AbstractID: 11138 Title: Monte Carlo Simulations of Compact Plasma Accelerators for Proton Radiotherapy

Purpose: One common characteristic of the compact plasma proton accelerators is a broad energy spectrum which can not be used directly for radiotherapy. The purpose of this study is to analyze the effect of the geometrical parameters of the treatment head components, their materials, and the magnetic field configuration, on the proton and neutron dose distributions to identify an optimal design for the plasma proton accelerator's treatment head and provide important feedback to ongoing plasma proton experiments.

Method and Materials: Calculations of proton dose distributions and the neutron dose equivalent were performed using Monte Carlo simulations by irradiating a water phantom with protons in the energy range of 175 to 250 MeV. The simulations were performed using the Geant4 (version 4.9.2) toolkit. The input spectra were experimental energy spectra scaled to energies relevant for radiotherapy, having a broad Gaussian distribution.

Results: We have designed a collimating system, magnetic field region, energy selector, and shielding components for a plasma accelerated proton therapy system. The collimating and energy selector systems are needed in order to achieve proton dose distributions superior to the conventional X-ray radiotherapy distributions. It is shown that a great number of unwanted electrons and photons is stopped by a sequence of tungsten absorbing disks placed inside the collimating and energy selector systems. Also, a sequence of three boronated polyethylene layers is shown to substantially capture the secondary neutrons. Dose deposited by neutrons in the water phantom is found to be 6 orders of magnitude lower than the dose deposited by protons, thus giving negligible contribution to the integral dose.

Conclusion: We have studied the design of the plasma proton accelerator's treatment head. It is shown that the proposed system is capable of delivering clinically relevant proton dose distributions. The implemented shielding components ensure extremely low neutron dose distributions.