AbstractID: 1185 Title: A Superconducting Magnet Design for a Laser-Accelerated Proton Therapy System

In a laser-accelerated proton therapy system, the initial protons have a broad energy spectrum and an angular distribution which are not suitable for direct therapeutic applications. A compact particle selection and collimation device has been designed to deliver small pencil beams of protons with desired energy spectra. Our previous work used an ideal magnetic field configuration to spread the protons with different energies and emitting angles for particle selection. In this work, we have designed a superconducting magnet system that produces a desired magnetic field configuration to achieve the same goal. Four magnets were set side by side along the central axis; each is made of NbTi wires which carry a current density of $\sim 10^9$ Am^{-2} at 4.2 K, and produces a magnetic field of ~ 4.4 T in the corresponding region. Collimation is applied to both the entrance and the exit of the particle selection system to generate a desired proton pencil beam. In the middle of the magnet system, where the magnetic field is close to zero, a particle selection collimator allowed only the protons with desired energies to pass through and be used in therapy. The simulation of proton transport in the presence of the magnetic field showed that the separation between 250-MeV protons and 220-MeV protons is 0.46 cm, while the 250-MeV protons need a collimator with an opening of 0.40 cm for a field size of 1×1 cm^2. Dose calculations will be performed for realistic treatment cases with the superconducting magnet system.