Queen Mary University of London
Science and Engineering

LhARA
Laser-hybrid Accelerator for Radiobiological Applications

# Optical simulations of SmartPhantom

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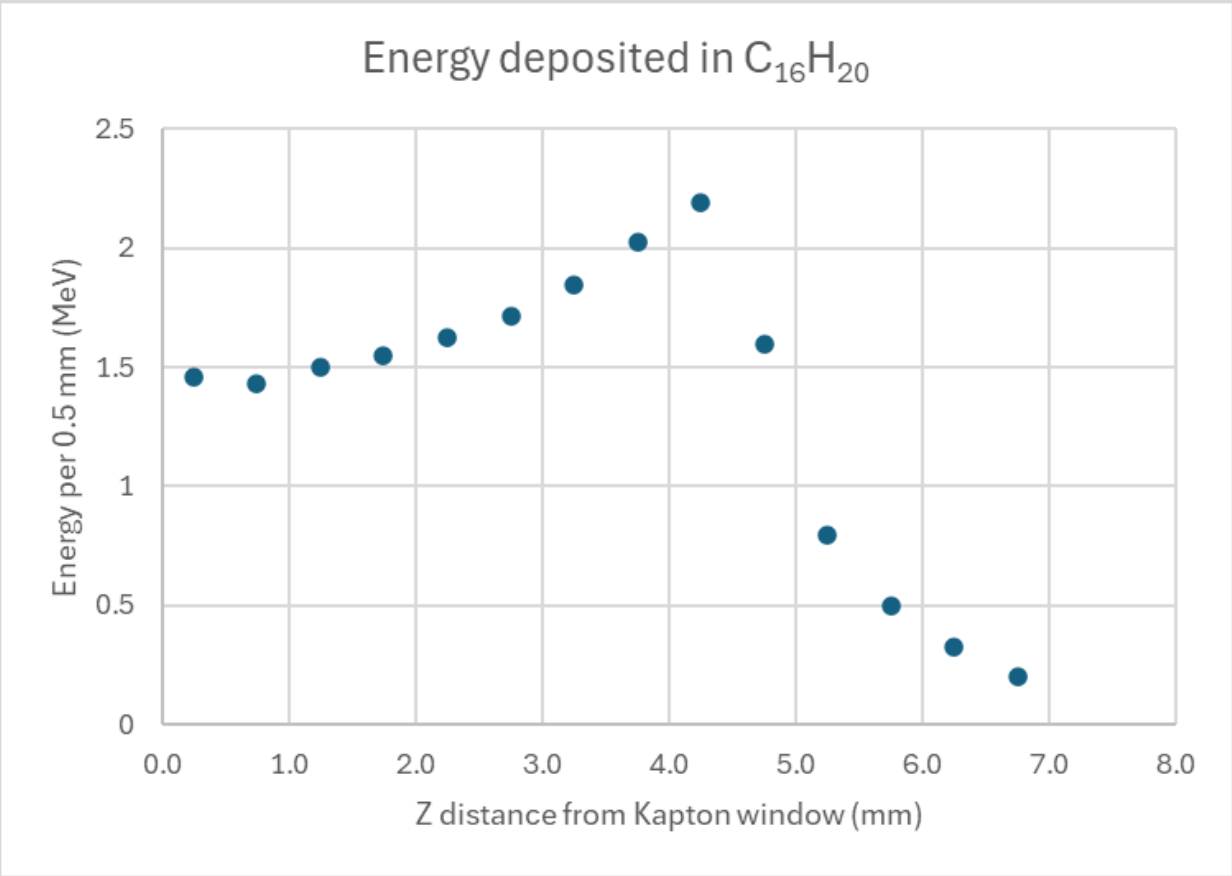
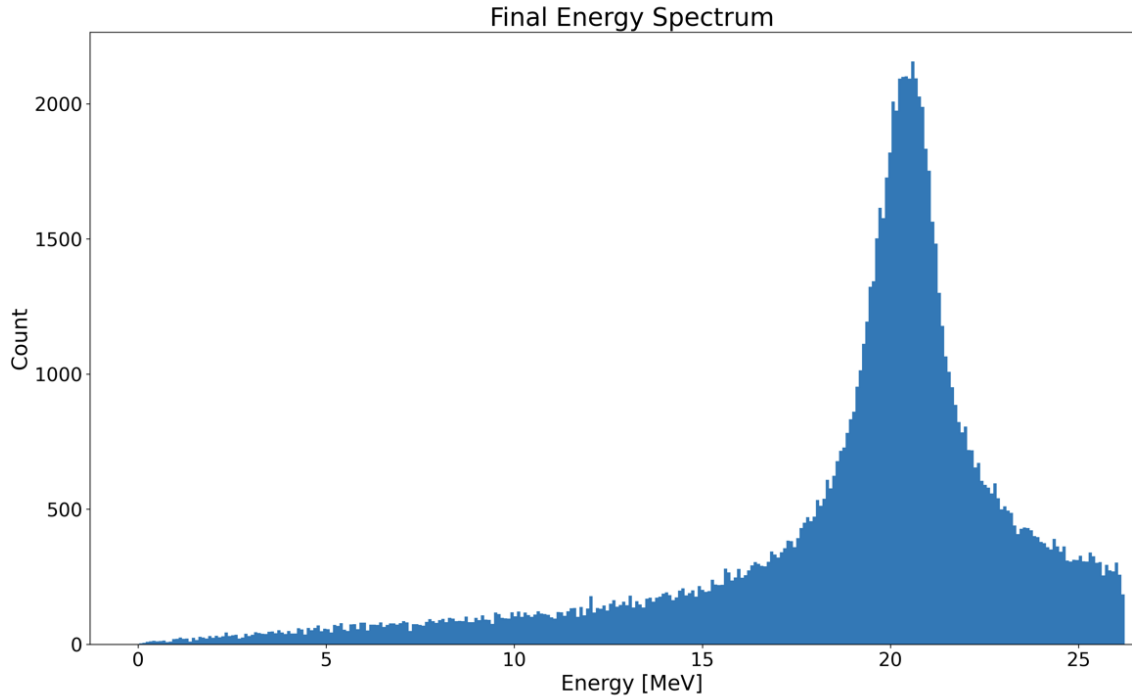
# Deposited Energy in DIPN

