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Characterization and Focusing of Light Ion Beams Generated by Ultra-Intensely Irradiated Thin Foils at the Kilojoule Scale[1]

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We present first observations of focused, multi-MeV carbon ions generated in ultra-intense, shortpulse laser interactions with thin, hemispherical ($400\,\mu m$ radius) targets. The focal distance was observed at $\approx$ $700\,\mu m$ from the apex with a spot size estimated at $100\,\mu m$. The parameters were determined by ray-tracing the ion trajectories using the projection of a witness mesh in the beam path onto a film pack detector. Protons were characterized using radiochromic film packs as a detector. To distinguish the carbon beam, targets were preconditioned using a heating laser to remove most of the hydrogen. Further distinction was made by replacing the film with a lithium fluoride plate and measuring the carbon dependent nuclear activation. These results have important implications for the design of integrated inertial confinement fusion experiments using ions beams such as fast ignition or implosion defect studies. The experiments were conducted at the Los Alamos National Laboratory's $90\,J$, $2 \times 10^{20}\,W/cm^2$ Trident Shortpulse and the Laboratory for Laser Energetics' $1\,kJ$, $5 \times 10^{18}\,W/cm^2$ Omega EP Backlighter and Sidelighter beams. Surprising discrepancies were observed when comparing peak ion energies from Trident (and similar lasers) with those from Omega EP, which cannot be explained by intensity scaling laws. Simulations using the hybrid pic code, LSP were performed to help explain the difference. We hypothesize energy scaling better predicts the peak ion energy. LA-UR 10- 03364

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