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Laser Plasma Interaction with Multi-Layer Targets: Ion Acceleration and Ion Heating G. SORASIO, L. SILVA, J. DAVIES, G. FIGUEIRA, M. MARTI, R. FONSECA, Golp / Centro de Física dos Plasmas, Instituto Superior Tecnico, Lisbon, Portugal — In the present analysis, we explored the physics of the interaction of high intensity ($I > 10^{21}$), short laser pulses with multi-layer targets of various densities and composition by means of particle in cell (PIC) simulations with Osiris 2.0 in 1 (1D) and 2 (2D) dimensions. The results have shown that, when the layer thicknesses are appropriate and the layer densities decrease along the laser propagation direction, multiple shock structures are formed in the transition regions between the layers. The shocks accelerate the ions inside the target creating a series of mono-energetic ion beams. Since the velocity of the shocks decreases with distance from the interaction region, the first shock rapidly reaches the next creating a new structure that accelerate the ions previously picked up from both shocks. As a result, the interaction of a short laser pulse with multi-layer targets give rise to a quasi-monoenergetic ion beams. The results have also shown that, when the layer densities increase along the laser propagation direction, the multiple shock structures move in opposite directions: the shock detaching from the front surface moves forward while the shocks formed at the boundaries between the layers move backward. The collisions of different shocks give rise to two stream vortexes that effectively channel their energies to high wave-number structures eventually leading to very localized regions of hot ions (> 100 keV).

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