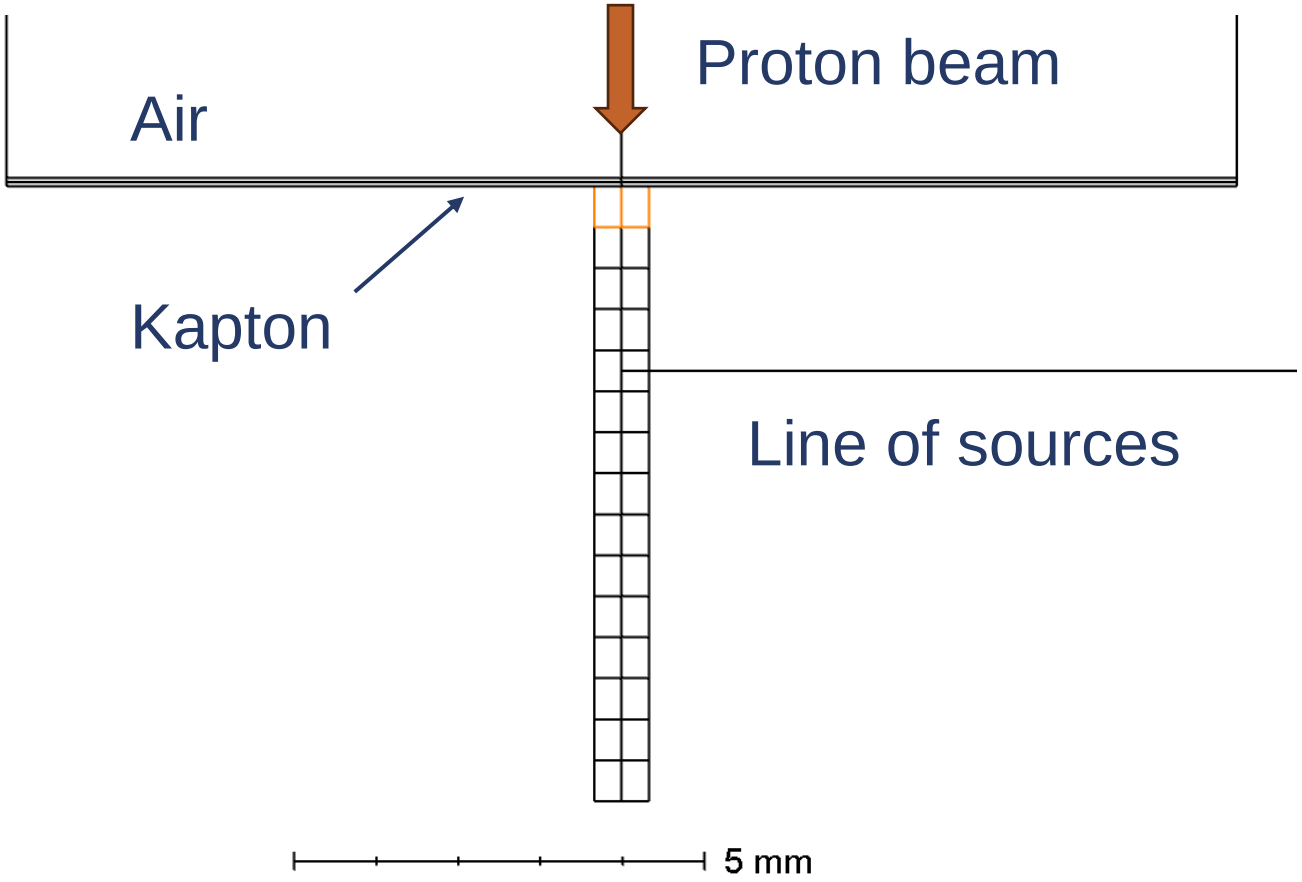
## Simulations by Maria Maxouti (IC)

