



LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS
partículas e tecnologia

Radiobiological Phantom Characterization

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Objectives

- Implement a Phantom in TOPAS
- Simulate different beam profiles
- Analyze the differences between micro and macro dosimetry

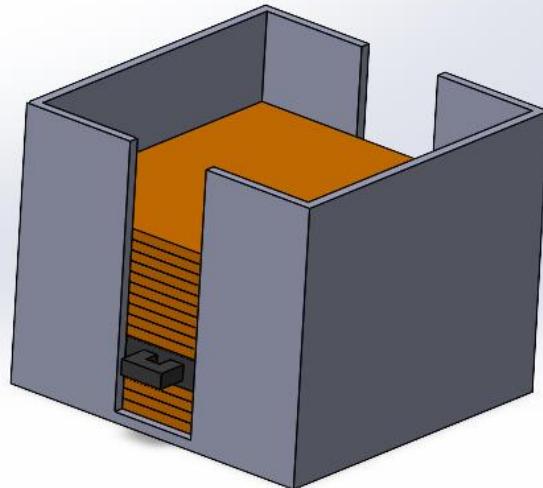


Fig. 1 – Phantom in the SolidWorks Interface

Implementation of the Phantom

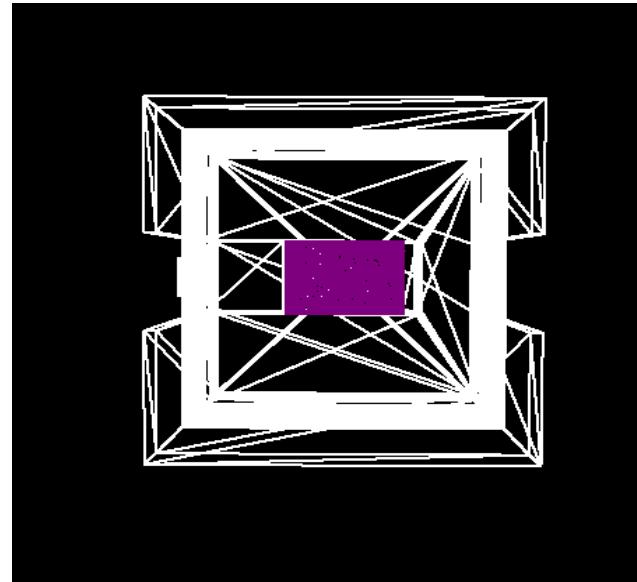
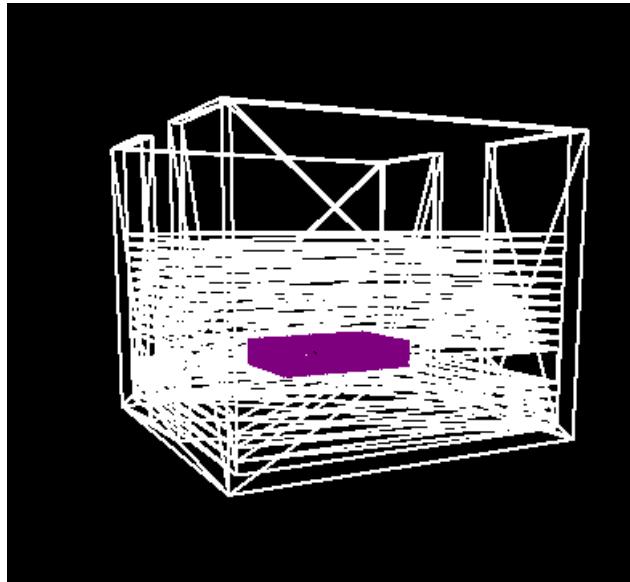


Fig. 2 and 3 – 3D Representation of the Phantom in TOPAS

Greiner Bio-One Microplates

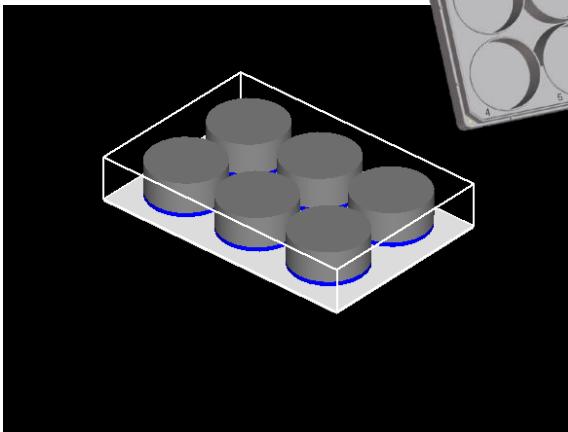


Fig. 4 – 6 Well Microplate

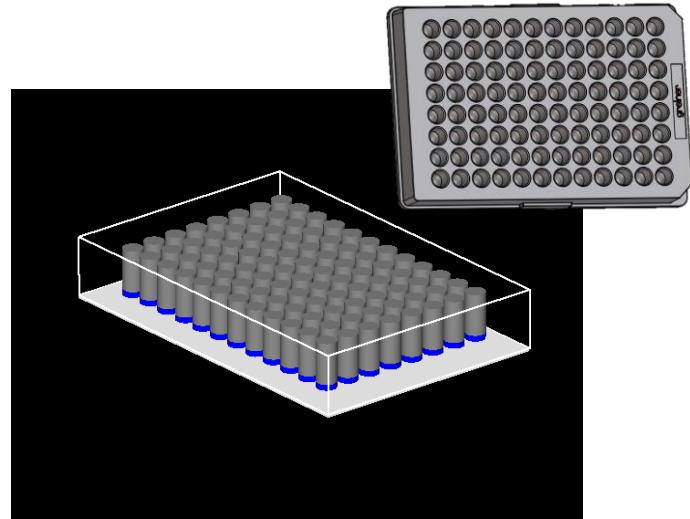
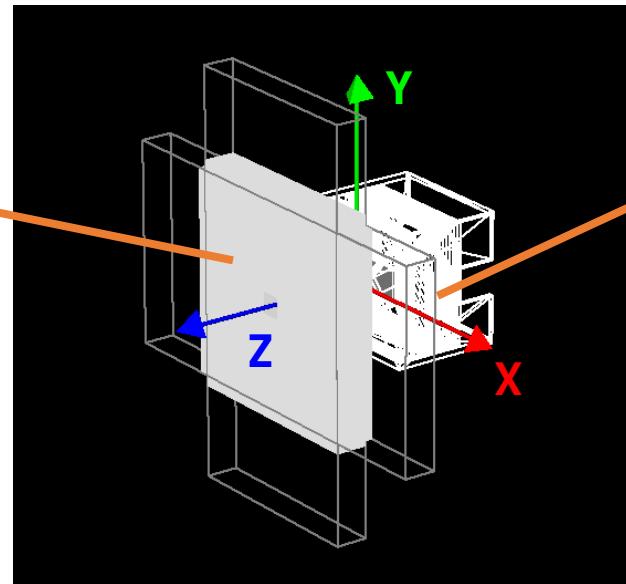


