



核数据重点实验室

R&D of Test Platform for PandaX-III

Lei Chen, Shouyang Hu & Xiaomei Li
On the behalf of CIHENP team of CIAE:
Xiaomei Li, Shouyang Hu, Jing Zhou,
Lei Chen, Wendi Liu, Yu Zhi, Mingrui Zhao,
Peiyu Li, Shihai Jia, Yunyu Zhang
China Institute of Atomic Energy

2019/10/17

Outline

- PandaX-III Experiment and NLDBD
- Test Platform and subsystem
- Preliminary test of Bulk MicroMegs with the Platform
- Conclusion and Future Plan



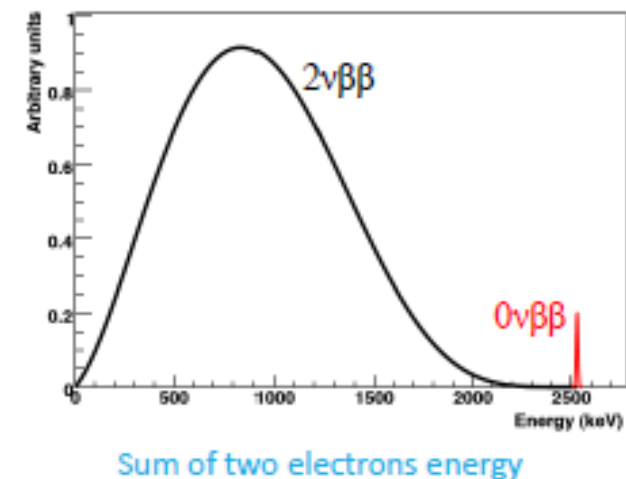
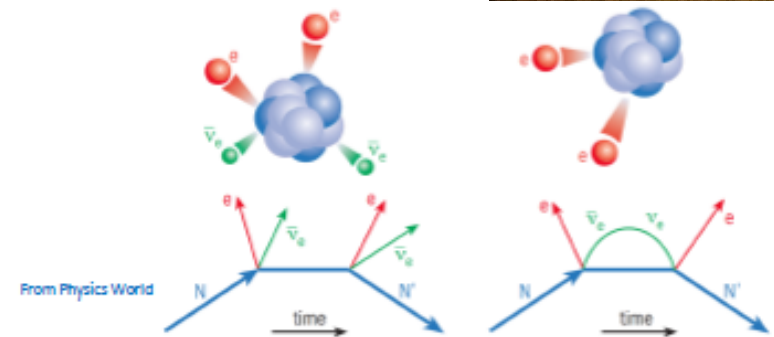
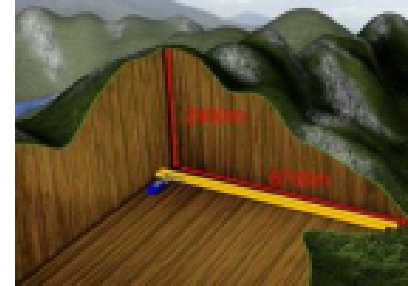
Outline

- PandaX-III Experiment and NLDBD
- Test Platform and subsystem
- Preliminary test of Bulk MicroMegs with the Platform
- Conclusion and Future Plan



PandaX-III Experiment

- Aim at neutrinoless double beta decay ($0\nu\beta\beta$) event
 - Explore nature of neutrino, Majorana or Dirac
 - Test number conservation of lepton
 - Measure the neutrino mass
- Request
 - Low background radiation
 - Enough material. Ton at least
 - Good energy resolution
 - Track discrimination.
- The mission of CIAE:
 - Readout detector (MicroBulk MicroMegas) assembly, test and QA on PandaX –III TPC

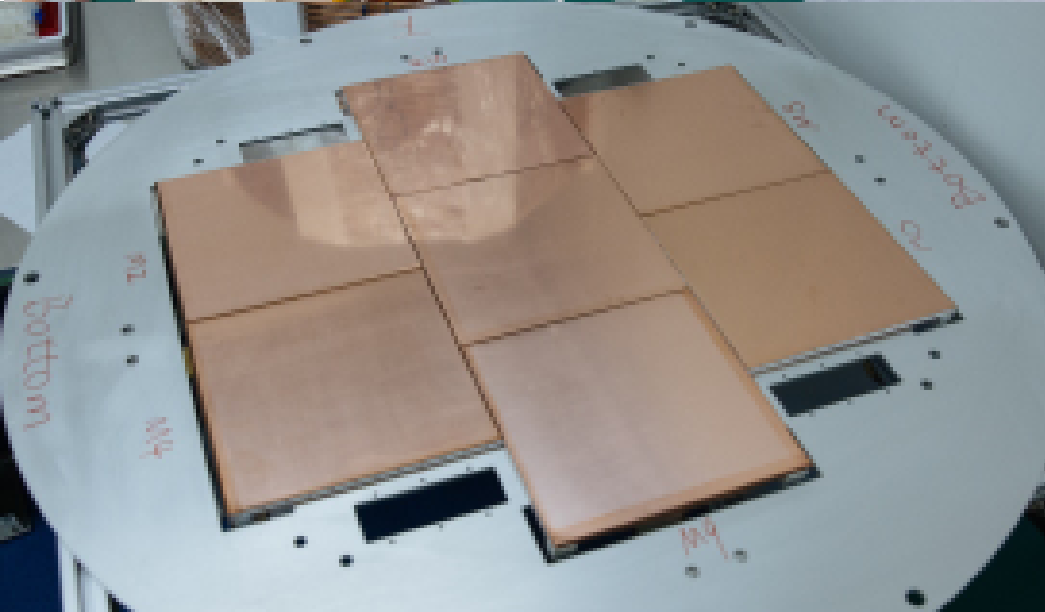
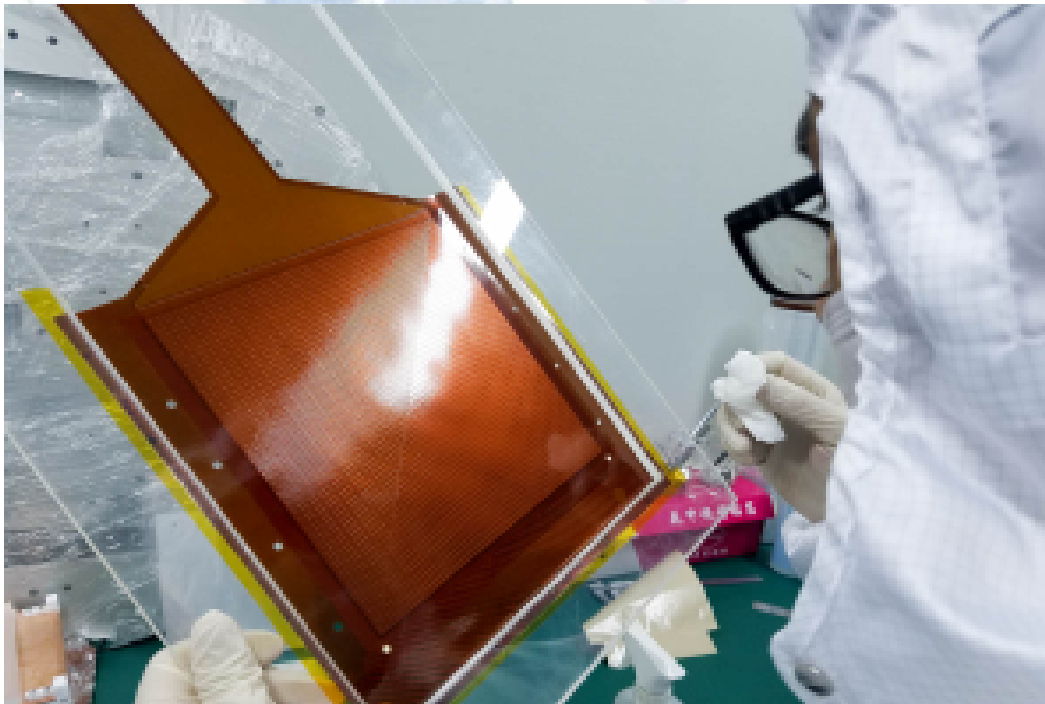


