Simulation Study of the Clatterbridge **Eye Proton Therapy Beamline**

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The Cockcroft Institute

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The Clatterbridge Cancer Centre **NHS Foundation Trust**

The world's first hospital proton beam therapy facility, the Clatterbridge Cancer Centre (CCC), UK has successfully provided treatment for ocular cancers over the past 30 years. As the facility supports a wide range of experimental work including cell biology studies, there is a need for an accurate and reliable simulation model for full characterisation of the beam. A comprehensive model of the CCC delivery system was developed using the Monte Carlo simulation toolkit Geant4 and is described in detail alongside recent simulated and experimental results.



Bragg Peak Measurements

Film Measurements

chamber was used to determine the proton depth dose in a water tank.

Clatterbridge Proton Beam Dose Profile





Simulation parameters consistent with water tank conditions:

Markus parallel plane ion

EBT3 GAFchromic film was irradiated in multiple locations along the beamline to evaluate the transverse beam profiles

Markus IC Classic at 300V+ Temp: 20.1C Entrance dose rate ~18Gy/min

- Middle of window positioned on beam line centre
- Window of tank to collimator distance: 50mm
- Collimator: 25mm



Film 4 Beam Profile

Film 8 Beam Profile

Film 5 Beam Profile

Film 7 Beam Profile





As indicated by the distinct differences between the simulated and measured profiles, there are still improvements to be made to the model. It is noted that there are errors with the calculated film FWHMs due to saturation effects and positioning misalignments. The plotted points along the vertical axis are of arbitrary units, as dependent on the number of simulated primaries. In terms of the model, the geometry is mostly complete, the simulated pristine Bragg Peak varies slightly and other issues stem from uncertainties with parameters of the primary input beam.



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intended the that İS finalised model will be available for wide use as a verified, standard simulation model for all related work performed with the beamline. Therefore, the inclusion of beam optics information, LET SOBP calculations, and parallel model in TOPAS are anticipated.

