Simulation of the ionization cluster in space and update testing of TPC prototype

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June 22, 2022

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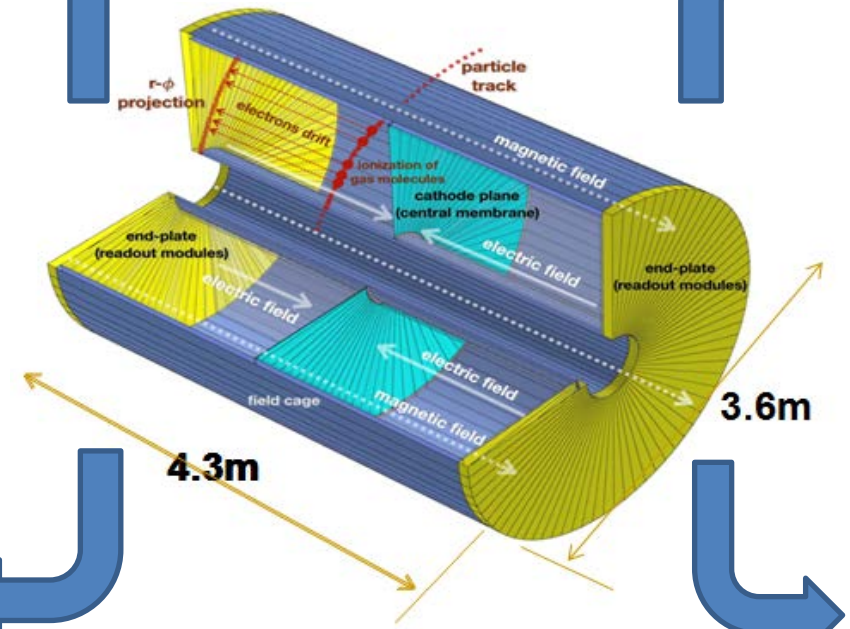
- Update testing of TPC prototype
- Summary

TPC – Physics requirements at CEPC

Pad readout TPC
- To meet Higgs physics
- 1mm×6mm of Pad
- TPC module
- TPC prototype with UV laser

TPC track technology for e+e- collider



Pixelated readout TPC
- To meet Z physics
- ~500μm of Pad
- TPC prototype with UV laser track
- dE/dx study

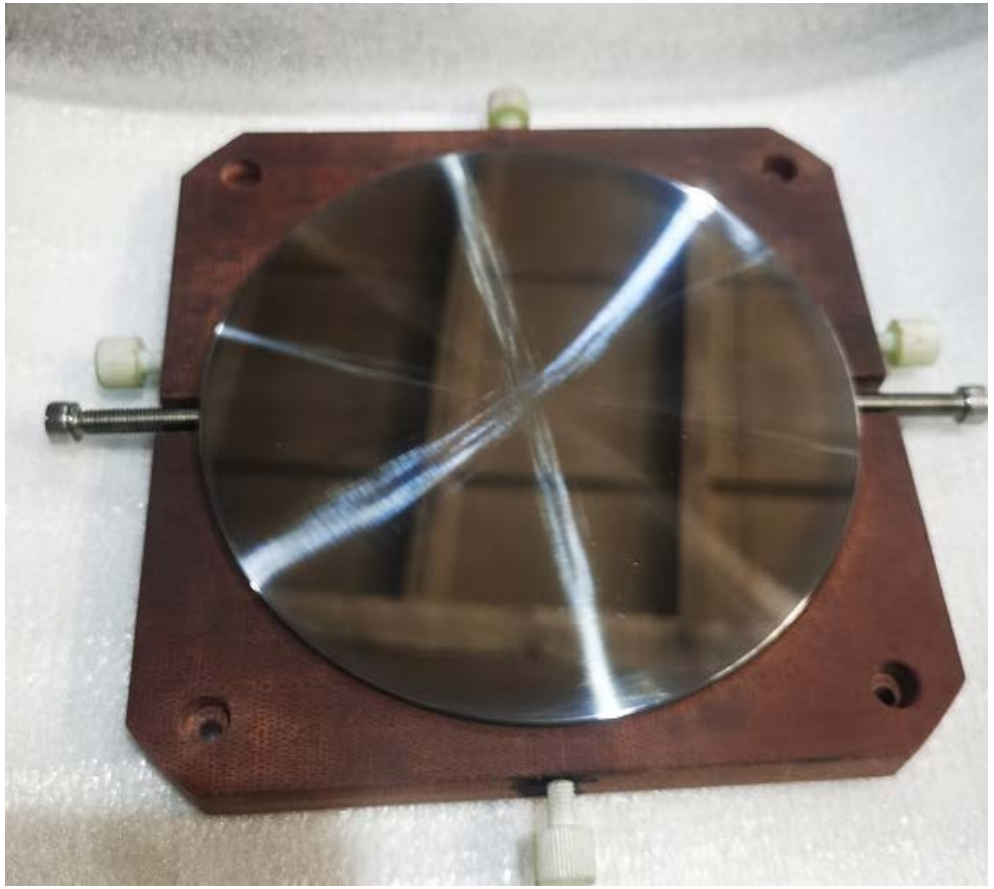
Ion back flow
- Simulation of Ion Back flow
- Testing the UV light created the ion disk by photoelectric effect

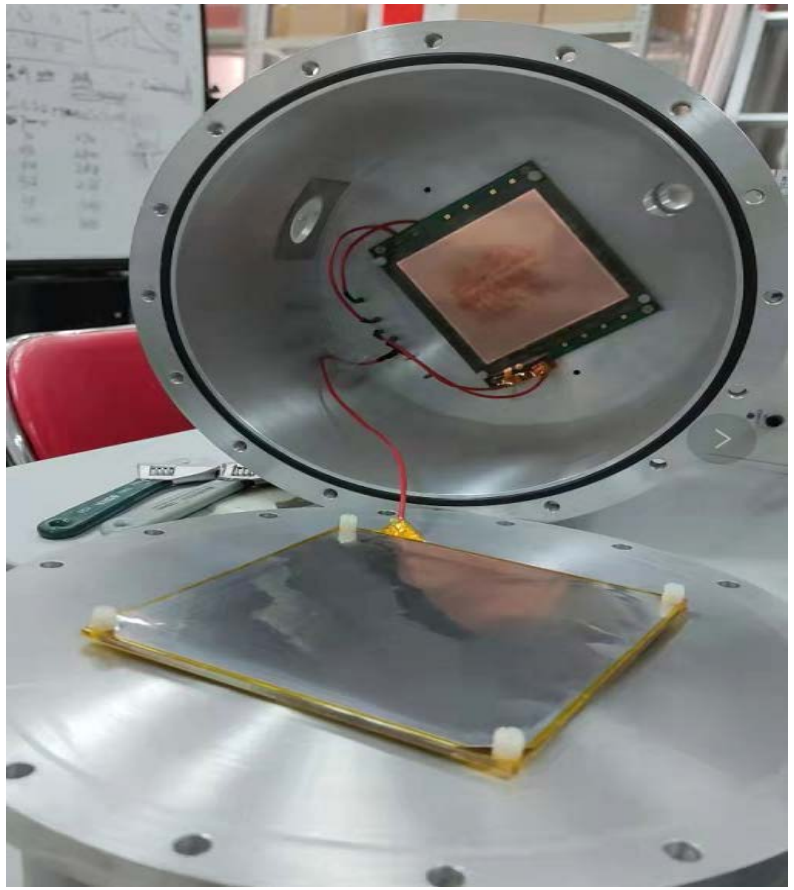
PID study
- Simulation of the ionization cluster in space
- PID studies of the different readout TPC prototype

