

# 中国科学院大学 THGEM 研究进展

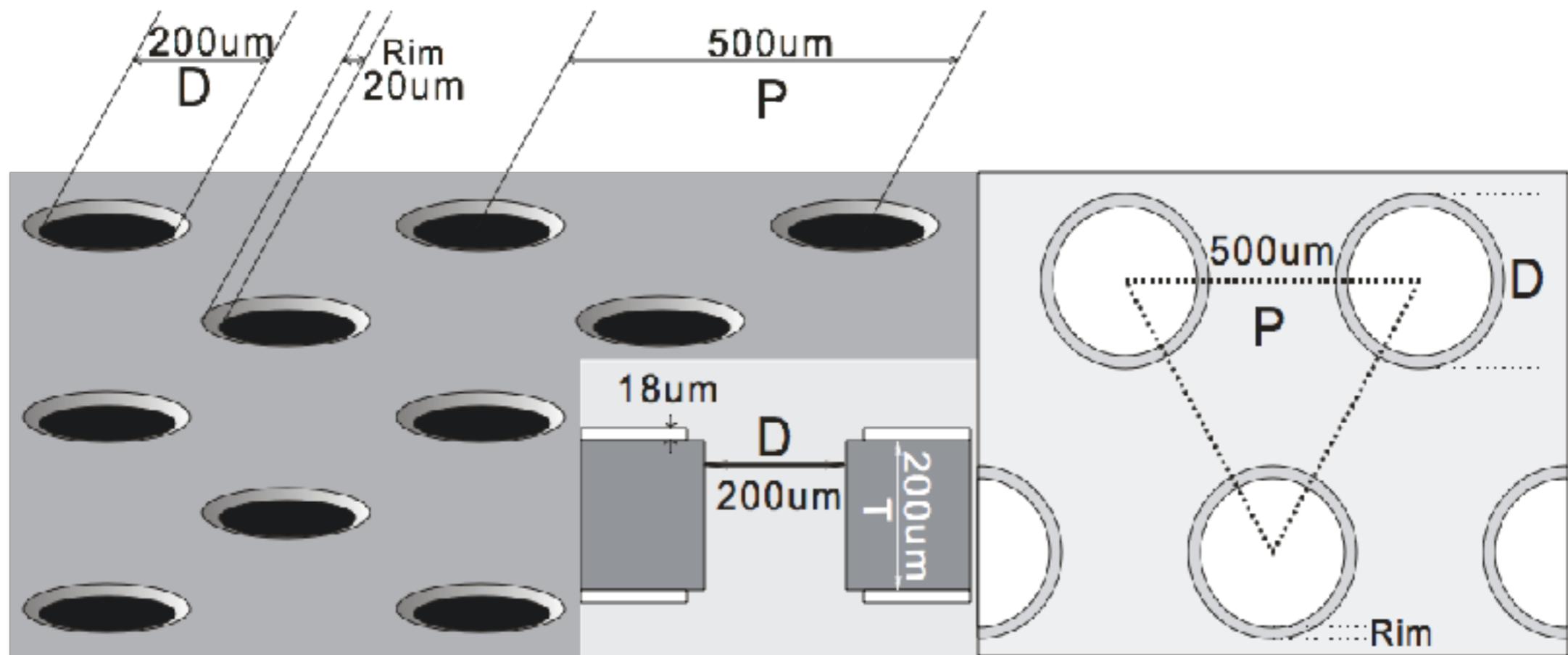
.....  
刘倩  
第六届全国微结构气体探测器会议  
2016.11.11



# OUTLINE

- New methods for THGEM production
- New types of THGEM
- Performance study
- Applications
- Conclusion

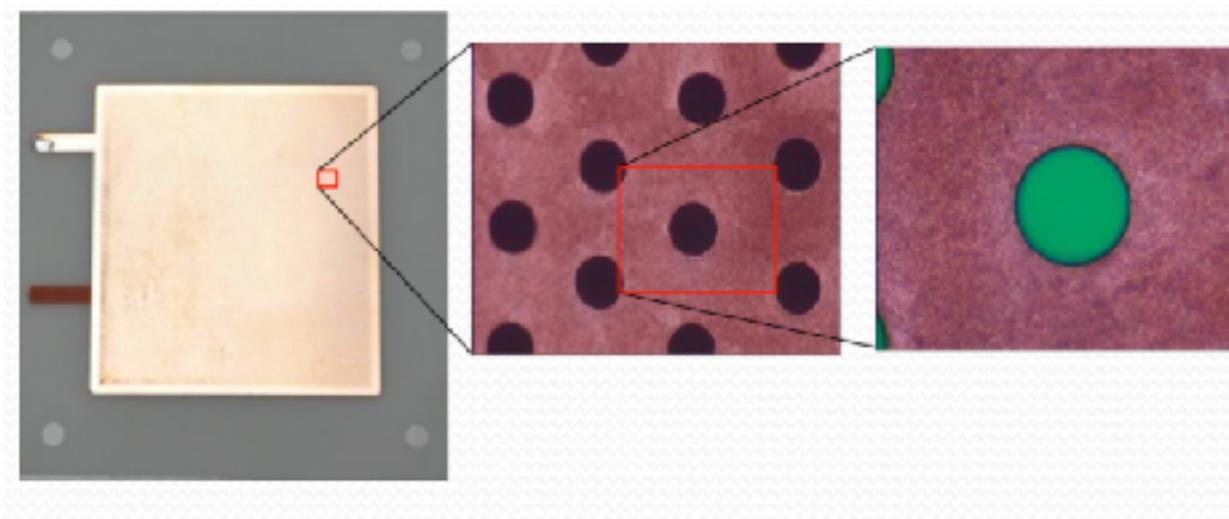
- 2001~2004年期间THGEM的概念被提出，并与2004年由Breskin以Thick GEM命名。THGEM厚度，孔径一般在mm量级，rim在亚mm量级。
- 在THGEM的基础上，UCAS THGEM发展了薄型THGEM，厚度范围150 $\mu\text{m}$ ~200 $\mu\text{m}$ ，最小孔径100 $\mu\text{m}$ ，孔间距200 $\mu\text{m}$ ，rim为20 $\mu\text{m}$ 。



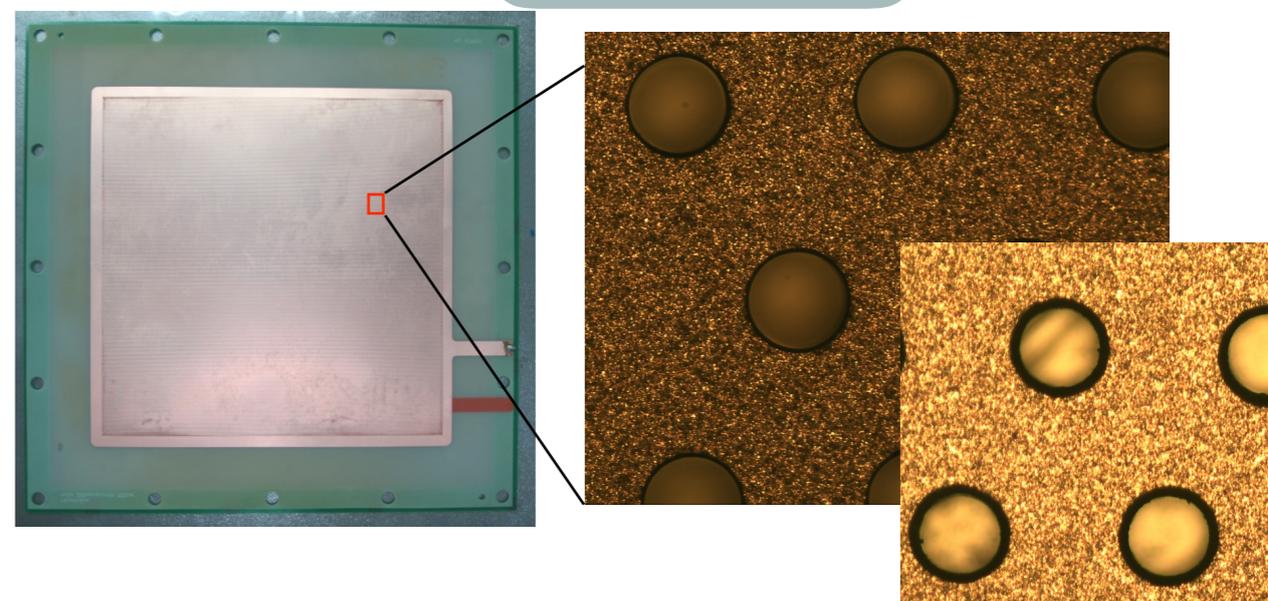
# THGEM制作工艺

- THGEM的生产过程中，其孔的边缘会由于机械加工而出现一些毛刺。为了去掉这些毛刺，并生成rim，我们研究了多种不同的制作工艺的方式。

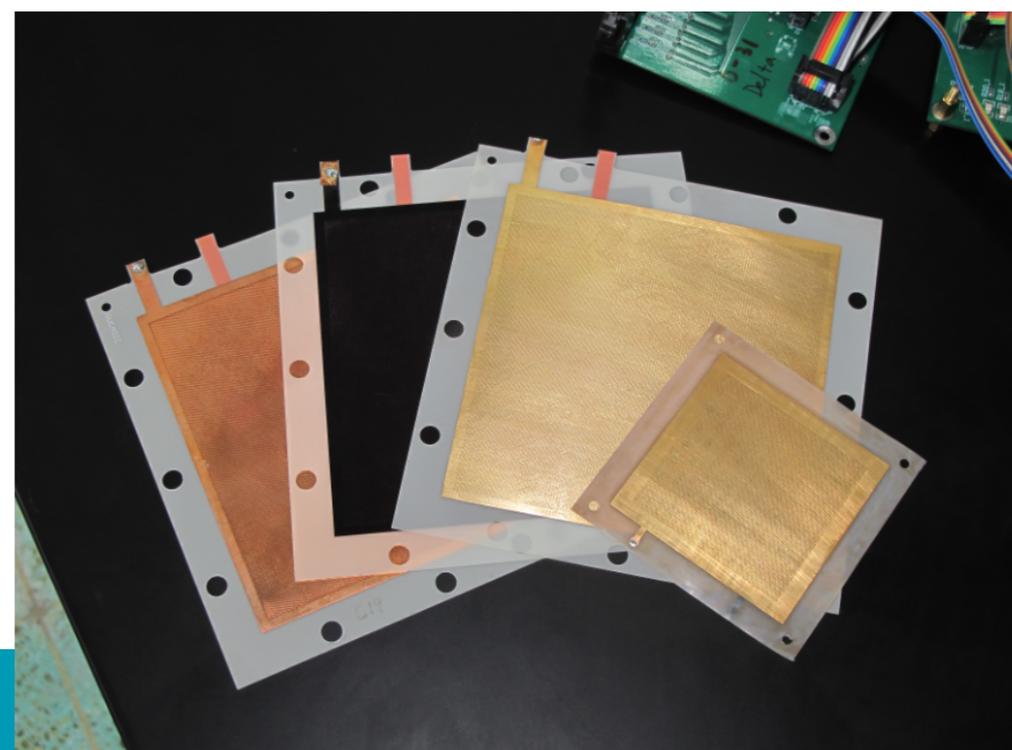
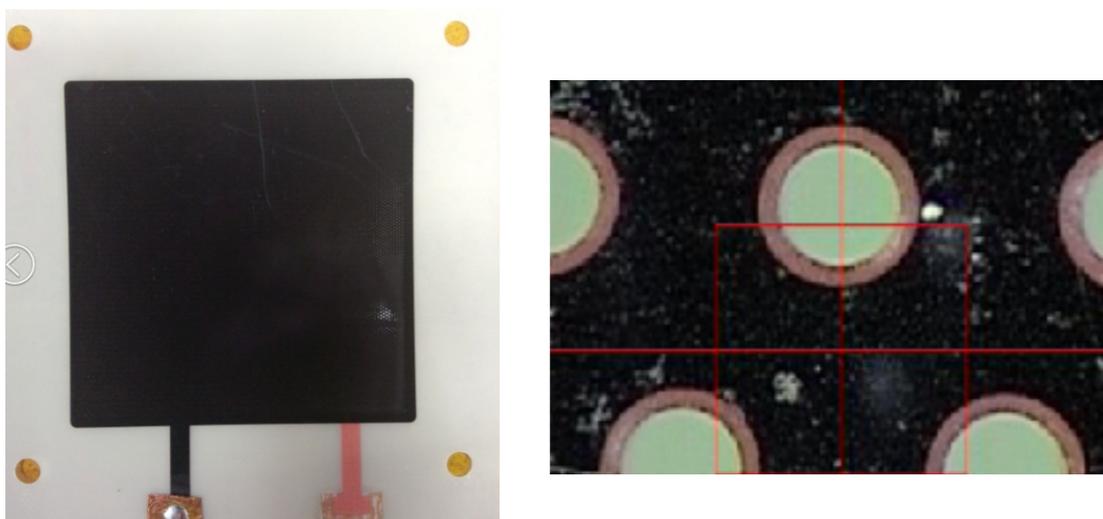
微蚀



