$\mathbf{Allpix^2}$ 的像素探测器电荷收集模拟

- 基于Geant4　确定入射粒子沉积 & 收集 信号范围

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入射粒子（MIPS）的电荷收集分析

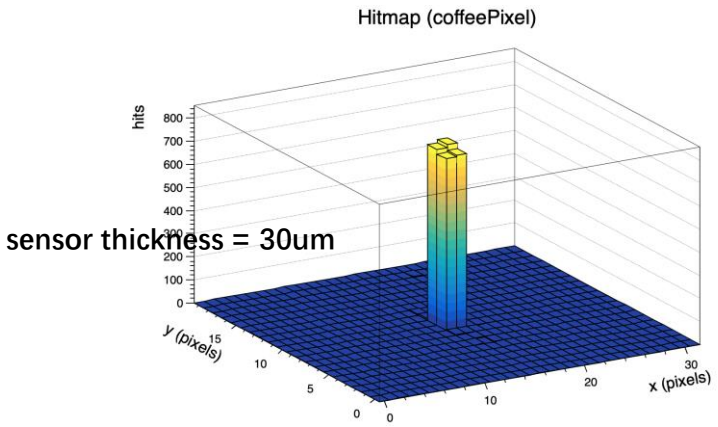
- 进一步精确模拟 需要从TCAD导入对应得电场分布和掺杂浓度分布文件 (*e.g.* Epi: $1.68e^{15}/cm^3$ $[8\Omega \cdot cm]$; Sub: $1.34e^{21}/cm^3$，该工艺未知)

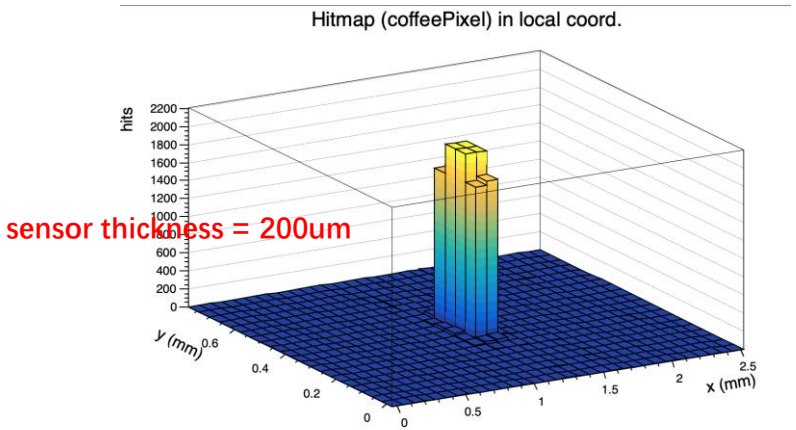
■ MIP粒子 收集电荷分布： 3GeV Proton

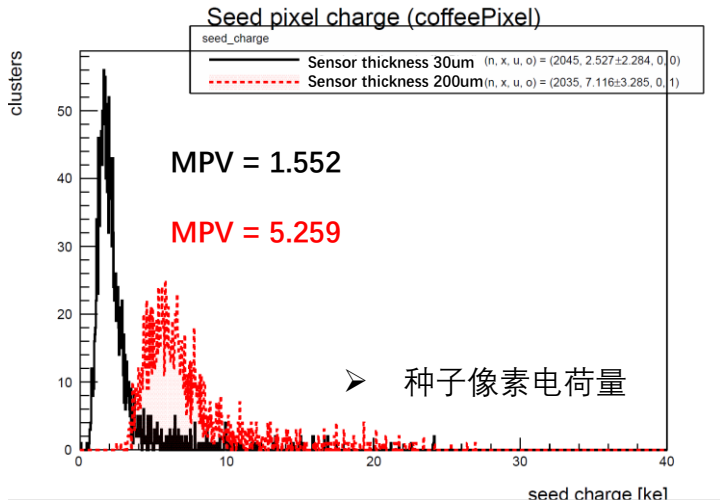
sensor thickness = 30/200um
Depletion depth = 30um
Bias voltage = 70V

