

AbstractID: 8704 Title: Monte Carlo Study of Distal Edge Degradation in Proton Therapy due to Heterogeneities. Proof of Principle with a Case Study.

**Purpose:** Degradation of the distal edge of quasi-mono energetic proton beams occurs when the proton beams penetrate geometries containing complex inhomogeneities. Contemporary treatment planning systems fail to accurately predict the degradation and its potential consequences, such as dose spill over into healthy tissue or the effects on dose homogeneity in the target volume. This work aimed to build a Monte Carlo model which accurately predicts the degradation.

**Methods and Materials:** In this study we built an MCNPX Monte Carlo model to simulate this degradation in a scanning-beam nozzle, using a 221.83 MeV proton beam impinging on a voxelized computer tomography-based phantom of a human head. Dose distributions, energy and angular distributions of the proton beam were tallied in and at the surface of a water phantom distal to the CT-based human head phantom.

**Results:** It was found that the degradation of the distal edge and the energy distribution of the proton beams are strongly correlated to the complexity of the heterogeneity. The angular spread of the beam showed only a weak dependence.

**Conclusion:** The Monte Carlo simulation model successfully produced the degradation of proton beams through a heterogeneous environment. It will be a useful tool to investigate the basic underlying physics and provide support for the development of optimization tools for proton therapy treatment planning and help to achieve escalated target doses and minimize collateral damage to normal tissue.

**Conflict of Interest:** None.