AbstractID: 10533 Title: A status update on the development of proton CT at Loma Linda University Medical Center

At present, proton therapy treatment plans are carried out using data from X-ray CT scans. This method relies on the conversion of CT Hounsfield units to relative proton stopping power values. Since these quantities are not related on a one-to-one basis, uncertainties in addition to other prevalent X-ray CT uncertainties due to beam-hardening and high-density artifacts are introduced into the treatment planning calculations. Proton computed tomography (pCT) is a novel imaging modality that is capable of directly reconstructing relative stopping power of the patient through individual proton energy loss measurements. The implementation of pCT requires a proton gantry with at least 180 deg rotational capability and sufficient proton energy to penetrate the anatomical proton planning region. Existing proton treatment centers with 230-250 MeV maximum proton energy should be able to use pCT for most targets in the head and neck and thoracic/abdominal regions, while there may be some restrictions in the pelvic region for adult patients. Design considerations of a modern pCT scanner and simulation results have previously been published. This contribution summarizes recent developments in the pCT project at Loma Linda University Medical Center (LLUMC). Both GEANT4-simulated and experimental pCT imaging data obtained with a small pCT prototype developed in collaboration with the Santa Cruz Institute of Particle Physics and installed on the proton research beam line at LLUMC will be presented. Hardware decisions regarding the next-generation pCT scanner, which will permit scanning of head-sized objects, will be presented and discussed. Progress has also been made in the formulation of the most likely path (MLP) of protons through an object, and parallelizable iterative reconstruction algorithms that can be implemented on general-purpose commodity graphics processing units (GPGPUs).