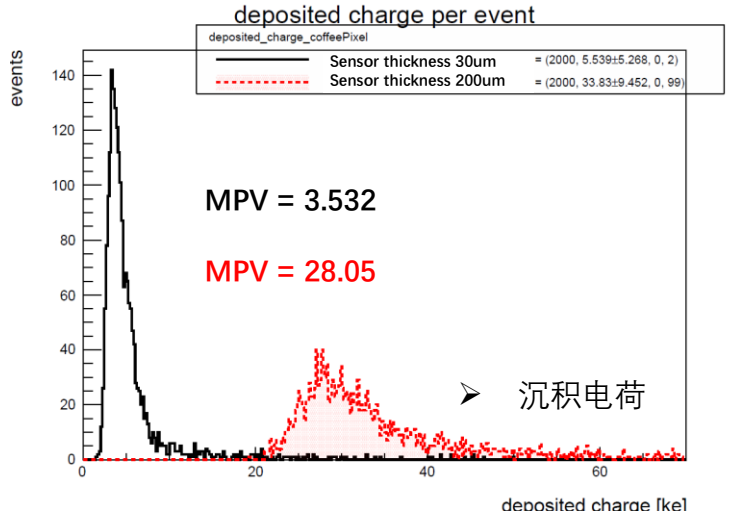
- **模拟MIP粒子穿透芯片；**
- ***Landau*** $\otimes$ ***Gauss*** **or Landau or Gauss**

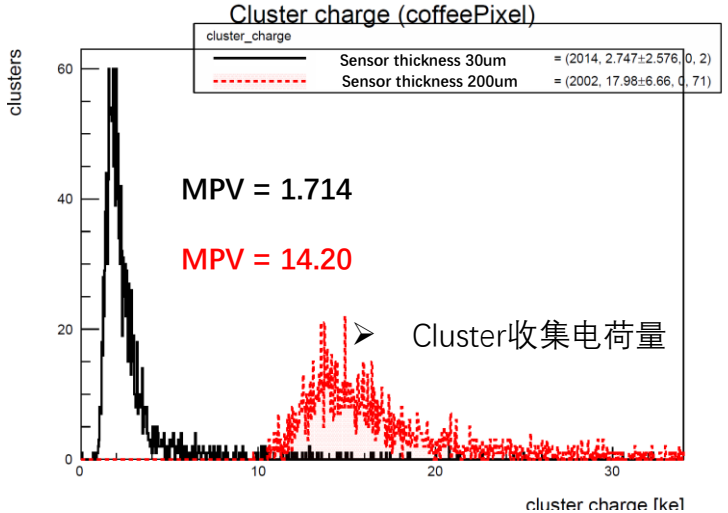
→ **The most probable value of landau or mean**

