

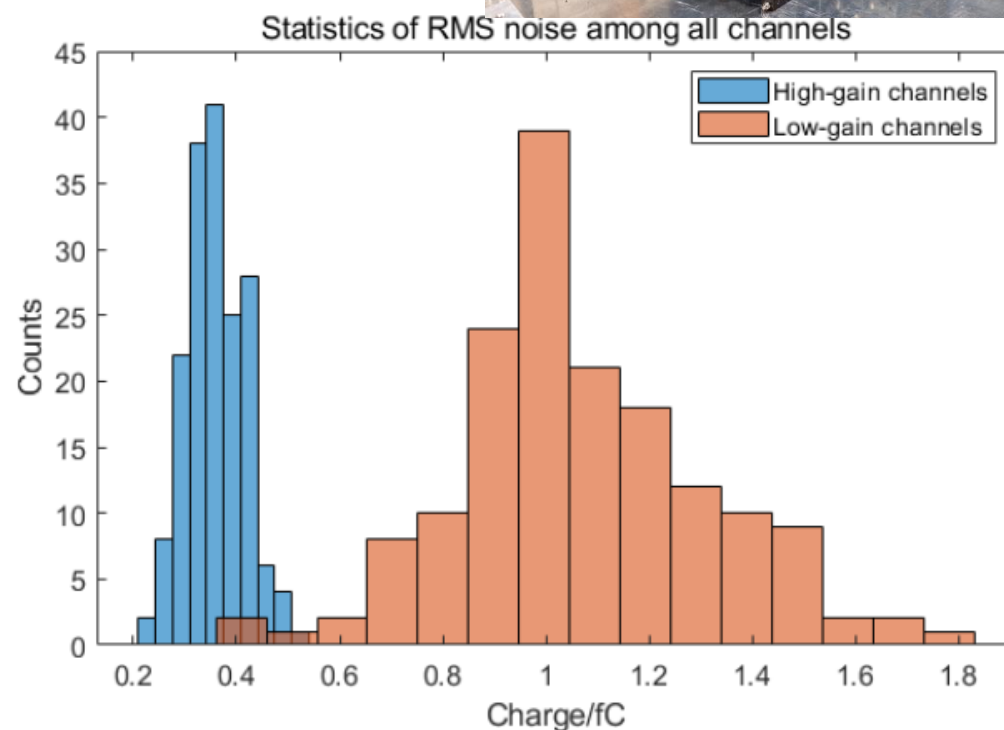
HEIC-Cube beam test data digitization

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2024.09.23

前端电子学噪声

- 电子学低增益通道（HL和LL）噪声小于 $2fC$ ；与ADC码值之间对应关系为 0.533 道/ fC ；
- 电子学高增益通道（HH和LH）噪声小于 $0.6fC$ ；与ADC码值之间对应关系为 20.576 道/ fC ；

