AbstractID: 14097 Title: Experimentally Optimizing Prompt Gamma Detection for Proton Therapy

Purpose: To model and optimize an experimental setup that could potentially provide *in-situ* range verification during proton therapy. The approach relies on measuring the prompt gamma emission profile produced by a beam of protons traversing a medium to provide information on the actual distal dose falloff in real time. **Method and Materials:** Calculations were performed using the GEANT4 Monte Carlo toolkit and a well-developed model of a therapy beam line at the Francis Burr Proton Therapy Center. A 150 MeV pencil beam of protons was transported through a cylindrical Lucite phantom and the prompt gammas emitted orthogonal to the beam direction were scored. Measurements were performed under similar conditions with beam intensities of approximately 5 nA using both an HPGe spectrometer and different scintillators. The experimental arrangement was then simulated as part of a design study to investigate a more optimized measuring geometry. **Results:** The measured and calculated gamma energy spectrum displayed several distinctive emission peaks corresponding to ^{12}C, ^{16}O, and ^{1}H as expected. Depth profiles measured with 150 MeV protons using two different detectors exhibited distal falloffs that correlated with the Bragg peak and agreed well with calculated gamma-ray emission profiles. Calculations found a significant neutron background that may be effectively reduced by energy deposit or possibly timing discrimination. **Conclusion:** This study highlights the necessity of performing accurate MC simulations to help interpret and design experiments under realistic conditions. Calculations, once properly correlated with measurements aid the effective and efficient use of beam time and will be used to optimize parameters for experiments such as collimation, shielding and detector media.