

Abstract Submitted
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Seeding of the Self-modulation of a Long Particle Bunch in a Plasma¹ YUN FANG, University of Southern California, PATRIC MUGGLI, Max Planck Institute for Physics, Munich Germany, WARREN MORI, University of California, Los Angeles, JORGE VIEIRA, Instituto Superior Tecnico (IST), Lisbon, Portugal, VITALY YAKIMENKO, KARL KUSCHE, MARCUS BABZIEN, CHRISTINA SWINSON, MIKHAIL FEDURIN, ROBERT MALONE, Brookhaven National Laboratory, Upton, NY, USA — We demonstrate experimentally for the first time the self-modulation seeding of a relativistic electron bunch in a plasma. The long (≈ 3.2 ps) bunch available at BNL-ATF drives wakefields with periods one to one fifth the bunch length in plasmas in a $10^{15} \sim 10^{16} \text{cm}^{-3}$ density range. The effect of the seeding is observed as a periodic modulation of the bunch correlated energy spectrum after the 2cm-long plasma. Although simulations and experimental results show that the self-modulation instability does not grow significantly over the 2 cm-long plasma with a 50 pC bunch, its development is confirmed by the resulting large energy gain and loss observed with a higher charge bunch (1 nC). This demonstration serves as a proof-of-principle test for the mechanisms of seeding of the transverse self-modulation of particle bunches in plasmas, and indicates the possibility of using long electron or proton bunches as drivers for plasma based accelerators. Detailed experimental and simulation results will be presented.

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