

AbstractID: 2939 Title: Implementation of Monte Carlo Dose Verification for Proton Therapy QA

**Purpose:** The use of proton beams provides the possibility of superior dose conformity to the treatment target as well better normal tissue sparing as a result of the Bragg peak effect. Recently, more effort has been dedicated to the investigation of practical solutions to compact, flexible and cost-effective proton therapy systems. The purpose of this work is to develop a Monte Carlo based dose verification tool for proton therapy treatment planning and beam delivery.

**Method and Materials:** As a part of this project, a Monte Carlo dose verification tool is developed based on the FLUKA Monte Carlo code and the MCSHOW graphic user interface. Direct Monte Carlo simulations included detailed physics of hadron, neutron, electron and photon interaction and transport. Magnetic field and beam modifiers are implemented to change the beam direction and shape. Phase space files and intensity maps are used to reconstruct the proton intensity distribution for each treatment field. The FLUKA voxel geometry is extended to read DICOM image files from CT and MR scans to reconstruct patient geometry for accurate dose calculation. Dose results will be displayed using MCSHOW on top of patient anatomy and analyzed to output DVH information.

**Results:** We have commissioned the FLUKA code system for radiotherapy dose calculation by comparison with other Monte Carlo systems including GEANT3/4 and the latest version of MCNPX. Consistent (within 2%) results were obtained among these codes and previously published measurement data. We also validated our implementation for various energy combinations and intensity modulation/weight adjustment for intensity-modulated proton therapy.

**Conclusion:** A useful Monte Carlo based dose verification toolkit has been developed for proton therapy research and clinical dose calculation. It will play an important role in the quality assurance for proton therapy treatment planning and dosimetry verification.