Testing the UV light created the ion disk by photoelectric effect

UV light created the ion disk

- Ions will fill in the drift chamber of TPC to mimic the ions distortion
- Metal mesh polish of Aluminum: 600/800/1000/1200/2000 (**Done)**
- Experimental testing of the current at GEM foil (Ongoing, **>100nA** level)



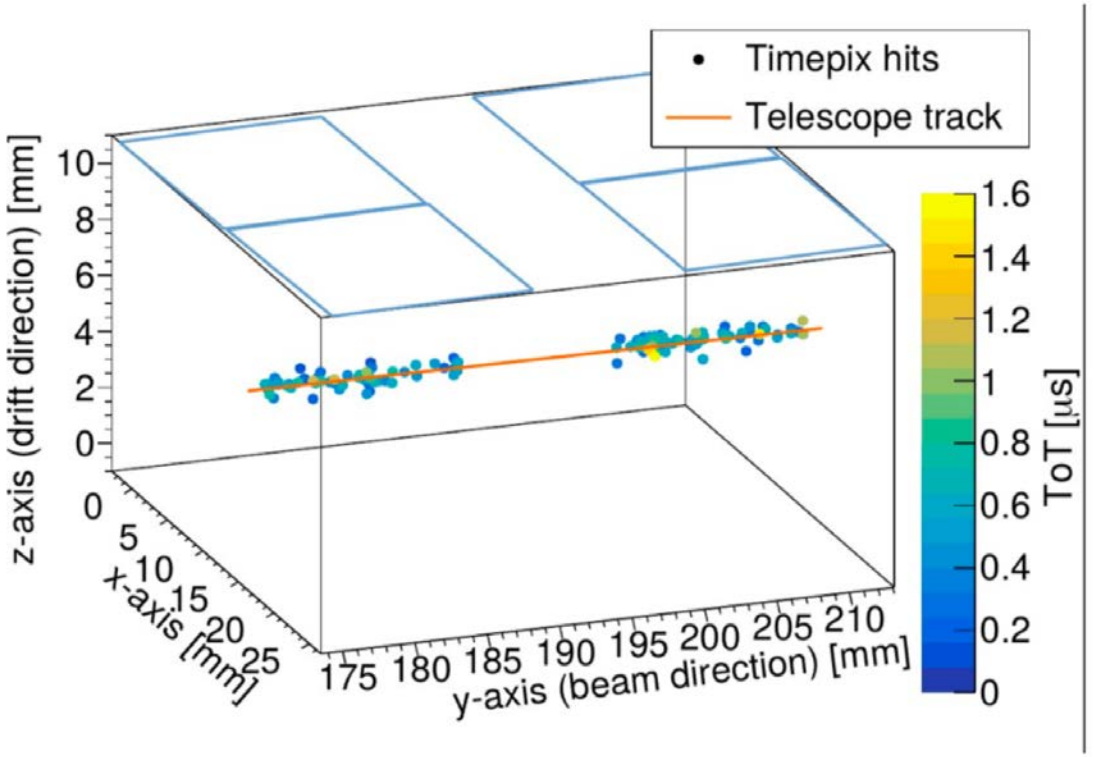


- Simulation of the ionization cluster in space

Motivation of identify the clusters in space

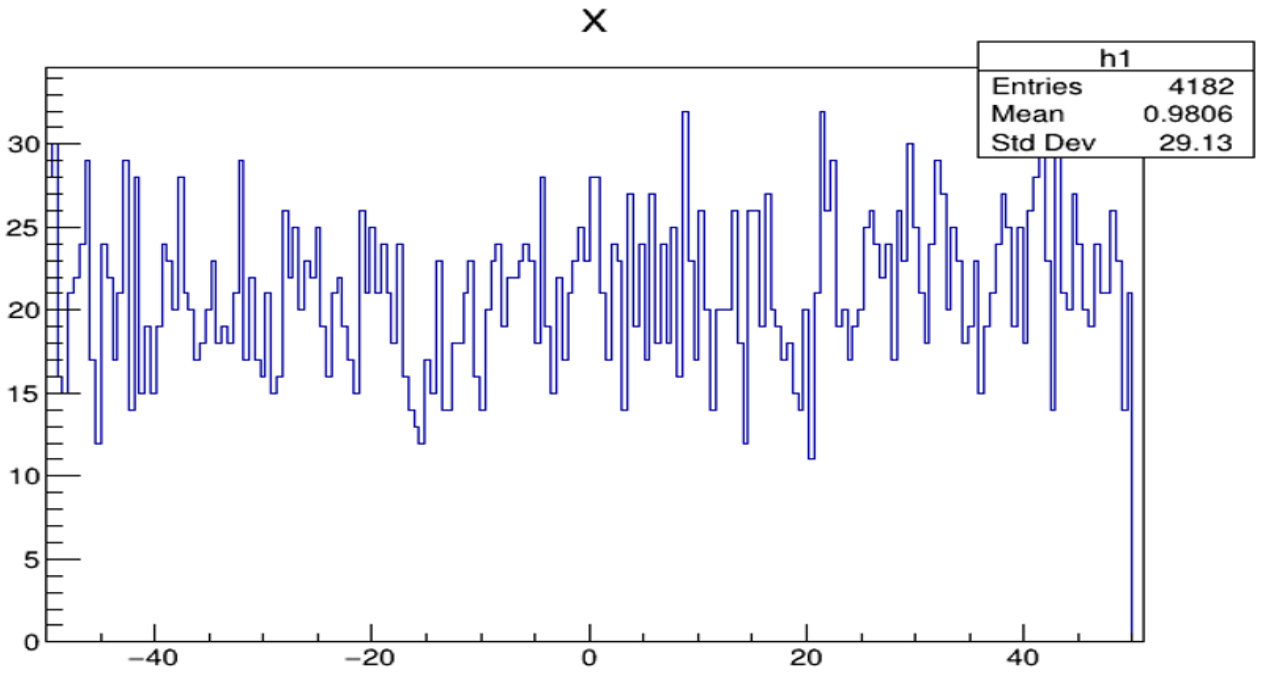
In Space

- Challenging of the low power consumption electronics (>40mV/fC needed at 2000 of gas gain)
- Pixelated readout
- → the reasonable pixilation reveals the underlying cluster structure in 3D chamber

