

# Summary of miniBETA trigger and cell behaviour simulations

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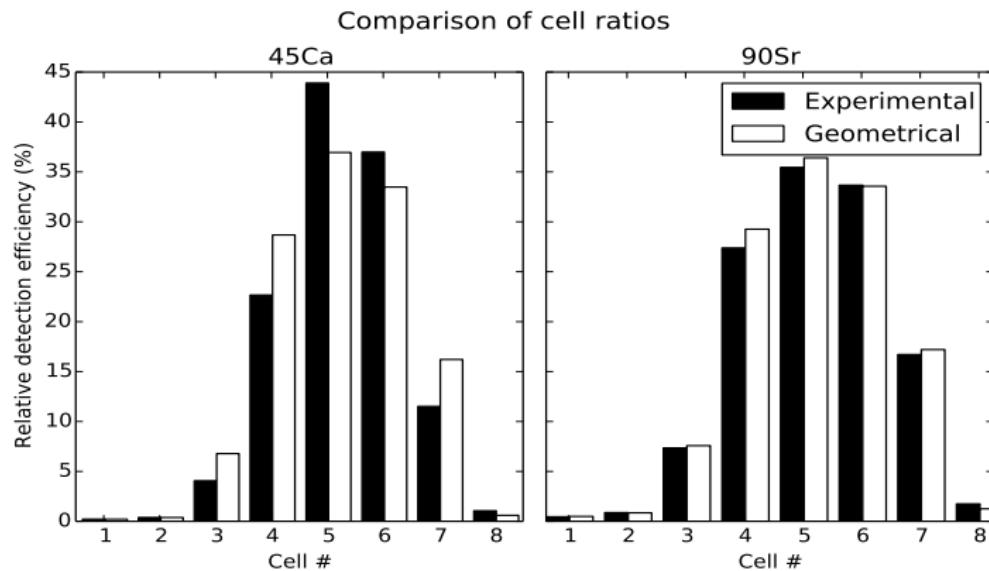
## 1 Geant4 Trigger Study

## 2 Single Cell Behaviour

# Problem

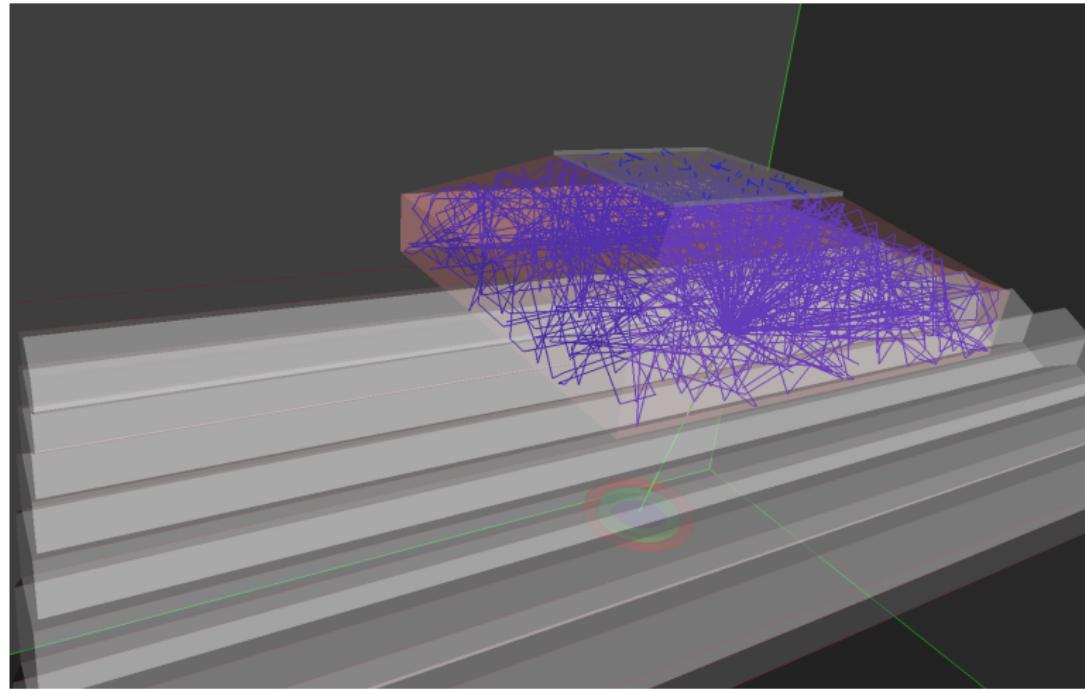
miniBETA requires coincidence between chamber and trigger: cell ratio's in single plane should be geometrical

