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A GEANT4 based simulation for proton therapy

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The GEANT4 Monte Carlo code provides many powerful functions for conducting particle transport simulations with great reliability and flexibility. GEANT4 has been extending the application fields for not only the high energy physics but also medical physics. Using the reliable simulation for the radiation therapy, it will become possible to validate treatment planning and select the most effective one. For the use of a simulation in the clinical application, the simulation has to reproduce the dose distributions in three-dimensions with the best accuracy for ensuring the patient safety.

As a generalized simulator, the GEANT4 based simulation framework has been developed and used for the verification of the simulated dose distribution to the measurements. Three types of irradiation systems for proton therapy were successfully implemented on the top of this framework; those are the gantry treatment nozzle at the Hyogo Ion Beam Medical Center (HIBMC), the gantry treatment nozzle at the National Cancer Center (NCC), and the eye treatment facility of UC San Francisco at the Crocker Nuclear Laboratory cyclotron, UC Davis (CNL).

The validation of the simulation was performed for the proton ranges in important materials at beam line and the size of radiation field, respectively. Then dose distributions in simulation were verified with measurements for Bragg peak and spread out Bragg peak, respectively. We will report a belief description of the developed simulation, and the comparisons of simulated dose distributions with measurements as well as the validation of the beam irradiation system.

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