AbstractID: 1929 Title: Construction of a tomotherapy beam model based on thick target bremsstrahlung and Monte Carlo derived parameters

For Monte Carlo transport calculations in a patient the photon source is usually sampled either from a previously constructed phase space file or from a beam model. A helical tomotherapy beam model was constructed in this work. Since the helical tomotherapy treatment head contains no flattening filter, a simpler source model is anticipated. For this reason the constructed model is based on an analytical thick-target bremsstrahlung expression with a combination of Monte Carlo derived parameters. Our model is based on the thick target bremsstrahlung model derived by Kondev[1], which uses the Schiff integrated-over-angle cross section and includes electron energy losses, absorption, and multiple scattering. The model is modified to include specific beam parameters of the helical tomotherapy machine. The analytical calculation is simplified by approximating the angular bremsstrahlung distribution with a sum of Gaussian distributions. The thick target is represented as a sum of thin target slabs, which are sampled according to the electron transmission derived from separate Monte Carlo simulations. In addition, photon attenuation in the electron target as well as other structures in the beam are explicitly accounted for. The use of Monte Carlo supported and derived parameters (e.g., improved electron transmission coefficients, spread of electrons in the target slabs) resulted in an improved beam model. Some explicit correction functions, however, were still needed for a good match of the beam model to derived dose distributions and experiments.

[1]Kondev, NIM B71,126-131, 1992.

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