Experimentally, however:

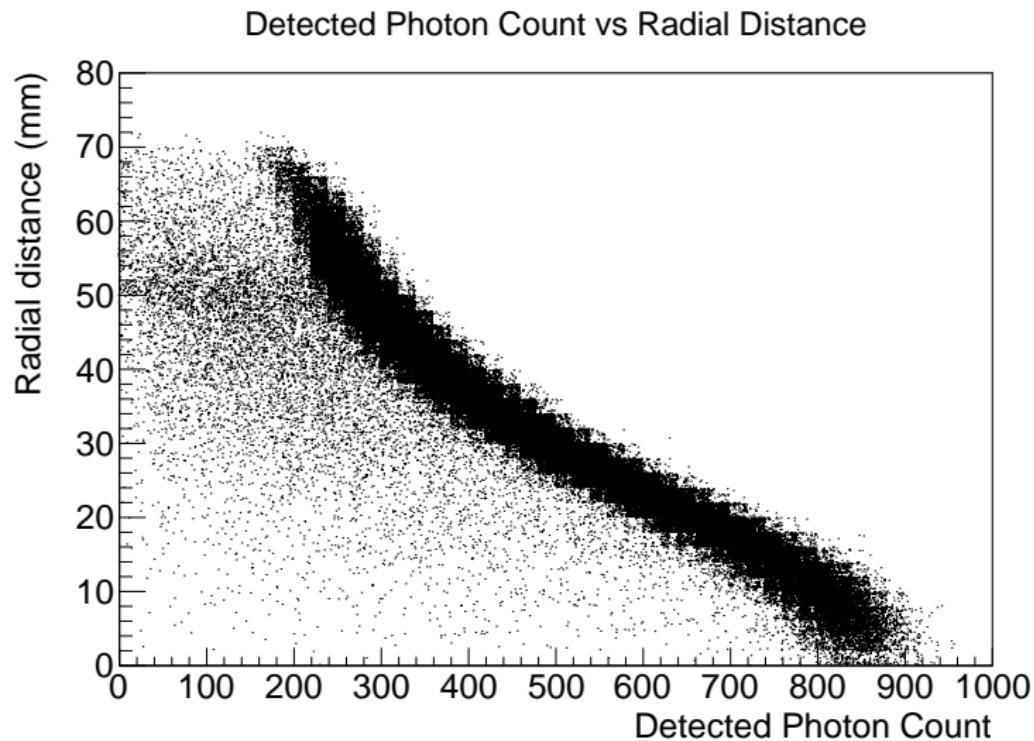


# Scintillator study

Inefficient scintillator: do proper scintillation propagation

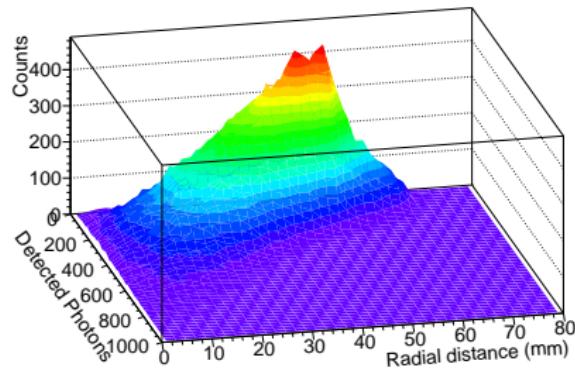