Fig. 5 – 96 Well Microplate

Collimator + Full Setup

TsJaws
Collimates
the Beam



Phantom
With Biological
Material

Fig. 6 – Full Setup on TOPAS

Beam Profiles

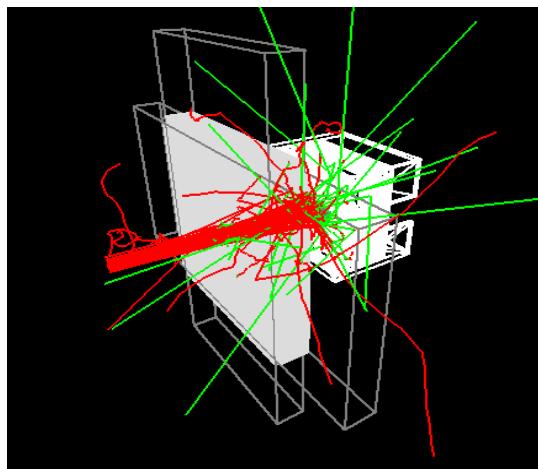


Fig. 7 – Pencil Beam

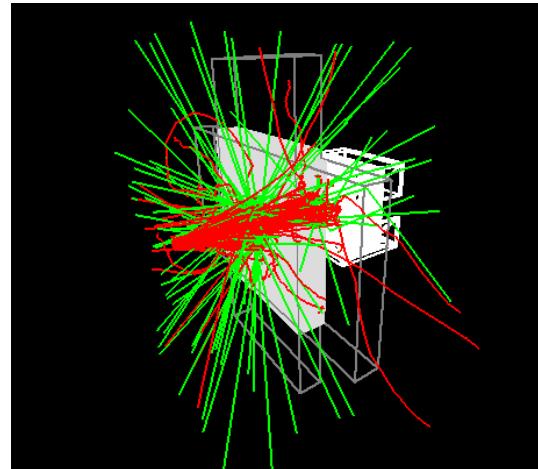


Fig. 8 – Cone Beam

Beam Particles

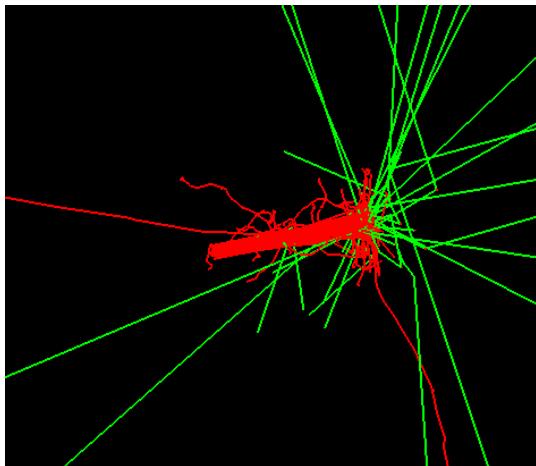


Fig. 9 – Electron Beam

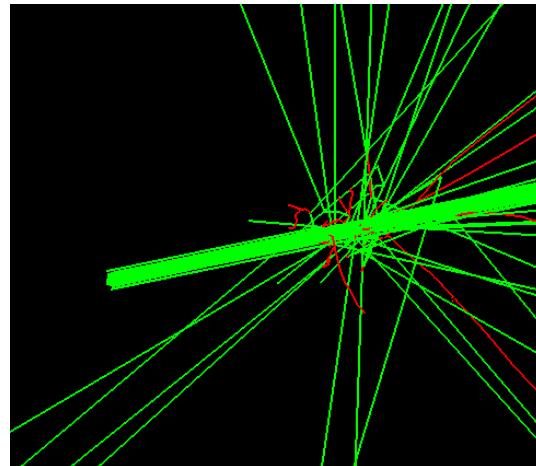


Fig. 10 – Photon Beam

- 6 and 12 MeV Mono-energetic Beam
- 10^6 Events
- Distance: 50 cm

Greiner Bio-One 6 Well Microplate

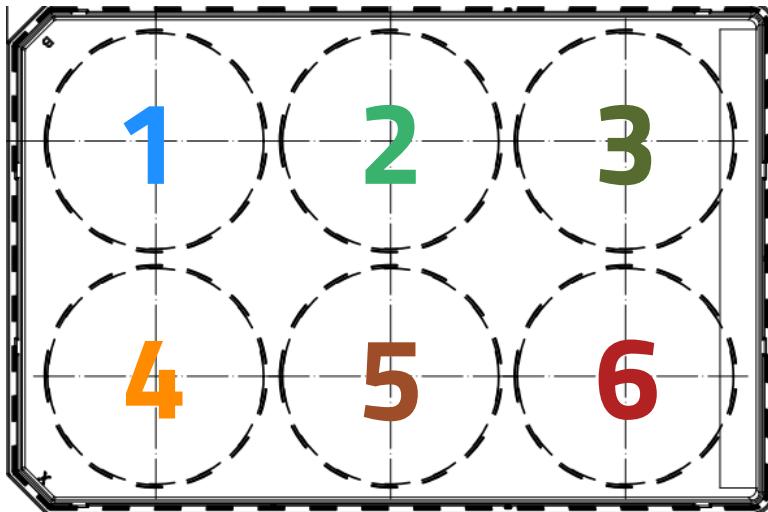


Fig. 11 – Well Distribution

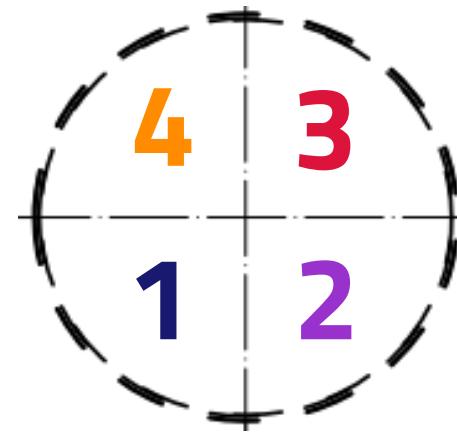


Fig. 12 – Quadrant Distribution

Greiner Bio-One 96 Well Microplate

1st Well Group

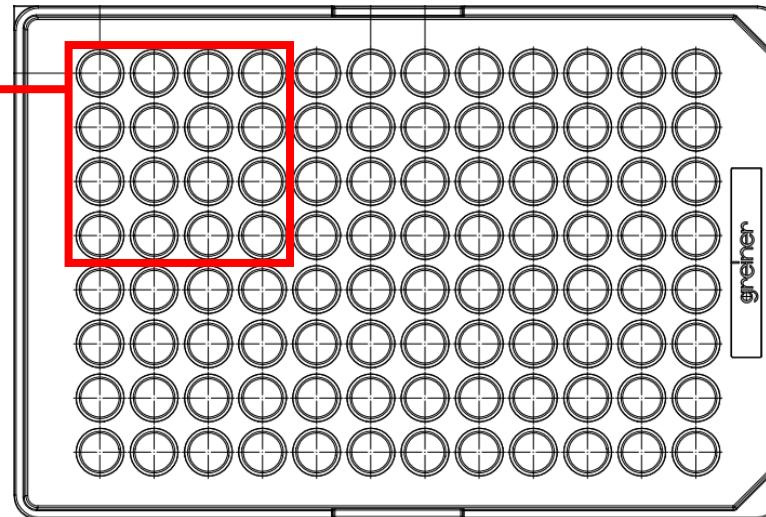
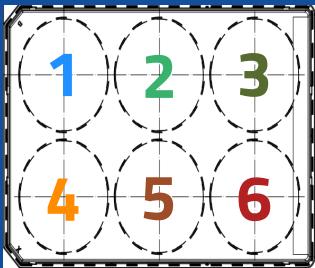