电化学

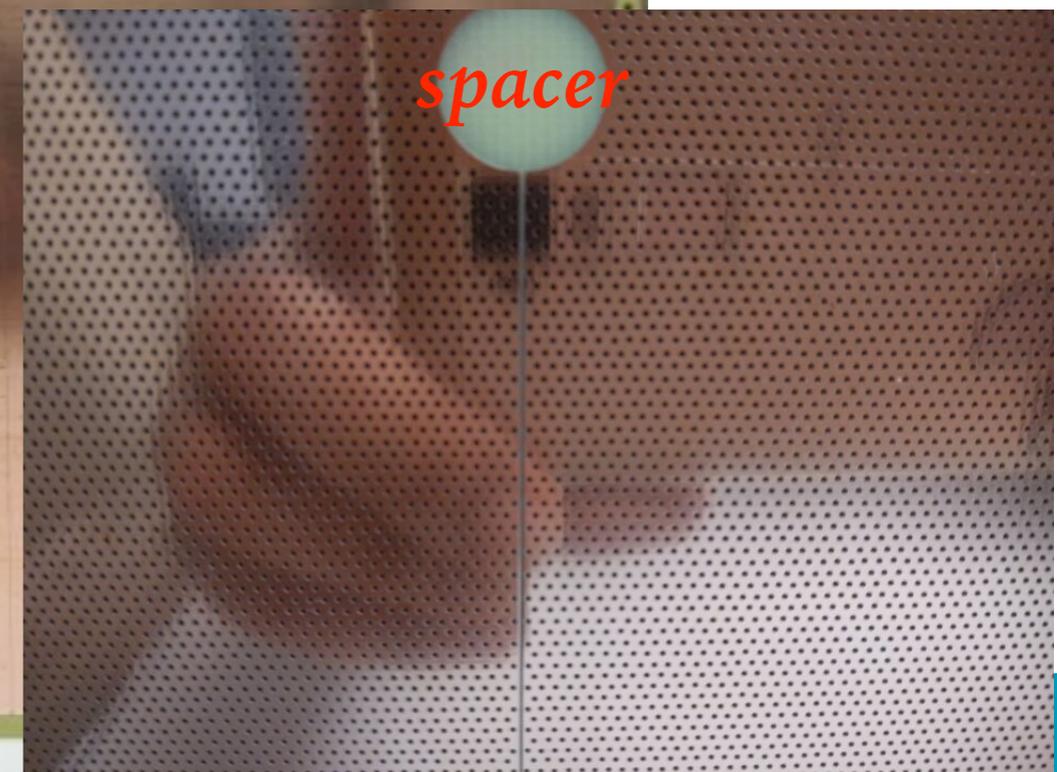


阻性



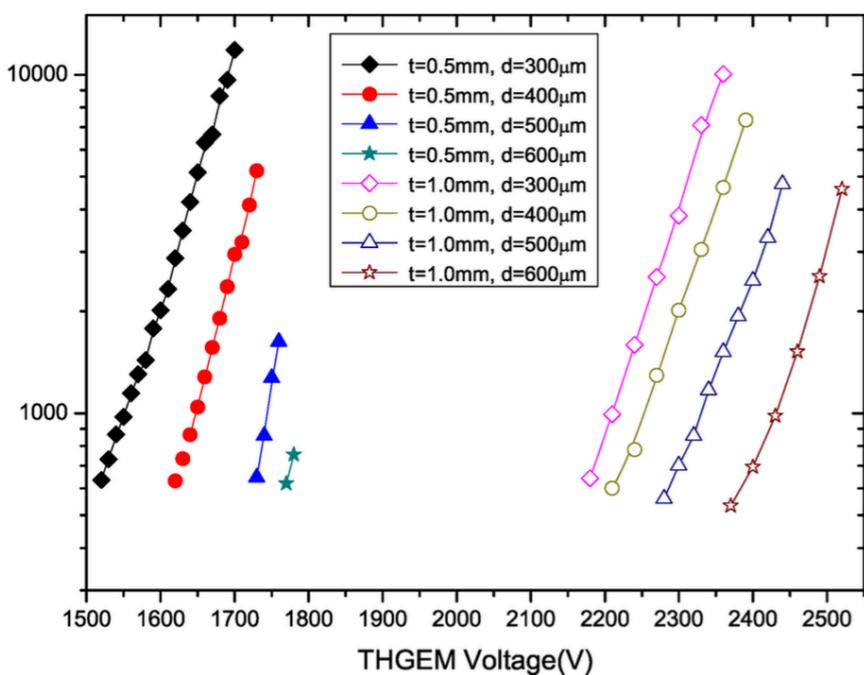
# LARGE SIZE THGEM

- 薄型THGEM: 300mmX300mm
- THGEM: 1mX0.5m

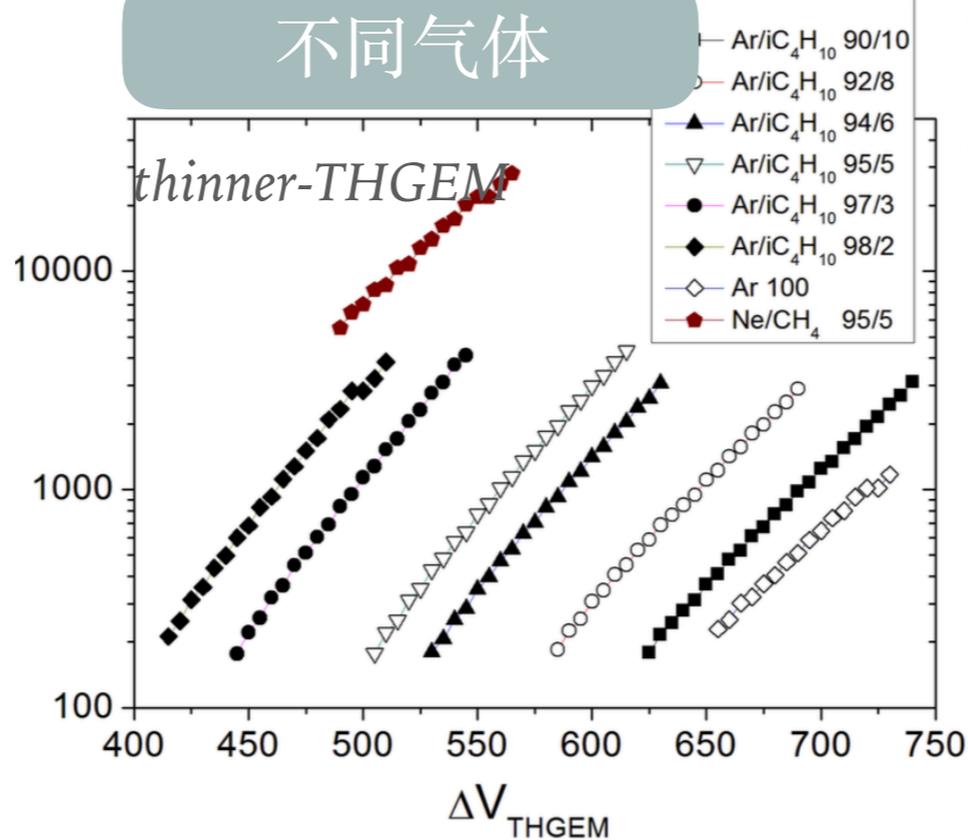


# PERFORMANCE STUDY

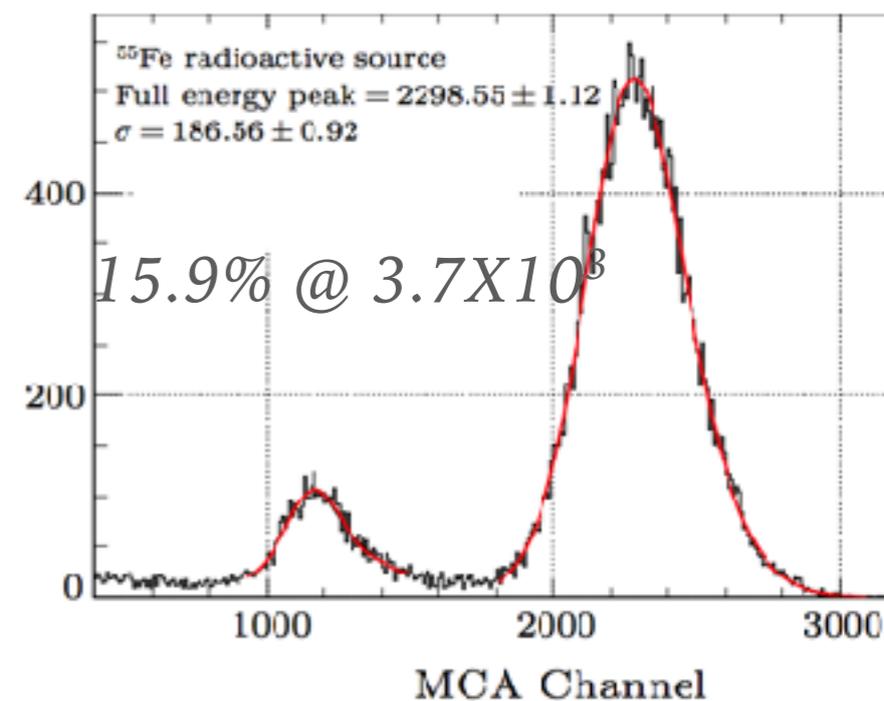
## 不同几何尺寸



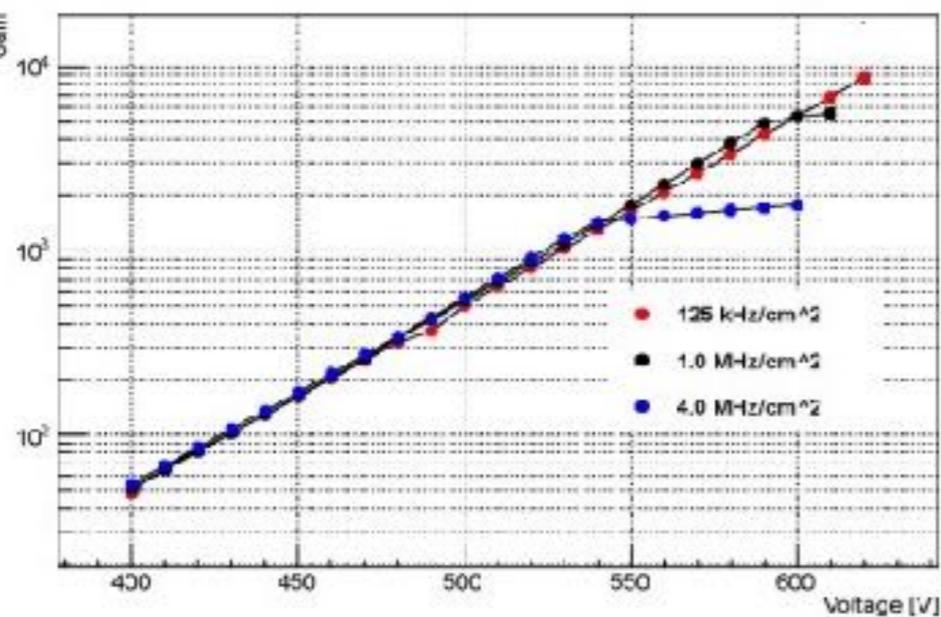
## 不同气体



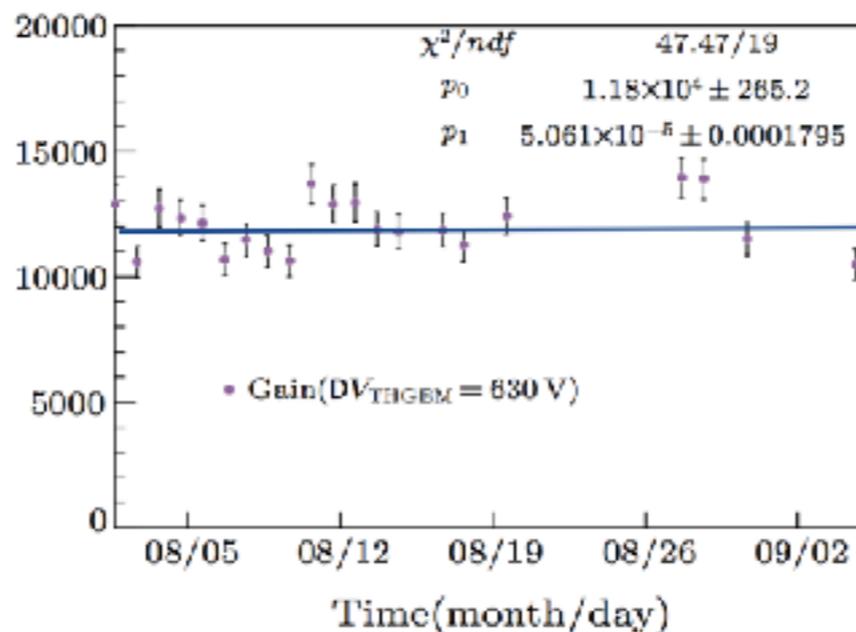
## $^{55}\text{Fe}$ 能量分辨



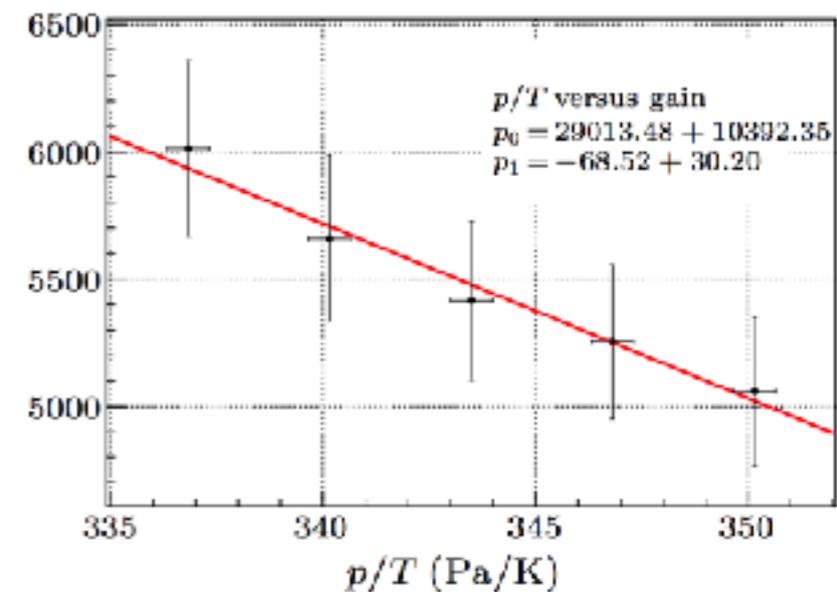
## 计数率



## 长期稳定性

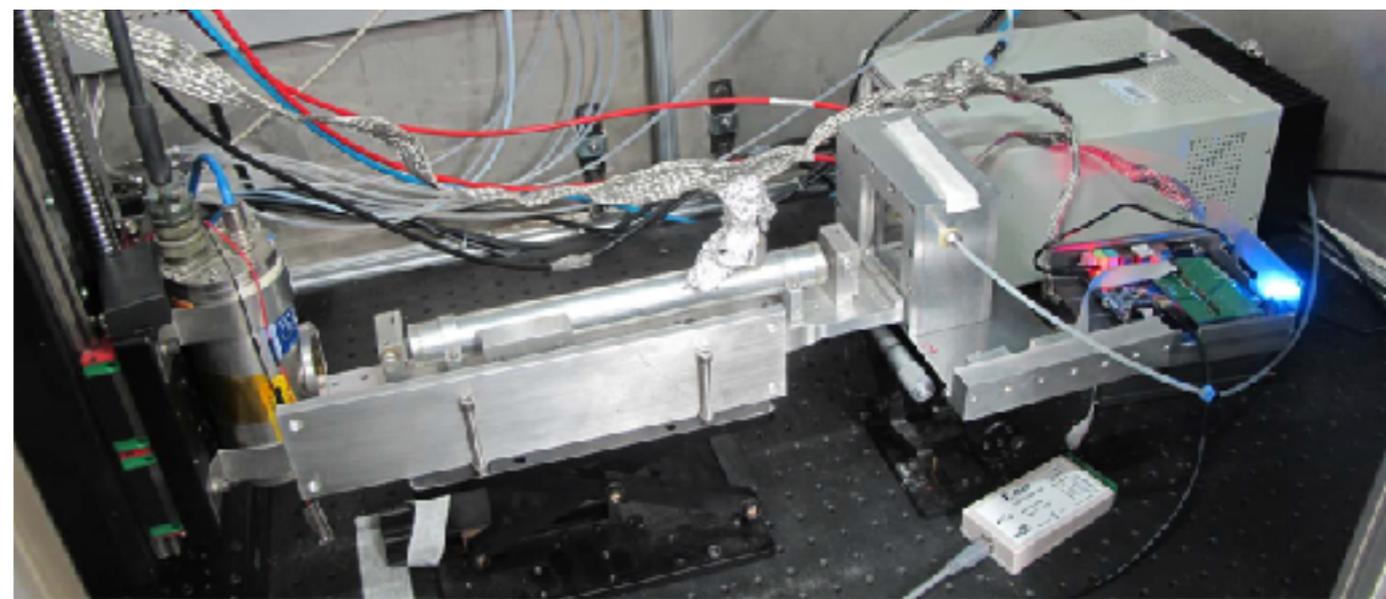
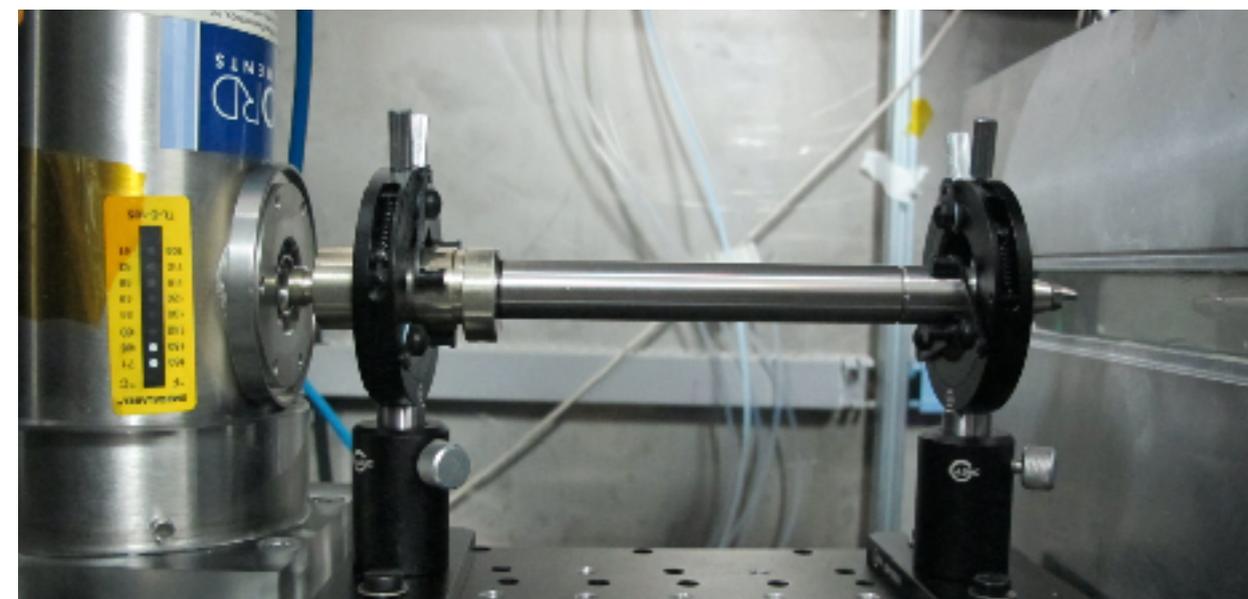
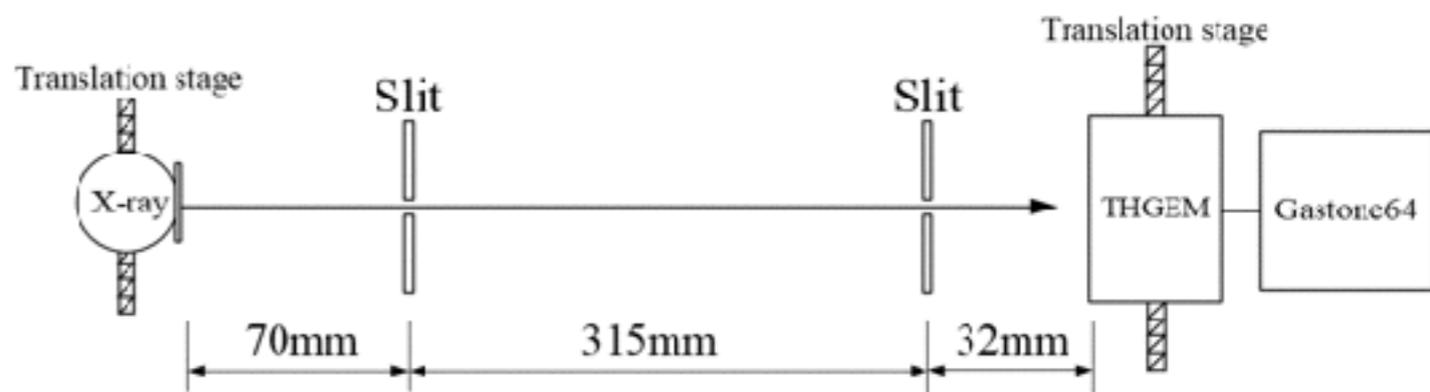
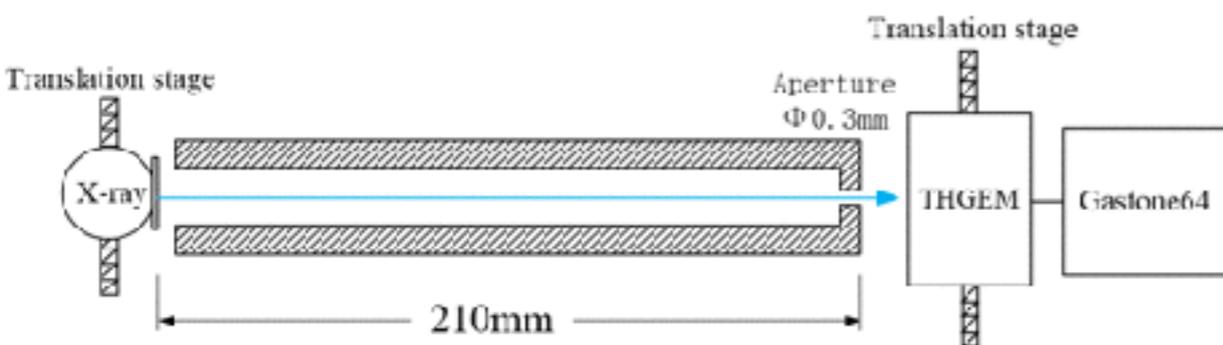