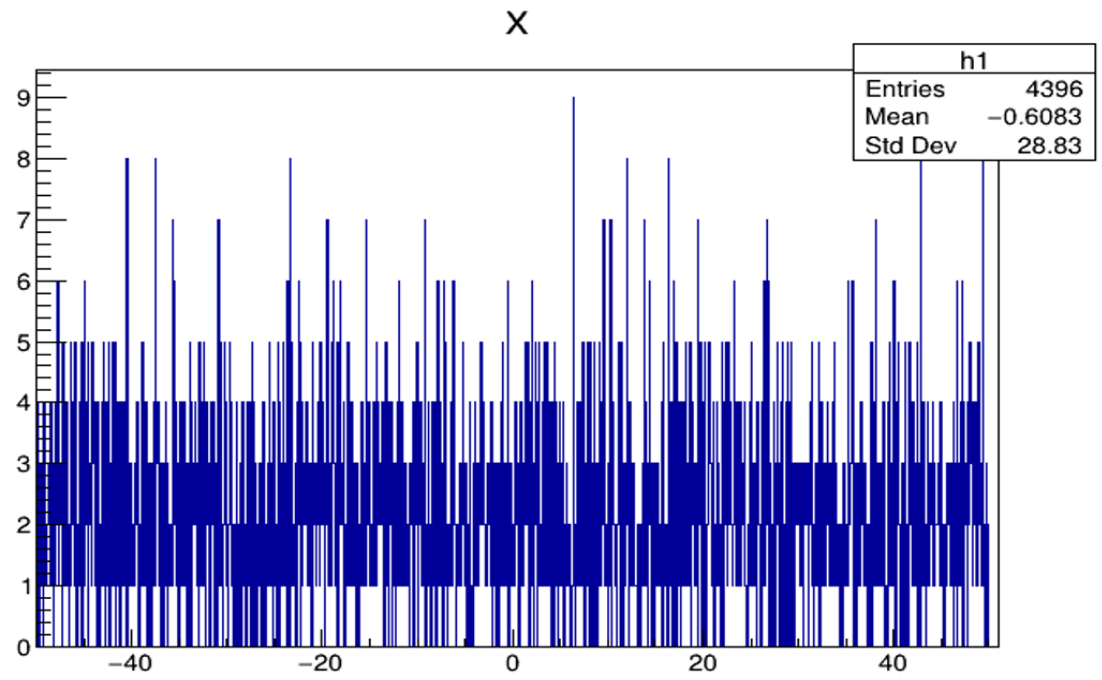


Primary cluster profile along the drift length

- Drift length: 1m
- Operation gas: **T2K gas**
- Running 10000 events using Garfiled++
- Simulation result show that the primary cluster profile along the drift length