Fig. 13 – Division of the wells into groups

Data Analysis



Pencil Beam
6 Wells

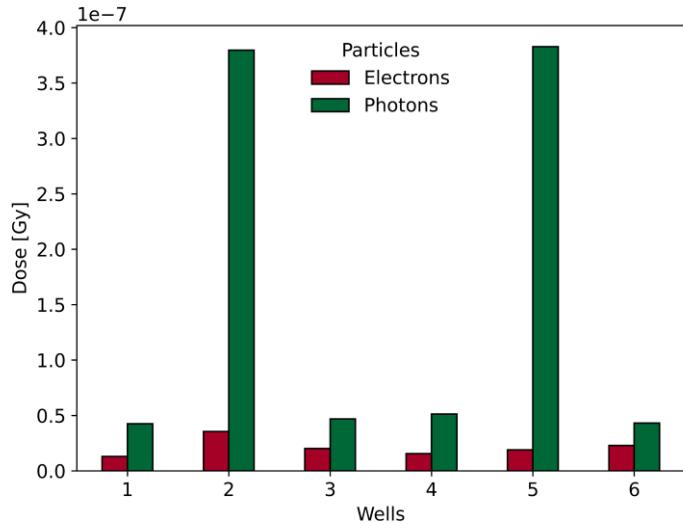


Fig. 14 – 6 MeV Average Dose per Well

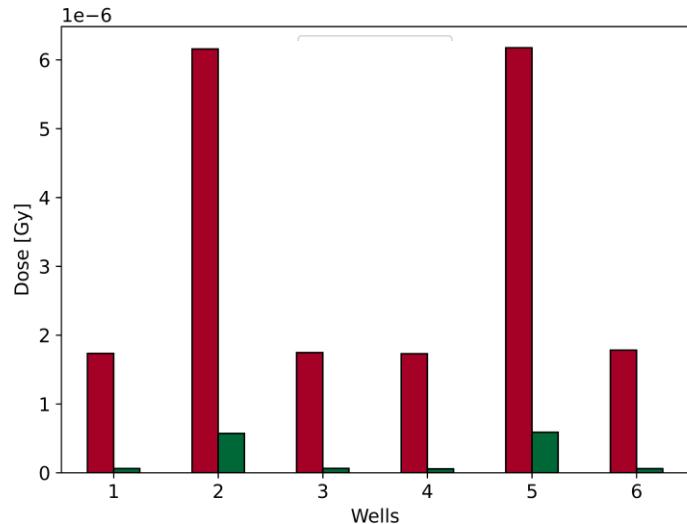
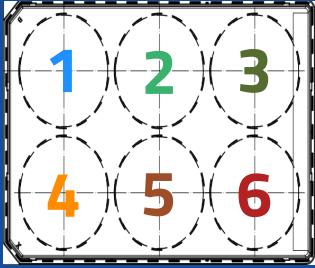


Fig. 15 – 12 MeV Average Dose per Well

Data Analysis



Photon Beam
6 Wells

Depth Analysis per Beam Profile – 6 MeV

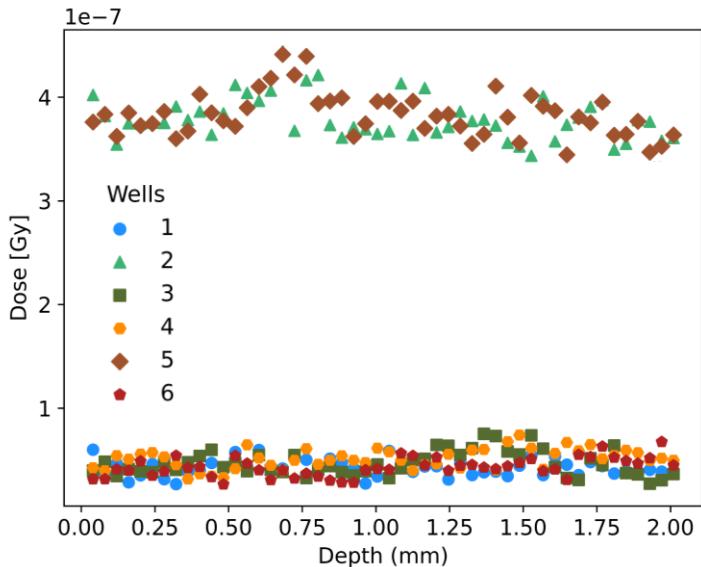


Fig. 16 – Pencil Beam Depth Dose Profile

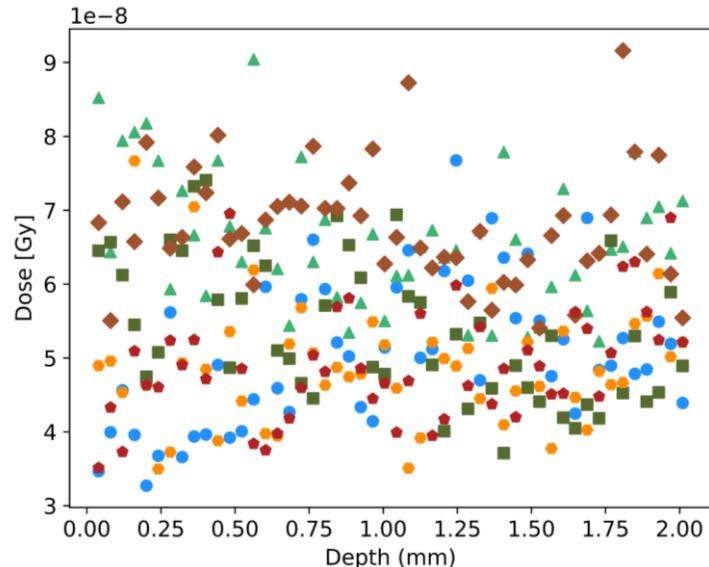
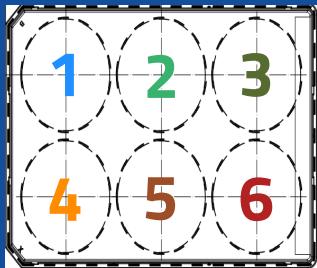


Fig. 17 – Cone Beam Depth Dose Profile

Data Analysis



Photon Beam
6 Wells

Dose Distribution per Beam Profile

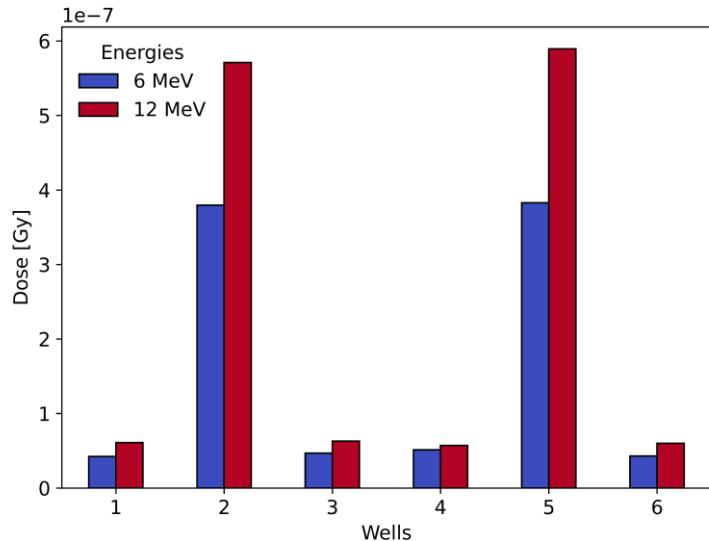


Fig. 18 – Pencil Beam Average Dose per Well

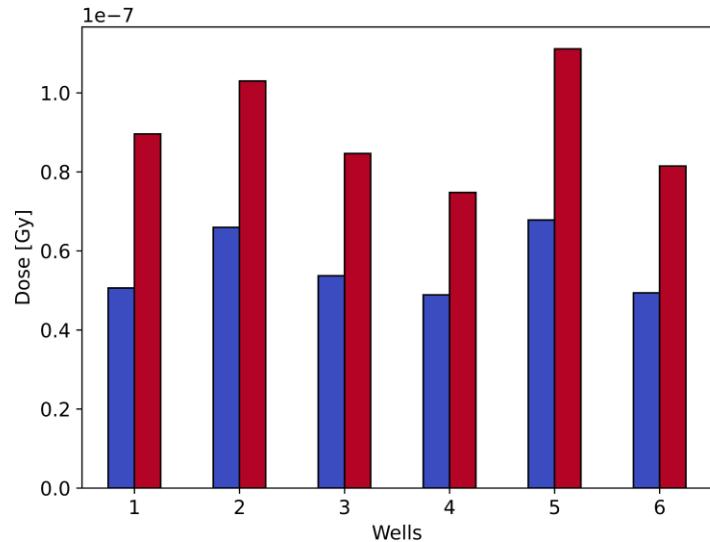
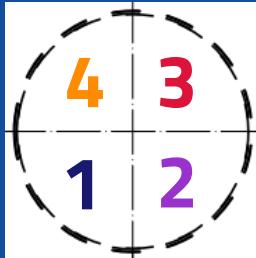