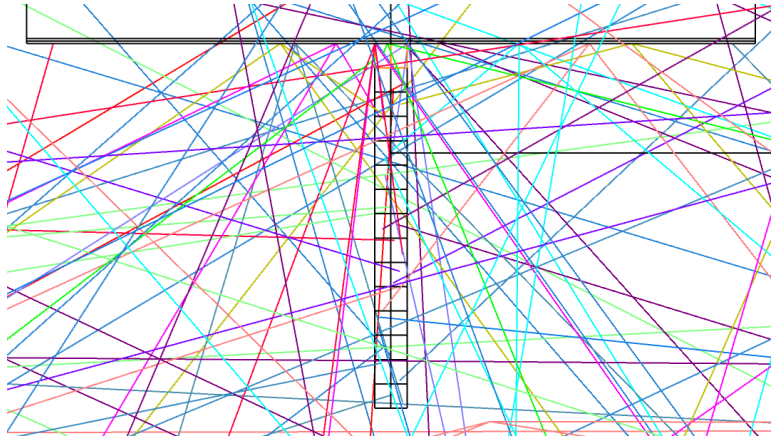
The figure shows the average energy deposited in the simulated DIPN. Peak Beam energy (just before air and Kapton window) is 19.1 MeV.

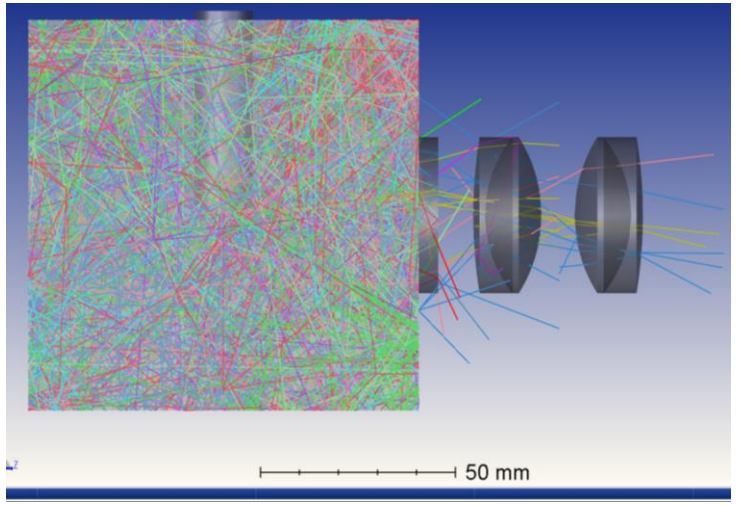


# Source model



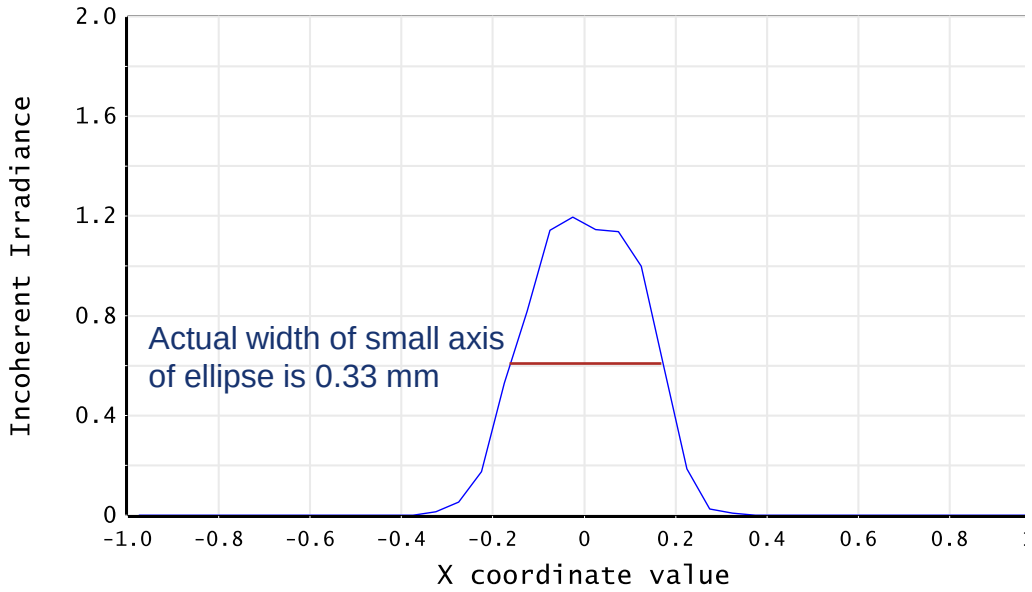





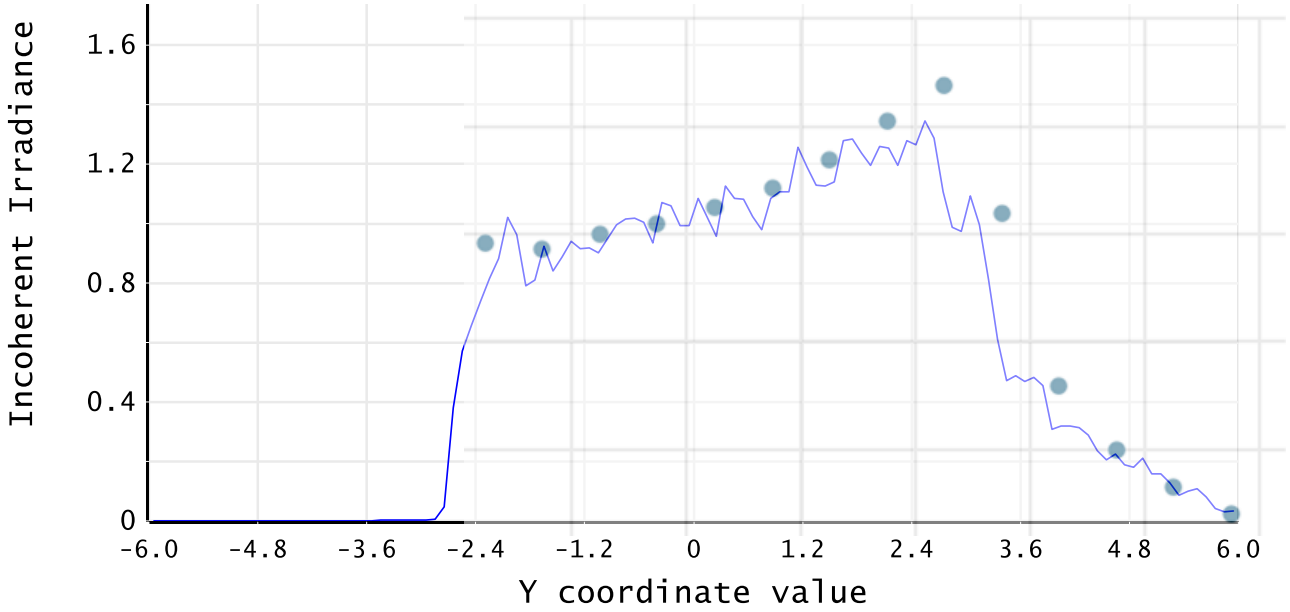

Source of scintillation photons is modelled as a line of elliptical elements each emitting isotropically. Intensity and # of photons are weighted by the Geant4 energy deposited in each 0.5 mm long elliptical cylinder.

Only 2 primary rays per source are generated in this ray trace. Ray splitting and scattering are switched on.

# Simulated image on camera (from talk of 27 February)




Cross-section through column near peak energy deposit




Cross-section along column centre. Maria's Geant4 simulation **is overlaid on top to give a qualitative idea of reconstruction.**