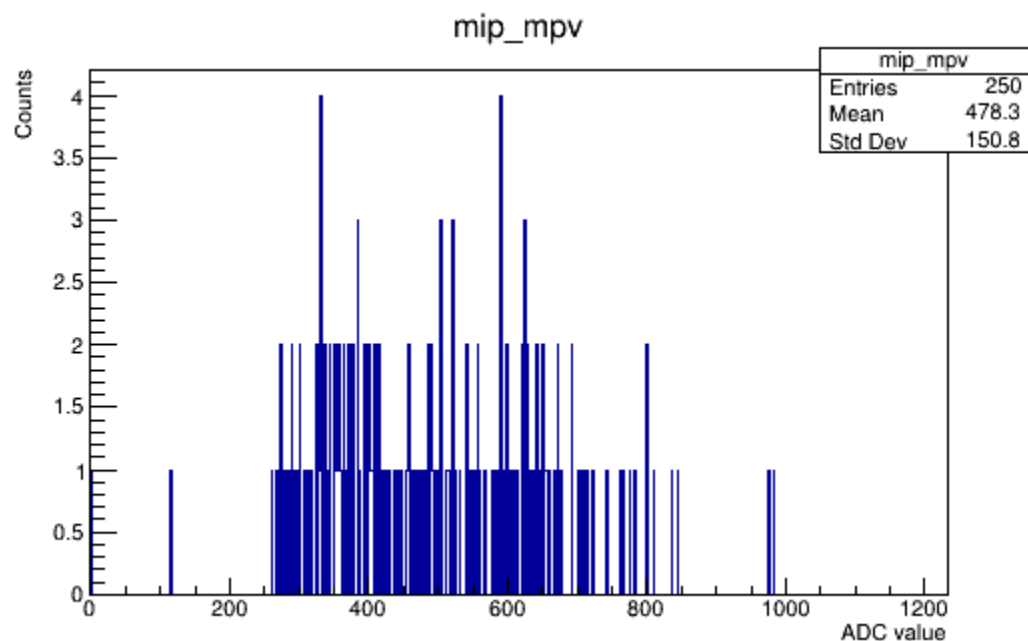


数字化

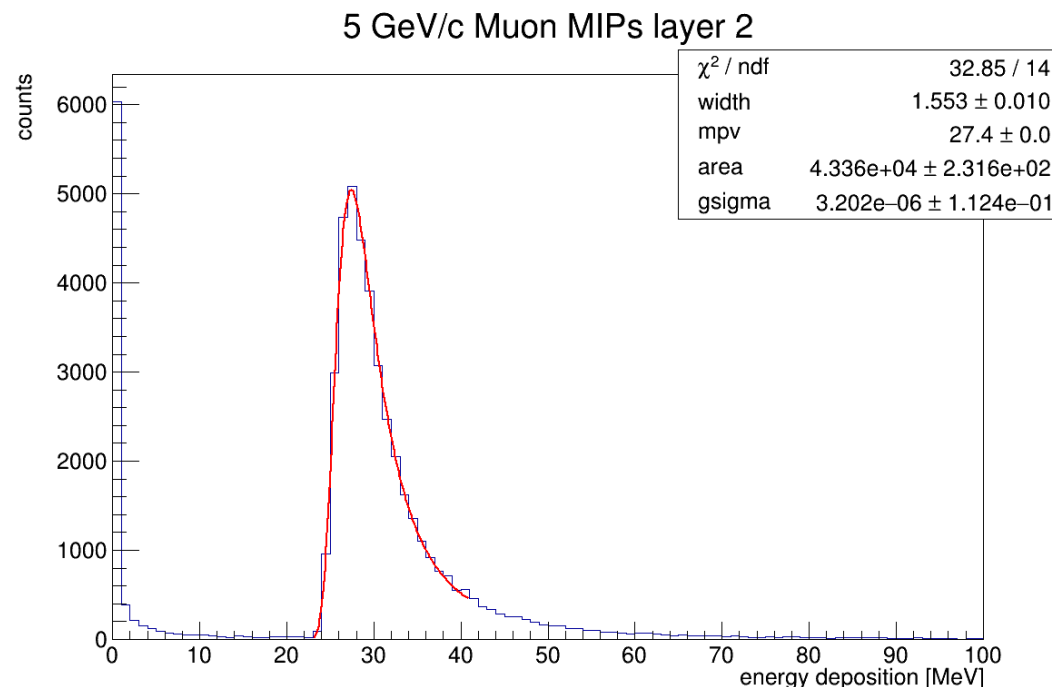
$\frac{480}{20.576} \times \frac{1\text{E-}15\text{ C}}{1.6\text{E-}19\text{ C}} \times \frac{1}{50} \times \frac{1}{27.4\text{ MeV}} = 106.4$, 取BGO 1MeV对应 100 个光电子;

$\frac{0.6\text{E-}15\text{ C}}{1.6\text{E-}19\text{ C}} \times \frac{1}{50} = 75$, 电子学噪声固定为 75 个光电子;

APD灵敏区域是硅, 平均电离能为 3.6eV;

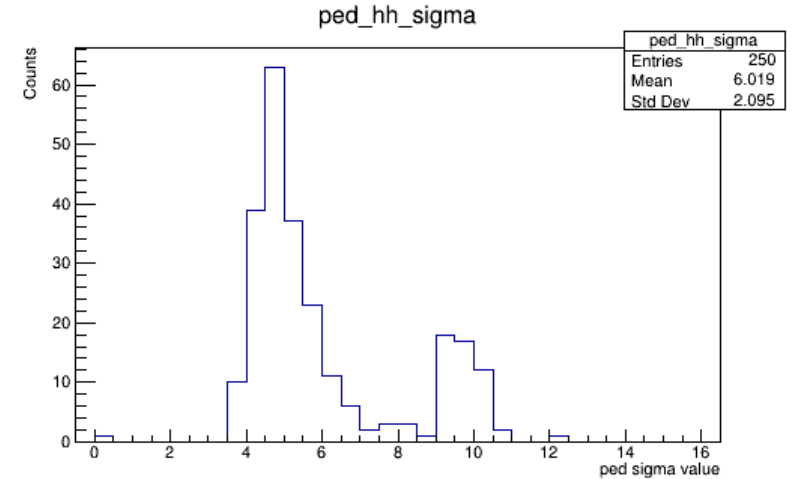
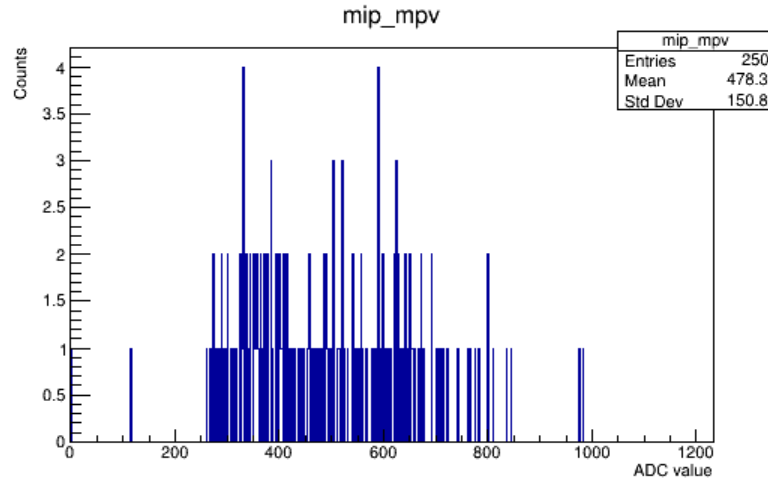