Main work

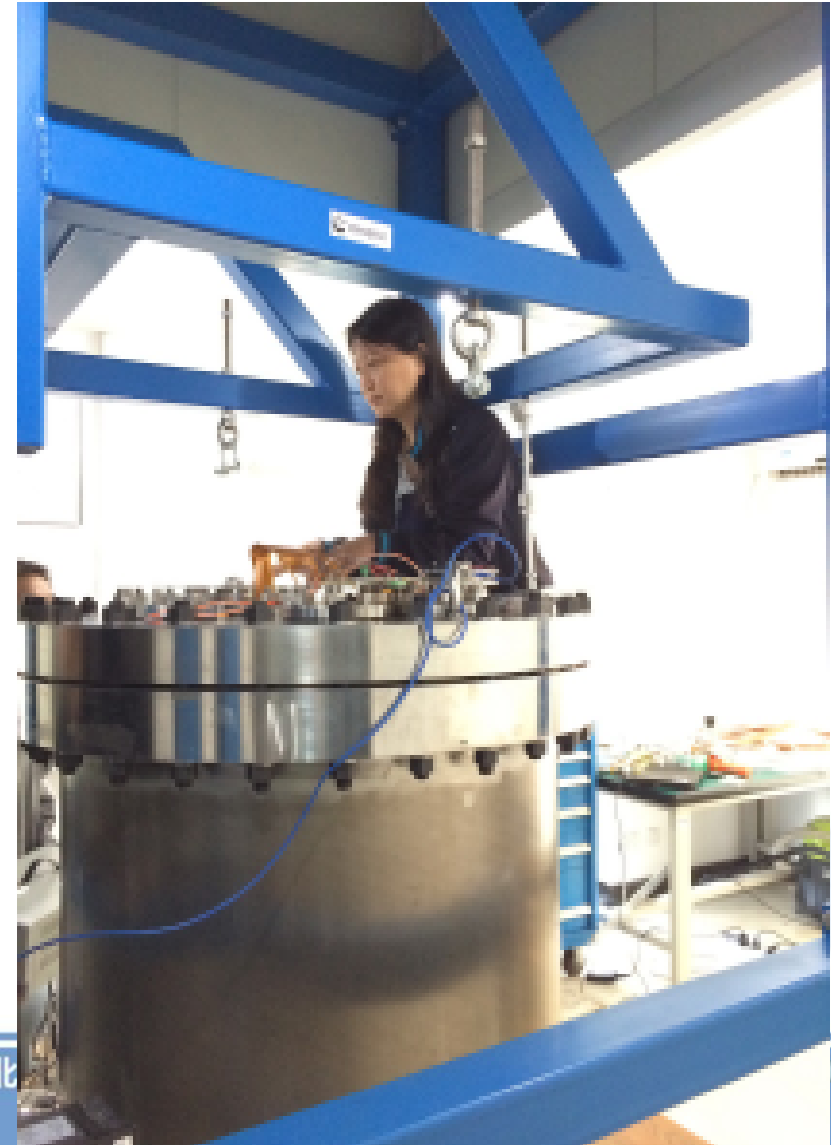
- **Install and test prototype TPC**
 - Test Prototype TPC
 - Bad channel check
 - gain curve
- **Install and test MINI TPC gas system**
- **Build MicroMegas detector test platform**
 - Electromagnetic Compatibility
 - Data analysis program
 - Test chamber



