GEM R&D in Lanzhou University

for The 11th Workshop on Hadron Physics in China and Opportunities Worldwide

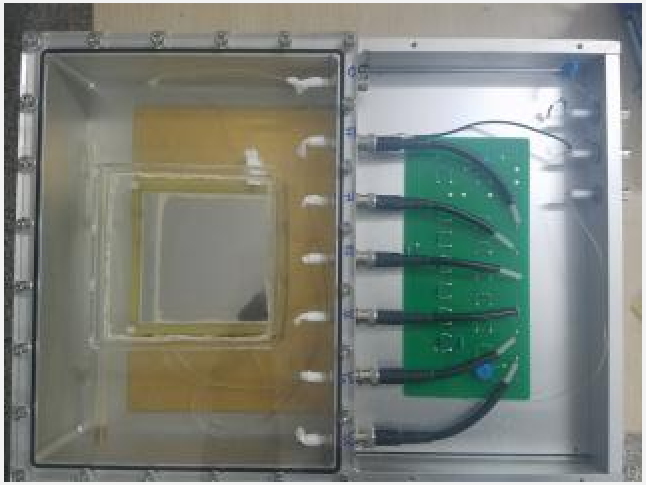
Yi Zhang, School of Nuclear Science and Technology

Outline

- new GEM box for R&D
- DAq and α-track reconstruction
- design of charge-exchange TPC

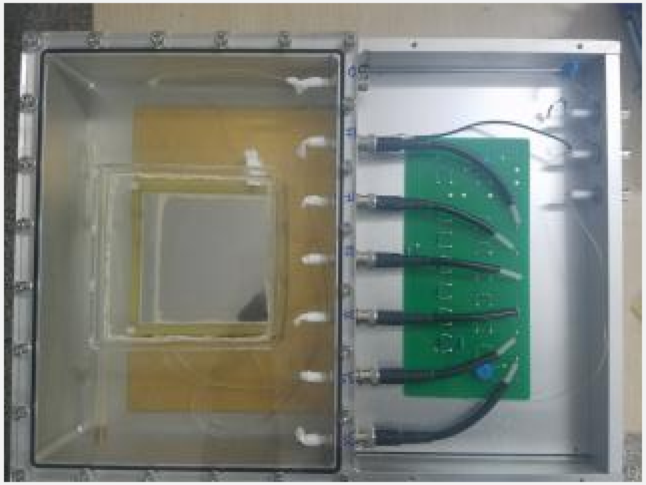
new GEM box for test

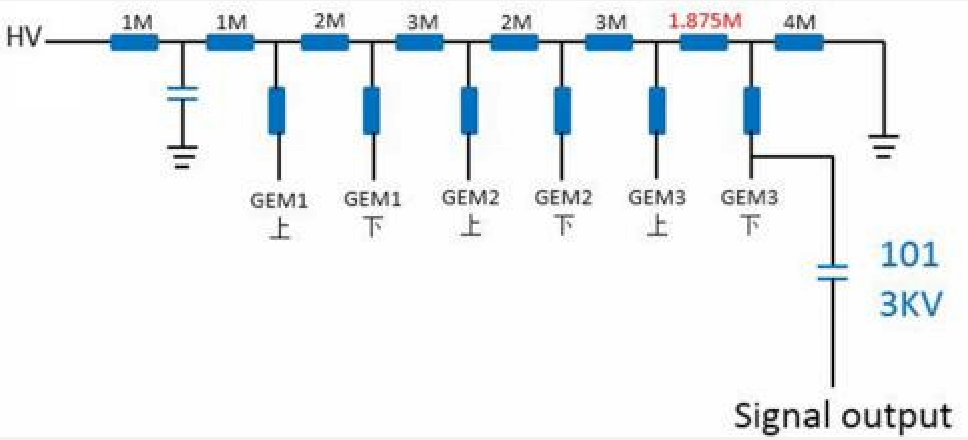
- 2-chamber box
- left chember sealed for the detector



new GEM box for test

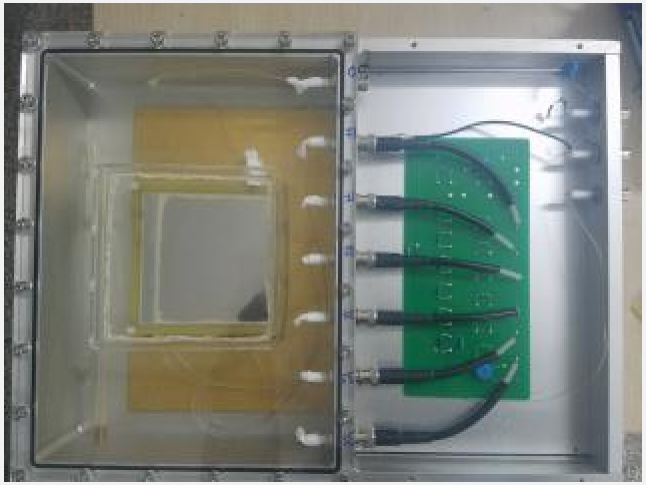
- 2-chamber box
- HV stuff are flexible

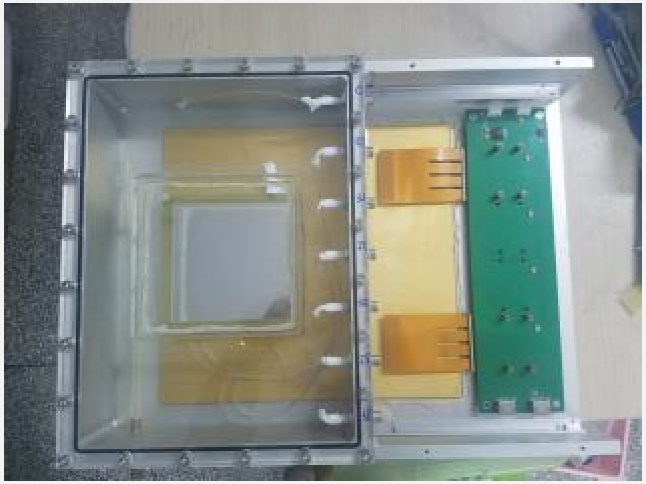




new GEM box for test

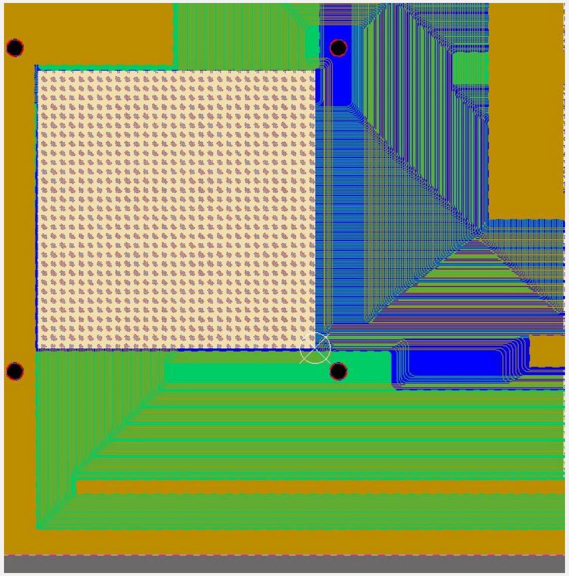
- 2-chamber box
- 2-layer right chamber for HV and FEE

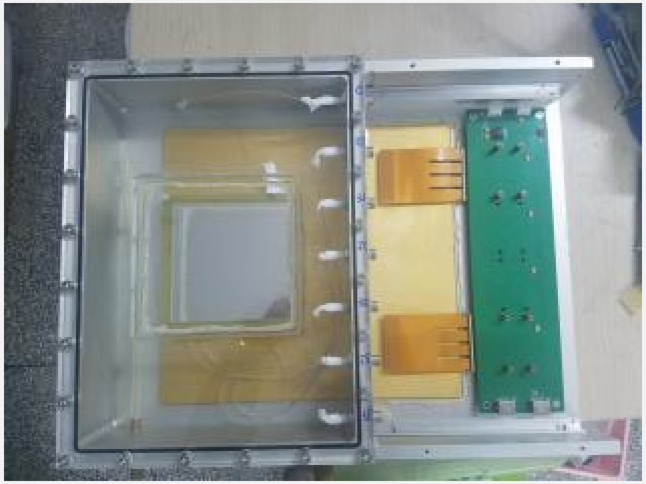




new GEM box for test

- 2-chamber box
- 2-layer right chamber for HV and FEE
- new designed strip-wise PCB readout electrode





