# AbstractID: 11555 Title: Dosimetic characterization of a compact proton therapy unit with Monte Carlo simulations


**Purpose:**
A compact proton therapy unit is under development, so measured dosimetry data does not yet exist. The beamline was modeled and profiles were generated using Monte Carlo methods to evaluate the dosimetric characteristics of the proposed proton unit.

**Method and Materials:**
MCNPX code was used to model the proton therapy unit and simulate beam profiles. The range modulator, scatterers, range shifter, applicator, aperture and other components in the beam shaping system were modeled according to the design data provided by the manufacturer. A Gaussian distributed source was assumed. Spread out Bragg Peaks (SOBP) were simulated by combining the simulation results for various steps of the range modulator wheel. Simulations were performed in a water phantom as well as in air. Up to $10^8$ proton histories were tracked per simulation to achieve < 2% statistical uncertainties. Beam characteristics such as flatness, symmetry and penumbra were evaluated against machine specifications.

**Results:**
The 14 combinations of range modulator wheel and scatterers were modeled for this unit. For each combination, beam profiles were generated including: lateral fluence profiles in air with an open aperture, lateral fluence profiles in air with a half beam block, fluence in air along the beam axis, lateral dose profiles in water, and percentage depth dose in water for both unmodulated beam and SOBPs. The generated data met expectations in most cases. Subsequently, a commercial treatment planning system was configured using the simulated beam data.

**Conclusion:**
The Monte Carlo tool allowed the generation of dose profiles and evaluation of beam characteristics for a compact proton therapy unit prior to its construction. The simulated data provided feedback for machine design optimization and valuable reference data for future acceptance testing and commissioning.