AbstractID: 4832 Title: Determination of the energy spectrum of bremsstrahlung of linear accelerations by Monte-Carlo calculations and an analysis of depth dose curves

Purpose: The knowledge of the bremsstrahlung spectrum of a linear accelerator (6 MV up to 18 MV) represents the physical base of therapy planning systems. It is obtained by Monte-Carlo calculations by taking account of the complete beam-line (geometry/materials). It is also obtained by an analysis of depth dose curves of small fields via Laplace transform, if the electron energy E_{el} is known (upper limit of photon energy).

Method and Materials: Monte-Carlo calculations with EGSnrc with respect to the beam-line of 6/18 MV (Varian 2300 C/D) and 6 MV (Varian 600C) have been performed for the AAA algorithm (Eclipse). The analysis of absorption depth dose curves in water (3x3 cm^2 / 4x4 cm^2 fields) of the mentioned machines has been performed for the central ray and tilted rays with the Laplace transform of a power sequence of Poisson distributions, which provide the reproducing kernel and the energy spectrum. The scatter profiles have been removed by a deconvolution.

Results: Monte-Carlo calculations and the Laplace transform method are in good agreement (standard deviation: ca. 1%) in the above cases. The formal integration of the reproducing kernel provides an analytical spectral distribution function

$$f(E) = (1 - \exp(-\alpha \cdot E / E_{el})) \cdot \exp(-\beta E^2 / E_{el}{}^2) \cdot (1 - E / E_{el})^q$$

The parameter α and q depend on the radial distance of tilted rays from the central ray at surface. It is also used to fit fluctuations of Monte-Carlo calculations.

Conclusion: The Laplace transform method even works, if only E_{el}, the measured depth dose curves and profiles of small field sizes are known. A comparison of 6 MV (2300 C/D) with 6 MV (600C) shows that the spectral distribution of the latter case rather corresponds to the 10 MV mode of a 2300 C/D machine. This results from the Pb-alloy of the flattening filter, whereas the 6/10 MV modes of the 2300 C/D use a Cu-filter.