

**AbstractID: 7618 Title: A Monte-Carlo based dose engine for proton radiotherapy treatment planning**

**Purpose:** To develop a fast Monte Carlo (MC) dose engine for proton radiation treatment planning calculations and research studies.

**Method and Materials:** We developed a complete MC simulation system for calculating the dose distributions in patients. The system uses a commercial treatment planning system with an analytical dose algorithm to design the treatment plans. A DICOM-RT-ION interface was developed to allow automated data transfer between the treatment planning system and the MC system. The MC model included all major components of a passively-scattered proton treatment unit and a CT-based patient model. A suite of programs converted the prescriptive data (e.g., range, modulation width, field size) and patient CT data into a MC input file, including coordinate system transformations for arbitrary treatment beam orientations. The radiation transport calculations are performed with the MCNPX Monte Carlo system running on a cluster of 512 64-bit CPUs. For each treatment field, multiple simulation output files were postprocessed and the resulting MC dose matrix was written to the DICOM-RT-ION plan. The plan was then imported into the commercial planning system for visualization.

**Results:** The MC simulations and pencil beam dose distributions are in good agreement for a two-field prostate plan and a three-field lung plan. The prostate plan required 1.6 hours and the lung plan required 14 hours using 512 CPUs to achieve  $< 2\%$  statistical uncertainty in the total dose at isocenter. The computing time was directly related to the number of voxels in the patient model. Timing studies revealed that the simulation speed for this system scales almost linearly with the inverse number of CPUs.

**Conclusion:** The results of this study strongly suggest that it is feasible to implement a fast and easy-to-use MC treatment planning dose engine with currently available computing technologies and resources.

**Conflict of Interest (only if applicable):**

None.