GEM Updates from China

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for the SoLID-GEM Chinese Collaboration

University of Science and Technology of China

SoLID Collaboration Meeting

December 3, 2016

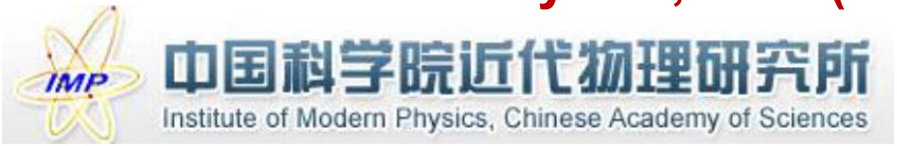
JLab

SoLID-GEM Chinese Collaboration

China Institute of Atomic Energy (CIAE)

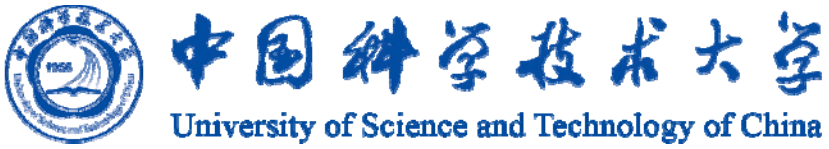
Lanzhou University

Institute of Modern Physics, CAS (IMP)



Tsinghua University

University of Science and Technology of China (USTC)



Words from CIAE (Xiaomei)

1) CIAE group are able to produce 40 cm x 40 cm foils;

2) CIAE group are able to do both single mask as well as double mask;

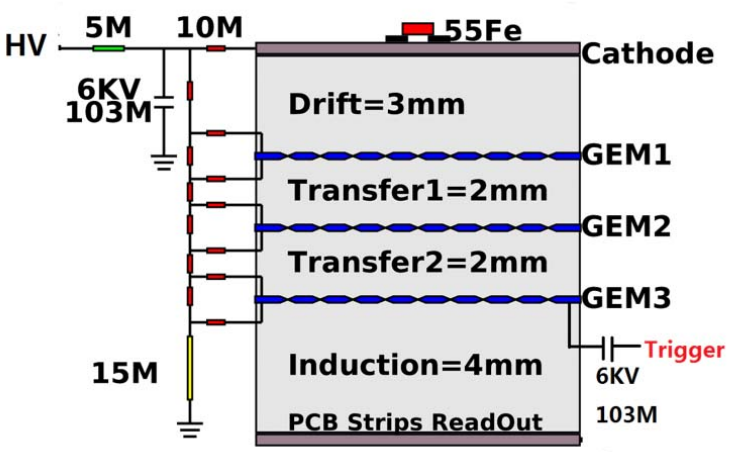
3)As CIAE does not allow to use bulk chemical reagents, CIAE group is working with a factory to transfer technology to them for production; so far, were able to produce 30 cm x 30 cm foils and success rate is not high (~10%);

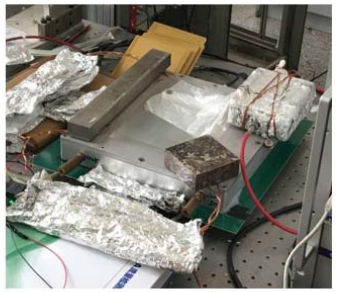
4) CIAE is working with the company to improve the foil production success rate by supporting the company to procure a new small etching instrument, which will make it easy to change etching solution to keep solution fresh;

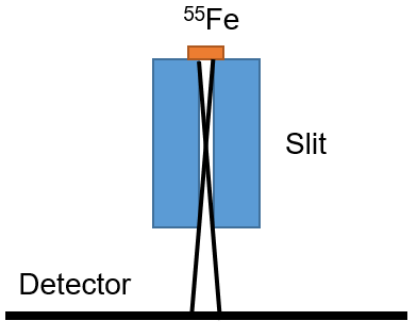
5) CIAE group is applying for a grant to continue R&D for large area foil production; if funding is available, it is expected that CIAE group will be bale to make the large area foil in one year;

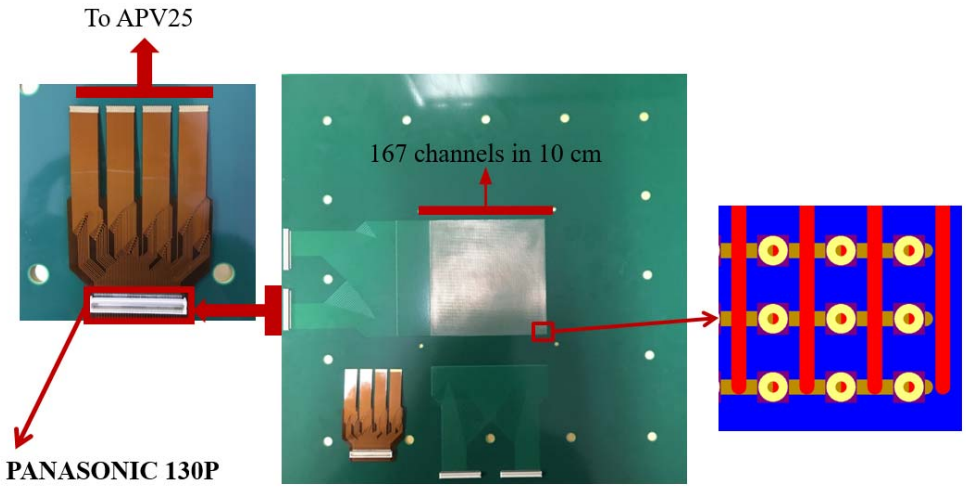
6) the step after that will be to transfer the technology to the company for production, which is expect to be in another year.

