AbstractID: 6440 Title: Beam of laser-accelerated protons: generation and characterization.

Purpose: To experimentally demonstrate the generation of proton beams by a novel technique based on the interaction of high-power laser pulses with thin solid-state targets. To fully characterize the beam of particles emitted from the laser accelerator and to compare its properties with the theoretically predicted divergence and energy spectrum.

Method and Materials: We have built an experimental set-up for generation of laser-accelerated protons. The high-power laser pulses are produced by a chain of lasers and amplifiers and are delivered to the target in a shielded vacuum chamber. The sharply focused laser beam creates light intensity in excess of $1x10^{18}$ W/cm^2. The cross-section of the proton beam is directly imaged using a CR39 nuclear track detector situated at a fixed distance behind the target. The energy spectrum on the beam axis was recorded by a proton spectrometer (Thomson parabola) that was assembled and calibrated in our lab. An alternative method for energy evaluation utilizing a set of calibrated mylar range-filters was used as well.

Results: The angular distribution of the proton beam was determined from the CR39 images. Full divergence angle of 40^o was measured, confirming the theoretical predictions. Our preliminary measurements were conducted at lower laser power (7 TW). Therefore, the energy spectrum of the proton beam revealed thermal (Maxwellian) distribution with cut-off energy slightly less than 1 MeV.

Conclusion: We demonstrated the acceleration of protons using powerful laser pulses and fully characterized the generated proton beam. Considerable improvements associated with increased laser intensity and novel target design are discussed as well. The experimental results presented here are the first step toward the generation of therapeutic proton beams with controlled characteristics using lasers.