AbstractID: 7574 Title: Particle in cell simulation of laser accelerated proton beams for radiation therapy

This work investigates particle in cell (PIC) simulations of laser plasma interaction and subsequent proton acceleration for radiation therapy treatments. Our results showed that under optimal interaction conditions, protons can be accelerated up to relativistic energies of 216 MeV by a petawatt laser field of intensity $I=10^{21}$ W/cm^2. The proton acceleration is due to the dragging Coulomb force arising from the charge separation induced by the ponderomotive pressure (light pressure) of high intensity laser. The accelerating electric field strength reaches the values of up to 40 % of the laser field (40 GV/m) which is 10^5 times larger than the maximum electric field found in present-day accelerators. The energy stored in this field is eventually converted into the kinetic energy of the protons. The proton phase-space distribution used in our calculations displays the particle momenta **p** versus their positions **r**. It is used in the calculations of dose distributions using the GEANT3 Monte Carlo simulation code. Because of the broad energy and angular spectra of the accelerated protons, the need for a compact particle selection and beam collimation system is discussed, which will generate small beams of polyenergetic protons for intensity and energy modulated proton therapy. We have also estimated the dose rate that one can expect from the laser-accelerated proton system. Typical lasers operating in a 10 Hz repetition rate yield D ~ 8.4 Gy/min, which is quite close to the dose rate given by the conventional linear accelerators (D=3-6 Gy/min).