MIPs mpv



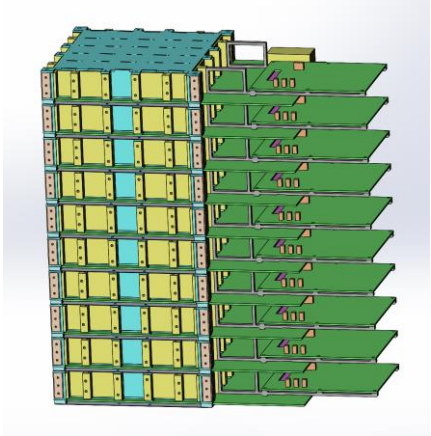
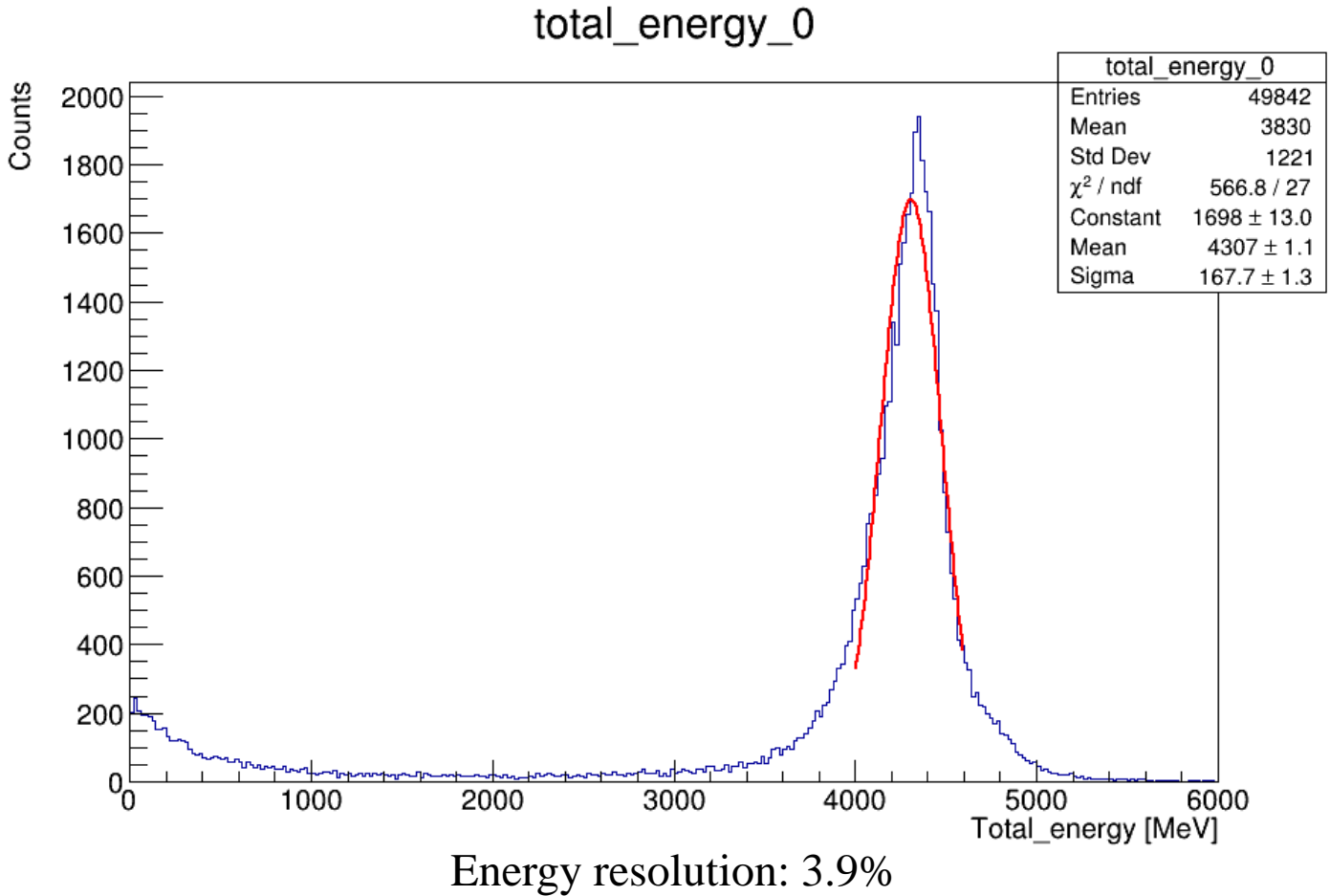
MIPs energy

