



核数据重点实验室

# The Progress of GEM foil at CIAE

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# Outline

- **The progress of GEM foil at CIAE**
- **Other developments at CIAE**

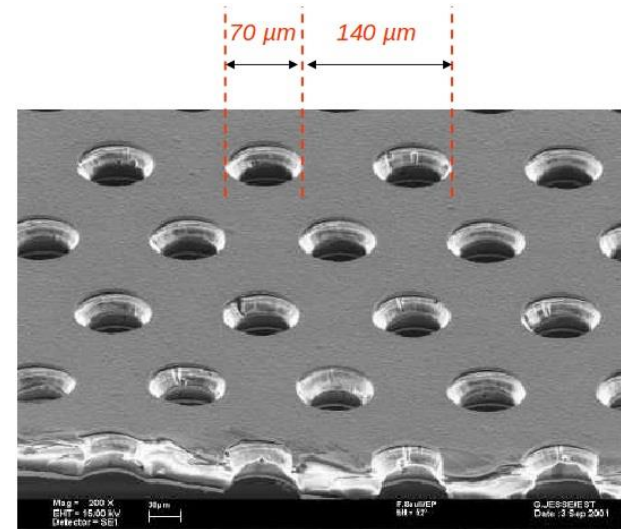


# The Progress of GEM Foil at CIAE

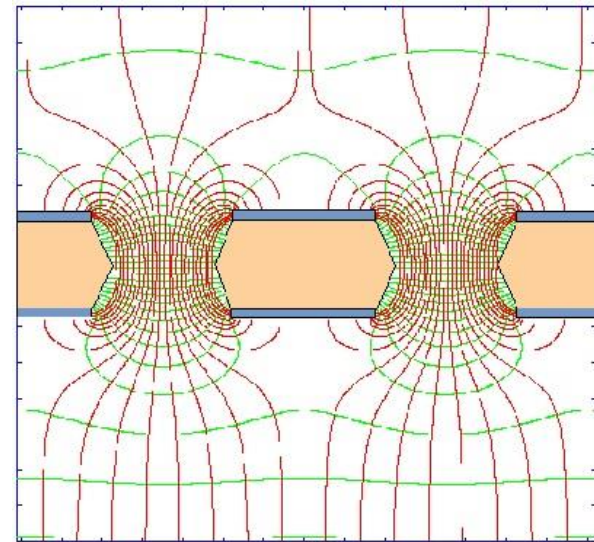


# GEM Foil Structure

1. Typical GEM Foil has 3 layers, two  $5\mu\text{m}$  thick copper foils and one  $50\mu\text{m}$  thick kapton foil in the middle.
2. Diameter of the hole is  $70\mu\text{m}$ , and the distance between them is  $140\mu\text{m}$ .
3. Apply electric voltages on the two copper layers.
4. Electric Field is very strong in the hole area, and weak outside the hole area.



GEM Foil



GEM Field

# Clean Room



**The cleanrooms at China Institute of Atomic Energy are ISO Class 6.**

# Photolithography Lab Construction At CIAE

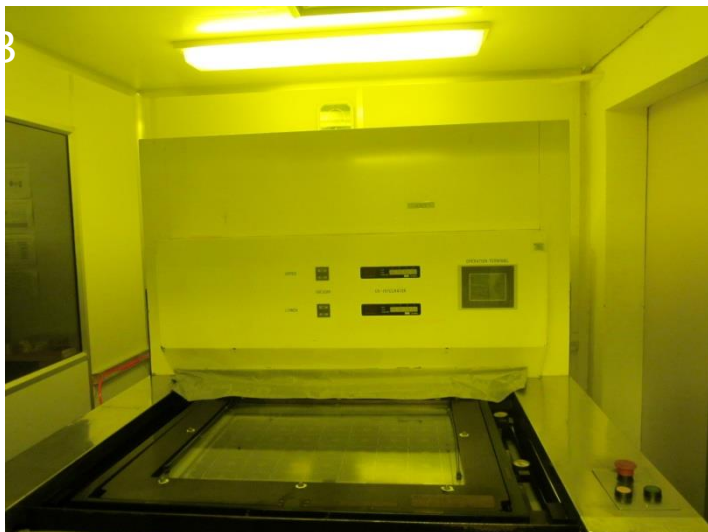


# The Equipments for Lamination and Exposure of Dry Film Photoresist



Lamination and exposure of dry film photoresist are the most important and difficult steps for GEM foil production.

We have established a yellow light zone, and have introduced Hot Roll Lamination (HRL) machine and Exposure system.



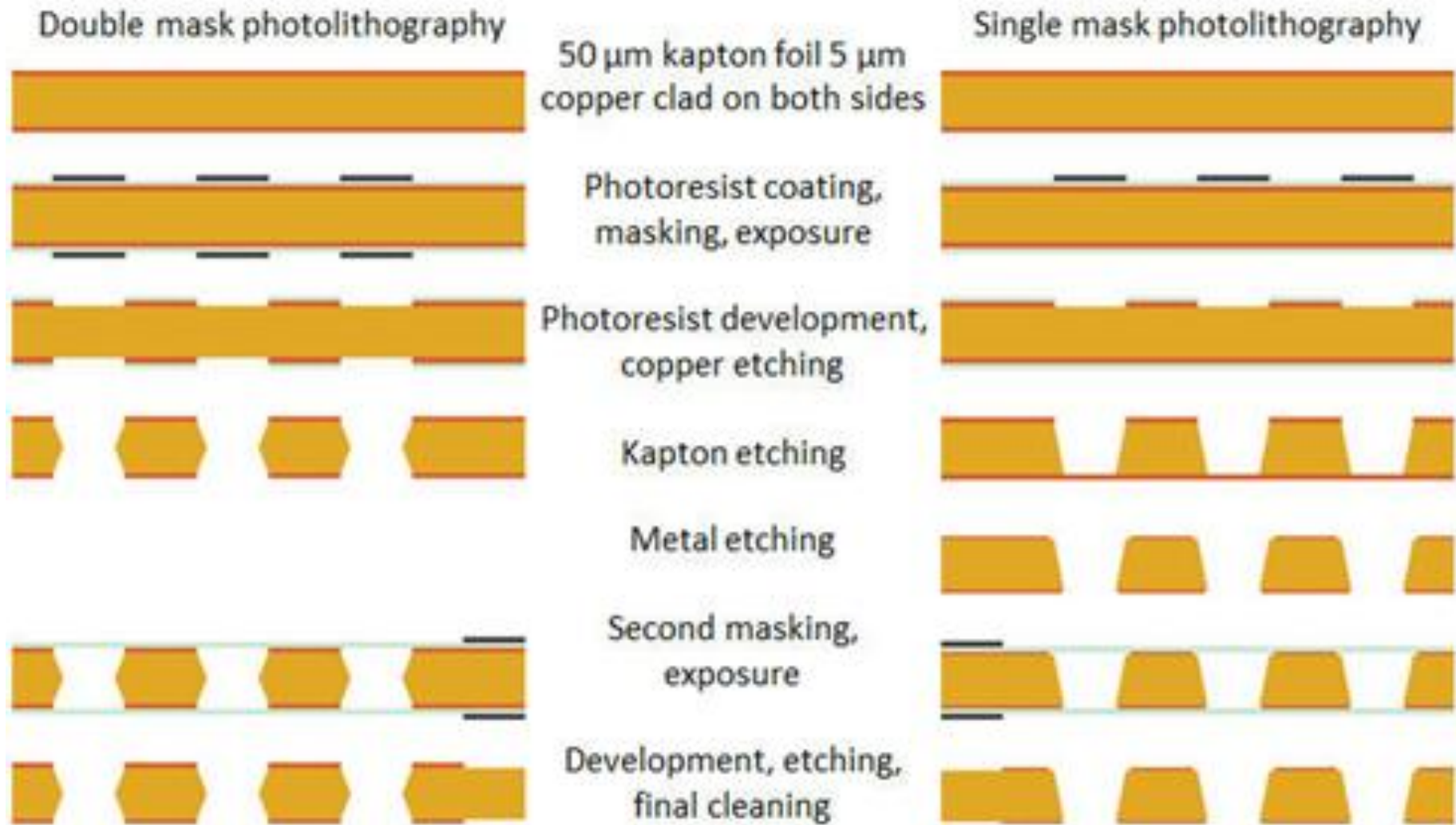
We invited the Senior engineer from a famous electronic factory to CIAE and taught the PCB technology.

