

Simulation of heavy ion therapy system using Geant4

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Geant4 is a toolkit to simulate the passage of a particle through matter based on Monte Carlo method. Geant4 incorporates many of available experimental data and theoretical models over wide energy region, extending its application scope not only to high energy physics but also medical physics, astro-physics, etc. We have developed a simulation framework for heavy ion therapy system based on Geant4 to enable detailed treatment planning. Heavy ion beam features high RBE (relative biological effectiveness) and intensive dose given at certain depth (Bragg peak), allowing patients to suppress unwanted exposure on normal tissue. Pioneering trials of heavy ion therapy carried out in a few countries proved its availability, triggering many projects to construct new heavy ion therapy facilities around the world. However, reaction of heavy ions on material involves many complex processes as compared to X-ray or electron beam used in traditional radiation therapy, and the development of a new reliable simulator is essential to determine the beam intensity, energy, size of radiation field, and so on required for each case of treatment. Geant4 is a suitable tool for this purpose as a generalized simulator with powerful capability to describe complicated geometry. We implemented the heavy ion beam lines of several facilities in Geant4, including dedicated apparatus, and tested the Geant4 physics processes in comparison with experimental data. We will introduce the simulation framework and present the validation results.

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