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Laboratory Studies of Turbulence Associated with Localized Current Layers

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Localized current layers are a natural consequence of the interaction of the solar wind with the earth's magnetic field. In particular, field-aligned currents dynamically link the active magnetotail to the auroral ionosphere. Within these currents there may develop small-scale phenomena such as density-gradient or shear-driven instabilities, or electron solitary structures and micro-turbulence which may profoundly influence the larger-scale dynamics of the system. The Basic Plasma Science Facility (BaPSF) at UCLA offers a unique opportunity to model magneto/heliospheric phenomena, including current sheets. We present measurements from laboratory experiments of an electron current sheet which is several ion-gyroradii thick by up to ten Alfvén wavelengths along the field(1cm by 20m). The current sheet leads to a depletion of the background plasma, forming a field-aligned density depression. Drift-Alfvén waves are spontaneously excited and drive cross-field particle transport which relaxes the density gradient and modulates the current flow. We will also present initial results of small-scale electric field spikes within the current sheet using specially fabricated dipole probes with separation on the order of the Debye length—here 13 microns. These measurements are motivated by the observation of electron solitary structures throughout the magnetosphere.