Abstract Submitted
for the DPP13 Meeting of
The American Physical Society

Laser wakefield acceleration of electrons with ionization injection in a pure $N5^+$ plasma channel[1] SUNG JUN YOON, ANDY GOERS, GEORGE HINE, JENNIFER ELLE, Institute for Research in Electronic and Applied Physics, University of Maryland, College Park, DANIEL GORDON, Naval Research Laboratory, Washington DC, HOWARD MILCHBERG, Institute for Research in Electronic and Applied Physics, University of Maryland, College Park — Preformed plasma channels have been successfully used in laser wakefield acceleration to accelerate electrons up to GeV with modest laser intensity by eliminating the need for self-focusing. Here, we show that nitrogen is an excellent medium for ionization injection-based laser wakefield accelerators because of the extremely large ionization potential gap between the L-shell ($98eV$ to ionize $N4^+ \rightarrow N5^+$) and K-shell electrons ($552eV$ to ionize $N5^+ \rightarrow N6^+$). We have measured pure $N5^+$ plasma channels with a base density of $1 \sim 5 \times 10^{18} cm^{-3}$ and shock walls at $\sim 2 \times 10^{19} cm^{-3}$ through hydrodynamic expansion of nitrogen cluster plasma. In this $N5^+$ plasma channel, we can decrease the laser intensity threshold for trapping and accelerating electrons by ionization injection and channel guiding. Particle-In-Cell simulations confirm trapping of electrons from $N5^+$ by tunneling ionization with initial laser intensity of $a_0 = 1$. Injection from the abundant $N5^+$ ionization source enables the space charge of the trapped electrons to stop further injection. The accelerated bunch can reach hundreds of pC with energy gain of hundreds of MeV. We will present preliminary results from corresponding acceleration experiments.

[1]This work is supported by DoE, DTRA, and NSF.

Sung Jun Yoon
Institute for Research in Electronic and Applied Physics,
University of Maryland, College Park

Date submitted: 12 Jul 2013 Electronic form version 1.4