GRID-enabling BEAMnrc and "first-class" particle transport

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ABSTRACT

Clinical implementation of Monte Carlo dose calculation is an aspiration of many radiotherapy departments. With increasing demands of complex radiotherapy modalities, the unmatched accuracy of Monte Carlo dose calculation is becoming a necessity. However, long computation time is a major drawback. As a first step in tapping unprecedented computing power to shorten simulation time, we have implemented BEAMnrc and DOSXYZnrc simulations on the Welsh e-Science GRID. We report efforts in GRID-enabling the simulations, and present a set of utility functions designed for streamlining the overall simulation task. With these functions, a complete BEAMnrc/DOSXYZnrc run could be automated by a single command line from the user. We also contrast advantages and disadvantages of GRID computing against those in cluster computing. Finally, we demonstrate BEAMnrc simulation of a linear accelerator using "first-class" EGSnrc transport parameters (e.g. exact boundary crossing, atomic relaxations and Koch & Motz angular sampling.) which, without the elementary GRID solution presented herein, would require 6 months of runtime on a 2.8 GHz Pentium 4.