AbstractID: 13036 Title: Initial studies of prompt gamma imaging during proton radiotherapy for the assessment of tumor and healthy tissue response.

Purpose: Future advancements in radiation therapy will require the development of patient specific treatment techniques that tailor and adapt dose delivery based upon the specific biological response of each patient over the course of treatment. Such techniques will require methods to routinely measure and quantify cancerous and normal tissues response. The purpose of this work is to study the use of "prompt" gamma rays emitted from tissues during proton beam irradiation for measuring and imaging physical responses (compositional and density changes) of irradiated tissues to assess patient response and treatment efficacy.

Methods and Materials: We preformed measurements and Monte Carlo calculations of the "prompt" gamma ray spectra emitted from tissue during proton beam irradiation. The emission spectra from several types of tissue where characterized according to the emission lines from the individual elemental constituents of the target tissue. Next, we studied the individual emission lines from the tissues as a function of elemental concentration and density.

Results: These results show that the prompt gamma emission lines from the major elemental components can be identified in the measured and calculated spectra. The intensities of these emission lines were found to be a function of concentration of each element and the physical density of the tissue.

Conclusion: Based on the results of these preliminary studies, we conclude that it may be possible to determine both the atomic composition and physical density of irradiated tissues by measuring and imaging the prompt gamma ray spectra emitted during proton treatment delivery. With further development, we believe this type of feedback could be used to track changes to elemental composition within cancerous and normal healthy tissues over the course of treatment allowing for the adjustment of the treatment as needed to ensure proper delivery of the prescribed dose.