$^{17}F+^{58}Ni$在库仑位垒附近弹性散射和破裂反应的探测器设计

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Outline

- 背景及探求的物理问题
- 研究方案
- 探测器介绍
- 相关模拟
- 参考文献

背景及探求的物理问题

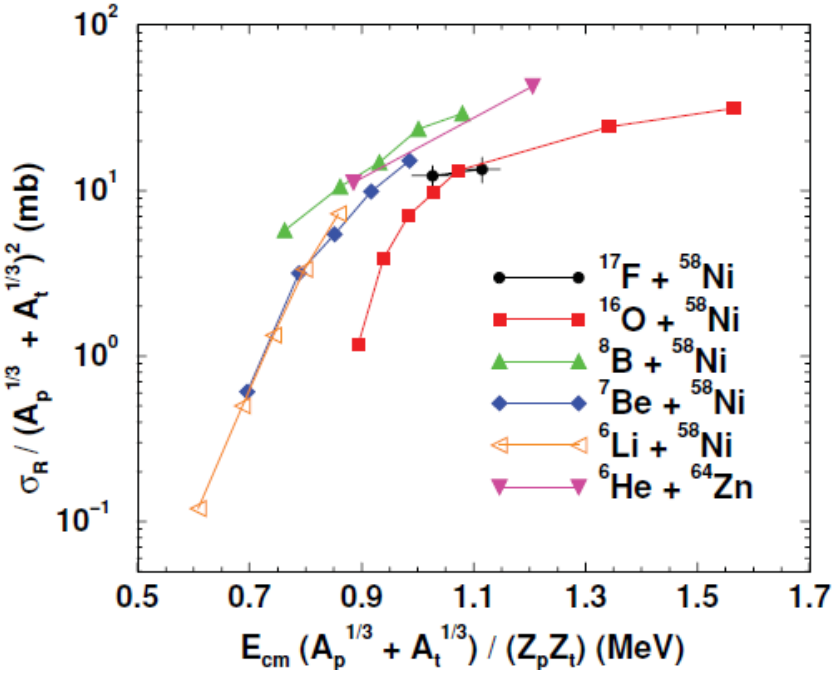
- $^{17}F = p + ^{16}O$, 价质子结合能0.6MeV

- $^{17}F + ^{58}Ni \rightarrow$晕核$^{17}F$与中重靶的反应机制（能量在库仑位垒附近）
  - ^{17}F的弹性散射截面
  - 破裂反应($^{17}F \rightarrow p + ^{16}O$)的反应截面

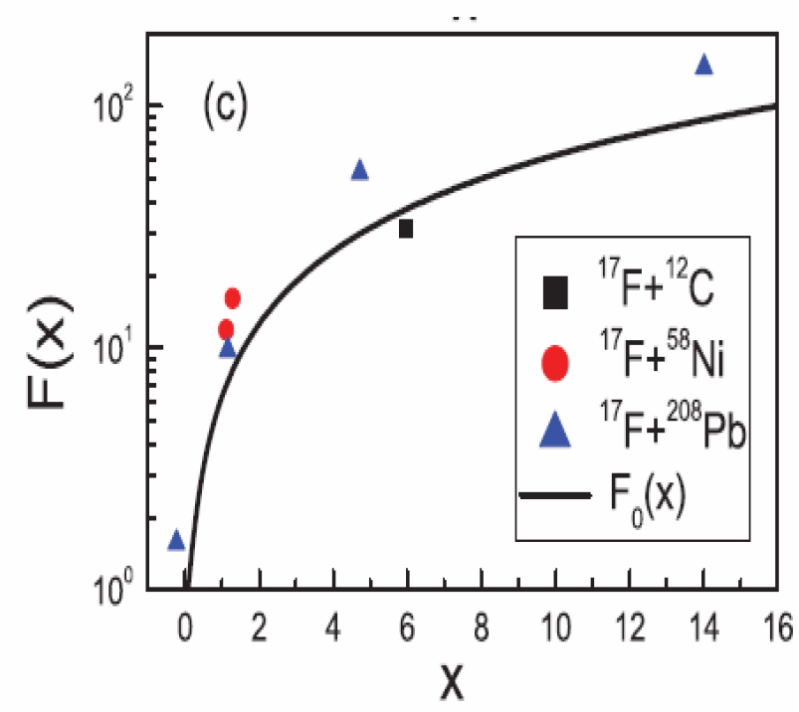
$$F(x) = \frac{2E_{\text{c.m.}}}{\hbar\omega R_B^2}\sigma_R, \qquad x = \frac{E_{\text{c.m.}} - V_B}{\hbar\omega}$$

$$F_0(x) = \ln(1 + e^{2\pi x})$$

not containing coupling channel [1]