数字化



- $\text{parameter} = \text{mip_mpv} / 20.576 * 10000 / 1.6 / 50 / 27.4;$
- $\text{crystal_p.e.} = \text{crystal_energy}(\text{MeV}) * \text{parameter};$
- $\text{crystal_p.e.} = \text{Gaus}(\text{crystal_p.e.}, \text{sqrt}(\text{crystal_p.e.}));$
- $\text{noise_p.e.} = \text{Gaus}(0, \text{sqrt}(\text{pedestal_sigma} / 20.576 * 10000 / 1.6 / 50));$
- $\text{apd_p.e.} = \text{apd_energy}(\text{eV}) / 3.6;$
- $\text{apd_p.e.} = \text{Gaus}(\text{apd_p.e.}, \text{sqrt}(\text{apd_p.e.}));$
- $\text{crystal_energy} = (\text{crystal_p.e.} + \text{noise_p.e.} + \text{apd_p.e.}) / \text{parameter};$

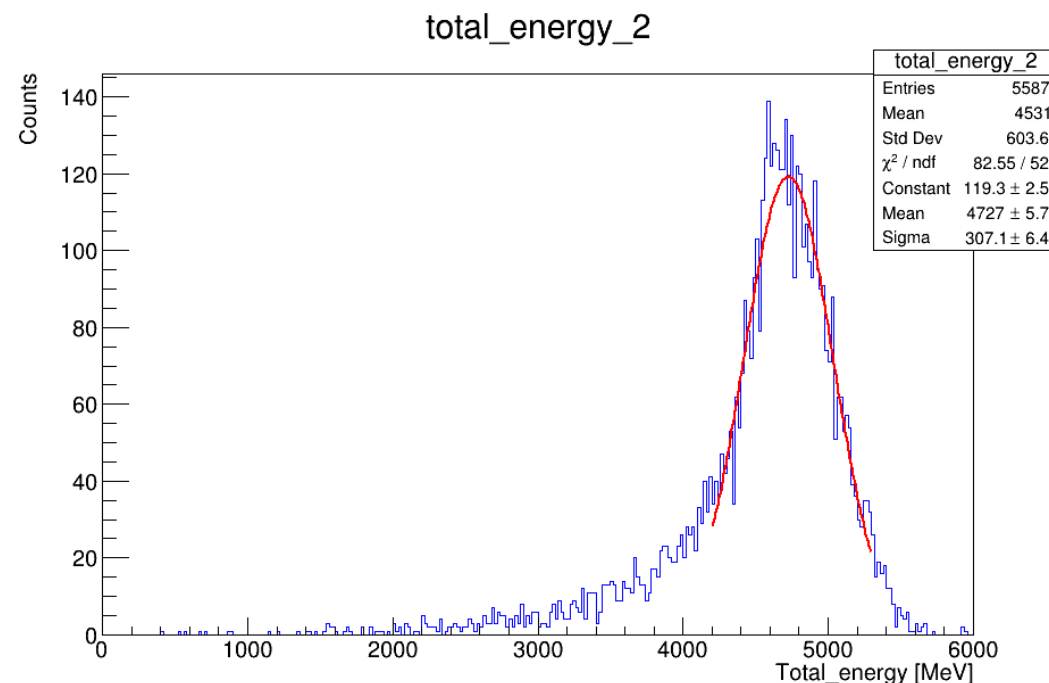
Digitization result



5GeV electron – beam test



- 筛选条件：
 - 前6层中至少3层的总能量大于2个MIPs;
 - $2.3 \leq x_center[2] \leq 2.7$;
 - $2.3 \leq y_center[2] \leq 2.7$;
 - $2.3 \leq x_center[3] \leq 2.7$;
 - $2.3 \leq y_center[3] \leq 2.7$;