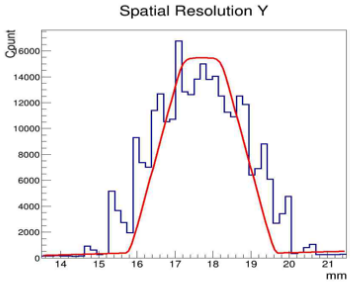
Updates from LanZhou University



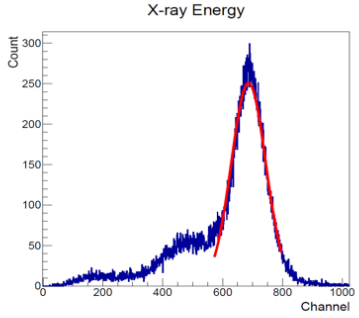




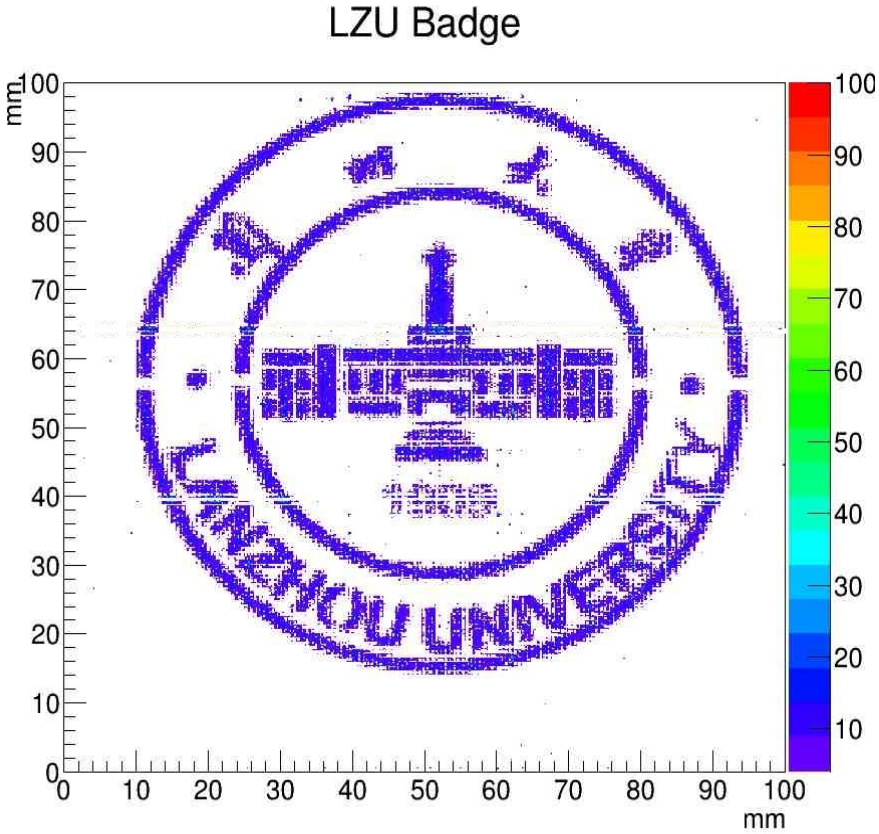




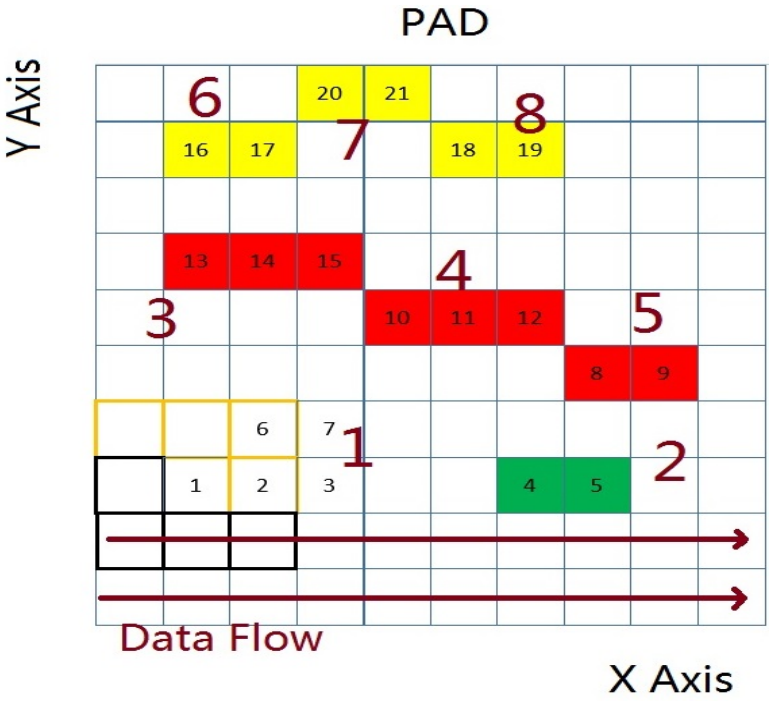
Spatial resolution~127um



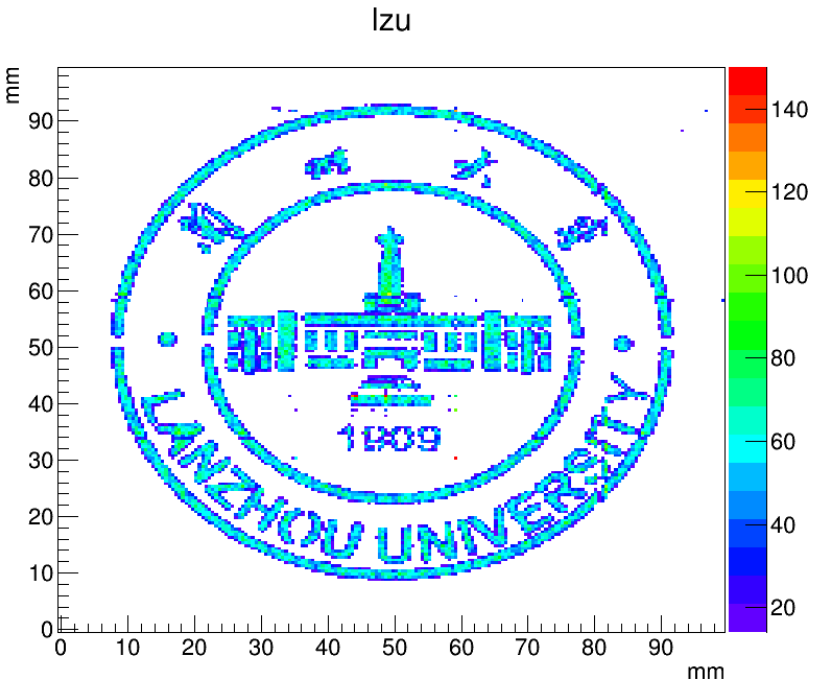
energy resolution 18.9%



Imaging test



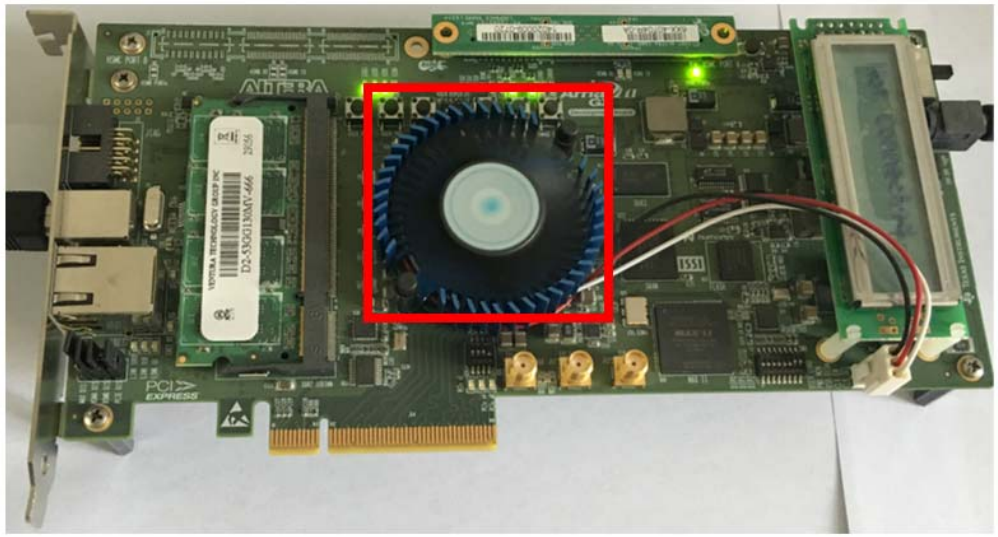
Cluster reconstruction principle

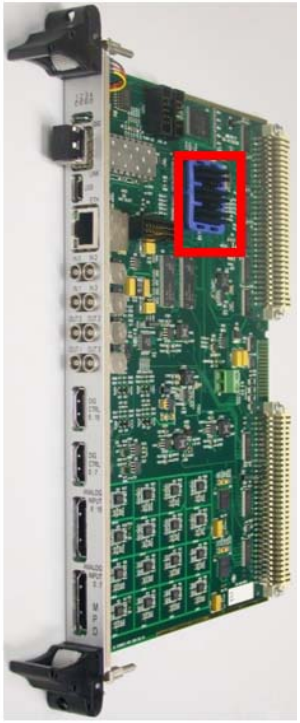


Reconstruction result with FPGA

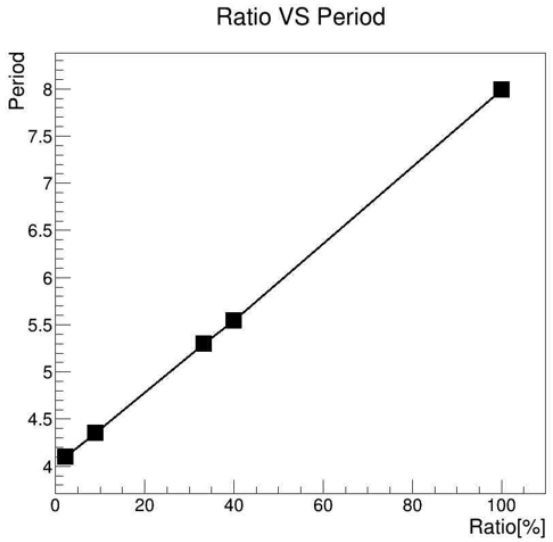
Development board: ARRIA GX FPGA toolkit

EP1AGX60DF780C6N





Processing speed VS signal coverage ratio



Resources consumption budget (2048 chs)

SPM.v

Flow Summary

Flow Status	Successful - Wed Aug 03 15:06:08 2016
Quartus II 64-Bit Version	14.1.0 Build 186 12/03/2014 SJ Full Version
Revision Name	retrack
Top-level Entity Name	retrack
Family	Arria II GX
Device	EP2AGX125EF35C4
Timing Models	Final
Logic utilization	38 %
Combinational ALUTs	14,092 / 99,280 (14 %)
Memory ALUTs	0 / 49,640 (0 %)
Dedicated logic registers	32,224 / 99,280 (32 %)
Total registers	32224
Total pins	144 / 512 (28 %)
Total virtual pins	0
Total block memory bits	73,216 / 6,727,680 (1 %)
DSP block 18-bit elements	3 / 576 (< 1 %)
Total GXB Receiver Channel PCS	0 / 12 (0 %)
Total GXB Receiver Channel PMA	0 / 12 (0 %)
Total GXB Transmitter Channel PCS	0 / 12 (0 %)
Total GXB Transmitter Channel PMA	0 / 12 (0 %)
Total PLLs	0 / 6 (0 %)
Total DLLs	0 / 2 (0 %)