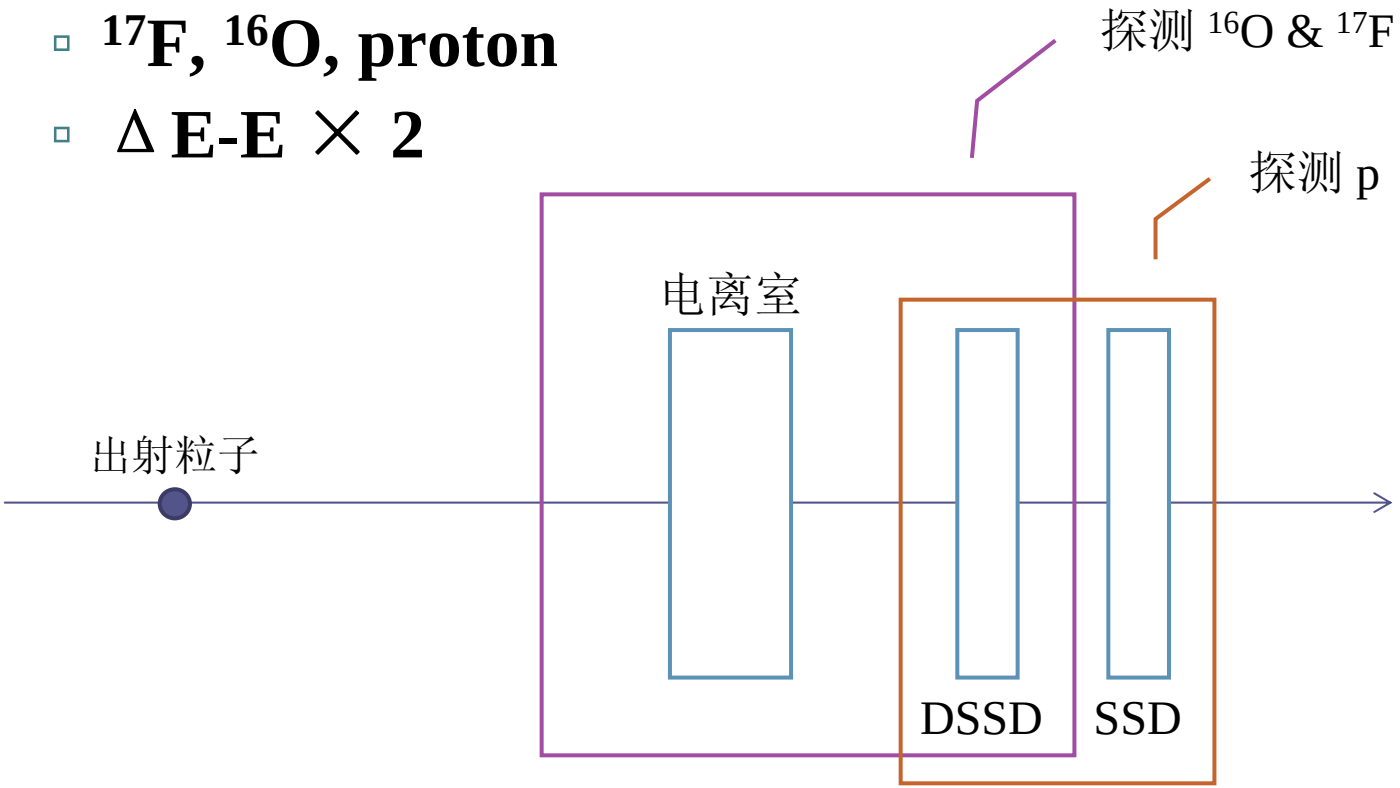
"reduced" reaction cross sections for light projectiles interaction with ^{58}Ni and ^{64}Zn [2]
E(^{17}F): 54.1MeV, 58.5MeV



reaction function F(x) for ^{17}F on ^{12}C, ^{58}Ni and ^{208}Pb[3]

