EGS4 Simulation of Target Heating from Photon Beam

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Photon Absorption in a Material

$$I = I_0 e^{-x\mu}$$

$$\mu = \mu(\rho, Z, E)$$

$$\Delta I = I_0 - I = I_0(1 - e^{-x\mu}) \approx I_0\, x\mu$$

EGS4

- A Monte Carlo Simulation Tool
- Simulates Coupled Transport of Electrons and Photons
  - Any Material
  - Brehsstrahlung, Moller, Bhabha, Pair Production, Compton, Rayleigh..
  - Arbitrary Geometry
  - Energies from 10's of KeV to Thousands of GeV
- Convenient Method of Determining I/I_0
- EGS4 User Code XYZDOS
  - Dose Output in a Given Region
  - Cartesian Coordinates
- Magnetic Field Using Additional Macros

EGS Inputs

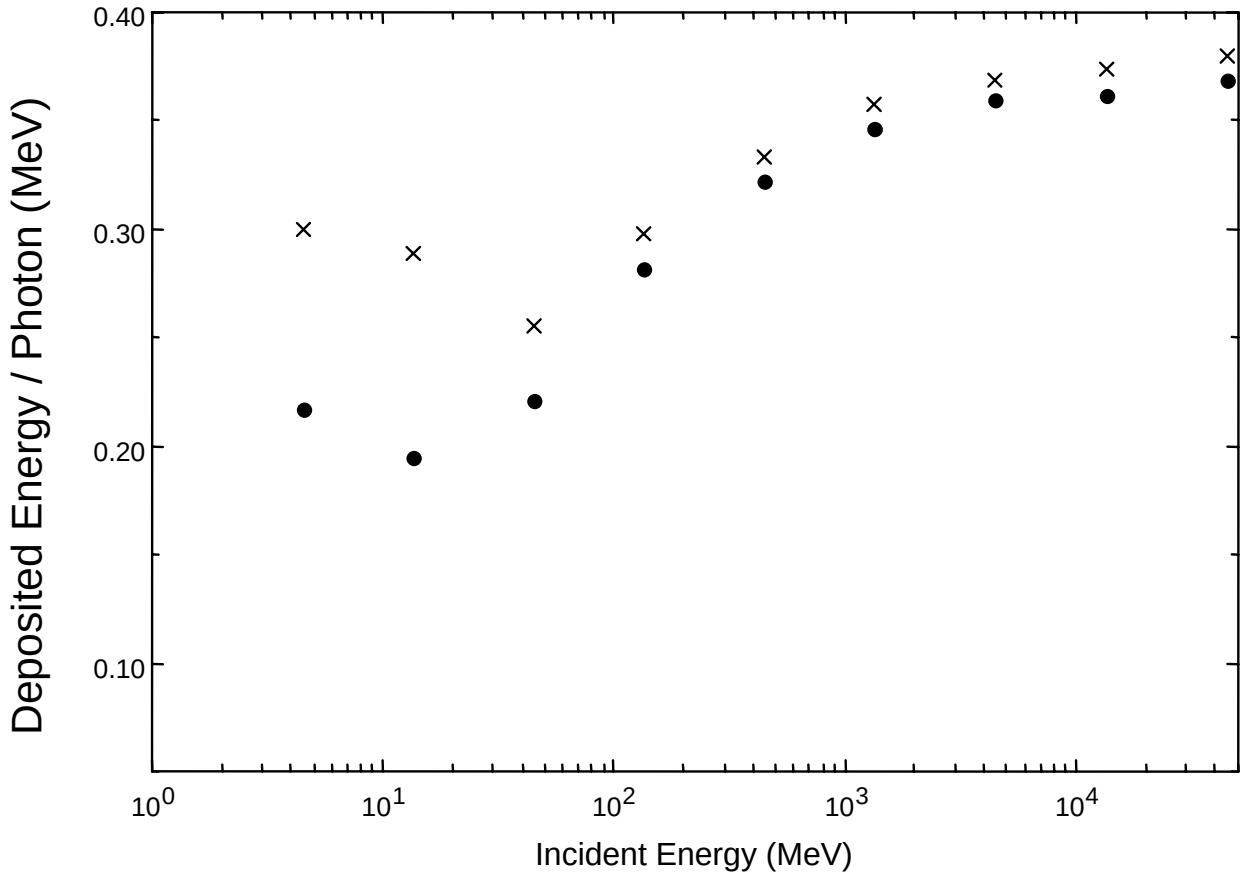
Geometry

- 1cm Diameter 8cm Long Cylindrical Target
- 0.127 mm Aluminum End Window
- Divided into .5cm regions in Z (longitudinal) and .06 cm Regions in X and Y(transverse)

