

Abstract Submitted
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Accelerating neutral atoms on a Table top KRISHNAMURTHY M, RAJEEV RAJENDRAN, MADHU TRIVIKRAM T, RISHAD KPM, NARAYANAN V, KRISHNAKUMAR E, Tata Institute of Fundamental Research, Mumbai, India — Plasma accelerators driven by super strong laser fields couple unusually large energies to charged particles. Acceleration of neutral atoms from such strongly ionized plasmas have remained elusive. A laser based neutralizer can convert laser accelerated fast ion source to fast neutral atom source. We report a scheme [1] to generate fast Argon atoms (up to 1 MeV) from an optical-field-ionized dense nano-cluster ensemble. Intense, ultrashort pulses ionize each atom in a Ar nanocluster to $8+$ and coulomb explode ions to energies up to MeV. We show that in a dense cluster ensemble, the electrons that stream out of the focal volume collisionally excited clusters in the periphery of the focus to high lying Rydberg excited states and form a sheath of electronically excited clusters. Cross sections for reducing ions by charge transfer collisions are orders of magnitude larger with the electronically excited systems. Fast ions that stream through the excited cluster sheath are reduced to neutral atoms with no change in momentum. We show that the scheme can covert ions to neutral atoms with nearly 100% efficiency, transferring 8 electrons per atom in a few mm span of the supersonic jet.

[1] R. Rajeev et.al., Nature Physics 10.1038/NPHYS2526.

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