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Simulation of a pencil proton beam through a phantom of water.

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Abstract content
   (Max 300 words)

This study investigates the Pencil Proton Beam scanning technique to compare the scattering parameters of Monte Carlo codes. Simulations in MCNPX and GEANT4 are of particular ineterest in this study. The study is based on a variation of the traditional Hogstrom Pencil beam model for electron beams to provide a description of clinical proton beams. This new Hogstrom model is based on the Fermi-Eyges theory of particle transport.

The method used in this investigation is to simulate a proton pencil beam entering a water phantom at various discrete energies and determining the secondary particles distributed throughout the water phantom by studying both Coulombic and Nuclear interactions of the incident proton in water. This allows one to determine how much of the total dosage obtained by the patient is from the primary particle and what part of the dosage is due to the secondary particles. In order to accurately compare the Monte Carlo codes, a further study was done to understand the underlying physics principles used by MCNPX and GEANT4. The development of an analytical model for primary proton beams which included depth distribution, propagations of protons in matter, and scattering theory was also investigated.

Besides comparing Monte Carlo codes this study also has real life implications. Pencil beam scanning leads to improving and advancing treatment planning.

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Main supervisor (name and email)
and his / her institution

Prof. Robert Lindsay
rlindsay@uwc.ac.za
University of the Western Cape

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Primary author: Ms JACOBS, Carmen (NECSA)

Presenter: Ms JACOBS, Carmen (NECSA)

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