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Self-sustaining relativistic ionization wave launched by a sheath field ALEXEY AREFIEV, Institute for Fusion Studies, The University of Texas, Austin, Texas 78712, USA, MATT MCCORMICK, HERNAN QUEVEDO, ROGER BENGTSON, TODD DITMIRE, Center for High Energy Density Science, The University of Texas, Austin, Texas 78712, USA — We present experimental evidence supported by particle-in-cell (PIC) simulations of a self-sustaining relativistic ionization wave launched into a surrounding gas by the sheath field of a high energy density plasma. We create a plasma filament with hot electrons by irradiating a supersonic clustering gas jet with a short pulse laser (115 fs) at an intensity of 5×10^{17} W/cm^2. In contrast with a single atom, a cluster of atoms produces super-ponderomotive electrons in the field of the laser. These electrons generate a sheath field at the edge of the plasma filament strong enough to ionize the gas atoms in the sheath. We observe that a collisionless ionization wave is launched in this regime, propagating radially through the gas at up to 0.5 c after the laser has passed. The expansion of the resulting plasma filament due to the ionization wave occurs in about 2 ps, more than doubling the initial radius of the filament. The remarkable longevity of the wave without continuous energy deposition into the electron population is explained by a moving field structure that traps the hot electrons near the boundary. 2D PIC simulations confirm that the trapped hot electrons maintain a sheath field required for the ionization despite the significant expansion of the filament.

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