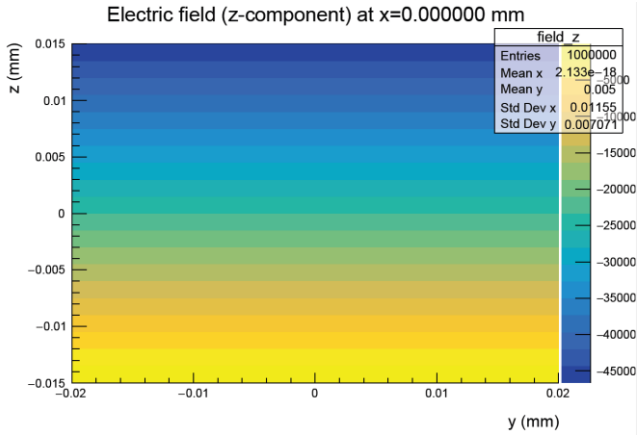












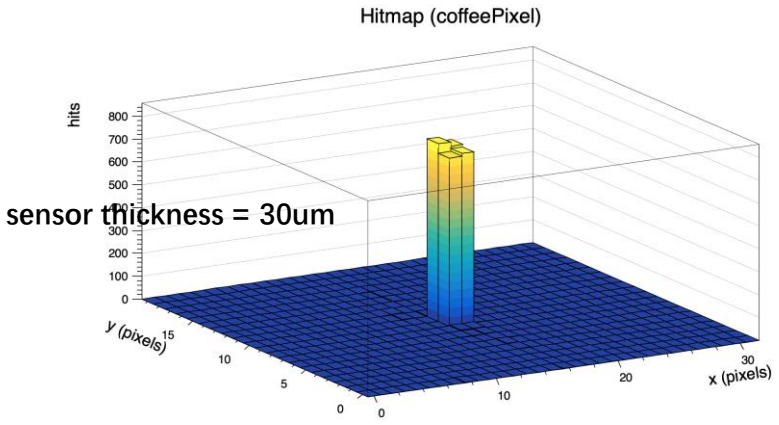
入射粒子（MIPS）的电荷收集分析

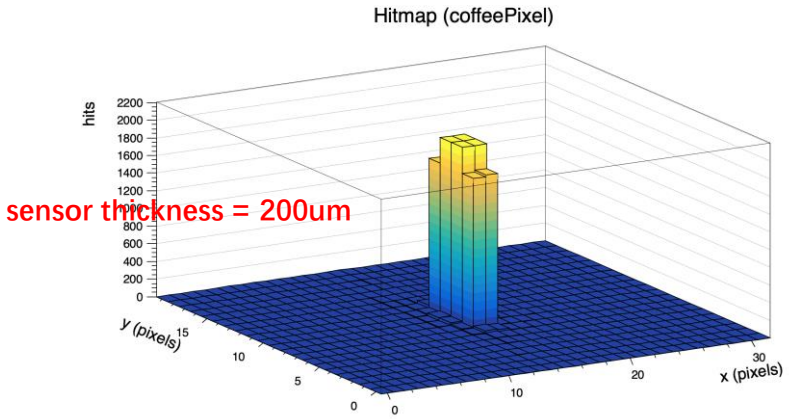
■ MIP粒子 收集电荷分布： 350MeV Muon

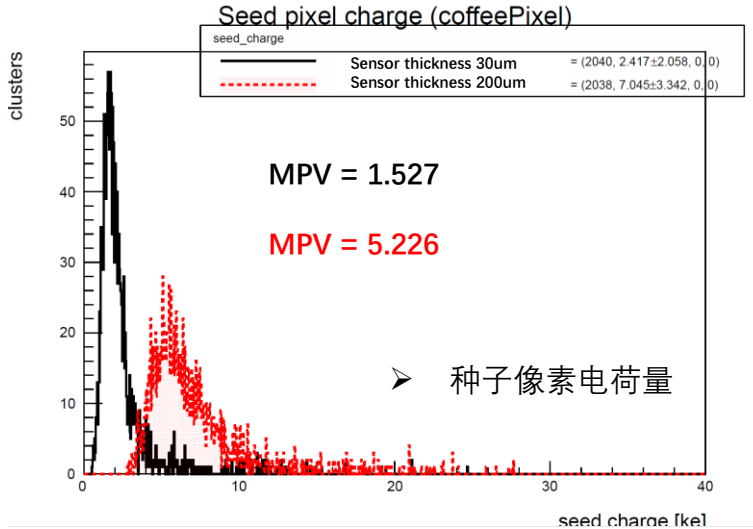
sensor thickness = 30/200um
Depletion depth = 30um
Bias voltage = 70V

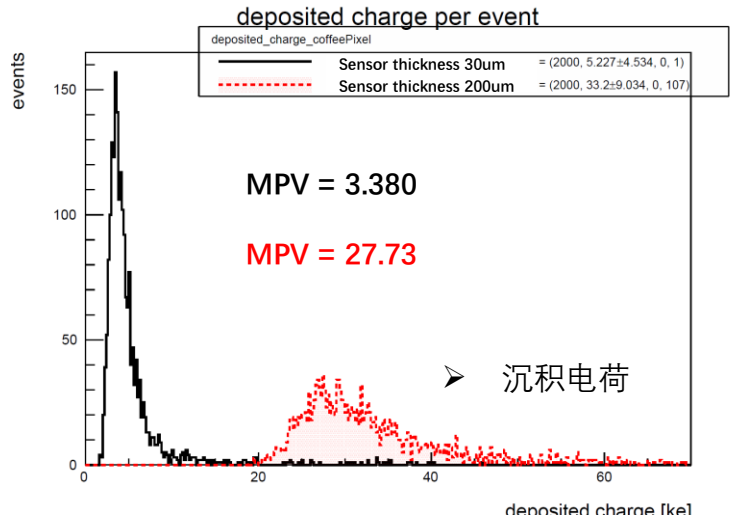
- 模拟MIP粒子穿透芯片；
- $Landau \otimes Gauss$ or Landau or Gauss

