Ionization induced trapping in a laser wakefield accelerator
WILLIAM SCHUMAKER, C. MCGUFFEY, A.G.R. THOMAS, T. MATSUOKA, V. CHVYKOV, F.J. DOLLAR, G. KALINTCHENKO, V. YANOVSKY, A. MAK-SIMCHUK, K. KRUSHELNICK, University of Michigan, V. YU. BYCHENKOV, P. N. Lebedev Physics Institute, I.V. GLAZYRIN, RFNC-VNIITF — Experimental measurements of electrons accelerated in a laser wakefield accelerator indicate trapping initiated by an ionization mechanism. By using a range of noble gases and nitrogen as a very small percentage contaminant in helium gas, it is found that tunneling ionization of inner shell electrons plays an important role in determining the trapped charge. Although there is a small increase in electron number density due to the higher Z contaminant, it is shown to be insufficient to account for the increase in charge in the trapped bunch. The behavior of the trapping with laser intensity is also consistent with the tunnel-ionization thresholds for the gases used. This mechanism is likely to allow lower power laser systems to be used to generate comparably high-energy and low-emittance monoenergetic electron beams than in pre-ionized gas configurations. 2D particle-in-cell simulations including an ADK ionization model were used to correlate with experimental results.

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Date submitted: 24 Jul 2009
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