## Example: Monoenergetic electron

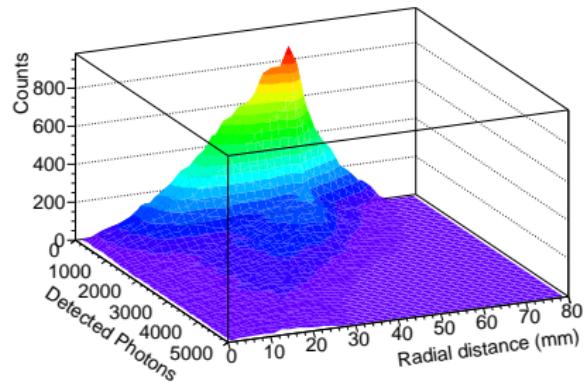


# Light maps

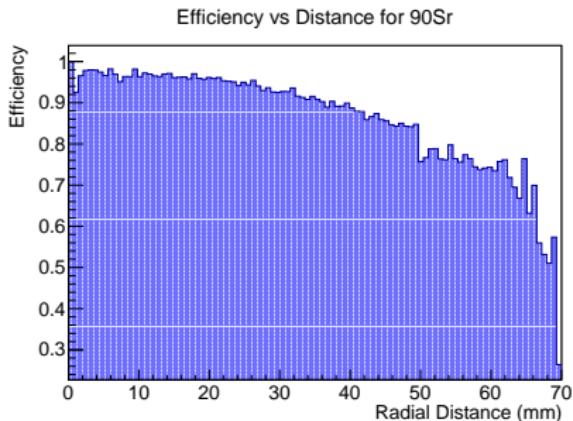
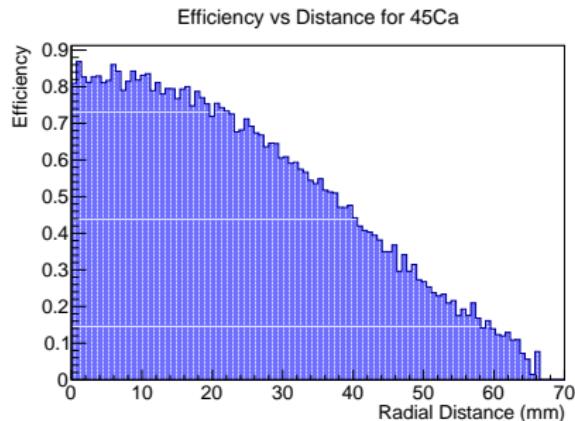
Detected Photon Count vs Radial Distance For  $^{45}\text{Ca}$