## PT相关性



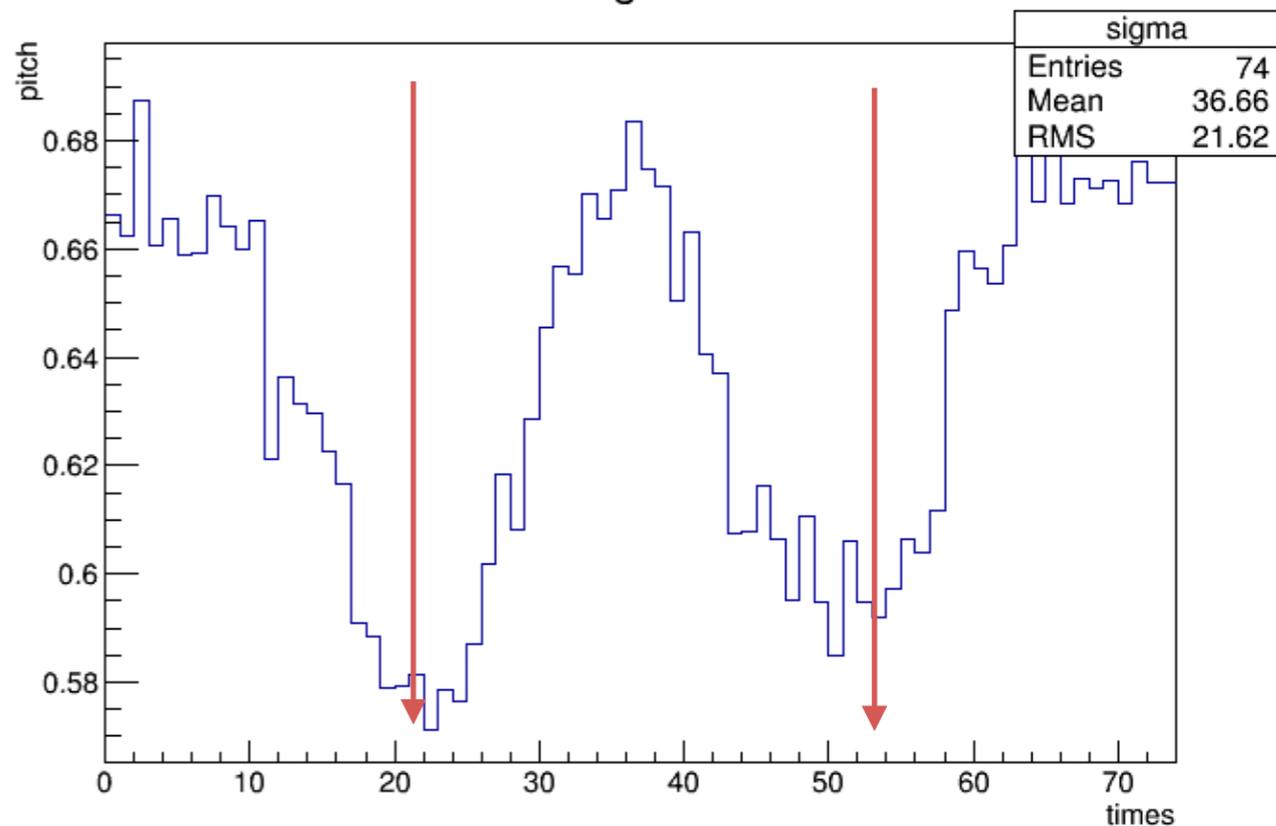
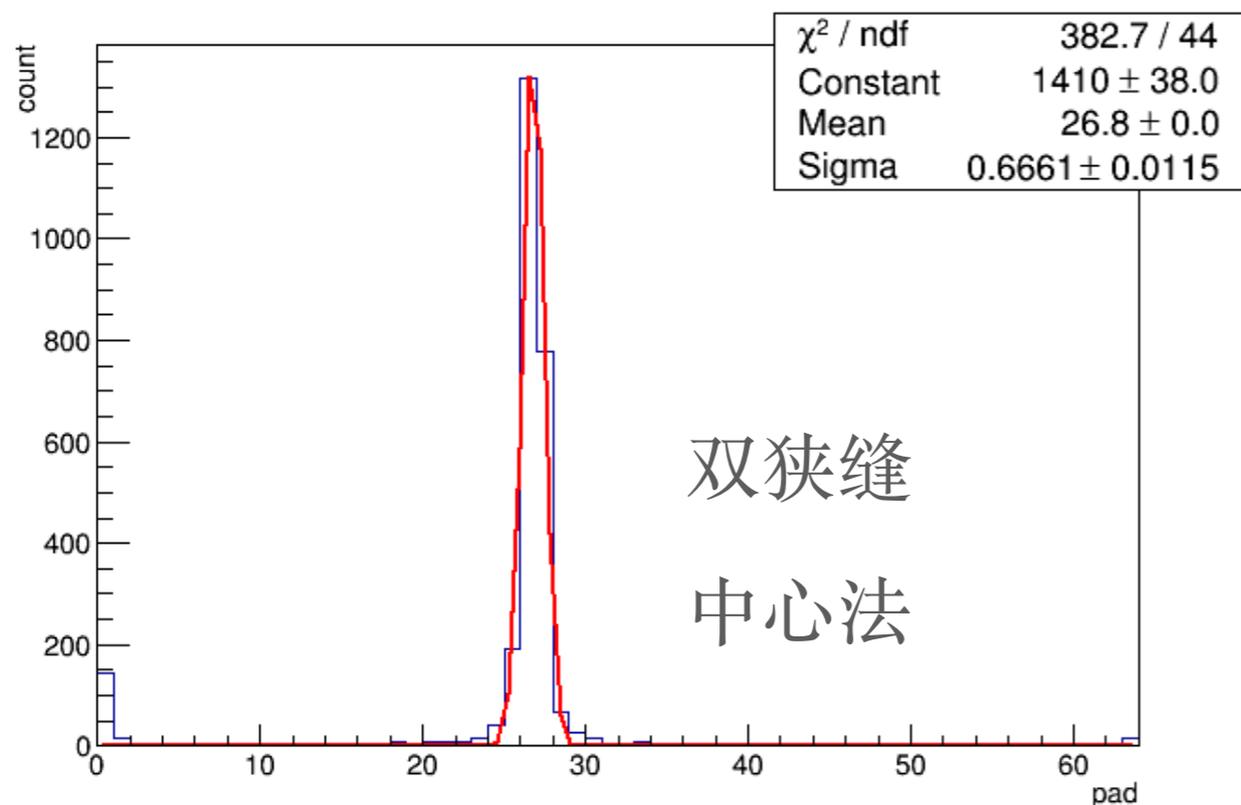
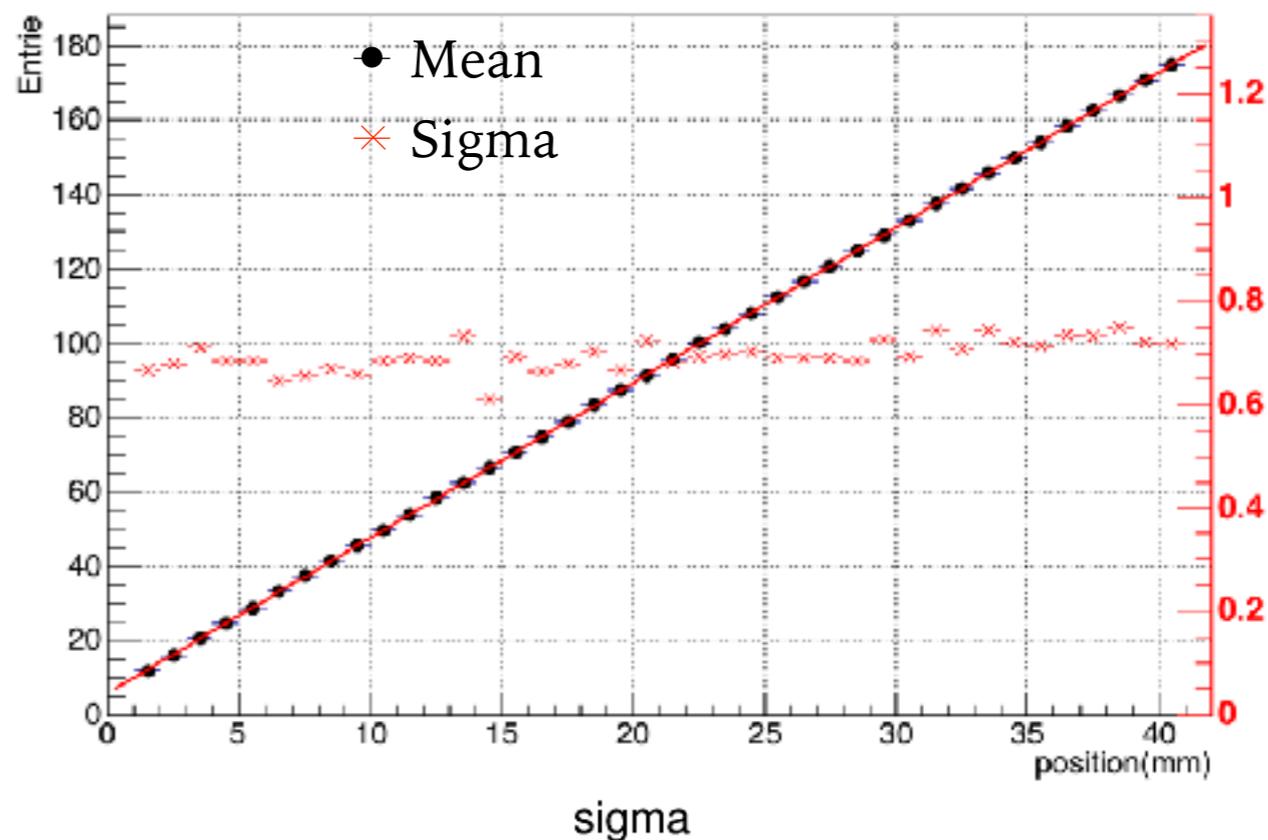
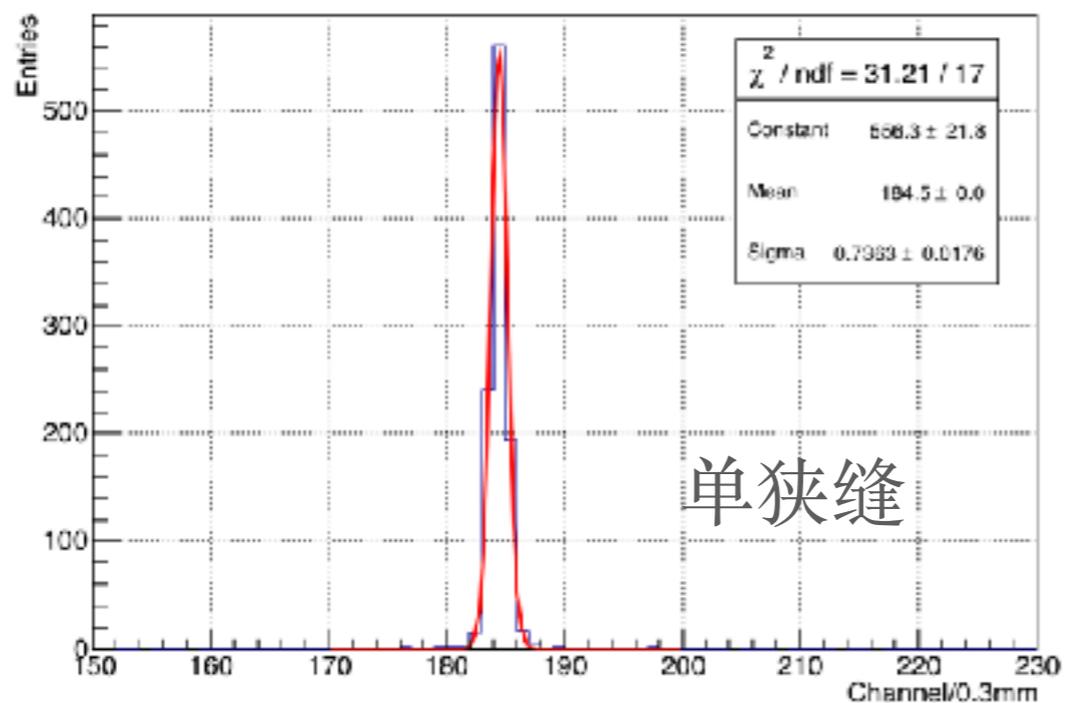
# 空间分辨

- ▶ 我们使用X光机对空间分辨进行了研究。
- ▶ 包含了光源位置不确定性，THGEM本征空间分辨，阳极结构，电子学等的共同贡献
- ▶ THGEM孔径150 $\mu\text{m}$ ，间隔300 $\mu\text{m}$ 。阳极条宽度150 $\mu\text{m}$ ，间隔300 $\mu\text{m}$

