Update results of the low gain TPC module

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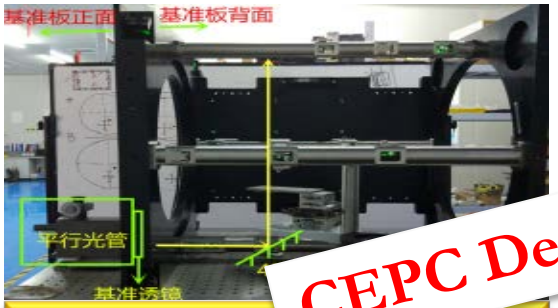
CEPC Det.&Phy., July, 7, 2021

Outline

- Pixel TPC module
- Low gain TPC R&D

Motivation for the pixelised TPC



Pad TPC Prototype
at IHEP 2015-2020

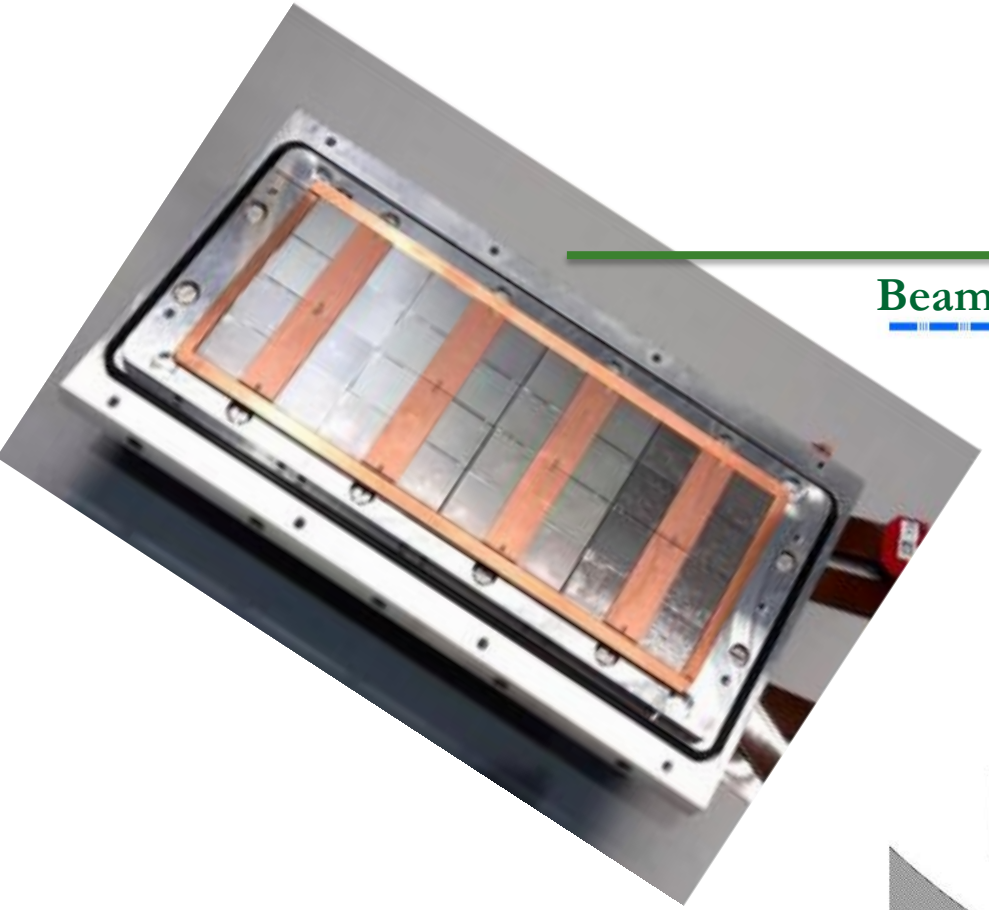
CEPC Det.&Phy., June, 7, 2021

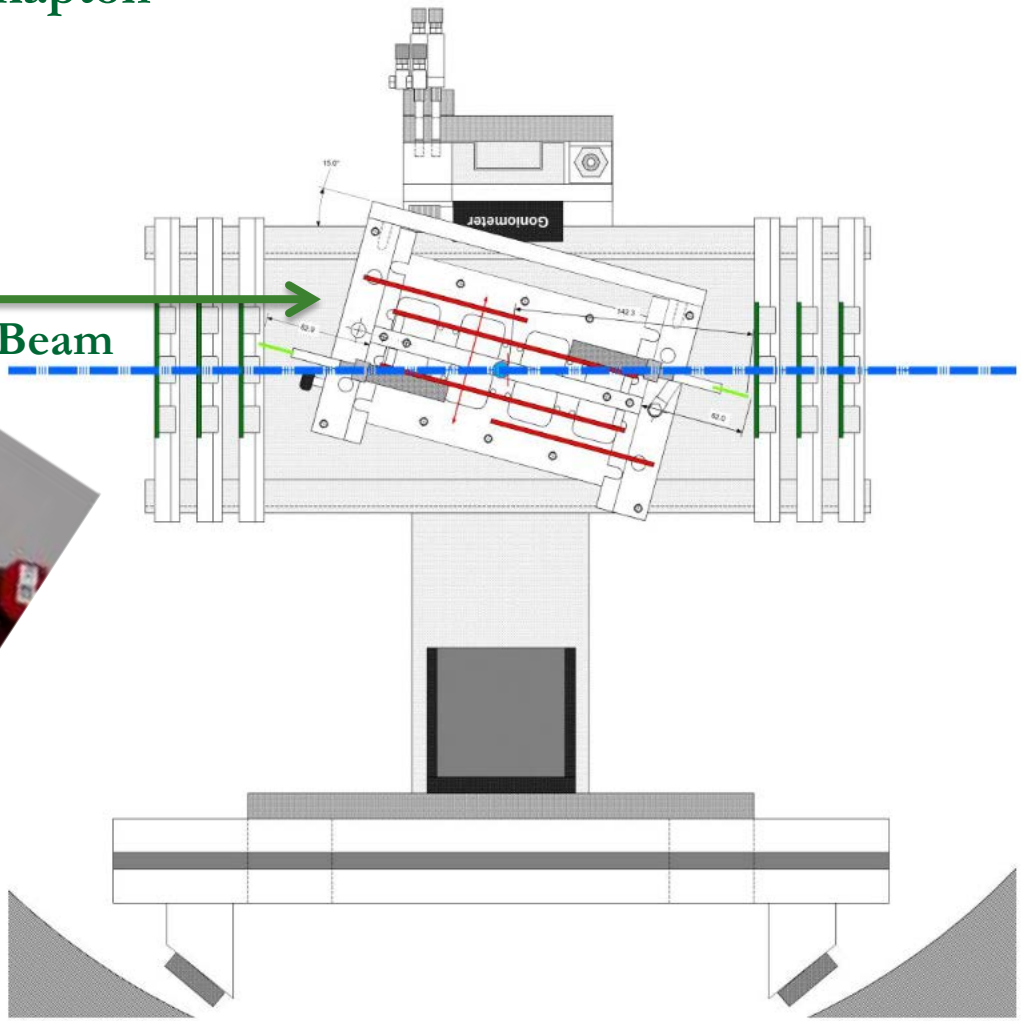
R&D

- Improved dE/dx by cluster counting
- Improved measurement for the low angle tracks
- Improved double track separation
- Much reduced hodoscope effect
  - Near to the endplate
  - Decreased the spatial resolution
- Lower occupancy in the high rate environments
- Fully digital readout

