Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Long lepton bunch self-modulation experiment at SLAC MARK HOGAN, SLAC National Accelerator Laboratory, JORGE VIEIRA, NELSON LOPES, Instituto de Plasmas e Fusão Nuclear-Laboratório Associado, Instituto Superior Técnico, RICARDO FONSECA, ISCTE-IUL, OLAF REIMANN, Max Plank Institute for Physics, Munich, MIKE LITOS, SELINA LI, SPENCER GESSNER, SLAC National Accelerator Laboratory, KEN MARSH, NAVID VAFAEI, CHAN JOSHI, WARREN MORI, University of California, Los Angeles, ERIK ADLI, SLAC National Accelerator Laboratory, YUN FANG, University of Southern California, LUIS SILVA, Instituto de Plasmas e Fusão Nuclear-Laboratório Associado, Instituto Superior Técnico, PATRIC MUGGLI, Max Plank Institute for Physics, Munich —
The use of long particle bunches to drive ultra-relativistic, high amplitude plasma waves through the transverse self-modulation instability (SMI) has been recently investigated numerically. This has motivated proton driven plasma wakefield accelerator experiments currently being planned at CERN and Fermilab. We propose to explore the SMI using the 20 GeV, 500 microns long lepton bunches currently available at SLAC FACET. Full-scale PIC simulations show gradients greater than 20 GeV/m and up to 10 GeV energy gain/loss at the 1% level in 1 meter plasmas using electron bunches. Simulations show that the blowout regime is reached at the saturation of the SMI. For the positron driven scenario, the blowout leads to the defocusing of most of the positrons and a gain/loss up to 5 GeV at the 1 % energy level is reached. Simulation results as well as diagnostics to measure the SMI in the planned experiments are discussed.

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Date submitted: 17 Jul 2012 Electronic form version 1.4