

Beam characterization and modeling for photon Monte Carlo treatment planning

Photon beams of 4, 6, and 15 MV from Varian Clinac 2100C and 2300C/D accelerators were simulated using the EGS4/BEAM system. The accelerator was modeled as a combination of component modules (CMs) consisting of a target, primary collimator, flattening filter, monitor chamber, mirror and jaws. A full phase space file was scored directly above the upper jaws and analyzed using a program, BEAMDP (BEAM Data Processor), to derive the particle planar fluence, angular distribution, energy spectrum and the fractional contributions of each individual CM. A multiple sub-source model was further developed to reconstruct the phase space. Separate sub-sources were used for the target, primary collimator and flattening filter components with accurate source intensity, energy, fluence and angular distributions. Good agreement (within 2%) was achieved in the dose distributions for field sizes 2 cm x 2 cm - 40 cm x 40 cm and source surface distances 80 cm - 120 cm between the Monte Carlo calculations with the source model and those with the original phase space, and measurements. The source model was implemented in an EGS4 user code, MCDOSE, for photon beam Monte Carlo treatment planning, which computes the dose distributions in a 3D rectilinear phantom built from the patient CT data and simulates the effect of beam modifiers such as wedges, multileaf collimator and blocks. The source model was also employed in the Monte Carlo beamlet profile calculation for inverse planning for intensity modulated radiotherapy (IMRT).