AbstractID: 11748 Title: Experimental implementation of the directed coulomb explosion regime of laser-proton acceleration

Purpose: To quantify the laser pulse requirements and target parameters required to achieve the Directed Coulomb Explosion (DCE) regime of laser-target interaction for the acceleration of protons to therapeutic energies. **Method and Materials:** Particle-in-Cell (PIC) simulations of the planned experiments along the funded upgrade path of the HERCULES laser at the University of Michigan have predicted a new regime of attainable laser-target interactions for proton acceleration. The laser was recently upgraded to 300 TW and a temporal pulse contrast ratio of 10^{-11}, allowing intensities of $2x10^{22}$ W/cm^2 to be achieved in a near diffraction limited, 1.3 micron, focal spot. The 2 ns long amplified spontaneous emission (ASE) pre-pulse was suppressed by a factor 10^{-3} through the implementation of a cross-polarized wave (XPW) pulse cleaner to prevent pre-plasma creation on the front surface and preserve the physical integrity of the thin-film target. Dual plasma mirrors are being characterized to reduce the prepulse at < 30 ps before the main pulse (caused by variations in the index of refraction through the optic path) below a contrast ratio of 10^{-11}. This will allow experiments on thin foil targets (< 100 nm) up to 300TW with no significant pre-pulse to compromise the target. **Results:** Preliminary measurements show an additional reduction of the contrast ratio of the ASE pre-pulse by a factor of 10^{-3} after the addition of dual plasma mirrors. Additional work is required to optimize the setup and parameters of the plasma mirrors to account for polarization effects and wave front distortions and variable intensity levels. **Conclusion:** Implementation of dual plasma mirrors is progressing with promising results and will soon allow experimental implementation of the laser pulse characteristics required to test the DCE regime of proton acceleration.