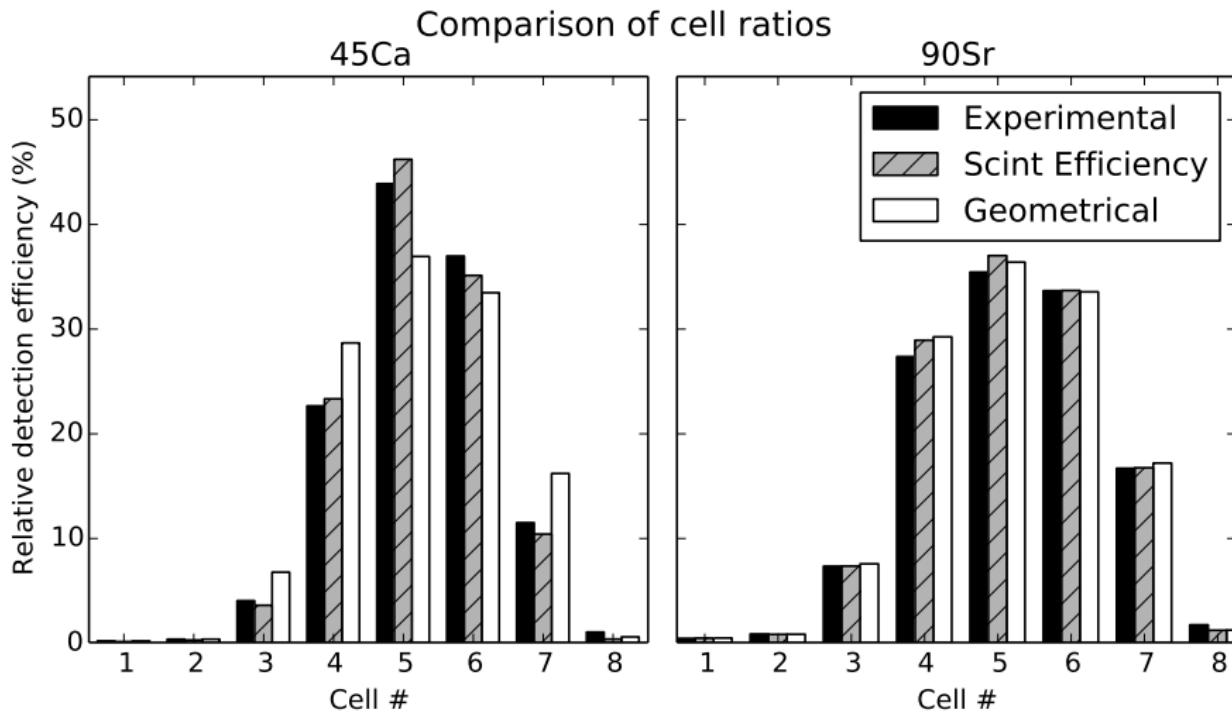
Detected Photon Count vs Radial Distance for  $^{90}\text{Sr}$



