Abstract ID: 14827 Title: Skin Dose Changes in Transverse Field MRIGRT: The ERE Or the LFP?

Purpose: This work investigates the ratio of the two source components of the undesirable skin dose increases seen in transverse field MRI-Linac systems: the Lorentz-force perturbation (LFP) and the electron return effect (ERE). Dose planning systems using kernels generated in magnetic fields will account for the LFP, however not the ERE. This work indicates the inaccuracies in not modeling the ERE in conventional planning.

Methods: Geant4 Monte Carlo simulations of a Varian 2100C 6MV photon beam in the presence of transverse magnetic fields are performed. By using tracking options the dose deposited by the ERE can be compared with that delivered by both the LFP. The effect of surface angle and field size is also examined on a phantom of 30x30x20cm3. High resolution scoring voxels are used to extract the 70 micron skin dose values.

Results: On the phantom entry side skin dose changes are clinically significant at large positive angles. The ERE causes about 50% of this depending on magnetic field strength. At negative angles the ERE plays a minimal role in the skin dose increases seen.

On the phantom exit side the skin dose increase is the greatest at negative surface angles, and furthermore, this is almost entirely due to the ERE electrons. For positive surface angles the ERE only gives rise to a small fraction of the exit skin dose increases.

Conclusion: The skin dose increases seen in 6MV transverse field MRI-Linac systems are significant at positive angles on the entry side, and at negative angles on the exit side. The ERE can cause a large proportion of these changes, which will not be inherently modeled correctly inside a typical dose planning engine. These results suggest that improvements to current planning systems are needed if accurate estimates of the skin dose changes in MRI-guided-radiotherapy are required.