NOTES

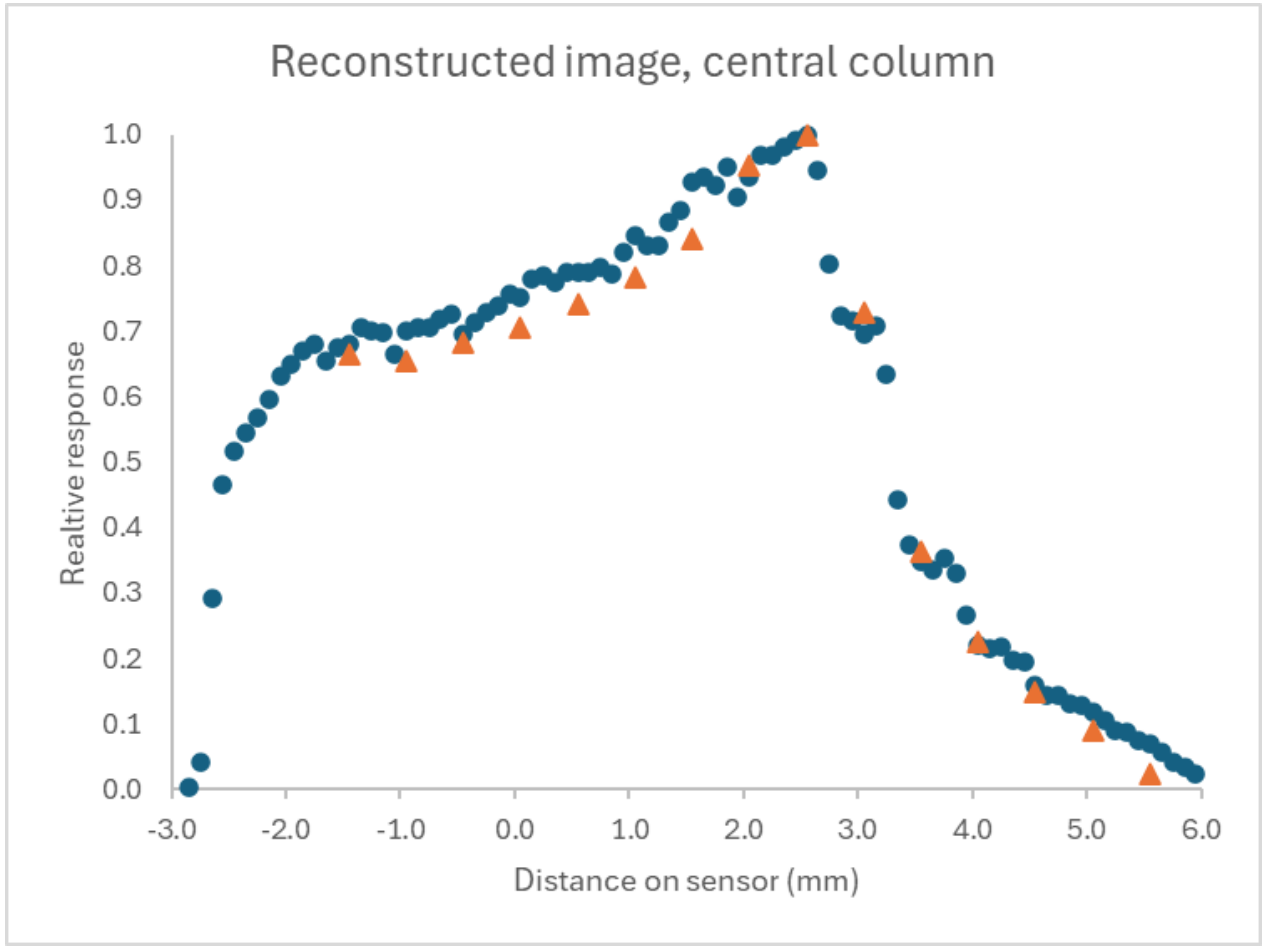
50 μm × 100 μm pixels

# Simulated image on camera

Cross-section along column centre. Image is shown as blue dots, Maria's Geant4 simulation as orange triangles.

Both data sets were normalised to area and then normalised to unity at the peak (2.55 mm on x-axis).

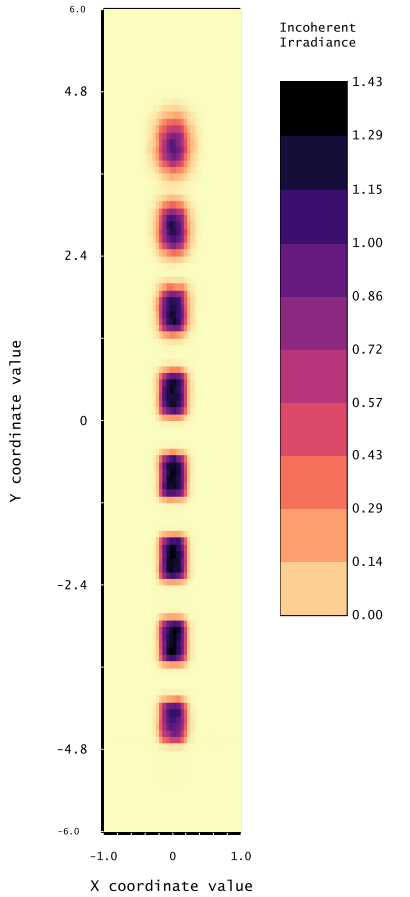
**Question – what is the most appropriate method to compare the Geant4 and the Zemax simulations?**

