An Overview of the PHITS Code and its Application to Medical Physics

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PHITS is a general purpose 3-dimensional Monte-Carlo particle transport simulation code developed under collaboration of Japan Atomic Energy Agency (JAEA), Research Organization for Information Science and Technology (RIST), High Energy Accelerator Research Organization (KEK) and a couple of other institutes in Japan and Sweden. PHITS can deal with the transport of all particles including neutrons, protons, heavy ions, photons, and electrons over wide energy ranges, using several nuclear reaction models and nuclear data libraries. Geometrical configuration of the simulation can be set with GG (General Geometry) or CG (Combinatorial Geometry). Various quantities such as heat deposition, track length and production yields can be deduced from the PHITS simulation, using implemented estimator functions called “tally”. The code has been distributed to many countries via RIST, OECD/NEA Data Bank and Radiation Safety Information Computational Center (RSICC).

In order to apply PHITS to medical physics, two special functions for calculating the radiation quality were implemented in the code; one is the event generator mode and the other is the microdosimetric tally function. Owing to these functions, PHITS can calculate the probability density of deposition energy in microscopic sites, which is the fundamental quantity to determine the cell-survival factions using the microdosimetric kinetic model (MKM). Thus we have established a computational model for calculating the RBE-weighted dose in charged particle therapy based on PHITS coupled to MKM [1]. General features of the PHITS code together with details of the established model will be presented at the meeting.

[1] T. Sato et al., Radiat. Res. 171, 107 (2009).