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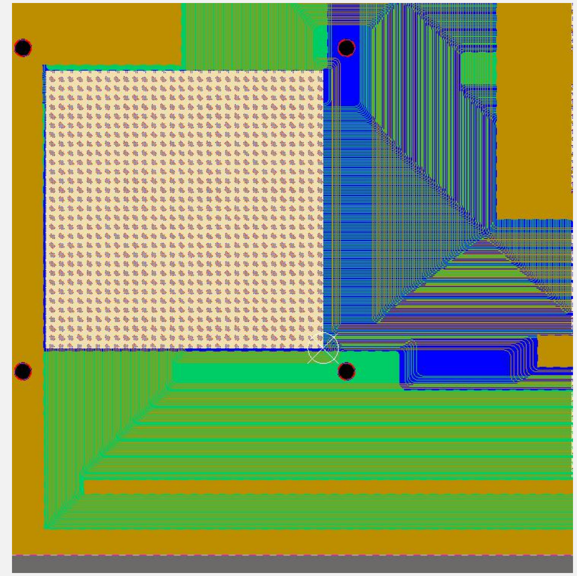
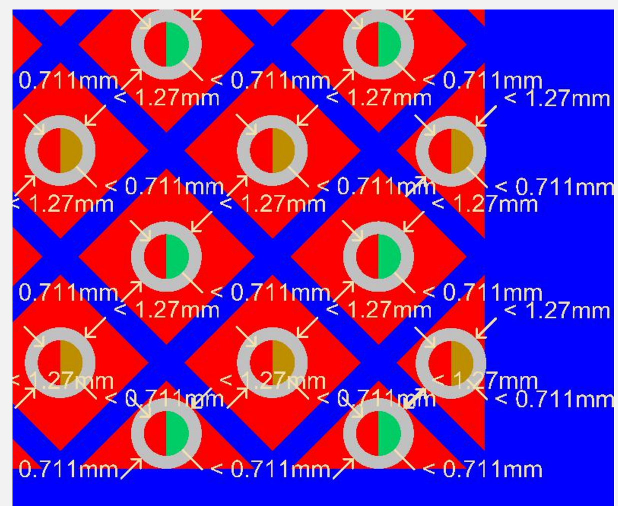
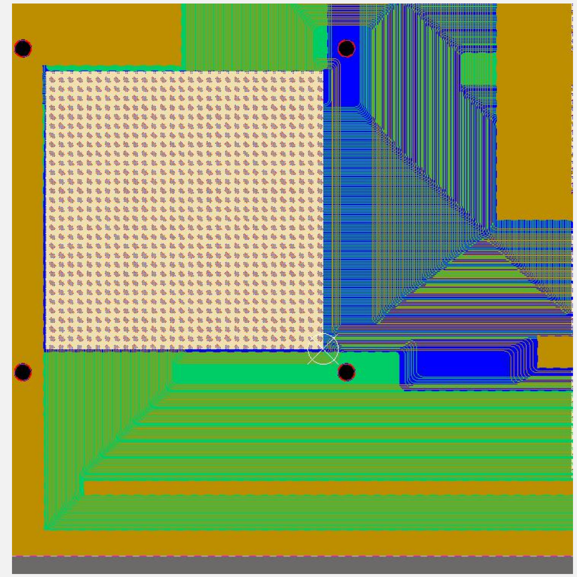




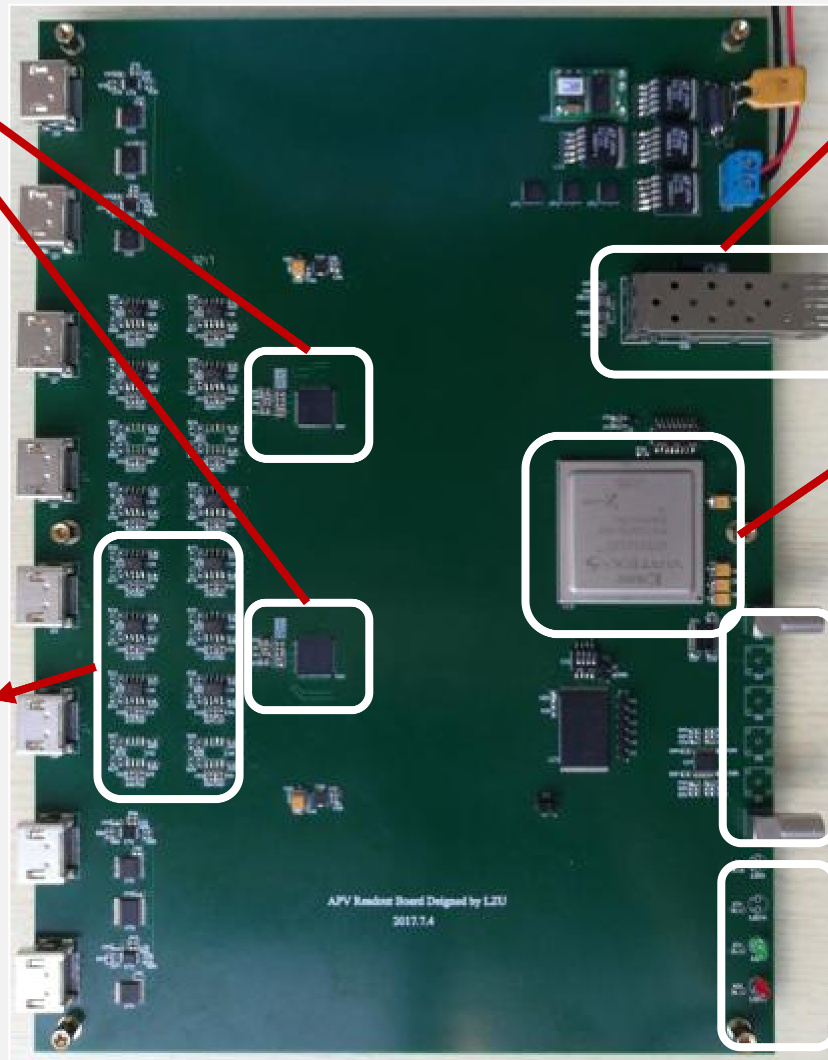
new GEM box for test

- 2-chamber box
- 2-layer right chamber for HV and FEE
- new designed strip-wise PCB readout electrode
- new readout electrode are connected to the same ground as FEE
  - –much less noise



