Geant4 Evaluation and Optimization of Portable Faraday Cup

Overview

- Evaluation (% charge defect [%cd])
  - HIT, Geant4

- Optimization
  - MCNP6: Height, Radius
  - Geant4: film thickness, %cd minimization

- Validation
  - G4 Energy Spectra, go99 branching ratios

- Discussion
  - Dosimetric quiver plot, Deposition Histogram

Evaluation

Charge defect = ([q_in – q_out] – q_beam)/q_beam

- Assumption:

Deposition/Removal of charge in Kapton produces mirror charge in Copper with magnitude linearly proportional to depth in Kapton between Copper and Silver interfaces

Evaluation

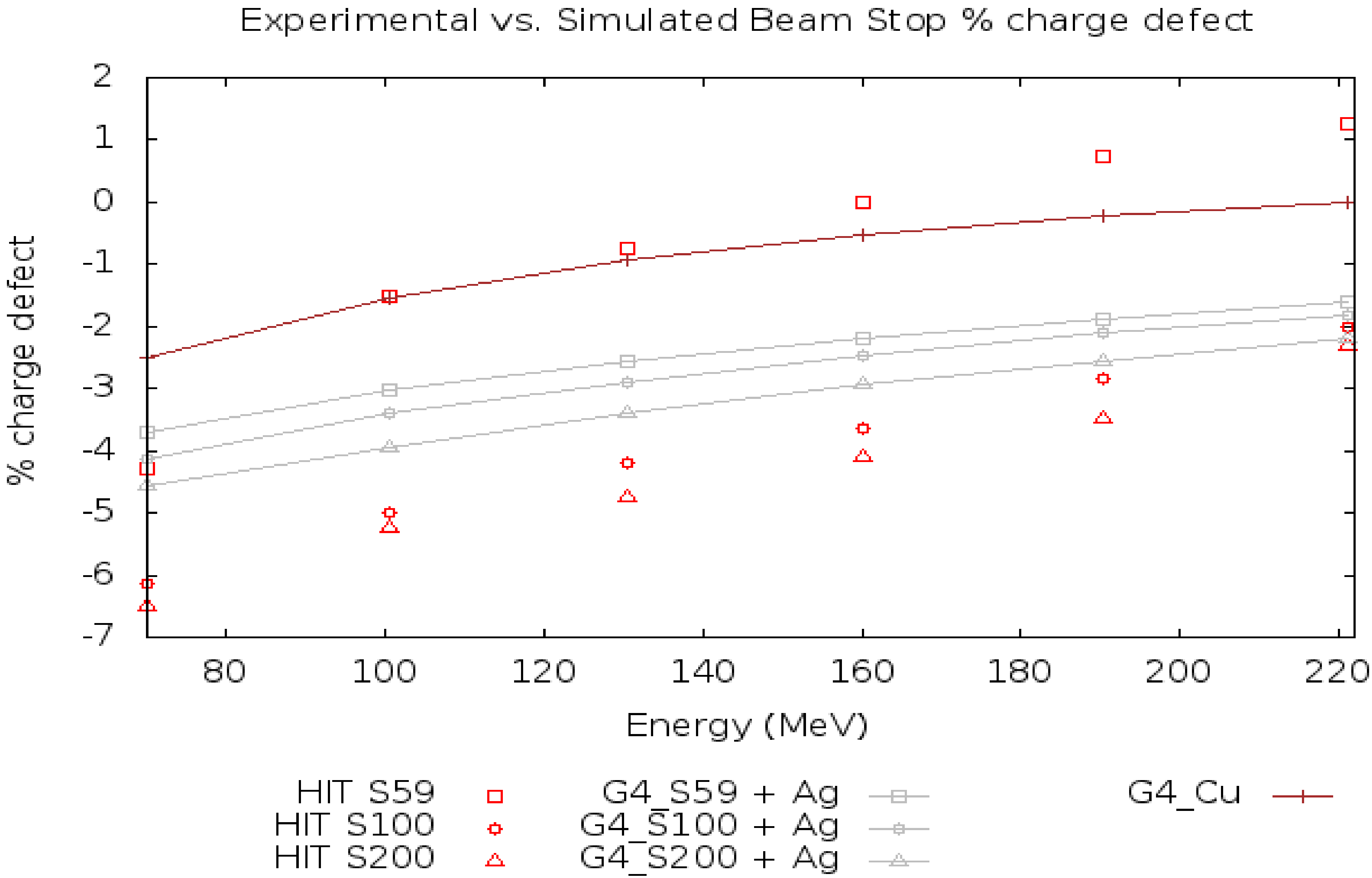

Fig 1: Comparison of Geant4 and HIT Experimental charge defect measurements

Optimization

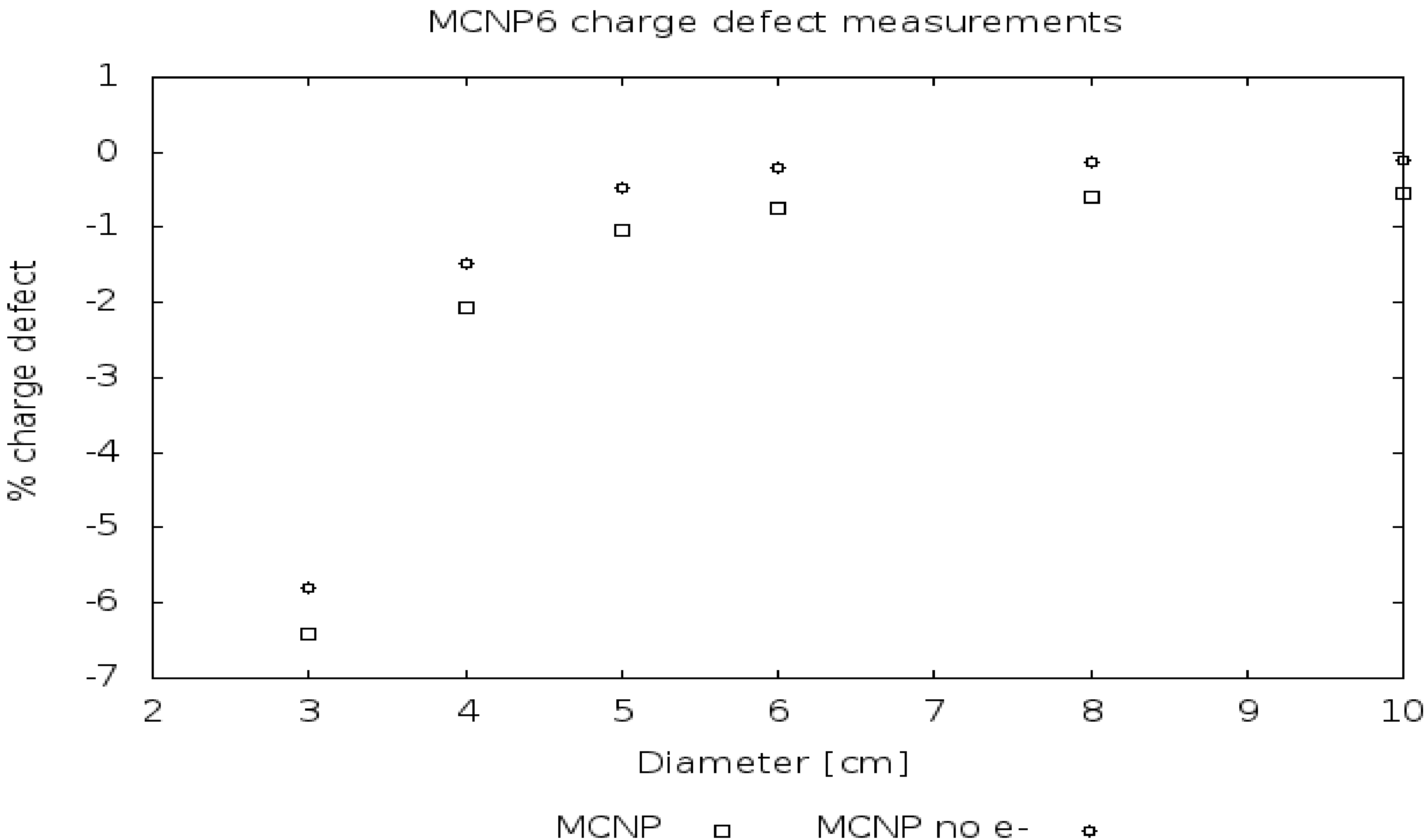

Fig 2: Charge defect measurement for coarse device dimension optimization

Optimization

- Goal: Minimize |%cd| by fine-tuning dimensions

- Thus:
  - Obtain functional Kapton thickness of energy such that [%cd](E=X, t_KA=Y) = 0