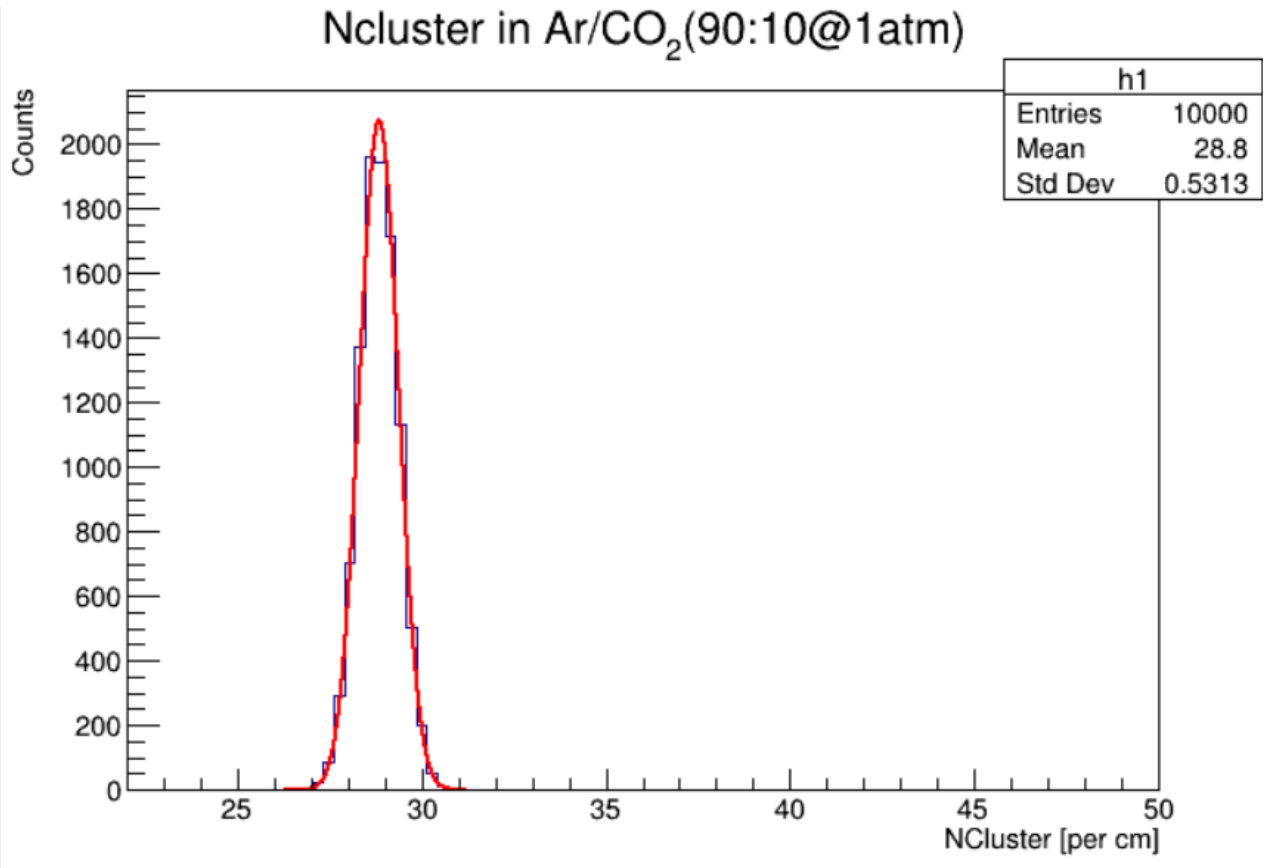
Bin: per 1cm

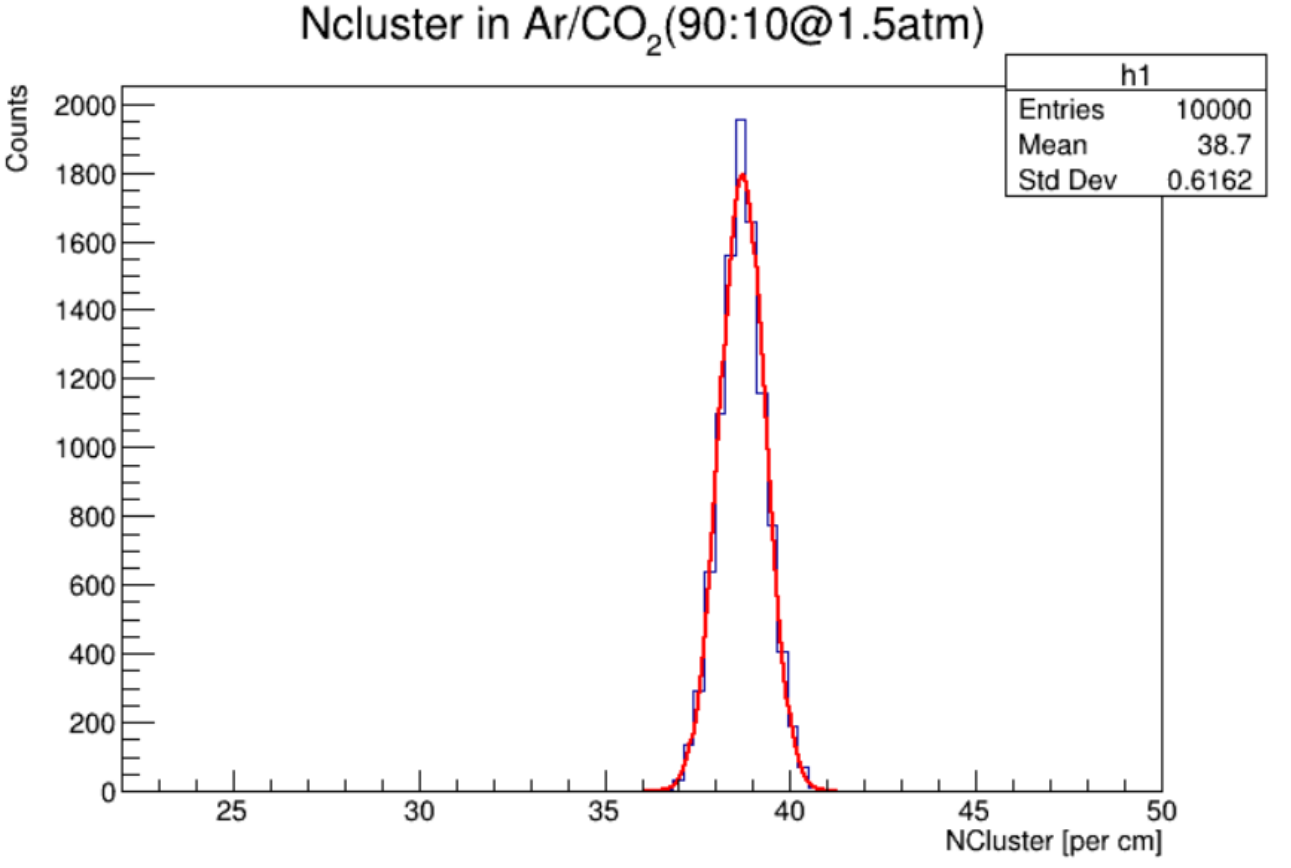


Bin: per 500um

Primary cluster profile using **Ar/CO2=90/10** gas at the different pressure

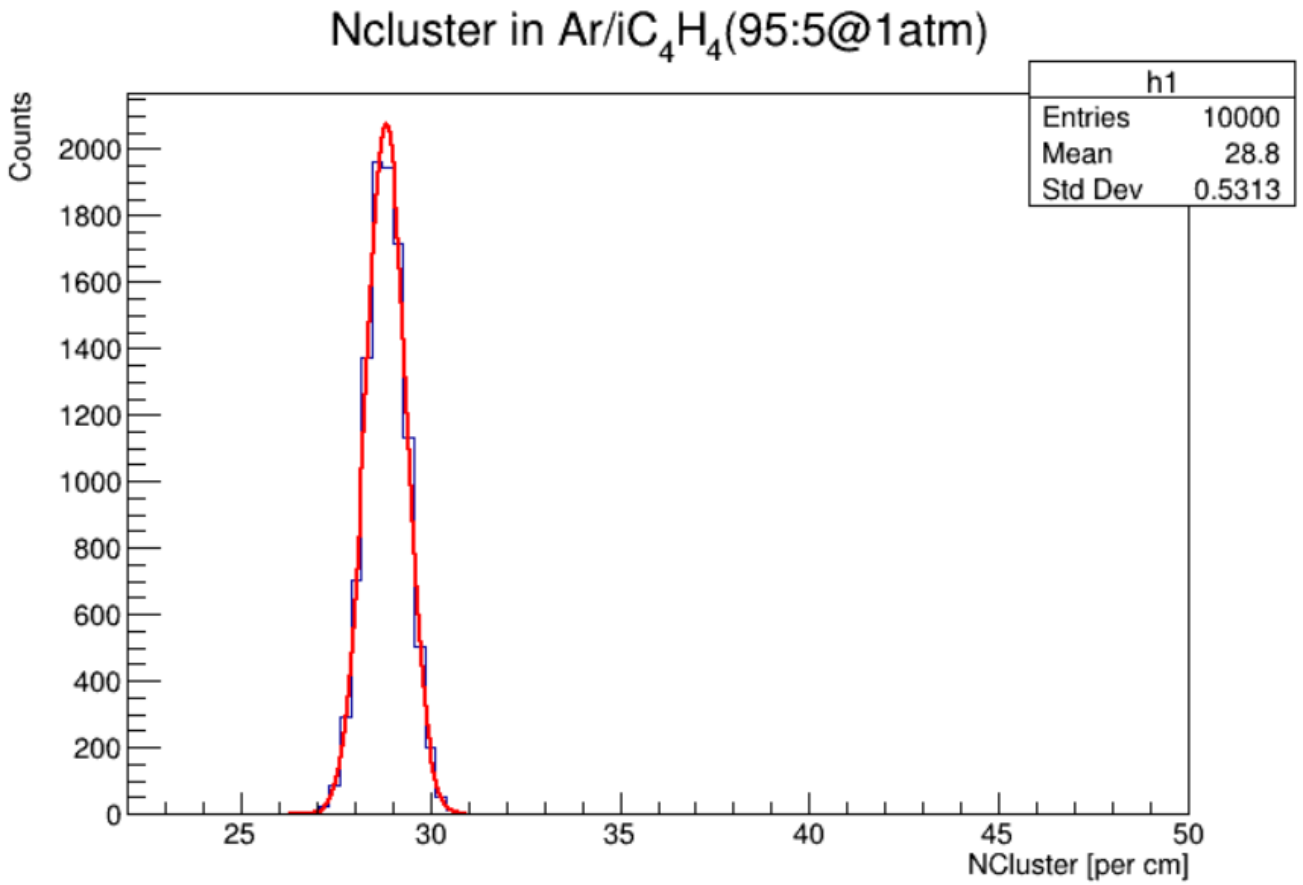
- Simulation result of the primary cluster using Ar/CO2=90/10 gas
- Mean of N_cluster: **1atm: 29.1 / 1.5atm 38.8**
- Increased 0.5atm operation gas pressure, the cluster will be bigger more than **35%**

