

# Effect of flattening filter mounting surface position in Monte Carlo model of linear accelerators

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## Purpose

Accurate Monte Carlo (MC) simulations of radiation transport for radiotherapy purposes rely on a detailed description of the linear accelerator.

The linac head is modelled using a geometrical description provided by the vendor (Figure 1). Interpreting the drawings is, however, sometimes subject to uncertainties and the position of the flattening filter (FF) mounting surface could be one such example.

This study aimed at investigating the potential impact of an error in modelling the linac FF mounting surface.

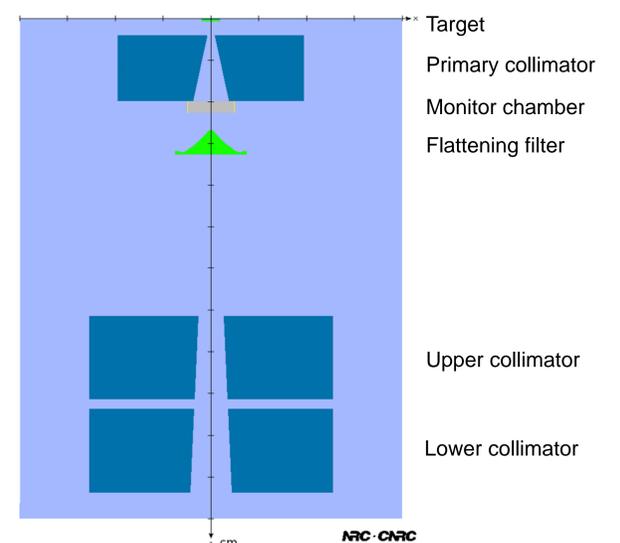


Figure 1. Schematic illustration of the linac head as modelled in BEAMnrc.

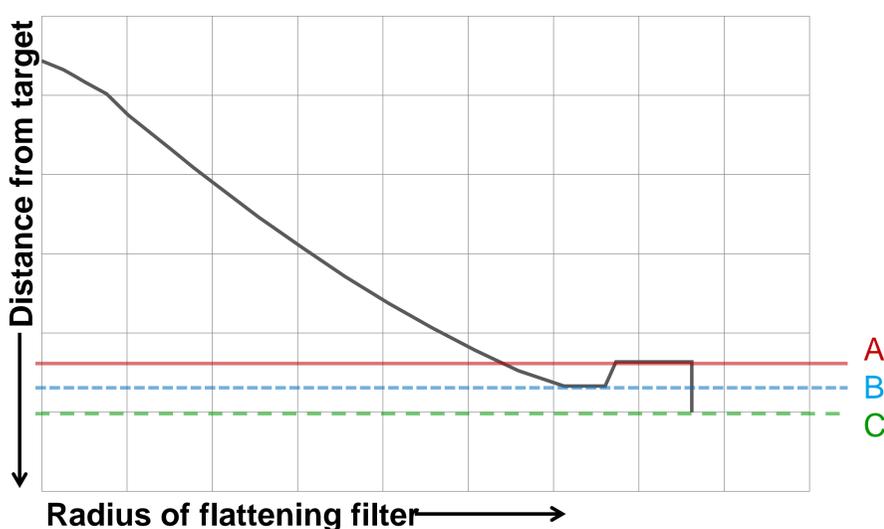


Figure 2. Illustration of possible interpretations A, B, and C of the flattening filter mounting surface position.

## Results

The 6 MV FF mounting surface positions A and C were within 1.6 mm from the most likely (B) option.

Beam energy fluence (function of energy and off-axis position) at 80 cm from target revealed small differences ( $\leq 1\%$ ) (Figure 3). Dose calculations in water were within the statistical uncertainty of 0.5% across the inline and crossline profiles at 5 cm and 20 cm depths.

## Methods

Vendor-provided drawings of a modern linac head were interpreted and the 6 MV FF mounting surface location was found to be uncertain.

The linac was modelled in BEAMnrc/EGSnrc with the mounting surface at three different distances from the linac target (A, B, and C in Figure 2).

Simulations of the radiation transport through the entire upper static part of the linac head were conducted and beam specific parameters were extracted and compared.

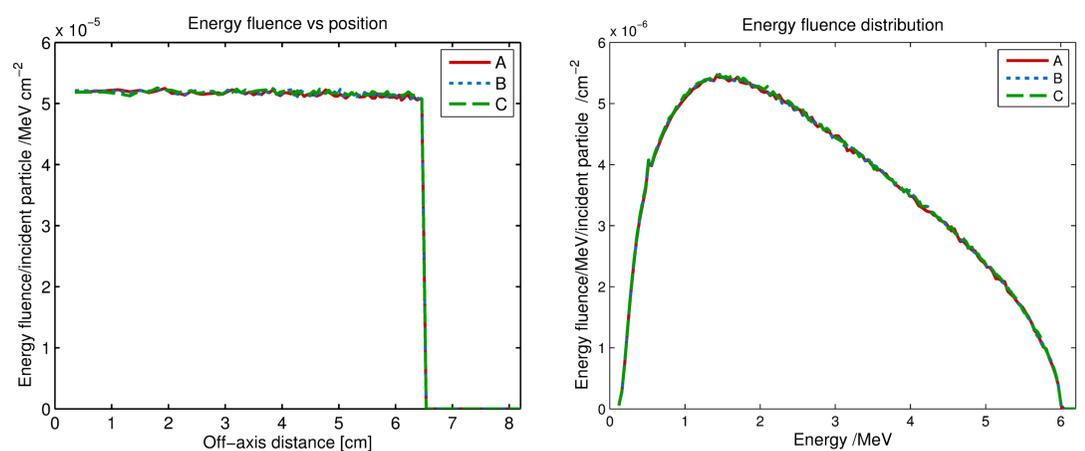


Figure 3. Beam energy fluence at 80 cm from target as a function of position (left) and energy (right).

## Conclusions

This study demonstrates that MC simulations are only marginally effected by various interpretations of the linac FF mounting surface position if positional differences are as low as 1.6 mm.

Nonetheless, thorough and critical study of vendor provided drawings is necessary in order to conduct accurate MC simulations for radiotherapy purposes.