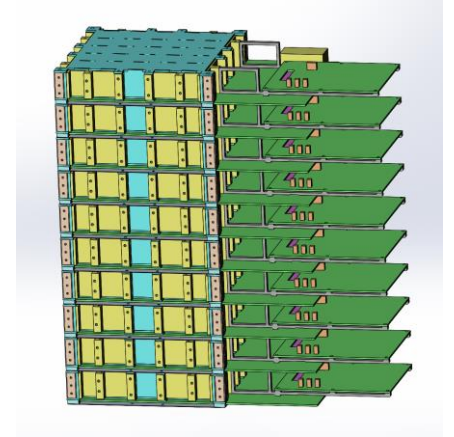


Energy resolution: 6.5%

Digitization result

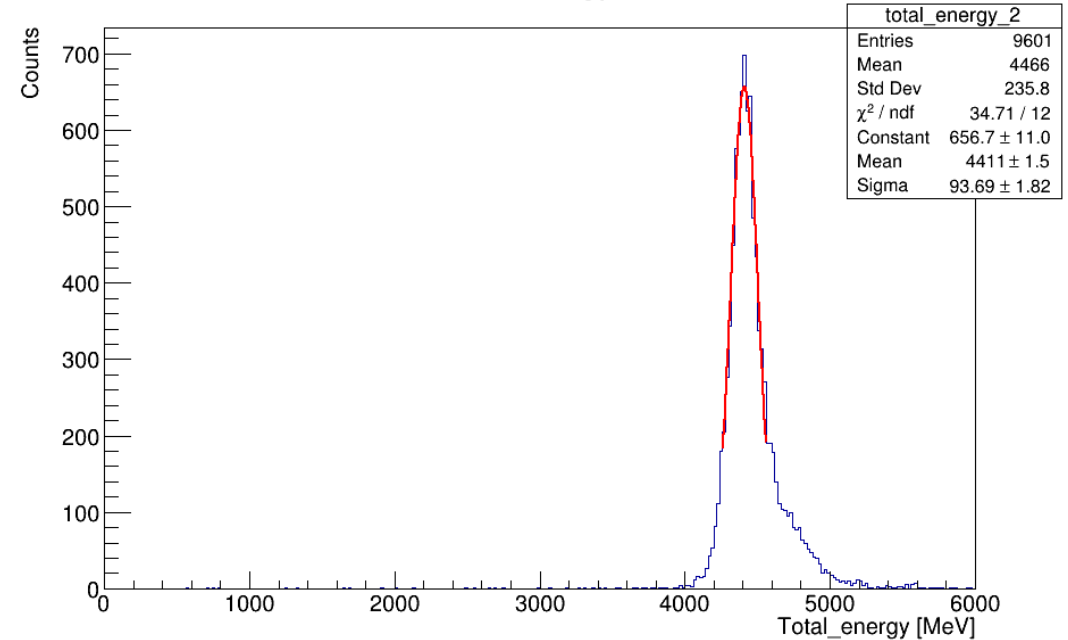
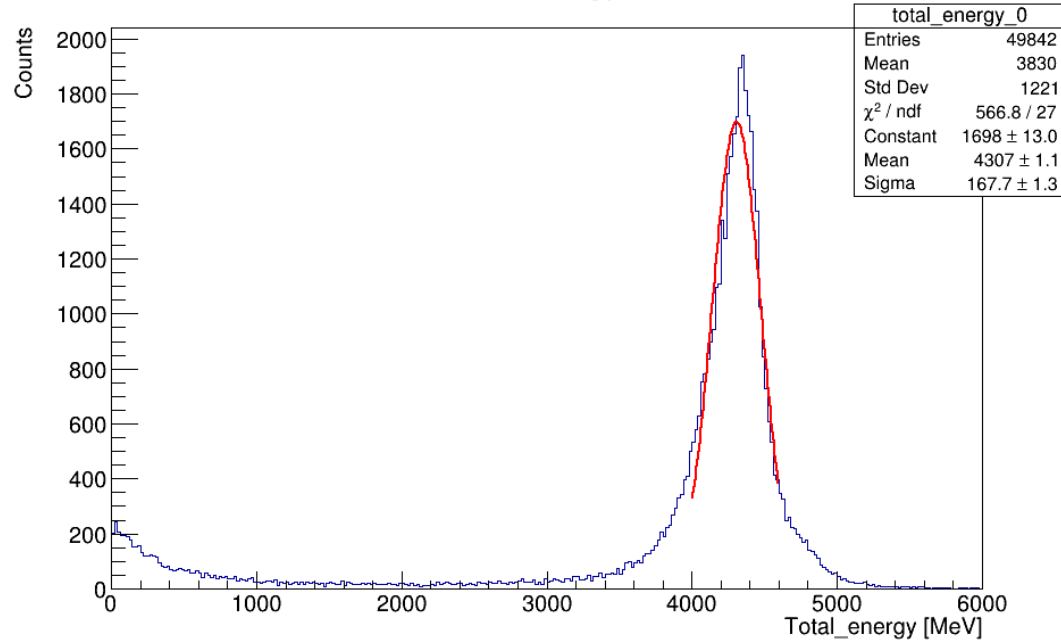
Original simulation