new DAQ pannel

2 ADC chip：TI-ADS5281, 12bits。



fiber to Ethernet port：communicate with PC by the Ethernet

FPGA：Xilinx V5，

RAM size:4.752 Mb，

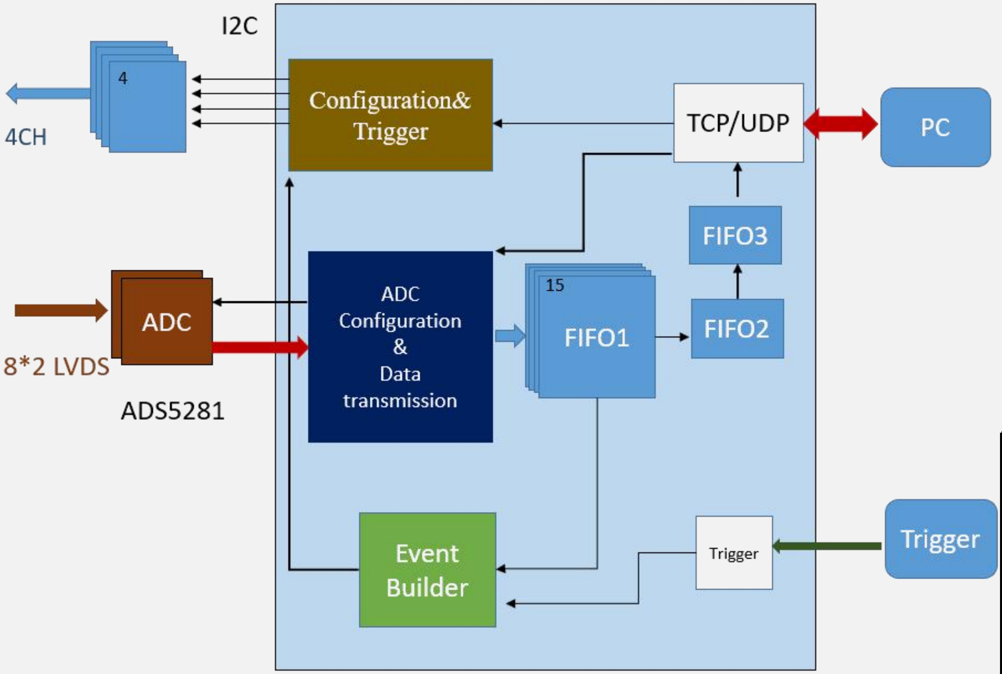
fulfill the requirement for 1 trigger

30*140*12*16=787.5 kb)。

16 difference ADC driver：AD-AD8138A

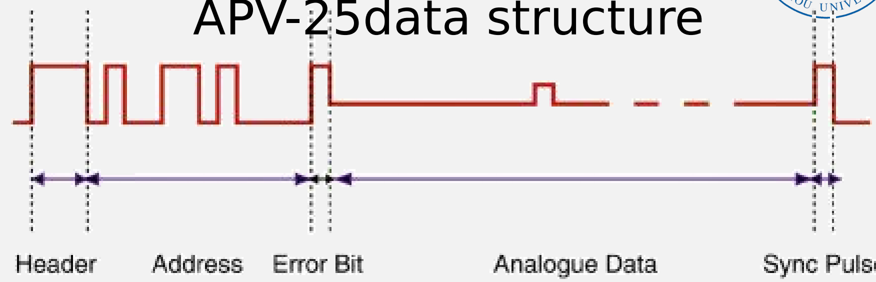
6 Lemo port

4LED



FPGA firmware

APV-25data structure



50.4 kb@12 bits ADC+30 periods

data package structure

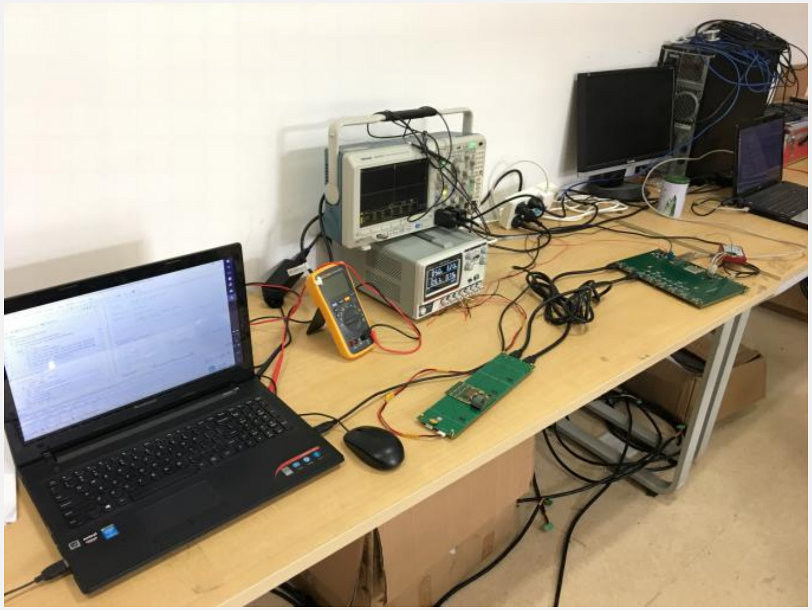
data head 0xFA	detector ID	readout ID	working type
Trigger Number			
Total Trigger Counts			
T_Data[63:32]			
T_Data[31:0]			
Reserve1			
Channel No-A Q-Data		Channel No-B Q-Data	
Channel No-C Q-Data		Channel No-D Q-Data	
......			
Channel No-F Q-Data		Channel No-G Q-Data	
Channel No-H Q-Data		Channel No-I Q-Data	
data tail 0xFB	Status		
Byte Count			

- UDP protocol for confirgration, while TCP protocol for data transfer
- new trigger is dropped when DAQ busy, but the trigger ID/time are recorded
- tripple FIFO buffer to reduce the data transfer dead time

improvements of new DAQ

	New DAQ	INFN MPD
Chip	Xilinx XC5VSX50T: 4.752Mb-RAM	Altera EP1AGX50DF : 2.475Mb-RAM
Protocol	Ethernet 1000Mbps	VME 60Mbps
I/O	HDMI Type A Easy to buy	VME bus for control
Power	low-voltage power supply	VME crate

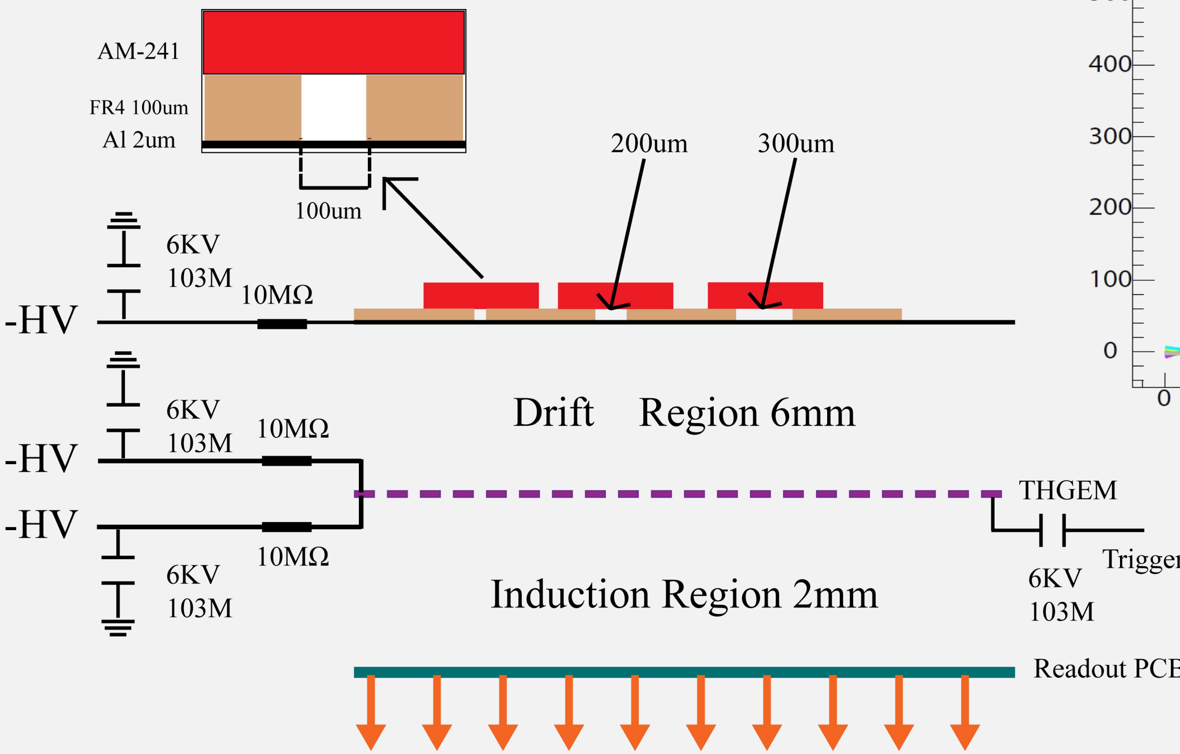
data transfer test

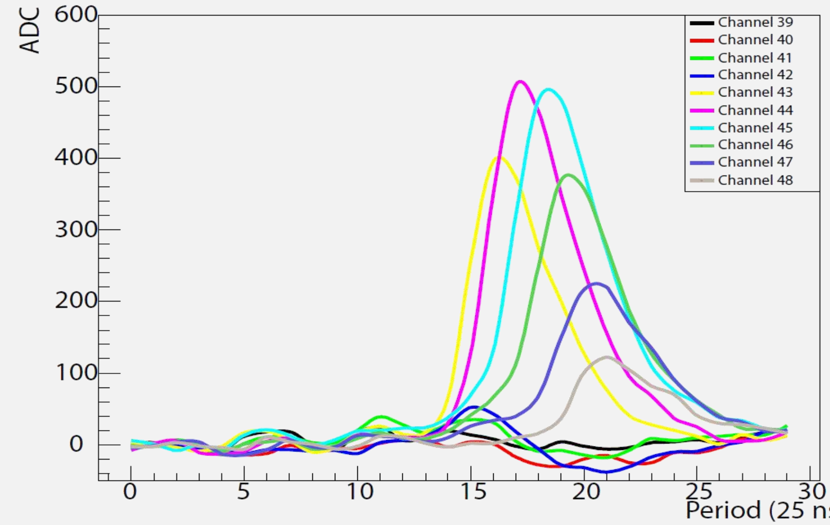


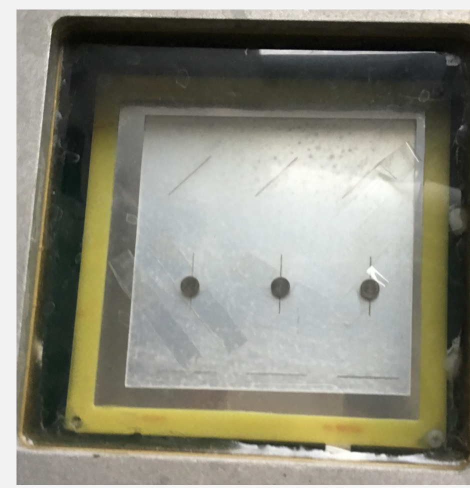
One PC for hardware
One PC for software

- One APV One sample per trigger : 288B
- One APV 30 samples per trigger : 8.408KB
- 4 chips * 30 samples * 320 Hz *2 hours =800GB
  - working smoothly
- Data transmission speed:
  - 120MB/s write to memory
    - Reach the limits of Gigabit Ethernet
  - 70MB/s write to the hard disk

