# Who is Yuzhen?

# Outline

1. Education background
2. Research experience
3、Other skill

# Education Background

- B.S.  in applied physics at Jimei University (2007-2011)

Dissertation: Research of traffic light system based on single ship microcomputer

- M.S. in particle physics at Guangxi University (2011-2014)

Dissertation:  Study of two-stack MCP component performance

- Ph.D. in physics (particle detector) at Nanjing University (20014-017)

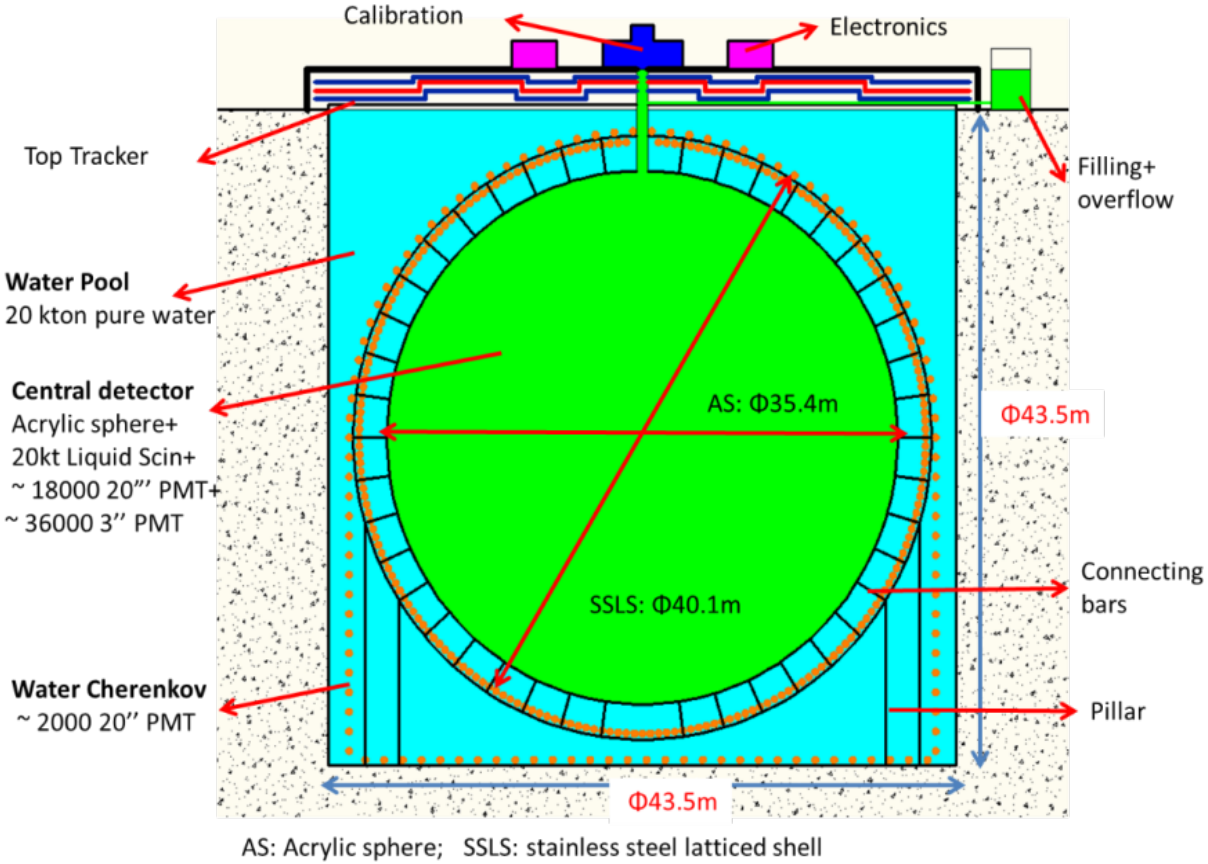
Dissertation:  Research and Optimation of Microchannel Plate Assembly for MCP-PMT based on JUNO

# Research Experience

Jiangmen Underground Neutrino Observatory (JUNO)

Center Detector(CD)： 20 000 ton liquid scintillator (LS)

photomultiplier tube(PMT)