Fig. 19 – Cone Beam Average Dose per Well

Data Analysis



Photon Beam
6 Wells

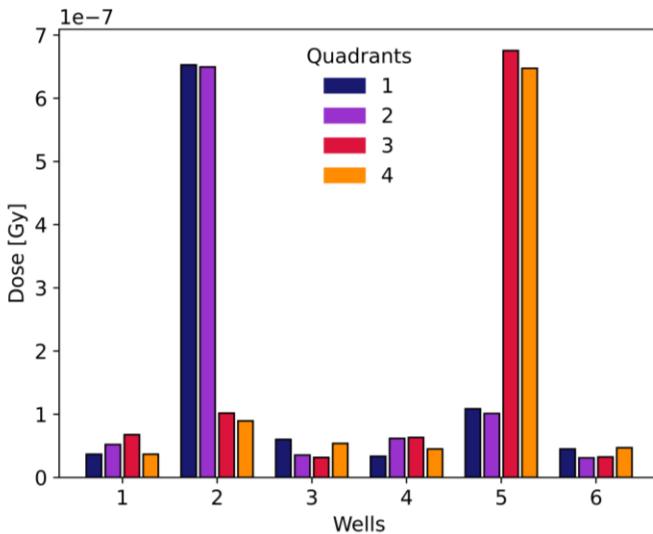


Fig. 20 – Pencil Beam Quadrant Distribution

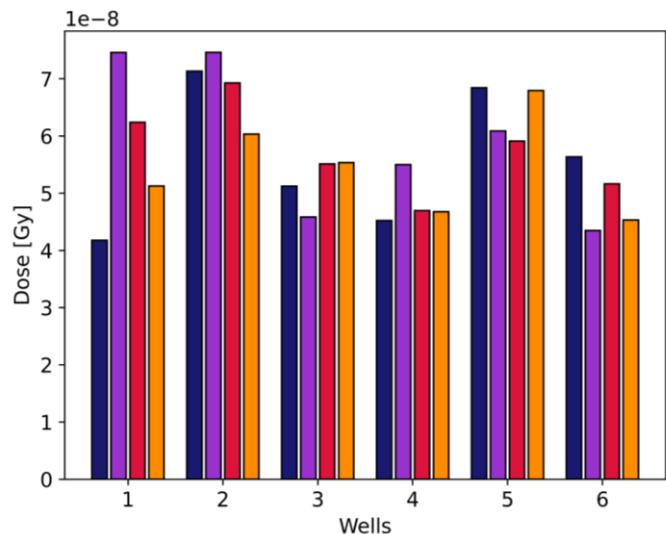
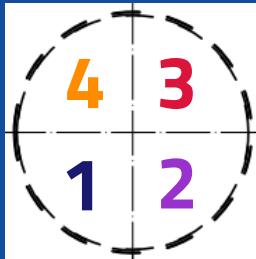


Fig. 21 – Cone Beam Quadrant Distribution

Data Analysis



Photon Beam
6 Wells

Quadrant Distribution per Beam Profile

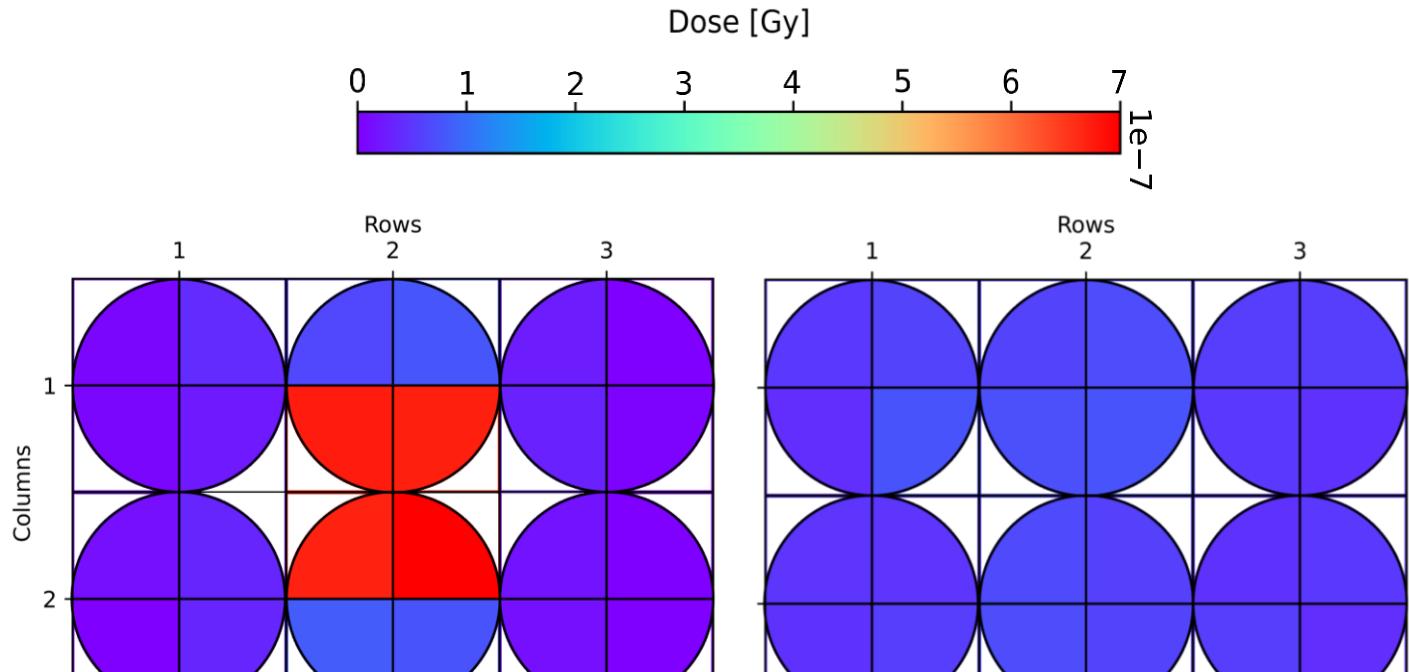
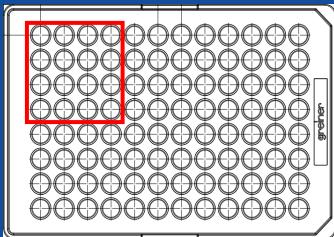


