

Abstract Submitted
for the DPP06 Meeting of
The American Physical Society

Experimental observations of Longitudinal Space-Charge Waves in a Long Solenoid Experiment System¹ KAI TIAN, YUN ZOU, YUPENG CUI, IRVING HABER, RAMI KISHEK, MARTIN REISER, PATRICK O'SHEA, Institute for Research in Electronics and Applied Physics — In the space-charge dominated beams, the nonlinear space-charge forces will introduce many collective effects, which may limit the maximum current or beam quality. Some of these collective behaviors are not well understood. One of the effects is the physics of longitudinal space-charge waves, which can be generated by density perturbations or energy perturbations caused by many factors, such as the discontinuity of the beam transport modules, fluctuations in the bunch, or the mismatch of the focusing channels. Studies of the dynamics of longitudinal space-charge waves in space-charge dominated beams propagating through a transport channel with a long solenoid are performed at the University of Maryland. In this paper, we report some experimental results on the energy modulations converted from density modulations. By changing the working conditions of the electron gun, pure initial density modulations are generated. Energy perturbation waveforms are measured with a high-resolution energy analyzer. The experimental results are compared with both the linear theory and the simulation results. Good agreements are achieved for the relationship between the energy and current perturbation strengths.

¹Work supported by the U.S. Department of Energy, grant numbers: DE-FG02-94ER40855 and DE-FG02-92ER54178.

Kai Tian
Institute for Research in Electronics and Applied Physics

Date submitted: 17 Jul 2006

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