AbstractID: 14215 Title: Modeling a New Varian Linac Using a CAD to Geant4 Geometry Implementation: Dose and IAEA-Compliant Phase Space Calculations

Purpose: To (1) use accurate CAD linac treatment head geometry for Geant4 Monte Carlo calculations to minimize the errors due to approximations of the linac treatment head components used in previous studies, (2) investigate the CAD to Geant4 linking procedure through 6MV dose calculations, and (3) provide IAEA-compliant patient-independent phase space files.

Method and Materials: Geant4 v4.9.2.p01 was employed to simulate the treatment head geometry of the newest Varian linac for a 6MV beam. The geometry components are tessellated solids included in Geant4 as GDML (Generalized Dynamic Markup Language) files obtained via STEP (STandard for the Exchange of Product) export from Pro/Engineering, followed by STEP import in Fastrad, a STEP-GDML converter. An IAEA-compliant phase space writer was implemented between the shielding collimator and the upper jaws on a cylindrical geometry due to the compact treatment head and the divergent arc of the jaws. The simulation was run in parallel on the SLAC cluster. The dose calculations were based on a combined total of 26 billion histories. The voxel size for the 60x60x40cm^3 water phantom was 4x4x4 mm^3.

Results: For the percent depth dose profiles, the agreement between experiment and Monte Carlo is within 2% for 4x4, 10x10, 20x20, 30x30 and 40x40 cm^2 field sizes. For the lateral dose profiles, the agreement is within 3%. The fractional uncertainty of the average dose for the voxels with dose larger than 0.5 of the maximum dose decreased from ~4% to ~2% for field sizes increasing from 4x4 to 40x40 cm^2.

Conclusions: We have developed and validated the Geant4 simulated IAEA-compliant phase space of the new Varian linac for the 6MV beam obtained using a high precision geometry implementation from CAD. These files will be made publicly available and could be used for further dose calculations.

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