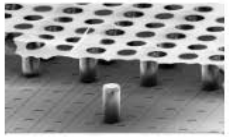
Pixel TPC@LCTPC

- 32 chip module in the gas envelop
- Entrance windows are 50µm kapton

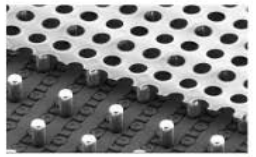


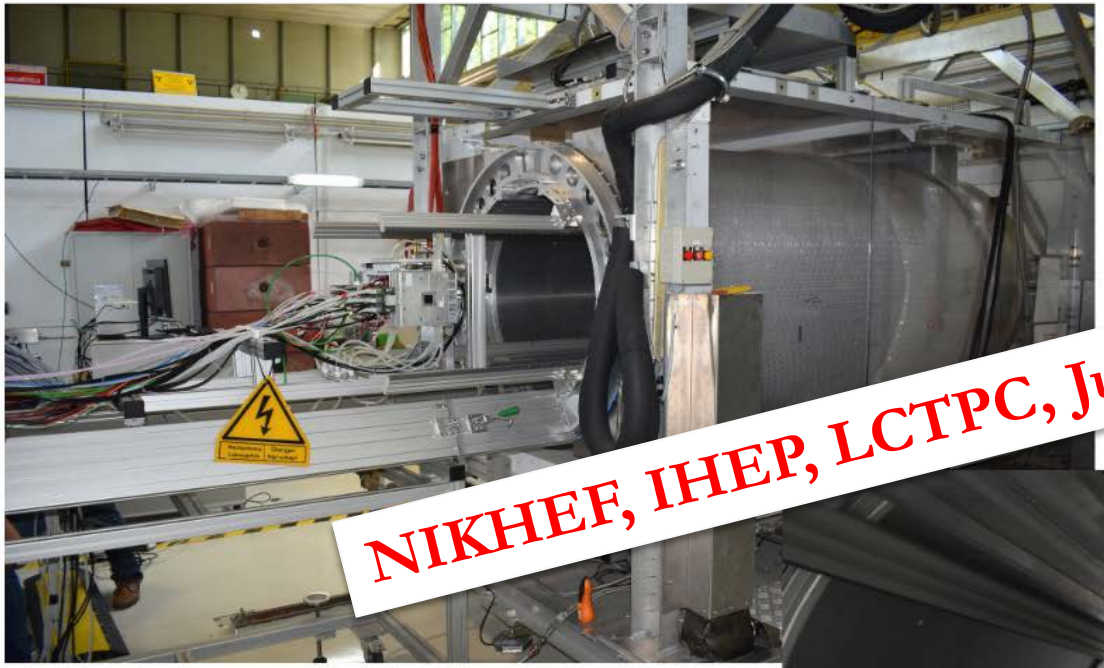


Beam test of the pixel TPC@LCTPC



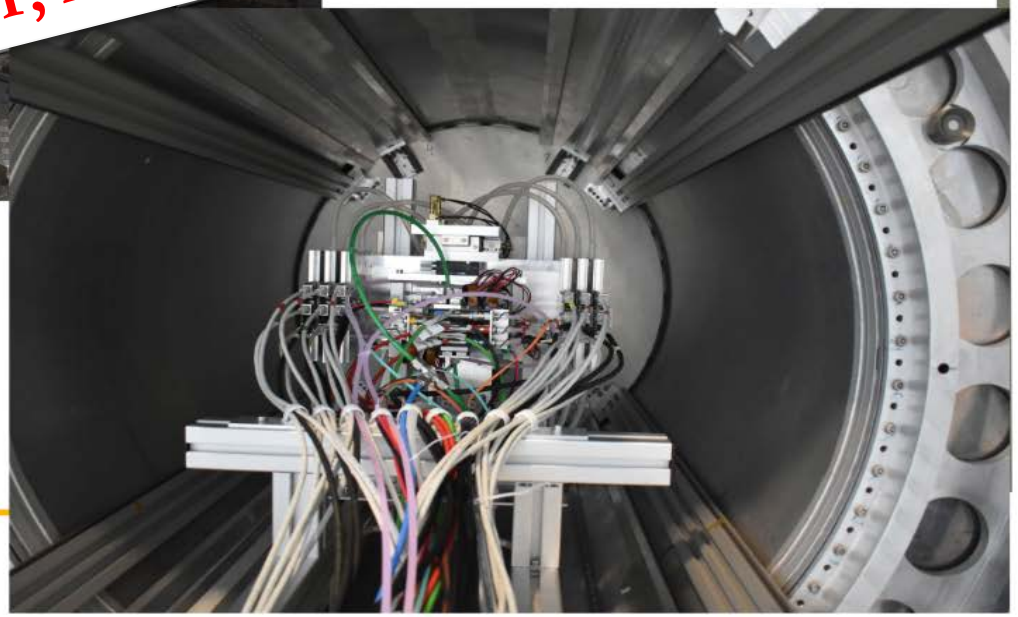
Setup in PCMAG





It was pushed into the magnet.

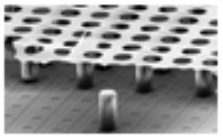
NIKHEF, IHEP, LCTPC, June, 28, 2021



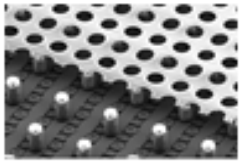
After some problems with HV lines, everything worked fine.

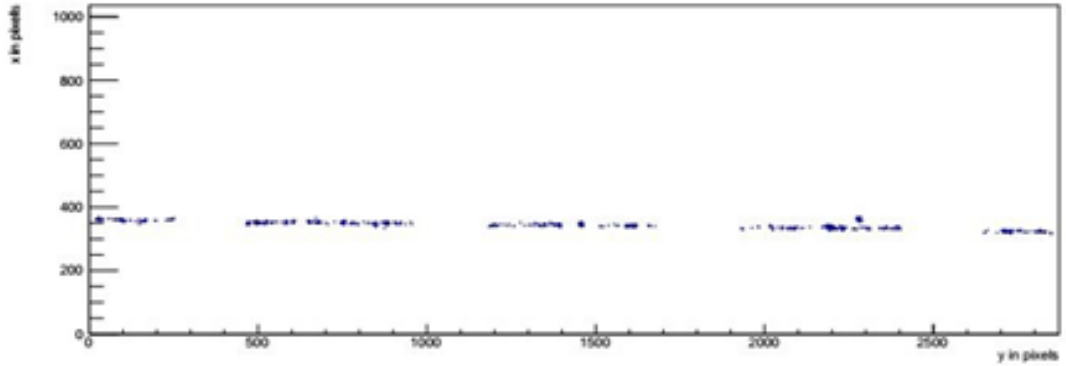
Started productive data taking on Sunday.