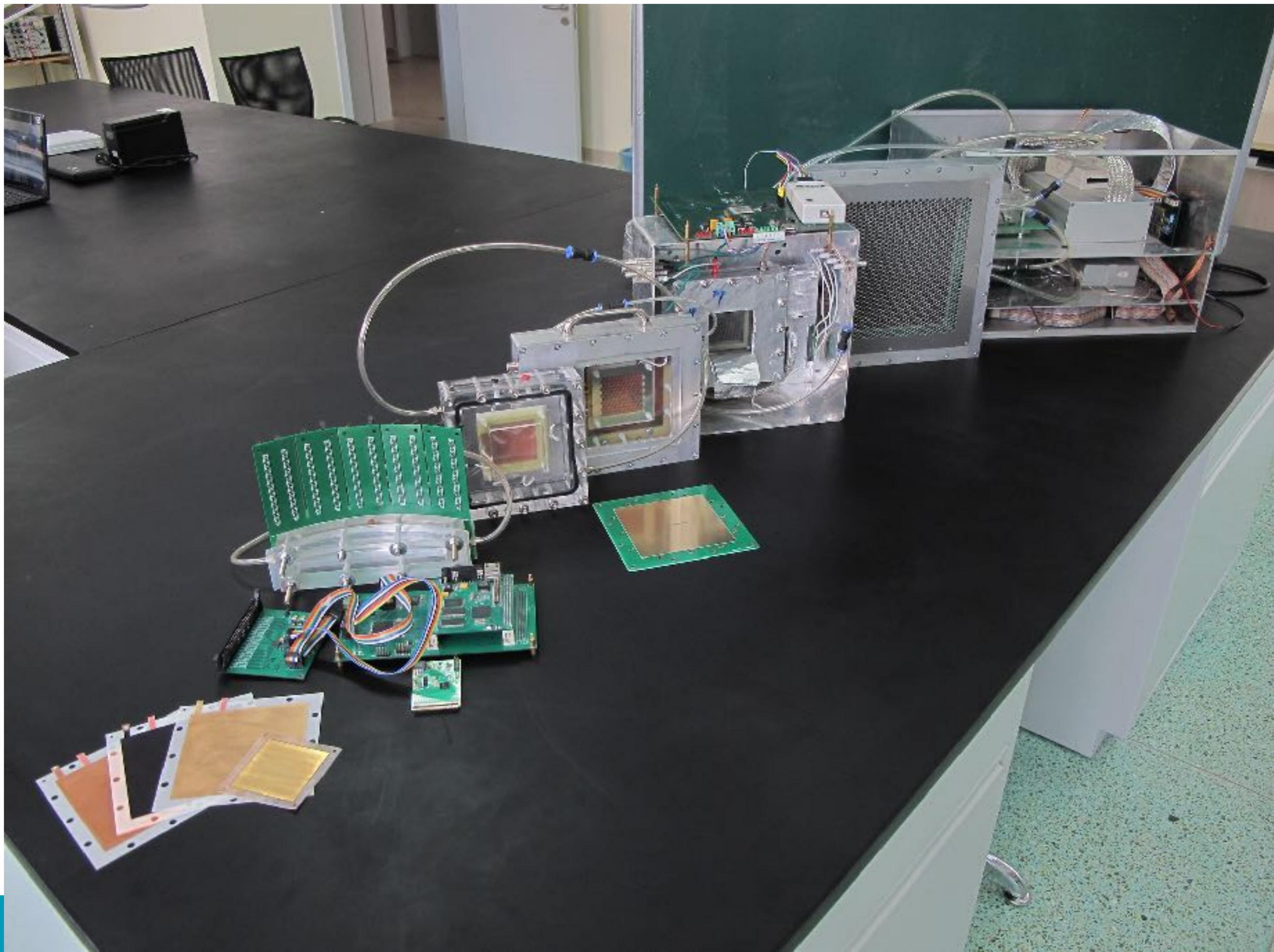


# PERFORMANCE STUDY

- ▶ 利用GASTONE芯片，开发了Binary读出的电子学，并采用中心法确定击中位置。
- ▶ 采用步进电机控制X光源，1mm步进扫描。

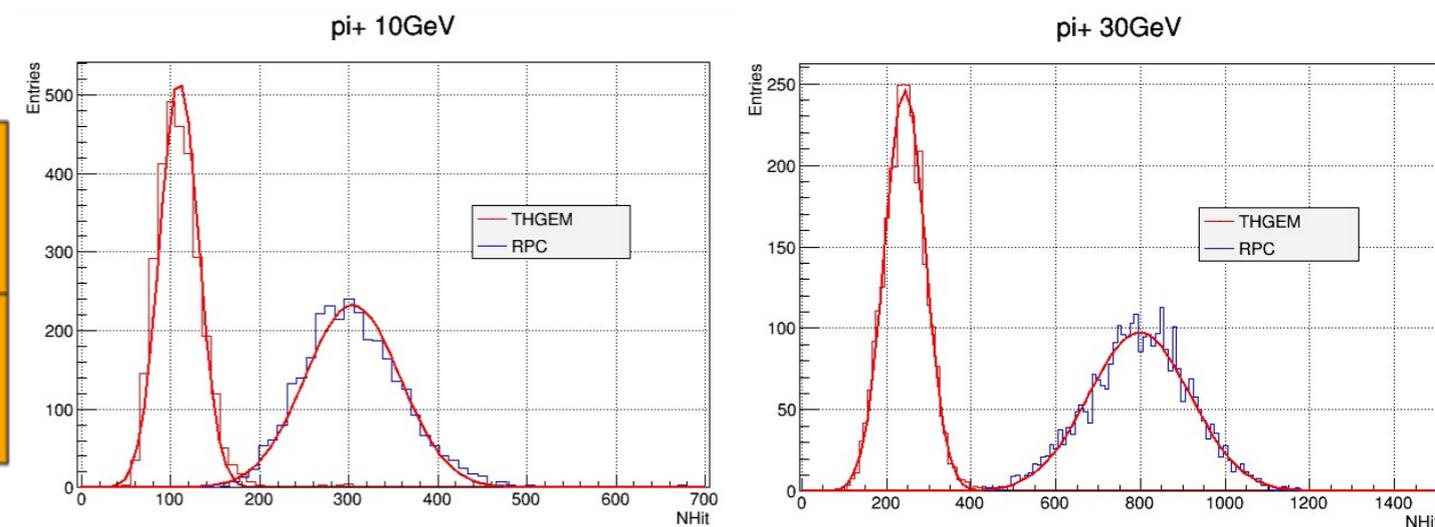
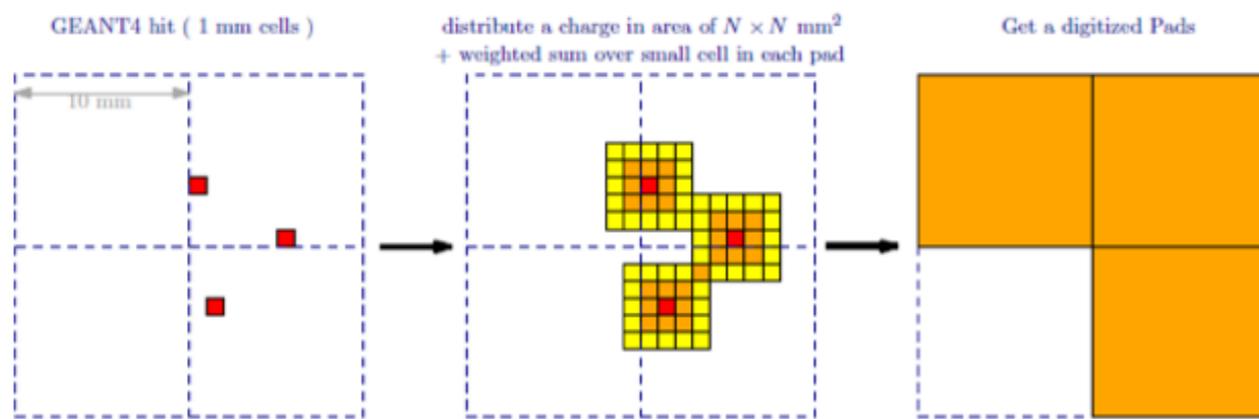
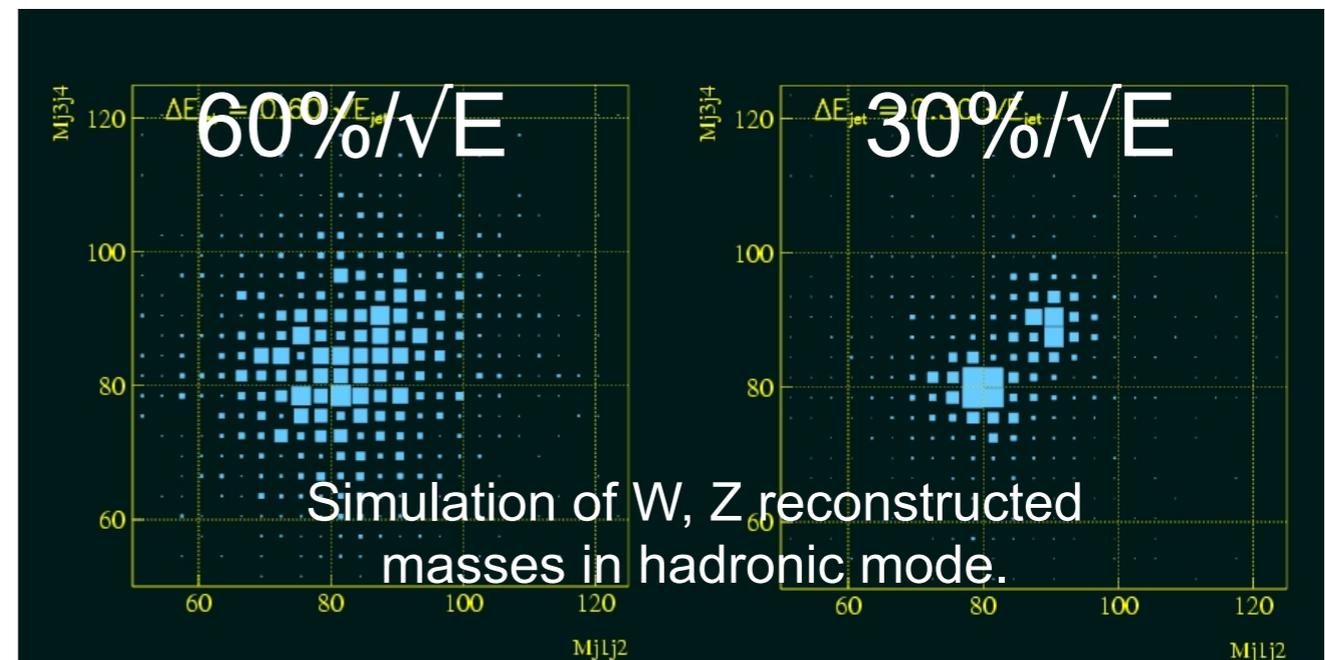
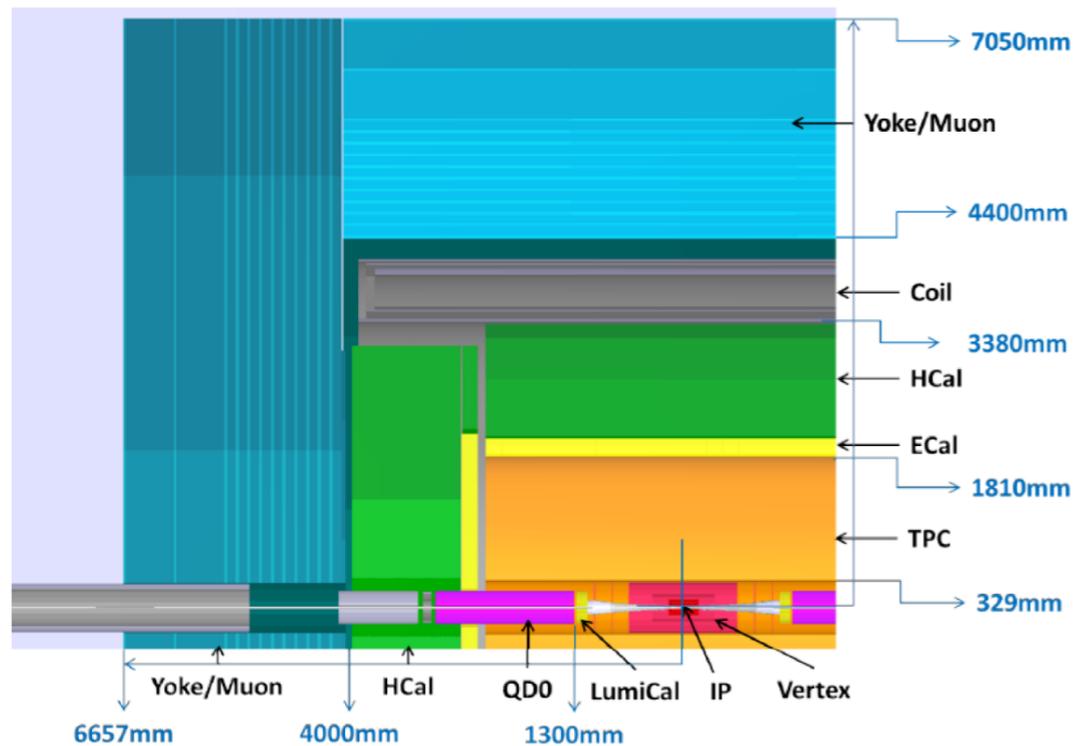


# APPLICATION



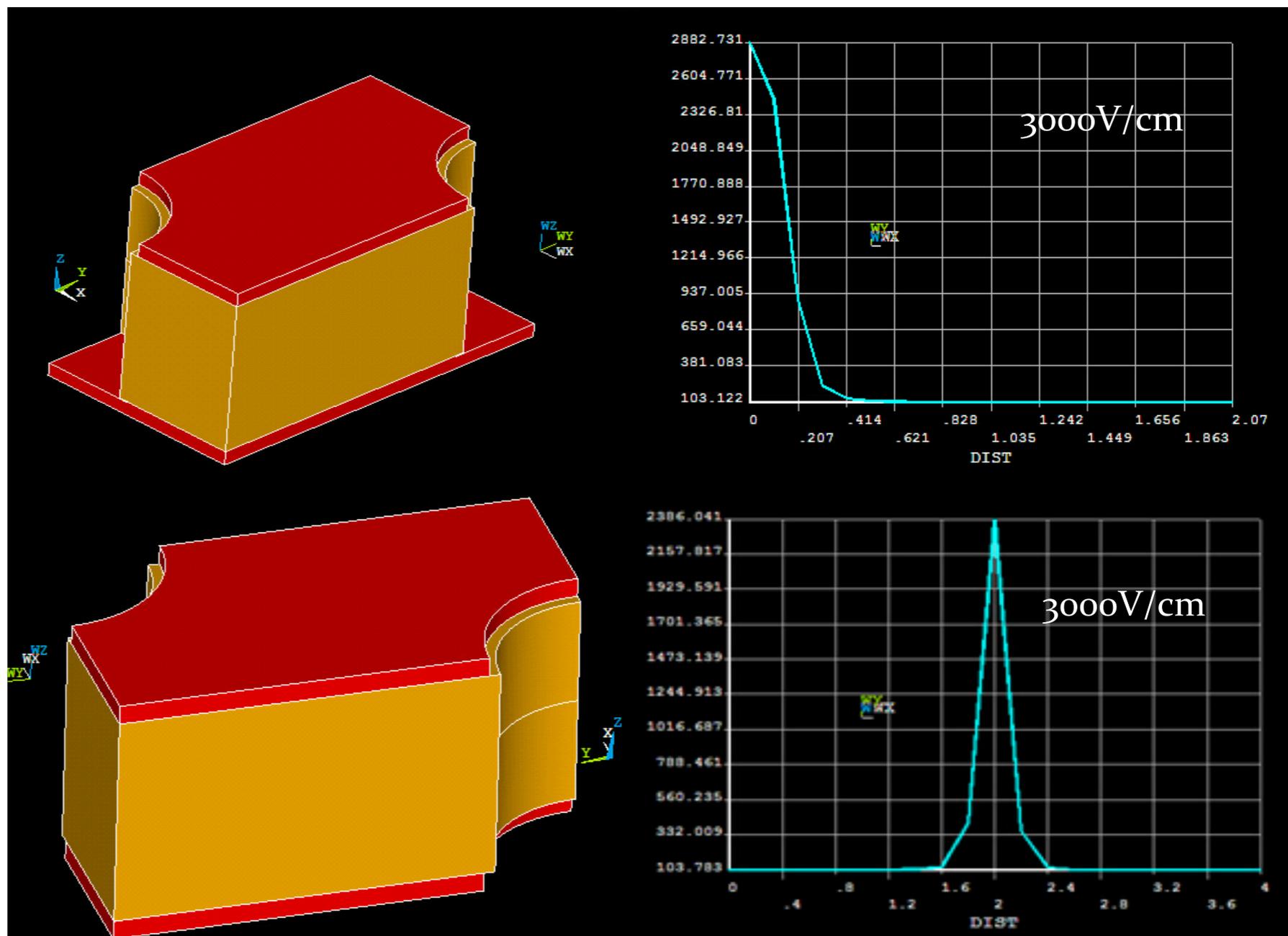
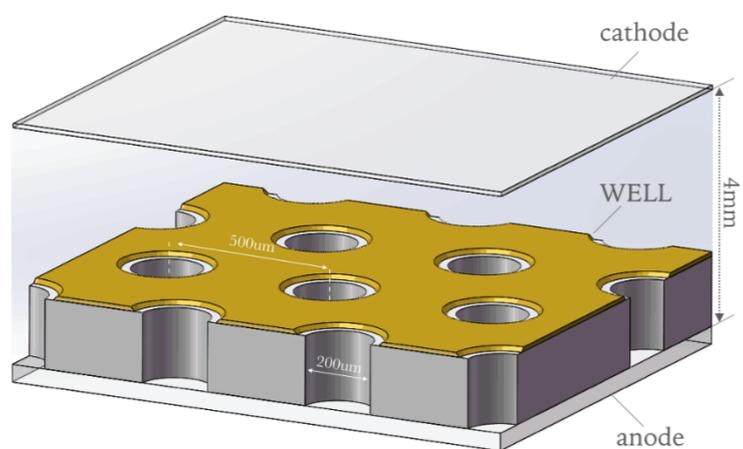
# CEPC DHCAL

- Goal: Jet Energy Resolution  $3 - 4\%$  or  $30\% / \sqrt{E}$  @  $100\text{GeV}$  based on Particle Flow Algorithm (PFA)