AS: Acrylic sphere; SSLS: stainless steel latticed shell

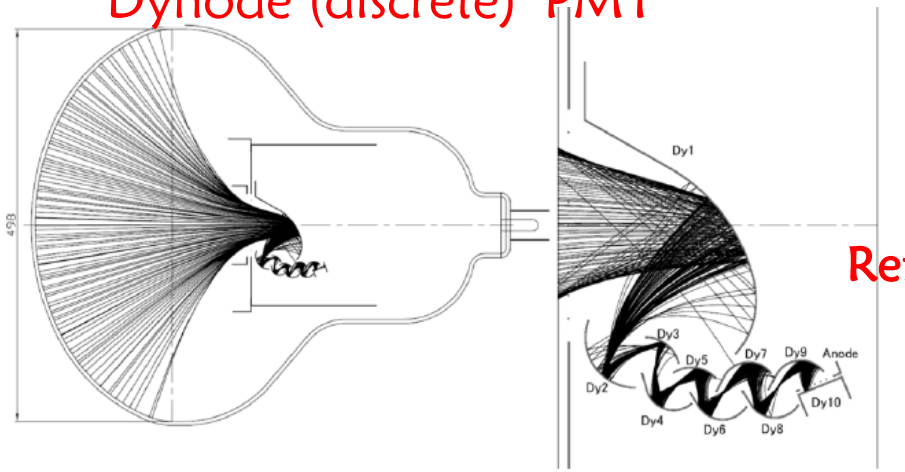
PMT:

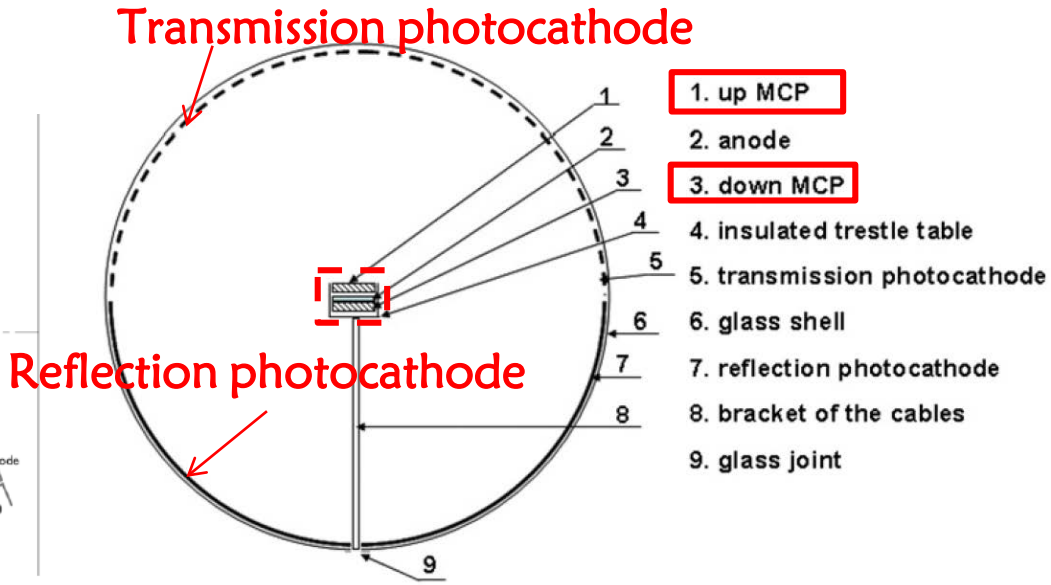
- Large number of 20000
- Large area 20 inch
- High coverage rate of photocathode (>75%)
- High detection efficiency
- Ability to detect single electron
- Low dark noise
- Low background
- Long age
- ……

# Microchannel Photomultiplier Tube, MCP-PMT

As there was not production of 20-inch PMT that meet the requirements at the beginning of JUNO, IHEP and several departments set up the 20-inch MCP-PMT project.

Dynode (discrete) PMT

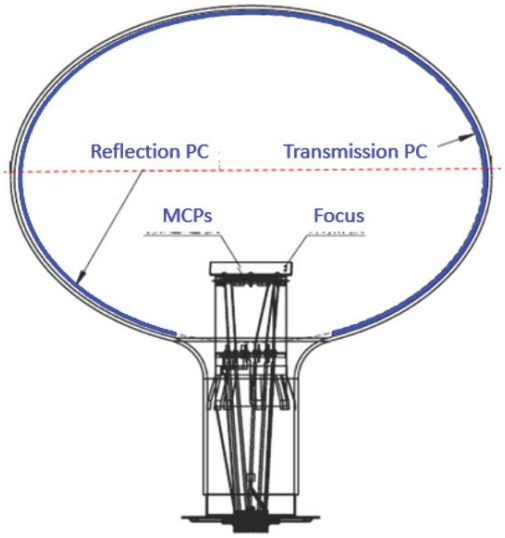



Initial design of MCP-PMT

Initial design：Yifang Wang, et al., Nuclear Instruments and Methods A 695(2012)113.

