Contribution ID: **218** Type: **oral (20 minutes)**

Geant4 implementation of an RBE calculation for ion therapy studies

Tuesday, 16 October 2012 12:10 (20 minutes)

Monte Carlo approach in hadrontherapy is widely used for the optimization of transport beam lines and/or dosimetric studies. In most of cases, in the clinical practice, depth dose distributions and lateral dose profiles are provided, without taking into account the biological effects of ionizing radiation.
In case of ion beams, a mixed radiation field is produced, due to projectile fragmentation, and the biological effects related to the different secondary particles have to be correctly weighted with those related to the primary particles.
It is so evident as, in such complex cases, Monte Carlo calculations for ion therapy may provide physical and RBE-weighted dose distributions in order to be routinely used in clinical practice.
A general Monte Carlo tool for calculations in hadrontherapy has been developed. The application, whose name is "Hadrontherapy", is based on the Geant4 toolkit, and it is included in the official Geant4 release inside the so called "advanced examples". A new class has been created inside the Hadrontherapy application, with the scope to create an interface to the Local Effect Model (LEM), developed at GSI by M. Scholz and co-workers. Starting from some basic assumptions, LEM model is able to predict the biological action of different charged particle beams by considering their specific track structure and the different spatial energy distribution at the cell level. This class-interface has the aim of managing the output data of the LEM model, provided by the INFN group of Turin who deeply work in this concern since many years. These output data are integrated run-time with step-by-step information retrieved by the Monte Carlo codes. At the end of a simulation run, α and β parameters of the cell survival curve are obtained as a function of the penetration depth in water in a simple "sliced"geometry. These two parameters are averaged according to Zaider and Rossi formula, tacking into account in realistic way also the contribution due to the secondary particles produced by nuclear interactions of the primary beam. Moreover, RBE and biological dose are also stored in ascii files.
Preliminary results will be shown, compared to experimental data of survival fraction for CHO cells, related to carbon ions at different entrance energies. Future developments are planned regarding the implementation of the recent versions of LEM model as well as other models with a different approach (MKM).

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Session Classification: Early Biophysical Processes

Track Classification: Early Biophysical Processes