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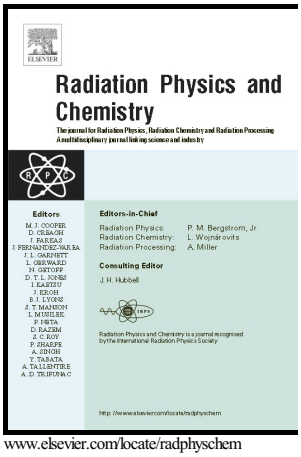

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A general photon source model for clinical linac heads in photon mode

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Abstract

In this work a general photon source model has been developed to describe clinical linac heads when operating in photon mode. Six different linacs (three operating at 6 MV, one at 15 MV and two at 18 MV) have been studied. The construction of the model as well as its validation have been carried out on the base of the virtual linac approach in which the complete linac geometries have been simulated with the Monte Carlo code PENELOPE. The model includes a primary and a secondary sources whose geometrical characteristics are determined from a set of simulated fluence distributions in air. The photon energy distributions are obtained from the Monte Carlo energy distributions of the photons moving along the beam axis, using a softening function that depends on the nominal energy of the beam and a Compton-like correction. To verify the model, output factors, percentage depth doses and transverse profiles in water obtained from a calculation performed with the complete geometry are compared to those found with the source model. A reasonable agreement is obtained in all cases analyzed except for the 18 MV Mevatron KDS linac for the 20 cm $\times$ 20 cm field.

Keywords: photon source model, PENELOPE, DPM

1. Introduction

Treatment planning systems (TPS) for cancer therapy use various types of calculation algorithms that have been developed from models that take into account the basic interaction mechanisms present in the problem and consider the contribution of the different radiation sources linked to the various components of the linac head.

Algorithms based on Monte Carlo (MC) simulations are one of the most accurate calculation tools in TPS (Verhaegen and Seuntjens 2003; Chetty et al., 2007). These algorithms require basically two inputs: a representation of the patient as trustworthy as possible and the details of the radiation impinging on it, these are particle type, energy, position, direction of movement, etc. Usually, there are two approaches to provide this

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