AbstractID: 11462 Title: Simulation of an in-line 6MV linear accelerator from electron gun to target

Purpose:
To report on the development of a comprehensive linear accelerator (linac) model that simulates the electron dynamics from the electron gun to the target. This model was developed to determine the maximum tolerable magnetic field strength that a linac can operate in, so that passive magnetic shielding can be optimized for use in a large scale linac-MR system which is currently being developed. The design of magnetic shielding is essential for the linac and MR systems to be coupled together making true real-time adaptive radiotherapy possible.
Method and Materials:
The finite element method (FEM) was used to solve the radiofrequency (RF) fields within an in-house designed 6MV in-line linac waveguide. A Pierce-type diode electron gun was designed and the emitted electron trajectories were solved using the particle tracking code EGN2w. The injected electron trajectories and solved RF fields then served as inputs into the particle tracking code PARMELA. Benchmarking of the simulation was performed by taking the electron phase space generated at the target, running it through the BEAMnrc and DOSEXYZnrc Monte Carlo algorithms and comparing the simulated dose distributions to measured values at various field sizes and depths.
Results:
Discrepancies of less than 0.04% were found when comparing the 3D FEM RF fields to the benchmarked program Poisson Superfish while the simulated dose results were found to be within 1% of measurement for the dose profile horns of various field sizes at various depths.
Conclusion:
A full simulation of an in-line 6MV linac waveguide from electron gun to target has been benchmarked, showing agreements of the simulated dose distributions to within 1% of measurement. By adding the known magnetic fringe fields from the bi-planar magnet, the exact extent of electron trajectory deflections can be determined and thus the optimal magnetic shielding can be designed.