# Efficiency curves

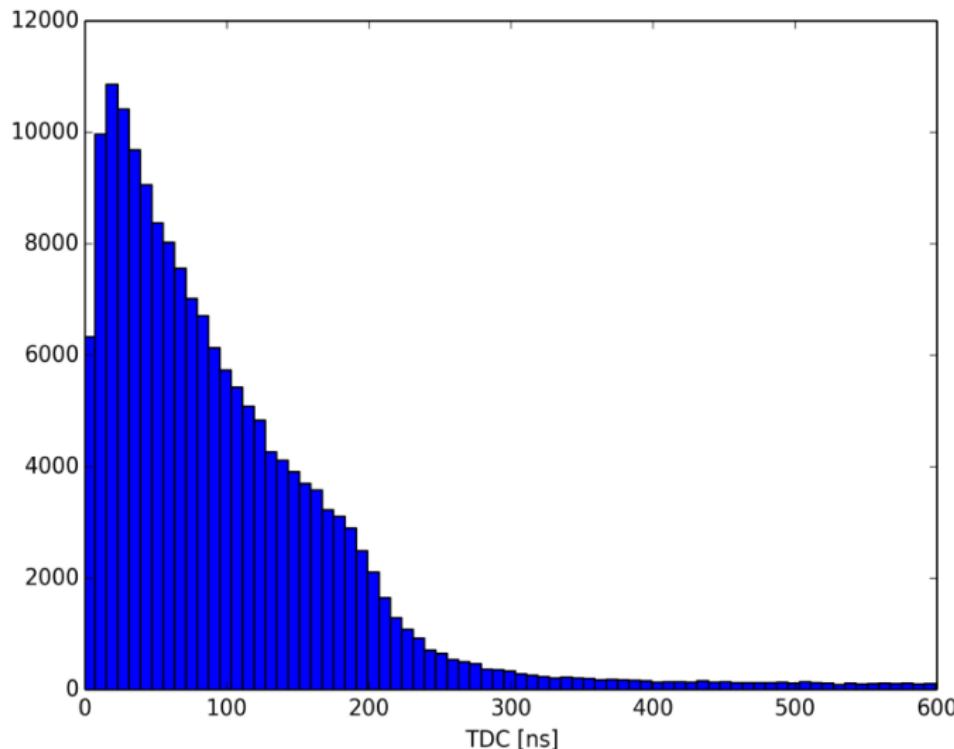


# Cell ratios



# TDC Spectrum

Goal is to explain experimental TDC shape



Three necessary parts

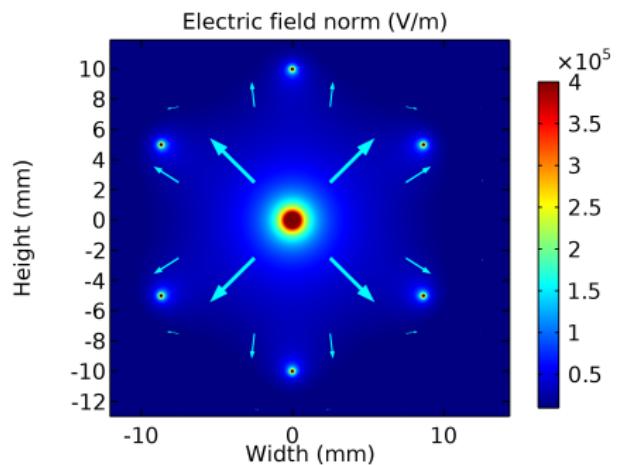
- ① Geometrical cell illumination
- ② Electric field inside hexagonal cell
- ③ Propagation of electron in hexagonal cell

Three necessary parts

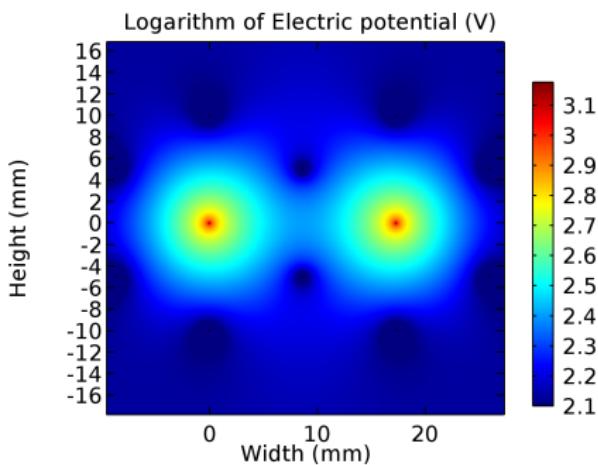
- ① Geometrical cell illumination: **Geant 4**
- ② Electric field inside hexagonal cell: **COMSOL**
- ③ Propagation of electron in hexagonal cell: **Custom code**

Focus on topics 2 and 3

# Electric fields



(a) Single cell



(b) Symmetry breaking

# Electron propagation

Consider *average* movement of electron in electric field.