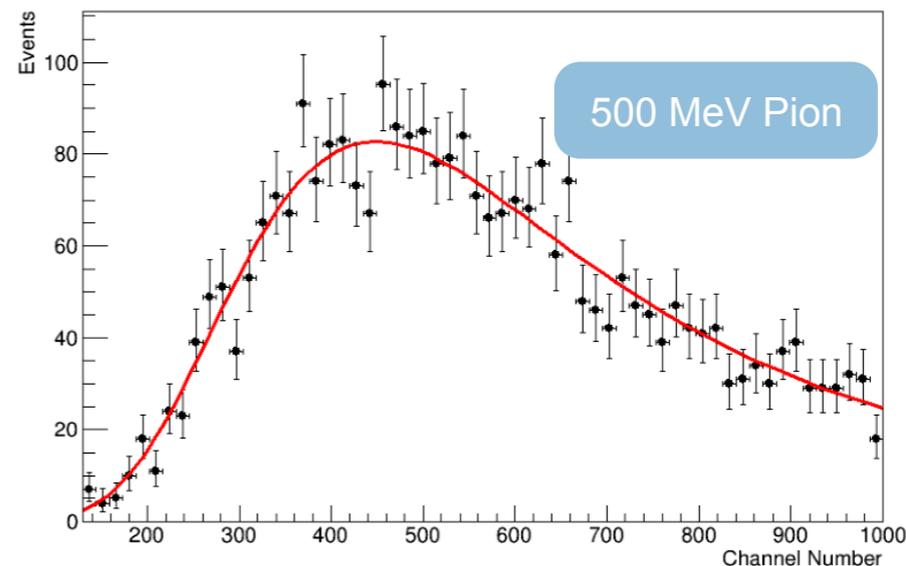
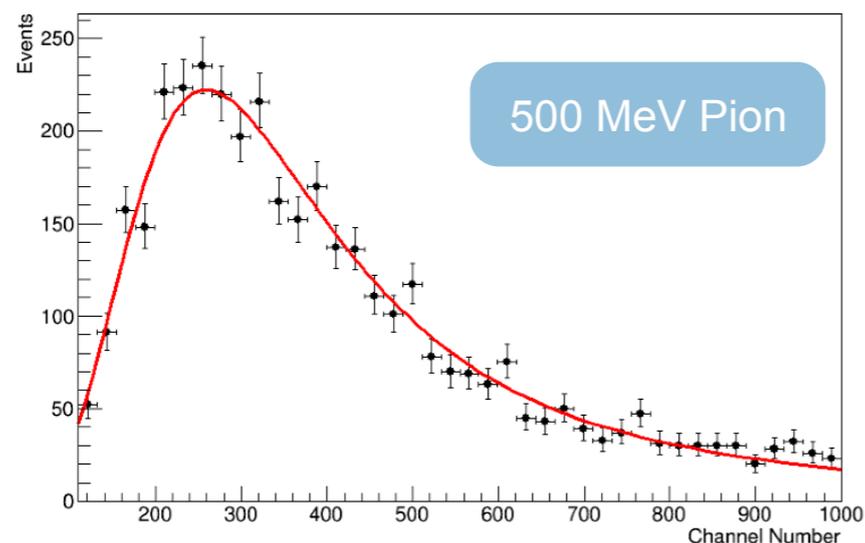
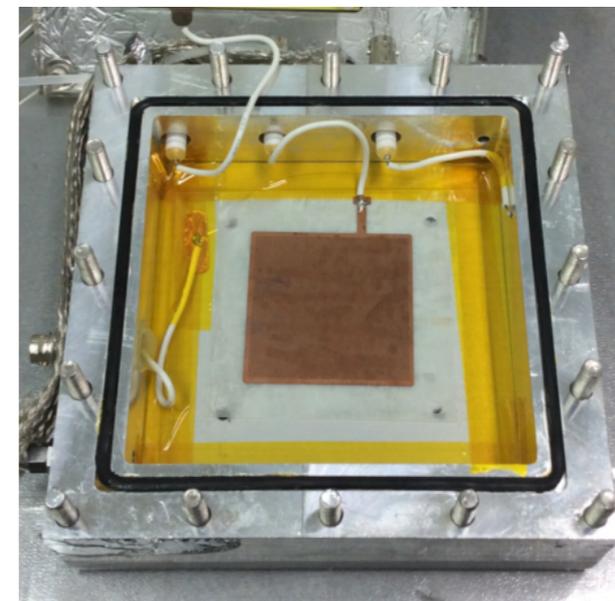
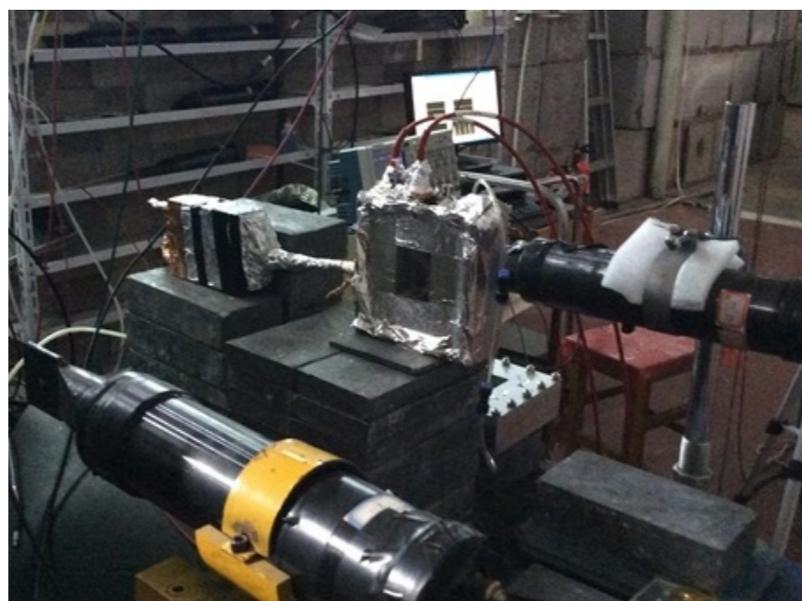
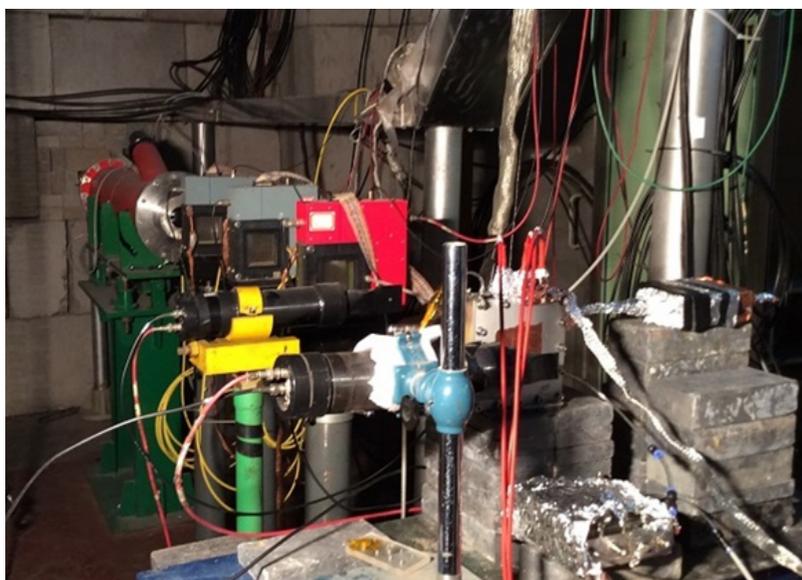
# 用于带电粒子探测的新型THGEM研究

► 井型THGEM在上下表面加上相同电场时，在孔心处能够达到更高的电场。



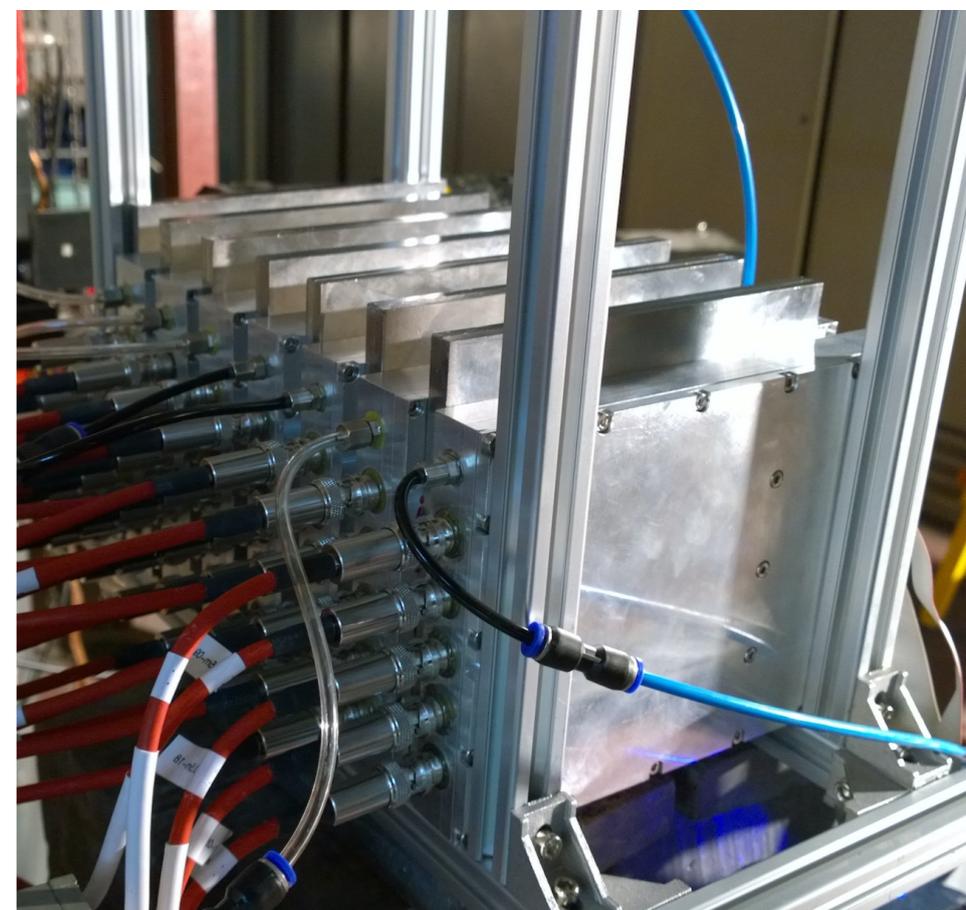
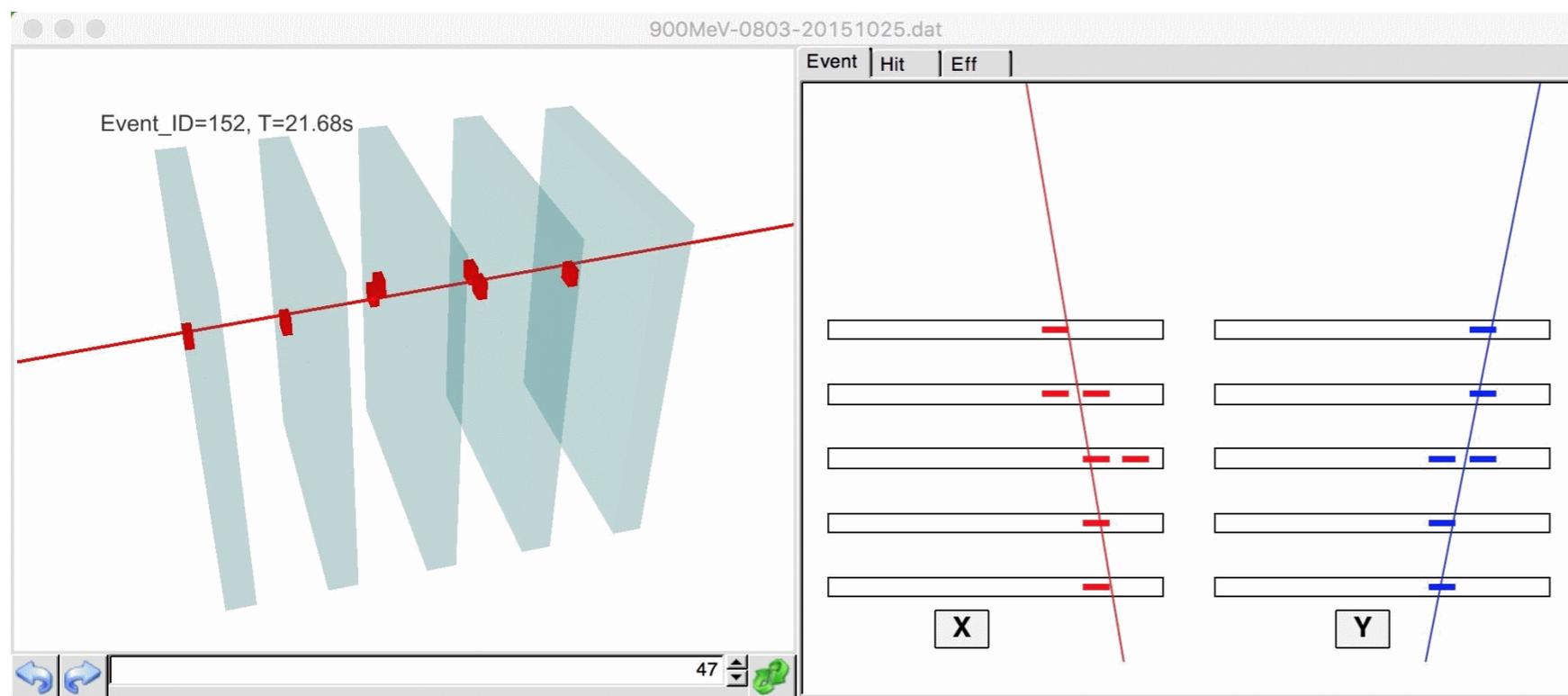
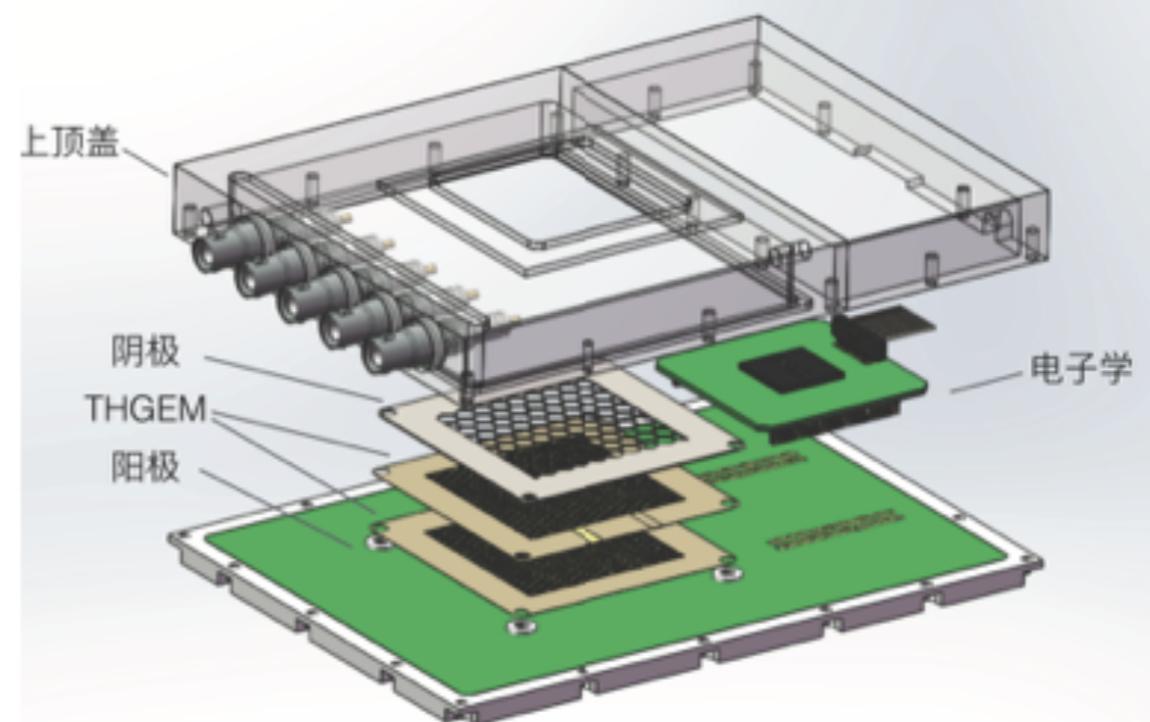
# 井型THGEM的束流测试

- ▶ 利用BEPC的pion和质子束流，研究了井型THGEM的探测效率
- ▶ Gain  $\sim 9000$ ; Eff (proton)  $> 99\%$ ; Eff(Pion)  $> 94\%$