# Microchannel Photomultiplier Tube, MCP-PMT




Later design MCP-PMT

Characteristic of 20-inch MCP-PMT:

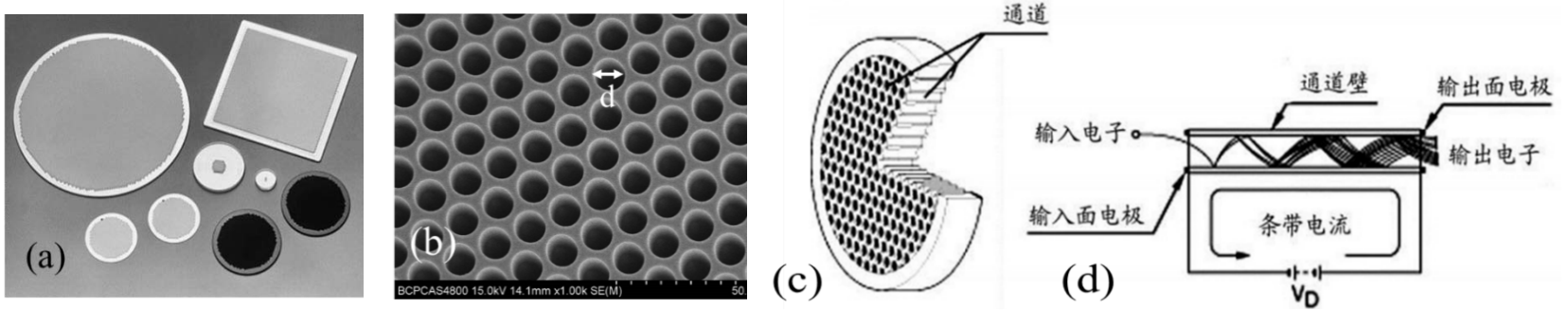
- Use the transmission and reflection PC to improve the detection efficience
- MCP has good time performance and magnetic immunity ability
- Low background of MCP

My research is to measure and improve the performance of MCP.

Later design： Feng Gao, et al. Status of the large area MCP-PMT in China[J] Proceedings of science, 38th ICHEP, 3-10 August 2016, Chicago, USA.

# Introduction of Microchannel Plate (MCP)

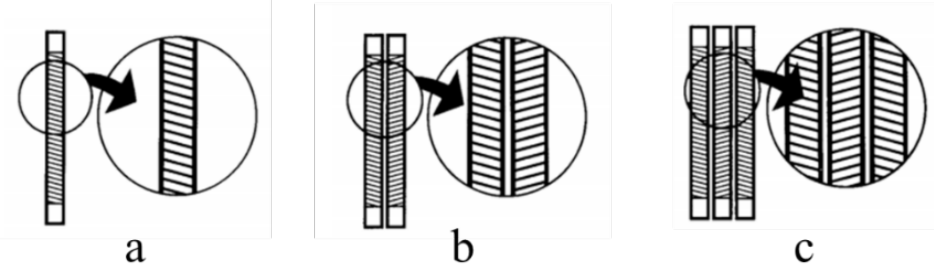
Electron multiplier(continuous)
A large number of channel to multiply




- MCP的优点：

a) 小型高增益；
b) 暗计数低；
c) 时间响应快、时间分辨率好；
d) 抗磁场性；
e) 电极数目少；
f) ……

- MCP组件：
  - 离子反馈
  - 具有斜切角的MCP组件



# MCP and its components processing and testing platform

It is capable of degassing the MCP and its components in two sets of vacuum systems and five relatively independent vacuum chambers (including vacuum baking and electronic cleaning), as well as static and dynamic on-line testing.