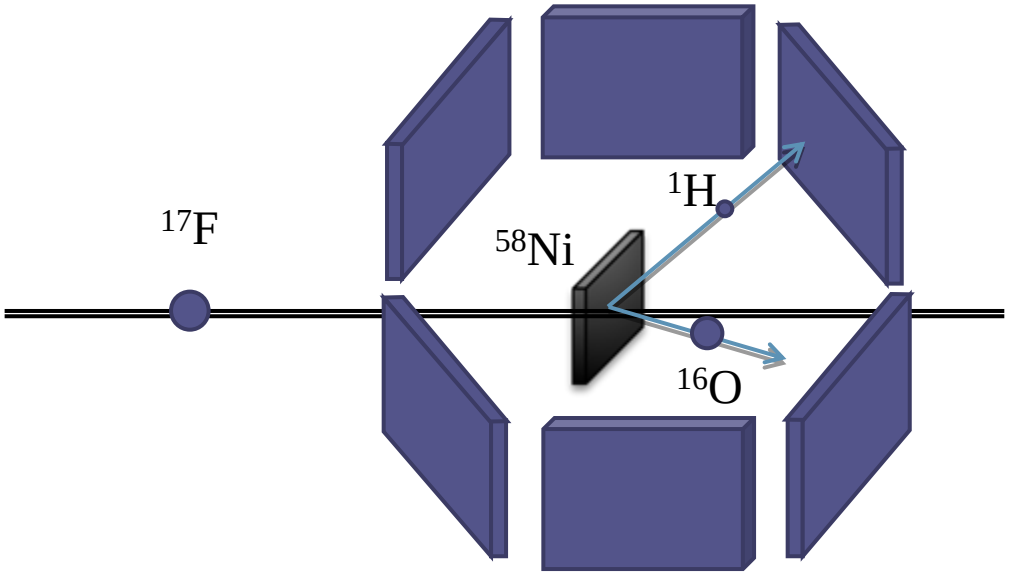
研究方案

- **^{17}F, ^{16}O, proton**
- **ΔE-E × 2**



DSSD: 双面硅条探测器
SSD: 四方硅探测器