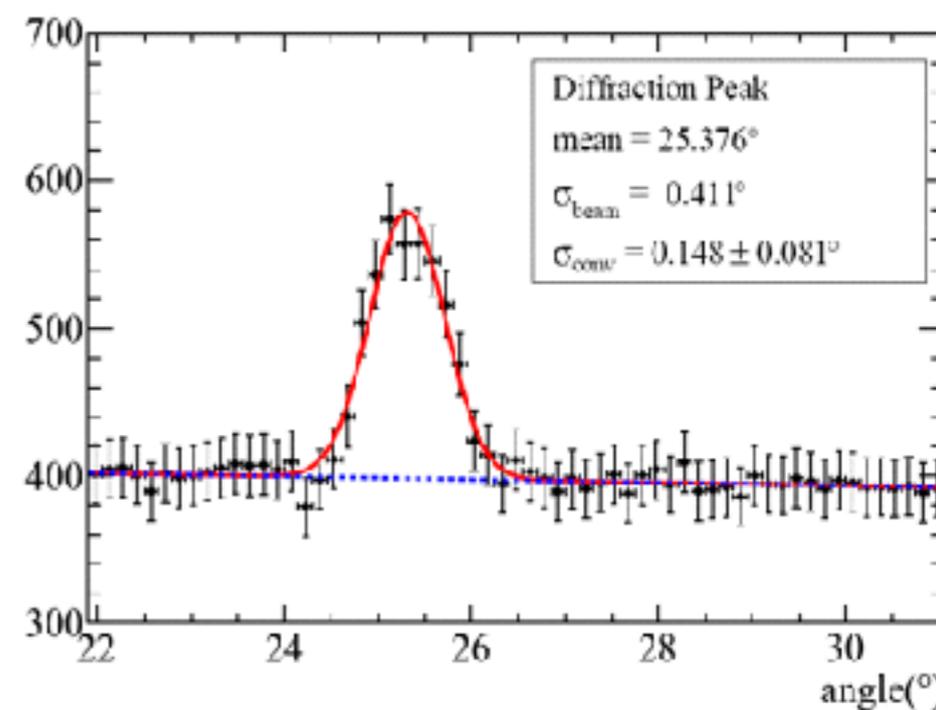
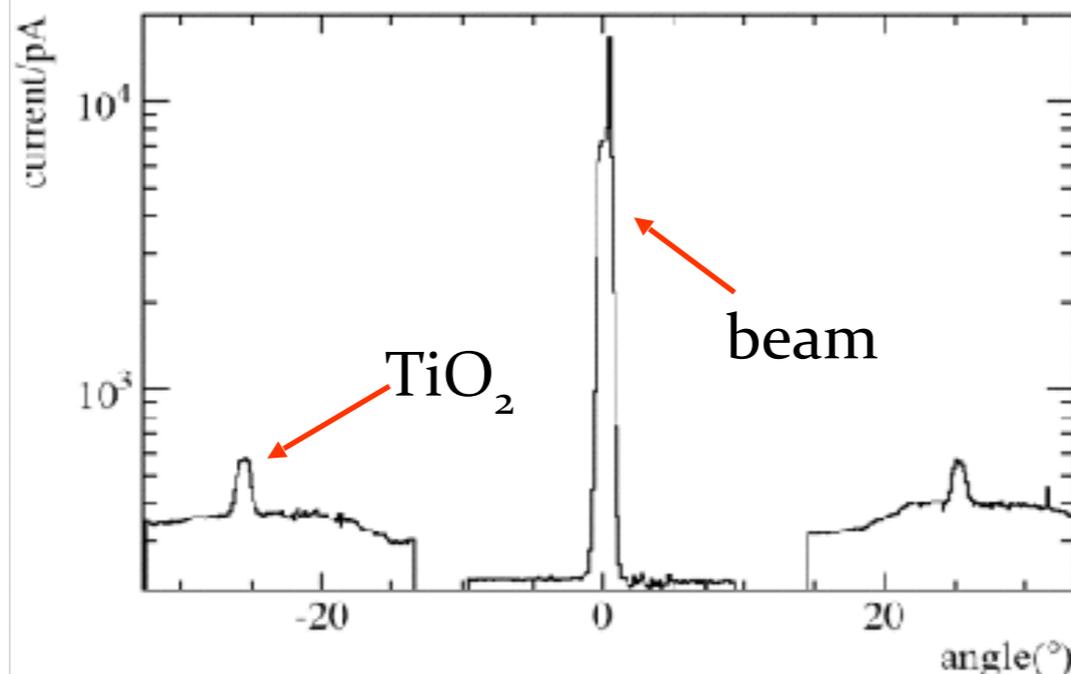
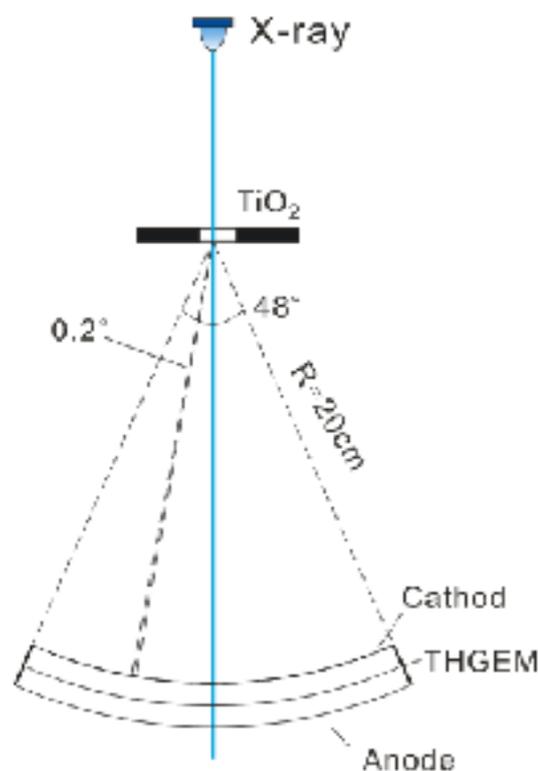
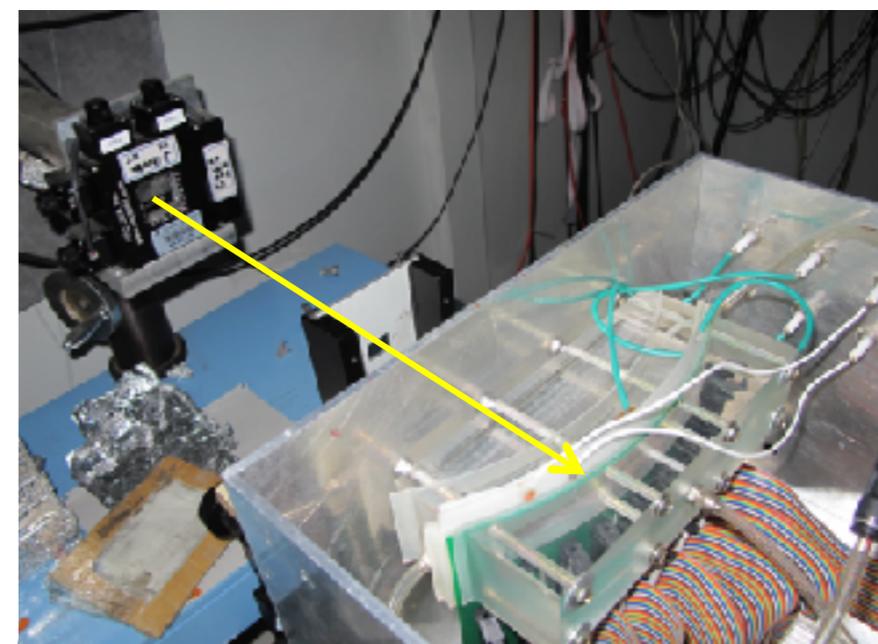
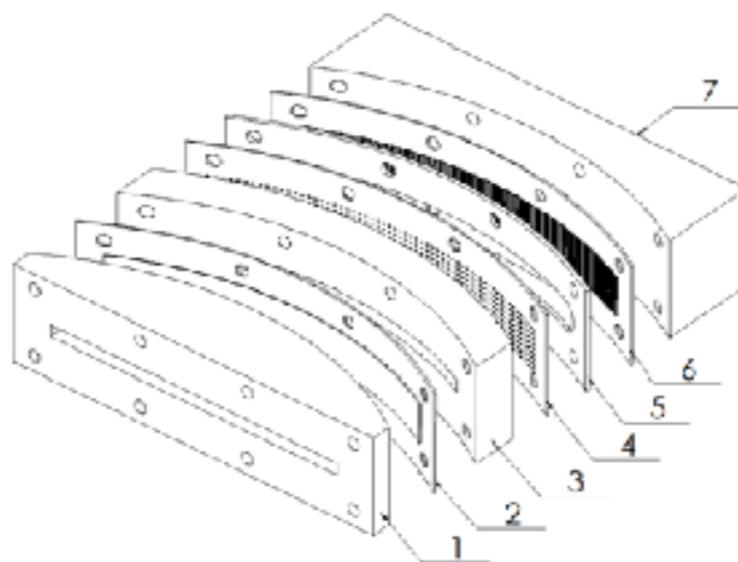
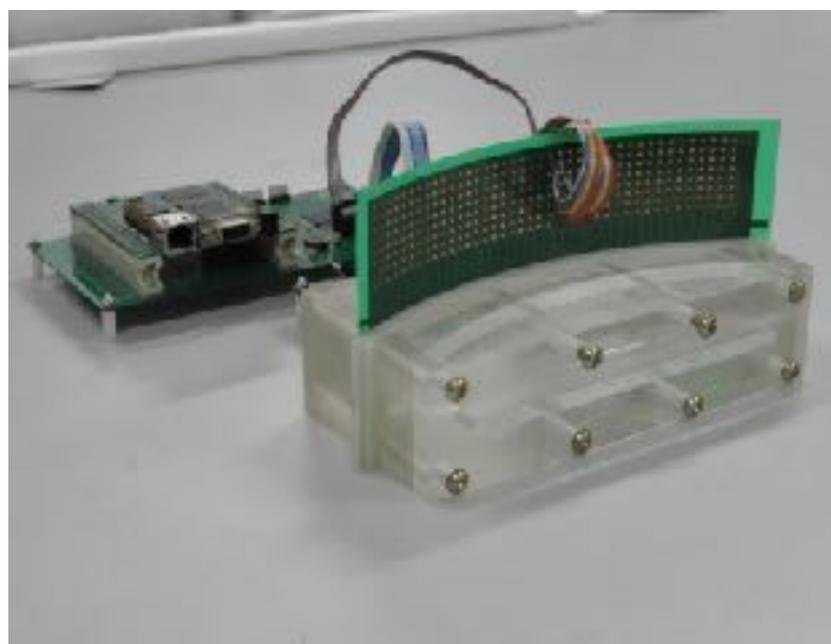
# 多个THGEM的束流实验

- ▶ 共安装7个THGEM探测器，5个探测器正常工作。
- ▶ 采用过阈的binary读出。
- ▶ 束流采用900MeV的质子
- ▶ 有效区域5cmX5cm

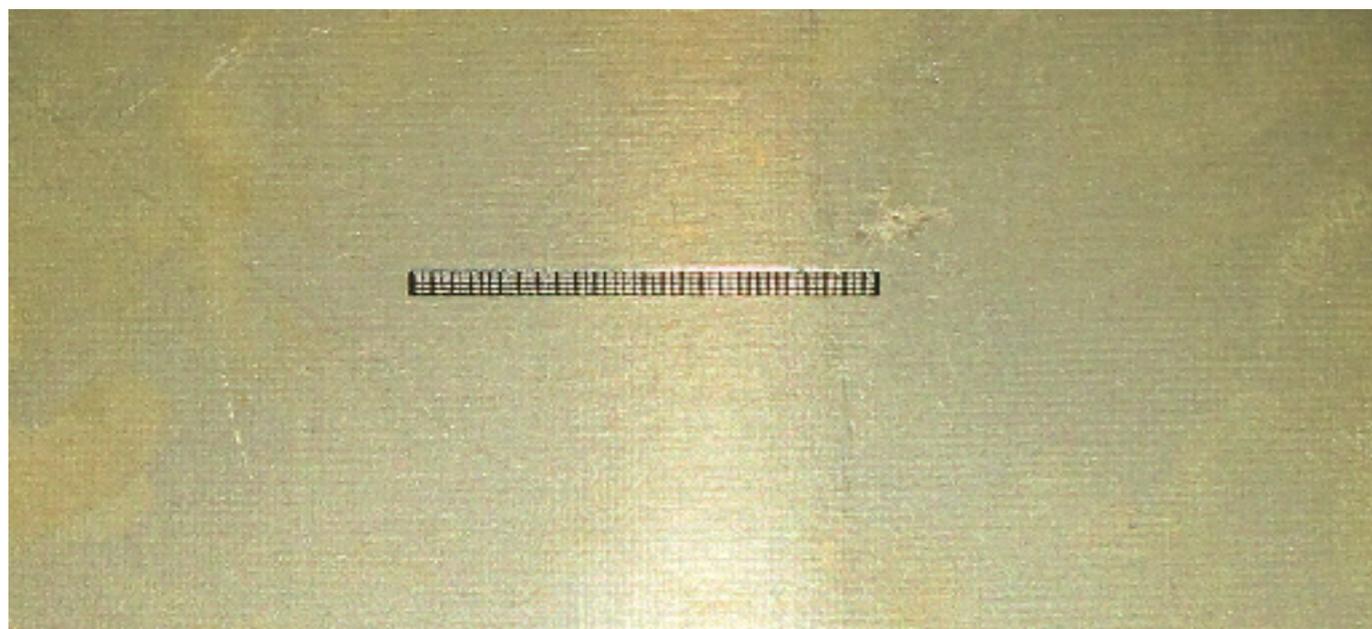


# 用于同步辐射探测的一维弧形探测器

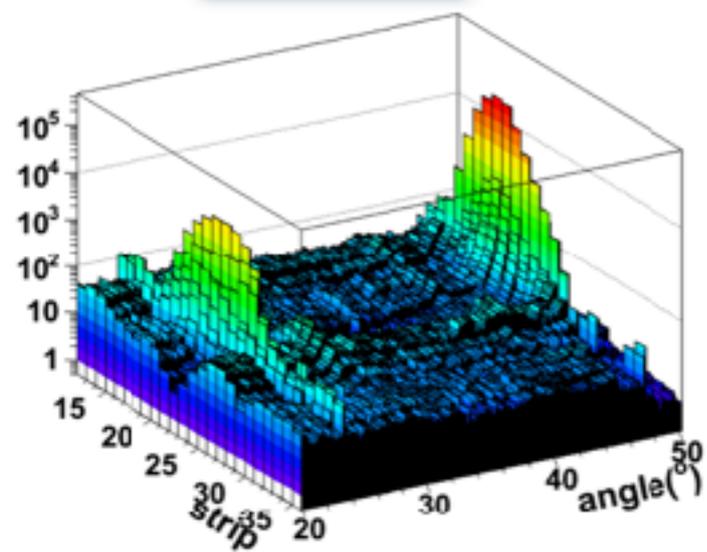
- ▶ 薄型THGEM易于弯曲，利用BEPC同步辐射进行研究。
- ▶ 同步辐射周期性高流强的特点，采用电流读出电子学。