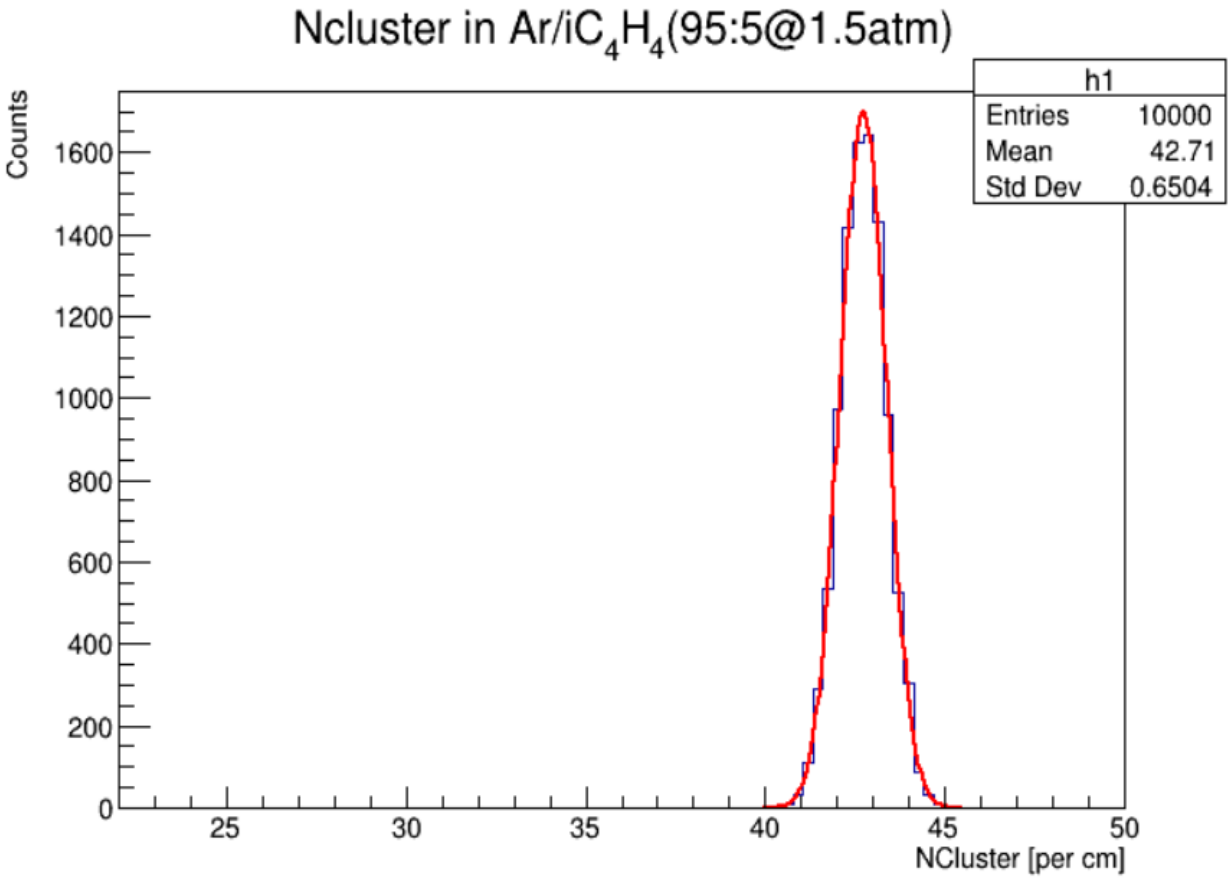




Primary cluster profile using **Ar/iC4H10=95/5** gas at the different pressure

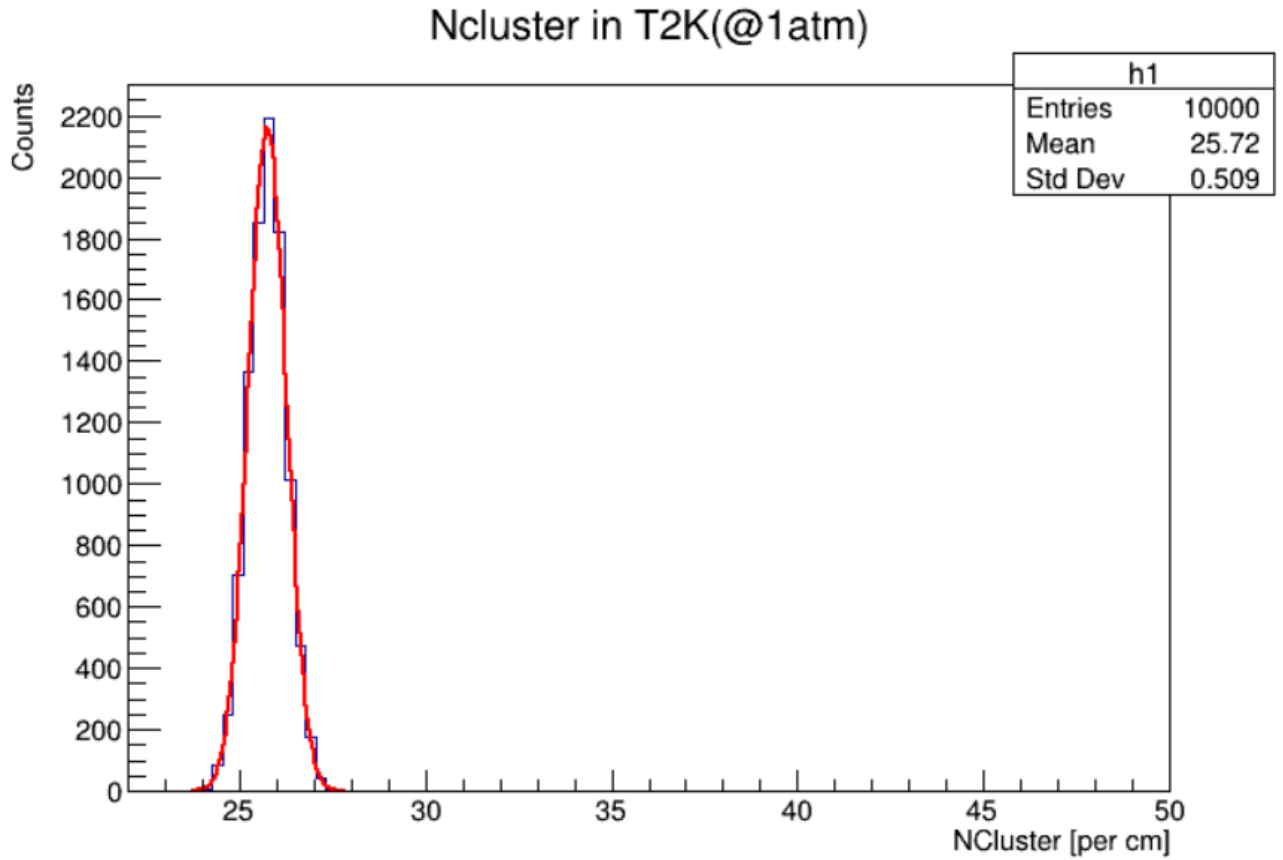
- Simulation result of the primary cluster using Ar/iC4H10=95/5 gas
- Mean of N_cluster: **1atm: 28.7 / 1.5atm 42.9**
- Increased 0.5atm operation gas pressure, the cluster will be bigger more than **50%**