研究方案



^{17}F能量：65MeV, 46MeV（库仑位垒47MeV）

探测器介绍

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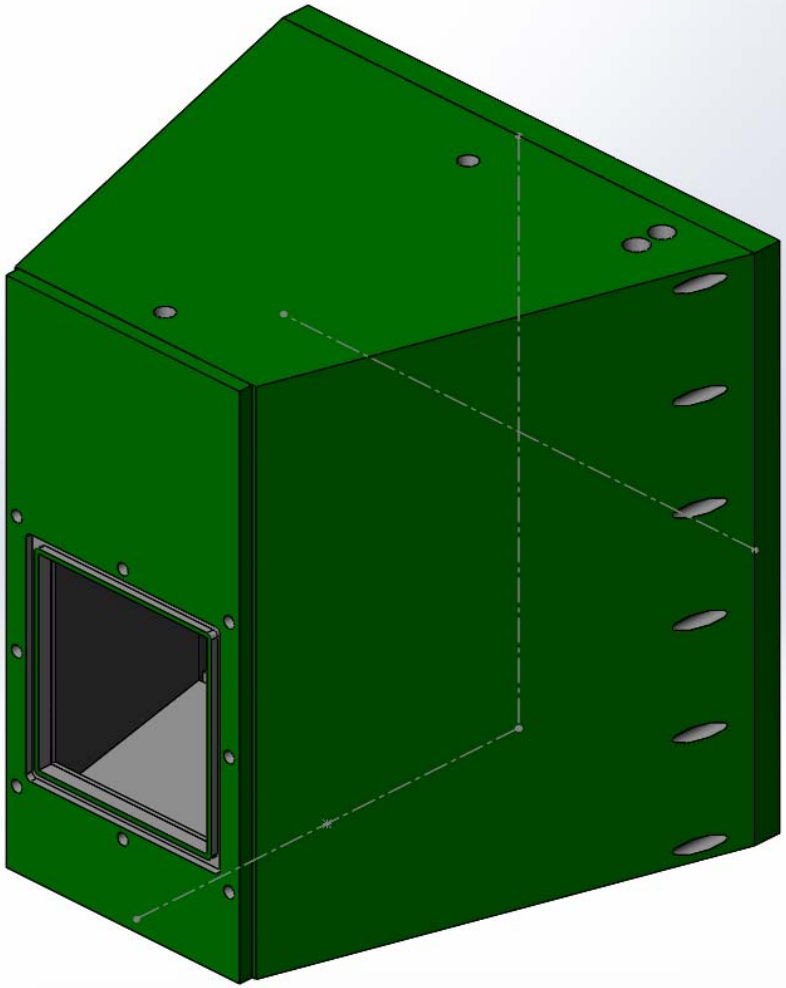
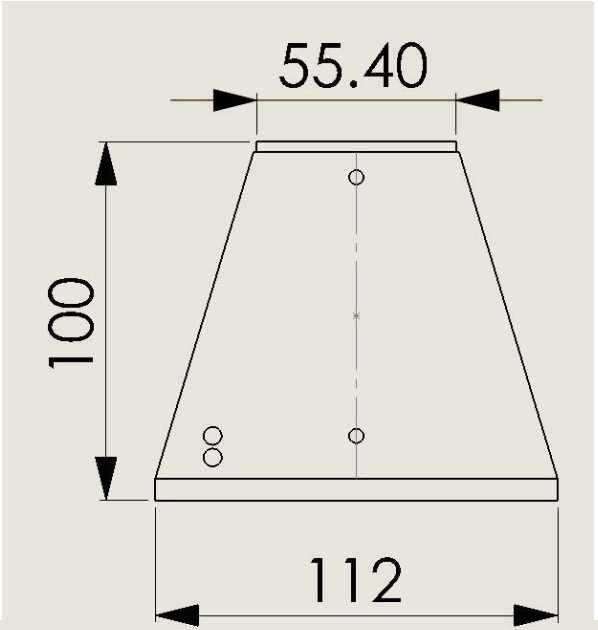
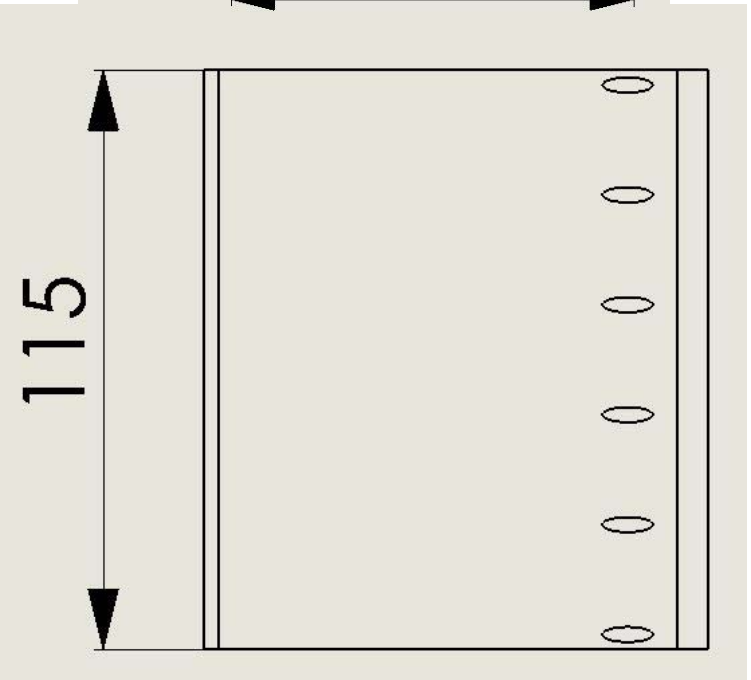