# Etching Room Construction

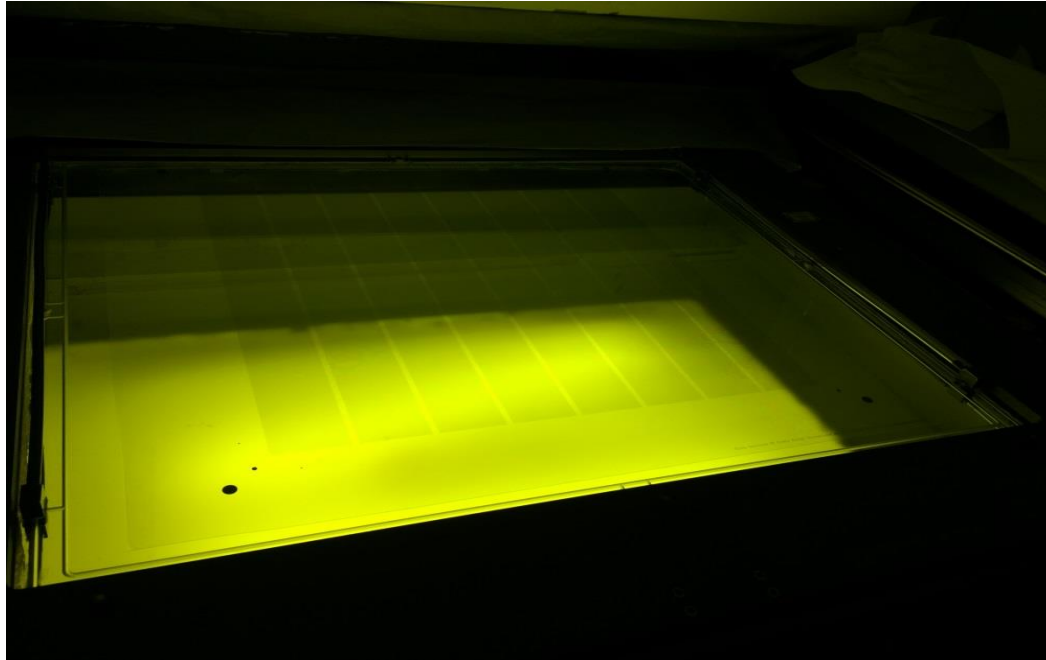




# The Procedure of GEM Foil

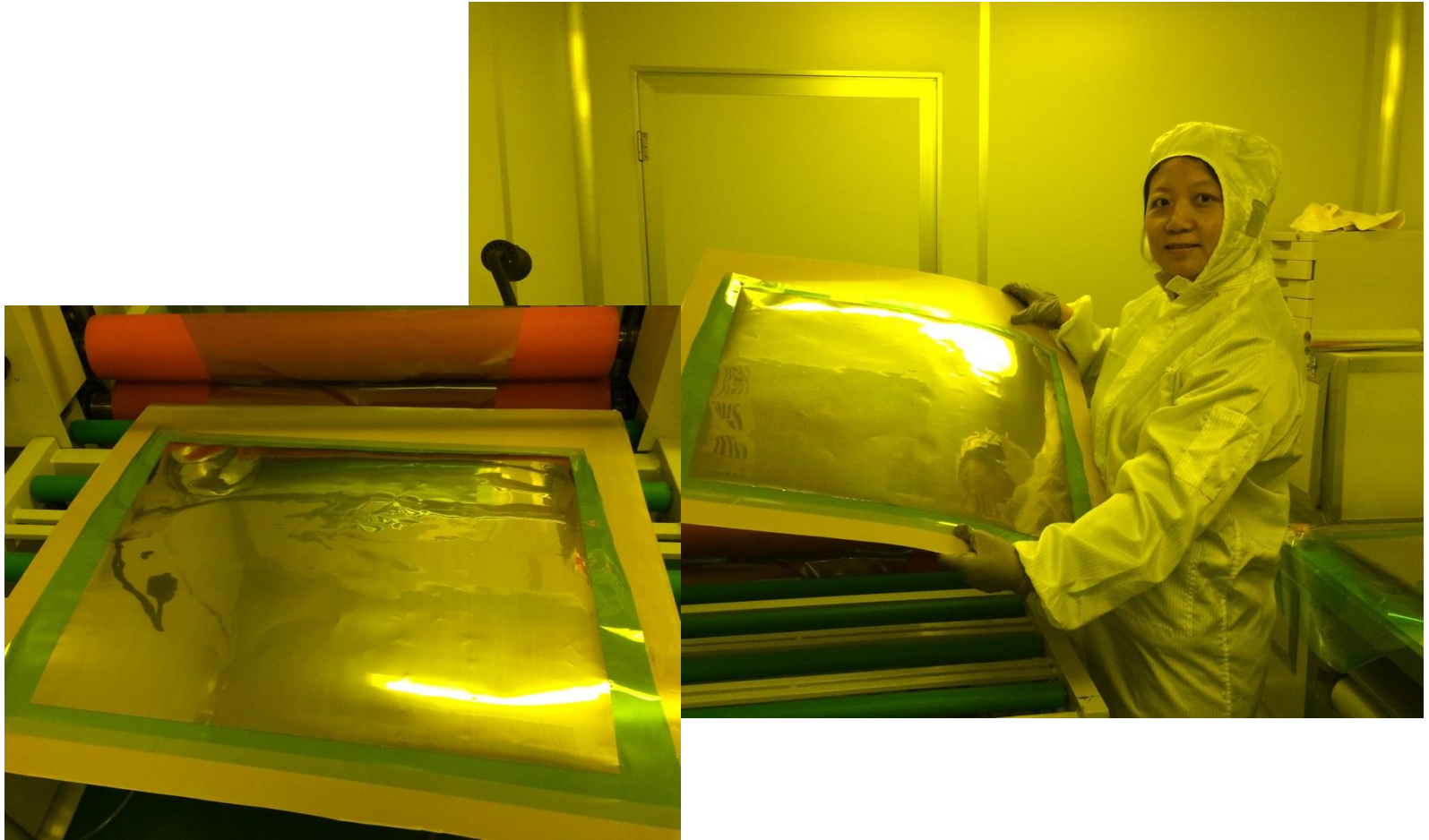


# GEM Photo Mask Plate



The copies of the photo-mask