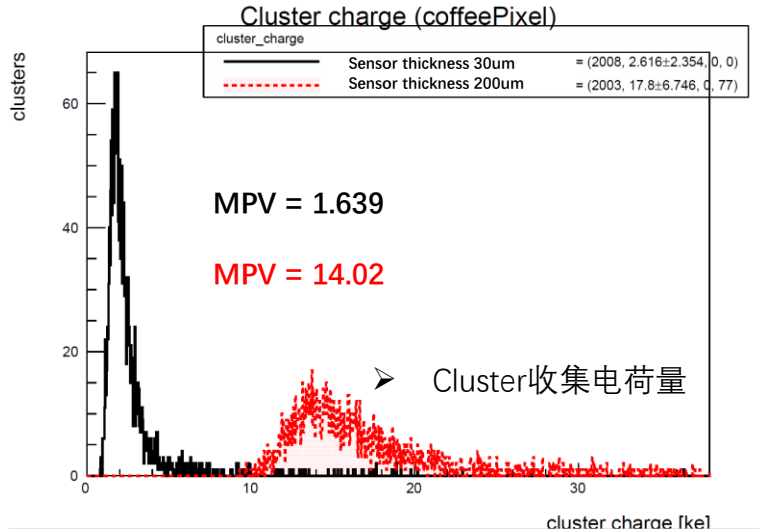
→ The most probable value of landau or mean