Sample Composition

- 95.4% ^{6}Li and 4.6% ^{7}Li
- 60% LiD and 40% ^{4}He

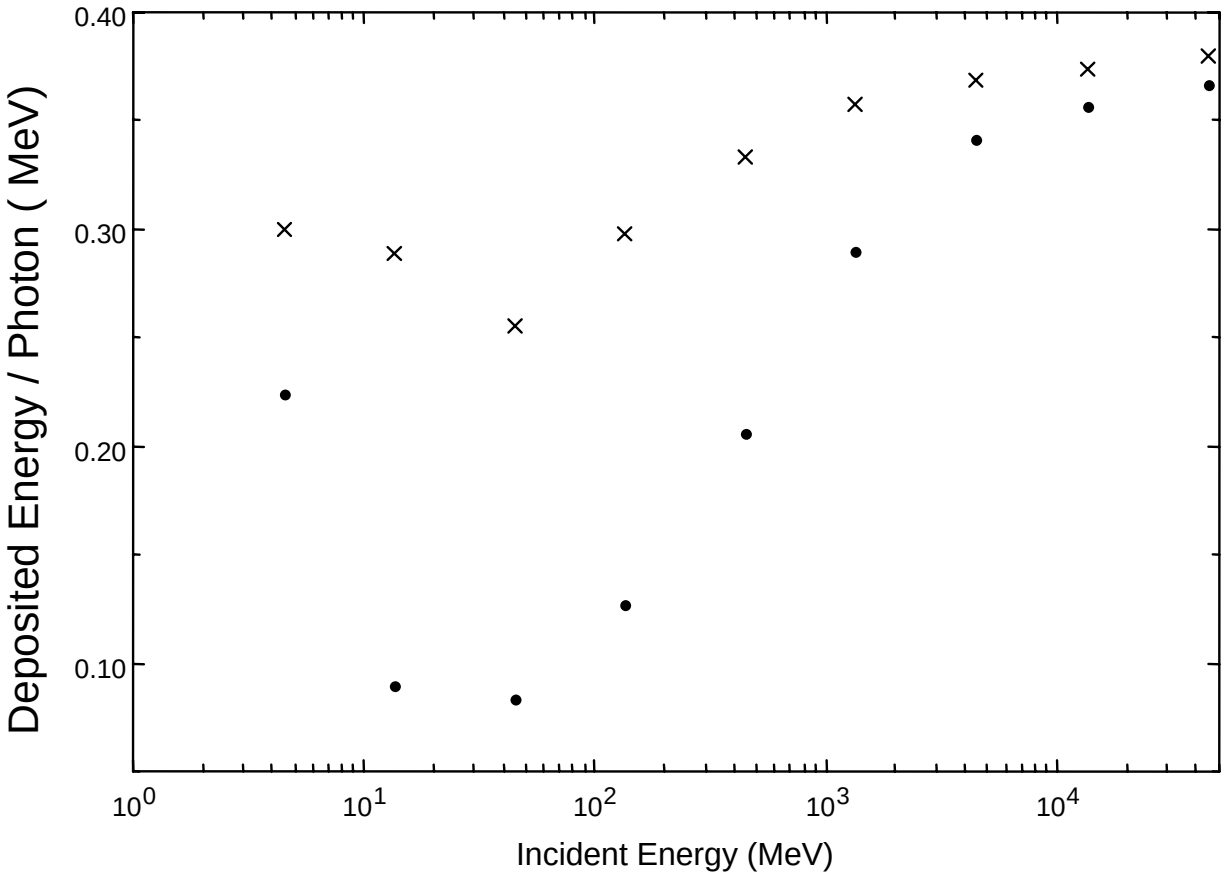
Effects of Magnetic Field



• 0T B Field