are done by photolithographic techniques.  
40cm\*40cm photo mask is produced.

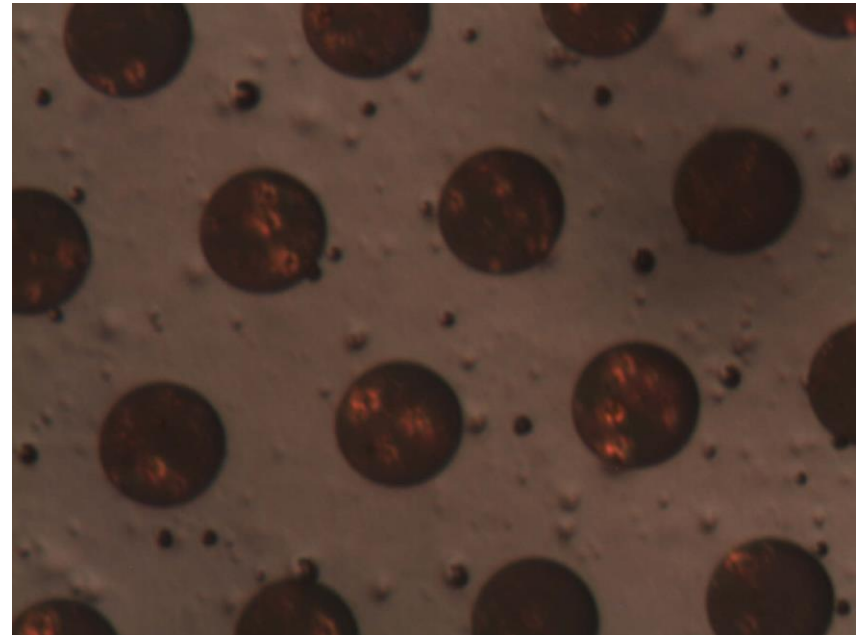
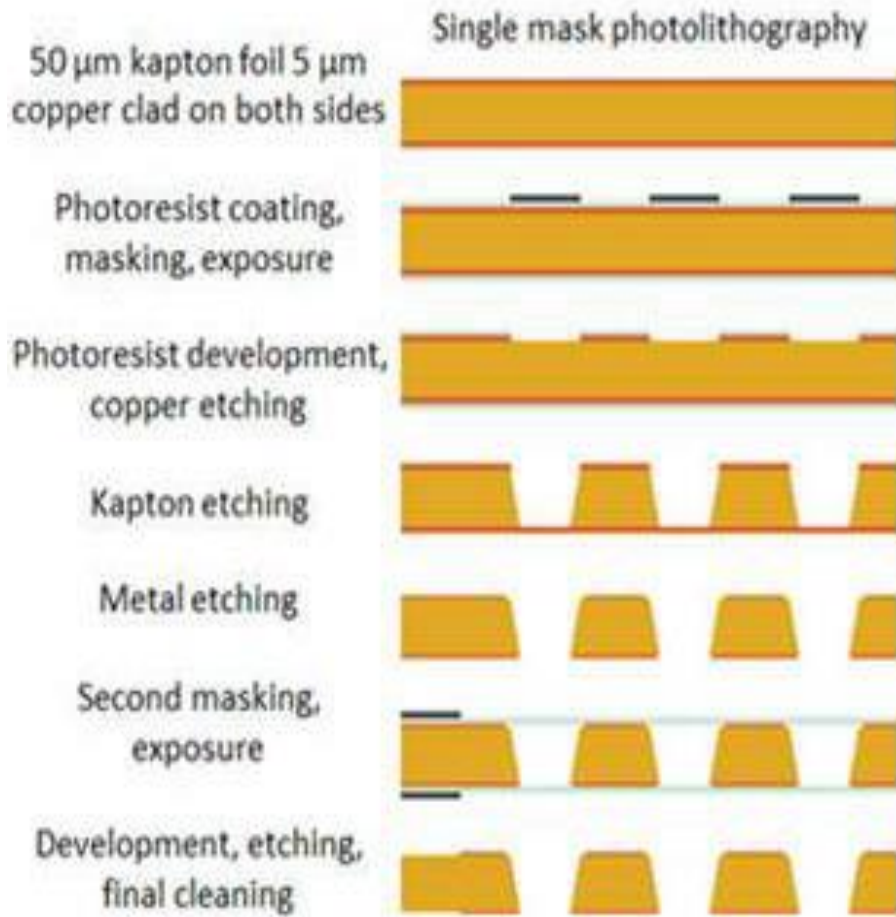
# Lamination of Dry Film Photoresist