  - Preliminary results show Y=36 microns when X=160 MeV

Validation

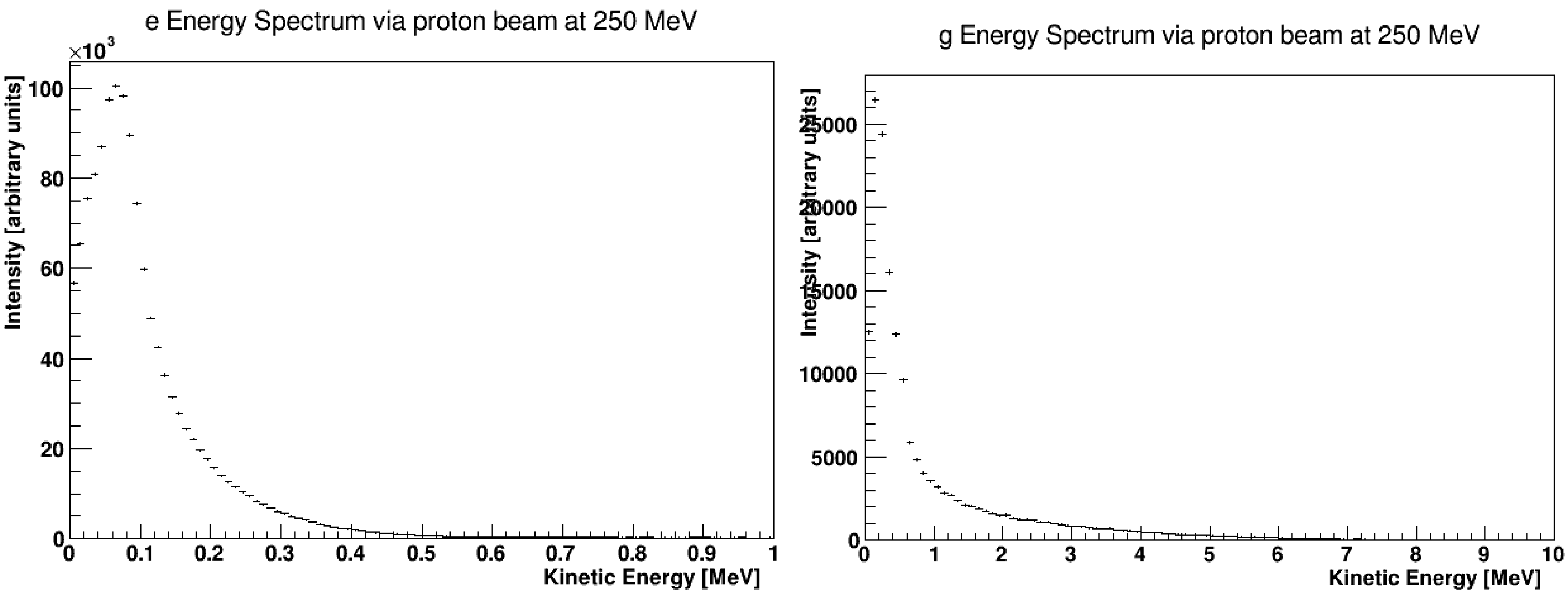

Fig 3: a) Beta spectra and b) gamma spectra in Copper via Geant4