项目职责：

1）负责设备部分机械结构的完善和设计；

2）调试烘烤温度控制系统（PID参数）；

3）搭建电荷谱测试系统(多道分析、波形获取)

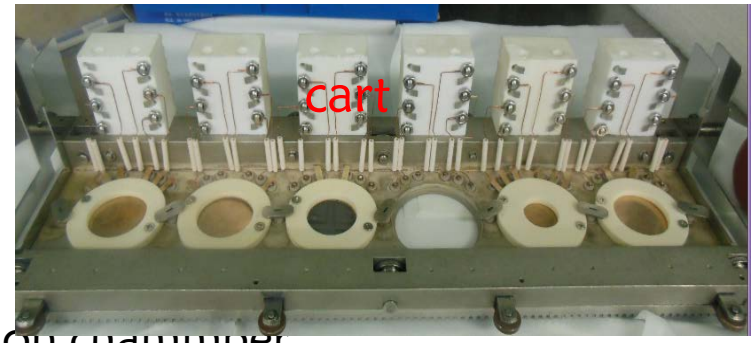
小电流测试系统，

电子清刷自动控制系统；

4）研制大尺寸均匀的面电子源；

5）使用和维护真空机组。

# MCP及其组件的处理与测试平台

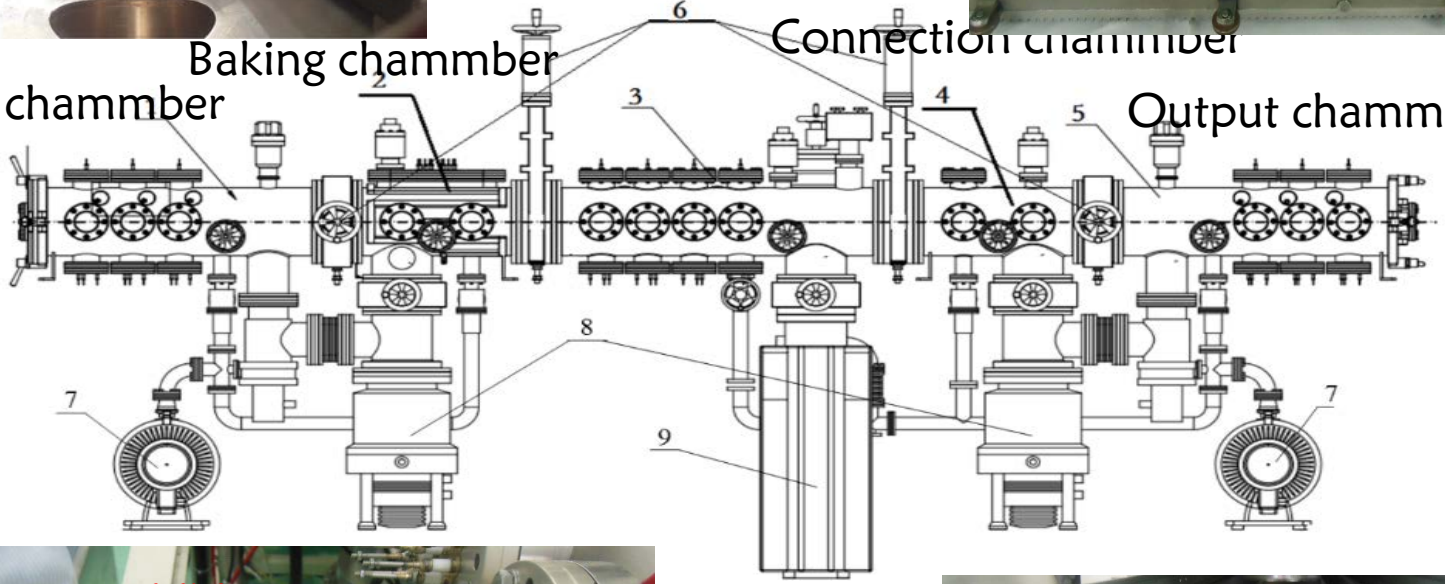

Testing chammber

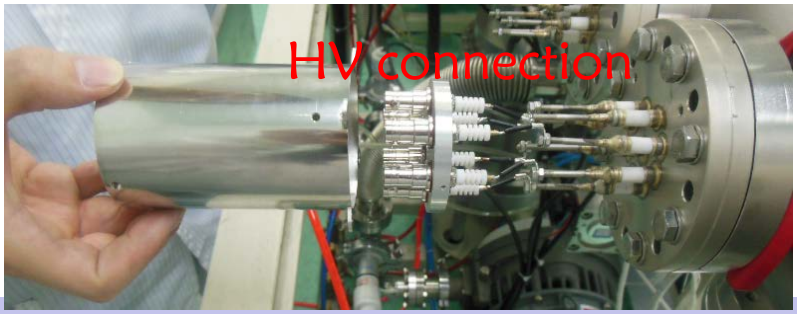
Baking chammber

Connection chammber

Input chammber