After selection



total_energy_0

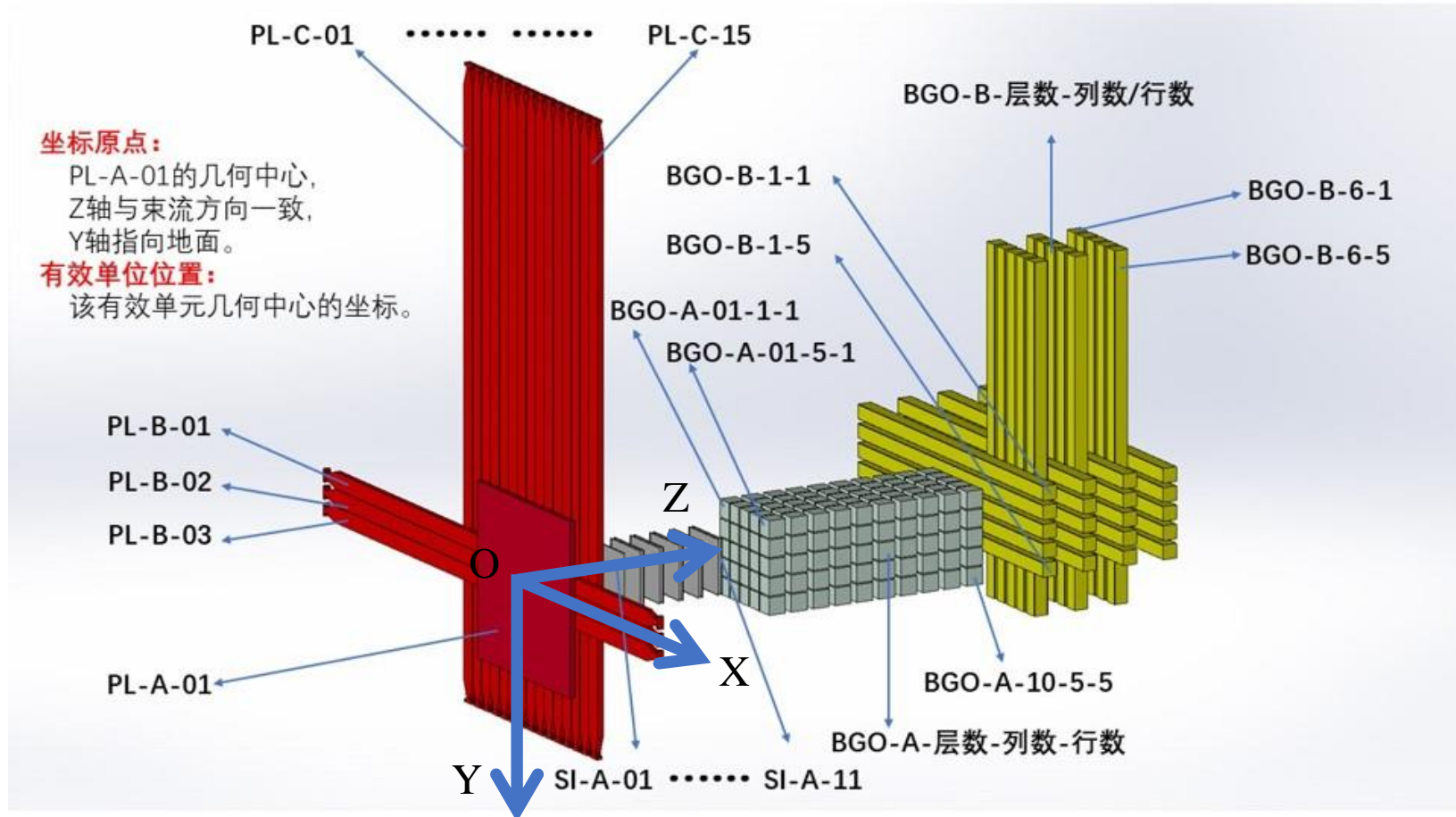
total_energy_2



Energy resolution: 3.9%

Energy resolution: 2.1%

Positional relation



STED-Si

- 有效单元：95mm*95mm*0.32mm，总计11层，1-2层中心点间距29.4mm，2-3层中心点间距7.1mm，...；
- 有效单元中心坐标(-12.85, 0, z)，z=182.3mm~364.8mm；
- 选取每层最大的cluster用作径迹重建；
- 数据结构：
 - <int>TriggerID，数值每到65536则翻转；
 - <TVector3>Track_direction，xOz和yOz平面径迹的斜率，z=1；
 - <TVector3>Track_point，z=0时在xOy平面击中点的坐标；