Installing 7 MM modules



PandaX-III TPC Prototype

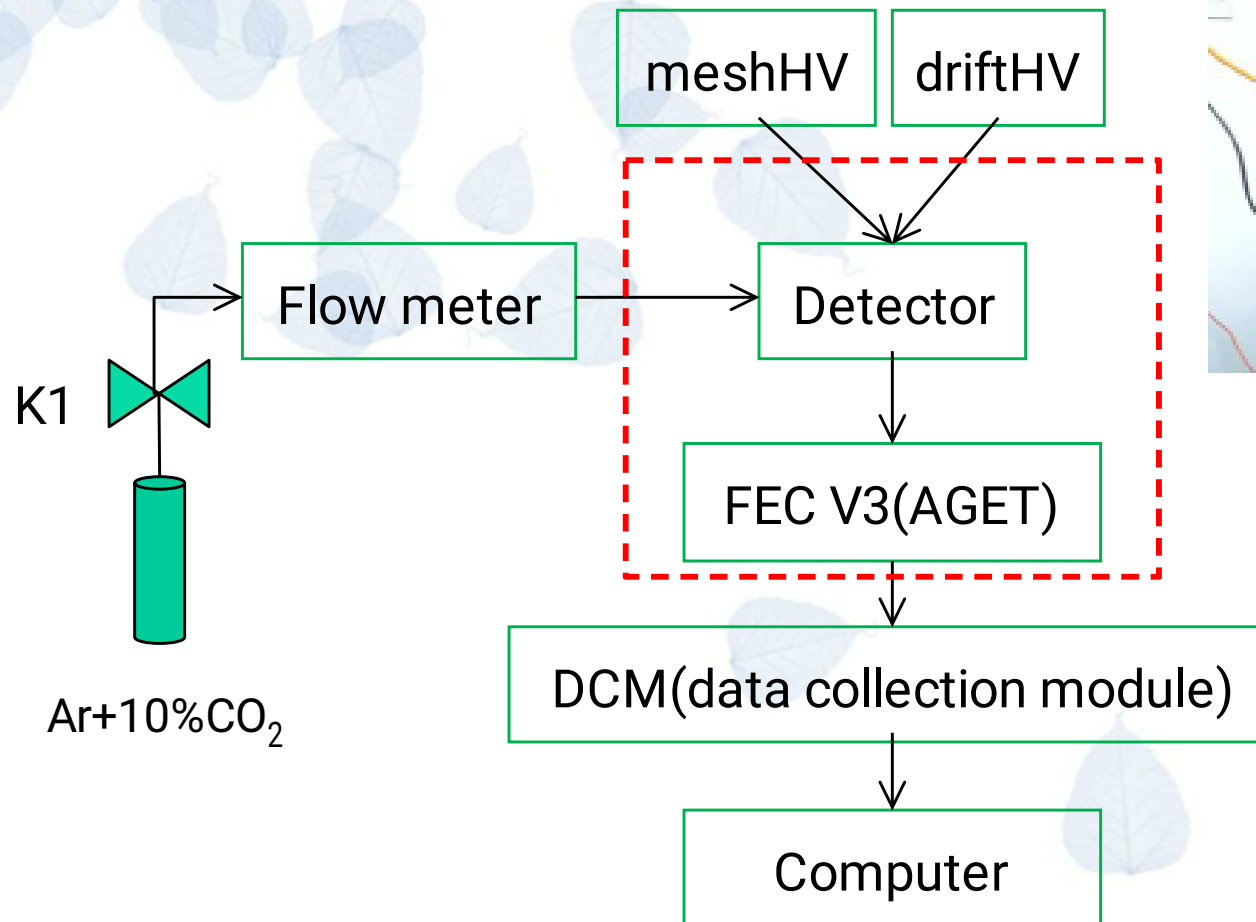


Outline

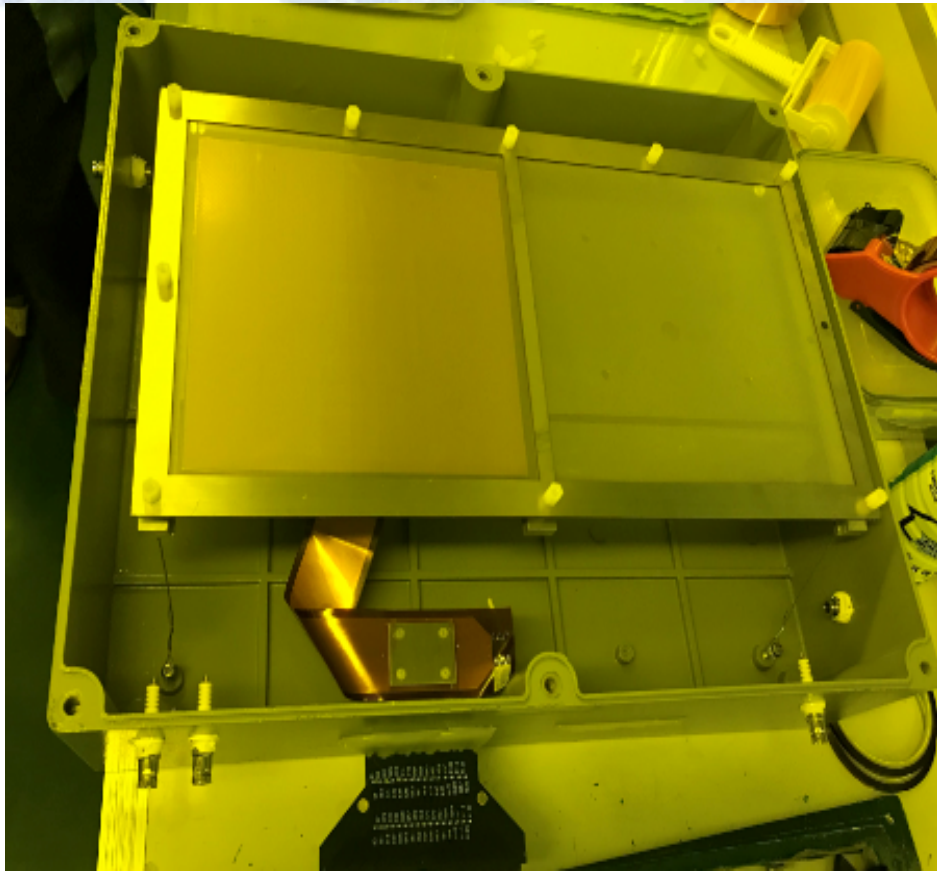
- PandaX-III Experiment and NLDBD
- **Test Platform and subsystem**
- Bulk MicroMegas Test with the Platform
- Conclusion and Future Plan



