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(I) Experiments and simulation of the nonlinear interaction between spinning magnetized plasma pressure filaments

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Filamentary plasma structures aligned with magnetic fields are ubiquitous in various space and laboratory plasma environments. In numerous magnetic confinement devices, such coherent structures called blobs or blob-filaments, are intermittently formed in the boundary layer region of the device and transported across magnetic field lines through ExB convective motion. These structures can be much more efficient at transporting particles and energy than standard diffusive processes, therefore it is important to understand their propagation and stability. The magnetized plasma pressure filaments are often created in pairs or bundles, therefore filament-filament interaction is important for purposes of estimating their lifetime. One other feature of these structures, is the presence of internal steep pressure gradients, with density and temperature gradient scale lengths on the order of the cross-field filament size. This provides a free energy source for driving spontaneous low frequency excitations such as drift waves and vortices. It is the purpose of this study to understand the nonlinear saturated state of small scale (few electron skin depths) magnetized plasma pressure filaments that undergo drift wave turbulence driven by their internal pressure gradients. Experiments were designed to form controlled plasma pressure filament structures within a large linear magnetized plasma device; for this purpose the upgraded Large Plasma Device (LAPD) operated by the Basic Plasma Science Facility at UCLA was used. The setup consists of single or multiple biased probe-mounted cerium hexaboride (CeB6) crystal cathodes that inject low energy electrons along a strong magnetic field into a pre-existing cold afterglow plasma, thus forming plasma pressure filaments. Langmuir probes inserted in the plasma measure the low frequency (˜10-20 kHz) gradient-driven fluctuations. A statistical study of the fluctuations reveals amplitude distributions that are skewed, which is a signature of intermittency in the transport dynamics. Large amplitude temperature fluctuation bursts have been analyzed and are related to spatiotemporal structures which propagate azimuthally and radially outward from the filaments. Details on the time scales of density, temperature and vorticity mixing in the interacting filaments will be presented along with fluid and kinetic simulation modeling results.

Keyword-1

turbulence

Keyword-2

transport

Keyword-3

mgnetized plasma

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