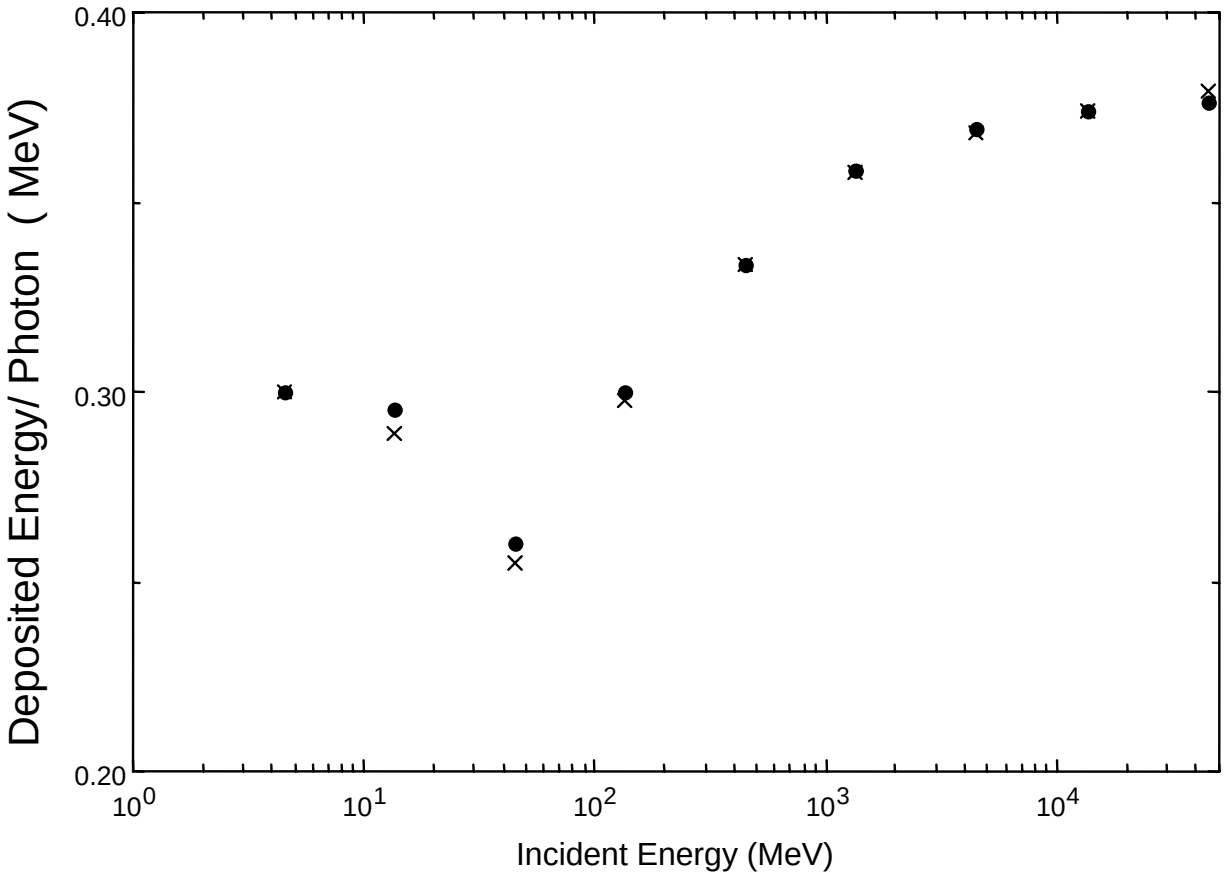
× 6.5T Longitudinal B Field

Effects of B Field Direction



- • Y Direction (Transverse) 6.5T B Field
- × Z Direction (Longitudinal) 6.5TB Field