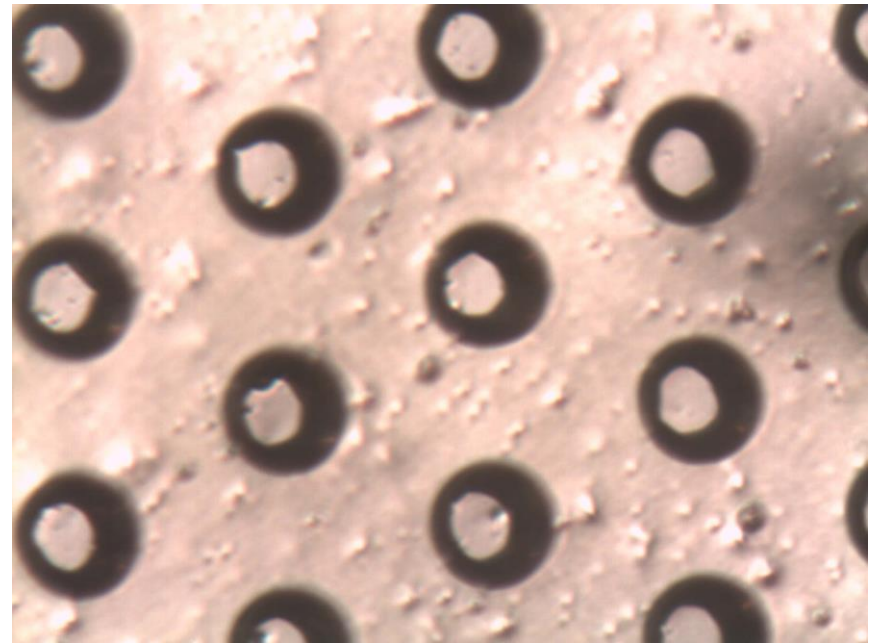
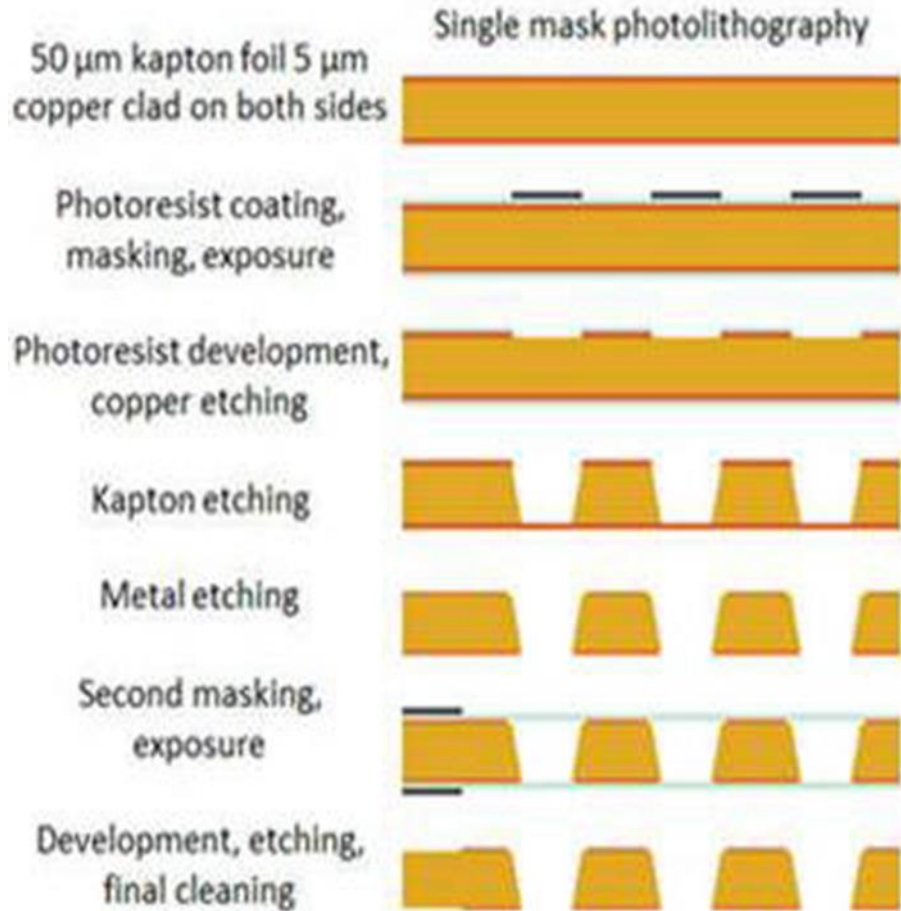
# Exposure of Dry Film Photoresist