Beam test of the pixel TPC

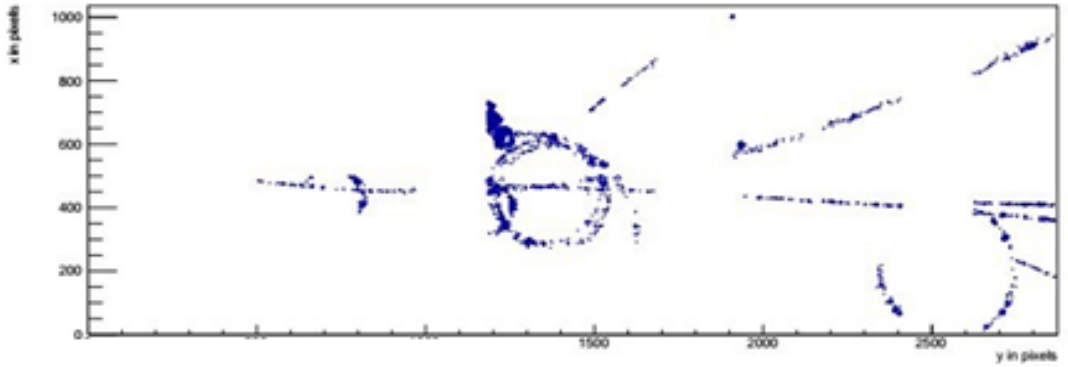


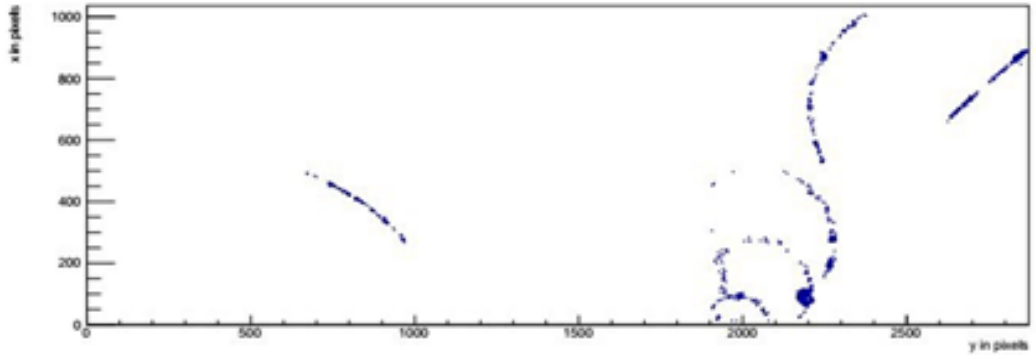
Event Pictures at B = 0.5 T



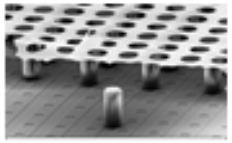


Tracks at
Drift d = 0.5-1.5 cm
Gain 2130
T2K gas
B =0.5 T
p = 6 GeV/c

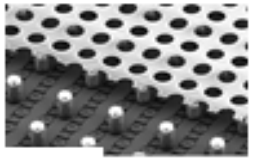


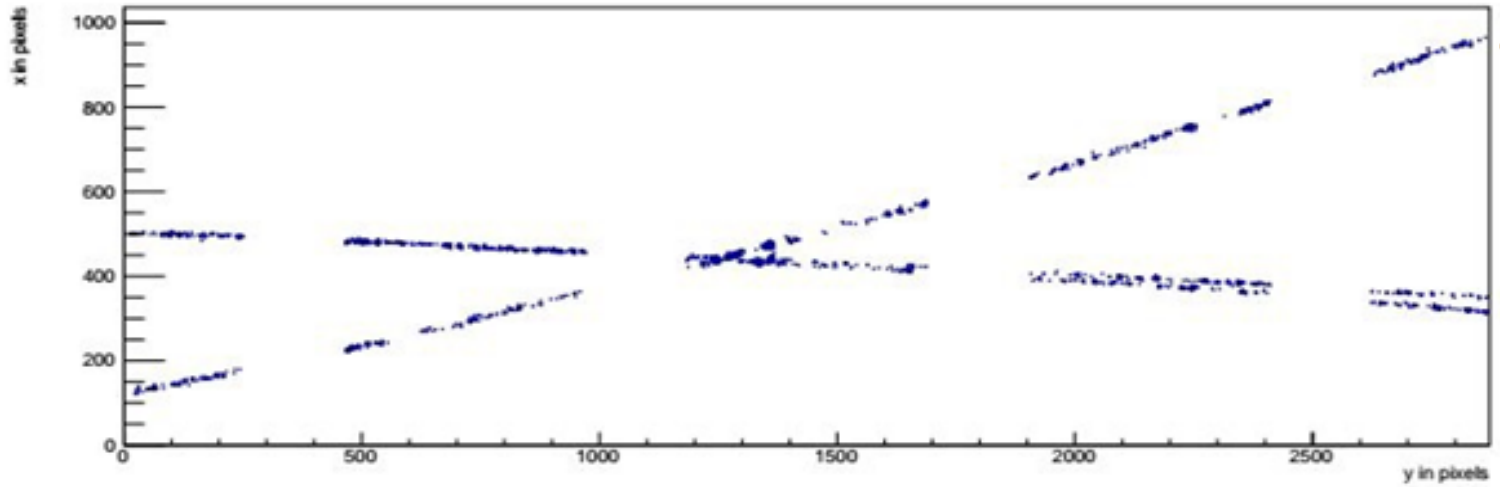


Beam test of the pixel TPC

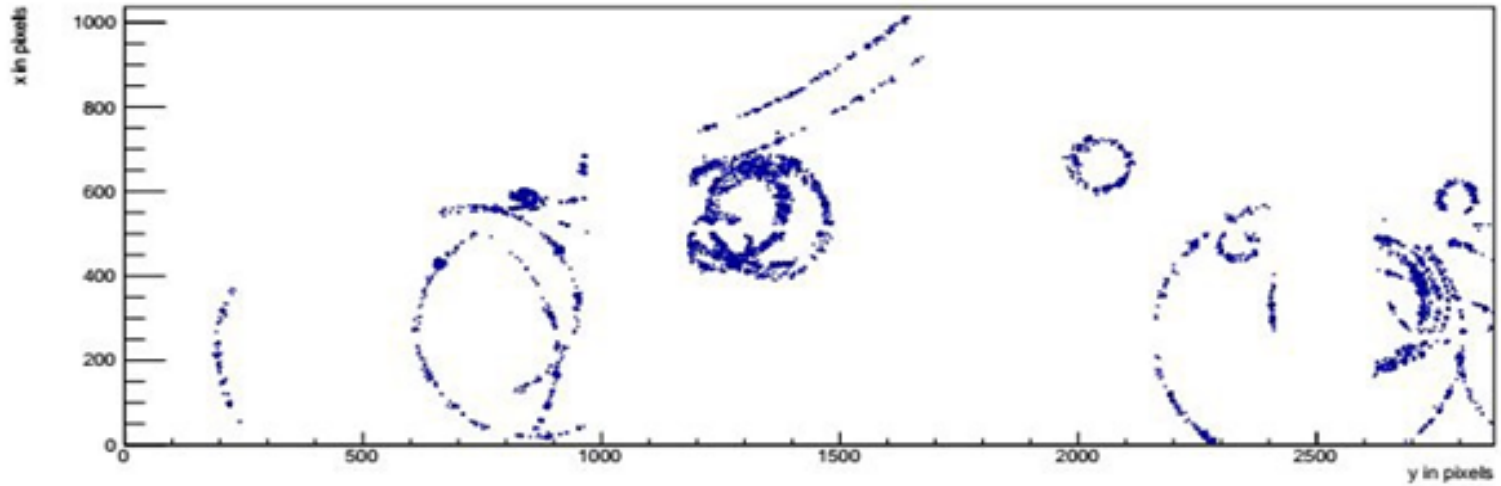


Event Pictures at B = 1 T





Tracks at
Drift d=1.5cm
Gain 2130
T2K gas
B =1.0T
p = 6 GeV/c

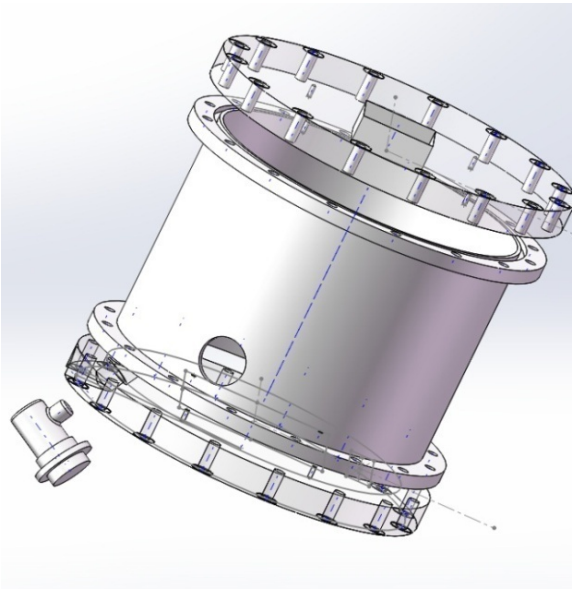


- **Low gain TPC module**

UV test of the new module

- UV lamp measurement
  - New designed and assembled UV test chamber
  - Active area: 100mm×100mm
  - Deuterium lamp and aluminum film
  - Principle of photoelectric effect
  - Wave length: 160nm~400nm
  - Fused silica: 99% light trans.@266nm
  - Improve the field cage in drift length