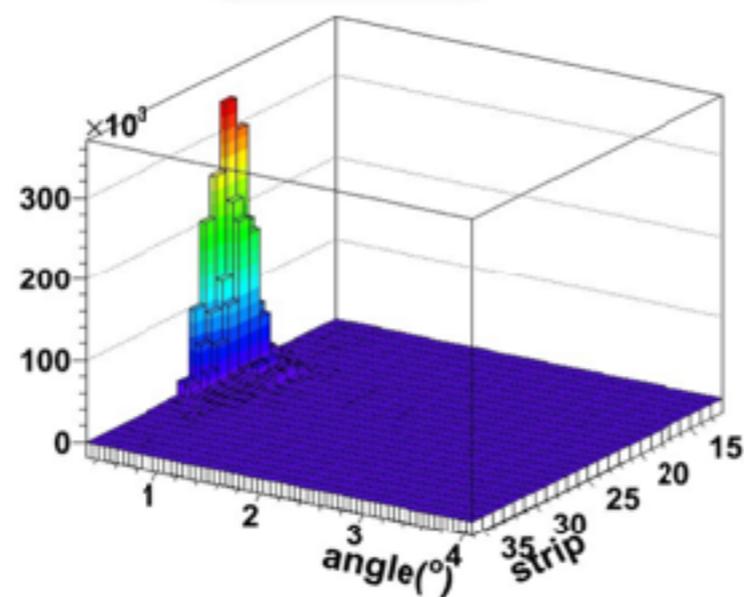
# 用于同步辐射的二维成像探测



FA54样品

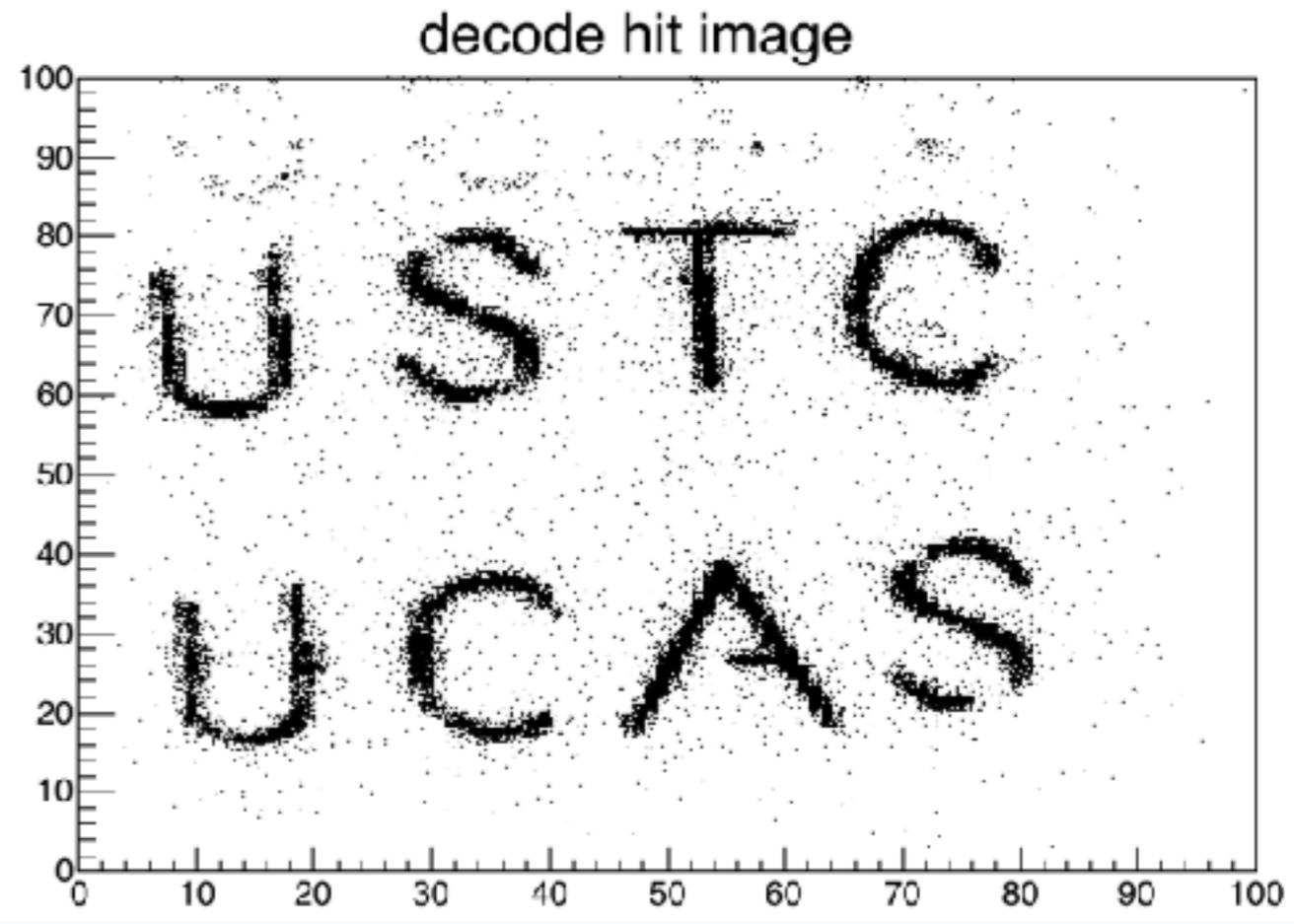
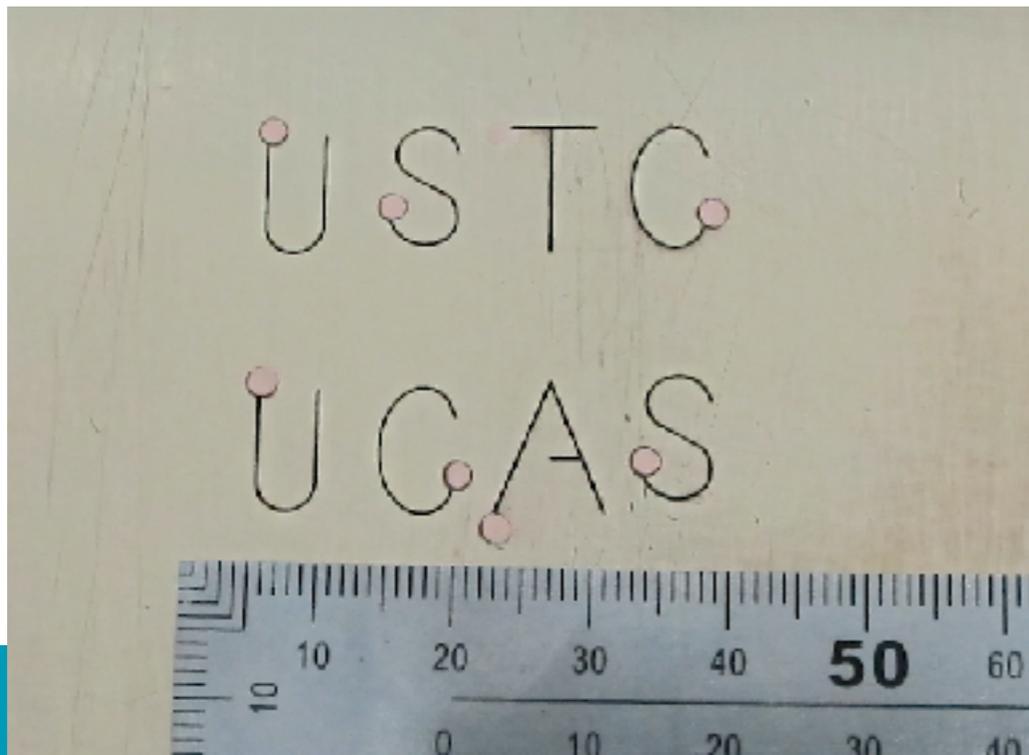
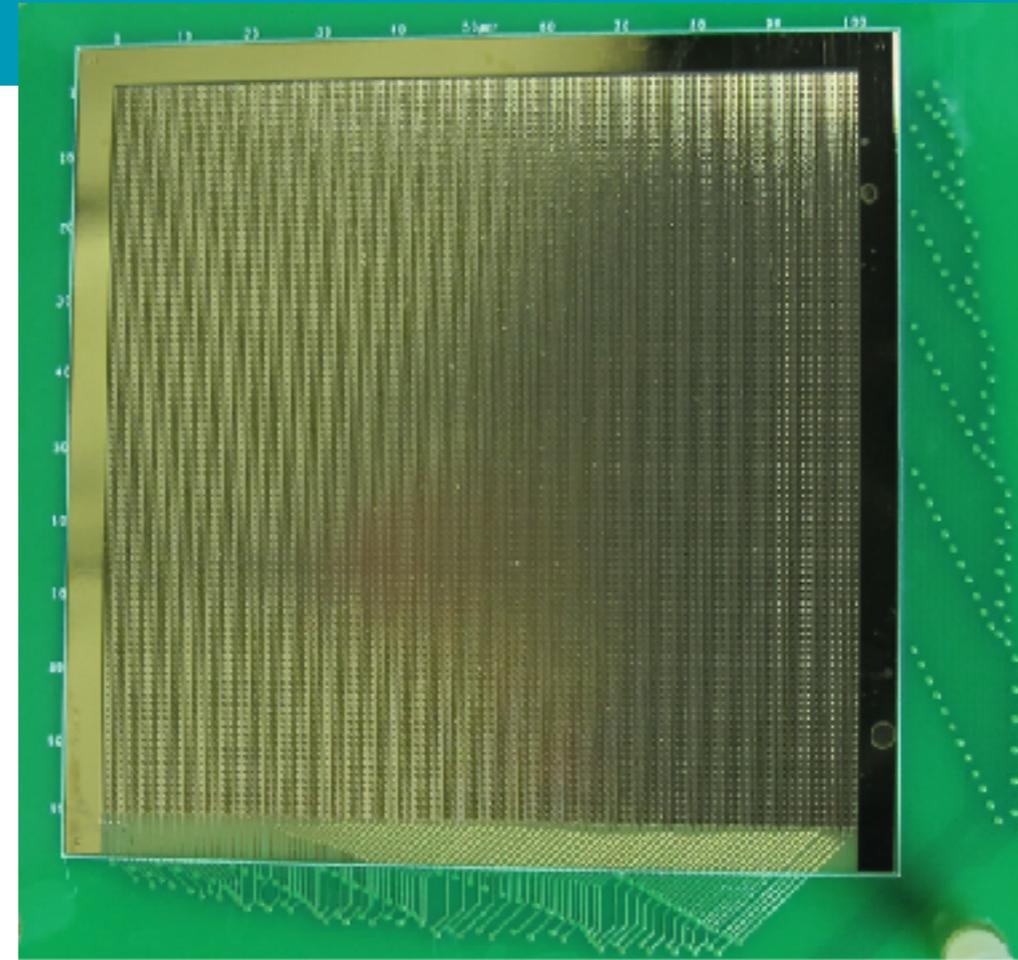
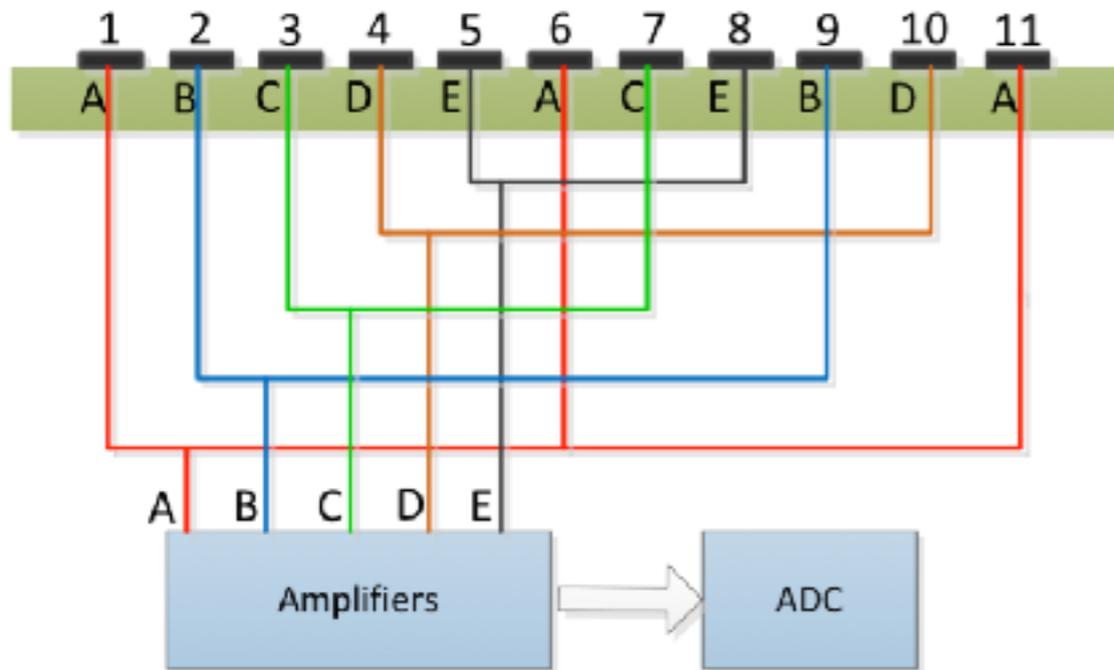


小角测量

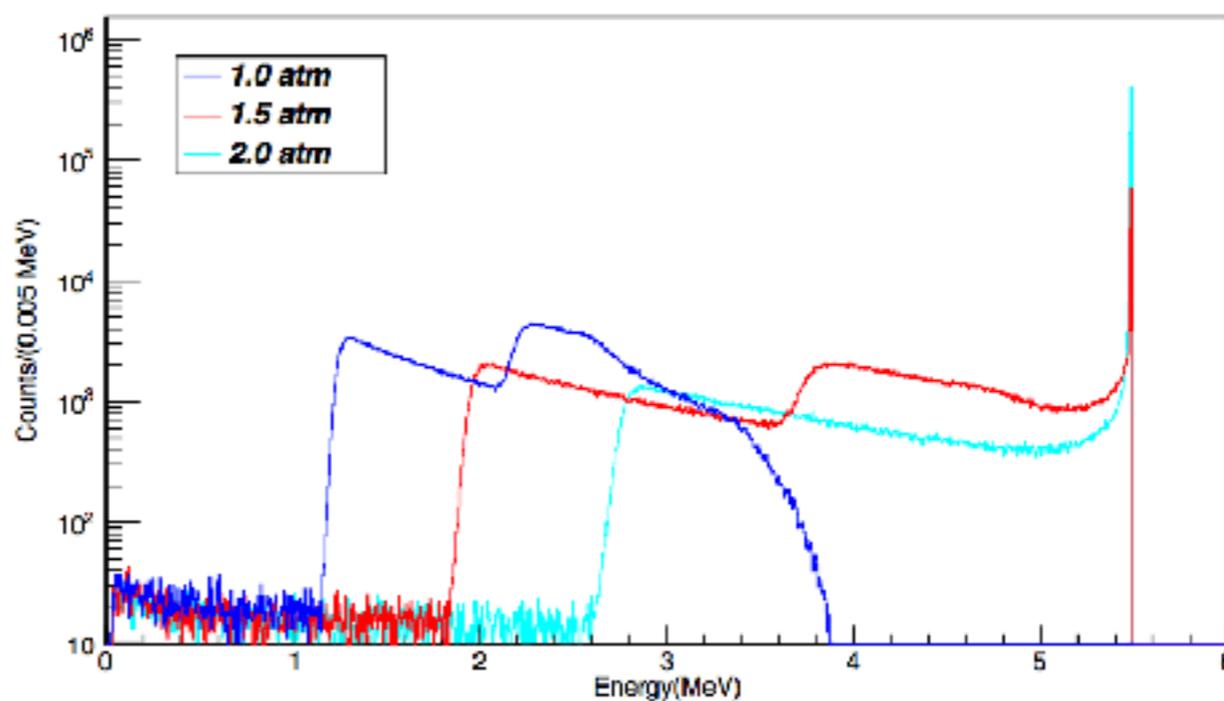
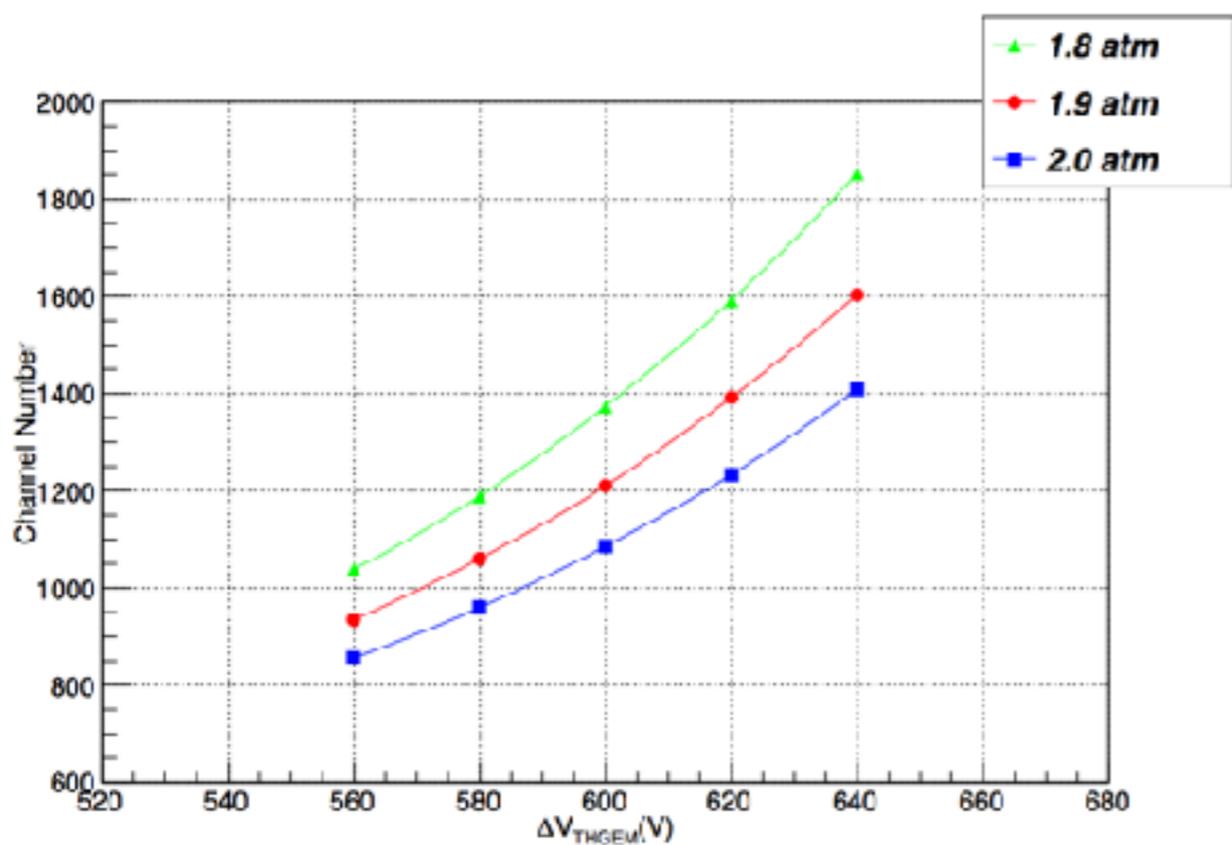
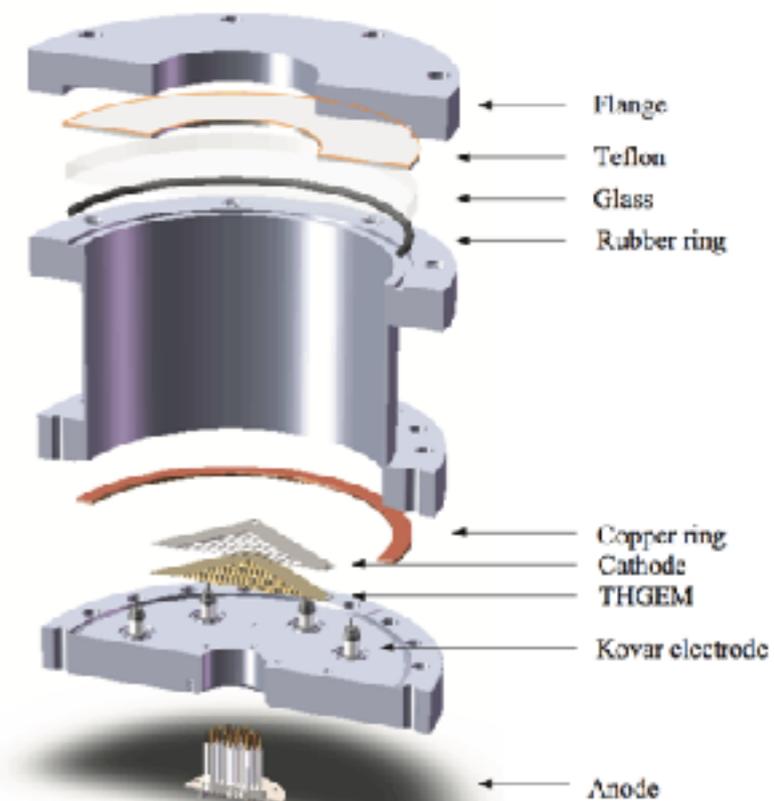
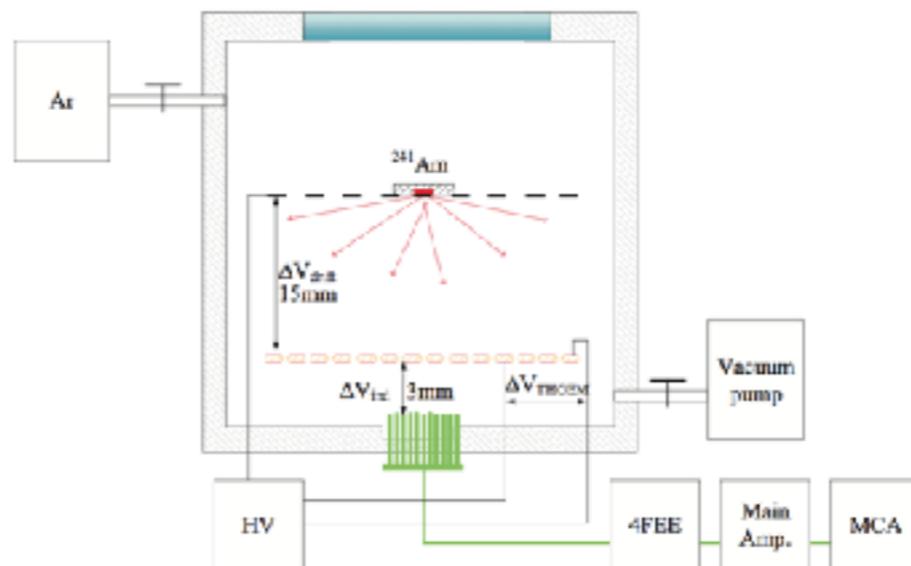
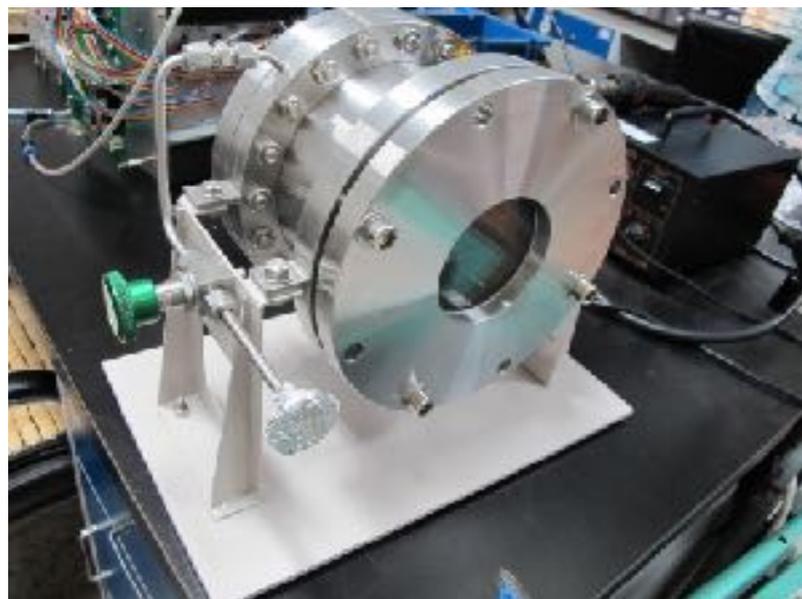


