Exponential Frequency Spectrum and Anomalous Transport

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Measurements of a controlled cross-field pressure gradient in a magnetized plasma show the development of a broadband spectrum of density and temperature fluctuations having exponential frequency dependence. The origin of the exponential spectrum is traced to soliton-like pulses of Lorentzian shape. The phenomenon is found to be present also in the limiter-edge plasma turbulence associated with blob transport. This finding suggests a universal feature of turbulence at frequencies below the ion cyclotron frequency in magnetized plasmas that results in non-diffusive cross-field transport. Results are reported from two separate experiments performed in the Large Plasma Device (LAPD-U) operated by the Basic Plasma Science Facility (BaPSF) at the University of California, Los Angeles. One experiment involves controlled temperature gradients using a small electron beam to create a hot electron temperature filament embedded in the center of a large, cold magnetized plasma. The other experiment uses a metallic plate inserted at the plasma edge to establish a sharp density gradient in the nominal plasma column of the LAPD-U.