

AbstractID: 9731 Title: Quick Monte Carlo calculations of electron output factors and beam penetration using superposition

A superposition approach is used to calculate central axis depth dose curves and output factors for electron beams, based on Monte Carlo. Particles are first transported, using Monte Carlo (EGS4), through the treatment head, electron applicator and final collimator, or insert, and into a water phantom. This is done for the largest field, for each applicator and energy. Each particle is tagged with its location when it crosses the plane of the downstream surface of the insert. This permits scoring the contribution to the dose on the central axis of particles from different regions at the insert level. For a given insert, the central axis depth dose curve, including the output factor, is calculated as the superposition of the contributions from the open region of the field. This calculation, done to 1% precision with 1 mm resolution, is done in mere seconds. These calculations take half a day on a standard (1.7 GHz) PC when the insert is fully simulated with Monte Carlo. This approach was used for 6-21 MeV beams from a Siemens Primus accelerator. The differences in calculated output factor for full simulation and superposition was 2% at 6 MeV, increasing to 5% at 21 MeV, for a 2.5 cm width, square insert 5 cm from the phantom surface. Detailed analysis shows the difference is due to dose contributions of particles scattered from and transmitted through the shield part of the insert. This error drops quickly with increasing field size and insert-to-phantom distance.