AbstractID: 14059 Title: Modeling Multiple Coulomb Scattering in Therapeutic Proton Beams: A Comparison of Two Algorithms

Purpose: Accurate modeling of multiple Coulomb scattering (MCS) of heavy charged particles is imperative to achieve accurate dose distributions for proton therapy simulations. The Gaussian approximation based on Rossi's theory used in the Monte Carlo N Particle eXtended (MCNPX) code overestimates the characteristic scattering angle for thin materials. The purpose of this research was to evaluate a new, more accurate MCS algorithm based on Moliere theory that has been implemented in MCNPX.

Method and Materials: Simulations of a proton beam with a range in water of 16.1 cm incident on steel spheres of diameters 6.4 mm, 9.5 mm, and 15.9 mm were run and compared to previous simulations completed with the old algorithm and to measured data. Simulated dose was tallied in air at the locations of the film measurements, which were 2 cm, 15 cm, 30 cm, and 63 cm distal to the spheres.

Results: When compared to the old MCS algorithm, the new MCS algorithm more accurately modeled the maximum dose enhancement due to scattering 58% of the time and the maximum dose shadow due to scattering 83% of the time. Visual inspection of the dose profiles distal to the steel spheres reveals the consistent improvement in the dose distribution resulting from the new algorithm.

Conclusion: The new MCS algorithm appears to be more accurate than the old algorithm. In order to further characterize the algorithm's performance, additional simulations with a simpler geometry and comparisons with measurements are required.