Output chammber



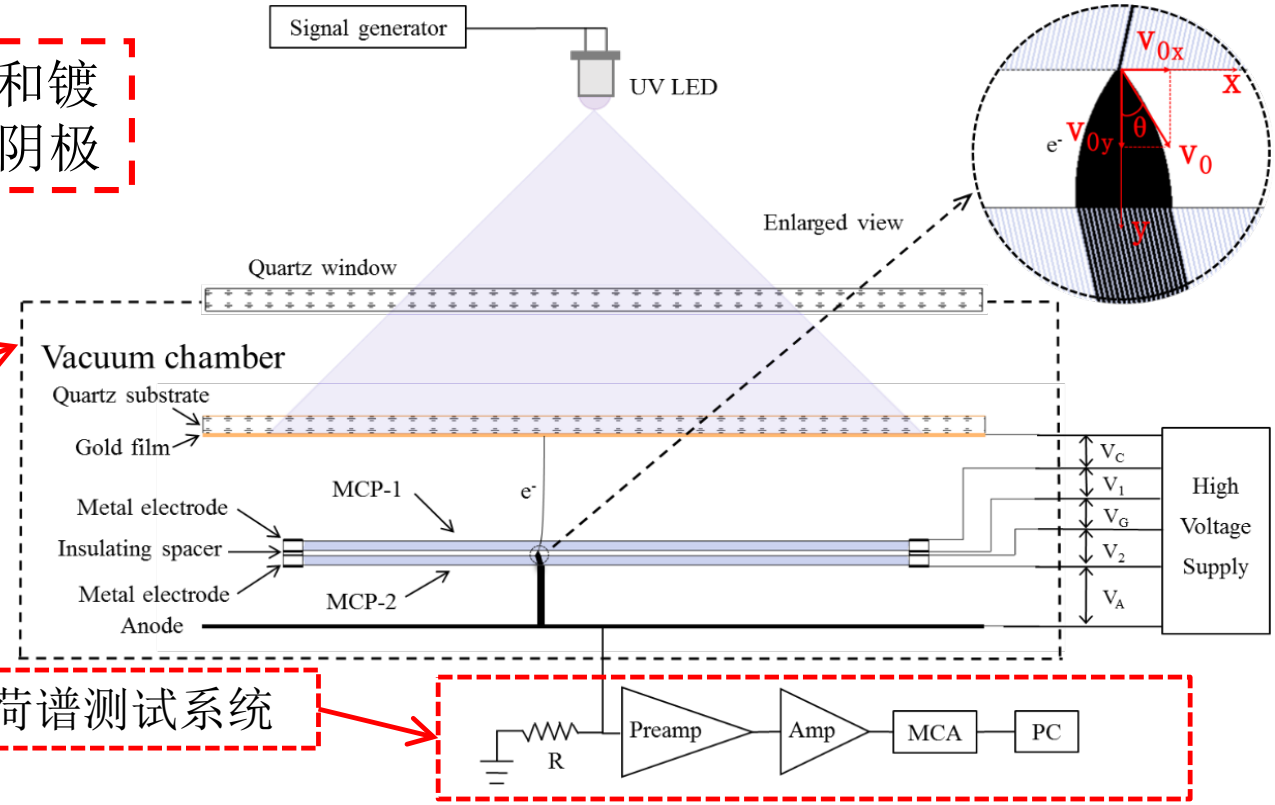




# 电荷谱测试系统

采用紫外LED和镀金石英作为光阴极

基于MCP及其组件的处理与测试平台

输出电荷谱测试系统




电荷灵敏前置放大器：Amptek A250
主放大器：Amptek A275
多道分析器：Amptek MCA8000D
数据获取软件：DppMCA

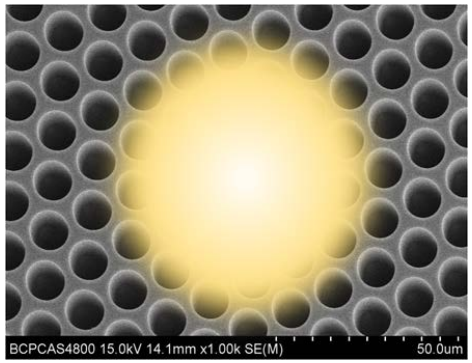
| 测试系统 | 每道对应电荷量 |
|---|---|
| MCA8000D工作在0 ~ 1V量程 | **0.138 fC** |
| MCA8000D工作在0 ~ 10 V量程 | **1.47 fC** |

