AbstractID: 9310 Title: A Method of Effective Attenuation that Preserves Detailed MLC Characteristics and Replicates Spectral Effects of Deliberate Transport

Purpose: to develop a fast, accurate method of incorporating spectral effects of photon transport through a Multileaf Collimator while maintaining detailed representation of MLC geometry in a virtual source model.

Method and Materials: A virtual source model for a 6MV Novalis LINAC with micro-Multileaf Collimator (mMLC) has been developed for use with the MCNPX Monte Carlo engine. This source model uses a comprehensive ray-tracing algorithm to determine pathlengths through a detailed representation of mMLC geometry in order to clearly represent leaf edge and rounded leaf tip effects on the virtual source grid. To ensure sufficient resolution, the virtual source grid elements are only 0.5 x 0.5mm^2 when projected to the isocenter plane. In addition to representing open-field energy spectra and effective mMLC attenuation of open beam fluence, a sub-source has been developed to simulate the energy spectra of mMLC leakage. For a given mMLC configuration, pathlength and effective attenuation maps are determined at the start of a simulation. For each particle simulated, transport through the mMLC is determined by comparing one random number generation to an effective attenuation value. Subsequent sampling from the leakage sub-source is triggered by comparing the sampled photon's pathlength through the current mMLC configuration against the pathlength at that location if the mMLC were completely closed.

Results: The virtual source model accurately represents leaf edge and rounded leaf tip effects as demonstrated by comparison with coronal film measurements. Simultaneously, the spectral effects of photon transport through the mMLC are effectively reproduced without any deliberate or abridged transport. Simulation results demonstrate these principles and are shown to agree with axial and coronal film measurements.

Conclusion: Explicit or pseudo-explicit transport through MLC leaves may be obviated while preserving mMLC representation by incorporating a more sophisticated ray-tracing algorithm that triggers the sampling of a leakage sub-source.