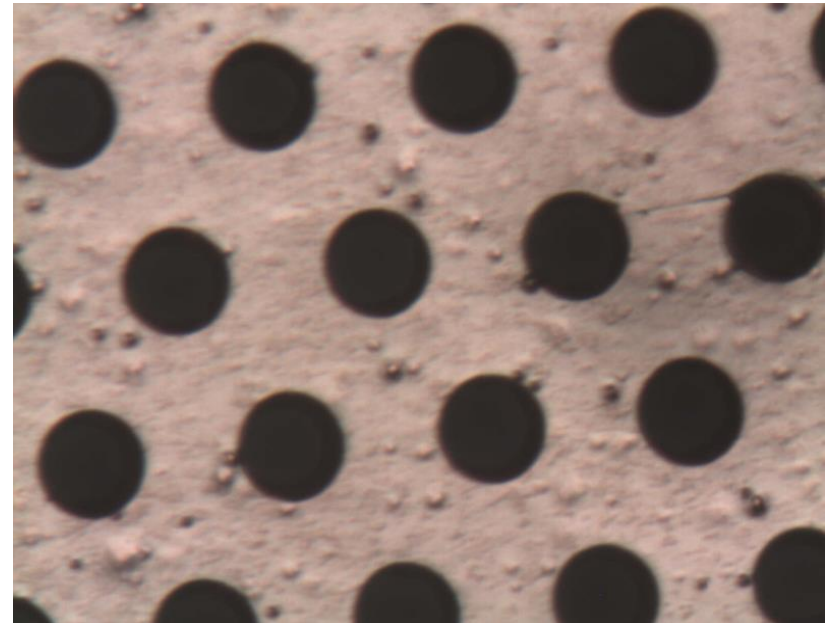
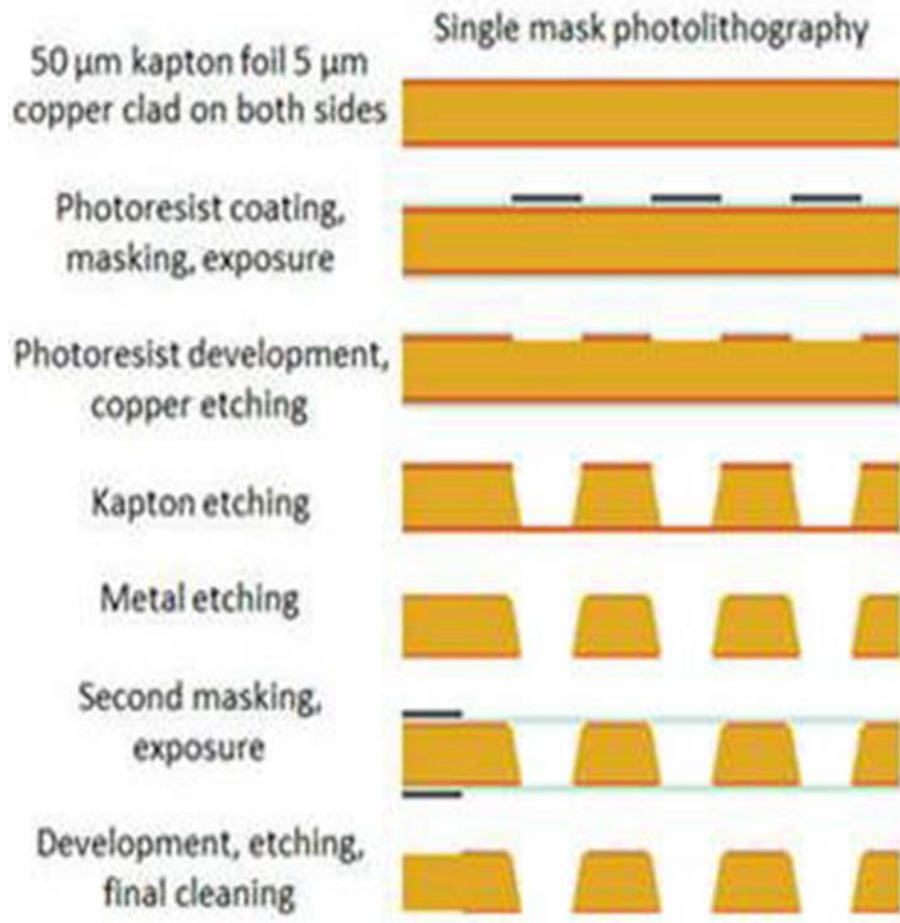
# After First Copper Etching



# After First Kapton Etching



# After Second Copper Etching



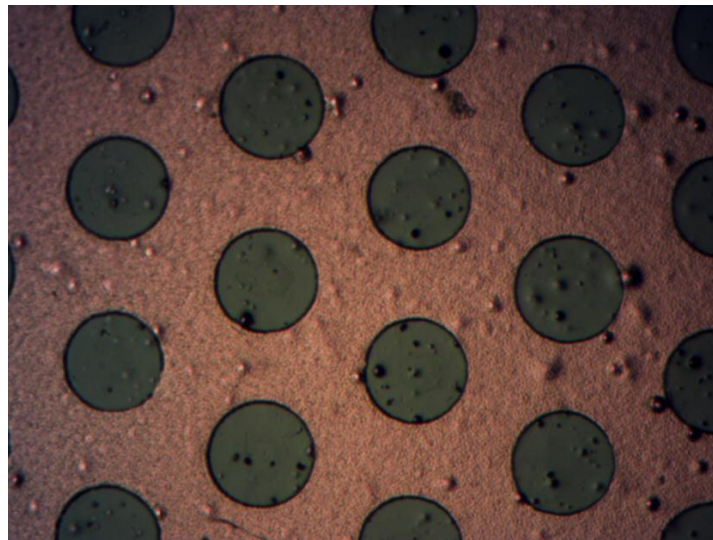
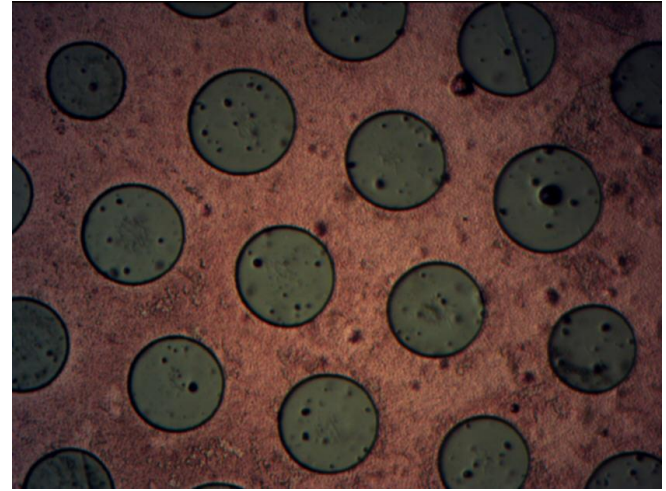
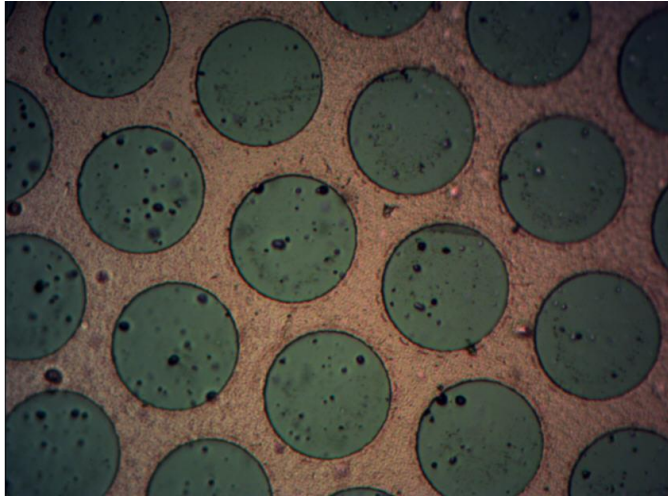
# 40cm\*40cm GEM Foil

- The 40cm\*40cm GEM foils were made successfully.
- Single-mask method was used.