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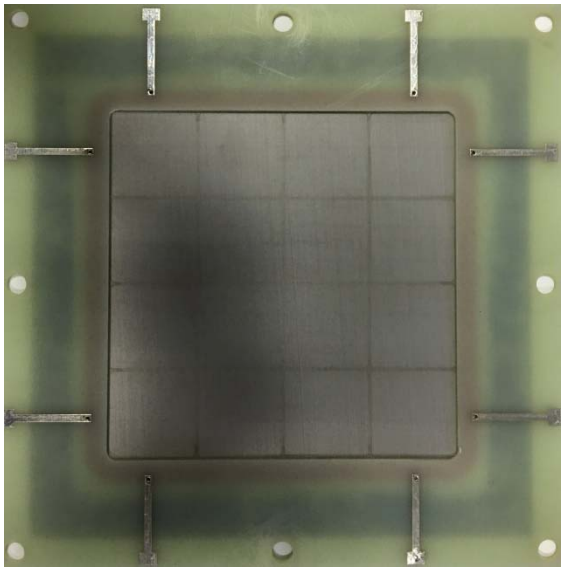
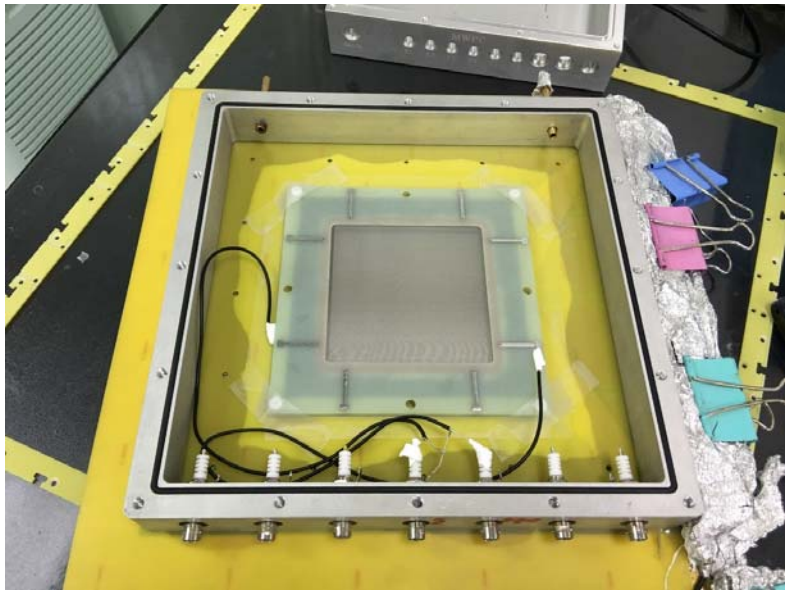
The fitting results without filters (actual version) are:
; Logic utilization                  : 56 %
;     Combinational ALUTs            : 21,247 / 48,080 ( 44 % )
;     Dedicated logic registers      : 13,382 / 48,080 ( 28 % )
; Total registers                    : 13661
; Total pins                         : 312 / 395 ( 79 % )
; Total block memory bits            : 1,808,252 / 2,528,640 ( 72 % )
; DSP block 9-bit elements           : 0 / 256 ( 0 % )
; Total GXB Receiver Channels        : 1 / 8 ( 13 % )
; Total GXB Transmitter Channels     : 1 / 8 ( 13 % )
; Total PLLs                         : 3 / 4 ( 75 % )
