Purpose: To determine the feasibility of using scintillating fibers for proton imaging purposes.

Methods and Materials: This study considered 2mm x 2mm square BCF-20 bicron fibers from Saint-Gobains CrystalsTM which emit a green spectrum with a peak at 492nm, and present a 2.7ns decay time, therefore making them suitable for particle-by-particle analysis. Photomultiplier Tubes (PMT) with approximately 3ns response pulses and 2x2.5mm sensitive areas were coupled to the fibers. Particle interactions were acquired with a fast oscilloscope (1.5GHz, 20Gs/s) for single event analysis, as well as with a multichannel data acquisition system for stream of events using multiple fibers simultaneously. A mono-chromatic proton beam set to different energies was used to irradiate individual fibers and the light output spectrum was recorded. Two individual fibers, one with and one without optical grease at the fiber-PMT interface, were also used for measurements in order to assess the benefit from using optical grease.

Results: Individual pulses were first recorded to assess the quality of the system. This highlighted the non-relevance of using optical grease versus a direct fiber-PMT interface. Light spectra were subsequently acquired with different incident proton energies. These correspond to the light output from each fiber, hence the energy deposited (dE/dx) by single protons inside the scintillator. The obtained data is in good agreement with the ICRU data which shows that scintillating fibers can be used to record incident energy from protons on a particle-by-particle basis.

Conclusion: Preliminary results show that scintillating fibers could be used for proton imaging. A prototype made of 64 scintillating fibers (2 perpendicular arrays of 32 channels) is currently under conception at MGH, and avant-garde pictures will soon be acquired with this first-of-a-kind proton radiography system.