Deuterium lamp
X2D2 lamp



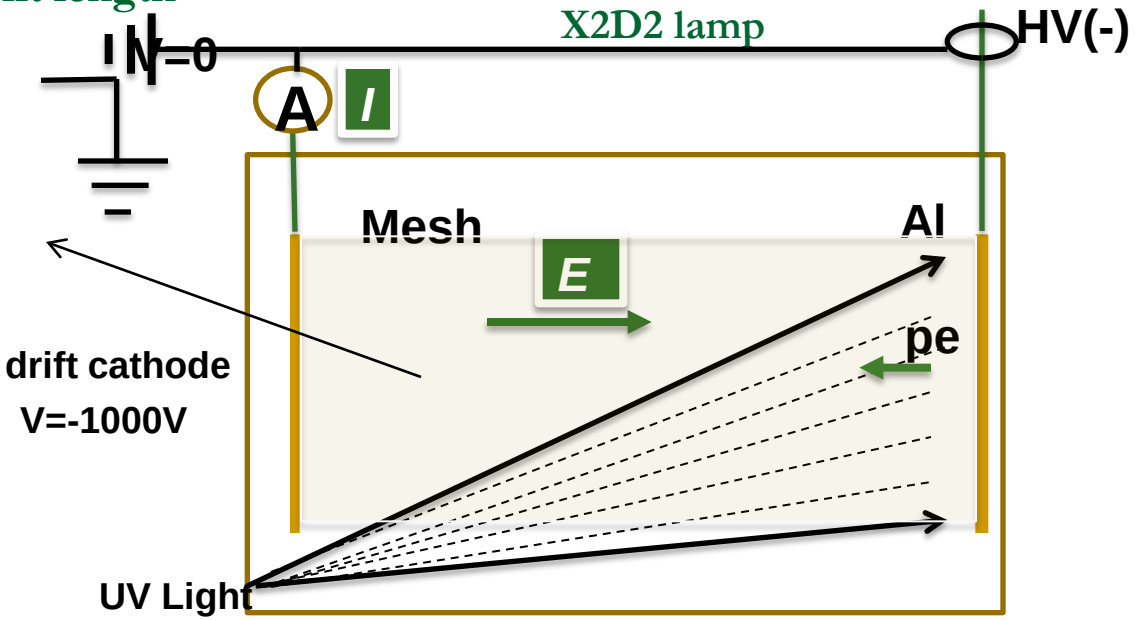
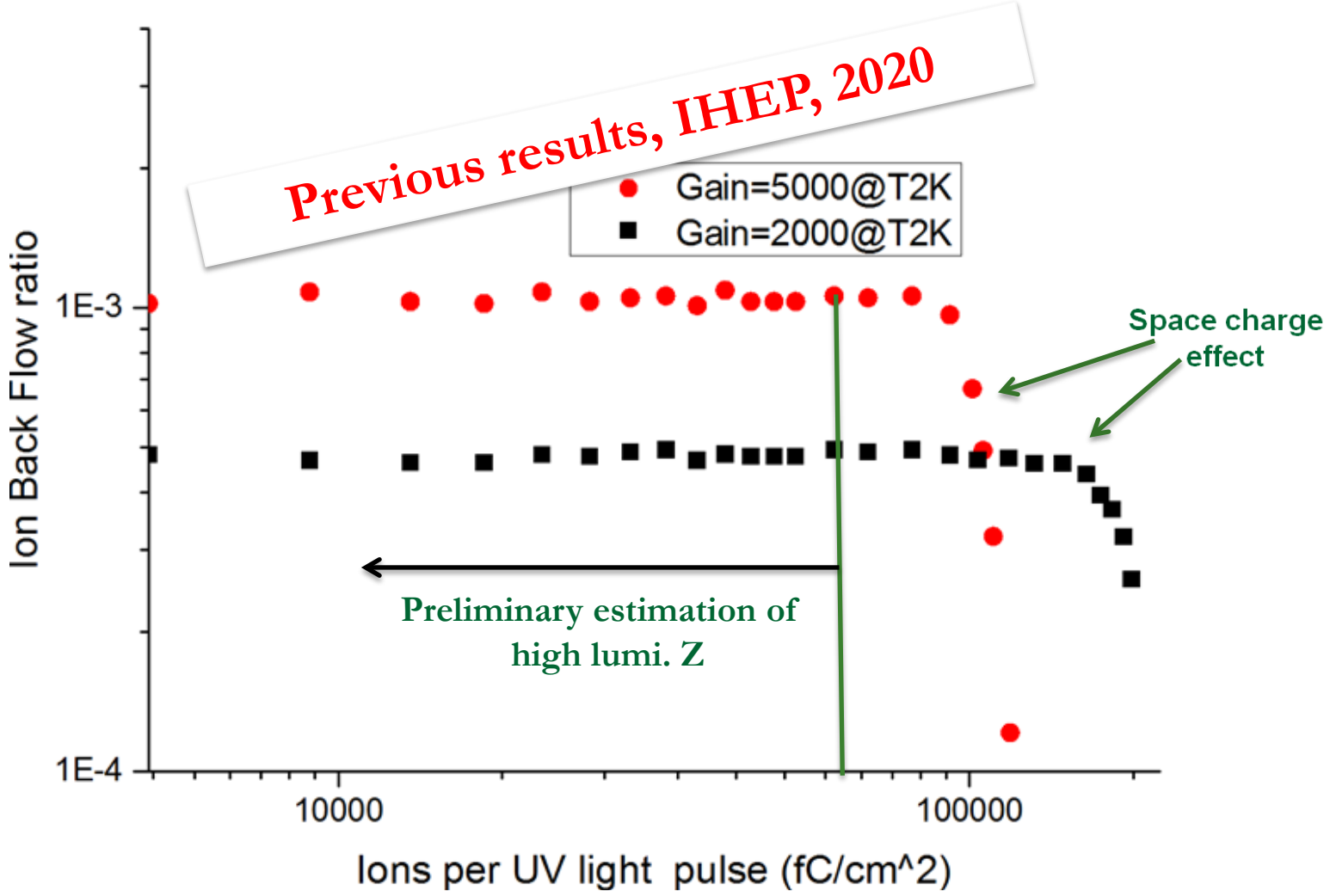


Diagram of UV test with GEM-MM

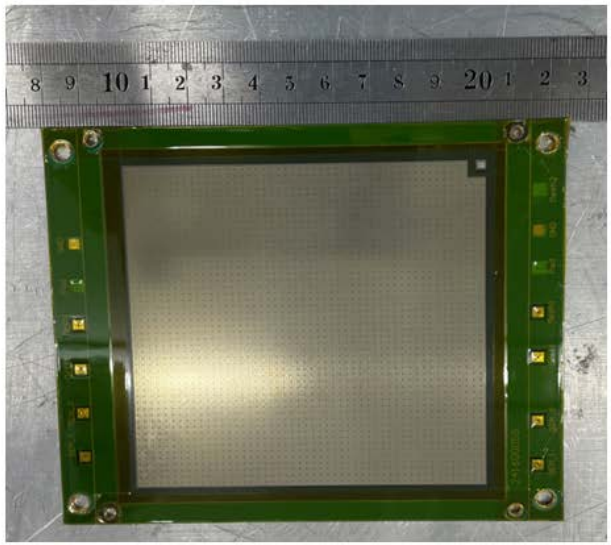
Space charge effect at the different gain in 2020