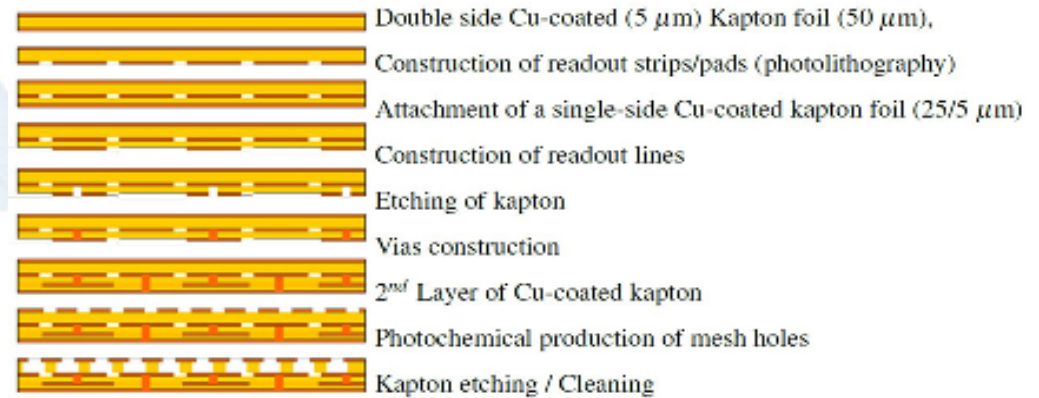
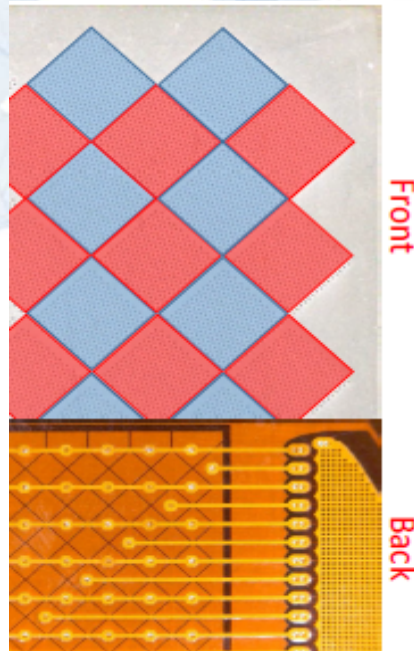
Test Platform and subsystem



PandaX-III MM Test Box at CIAE



Tested Detector of MM



Parameter of Bulk MicroMegs

Total channel: 128channels

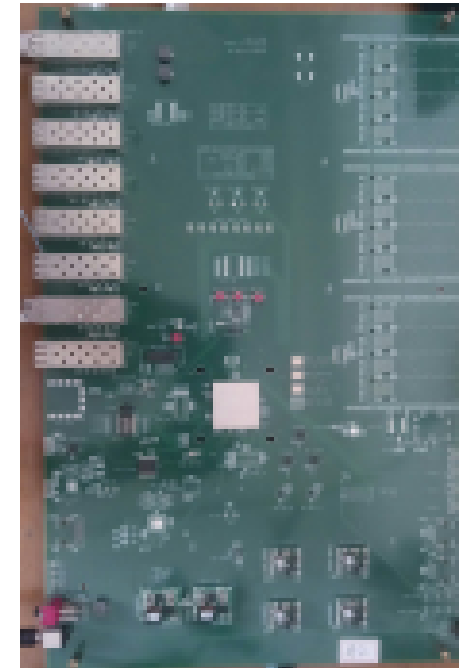
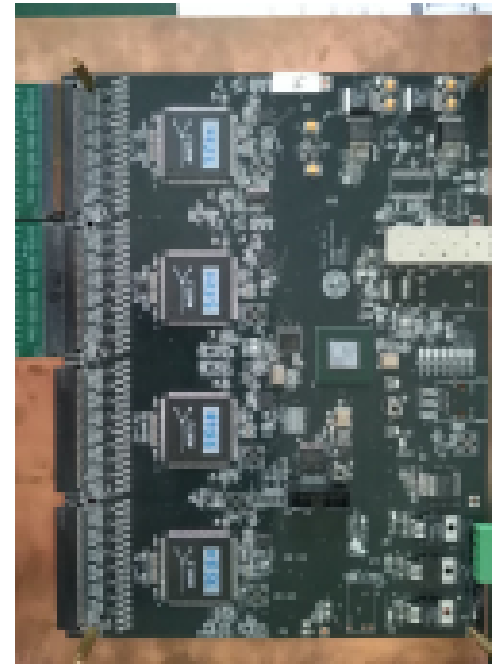
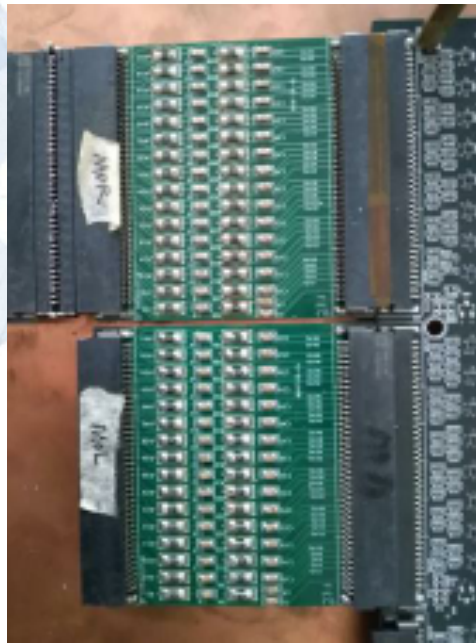
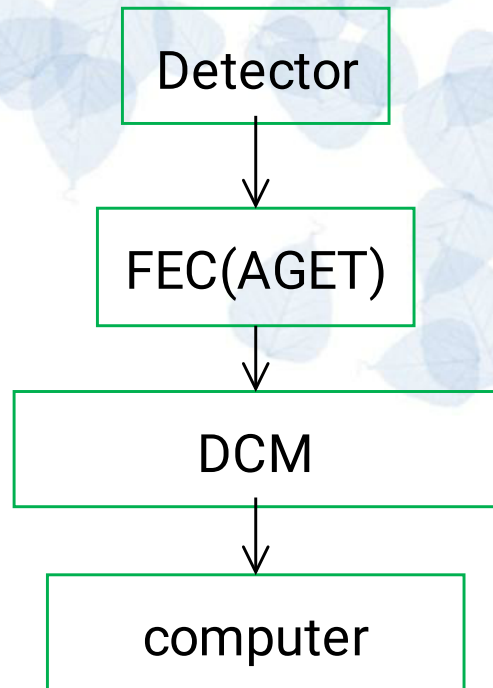
Amplify gap: 50 μm

