# AbstractID: 7007 Title: Energy Deposition Contributions from Secondary Particles in Proton Therapy

**Purpose:** The purpose of this work was to evaluate the LET energy deposition contribution from primary proton particles versus the contribution of secondary particles.

**Method and Materials:** The energy deposition contribution from primary proton particles versus contribution of secondary particles was calculated using HETC-HEDS (*High Energy Transport Code for Human Exploration in Deep Space*). HETC-HEDS simulates particle cascades by using Monte Carlo methods to compute the trajectories of the primary particle and all the secondary particles produced in nuclear collisions. For the initial phase of this study, the proton beam was incident on a computer model of a detector that is being designed to measure the LET spectra for proton beams. Simulations were performed using incident proton beams between 90 and 200 MeV/Nucleon in 5 MeV/Nucleon increments incident on 10 $g/cm^2$ of A-150 Tissue Equivalent Plastic. In the second phase, the proton beam will be incident on a computer model of an anthropomorphic RANDO phantom. Simulations will be performed for different patient treatments to determine the LET spectra of the protons and secondary particles.

**Results:** The simulations showed that secondary particles contribution is of significance, and the contribution is about 50% of the total energy deposited into the Tissue Equivalent Plastic. Overall, the results suggested that secondary particles are of concern during proton radiation therapy treatments and need to be investigated, especially at low proton energy, and beyond the Bragg peak point.

**Conclusion:** For proton therapy beams, the simulations presented show a significant contribution of about 50% of total energy deposition originates from secondary particles. Furthermore, a significant fraction of the fluence comes from secondary particles produced beyond the Bragg Peak. The authors are currently developing a model to incorporate the biological effect of the secondary particles in the proton treatment planning process.