Fig. 22 – Pencil Beam 2D Quadrant Distribution

Fig. 23 – Cone Beam 2D Quadrant Distribution

Data Analysis



Photon Beam

Dose Distribution per Beam Profile – 6 MeV

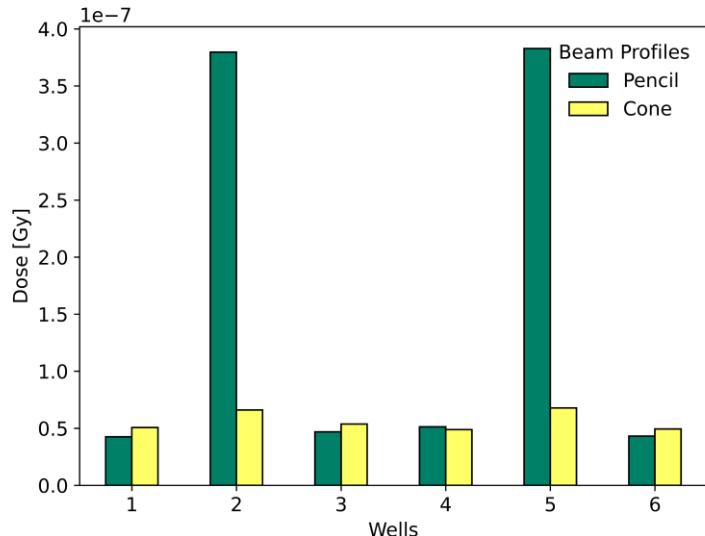


Fig. 24 – 6 Wells Average Dose Distribution

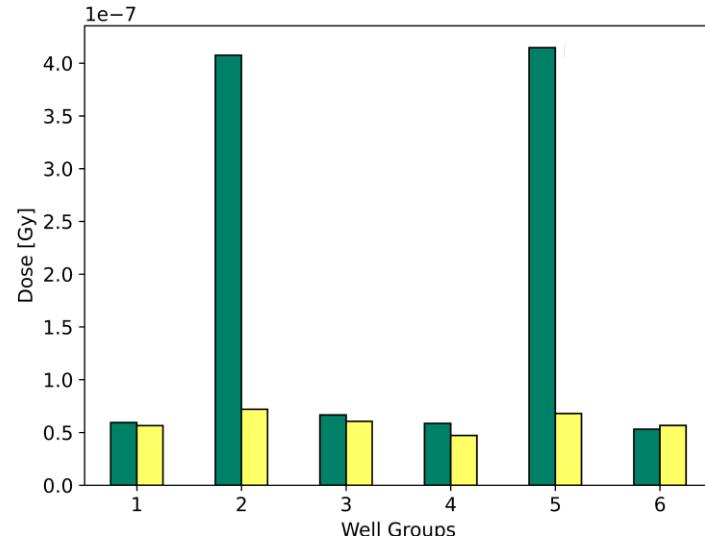


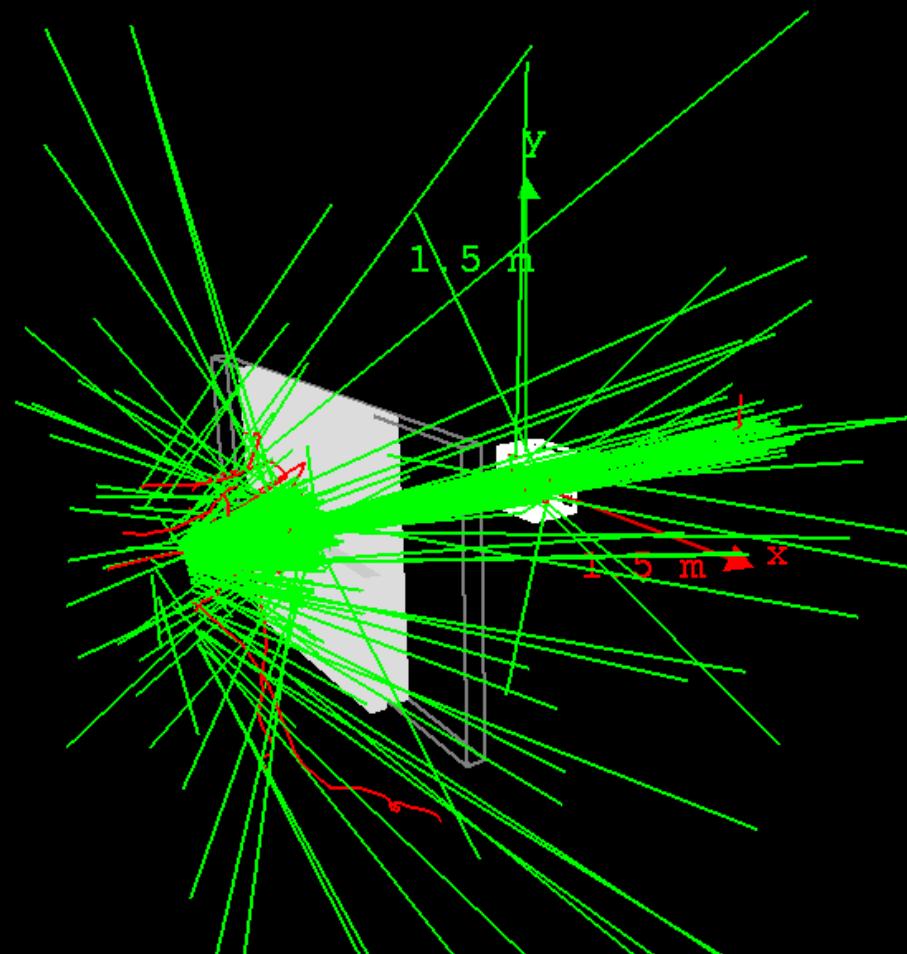
Fig. 25 – 96 Wells Average Dose Distribution

Conclusions

- The pencil beam is directed to the center of the phantom, so the center wells receive the higher dose;
- The cone beam is more evenly spread out, which provides a more homogeneous dose distribution;
- The results are the same for both microplates.

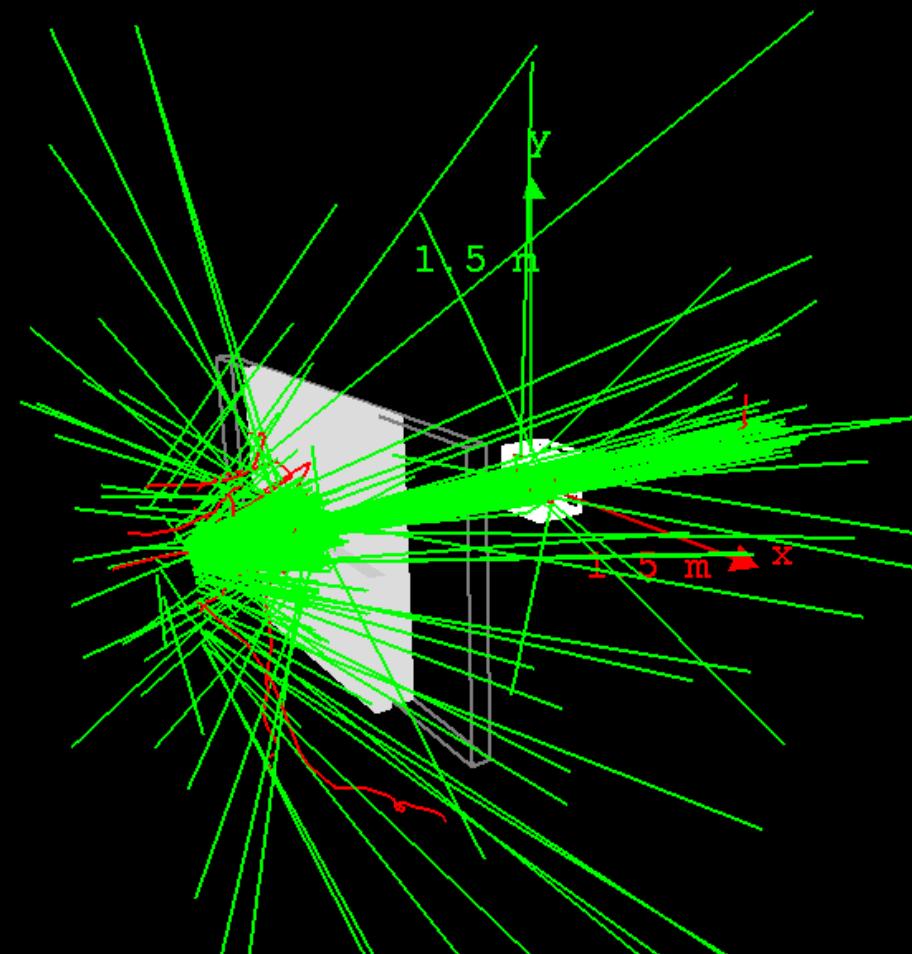
What's Next?

- Bremsstrahlung
- Compare Experimental Data
- Beam Distance Changes
- Proton Beam



What's Next?

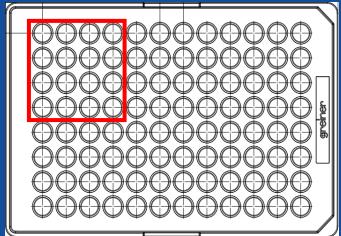
- Bremsstrahlung
- Compare Experimental Data
- Beam Distance Changes
- Proton Beam



Thanks!

Questions?