α-track measurement

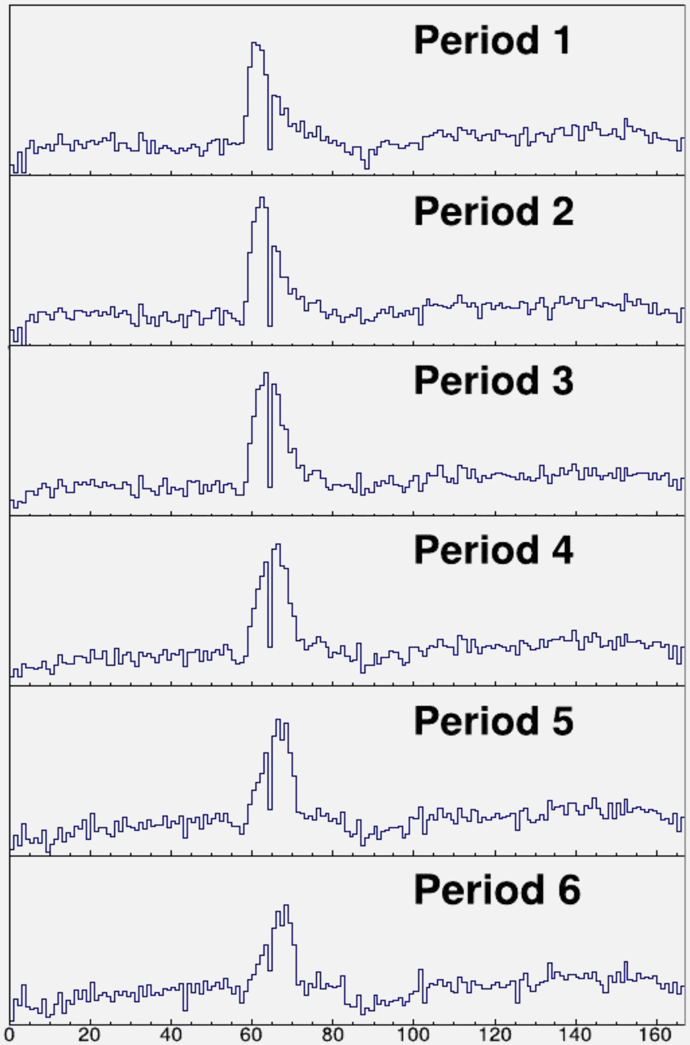


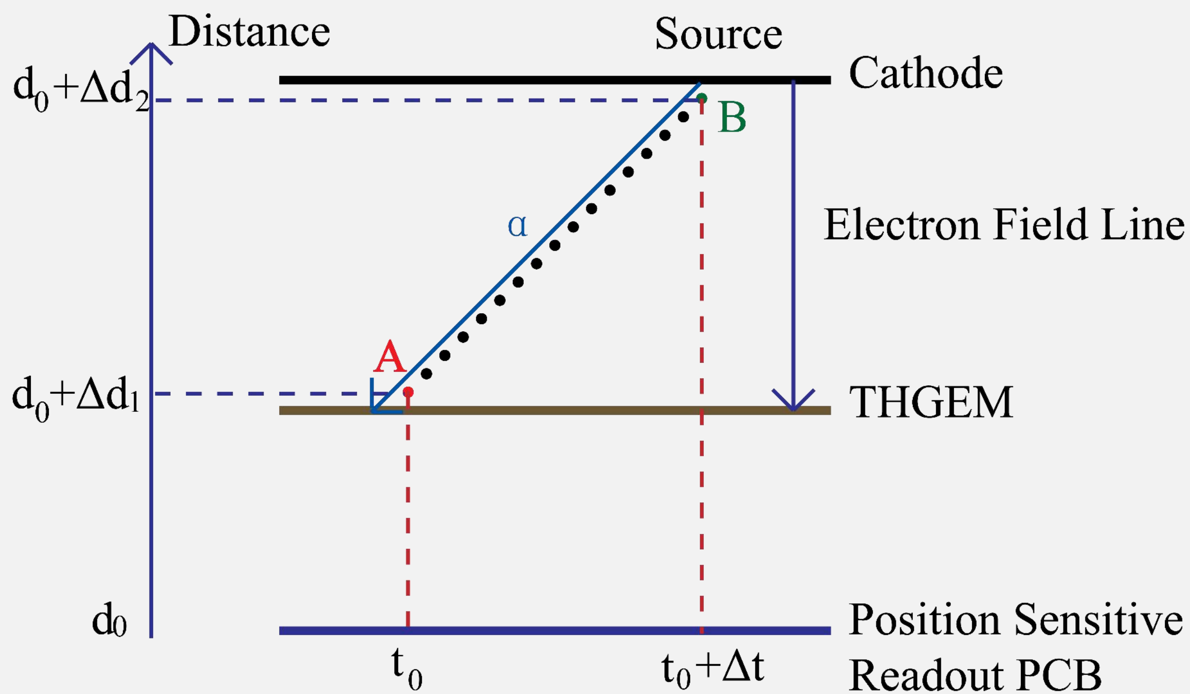




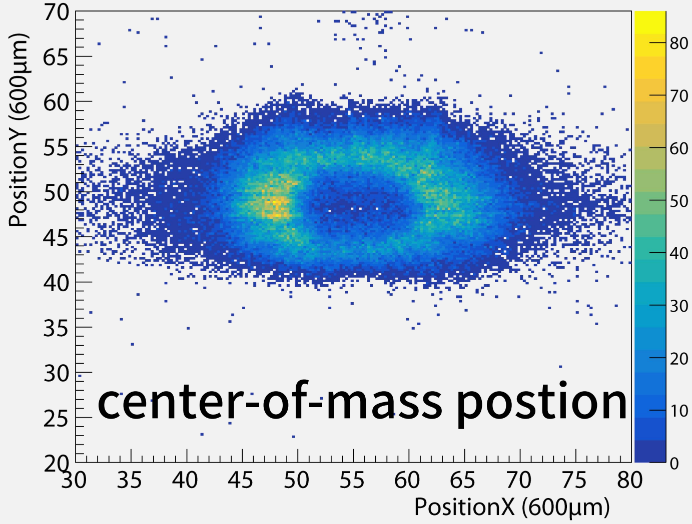
- 3 α sources (^{241}Am)
- The distance between each slit is 30mm
- 2D strip readout with 167 for each dimension

