AbstractID: 10845 Title: The effect of metal implants on proton transport

Purpose: Proton therapy treatment planning in the presence of high-density metal implants has considerable uncertainty. This uncertainty arises from artifacts produced through the imaging process, uncertainty in the CT density of the implant itself and the effect which both of these have on the range of protons. Because of this uncertainty, beam directions which pass through such implants are avoided if possible. However, in some cases such beams are unavoidable in order to preserve normal tissue and treat the tumor volume effectively. The goal of this ongoing project is to investigate proton transport through high-density implants and to determine the accuracy of treatment planning software in reproducing isodose distributions when such materials are present.

Methods and Materials: We have constructed a phantom with titanium and medical grade stainless steel plates of 1-4 mm thickness embedded within polystyrene. The phantom has been CT-scanned and then planned using the Odyssey treatment planning system (PerMedics Medical Systems), which is used in routine treatment planning at Loma Linda University Medical Center. The plan generated will be compared to physical dose measurements using ion chambers inserted into the polystyrene phantom. In addition, GEANT4 Monte Carlo simulations of the experimental setup will be completed using CT data as the basis for geometry and material definitions. Additional simulations will be performed with geometry defined based on manufacturers' specifications.

Results: Treatment plans of the experimental setup provide an indication of the perturbation of the proton radiation field caused by the metallic implants and indicate areas where measurements and comparisons with GEANT4 should be completed.

Conclusions: This study will provide useful data on the accuracy in treatment planning in the presence of metallic implants in proton therapy, and may indicate areas in which improvements to current treatment planning methods can be made.