Drift distance: 1 cm

Effective Area: 20cm*20cm



Universal Readout Electronic



Adapt board, FEC V3(front end card),Data collection module are made by USTC



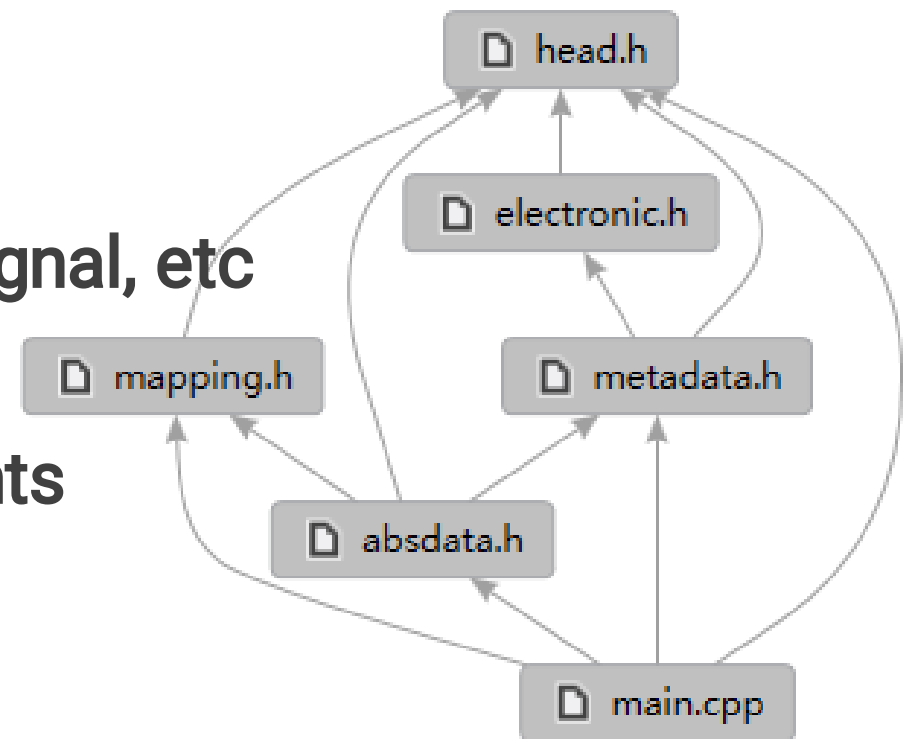
Data Analysis program

➤ Metadata.h

- read and check raw data
- Calculate baseline, RMS of signal, etc

➤ Absdata.h

- Reconstruct raw data to events
- Obtain center of an charge
- Get amplitude of an event

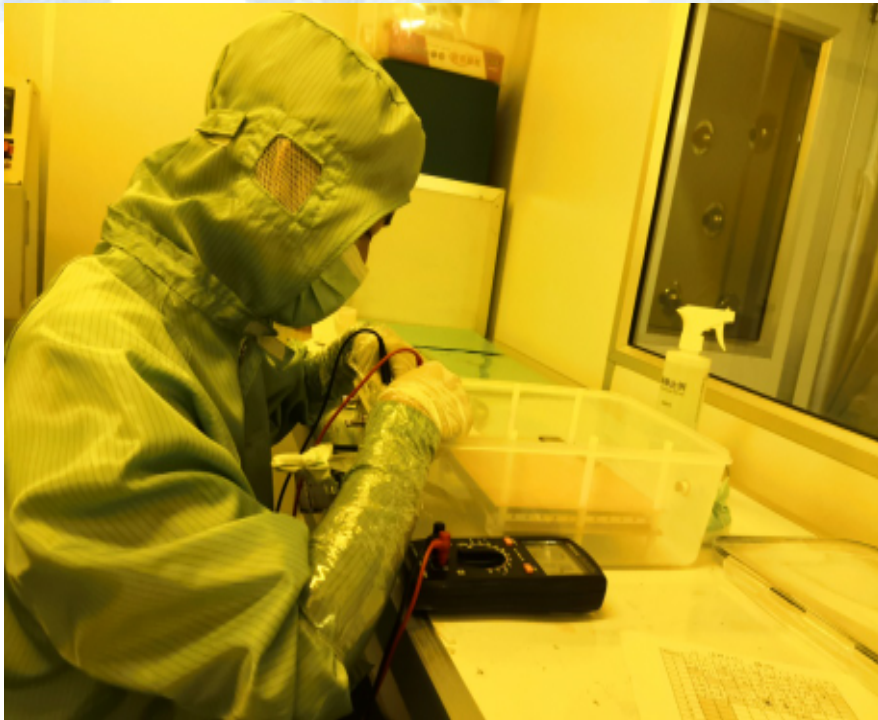


Seal and Gas Substitution

- Seal
 - Hot Melt
 - silicon oil
 - Rubber ring
- Calculation for gas substitution
$$t = -v \cdot \ln(P) / I$$
 - $V=9L$ $I=1L/min$ $P=0.1\%$
 - $t=1\text{hour}$