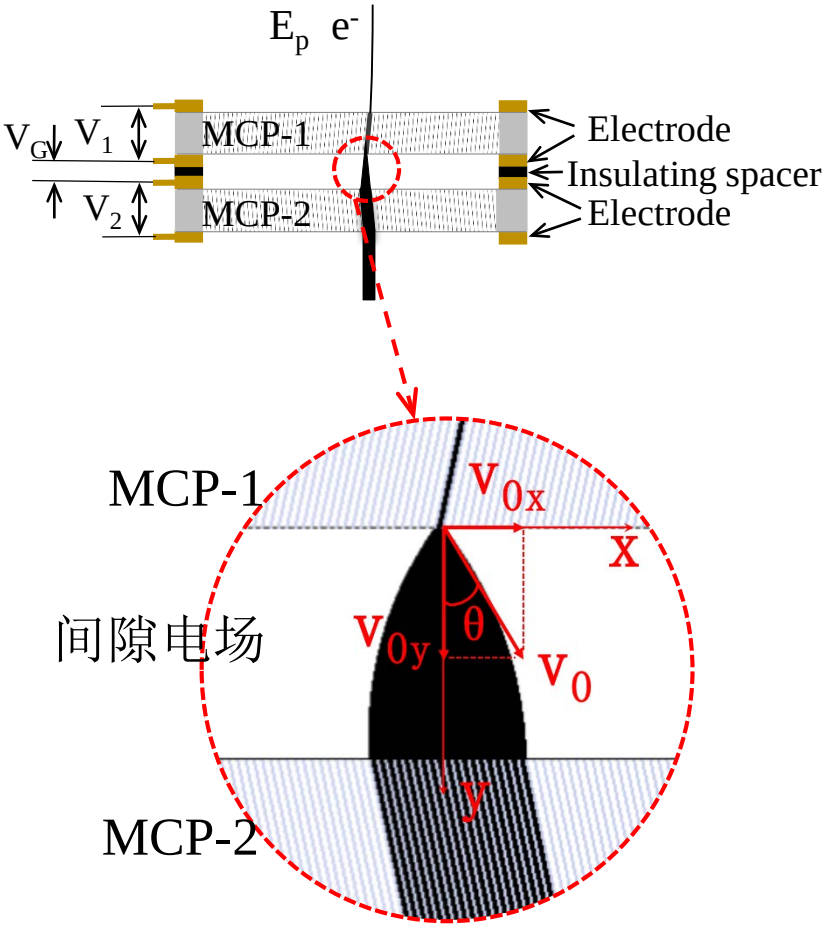
优点：精度高, 可用于测试低增益MCP探测器，便于携带

# 双MCP组件的单电子探测

MCP组件的参数：

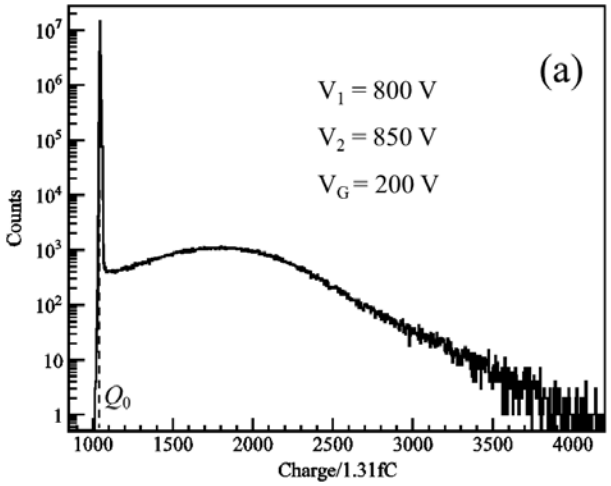
- MCP为用于像增强器的标准MCP
- Φ32.8 mm，有效部分Φ25 mm
- 相邻通道的中心距离P = 12 μm
- 通道直径d = 10 μm
- 长径比L/d = 48:1
- 斜切角为12°  双片MCP的间隙280 μm