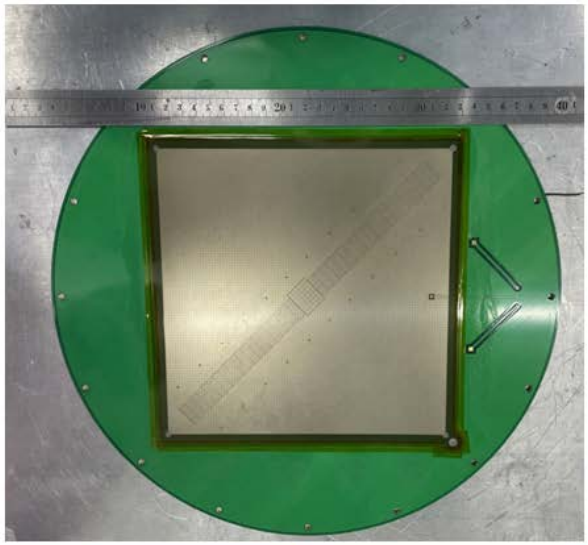


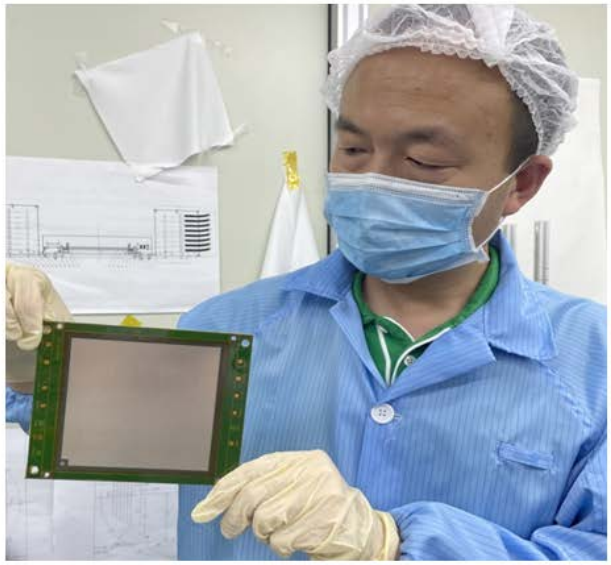
- Preliminary estimation of the high luminosity Z
- There are more safe factor when the detector will run at the lower gain (eg.2000-3000)

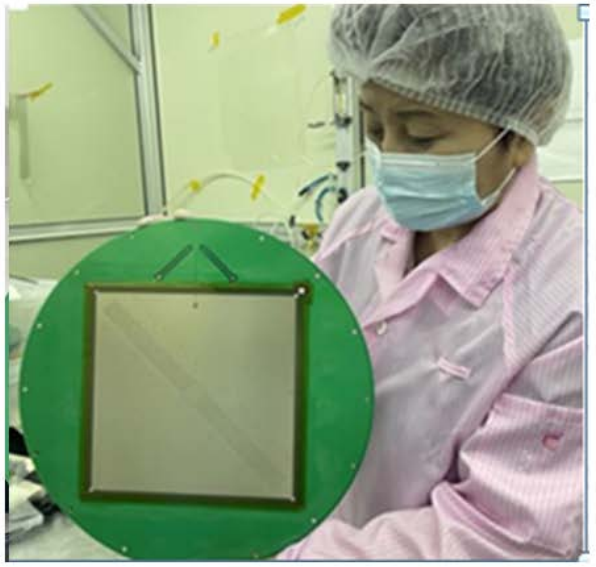
Start of mock up preparations in 2021

- Some samples of the Micromegas detector successfully were assembled in our lab
- The different active area of the detector could be prepared, and the maximum size could be more than 1000mm
- The preliminary gain test of the detector were fine