# New Chemical Reagents

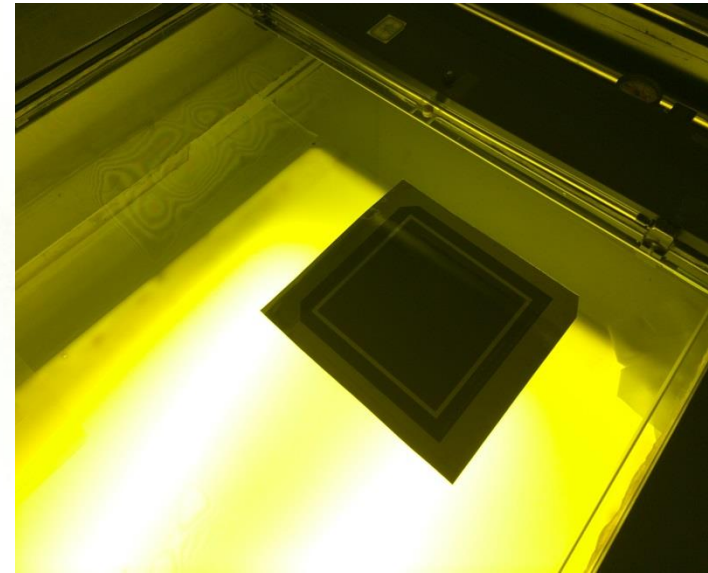
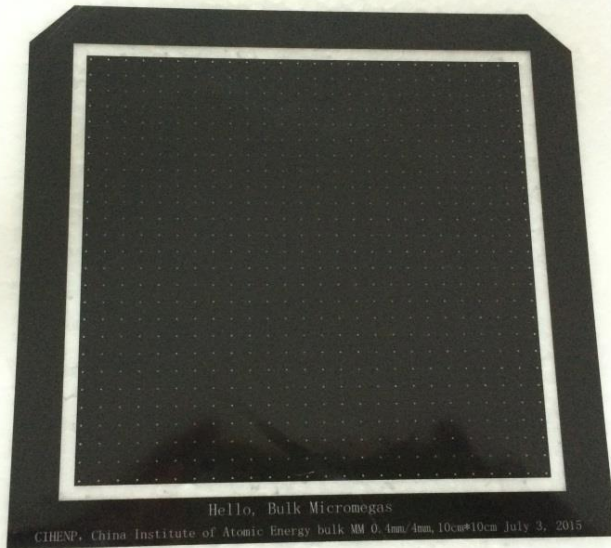


# Other Developments



# R&D of Bulk MicroMegas

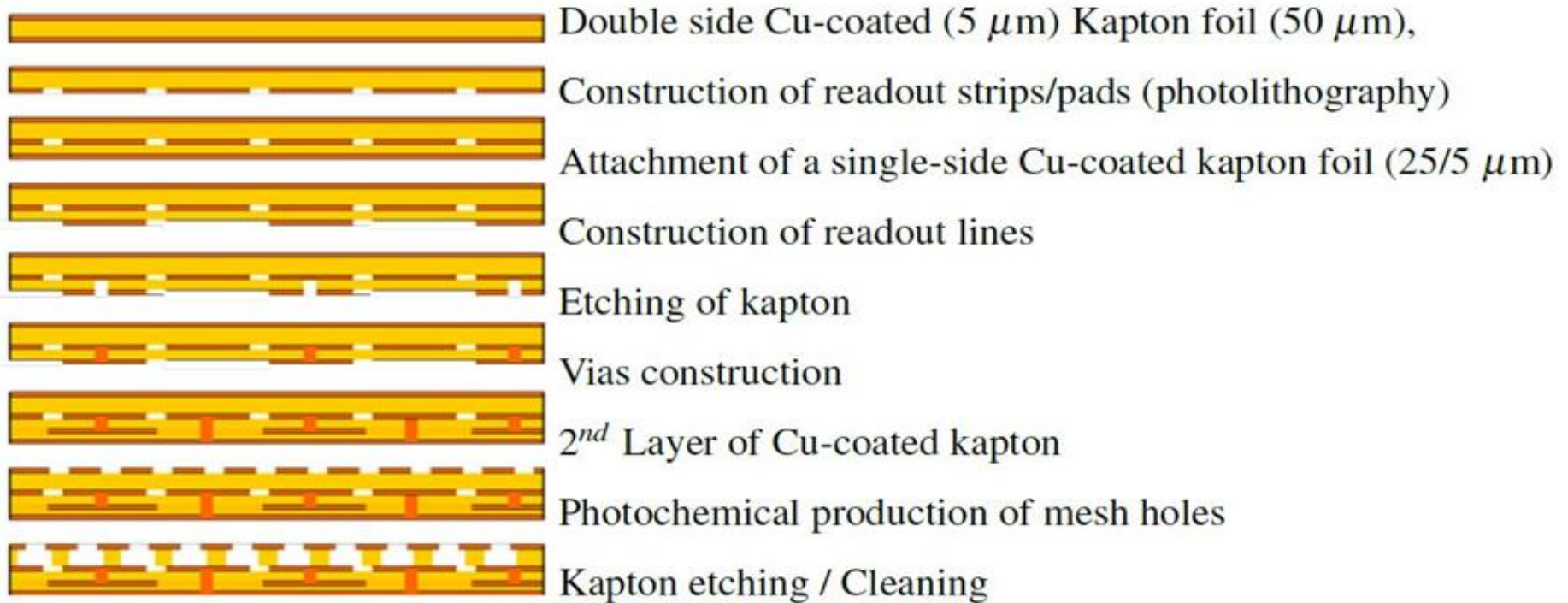
Based on the Collaboration with CEPC TPC (IHEP)



# R&D of MicroBulk MicroMegas

## Microbulk Micromegas Fabrication Process

This technology is inspired by  
the GEM detector fabrication process invented at CERN .