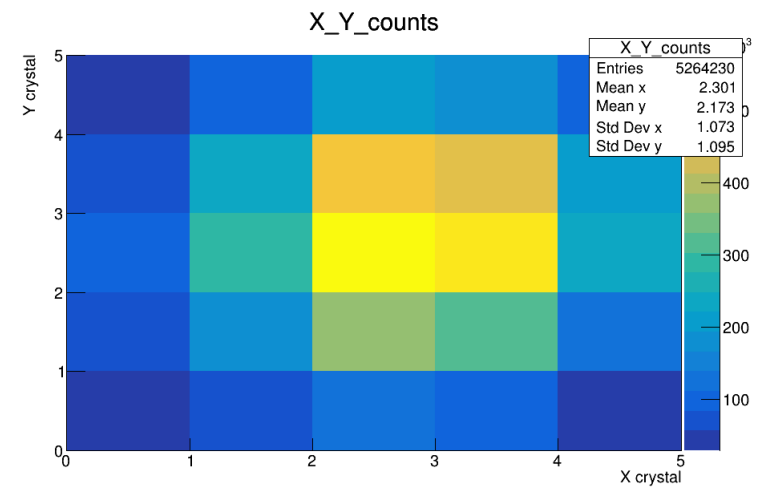
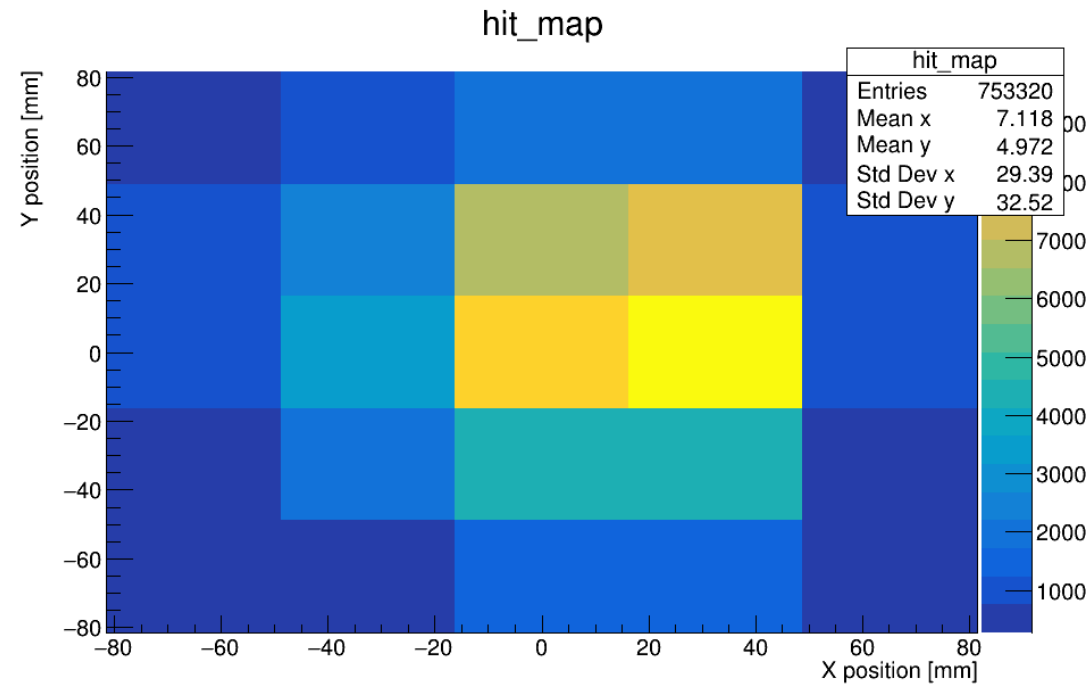
HEIC-Cube



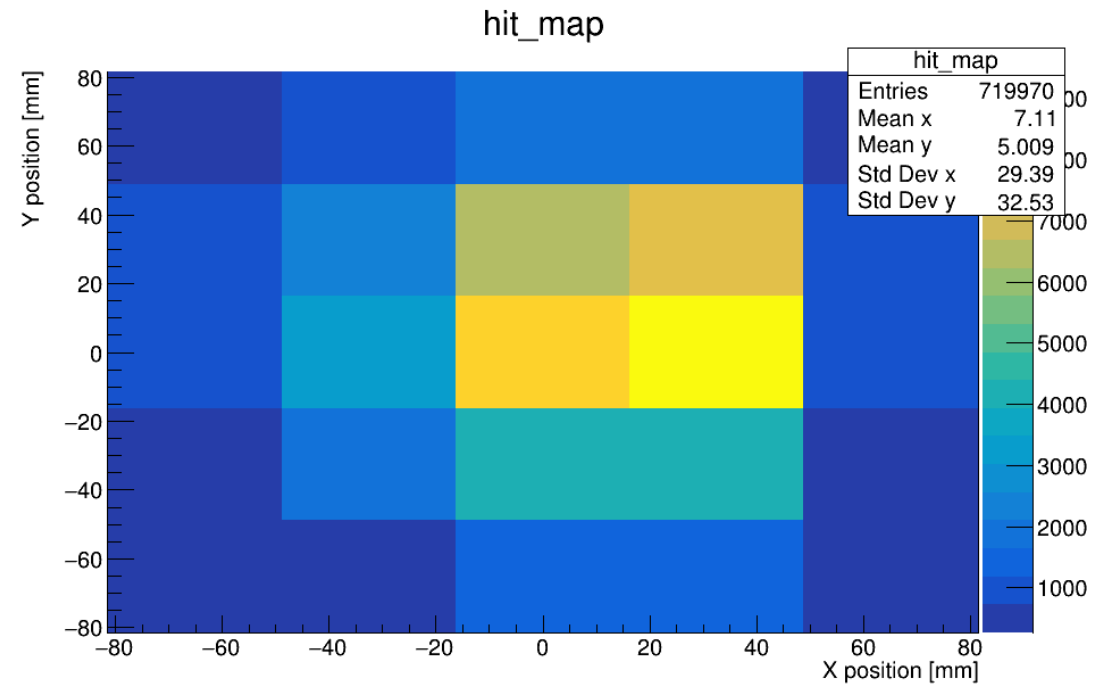
- 有效单元：30mm*30mm*30mm，总计10层，相邻层中心点间距41mm；
- 每层最中心单元坐标 $(0, 0, z)$ ， $z=441.7\text{mm}\sim 810.7\text{mm}$ ；
- 选取径迹起点和终点都在最中心晶体区域内的事例；
 - 即：当 $z=426.7\text{mm}$ 时， $(x,y)\in(-15\text{mm}, 15\text{mm})$ ；
 - 当 $z=825.7\text{mm}$ 时， $(x,y)\in(-15\text{mm}, 15\text{mm})$ ；