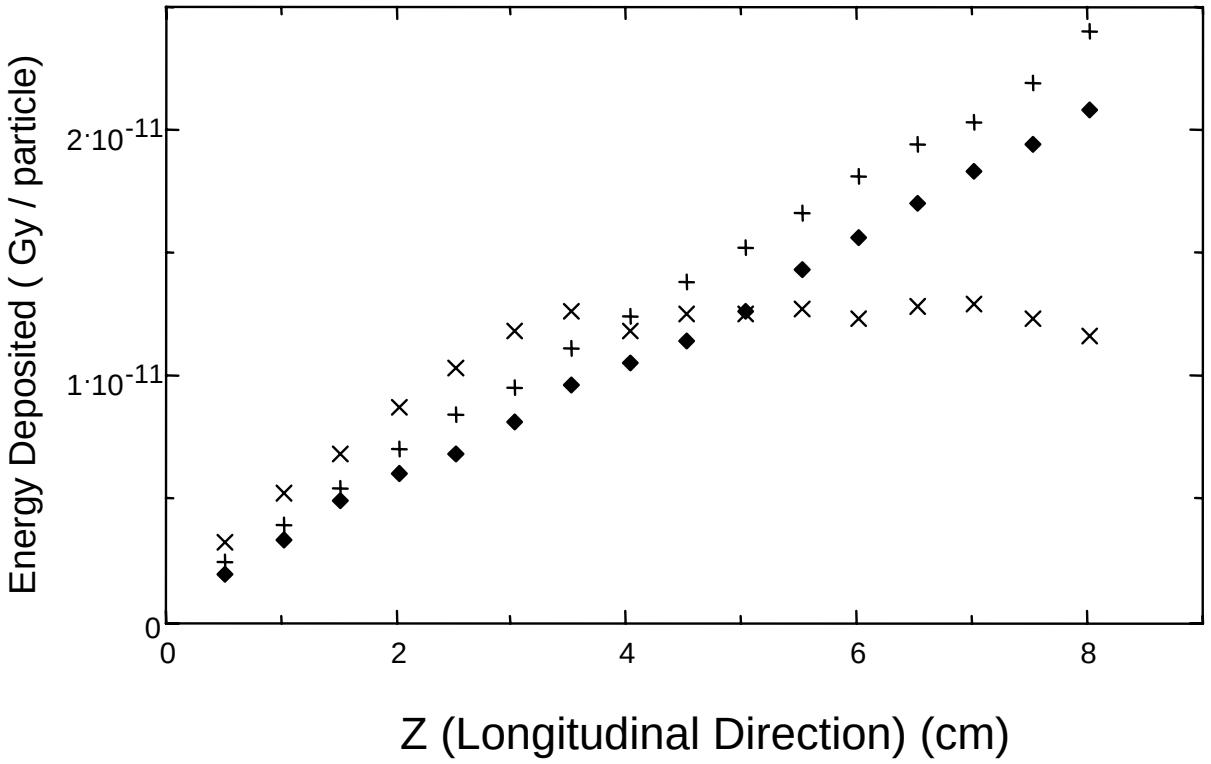
Effects of Incident Beam Area



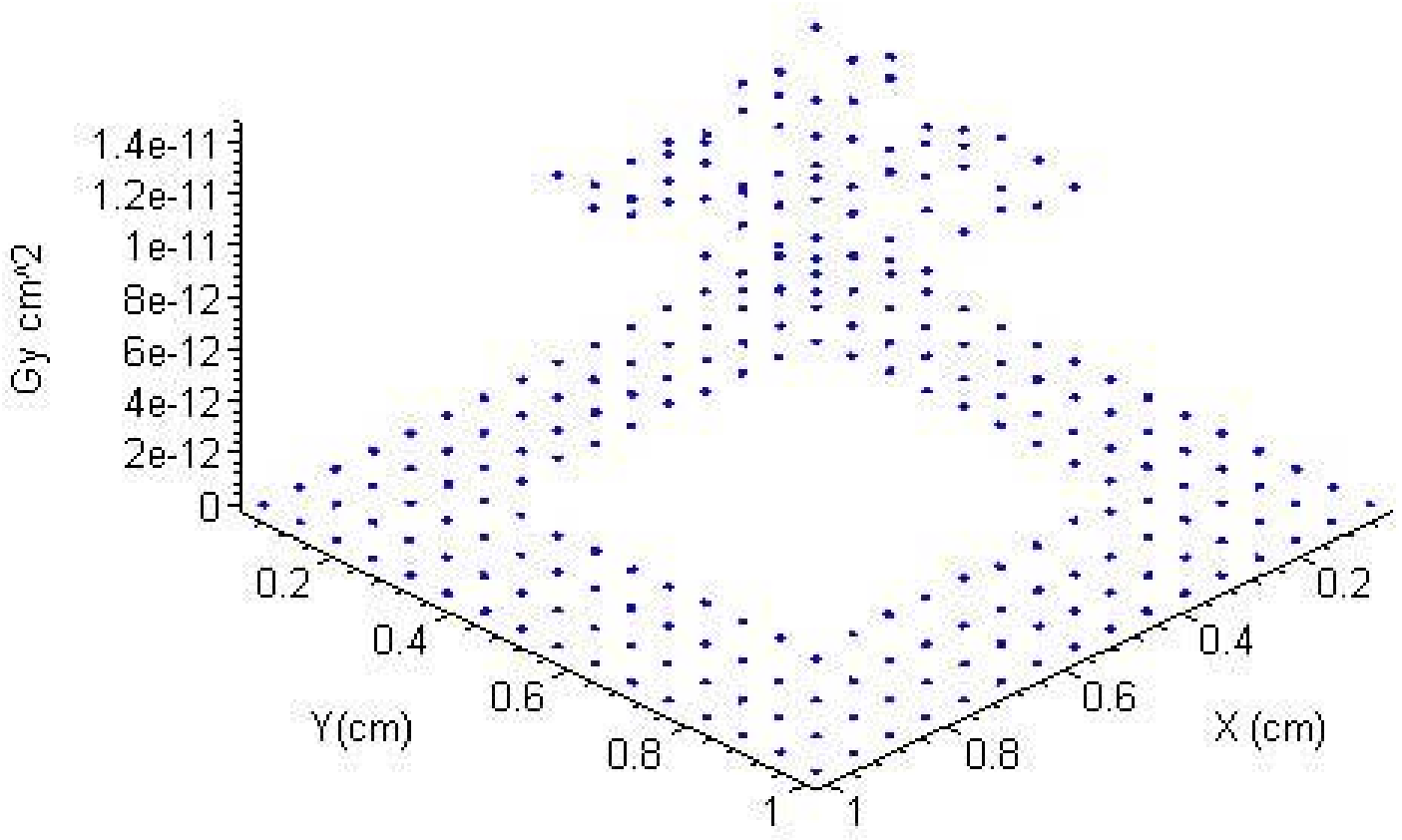
• .5 cm Incident Area

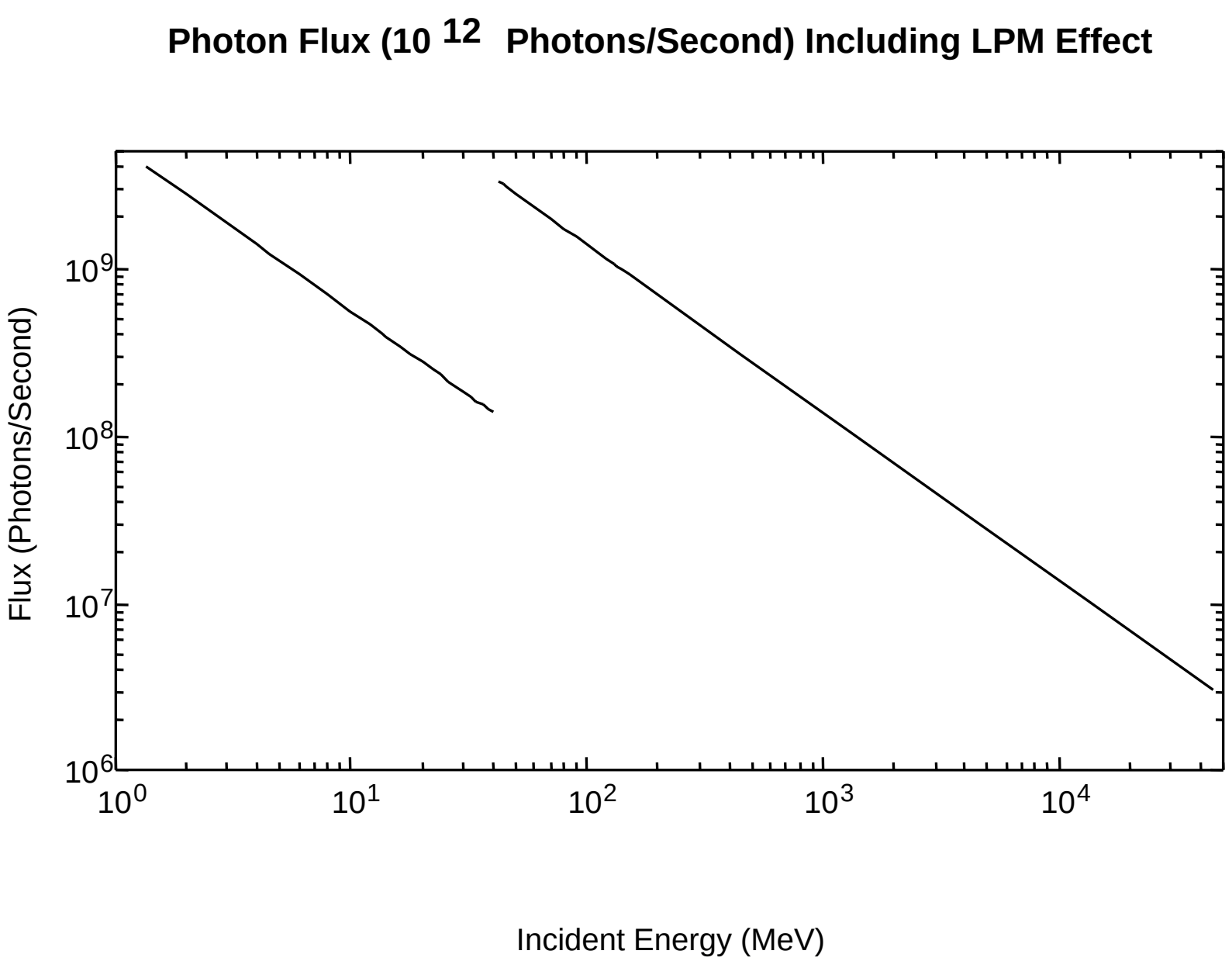
× 0 cm Incident Area