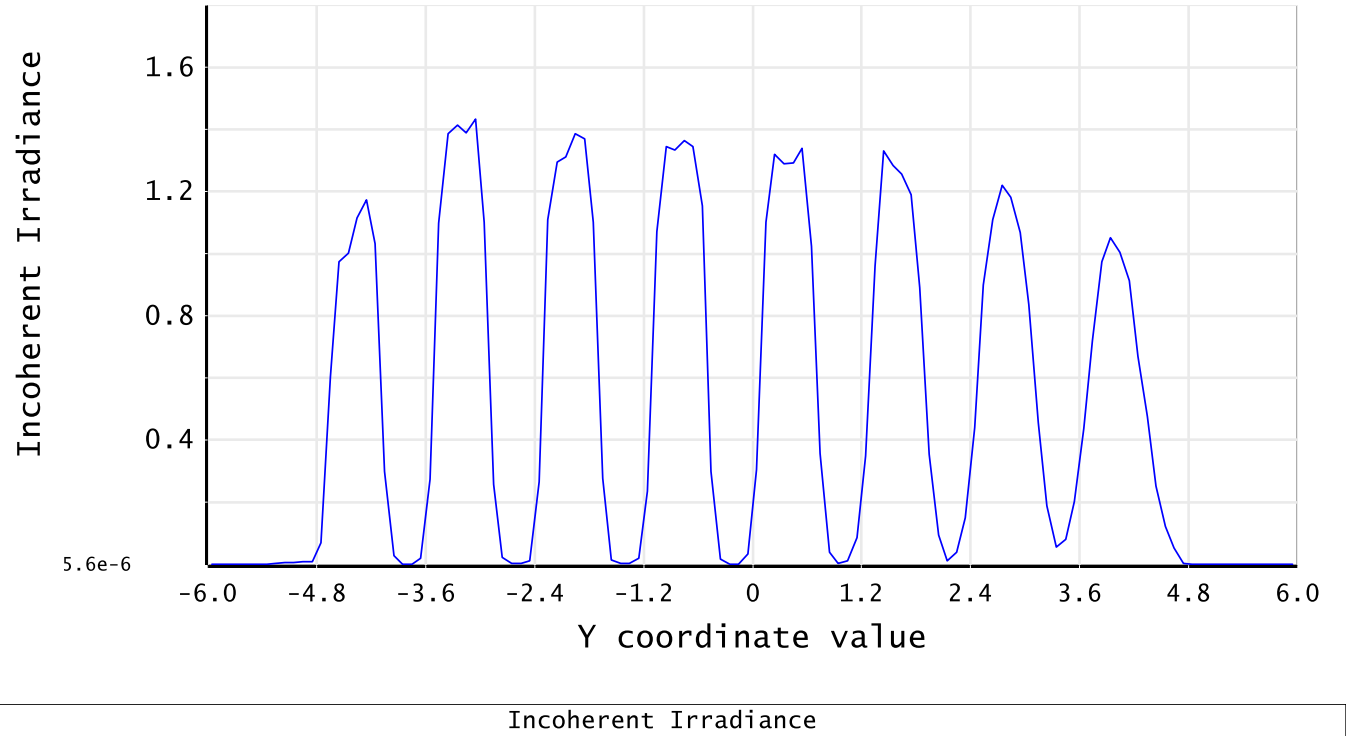



NOTES

50 μm × 100 μm pixels

# Simulated image on camera – alternating segments




Cross-section along column centre.

NOTES

50 μm × 100 μm pixels

Alternating segments were set to 1.0 and $10^{-6}$ W respectively with $5 \times 10^6$ primary rays per emitting segment traced.

# Further Zemax work

- Develop image correction procedure based on synthetic sources;
- Include realistic sensor pixel size and noise;
- Investigate the optical effect of including an acoustic sensor within the scintillator volume;
- Determine the sensitivity of the simulation to intensity cut-off (0.1 % relative at present);
- Determine the sensitivity of the simulation to scintillation wavelength (chromatic aberration);
- See if any further optimisation of the imaging optics is helpful;
- Develop a system to help us focus the imaging optics