STED-Si hit map

STED-Si: 2024.06.20 13:43



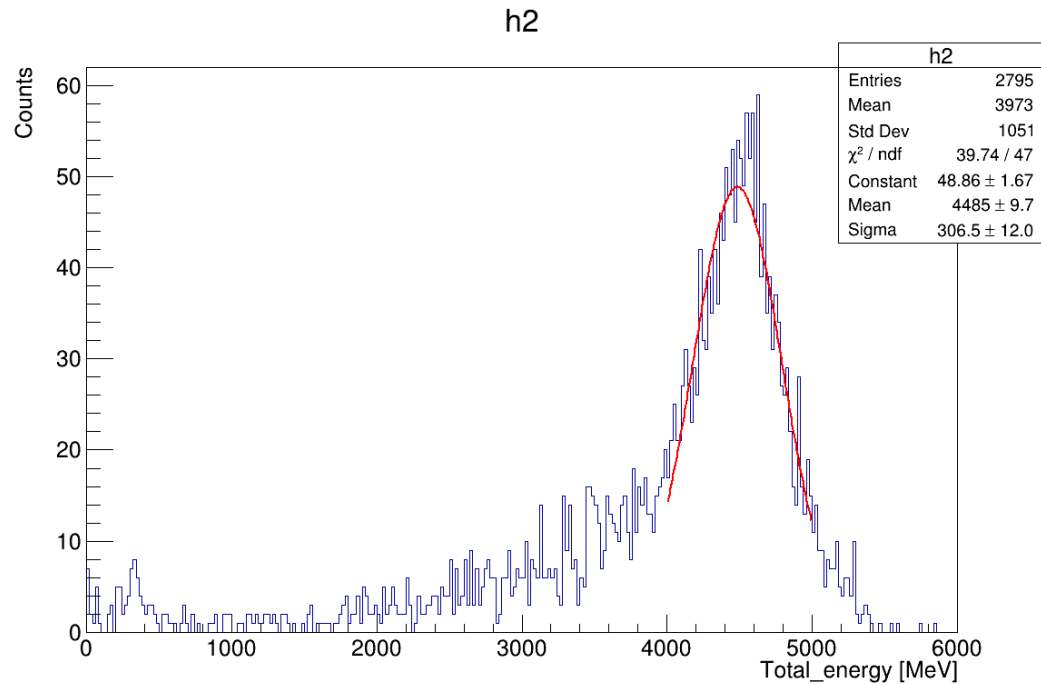
STED-Si: 2024.09.04 06:34



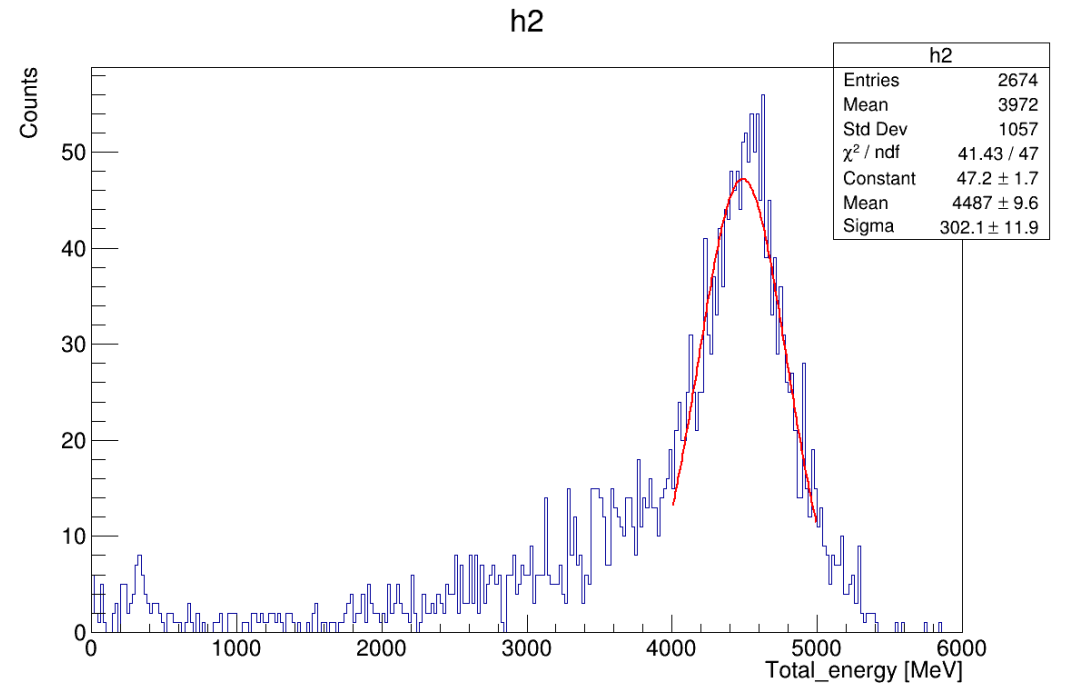
Tracker selection: 5GeV electron

STED-Si: 2024.06.20 13:43

STED-Si: 2024.09.04 06:34



Energy resolution: 6.8%



Energy resolution: 6.7%