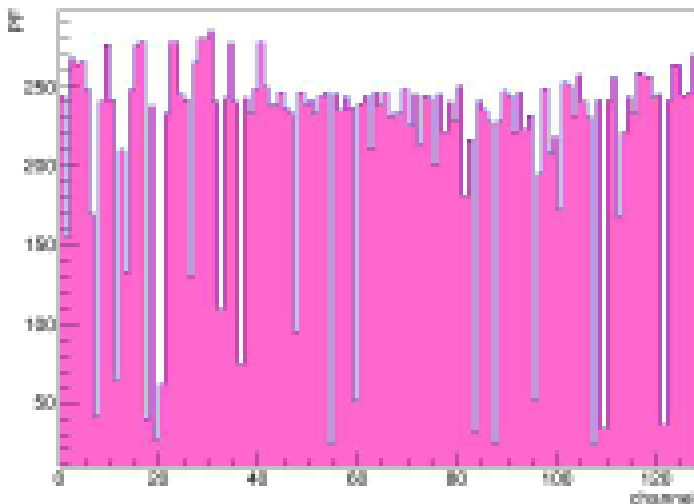


Bad channel check

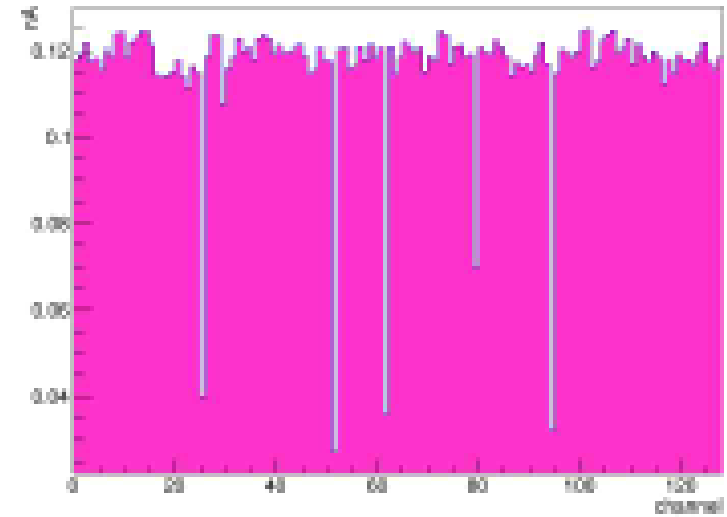
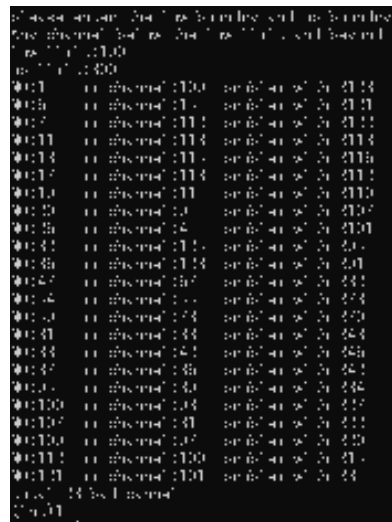


Bad channel check

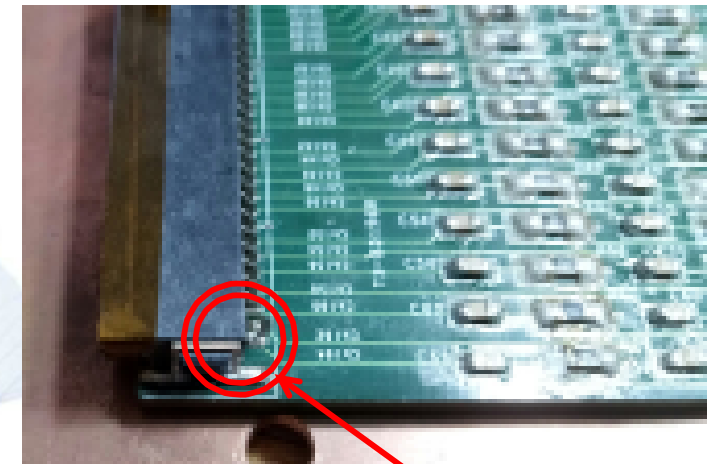
- Abnormal capacitance
- Current leakage
- Connection problem



Capacitance distribution of Microblik MicroMegas



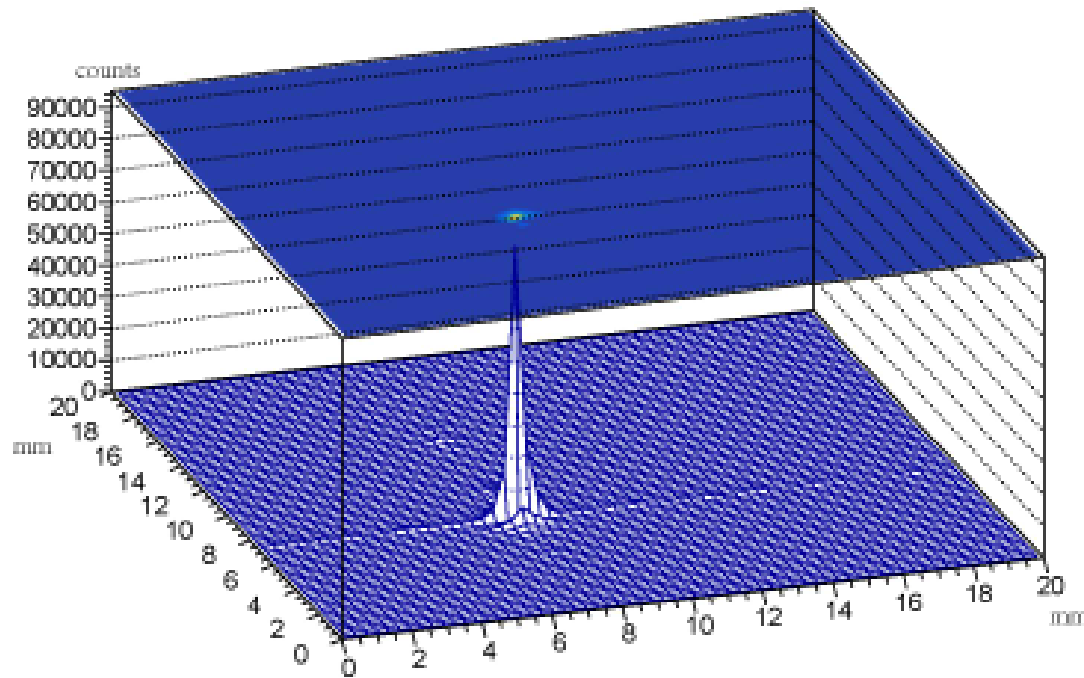
Current distribution of MM on Mesh HV=300V