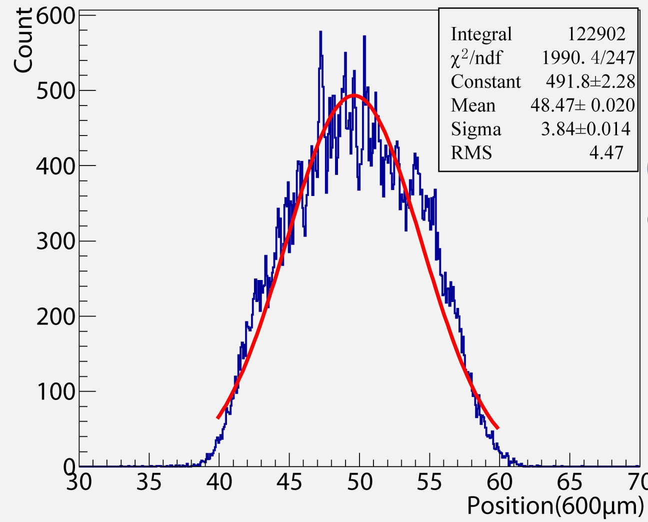
principle of vertex correction



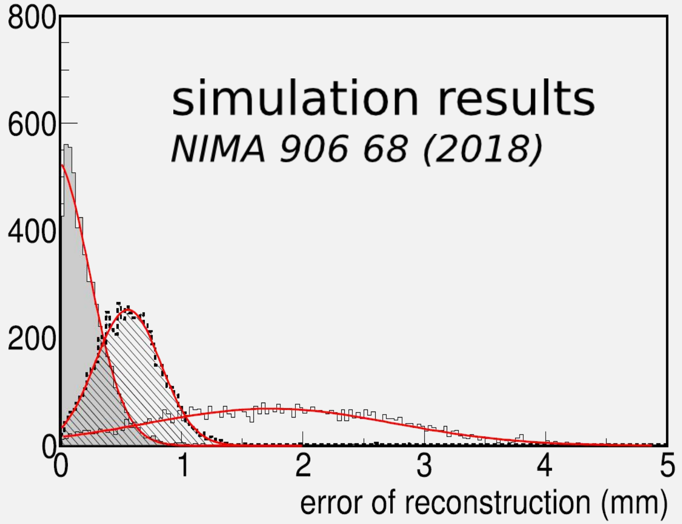


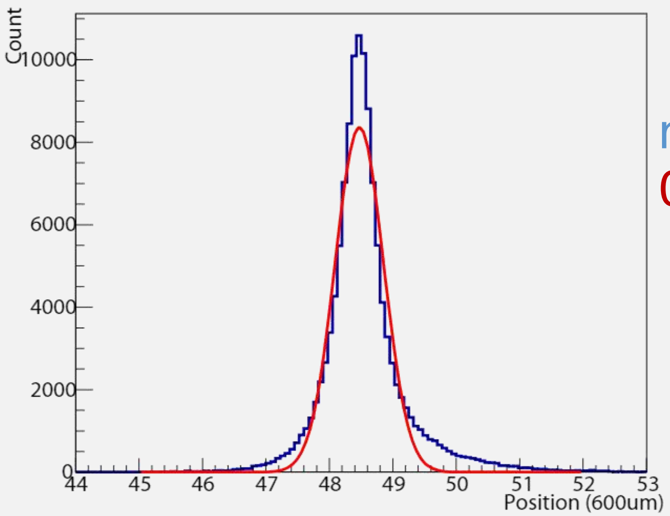
result of vertex correction





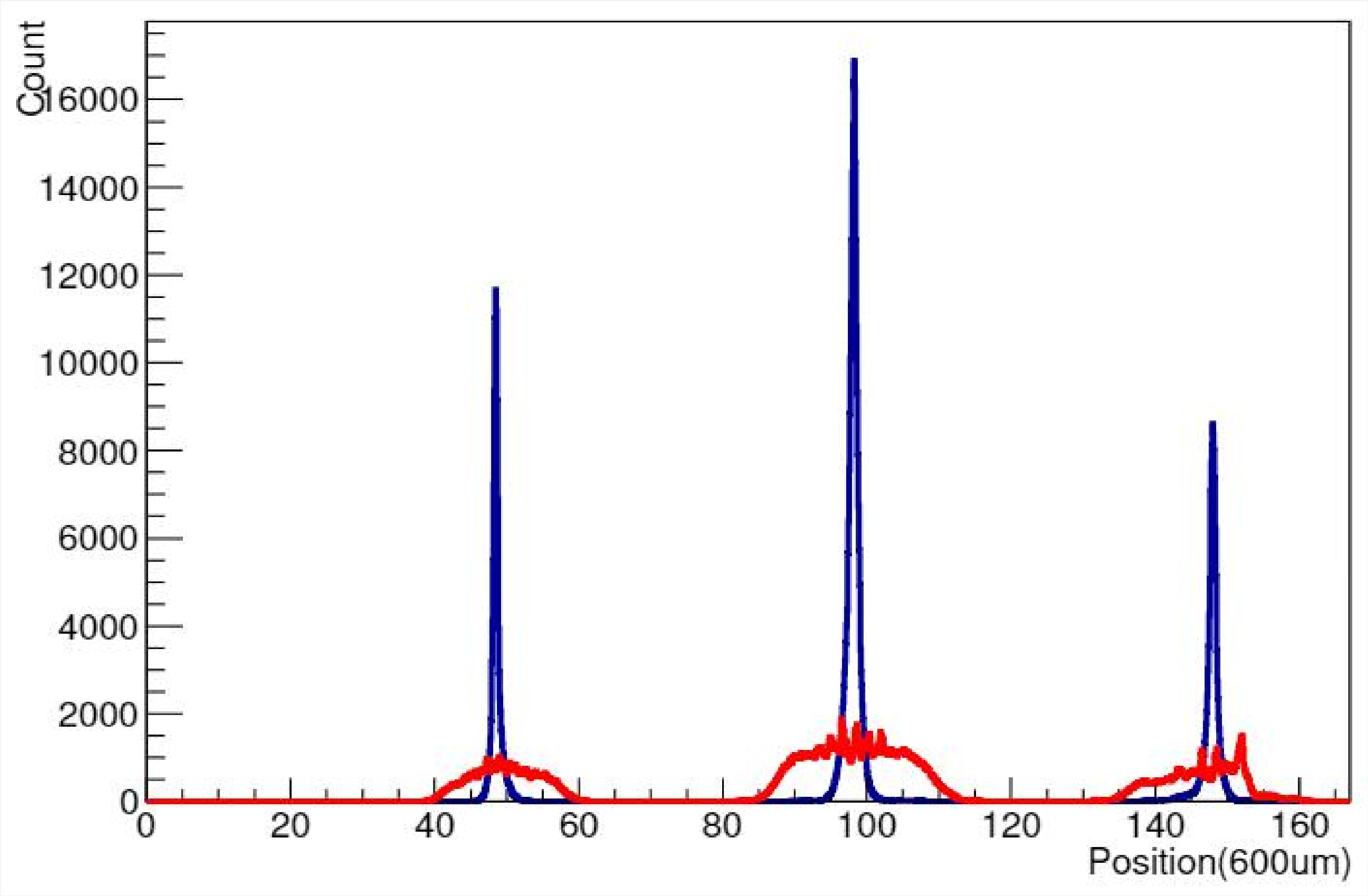
CM σ:
9.1 mm





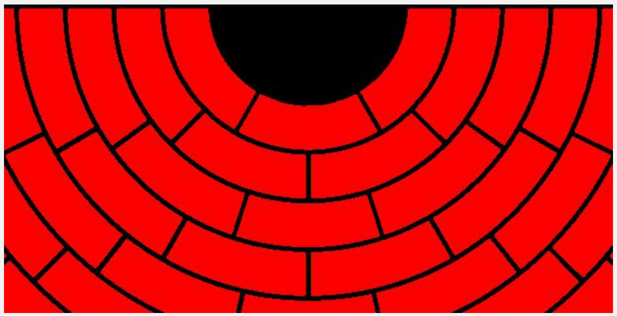
recorrected σ
0.45mm

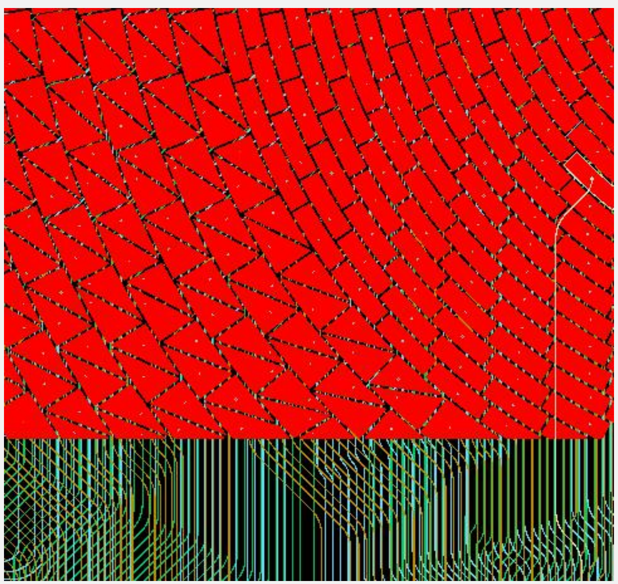
result of vertex correction

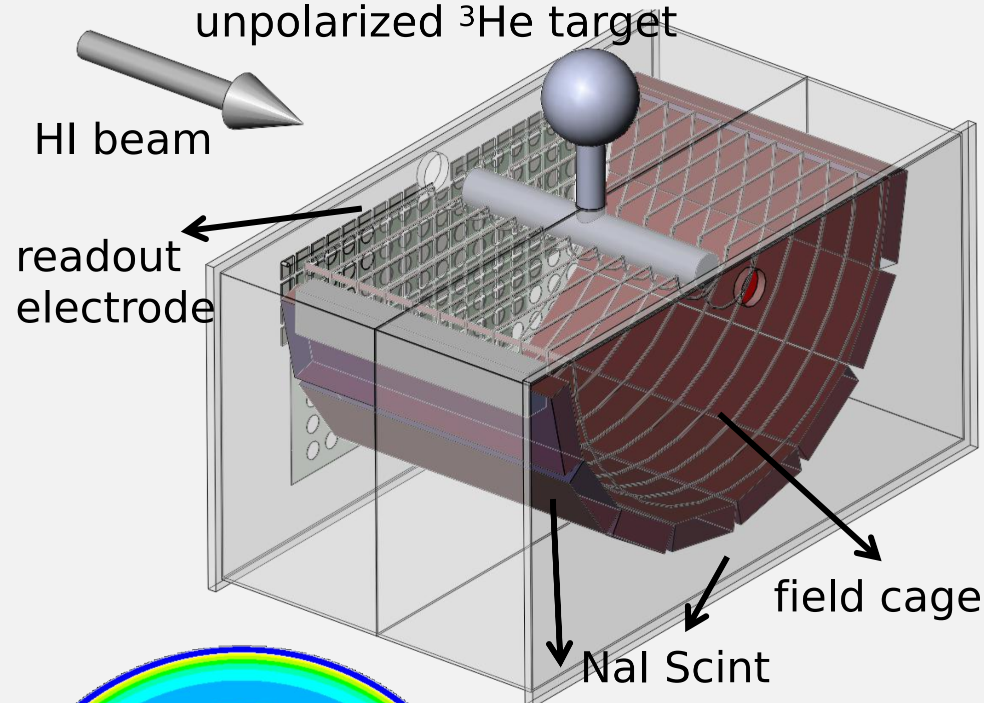


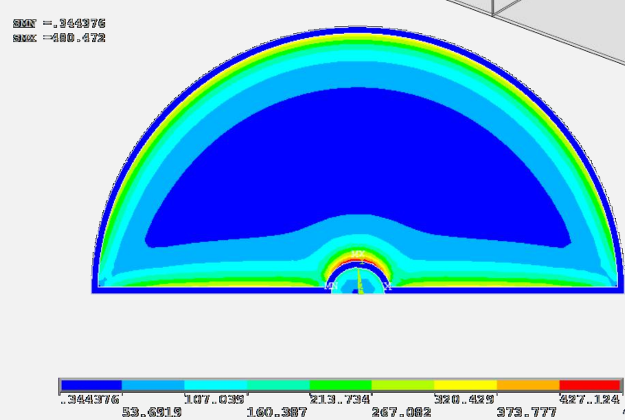
