Abstract ID: 18907  Title: Evaluation of the Analytical Scattering Models of 1) Lynch-Dahl 2) Highland and 3) Rossi for Proton Beams and Comparison with GEANT4 Monte Carlo Simulations as a Prerequisite for Proton Radiography Applications for Patients

Purpose: To evaluate the approximate 1) Lynch-Dahl 2) Highland and 3) Rossi scattering models for proton beams with GEANT4 Monte Carlo. This is a prerequisite for proton radiography applications for patients.

Methods: A Matlab program developed in-house at MGH was used to obtain a semi-analytical generalized Fermi-Eyges theory estimation of the spatial and angular spreads of a 230 MeV zero-spread incident proton beam as a function of depth. The constants of 1) Lynch-Dahl 2) Highland and 3) Rossi were used respectively for each model. MC simulations will determine which approximation provides the best prediction for different media configurations. Further, the calculated spreads were used to inform proton radiography imaging by calculating two limiting angles, a positional Acut and a directional Ccut. Acut is defined as the viewing angle of a point of incidence observer at which they see a point displaced by one positional standard deviation. Ccut is defined as the direction cosine of one angular standard deviation momenta.

Results: Both the angular and spatial spreads as well as their respective model differences rose monotonically with depth in water. At 30 cm depth the angular spread reached values around 3 degrees with about 0.32 degrees model difference, translating to Ccut differences in the first or second significant digit. At the same depth the spatial spread reached values around 1.2 cm with about 0.7 mm model difference, translating to Acut differences in the first or second significant digit. Preliminary MC data (not shown) indicate that the signals obtained due to the influence of inhomogeneities are small and the model differences may be relevant.

Conclusions: We observed non-negligible differences between the models using MC. Further analysis is required to understand, which model provides most accurate scattering predictions for protons penetrating different media configurations.