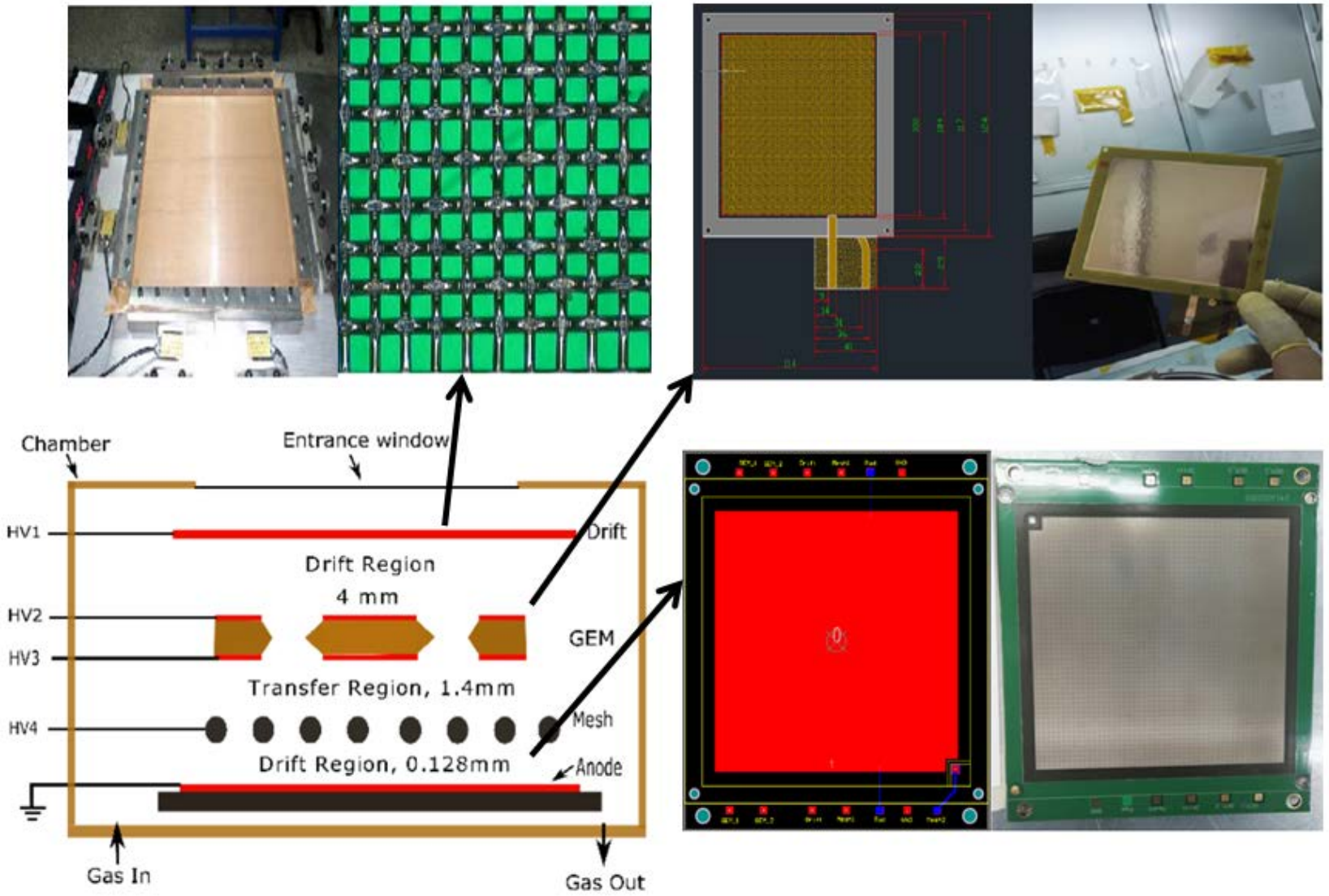








Starting test of the hybrid TPC module

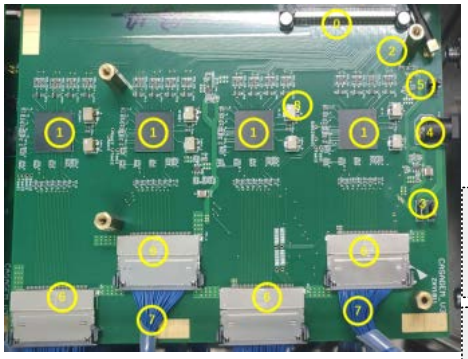


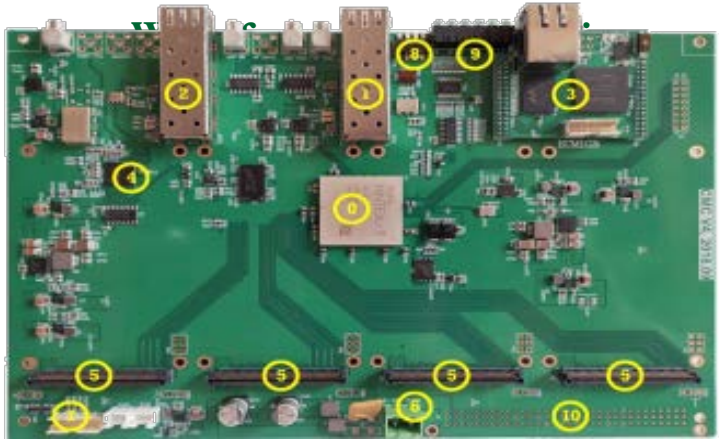
Hybrid TPC module with IBF suppression function

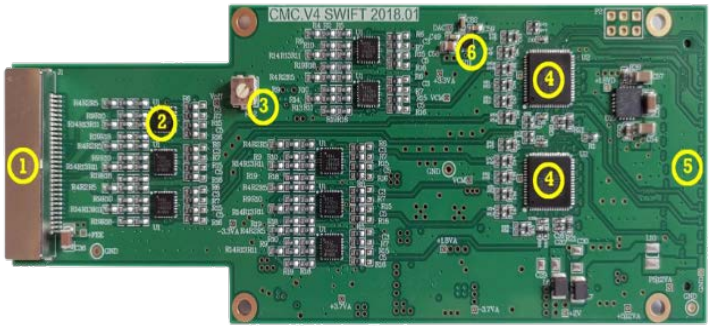
Commissioning with Electronic and DAQ

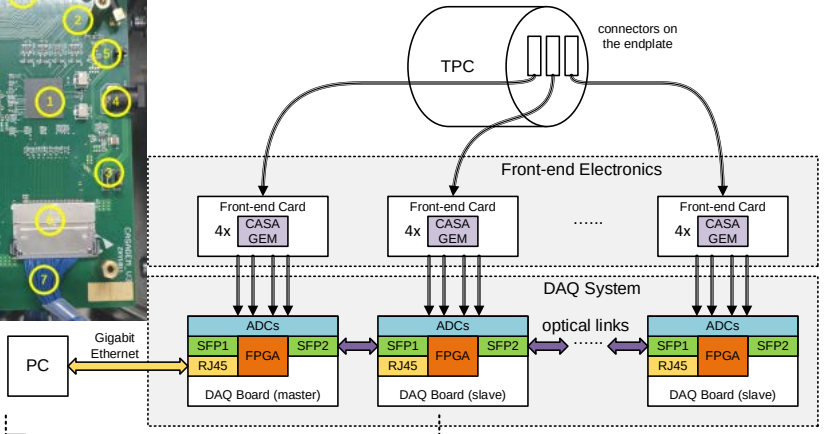
Electronics for TPC

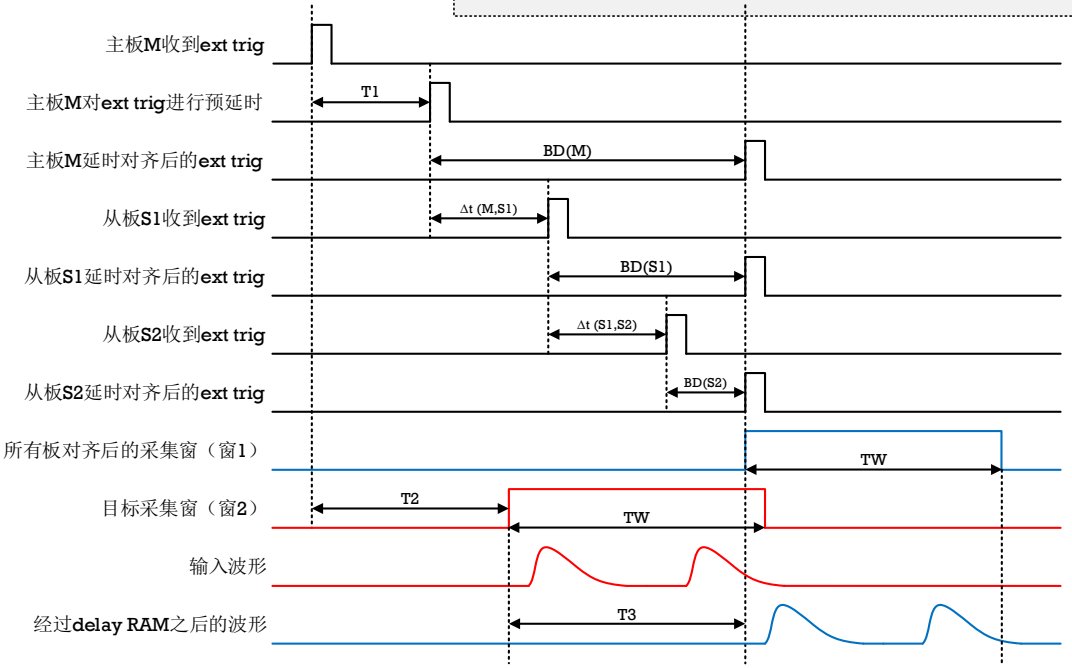
- Gain: 10mV/fC，20mV/fC, 40mV/fC
- FEE electronics with self-calibration
- Zero compression







