

## AbstractID: 13950 Title: A Monte Carlo Based Proton Therapy Dose Distribution Verification System

**Purpose:** Create a Monte Carlo based proton therapy dose distribution verification system which can be used as a clinical aid in determining the adequacy of proton treatment plans.

**Method and Materials:** The GEANT4 Monte Carlo toolkit is used for all simulations. The absolute dose value per proton of the Bragg peak and its location were benchmark against NIST and other published data to ensure the accuracy of the physics models used in the simulations. For the patient specific dose distribution verification, the full nozzle is not simulated, only the beam spectrum, patient specific snout components, and the patient's CT. The beam spectrum, which for the IBA double scattering machine, depends on the time dependent proton current and range modulator, is calculated based on a spreadsheet which uses water equivalent thicknesses for the nozzle components. This allows for relative fast calculations compared with full nozzle simulation. The speed is needed if this system is to be used in a clinical setting.

**Results:** The beam spectrum has been verified for multiple ranges and SOBP widths for the different options. The MC distal and proximal 90% of the SOBP matches the TPS to within 3% or 3mm for all tested cases. The MC penumbra for different aperture sizes match the TPS at 20%, 50% and 80% within 3% and 3mm, however the 10% value of the penumbra for the MC is wider than the TPS, which has been noted as a limitation of the TPS in literature. Comparisons to measurements have not been made to date and adjustments to model parameters will be made to match measurements. Compensator simulations have not been performed to date.

**Conclusion:** This Monte Carlo dose verification system is fast and accurate; therefore it holds promise as a clinically useful tool.