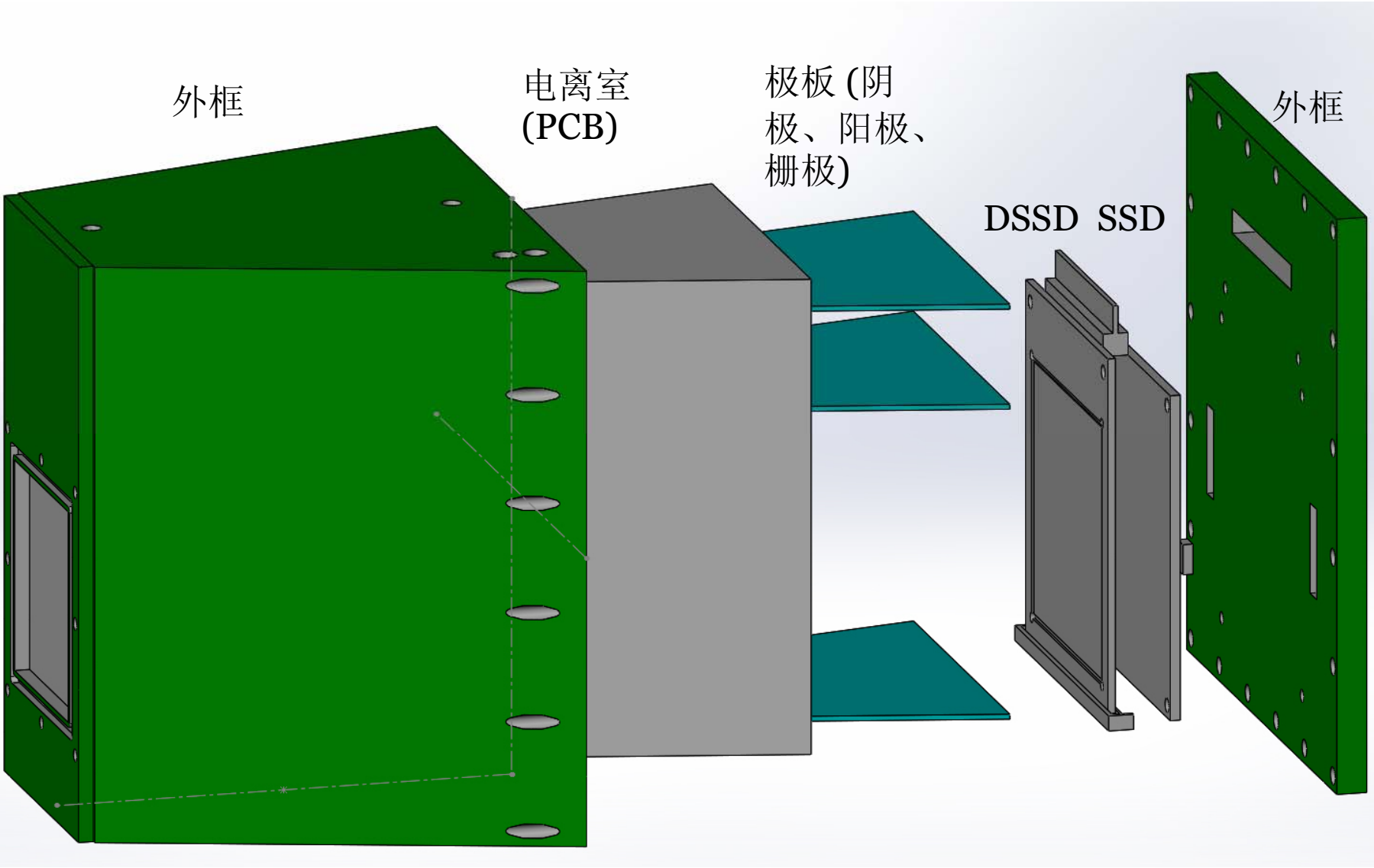
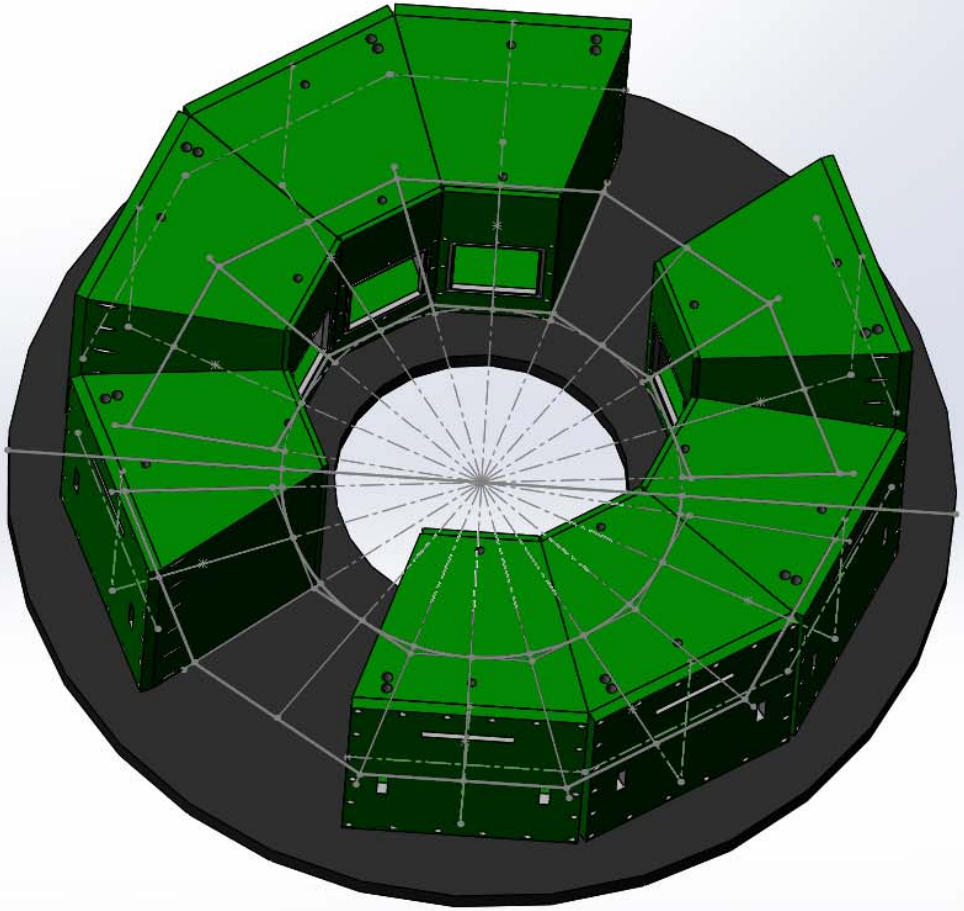
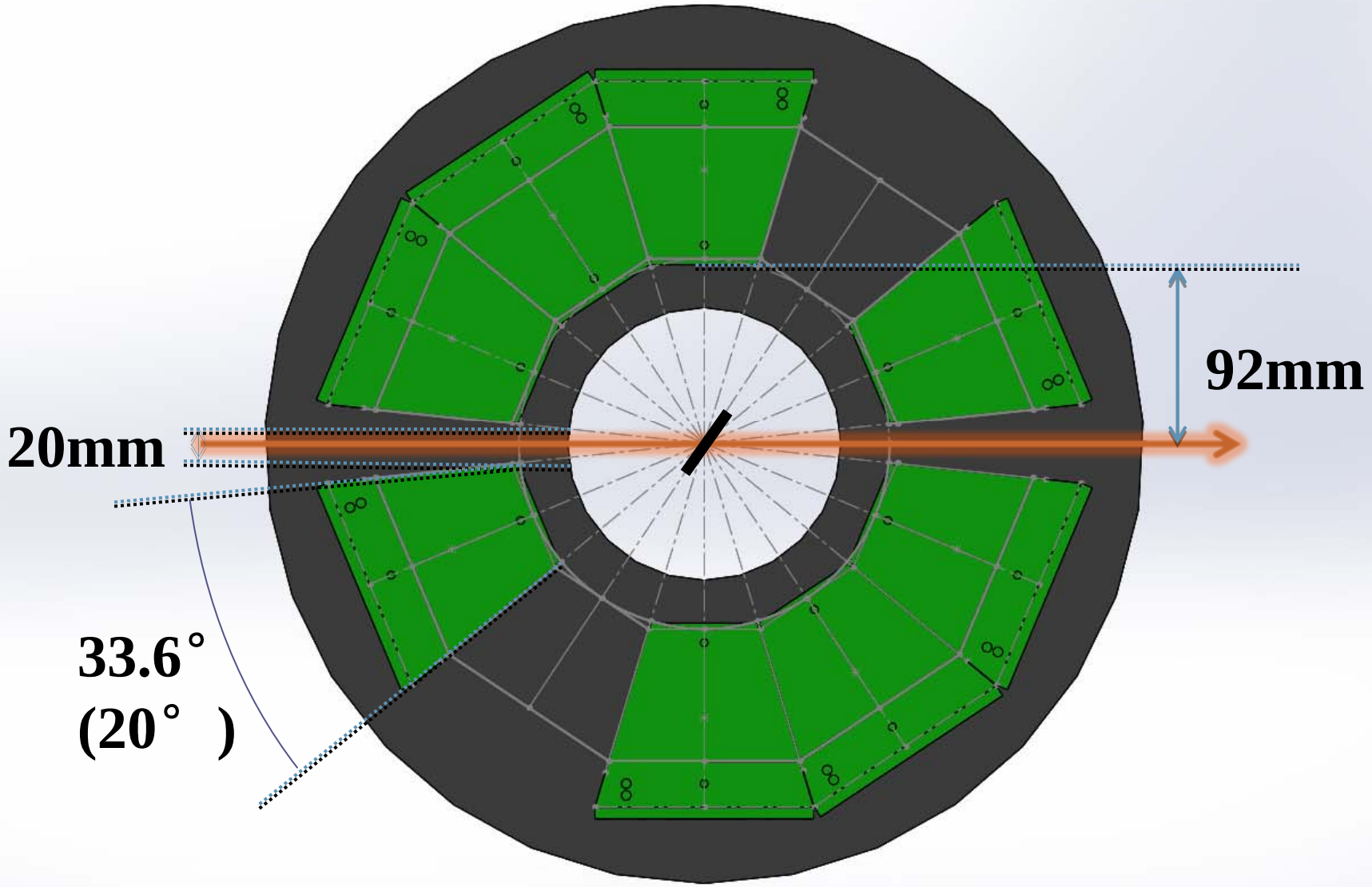







