideration stability of parameters
・Write paper

④ 【Measurement of ion back flow】

Sugiyama, Kobayashi, Aiko

・Discuss/propose measurement method of ion back flow
・Construction of measurement system

⑤ 【Optimization of Amplidication GEM】

Yumi, Fujii, Kobayashi

・Simulation of gain (uniformity), discharge, transmission under magnetic field
・Trial product with φ=100 μm and the area 10×10cm^2

⑥ 【Other possible candidate of a GEM】

Kato (Kindai Univ.), Narita (Iwate Univ.)

・Study of ceramic GEM (Kindai Univ.)
・Investigate and study of new material for GEM

⑦ 【CO_2-cooling system】

Fusayasu (Saga Univ.)

⑧ 【Gain fluctuation measurement】

Kobayashi

⑨ 【Module boundary】

Aiko

・Restart the mock up study for improving the structure

⑩ 【Measurement transmission under B=3.5T, 4T】

・Make small chamber?

・Discuss solenoid magnet

・If Grants-in-aid is accepted, we might have one more meeting and discuss about our study plan in detail.

・Kobayashi will write paper about the electron transmission focusing on the ion stopping power with module-size gating GEM. *no usage of beam test data