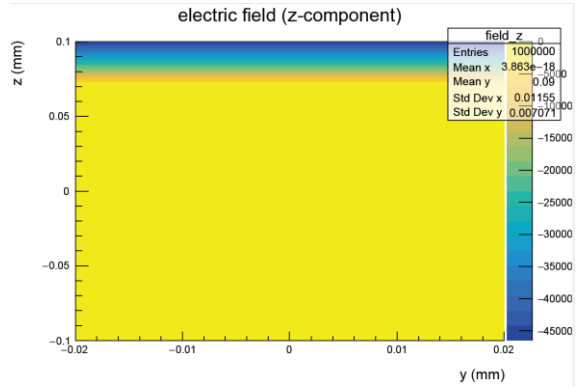








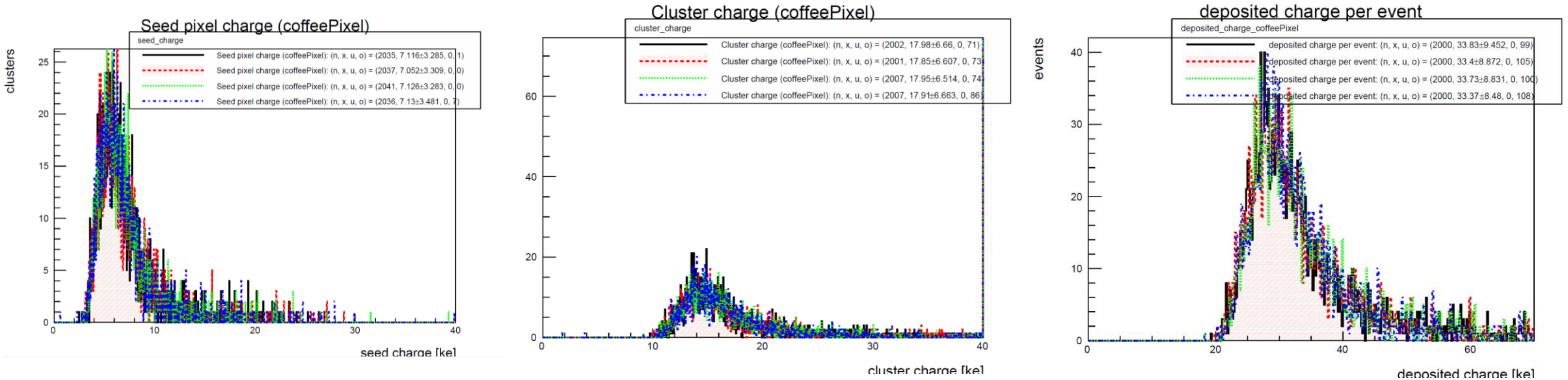




入射粒子（MIPS）的电荷收集分析

- MIP粒子 收集电荷分布： 3GeV / 10GeV Proton

sensor thickness = 200um
Depletion depth = 30um / 100um
Bias voltage = 70V



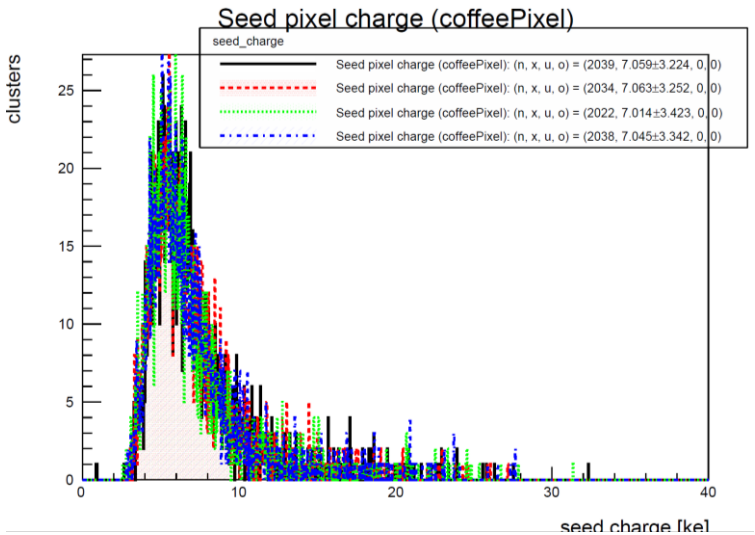
CCE = $Collect\ \mathrm{Charge}_{MPV}/Deposited_{MPV}$ 约为50%