Discussion

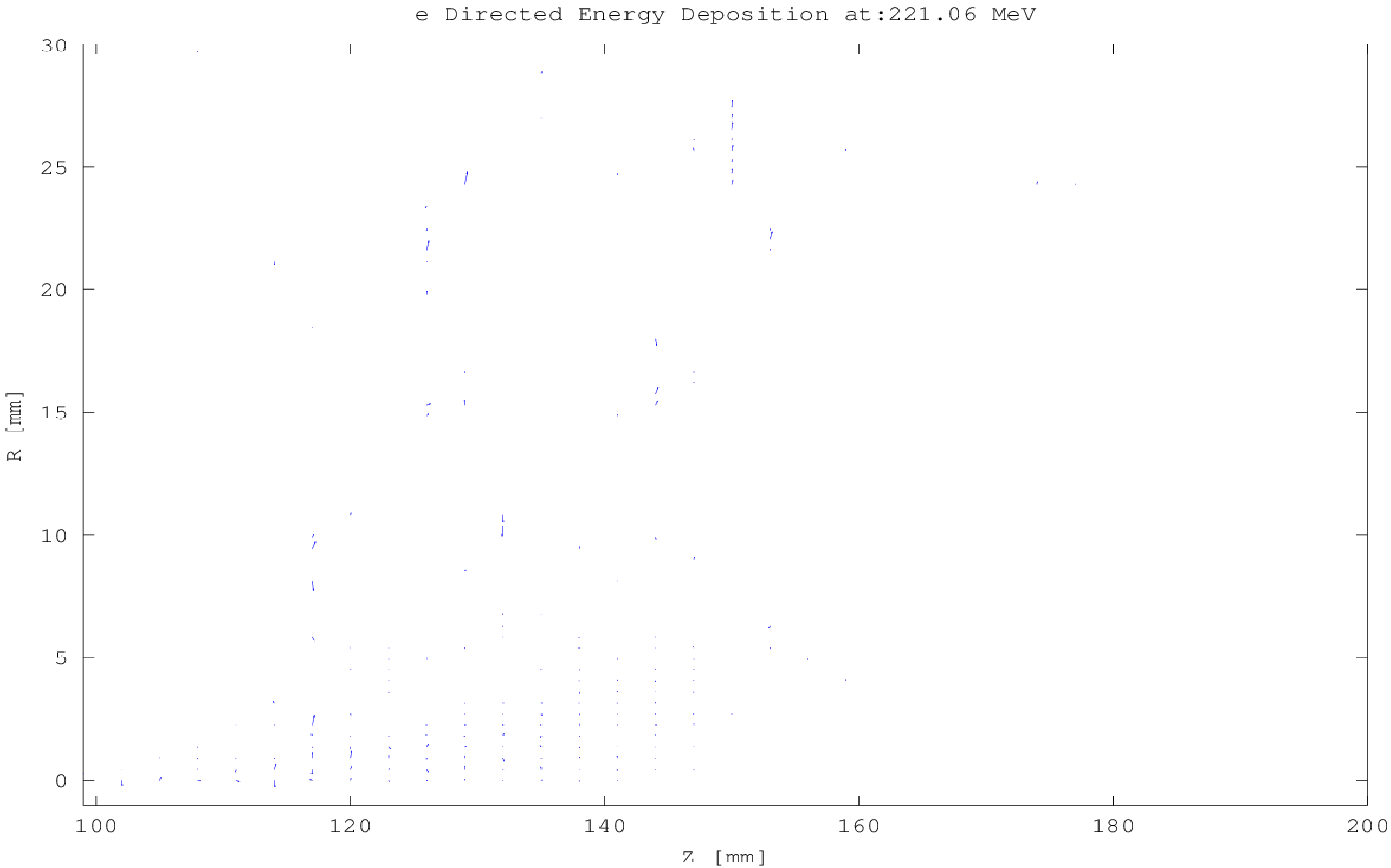

Fig 4: Energy deposition gradient for electrons via Geant4; note both spray and halo/aura presence