Data Analysis



Pencil Beam
96 Wells

Dose Distribution per Energy

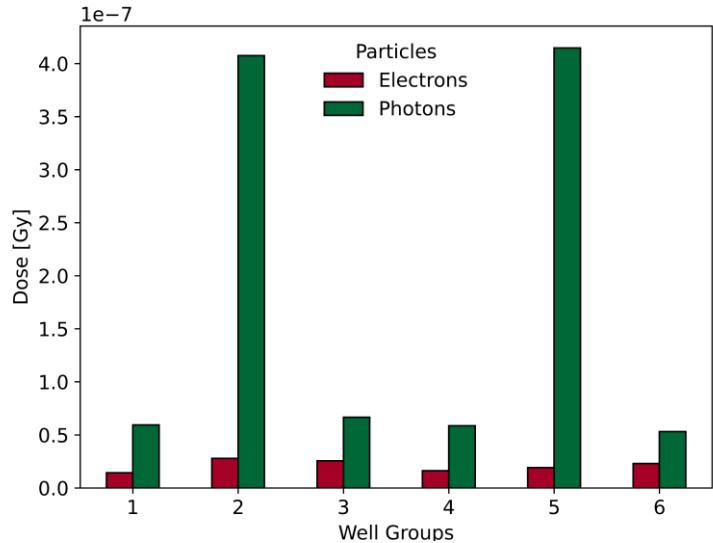


Fig. 26 – 6 MeV Average Dose per Well Group

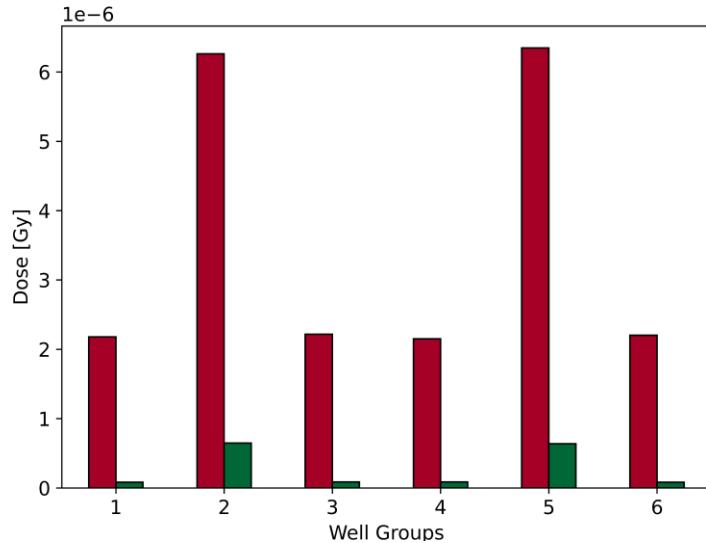
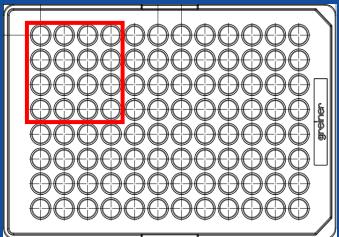


Fig. 27 – 6 MeV Average Dose per Well Group

Data Analysis



Photon Beam
96 Wells

Dose Distribution per Beam Profile

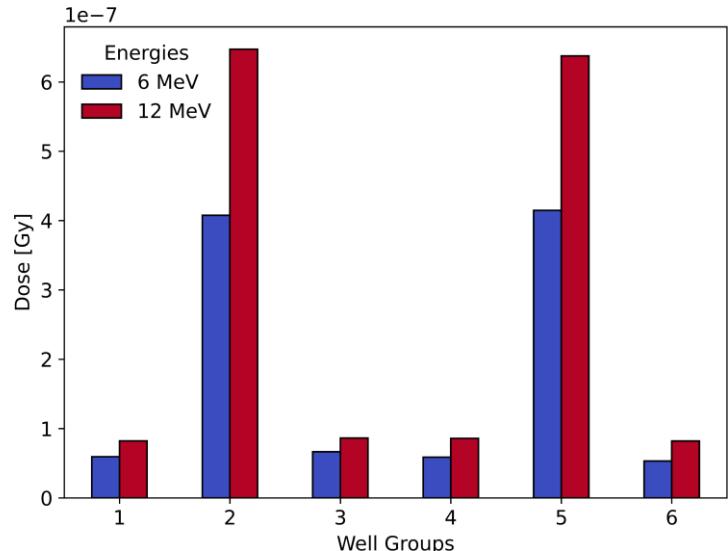


Fig. 28 – Pencil Beam Average Dose per Well Group

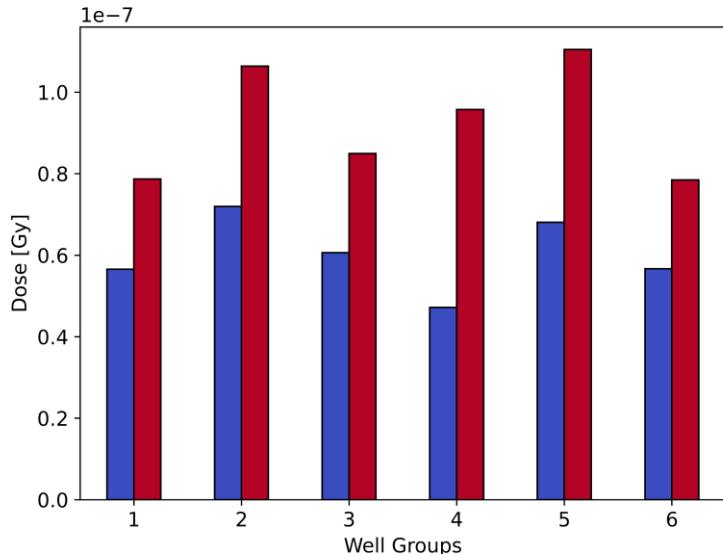
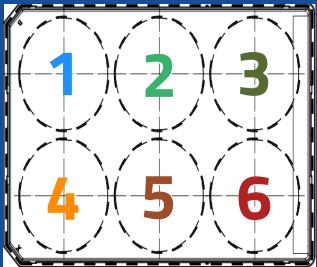


Fig. 29 – Cone Beam Average Dose per Well Group

Data Analysis



Electron Beam
6 Wells

Depth Analysis per Beam Profile – 6 MeV

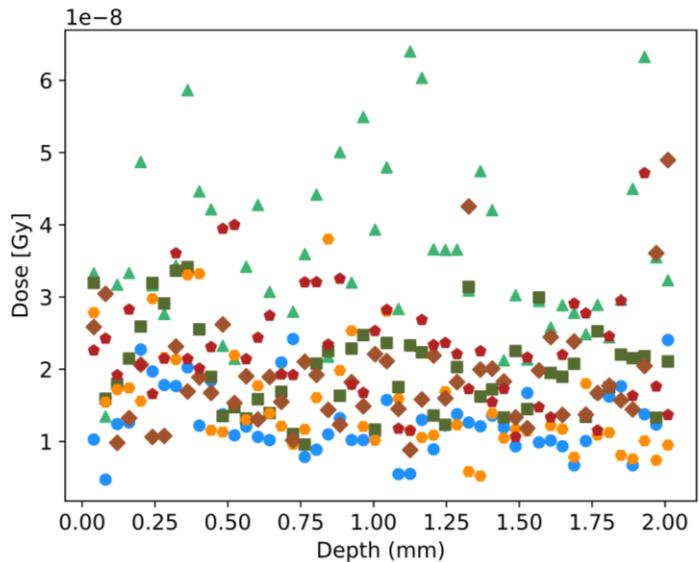


Fig. 30 – Pencil Beam Depth Dose Profile

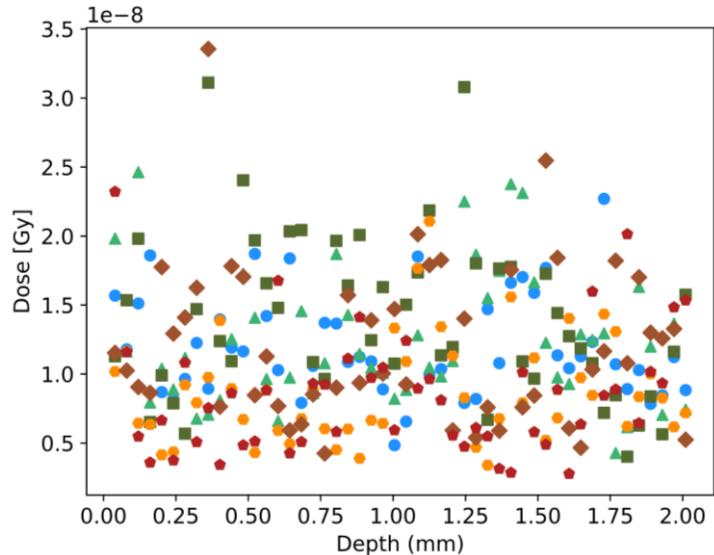
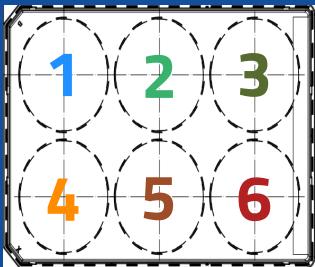