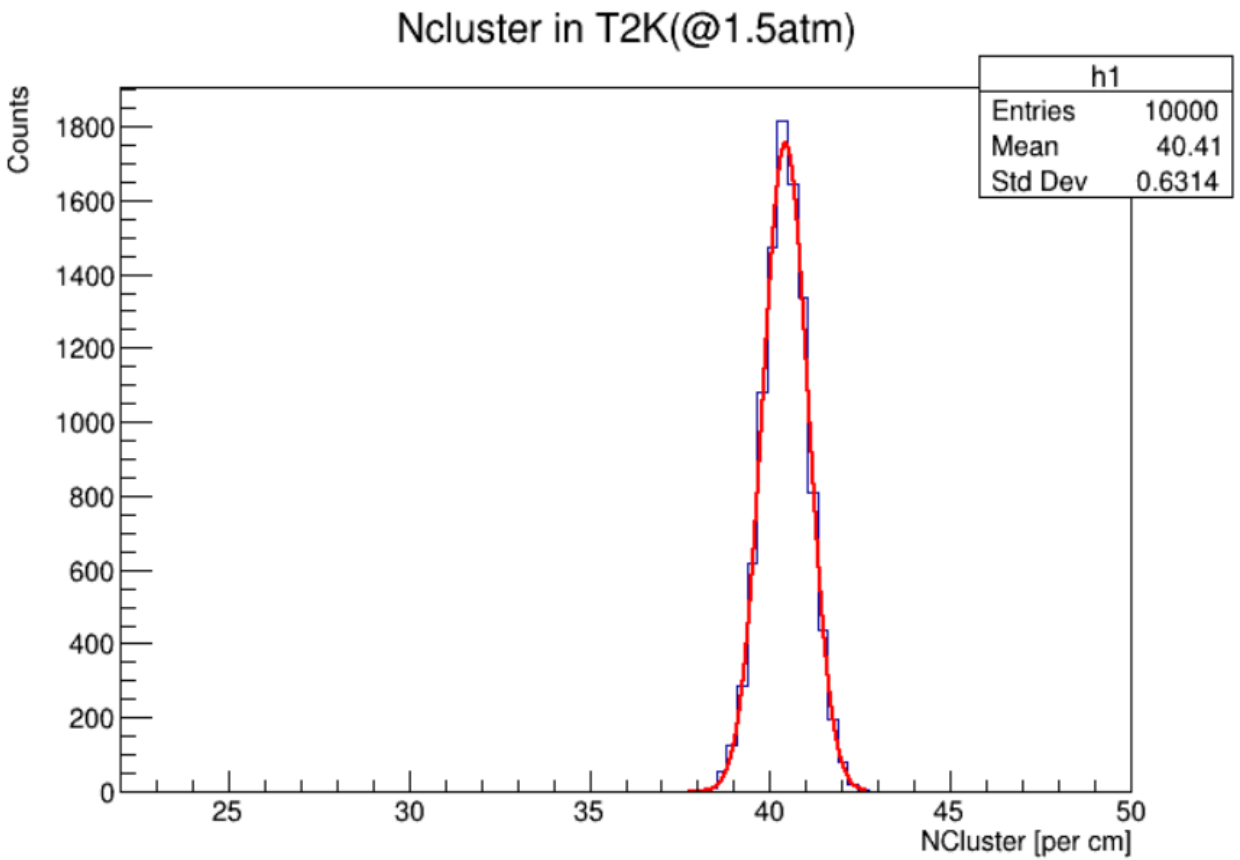




Primary cluster profile using **T2K** gas at the different pressure

- Simulation result of the primary cluster using T2K gas
- Mean of N_cluster: **1atm - 25.8 / 1.5atm - 40.7**
- Increased 0.5atm operation gas pressure, the cluster will be bigger more than **57%**