future usage: charge-exchange TPC

measurement of $^{14}C(^{3}He, t)$ reaction in the inverse kinematic region

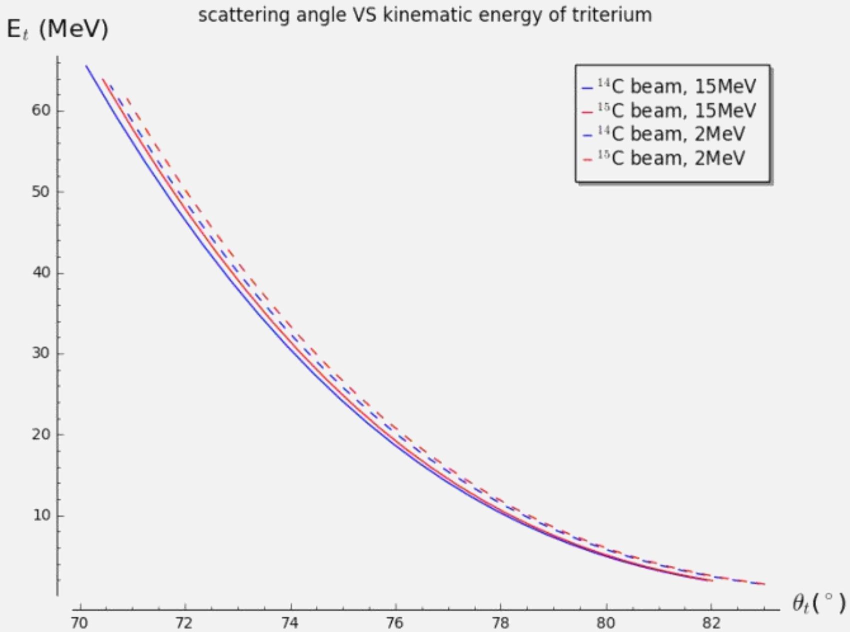


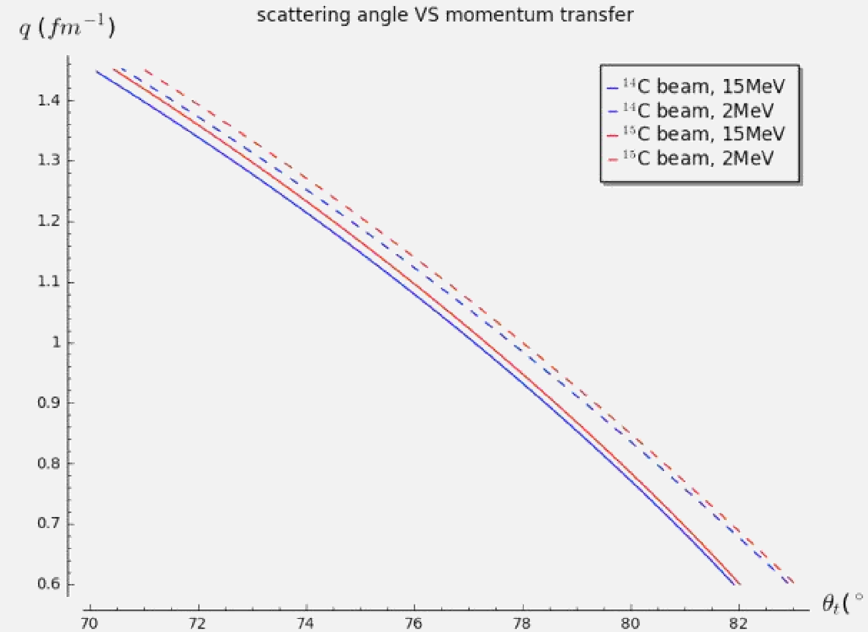


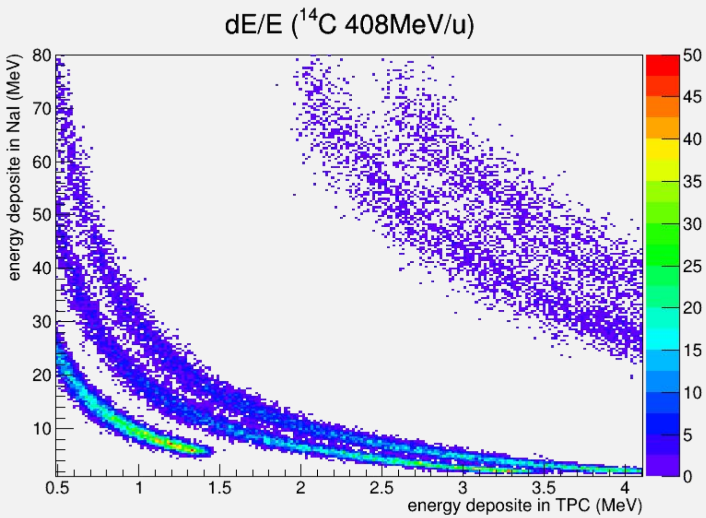




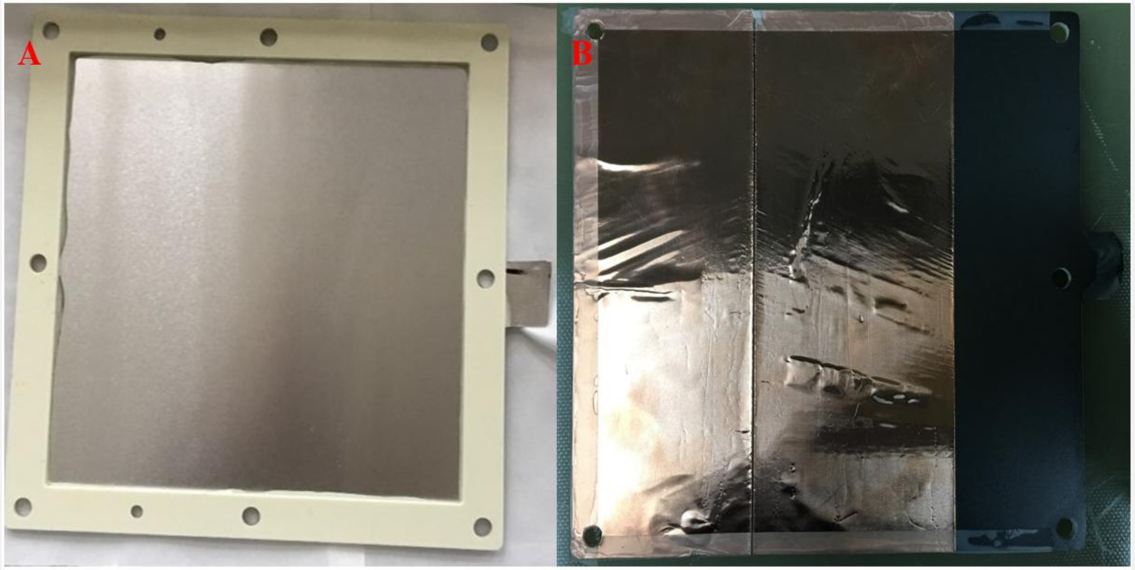
kinematic curve of CE-TPC







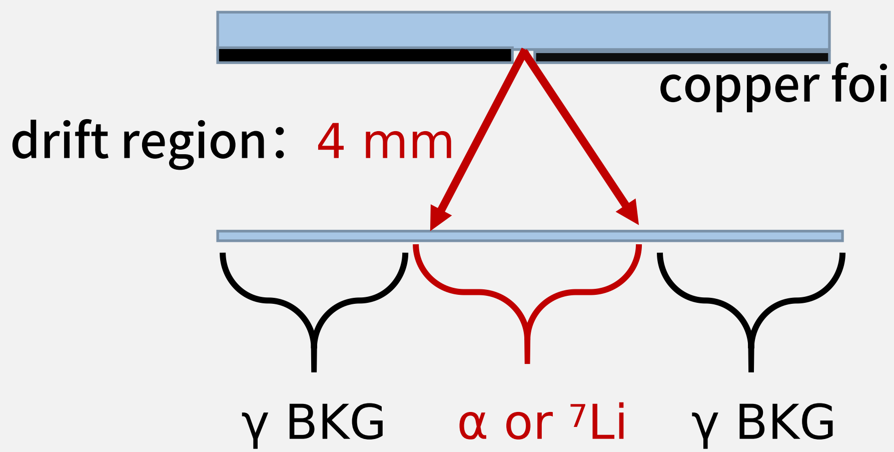
Thanks!



A： drifting electrode with B

- area: 10 cm × 10 cm
- Borium thinckness:1 um
- efficiency for thermal neutron : 2%