$$m_e \frac{d^2 \vec{x}}{dt^2} = q \vec{E} - K \frac{d\vec{x}}{dt}$$

where

$$K \propto \sqrt{\frac{\sigma}{E}} \frac{1}{\lambda^{1/4}}$$

with  $\sigma(E)$  cross section and  $\lambda(E)$  fractional energy loss

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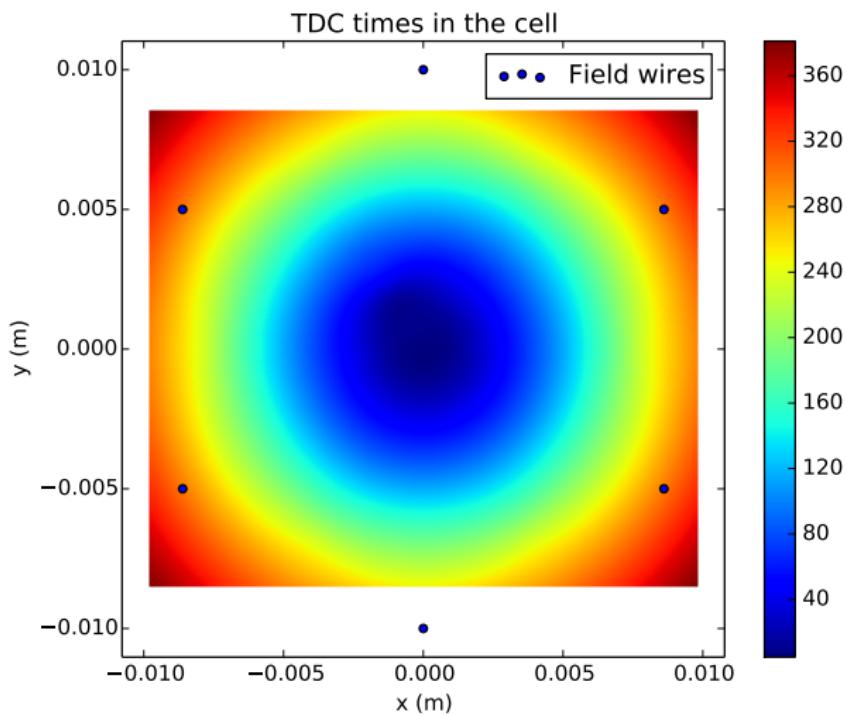
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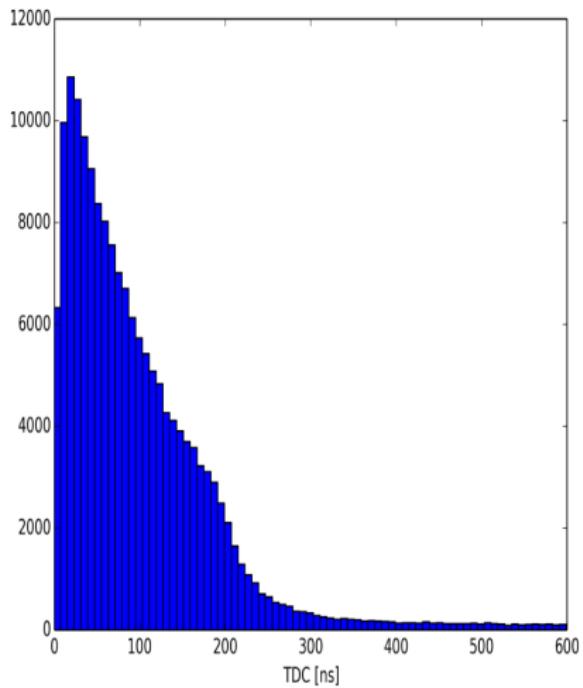
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Integrate equation of motion to get TDC time vs position in cell

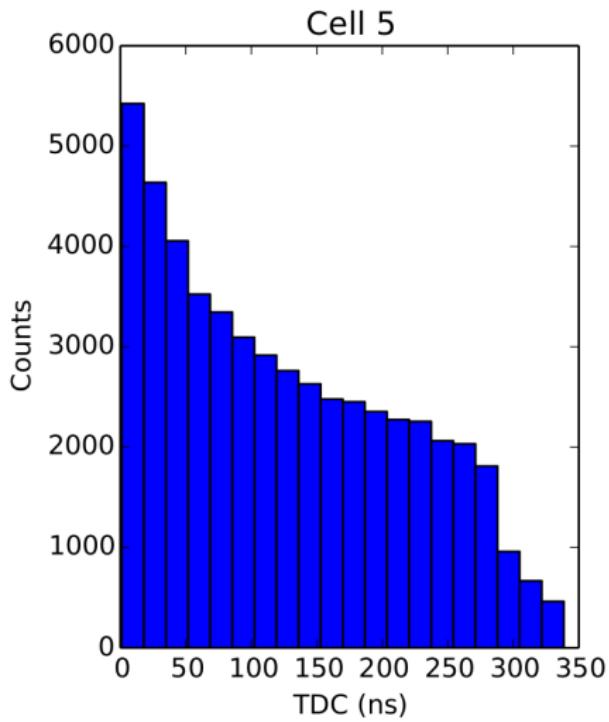
# TDC in cell



# TDC Spectrum



(a) Experimental



(b) Simulated

# Stability struggles