Fig. 31 – Cone Beam Depth Dose Profile

Data Analysis



Electron Beam
6 Wells

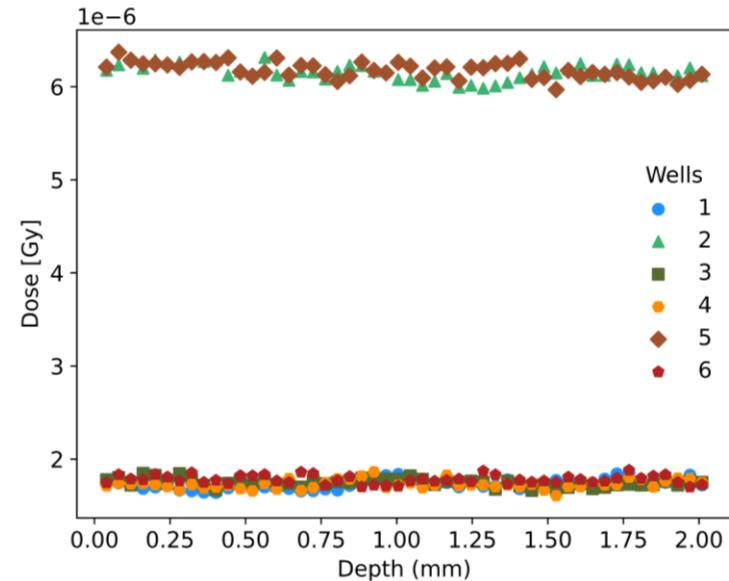


Fig. 32 – Pencil Beam Depth Dose Profile

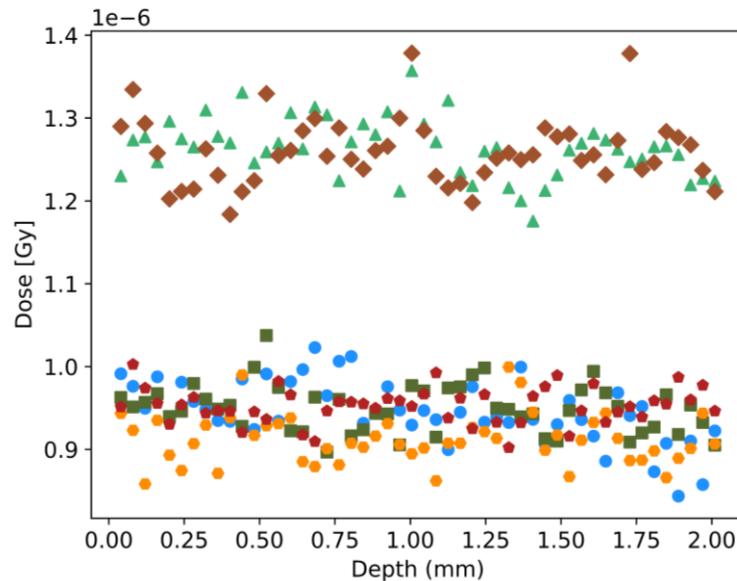
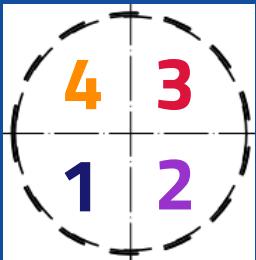


Fig. 33 – Cone Beam Depth Dose Profile

Data Analysis



Electron Beam
6 Wells

Quadrant Distribution per Beam Profile – 6 MeV

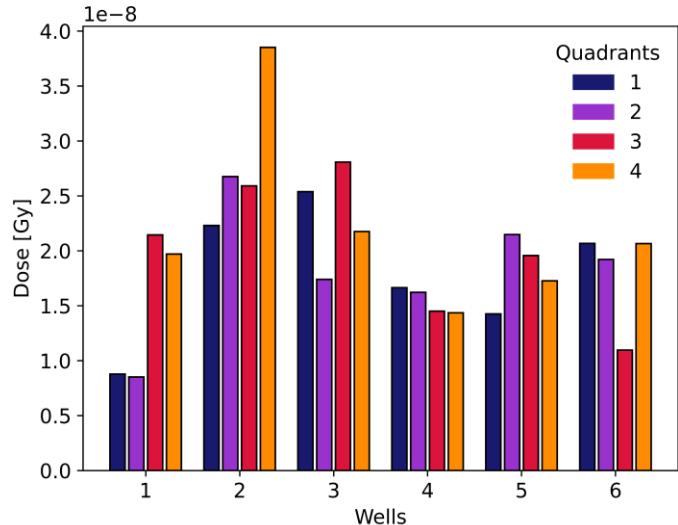


Fig. 34 – Pencil Beam Quadrant Distribution

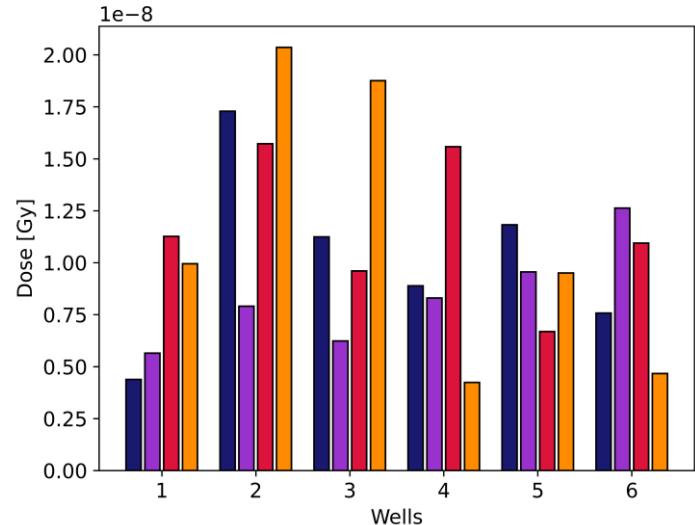
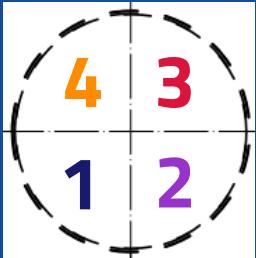