Disconnected pin on adapt board



Hitmap of Microbulk MicroMegas with ^{55}Fe Source



- MM: 20cm*20cm
- Ar+ 10%CO₂
- Mesh HV: -370V
- Drift HV:-1500V
- Flowing gas

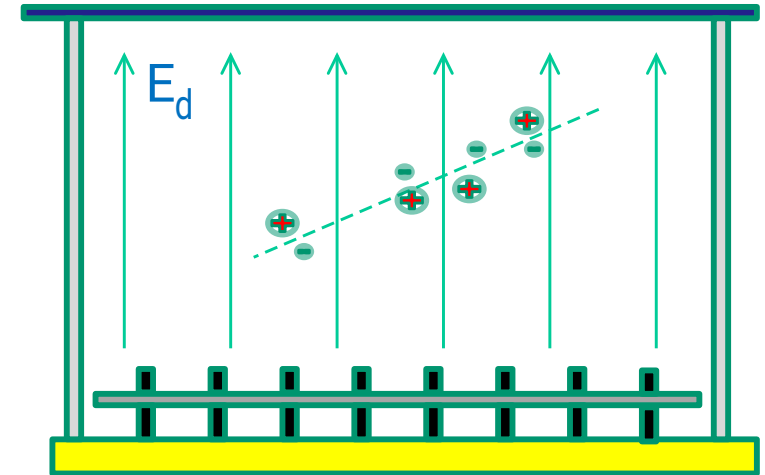
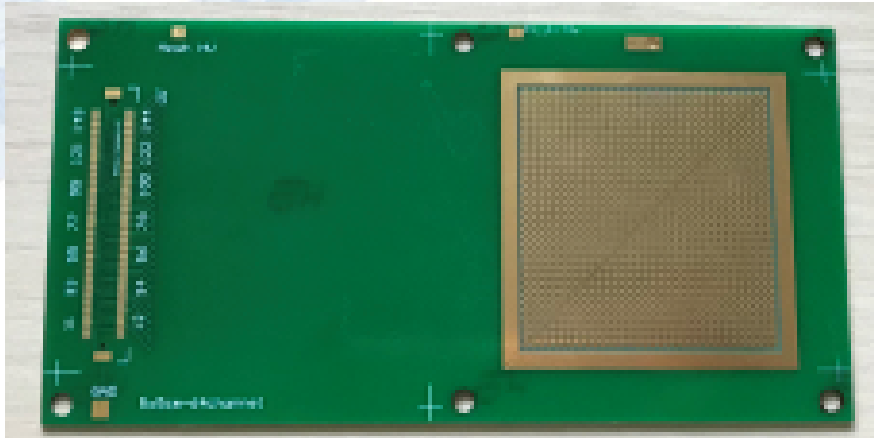


Outline

- PandaX-III Experiment and NLDBD
- Test Platform and subsystem
- **Preliminary test of Bulk MicroMegs with the Platform**
- Conclusion and Future Plan