Discussion

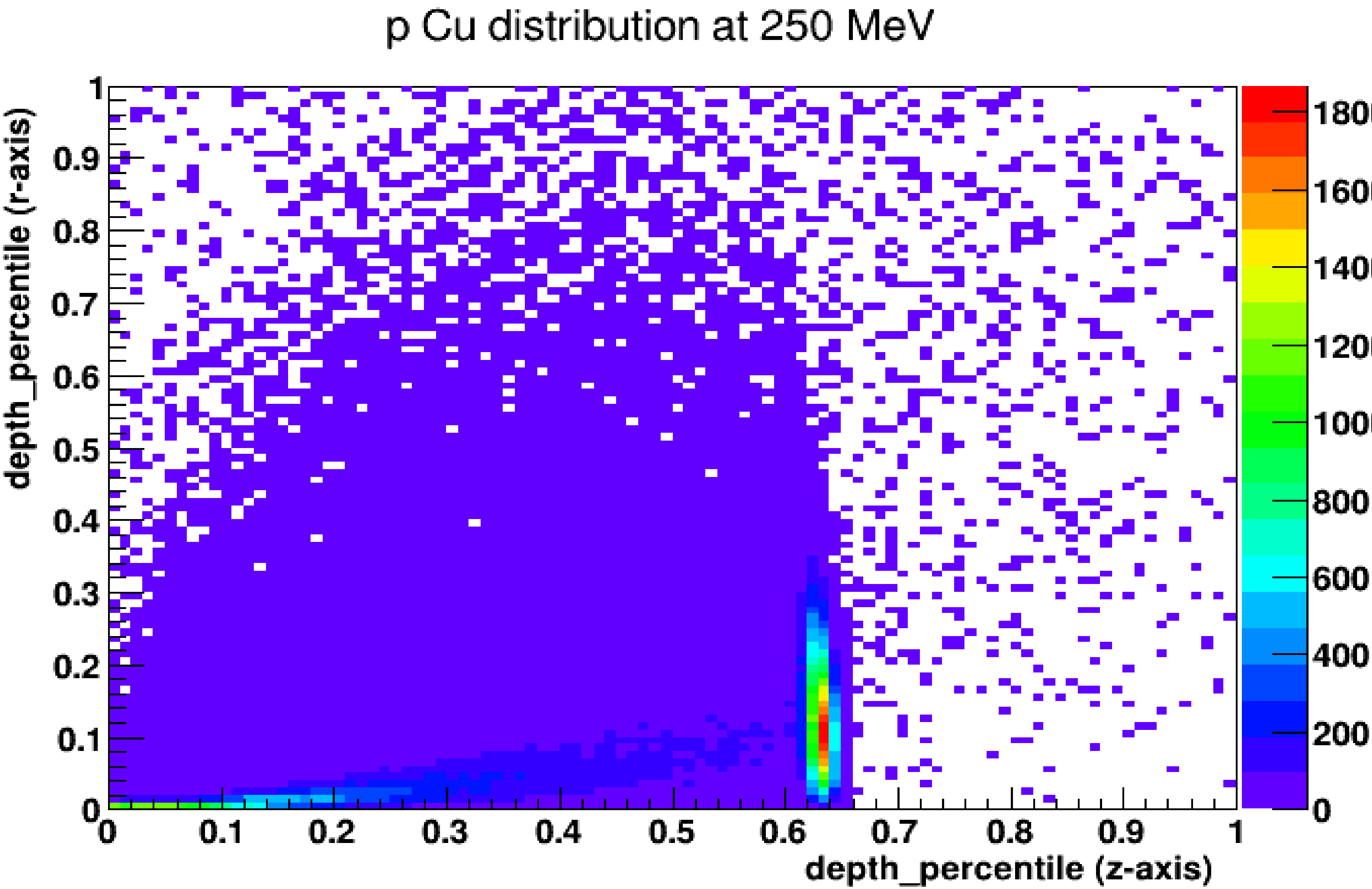

Fig 5: Proton deposition count in Copper via Geant4