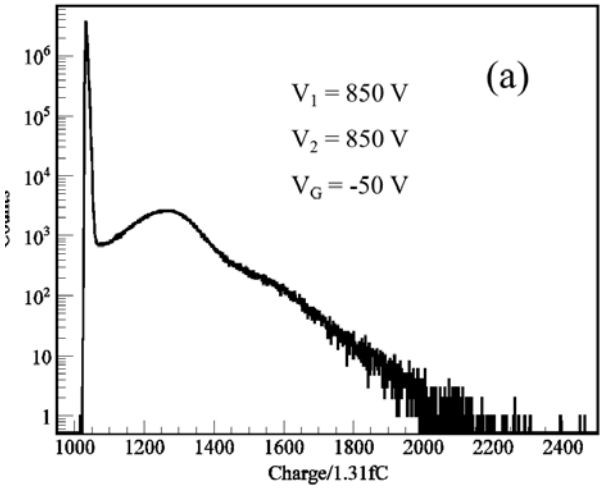


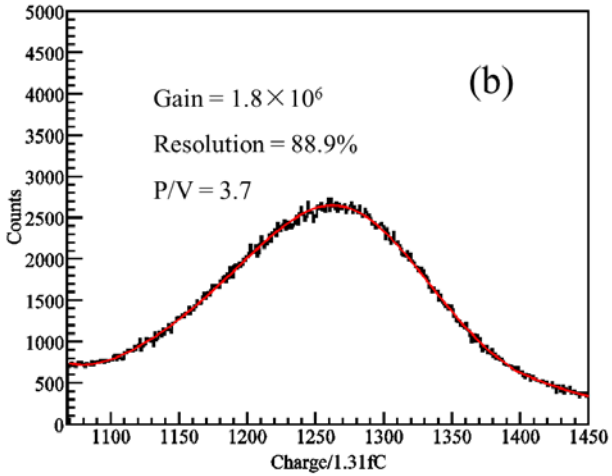




研究入射电子能量、间隙电压和MCP电压，对组件增益、单电子峰分辨率和峰谷比的影响，得到最佳的工作状态。

# 最佳工作状态



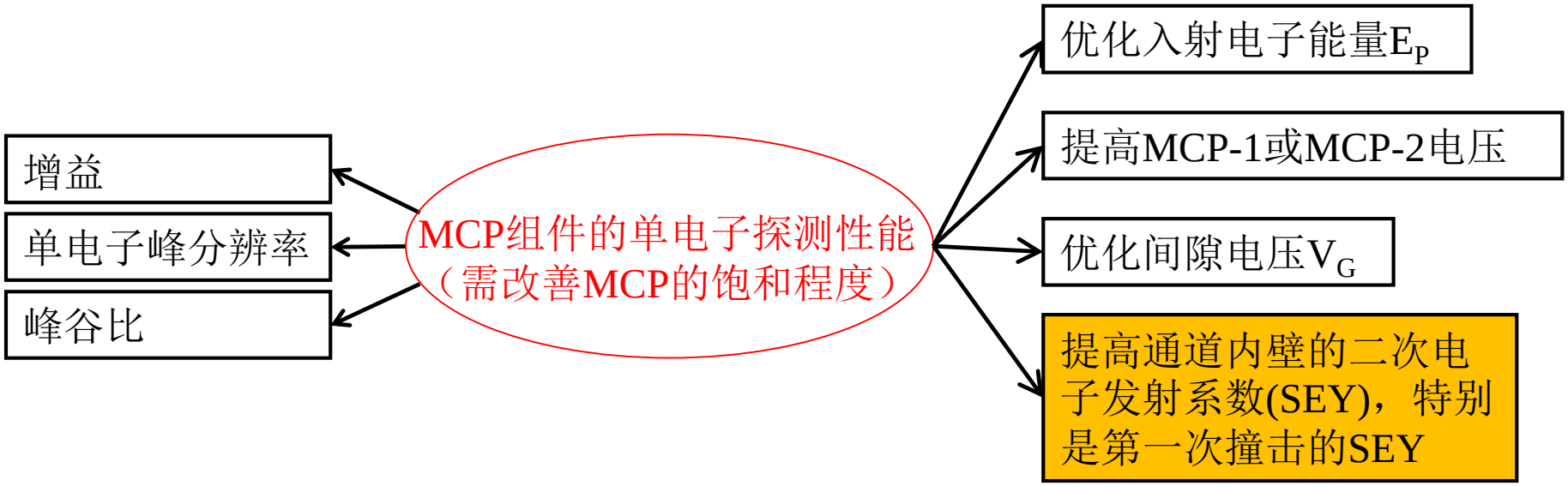




最佳工作状态：1）适当的反向间隙电压，2）MCP-2工作在饱和模式，3）相对提高MCP-1的偏压

反向间隙电压工作模式已被MCP-PMT厂家的批量生产所采用，明显改善了产品的探测性能，成为JUNO所用新型20英寸MCP-PMT达到最佳使用状态的备选方案。

该结果已经发表：Yuzhen Yang, et al. Single electron counting using a dual MCP assembly, Nucl. Instrum. Methods Phys. Res. A 830 (2016) 438-443.