Tested Detector of Bulk MicroMegs



Parameter of Bulk MicroMegs

Total channel: 64 channels

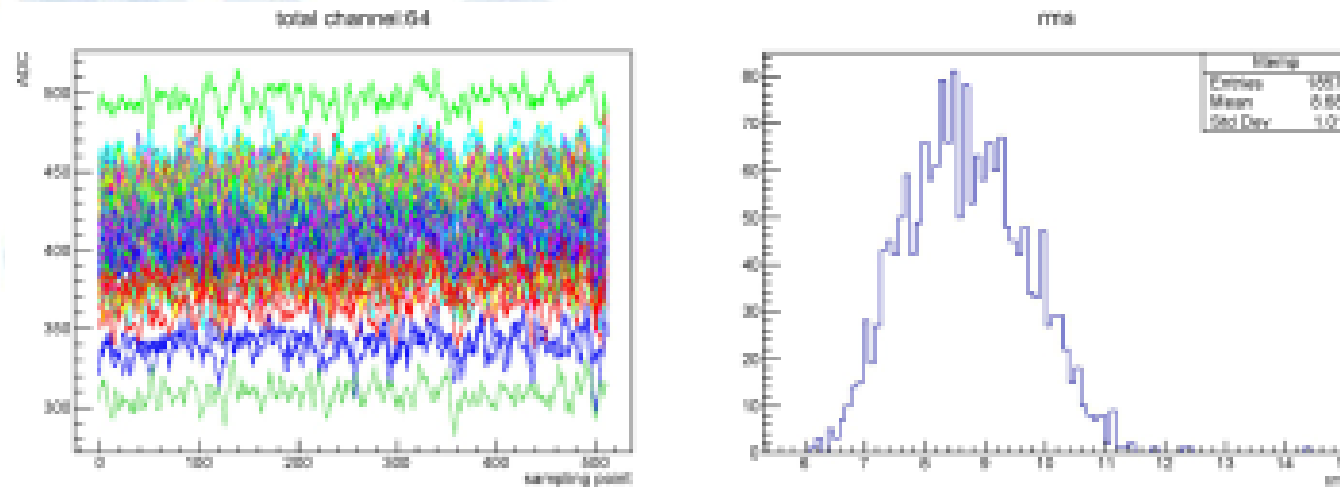
Amplify gap: 128 μm

Drift distance: 1 cm

Effective Area: 5cm*5cm



Noise Level

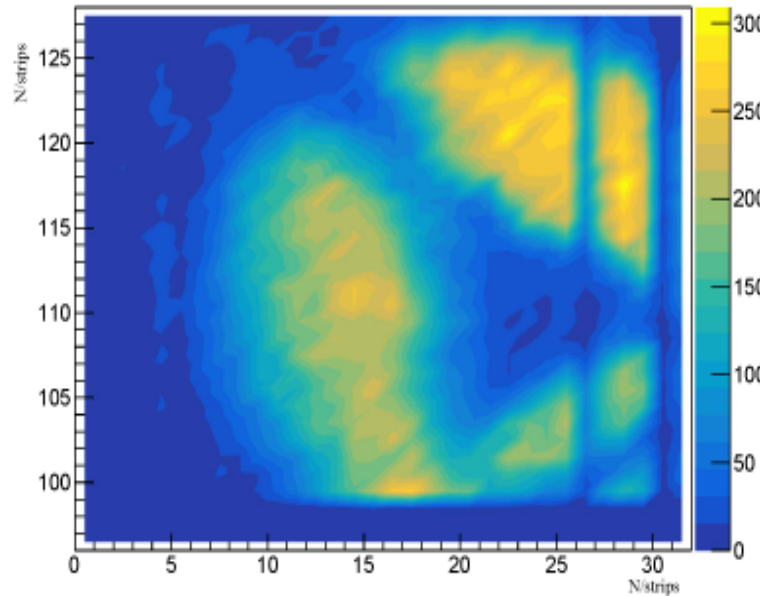


Left: Noise of detector. Right: RMS of detector system

Sampling rate: 5MHz
4096ADC \Leftrightarrow 120fC \Leftrightarrow 12bit
ENC: 9ADC



Image of key



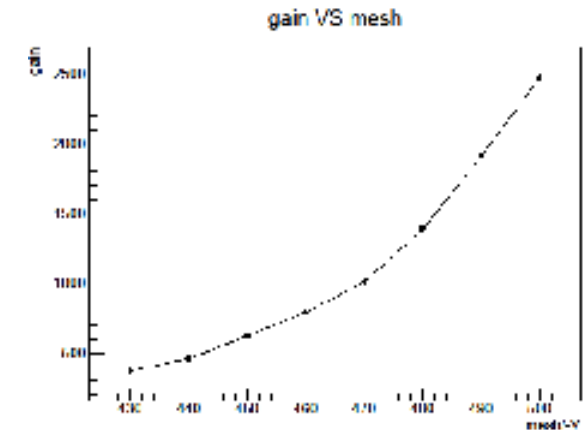
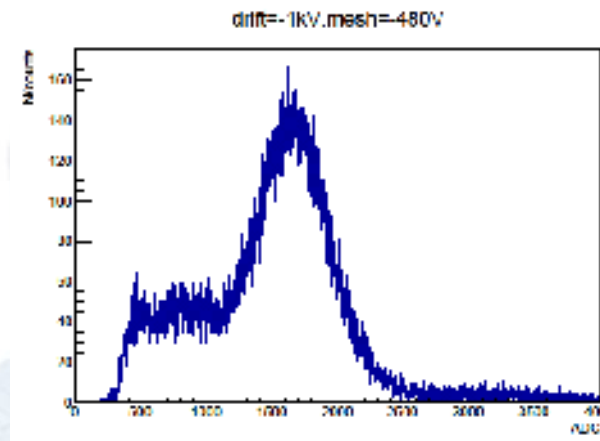
- Bulk MicroMegas: 5cm*5cm
- Ar+ 30%CO₂
- Mesh HV: -550V
- Drift HV:-2500V
- 50kV X-Ray tube

it shows key was taken by Bulk MicroMegas under X-Ray .
X-axis and Y-axis is strip number, Both of them have 32 channels.

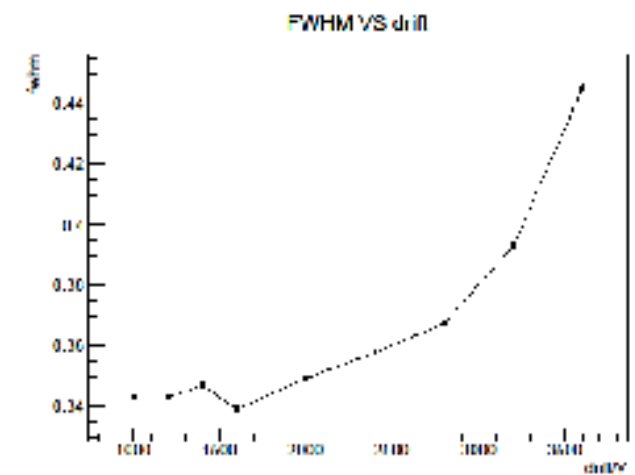
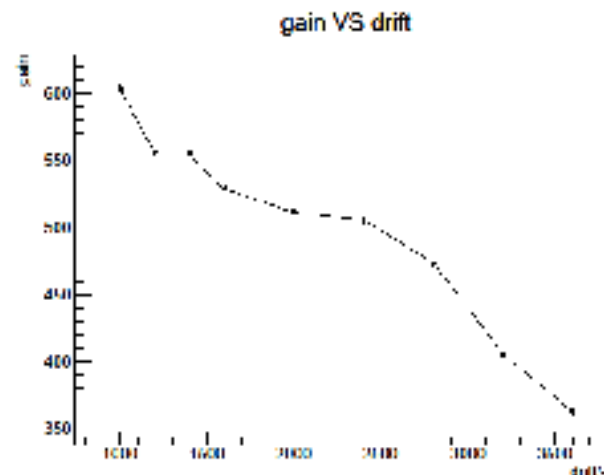


Energy Spectrum and Gain

- ^{55}Fe 5.9keV
- $\text{Ar}+10\%\text{CO}_2$
- Highest gain: 2000
- Energy resolution: 33%



Energy spectrum and gain curve on Drift HV=-1kV



Gain and energy resolution on Mesh HV=-450V



Conclusion and Future Plan

➤ Conclusion

- Build a detector test platform for PandaX-III experiment
- Developed capacitance and resistance automatic testing system
- Get Hitmap of Microbulk MicroMegs with ^{55}Fe Source
- Preliminary test of Bulk MicroMegs with the Platform

➤ Future Plan

- Design new structure to test more MicroMegs in one time
- Build a new gas system