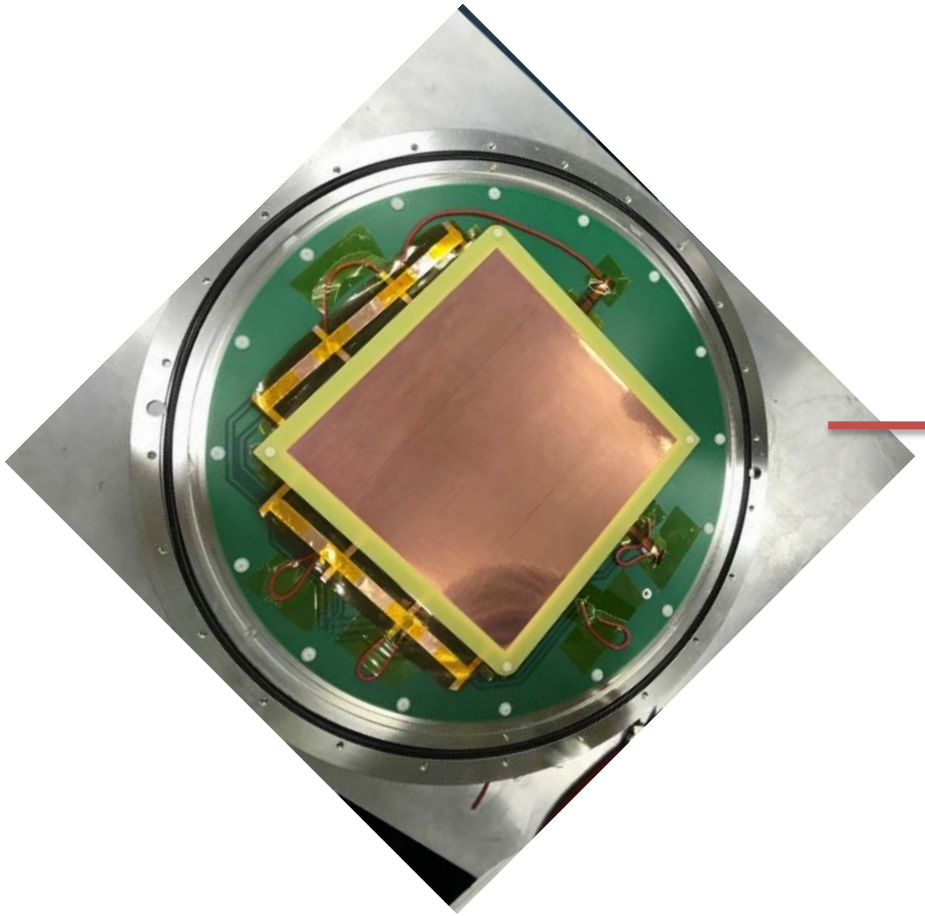
Simulation results

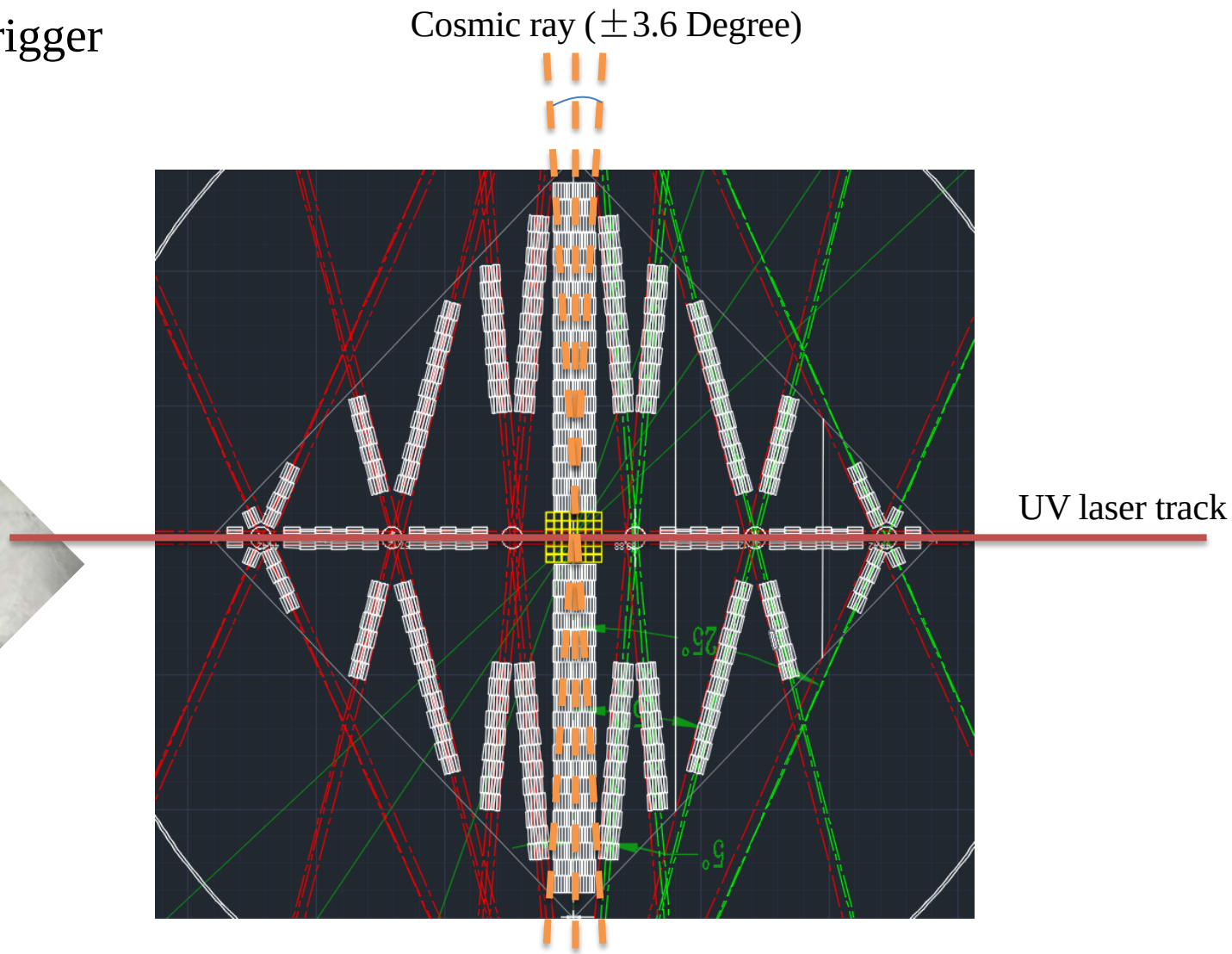
- The codes successfully simulated the primary cluster using the different operation mixture gases.
- Simulation result show that the primary cluster profile along the drift length, and it could meet the pixelated readout TPC detector if the pad size will be kept in the rang of 300um – 500um.
- Simulation result show that the number of the primary cluster under the different gas pressure, and it could be optimized and meet the requirements of the pixelated readout TPC detector if the MPGD readout will run at the low gain.
- More details of the cluster along the drift in the T2K gas are ongoing…

- Update testing of TPC prototype

TPC detector with UV laser/55Fe/Cosmic ray

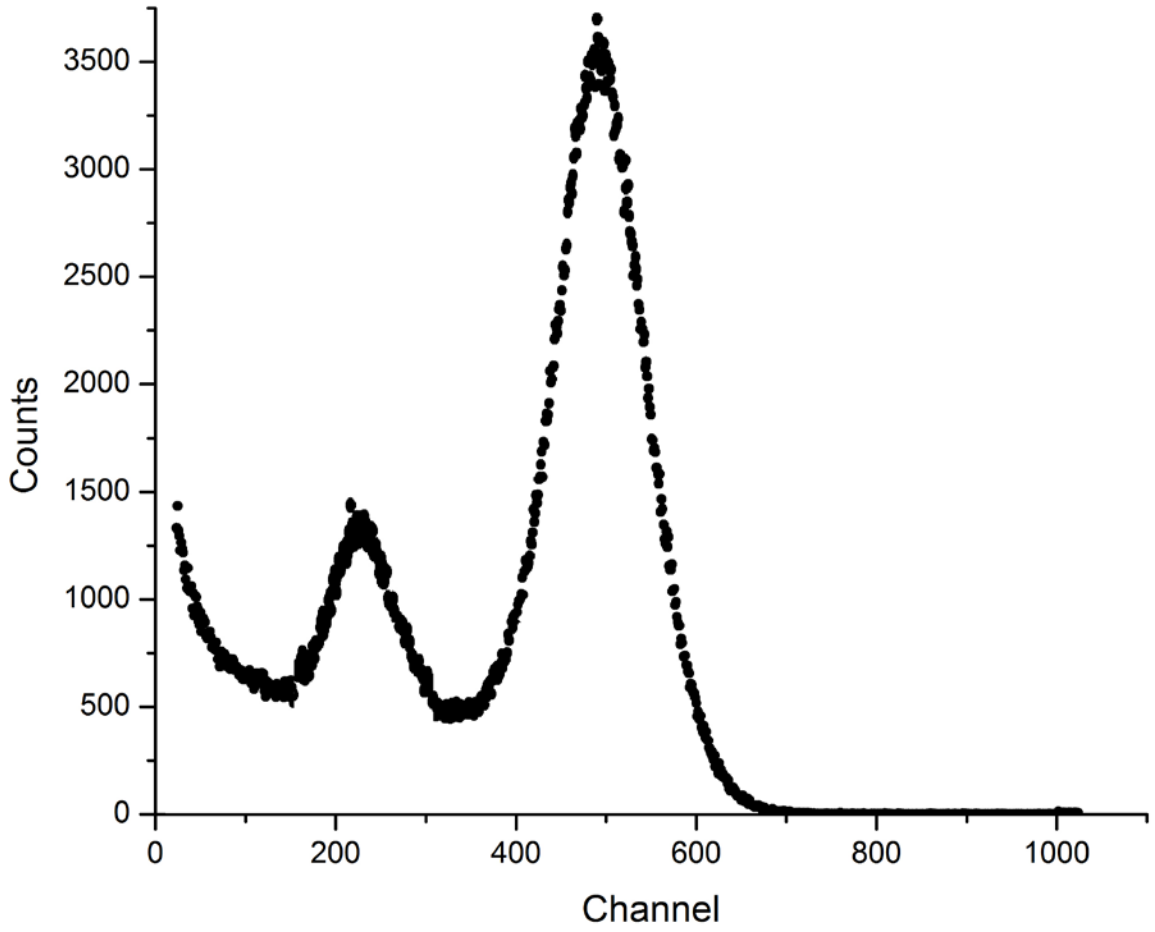
- TPC detector prototype can study the UV laser track, ^{55}Fe radiation source and the cosmic ray.
- Self-trigger, only UV with the external trigger





