Geant4 applications in MRI-guided x-ray and proton beam therapy

B. M. Oborn[1,2,3]

[1]Centre for Medical Radiation Physics, University of Wollongong, NSW, Australia.
[2]Helmholtz-Zentrum Dresden-Rossendorf- Institute of Radiooncology-OncoRay, Radiooncology, Dresden, Germany.
[3]Illawarra Cancer Care Centre, Wollongong Hospital, NSW 2500 Australia.

Background: MRI-guided radiotherapy has been one of the most important and challenging advancements in radiotherapy in the last decade. Monte Carlo simulations have proven to be extremely useful in predicting the various dosimetry changes due to the presence of the strong magnetic field of the MRI scanner. This presentation will cover some of the various projects that have successfully utilized Geant4 simulations over recent years and address various concerns.

Material and Methods: Geant4 has been used to model the radiation transport of x-ray and proton beams subject to the magnetic fields produced by various MRI systems. COMSOL Multiphysics simulations was used to generate the magnetic field maps used by Geant4.

Results: Skin dosimetry in MRI-linacs systems has been extensively examined for prototype MRI-linac systems and simulations have been used to propose methods to lower harmful skin doses when they occur. The integration of proton pencil beam scanning with an MRI scanner has been shown feasible for both orientations of MRI field with respect to the beam line direction. Further simulations will continue to refine how the integration of a proton pencil beam scanning beam line will be integrated with an MRI scanner at the OncoRay facility in Dresden, Germany.