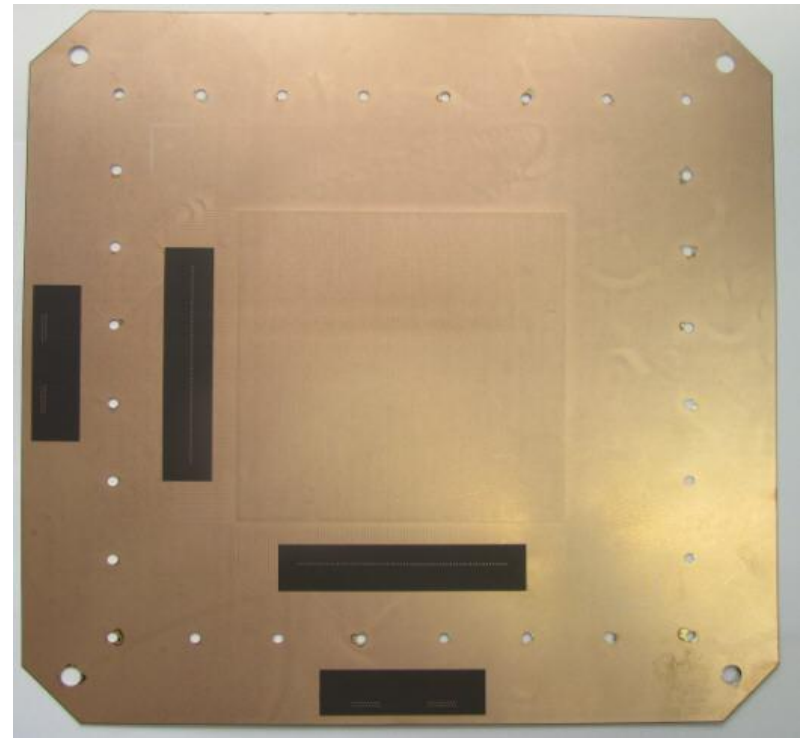
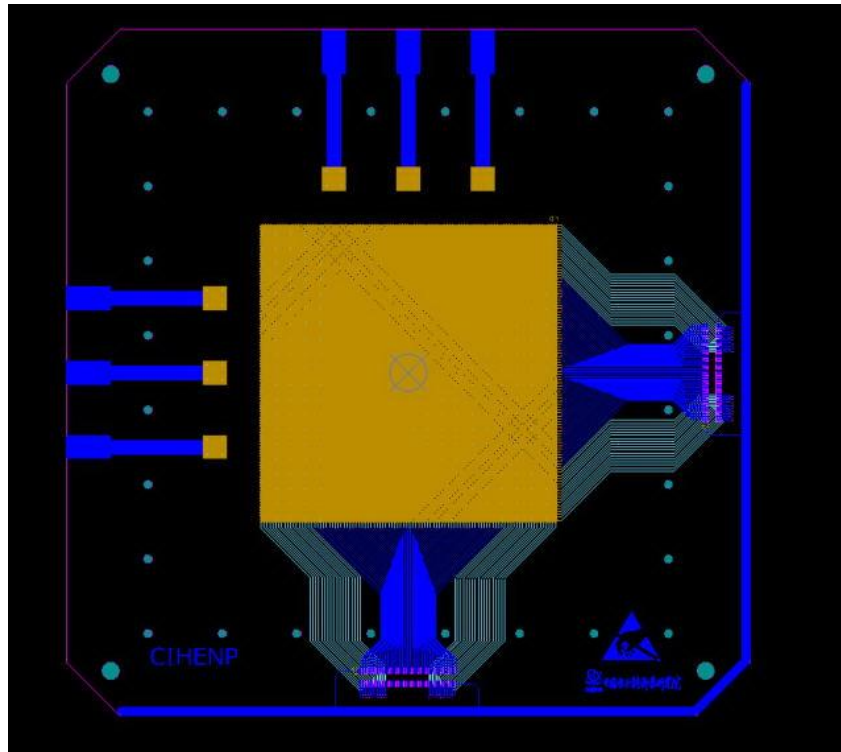


# Current Work on MicroBulk MicroMegas

Based on the Collaboration with PANDAXIII(SJTU)

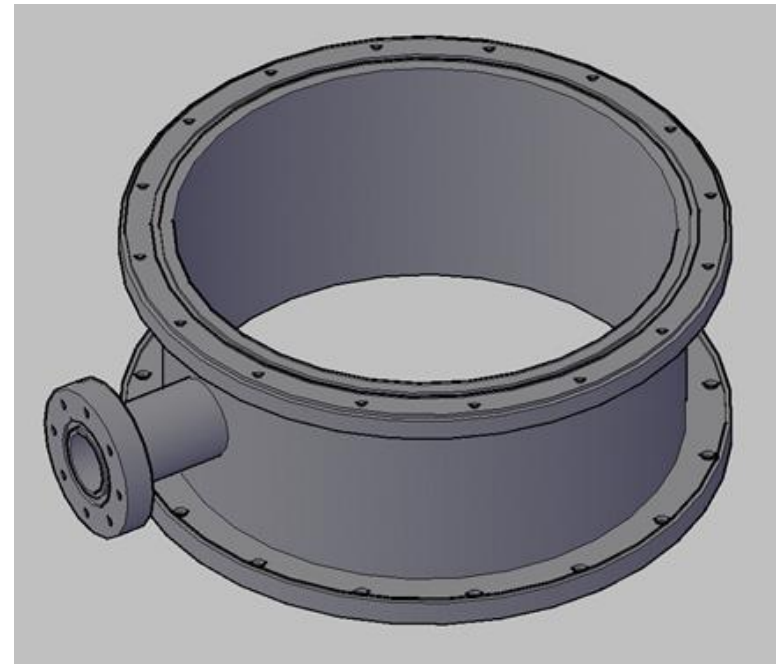
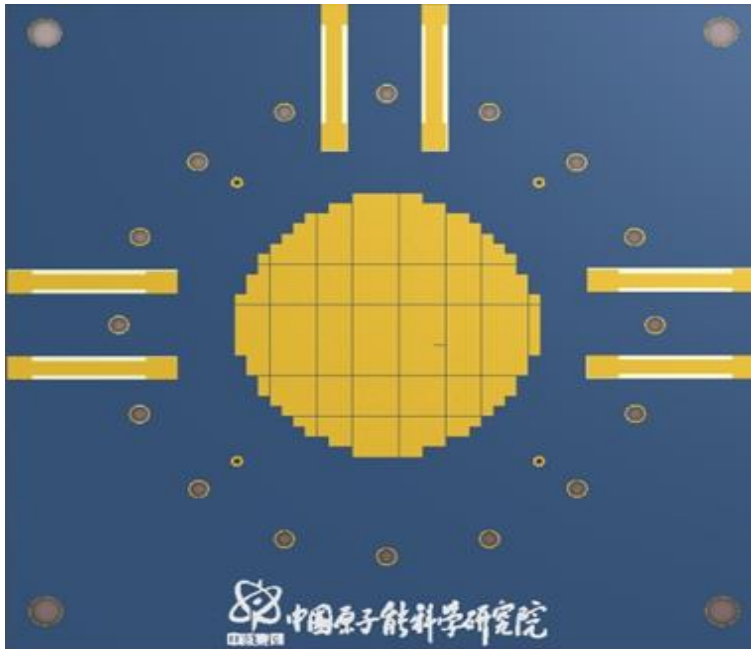
New design of 10cm\*10cm MicroBulk MicroMegas