Discussion

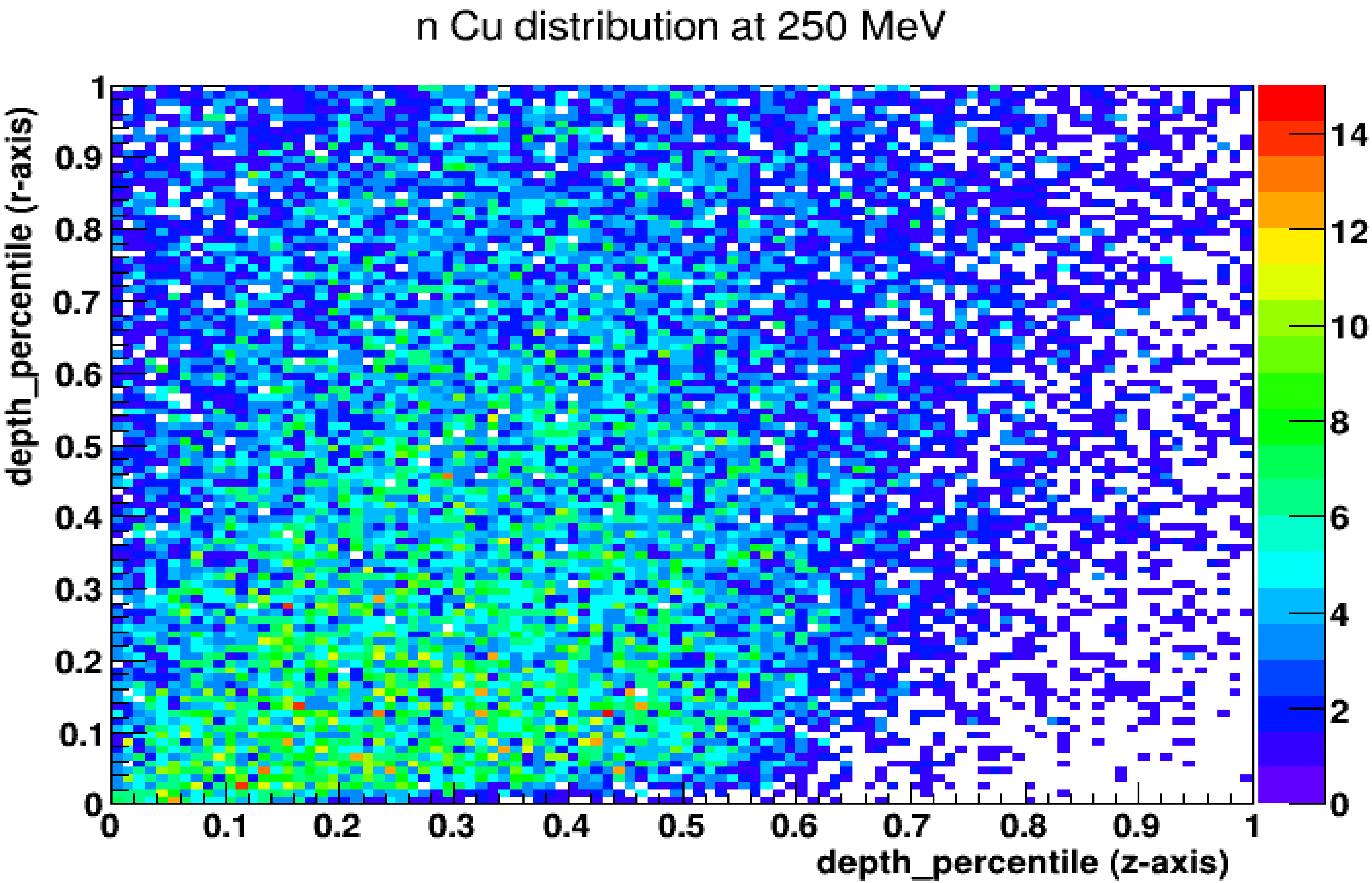

Fig 5: Neutron deposition count in Copper via Geant4