; Total DLLs                         : 1 / 2 ( 50 % )
```

Iterms of resources	Total	Usage of current daq	Usage of out code
Combinational ALUTs	48,080	21,247 (44%)	14,092 (29%)
Dedicated registers	48,080	13,382 (28%)	32,224 (67%)
DSP	256	0	3(1%)
Block Memory Bits	2,528,640	1,808,252 (72%)	73,216 (3%)

Source of MPD's FPGA is enough

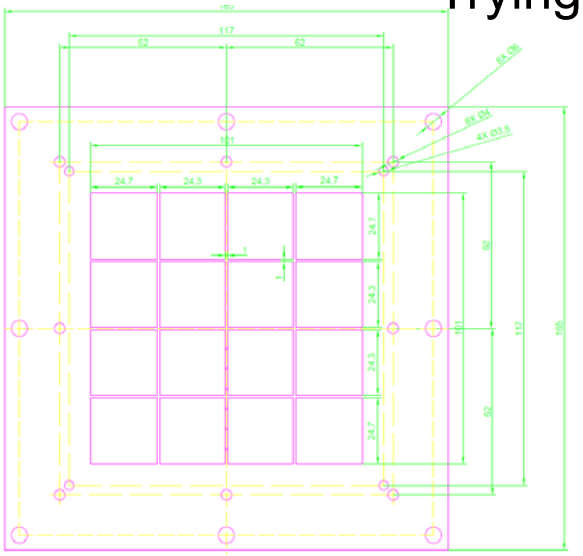


MicroMesh: 400 mesh

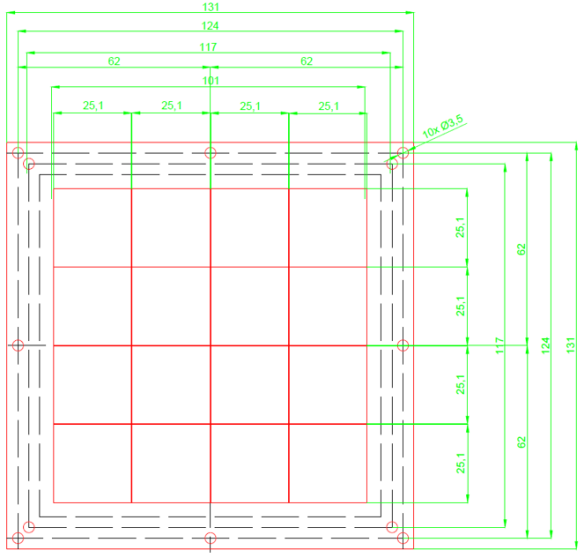


Active area:100mm*100mm

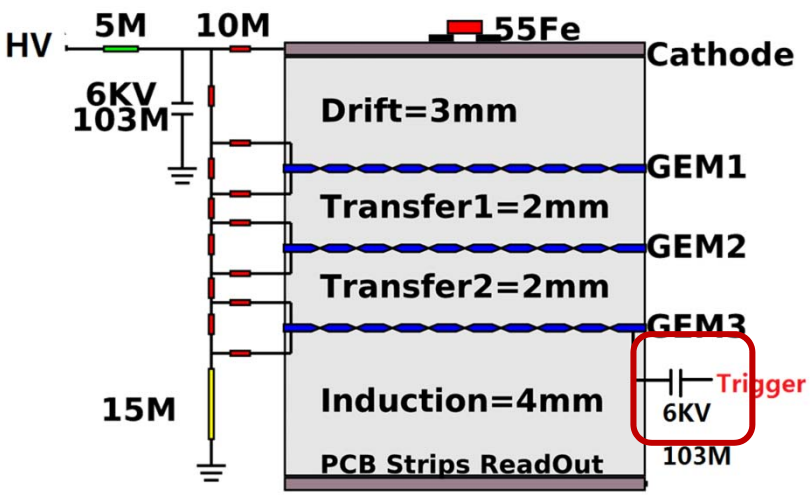
Trying to reduce the dead zone



Pillar Dead Zone: 8.91%

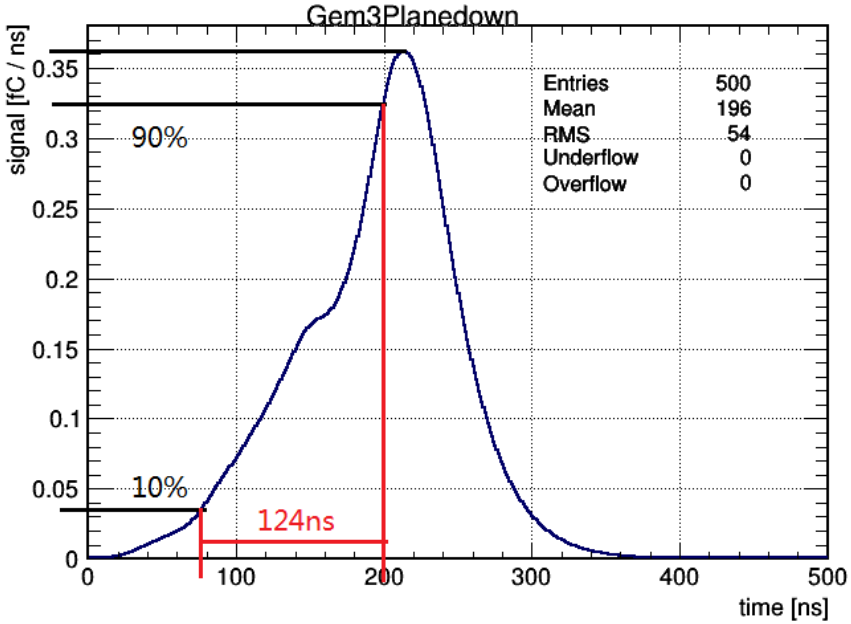


Dead zone: 1.79%

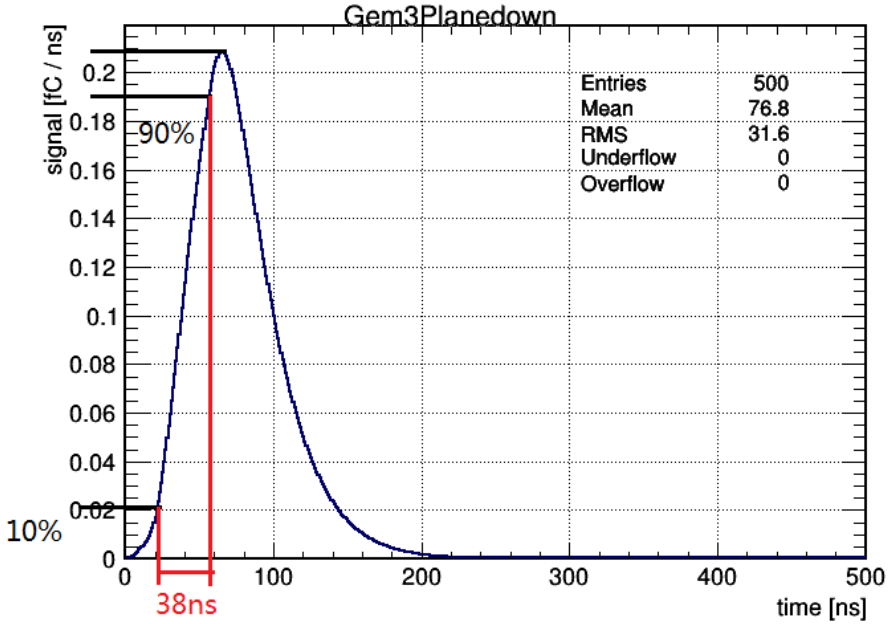


Try to discriminate X-Ray background using signal rise time