Energy Deposited vs z

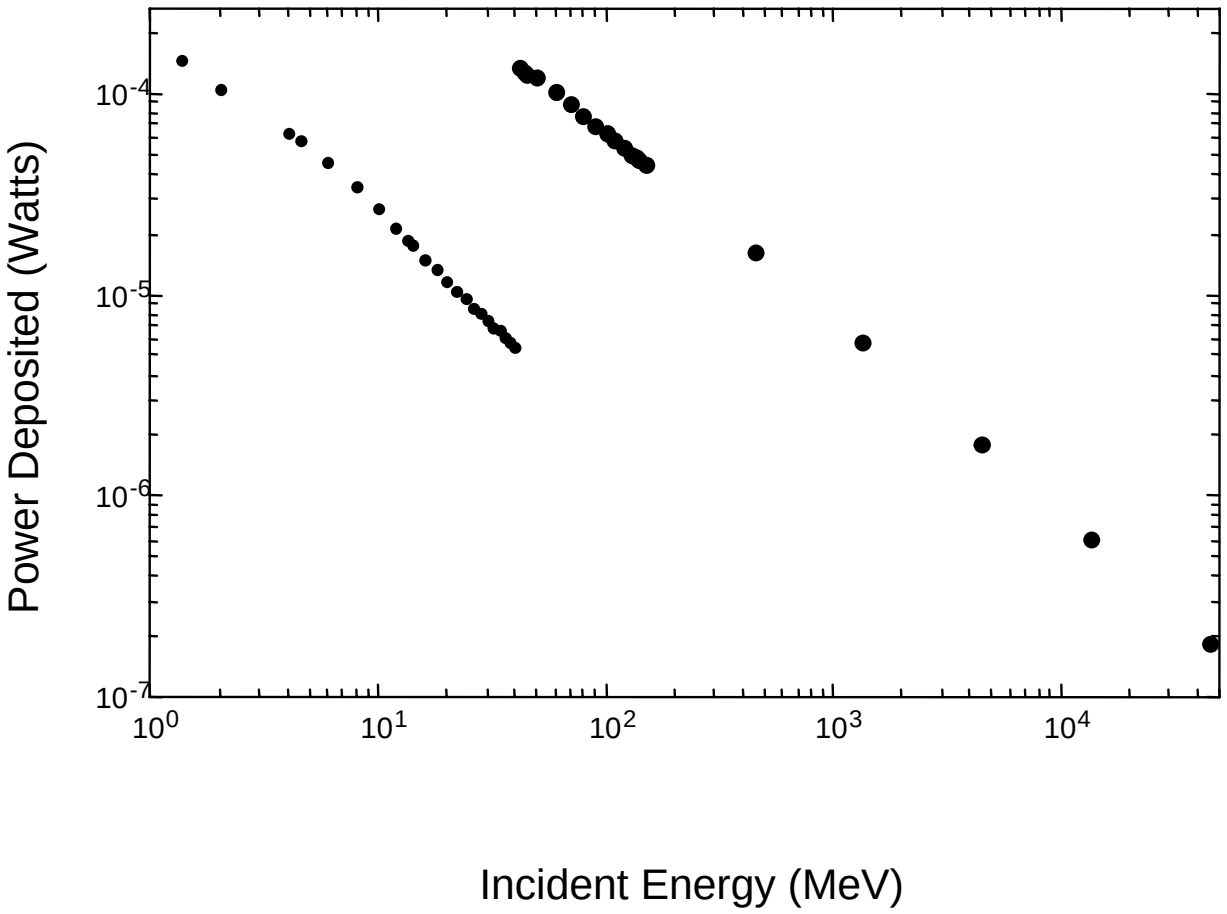


Energy Deposited vs X and Y




Photon Flux (10 12 Photons/Second) Including LPM Effect
Flux (Photons/Second)
10^9
10^8
10^7
10^6
10^0
10^1
10^2
10^3
10^4
Incident Energy (MeV)

Power Deposited (10^{11} Photons / Second)



Low Energy Photons ≈ 1.2 mW
High Energy Photons ≈ 51.3 mW

Conclusions

- Magnetic Fields < 16 mW
- Incident Area < 1mW
- Energy Deposited in Incident Area
- 10^{12} Photons/Second
- Photon Flux
  - $\propto 1/k$ > 40 MeV
  - LPM Effect
    - $\propto k/25$ < 40 MeV
- 52.5 mW Power Deposited