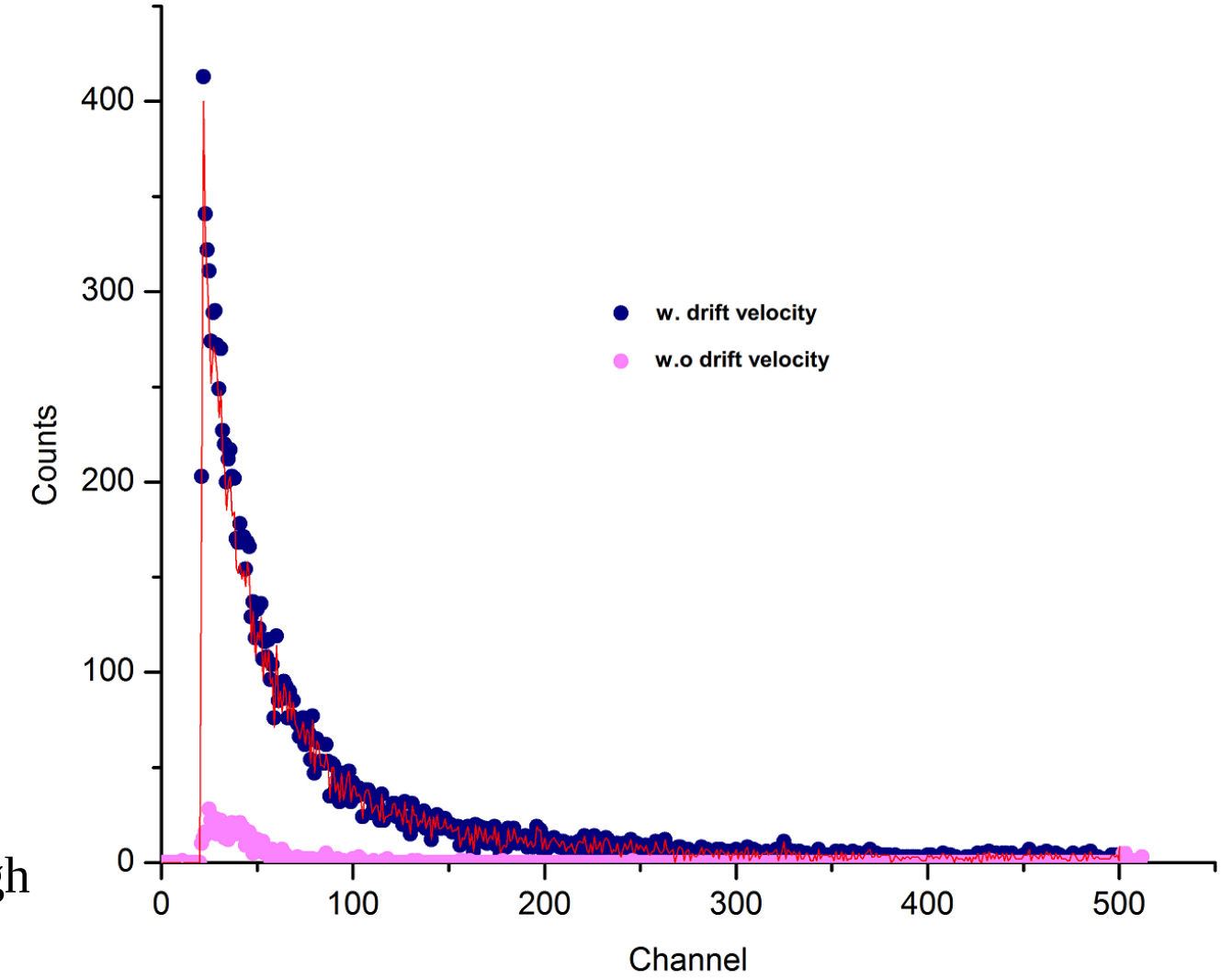
TPC detector with 55Fe

- TPC detector prototype can study using ^{55}Fe radiation source
- 5.9keV X-ray
- Operation gas: T2K
- Only using 7 adjacent readout pads
- TPC prototype was checked after one year development
  - 55Fe X-ray spectrum profile is very good
  - Gain just shift -2% than one year before.



TPC detector with Cosmic ray

- TPC detector prototype can study using the cosmic ray.
- Operation gas: T2K
- All middle adjacent readout pads
- TPC prototype was studied after 55Fe testing
  - Taken one month data
  - Trigger rate: 0.32Hz in ± 3.6 degree
- The Landau distribution of the cosmic ray's energy spectrum was successfully obtained, but the dE/dx analyzed is so difficult without enough data statistics.



Summary

- The simulation is starting to study the primary cluster using the different operation mixture gases, the different operation gas pressure and optimization.
- To meet high luminosity of Z pole run, the testing the UV light created the ion disk by photoelectric effect, and the experimental results show good to study.
    - Created the enough ions in the drift chamber
    - Mimic the ion distortion and calibrate by UV track, physics events.
- TPC detector prototype was studied using the UV laser track, ^{55}Fe radiation source and the cosmic ray.
    - TPC prototype was checked after one year development (Good performance!)
    - Landau distribution of the cosmic ray's energy spectrum was analyzed.
    - PID testing will be finished to need enough data statistics.

Many thanks!