Simulation result with Garfield++(20ns pre-amplifier input capacitance)



Cosmic Muon signal

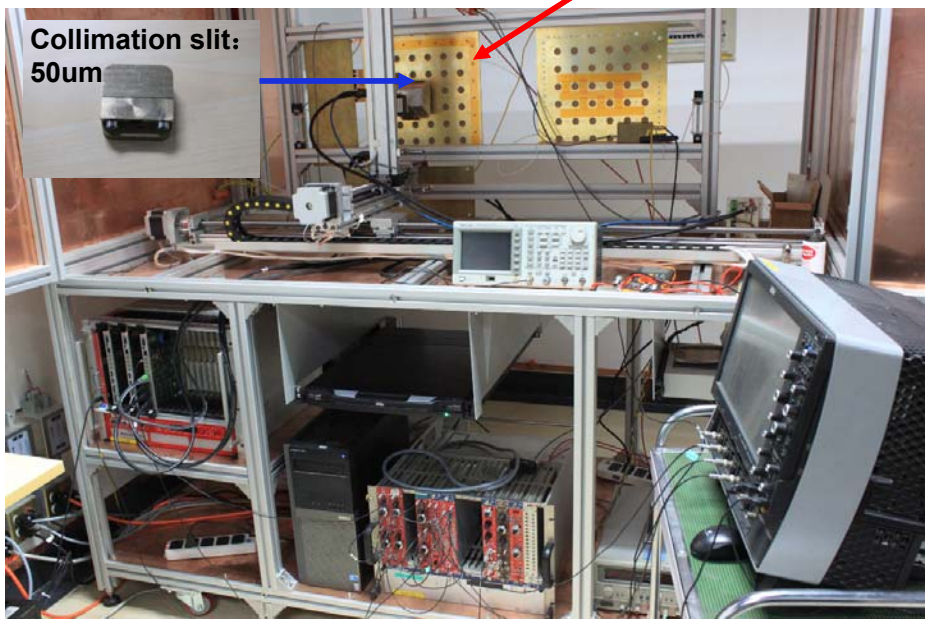


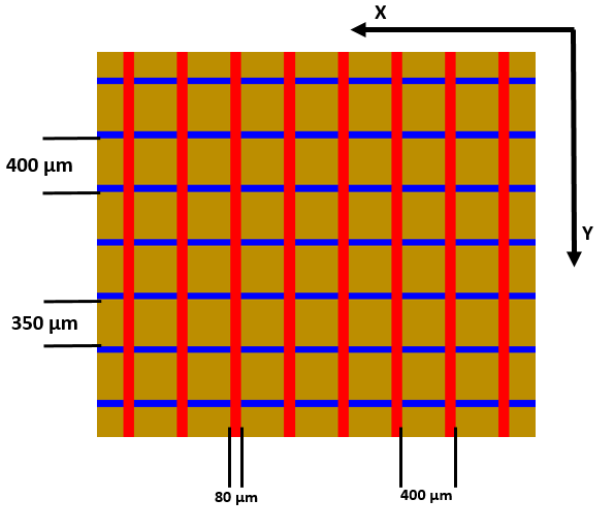
X-Ray signal

Updates from USTC

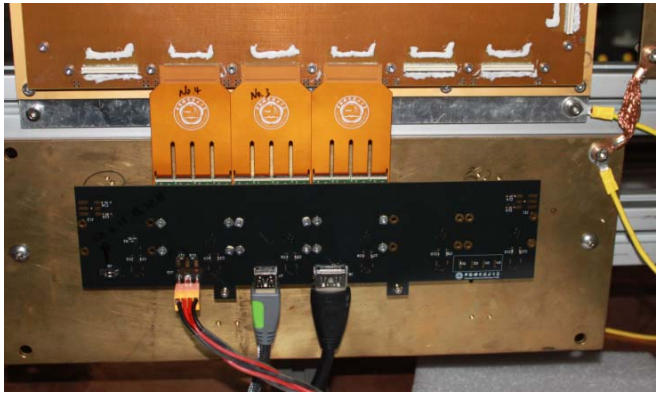
30cm×30cm GEM position resolution test

➢ Test setup





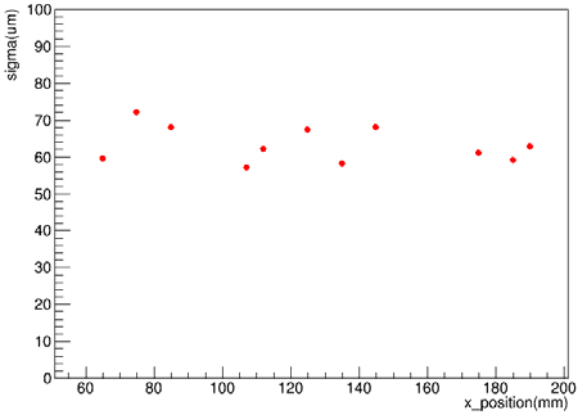
- ➢ Pitch: 400um;
- ➢ Strip width: x(80um), y(350um)

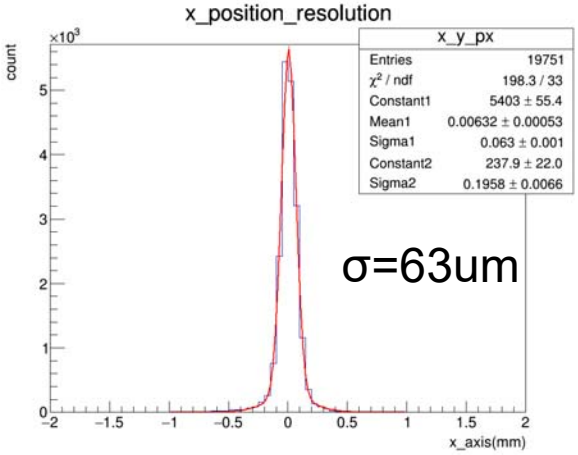


- ➢ Readout using APV25

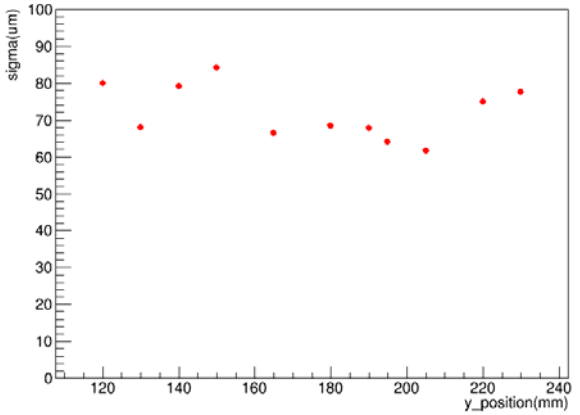
Test results

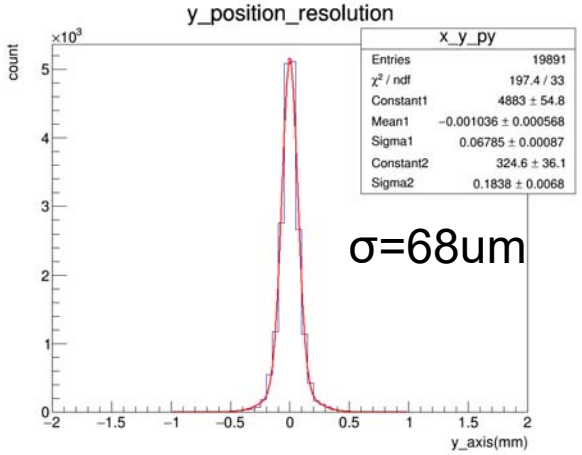
Position resolution vs. x





Position resolution vs. y

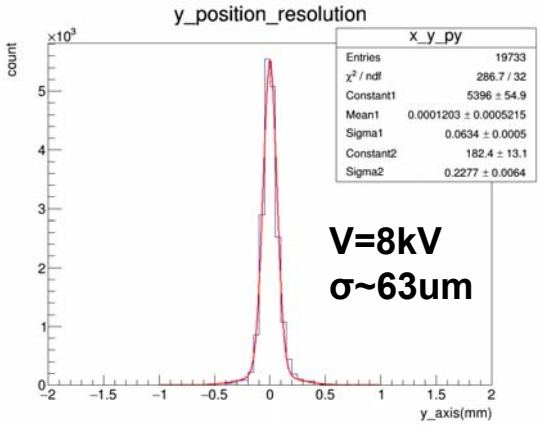


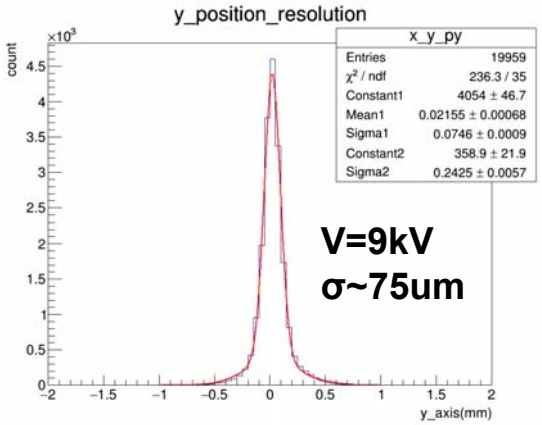


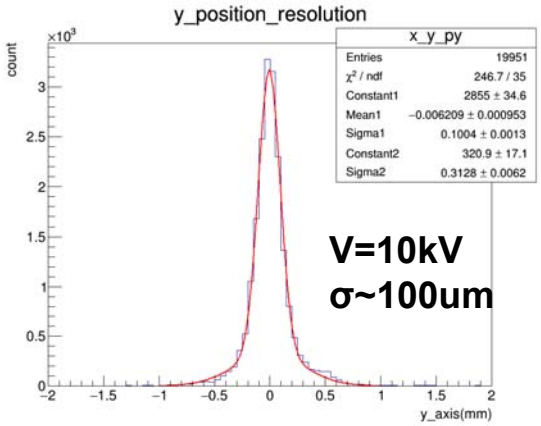