Prototype: XY readout, 200 channels electronics

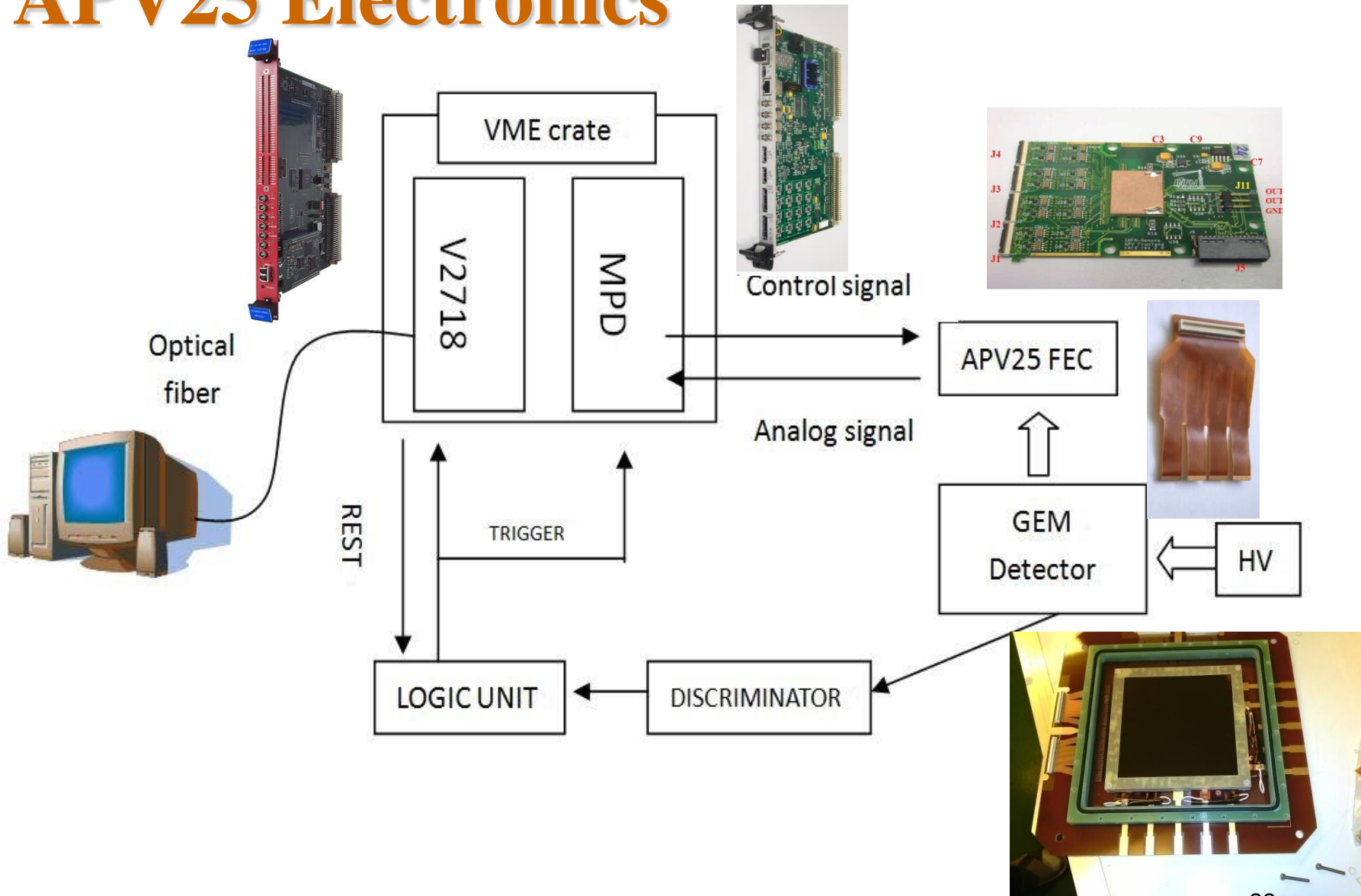


# Next Step on on MicroBulk MicroMegas

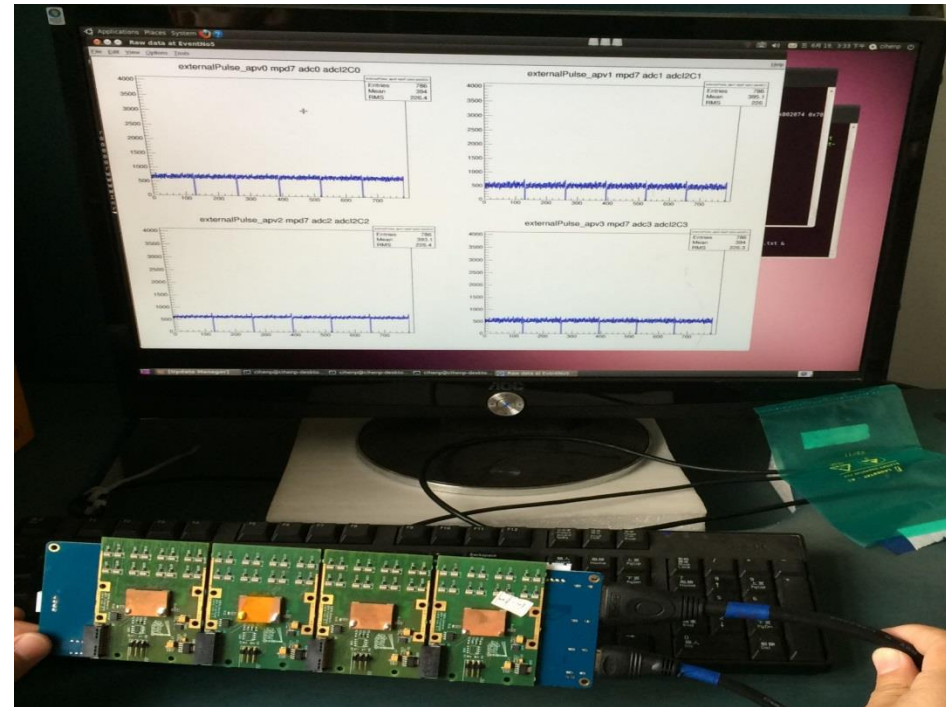
New design of 20cm diameter round MicroBulk MicroMegas  
Prototype: 0.5cm<sup>2</sup> pad, 512 channels electronics



# GEM Test system with APV25 Electronics



# R&D of BackPlane





## Next Step

- Made 30cm\*30cm and 40cm\*40cm GEM foils by using double mask and single mask technologies respectively.
- Upgrading current equipment and improving the rate of final products.
- Establishing collaboration with company.



Thank You !