外框
电离室
(PCB)
极板 (阴
极、阳极、
栅极)
DSSD SSD
外框




92mm
20mm
33.6°
(20°)

探测器介绍

探测器介绍

- 电离室

  50mm;

- Si 探测器
  - DSSD:

    50mm×50mm; 60μm

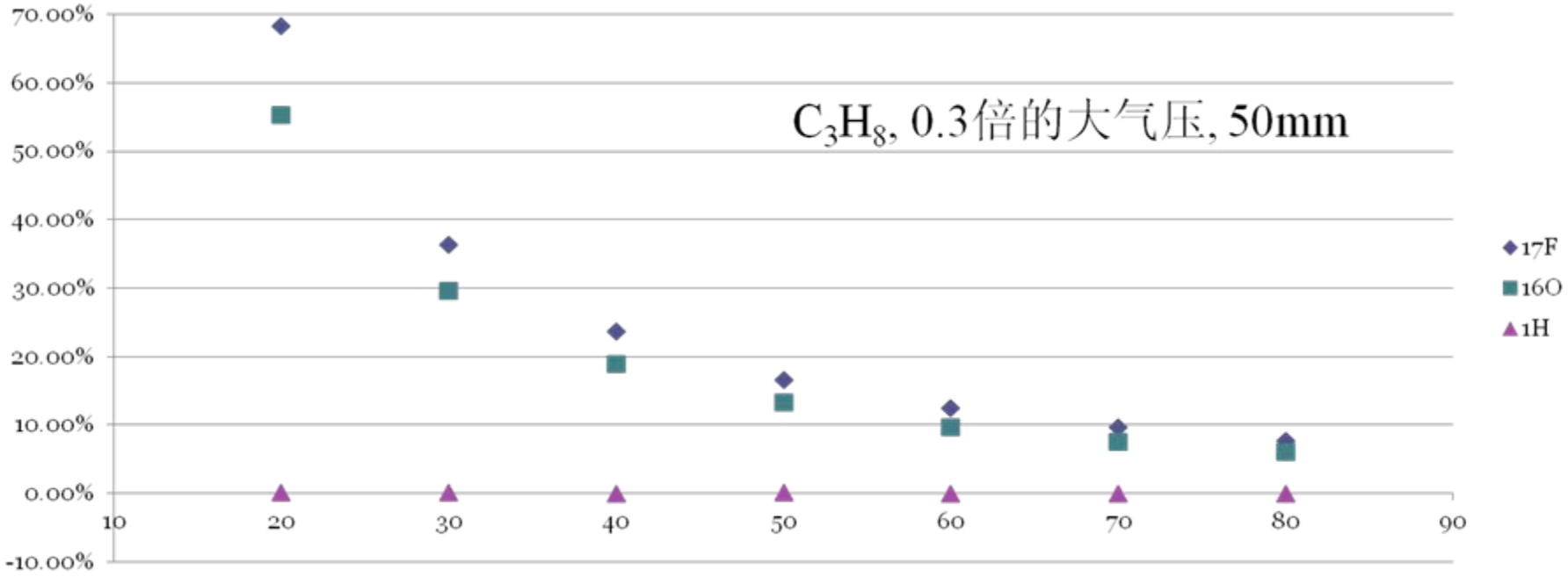
    X×16条，Y×16条

  - SSD:

    50mm×50mm; 300+μm

能损模拟（Geant4）

	20 MeV	30 MeV	40 MeV	50 MeV	60 MeV	70 MeV	80 MeV
^{17}F	68.40%	36.47%	23.78%	16.70%	12.50%	9.76%	7.79%
^{16}O	55.35%	29.60%	18.98%	13.26%	9.73%	7.51%	6.06%
p	0.12%	0.09%	0.07%	0.07%	0.04%	0.06%	0.05%
p in DSSD	25.50%	17.70%	13.90%	11.85%	10.05%	8.90%	8.05%



