AbstractID: 8198 Title: A fast Monte Carlo code for proton transport in radiation therapy based on Pre-Calculated tracks from MCNPX

Introduction: This work extends Pre-calculated Monte Carlo (PMC), successfully developed for electrons to protons. PMC uses pre-calculated tracks for each material in the simulation and applies these to heterogeneous geometries such as CT-data.

Method and Materials: The tracks of 10000 primary protons are generated in the middle of a large homogenous material for various energies using MCNPX. The proton range was 20, 40,…100, 110, …200 MeV with ECUT=200 keV. The ptrac routine of MCNPX writes the various events of each particle in a particular format. An in-house Fortran code was developed to read and extract the position, direction, energy and deposited energy of a particle in each step from the ptrac file. Unlike electron and photons, protons produce many different secondary particles such as neutrons, deuterons, tritons, alphas, secondary protons, etc and they are handled in three categories: 1-Secondary protons: treated like a primary protons and transported using a track picked up from pre-calculated tracks; 2- Neutrons: The energy of the neutron are deposited far from the initial point and neglected. 3- All other secondaries: Since other secondaries have a very short range their energy is deposited locally.

Results and discussion: The size of the pre-calculated data for each material is about 100 Mb. The performance of the code is evaluated in various homogeneous and in-homogeneous phantoms. In comparison of the code with MCNPX as the reference the difference is generally between 2-5% and it runs 200 times faster than MCNPX. For electron transport the code runs 40-60 times faster than EGSnrc.