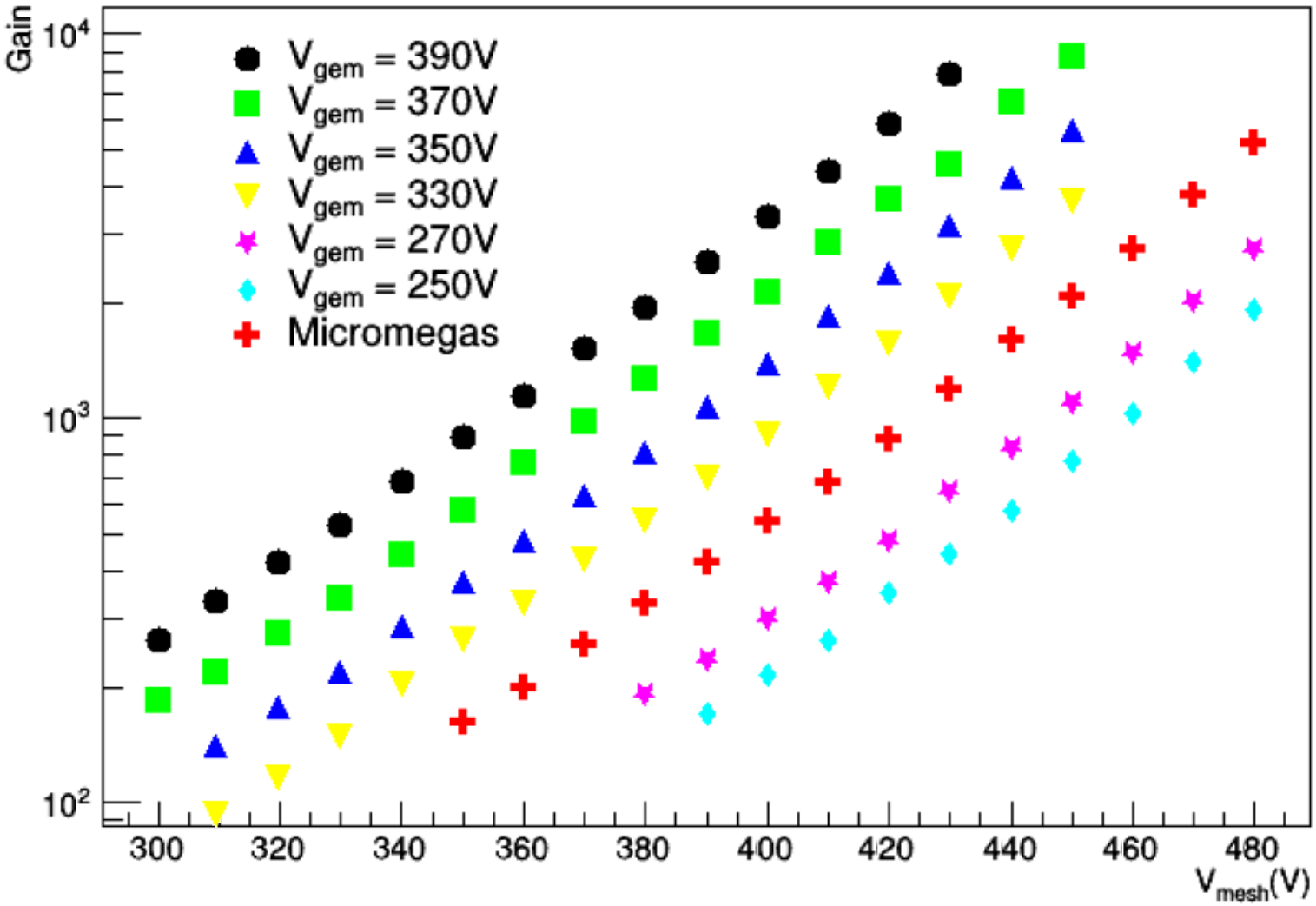




$$T_{relative3} = T_3 - T_{ext} + T_{B1/B2} + T_{B2/B3}$$

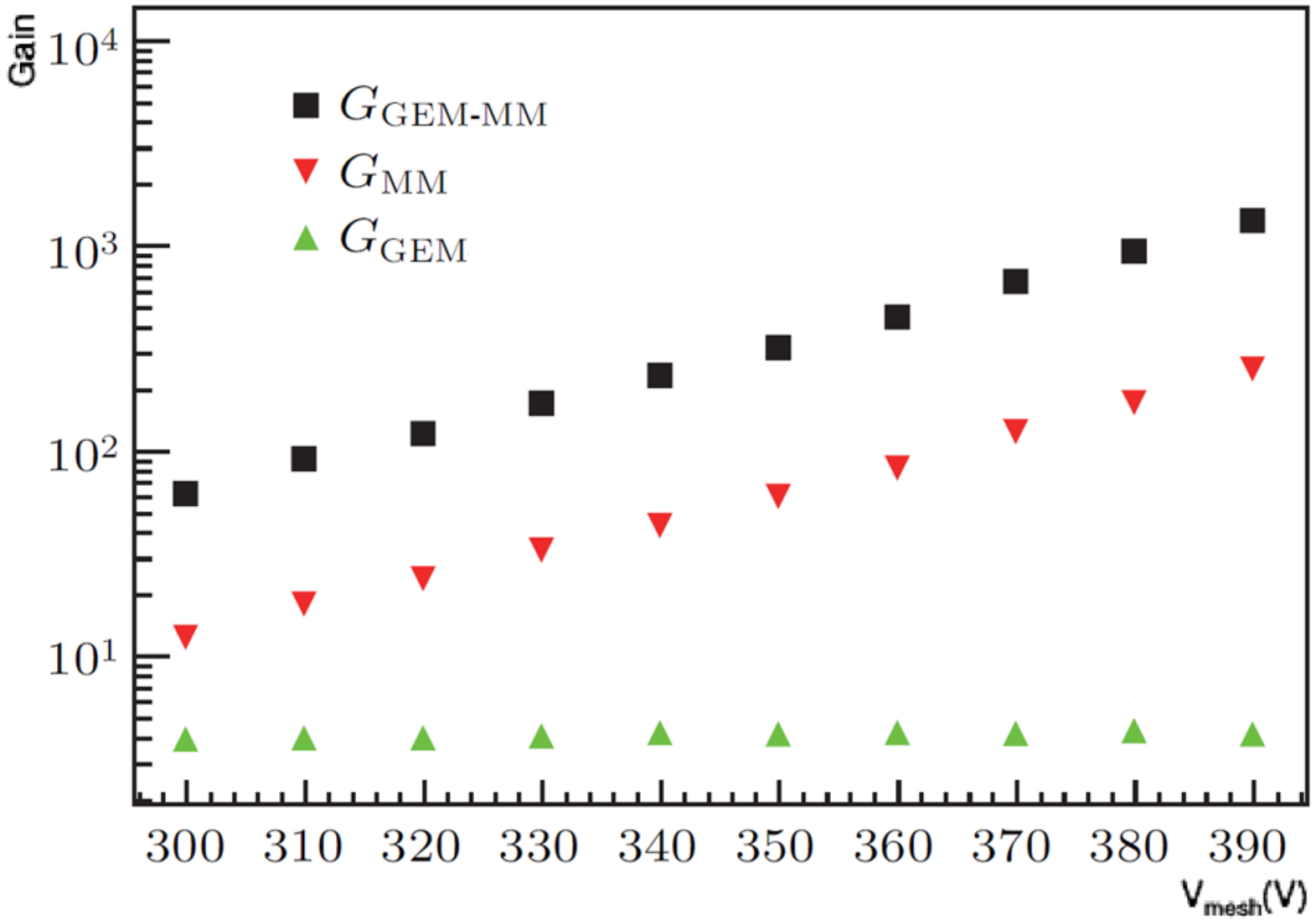
$$T_3 = T_{3gravity} - T_{delay} + T_{int}$$