- **Typical resolution： x~65um； y~70um.**

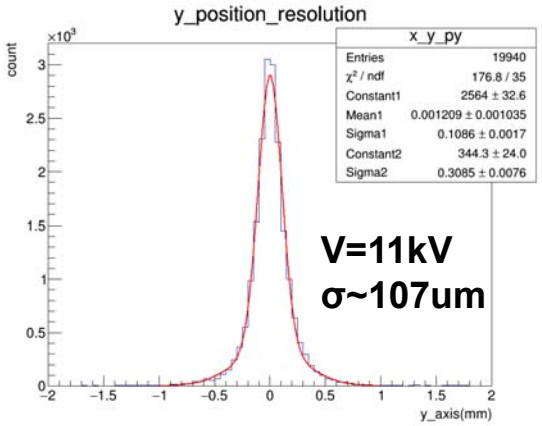
Impact of X-ray operation voltage on resolution

Copper X-ray



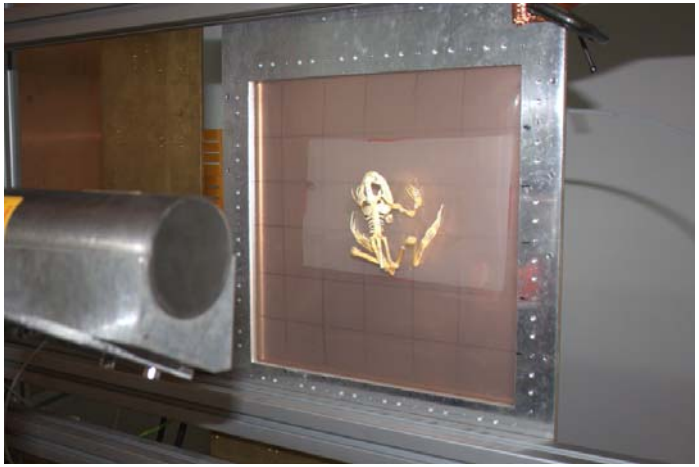


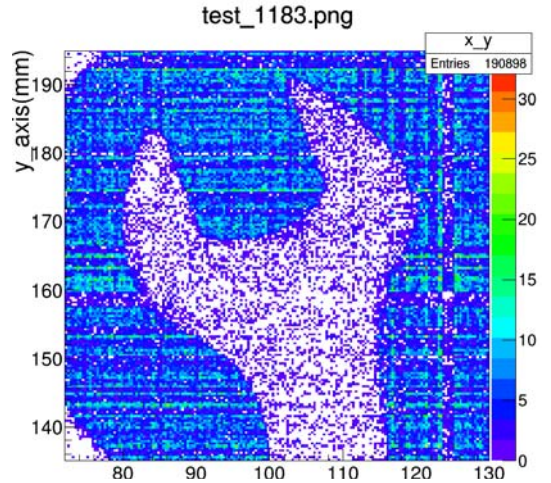


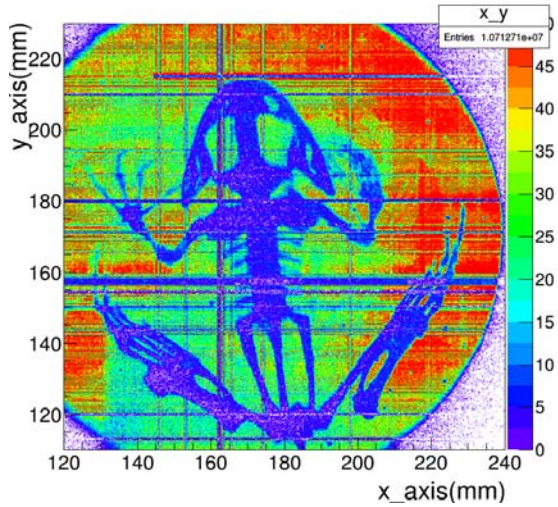


- **Higher voltage produces harder X-rays that have longer range resulting in worse measurement for resolution.**
- **harder X-rays produce more charge for signals that could saturate APV25**

Imaging tests

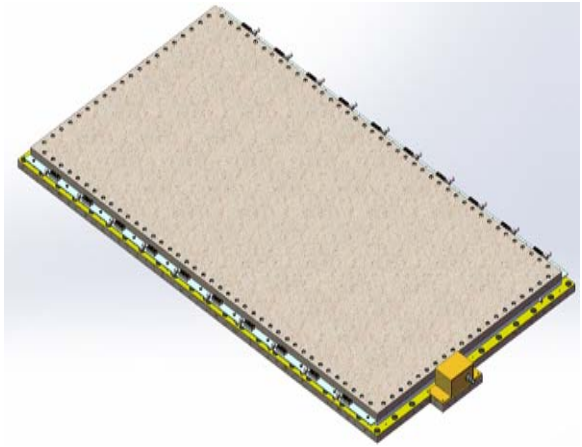


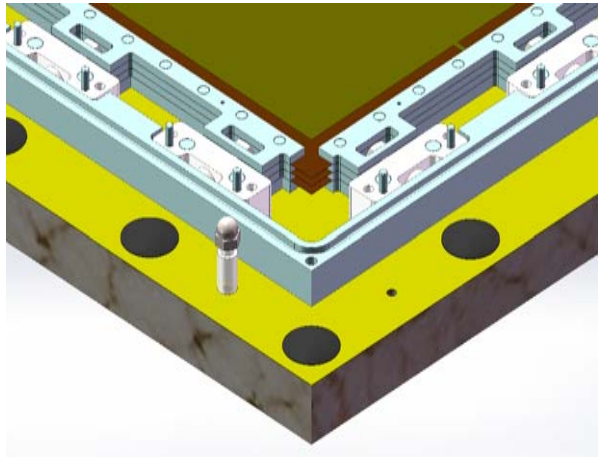




Low-mass Design for large GEM with Self-stretching

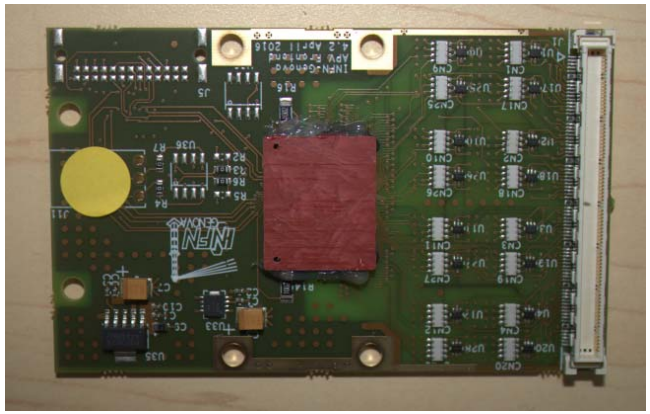
- Work in progress
  - 0.5m*1m active area with no spacers.
