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Real-time diagnostics of laser acceleration of ions in overdense gas-jet plasma CHAKRA MAHARJAN, Stony Brook University, OLIVER TRESCA, Brookhaven National Laboratory, NATHAN CROOK, Stony Brook University, NICHOLAS DOVER, Imperial College, MIKHAIL POLYANSKIY, Brookhaven National Laboratory, ZULFIKAR NAJMUDIN, Imperial College, PETER SHKOLNIKOV, Stony Brook University, IGOR POGORELSKY, Brookhaven National Laboratory — Laser acceleration of ions to MeV energies in overdense plasma at relativistic intensities shows promise for obtaining ion beams for important applications. Recently, gas jet targets were proposed for laser acceleration of ions, utilizing the fact that plasma overdense for CO_2 lasers ($\lambda \sim 10$ μm) is easily created in gas jets. Among advantages of gas targets are availability of optical plasma diagnostics, easy control of plasma density, non-destructiveness, and the ability to generate purely proton beams. With experiments underway, much of the physics of the process is still unknown. Several acceleration mechanisms are currently under consideration, with shock-wave acceleration been studied most extensively. We report our results on ion generation in overdense plasma of H and He gas jets. Laser-plasma processes have been studied using two probe pulses. Varying delays between these pulses and the CO_2 laser pulse, we observe and evaluate the evolution of the laser-driven shock which, we believe, is the process mainly responsible for ion acceleration in our parametric regime. We present our real-time study of the formation and evolution of plasma shock waves and their correlation with maximum ion energy.

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