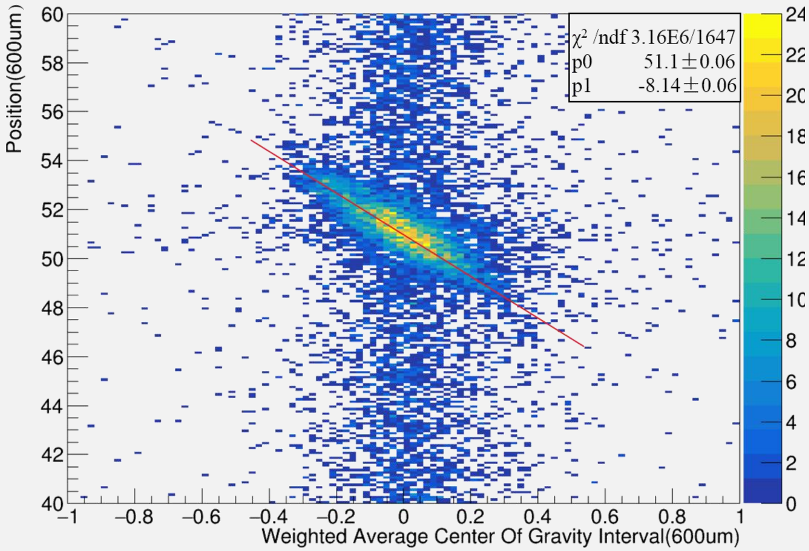
B： 1 mm slits on 30um Cu foil

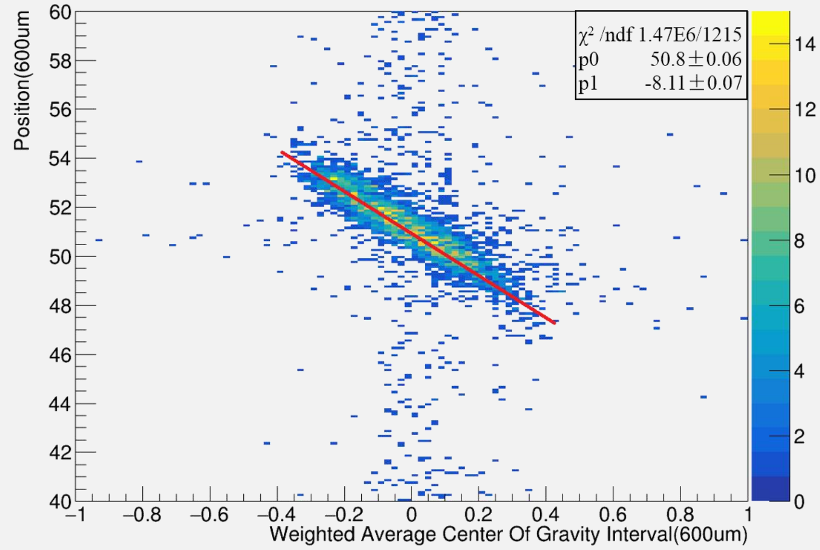


粒子区域划分

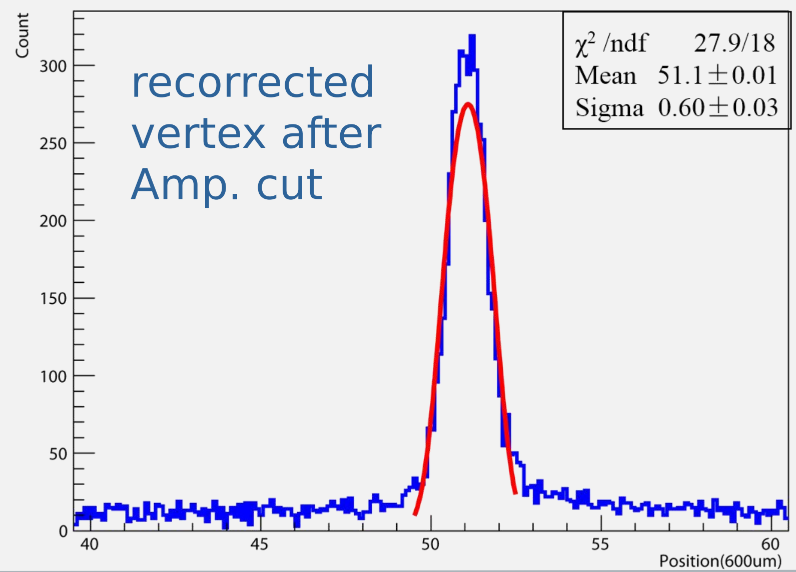
^{252}Cf source measurement

vertex recorrection of the thermal neutron measurement (^{252}Cf)





- CM resolution: 2.27 mm (consistent with CSNS result)
- recorrected resolution: 0.50 mm
- thermal neutron VS γ: 4:1



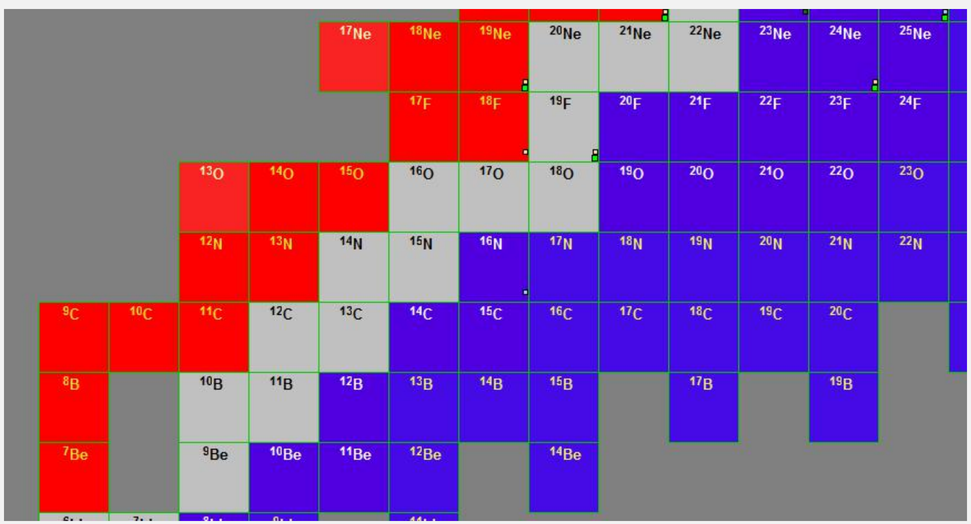
1. 验证方法可行性候选核的选择

核物质半径变化较大的邻近核素：

- $^{14}C \rightarrow {}^{15}C$
- $^{17}N \rightarrow {}^{18}N$
- $^{21}O \rightarrow {}^{22}O$
- $^{23}F \rightarrow {}^{24}F$

靠近稳定线，核素产额高

选择^{14}C、^{15}C



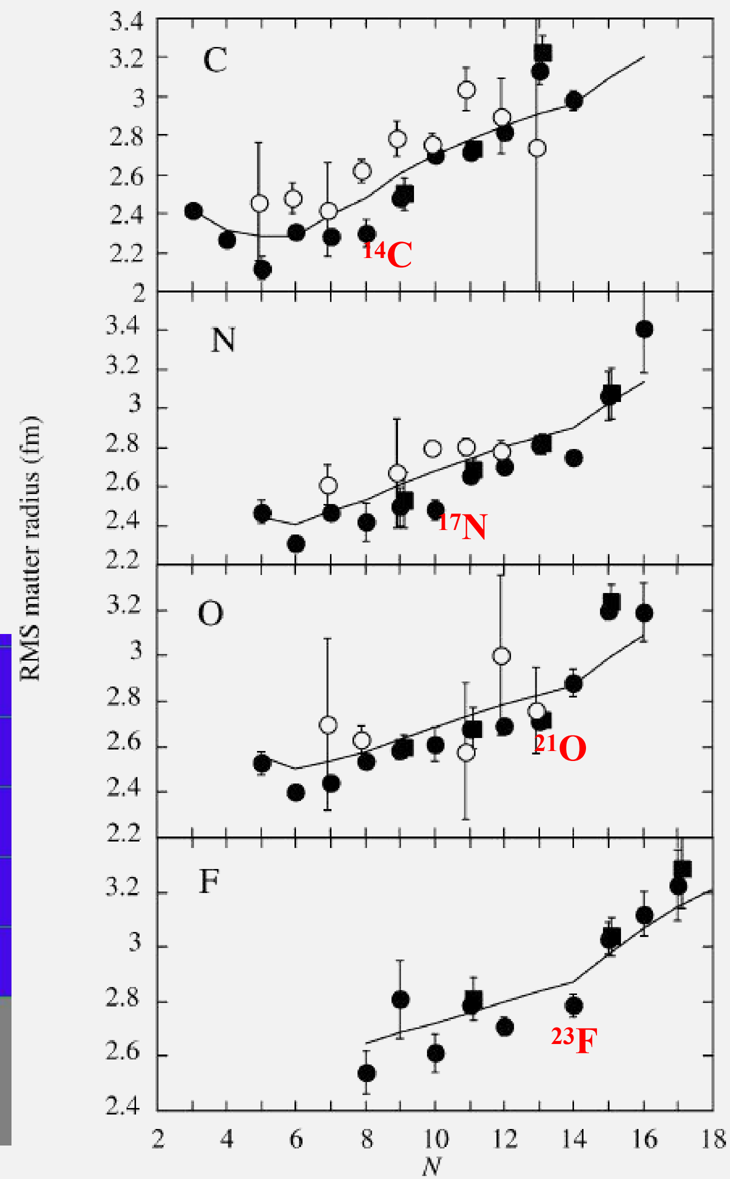


Fig. 4. Root-mean-square (RMS) matter radii for carbon, nitrogen, oxygen and fluorine isotopes. The closed circles represent radii obtained by the GMOL. The closed squares denote radii obtained by the GMFB. The open circles represent radii obtained from reaction cross sections at intermediate energies [23]. The solid lines show radii calculated by RMF calculations [20].

CCCS方法测量得到的C同位素中子皮厚度：

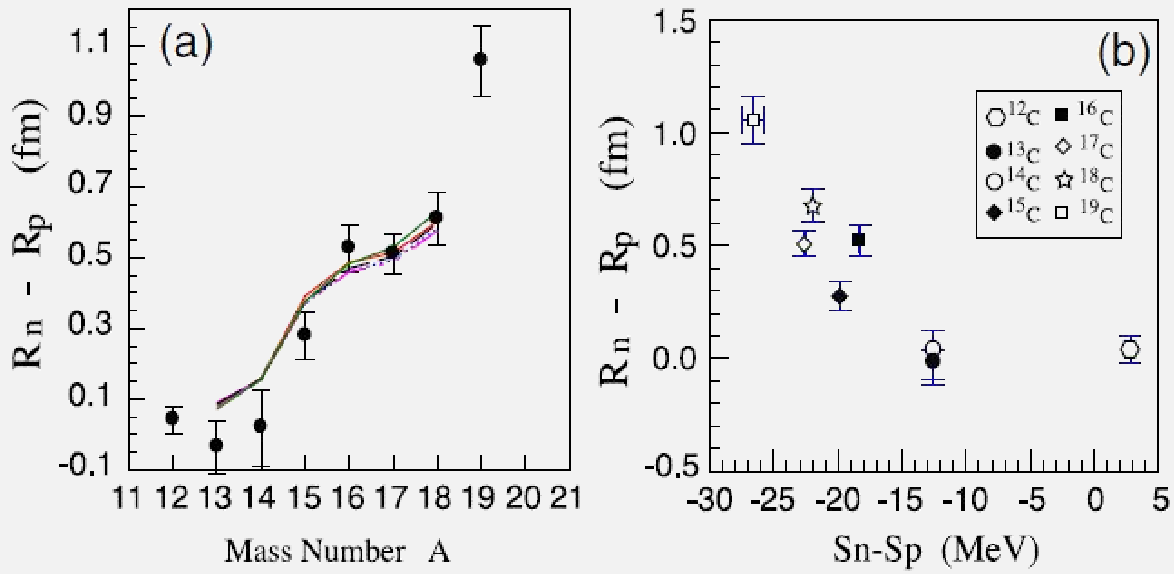


FIG. 4. (a) The measured neutron skin thickness for $^{12-19}C$ compared to predictions using the different interactions, $NNLO_{sat}$ (red solid curve), EM1 (dotted blue curve), EM3 (dashed-double-dotted pink curve), EM4 (dashed black curve), and EM5 (solid green curve). (b) The measured neutron skin thickness variation with $S_n - S_p$ for $^{12-19}C$.