  - Drift and readout boards are made of Kapton + Cu
  - All screws and nuts are plastic.
  - Honeycomb on both top and bottom sides for mechanical support.



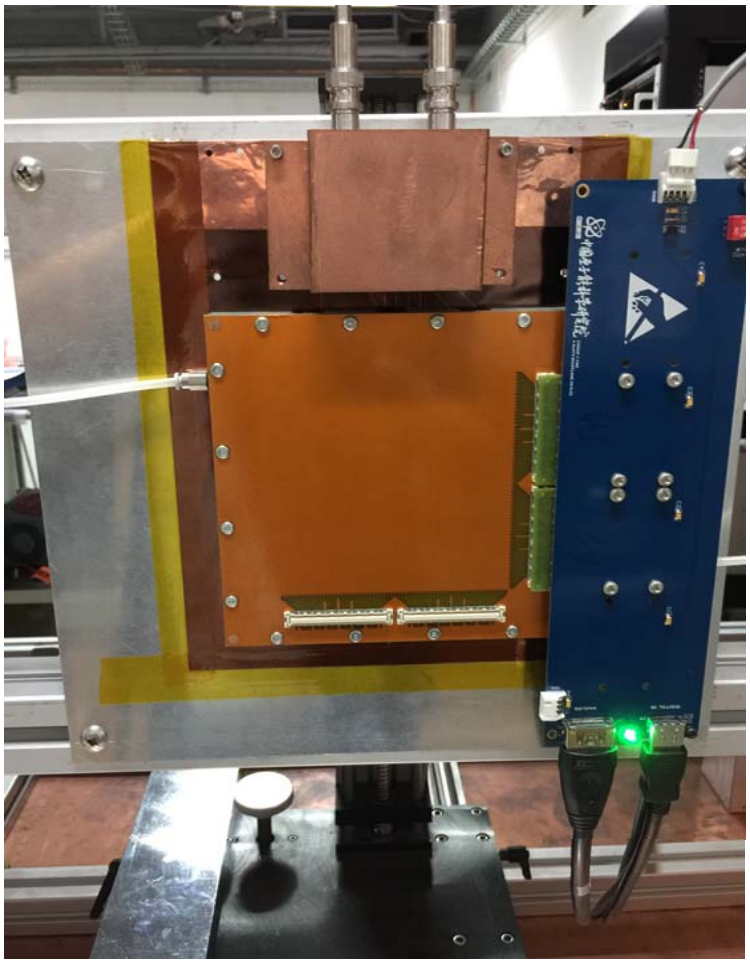


APV25 FEE with Hirose connector

APV24 hybrid with Hirose connector



The new APV24 hybrid being tested with GEM



- We lately received a few samples of APV25 hybrids with a new connector of HIROSE from EES.
- We are testing the samples and will give our feedback to EES.
- Then EES will start large-scale production for us.

Summary

- CIAE
  - Progressing in GEM foil industrialization
- LZU
  - Working on online gamma-rejection and clustering
- USTC
  - GEM characterization, low-mass design and APV25 readout with new connectors