Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Ultra-low emittance electron beam generation using ionization injection in a plasma beatwave accelerator[1] CARL SCHROEDER, CARLO BENEDETTI, ERIC ESAREY, WIM LEEMANS, Lawrence Berkeley National Laboratory — Ultra-low emittance beams can be generated using ionization injection of electrons into a wakefield excited by a plasma beatwave accelerator. This all-optical method of electron beam generation uses three laser pulses of different colors. Two long-wavelength laser pulses, with frequency difference equal to the plasma frequency, resonantly drive a plasma wave without fully ionizing a gas. A short-wavelength injection laser pulse (with a small ponderomotive force and large peak electric field), co-propagating and delayed with respect to the beating long-wavelength lasers, ionizes a fraction of the remaining bound electrons at a trapped wake phase, generating an electron beam that is accelerated in the wakefield. Using the beating of long-wavelength pulses to generate the wakefield enables atomically-bound electrons to remain at low ionization potentials, reducing the required amplitude of the ionization pulse, and, hence, the initial transverse momentum and emittance of the injected electrons. An example is presented using two lines of a CO_2 laser to form a plasma beatwave accelerator to drive the wake and a frequency-doubled Ti:Al_2O_3 laser for ionization injection.

[1]Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Carl Schroeder
Lawrence Berkeley National Lab

Date submitted: 14 Jul 2017 Electronic form version 1.4