# 编码阳极成像研究

- ▶ 利用科大刘树彬老师电子学组设计编码阳极，成功实现了编码读出成像。
- ▶ 30路电子学实现了100+100路X / Y二维读出

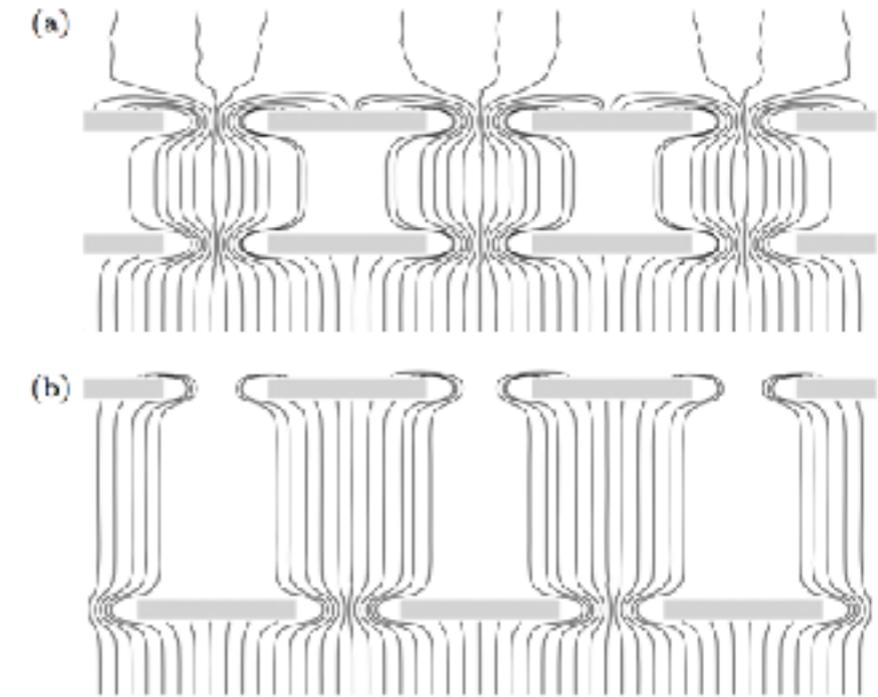
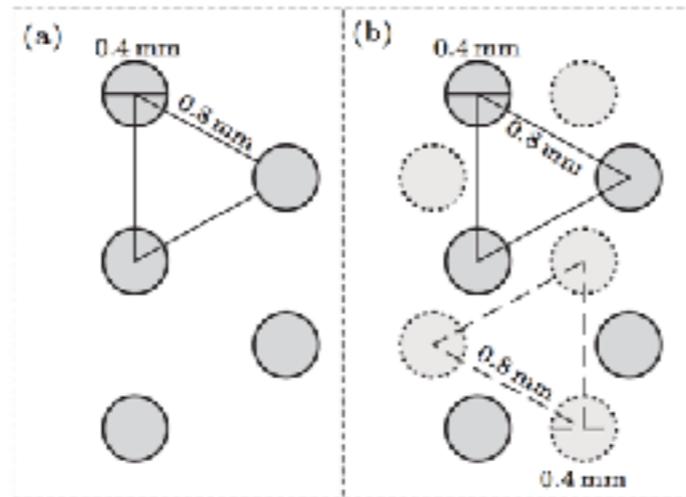
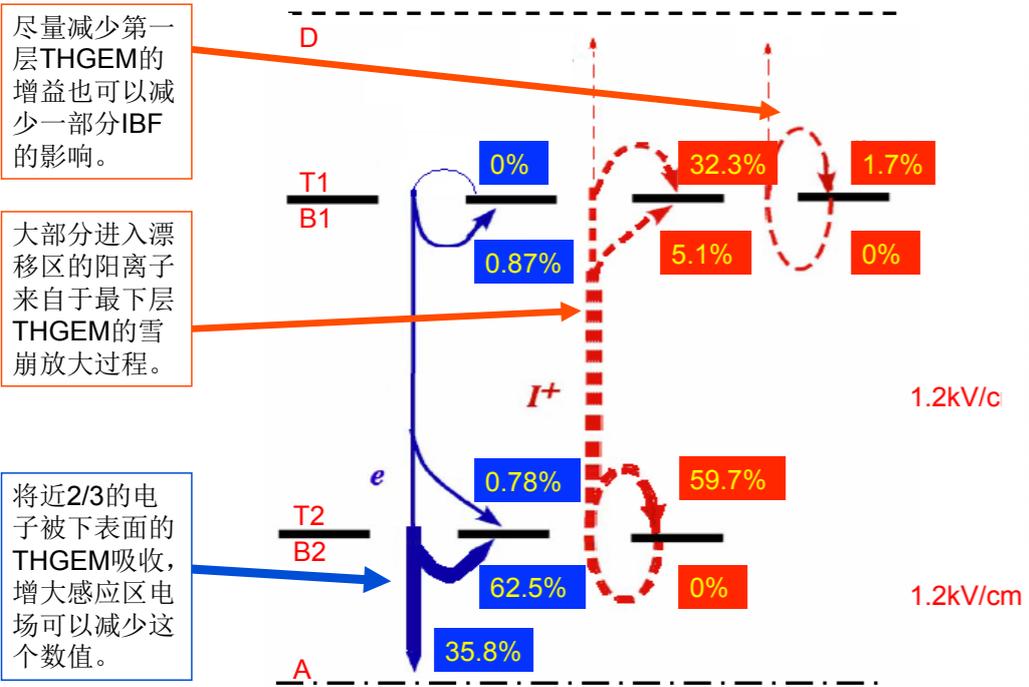


# 密闭探测器性能研究

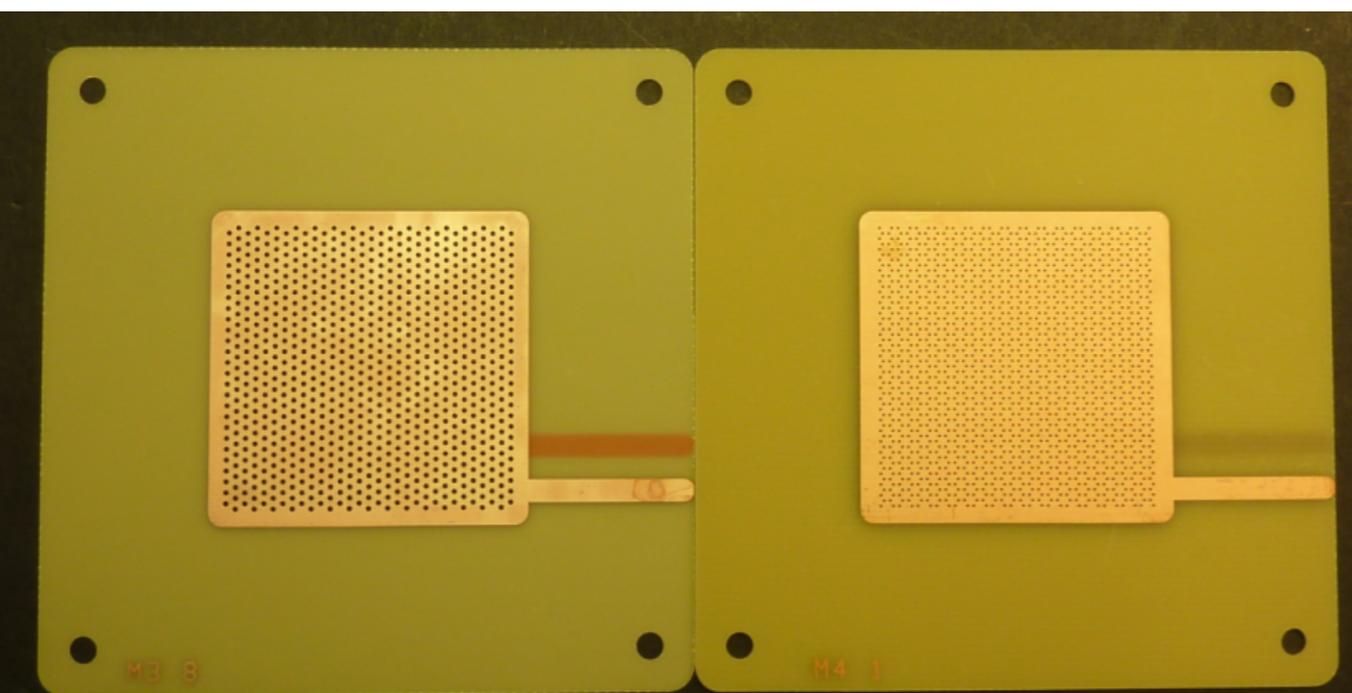
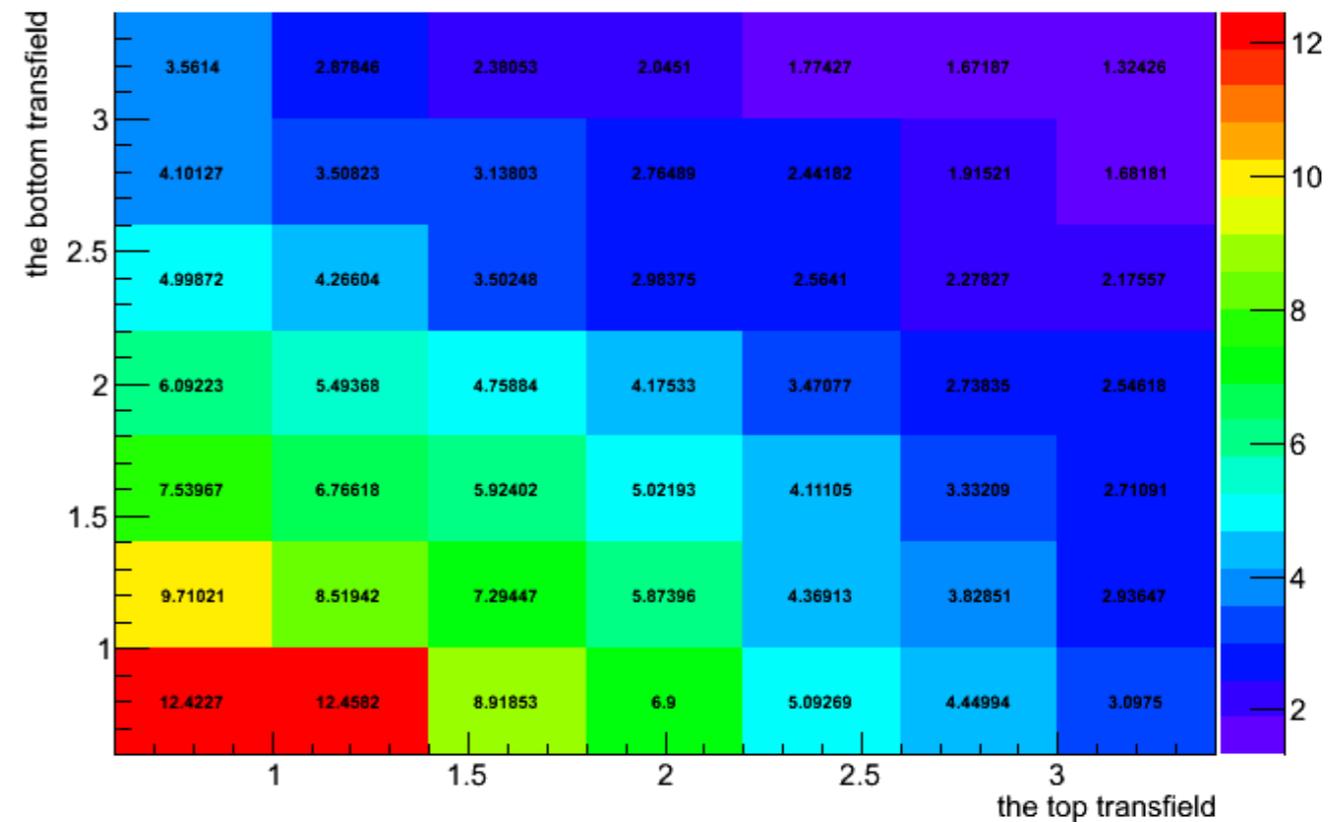


# THGEM BASED TPC (IBF)

➤ 采用多层交错的层叠stag模式来抑制IBF



IBF 2D map for transfer field scan for not-aligned TTHGEM with 6.5V LED



“

感谢大家一如既往的支持！

谢谢大家！