Fig. 35 – Cone Beam Quadrant Distribution

Data Analysis



Electron Beam
6 Wells

Quadrant Distribution per Beam Profile – 12 MeV

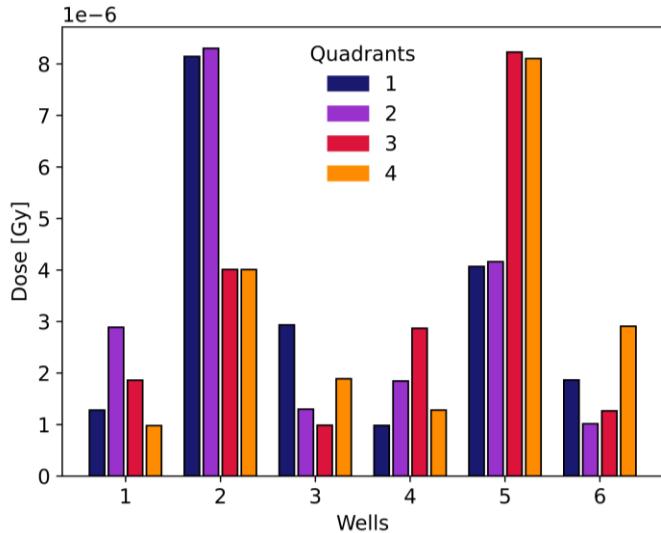


Fig. 36 – Pencil Beam Quadrant Distribution

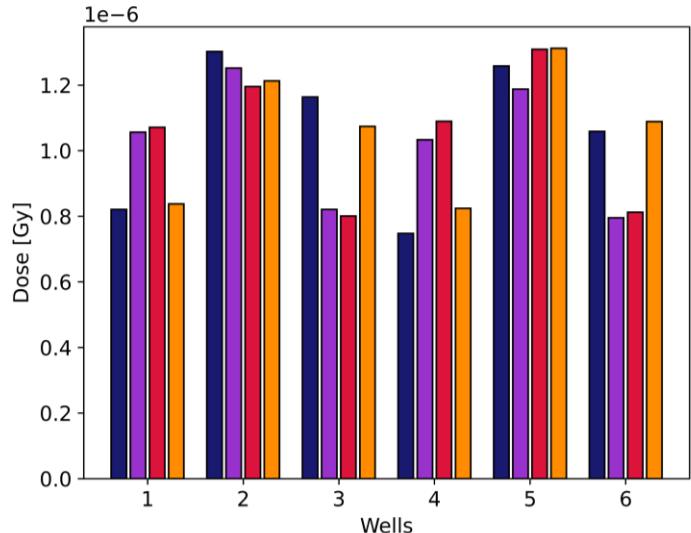
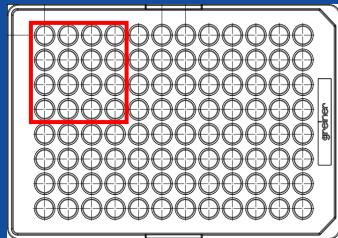


Fig. 37 – Cone Beam Quadrant Distribution

Data Analysis



Electron Beam

Dose Distribution per Beam Profile – 6 MeV

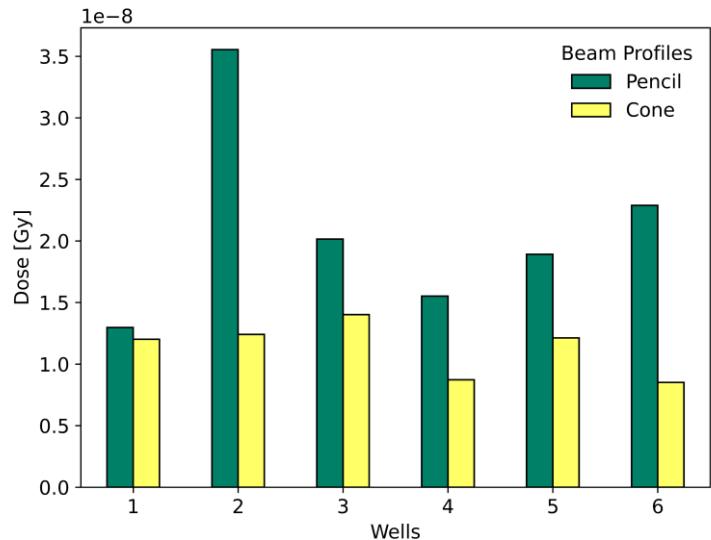


Fig. 38 – 6 Wells Average Dose Distribution

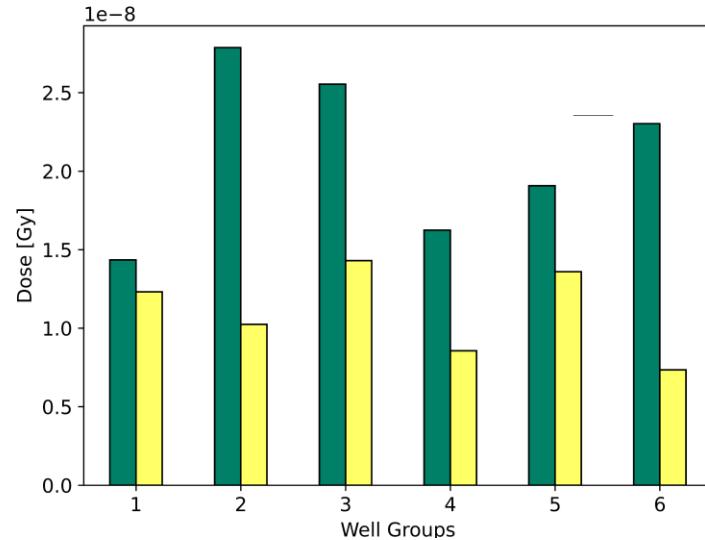
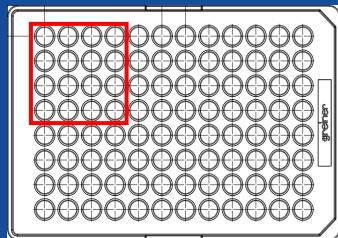


Fig. 39 – 96 Wells Average Dose Distribution

Data Analysis



Electron Beam

Dose Distribution per Beam Profile – 12 MeV

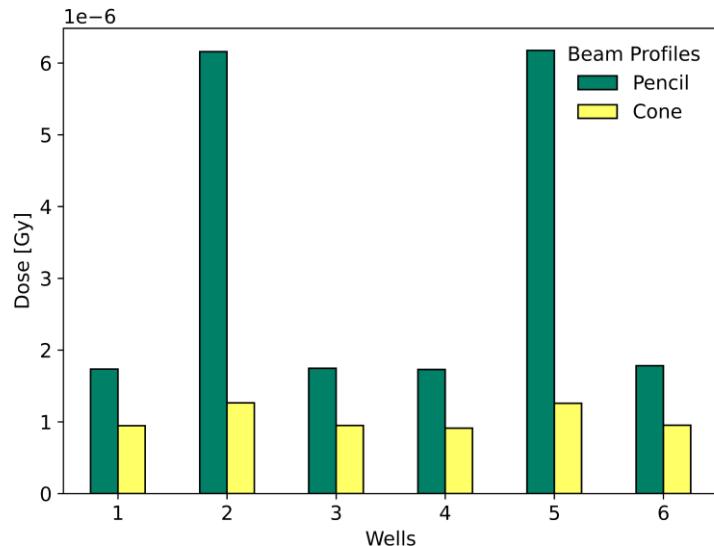


Fig. 40 – 6 Wells Average Dose Distribution

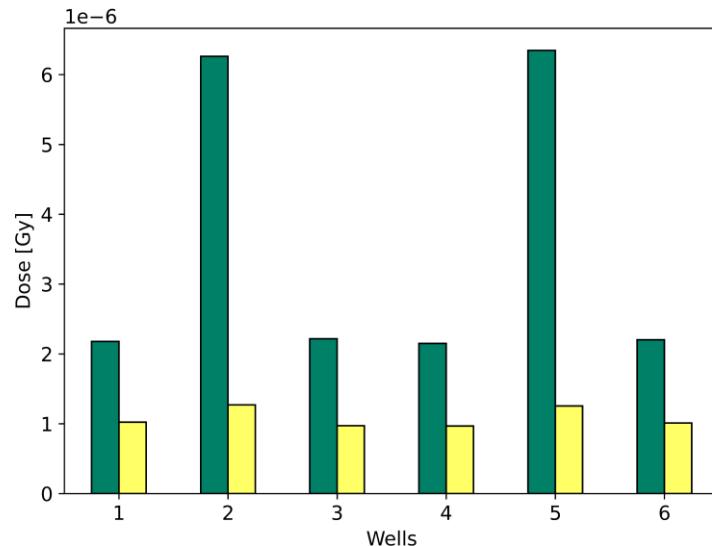


Fig. 41 – 96 Wells Average Dose Distribution