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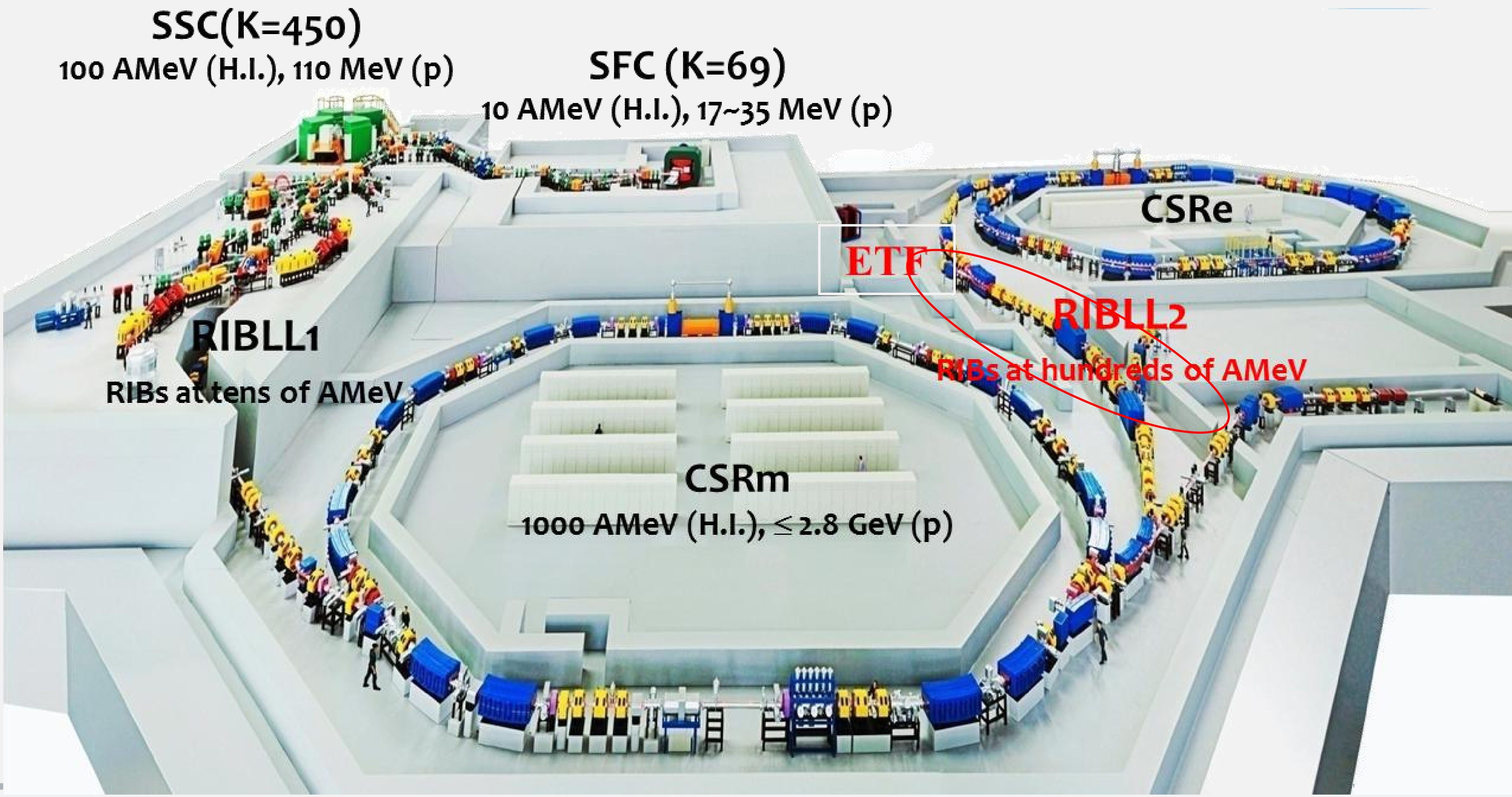
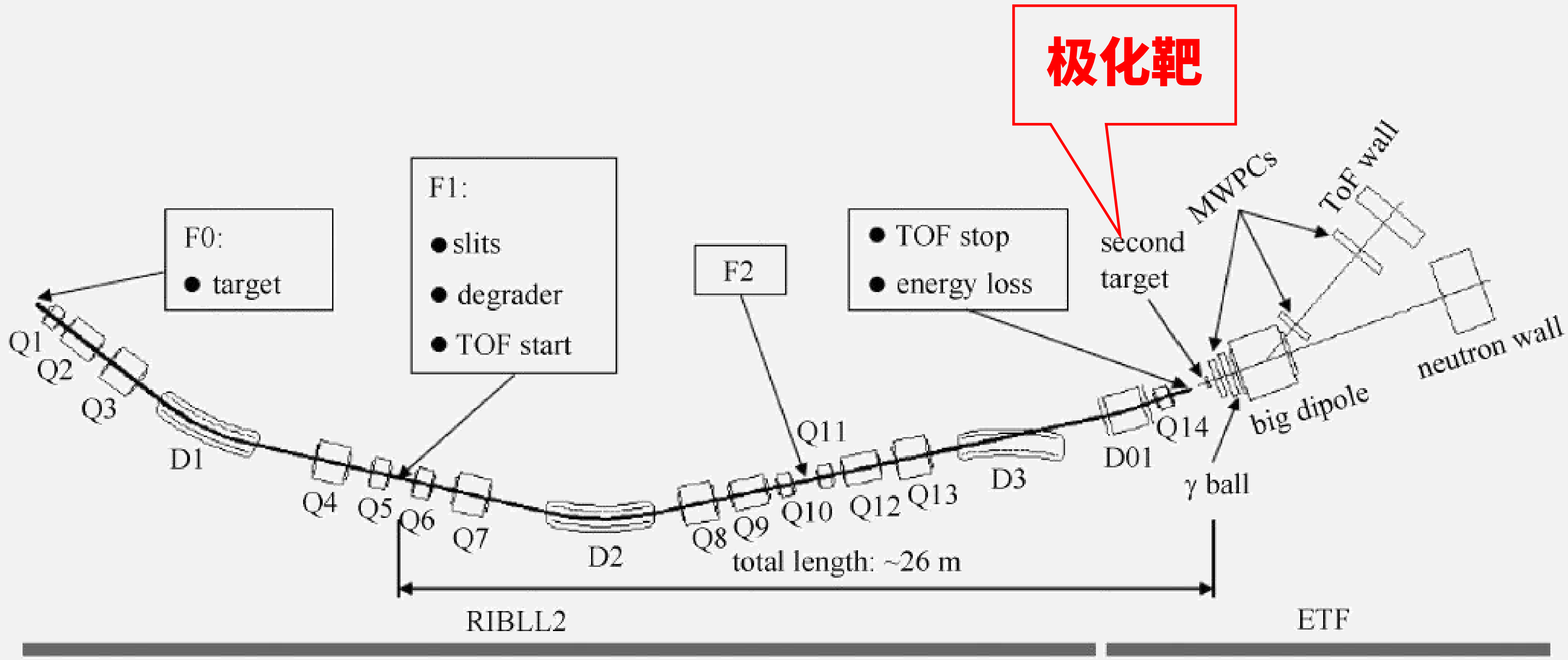
利用极化靶测量14、15C中子皮厚度，与CCCS法测量结果对比检验方法的可行性及灵敏度等。

2. 拟使用的实验装置

RIBLL2前半段+外靶ETF





- 极化靶前入射束流14、15C由RIBLL2通过Bρ-TOF-ΔE鉴别
- 靶后电荷交换产物由ETF通过Bρ-TOF-ΔE鉴别

3. 极化靶前入射束流情况

弹核碎裂产生目标核：
主束：18O， 450AMeV， 1e+7pps
F0靶：Be，30mm厚

目标核		14C	15C
RIBLL2设置	F1降能器	无	无
	F0->F1磁钢度	7.478 Tm	8.0385 Tm
	F1->ETF磁钢度	7.4467 Tm	8.0073 Tm
	动量接收度	1.71%	1.71%
极化靶前目标核信息	能量	403.8 AMeV	406 AMeV
	产额	~4.79e+3 pps	~2.36e+3 pps
	纯度	~48%	~78%

极化靶前目标核的束斑及角分布