Gain of the hybrid TPC module



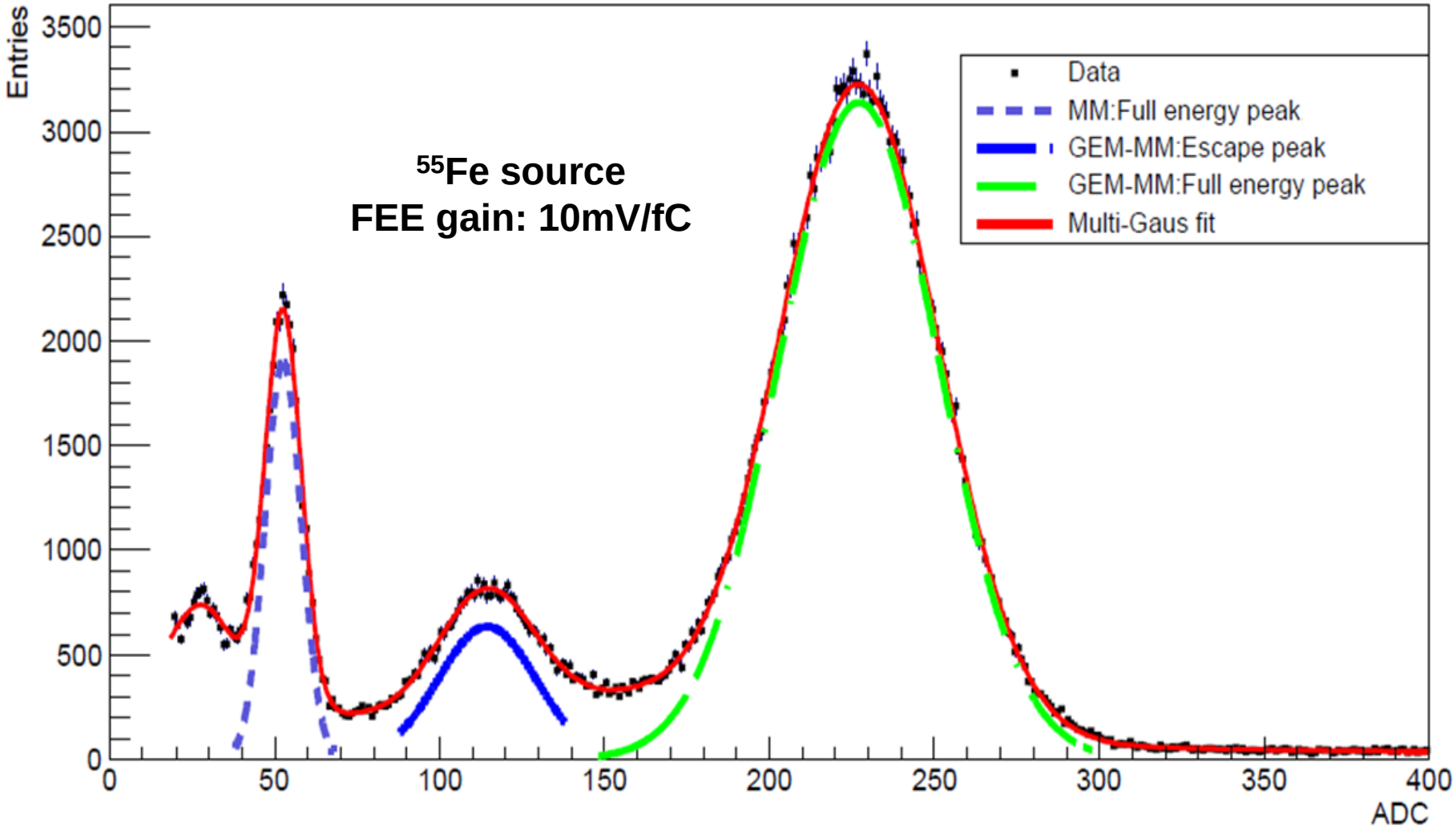
Gain of the Hybrid TPC module@T2K gases

Gain of the hybrid TPC module



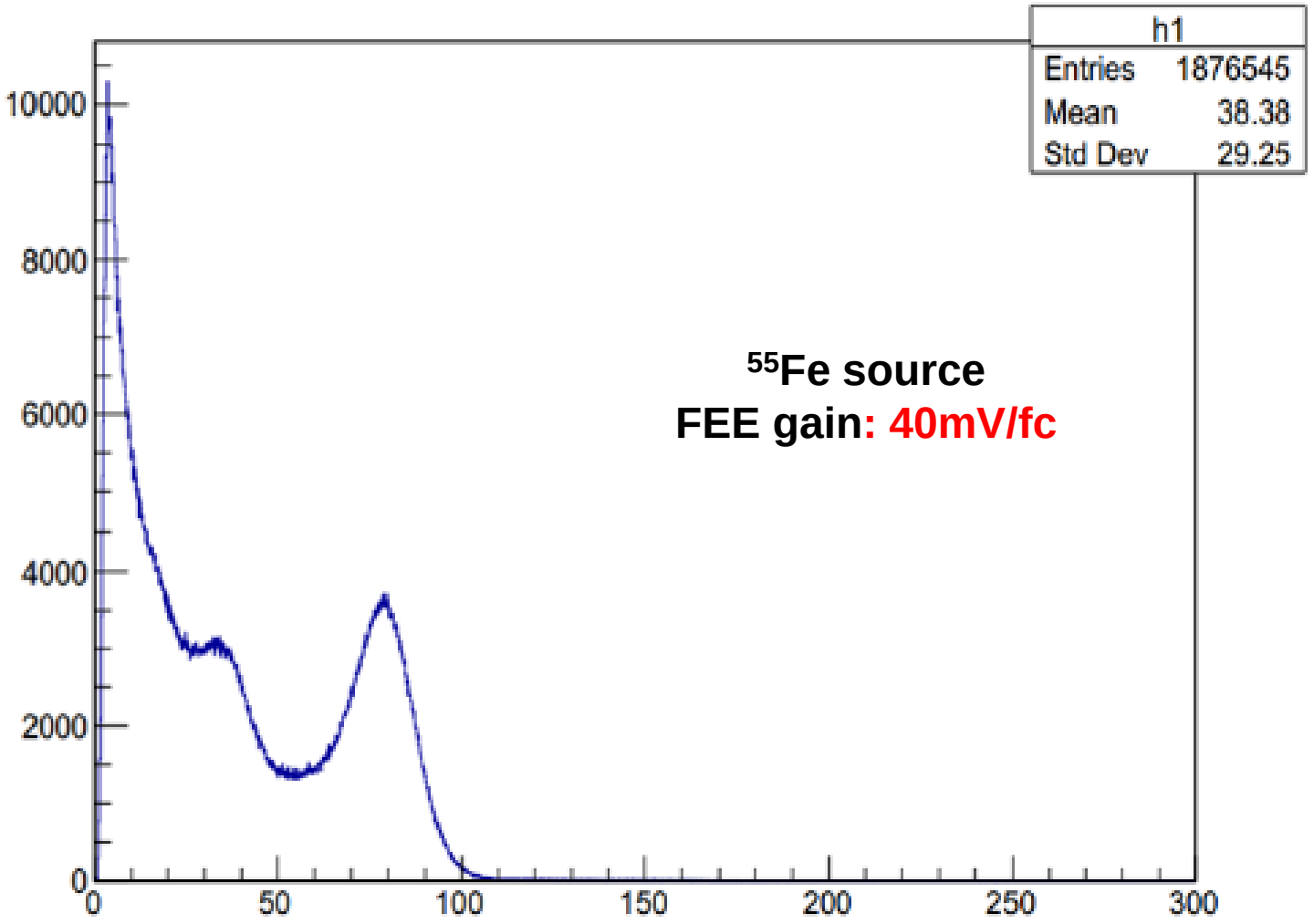
Gain of the Hybrid TPC module@T2K gases

Energy spectrum of the hybrid TPC module



Energy spectrum of the Hybrid TPC module @T2K @Gain/6000

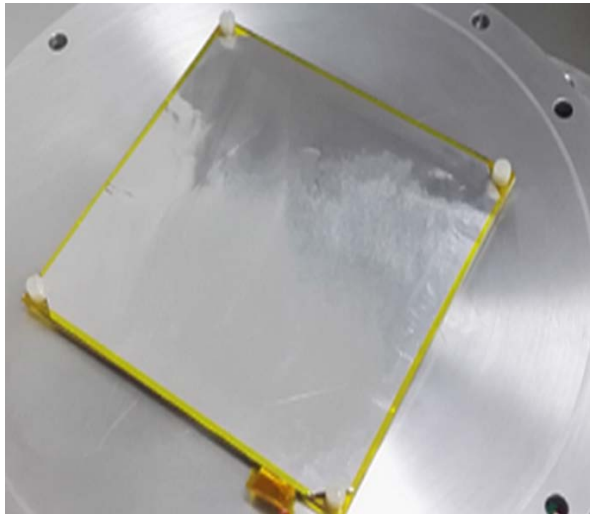
Energy spectrum of the hybrid TPC module



Energy spectrum of the Hybrid TPC module@T2K gases @Gain/1980

Ongoing studies the low gain

- Single point resolution (δ_x) with the low gain, and comparison of the gain from 2000-6000
- UV light shining on the smooth Aluminum testing the high current to mimic the high luminosity of Z pole run
- Studies of ^{55}Fe source and UV laser
- Supplementary Research on TPC Prototype



Smooth Aluminum Board
600 mesh/ Ra0.4vm

Setup of the Hybrid TPC module

Summary

- Some update information of the pixel TPC beam test in DESY this month
- Some update results of TPC module with the low gain
- Some studies starting using the high gain FEE electronic

Thanks for your attention.