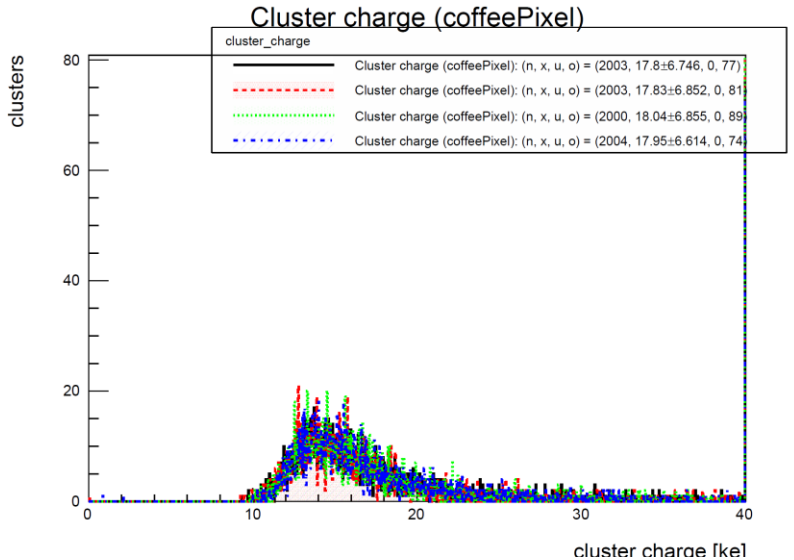
入射粒子（MIPS）的电荷收集分析

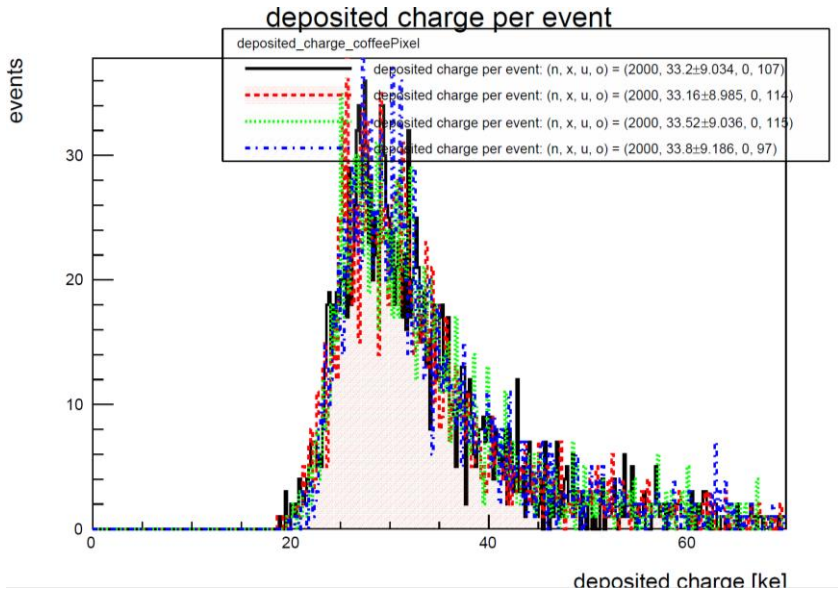
- MIP粒子 收集电荷分布： 350MeV / 1GeV Muon

sensor thickness = 200um
Depletion depth = 30um / 100um
Bias voltage = 70V

3Gev_depletion_depth=30um
3Gev_depletion_depth=100um
10Gev_depletion_depth=30um
10Gev_depletion_depth=100um







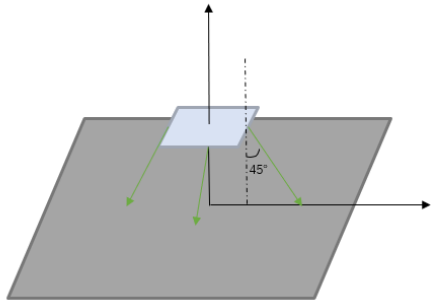
CCE = $Collect\ \mathrm{Charge}_{MPV}/Deposited_{MPV}$ 约为50%

Back up

二、 $Allpix^2$：模拟过程设置

■ 几何模型的搭建model

- 单片式像素探测器： monolithic
- 像素数量：100 × 100 ；
- 像素阵列的间距：50um 50um;
- 外延层厚度：5um;
- 衬底厚度：50um;



■ 物理过程

- physics_list = FTFP_BERT_LIV;

■ 粒子源设置

A. 中心为像素阵列上方 (0,0,1) mm;

- 粒子源为50um*50um的正方形平面;
- 各向同性发射;
- θ角为0~45° && ∅角为0~360° ;

B. 位置为像素阵列上方 (0,0,0.5) mm;

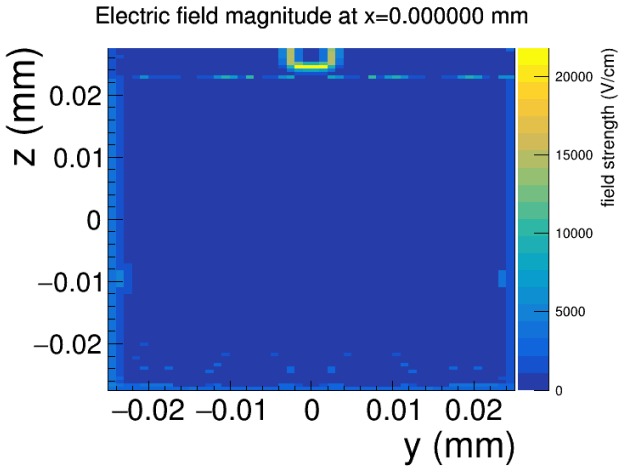
- 种类为 Fe55放射源;

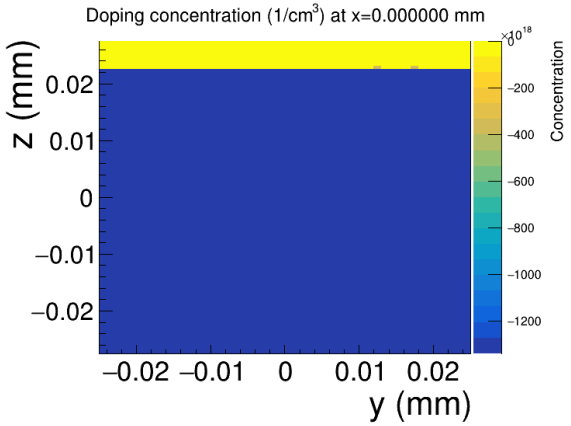
■ 电场分布

- 从TCAD中导入对应的电场分布文件;

■ 掺杂浓度分布

- 从TCAD中导入对应的掺杂浓度分布文件;
- (Epi: $1.68e^{15}/cm^3$ $[8\Omega \cdot cm]$; Sub: $1.34e^{21}/cm^3$)





■ 载流子传播（manual 6.2&6.3）

- 设置的传感器温度: 300K
- 载流子迁移率模型: masetti_canali (与掺杂浓度相关)
- 载流子寿命&复合模型: srh_auger (与掺杂浓度相关)