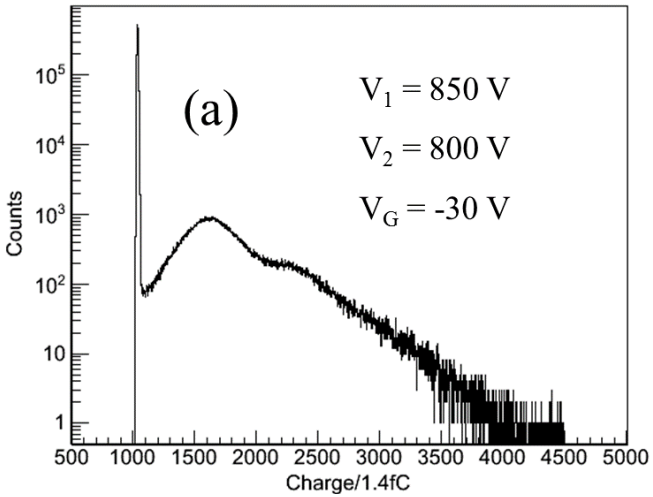
# ALD改善MCP组件性能

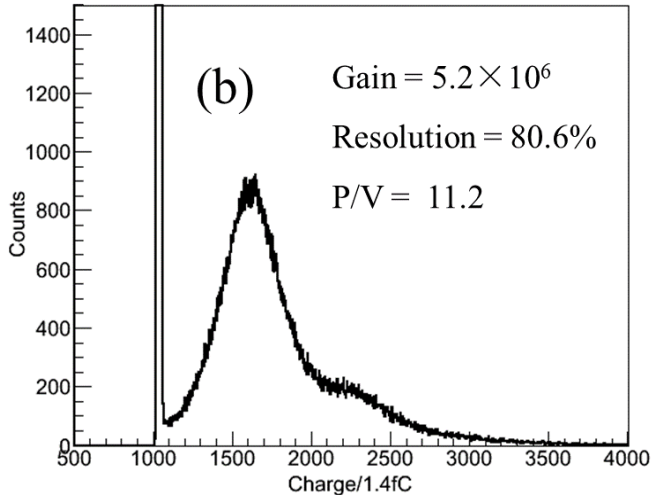



原子层沉积技术(Atomic Layer Deposition, ALD)是一种基于连续、自限制性表面反应的气相沉积技术，可将物质以单原子层形式，一层一层镀在衬底表面的镀膜方法。

采用ALD方法给传统氢还原MCP表面镀上高SEY的Al2O3，以提高其单电子探测性能。

# 镀膜后的最佳输出电荷谱




入射电子能量$E_P$、间隙电压$V_G$和MCP偏压$V_1$和$V_2$对间隙加压型MCP组件的影响与未镀膜的类似。

镀膜后的最优化性能
- 入射电子能量$E_P$，从未镀膜的350~400 eV下降为~250 eV
- 相同增益条件下， MCP偏压$V_1$和$V_2$下降了100 V

已经发表：Yuzhen Yang, et al. MCP Performance Improvement Using Alumina Thin Film, **Nucl. Instrum. Methods Phys. Res. A** 868 (2017) 43-47.

# Other skill

- 掌握核物理实验方法、数据获取方法和快信号处理，熟悉各种核仪器、插件。
- 熟悉对各种不同类型探测器，如：CZT、正比计数器、GEM、塑料闪烁体、MPPC，特别是对光电倍增管（PMT）有一定研究；并拥有真空设备研制和维护的经验，熟悉各种真空管道、器件设备。
- 熟悉会议举办、进口设备采购、项目申请与验收等工作流程，擅长真空设备调试。
- 熟练使用Solidworks、LabVIEW、ROOT和Origin等制图与数据处理软件，word、excel、ppt和project等办公软件。
- 专利代理人资格证书、英语六级、计算机国家二级、驾照。

# The End

谢谢大家！