Abstract Submitted
for the DPP16 Meeting of
The American Physical Society

A Stable High-Energy Electron Source from Laser Wakefield Acceleration[1] PING ZHANG, BAOZHEN ZHAO, CHENG LIU, WENCHAO YAN, GRIGORY GOLOVIN, SUDEEP BANERJEE, SHOUYUAN CHEN, DANIEL HADEN, COLTON FRUHLING, DONALD UMSTADTER, University of Nebraska-Lincoln — The stability of the electron source from laser wake-field acceleration (LWFA) is essential for applications, such as novel x-ray sources and fundamental experiments in high field physics. To obtain such a stable source, we used an optimal laser pulse and a novel gas nozzle. The high-power laser pulse on target was focused to a diffraction-limited spot by the use of adaptive wavefront correction and the pulse duration was transform limited by the use of spectral feedback control. An innovative design for the nozzle led to a stable, flat-top profile with diameters of 4 mm and 8 mm with a high Mach-number (~6). In experiments to generate high-energy electron beams by LWFA, we were able to obtain reproducible results with beam energy of 800 MeV and charge >10 pC. Higher charge but broader energy spectrum resulted when the plasma density was increased. These developments have resulted in a laser-driven wakefield accelerator that is stable and robust. With this device, we show that narrowband high-energy x-rays beams can be generated by the inverse-Compton scattering process. This accelerator has also been used in recent experiments to study nonlinear effects in the interaction of high-energy electron beams with ultraintense laser pulses.

[1]This material is based upon work supported by NSF No. PHY-153700; US DOE, Office of Science, BES, DE-FG02-05ER15663; AFOSR FA9550-11-1-0157; and DHS DNDO HSHQDC-13-C-B0036.

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Date submitted: 14 Jul 2016 Electronic form version 1.4