几何效率模拟（Geant4 ）

- 30000个^{17}F向4π均匀发射，70MeV

  对^{17}F的探测效率: **16.6±0.2%**

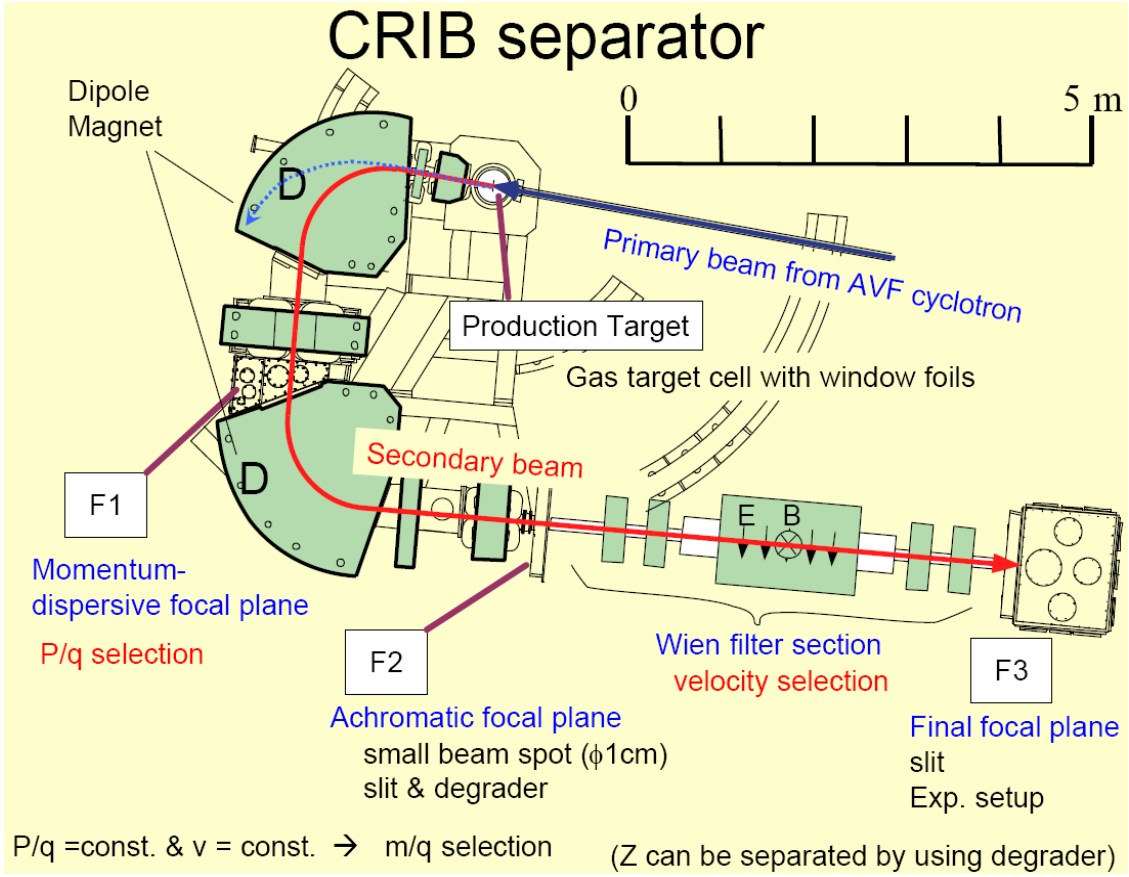
- 全部破裂成^{16}O 和 p，激发能10MeV

  ^{16}O&p 符合探测效率: **4.7±0.1%**

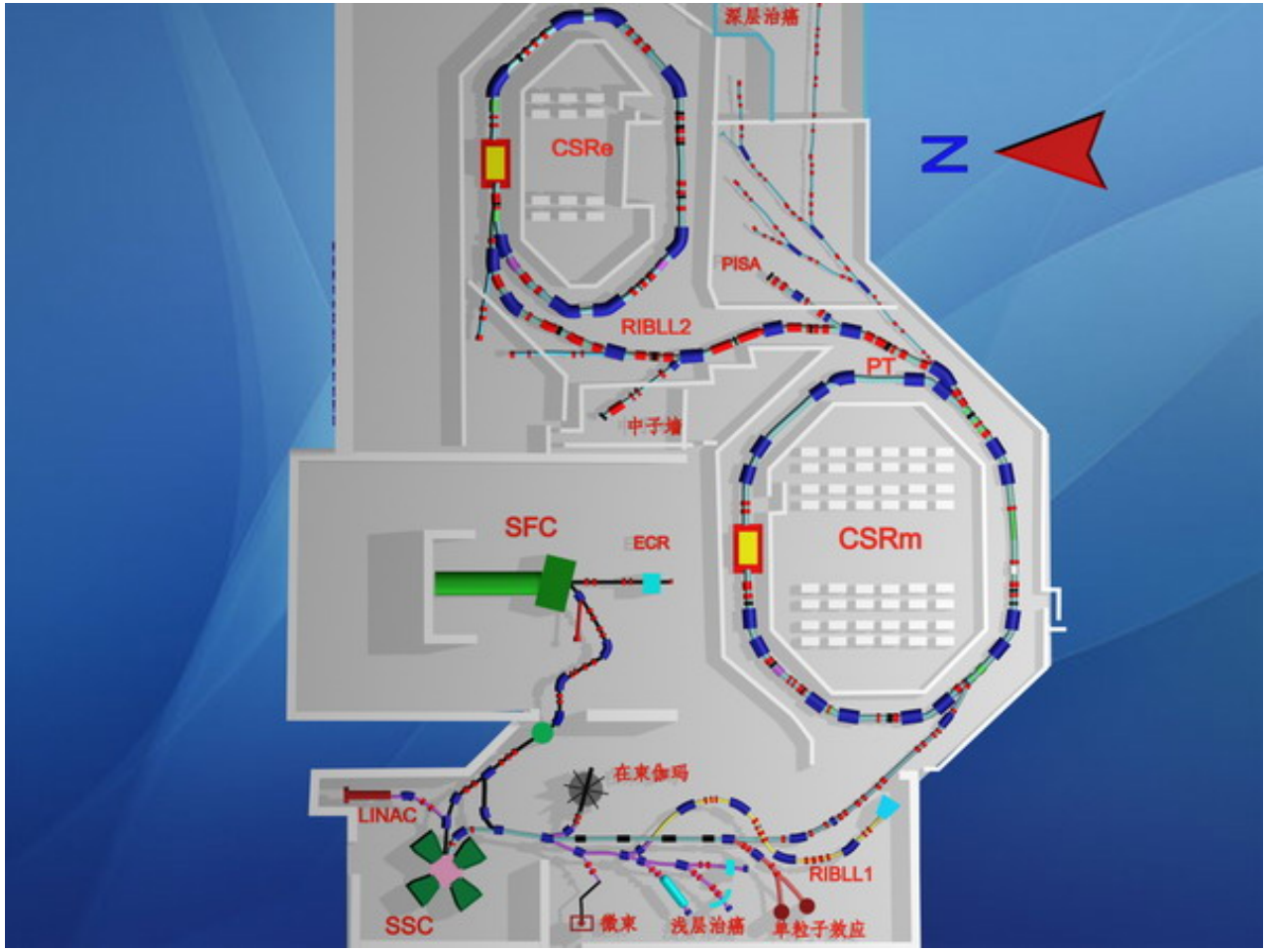
现阶段

- 探测器组装
- 测试

2015年2月1日-2015年2月10日



该套装置也将用于兰州的$^{17}F+^{208}Pb$的实验，实验在12月份。



参考文献

- [1] Wong C Y. Interaction barrier in charged-particle nuclear reactions[J]. Phys. Rev. Lett., v. 31, no. 12, pp. 766-769, 1973, 31(12).
- [2] M. Mazzocco, C. Signorini, et al. Reaction Dynamics for the System $^{17}F+^{58}Ni$ at near-barrier energies. Physics Review C 82, 054604(2010).
- [3] Yang X P, Zhang G L, Zhang H Q. Systematic study of reaction functions of weakly bound nuclei[J]. Physical Review C, 2013, 87(1): 014603.

Thank you~