## Nonlinear Dynamics of Fluctuations in the Presence of Sheared Parallel and Perpendicular Flows in a Magnetized Laboratory Plasma

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Laboratory experiments are described which utilize a set of concentric bias rings to affect the velocity (flow) shear in the linear HELCAT (HELicon-CAThode) device at the University of New Mexico. HELCAT is 4 m long, 0.5 in diameter, with  $B_0 \le 2.2$  kG, and utilizes two plasma sources: an RF helicon at one end of the device, and a thermionic cathode at the other. With increasing ring bias, relative to the vacuum chamber wall, it is found that both axial and azimuthal flow shear change by only a small amount in magnitude, but move inward to the plasma core from the wall. As bias is increased, drift waves decrease in magnitude and are eventually fully suppressed, then the K-H mode is destabilized. It appears that the azimuthal flow shear is mainly responsible for suppression of drift modes, while the azimuthal shear is the primary driver of the K-H instability. While bias applied to rings at any radii suppresses drift fluctuations with nearly equal effectiveness, the K-H mode is more easily excited by biasing at the plasma edge. Fluctuations show increasingly chaotic and intermittent behavior as bias increases, up to V ~ 10kTe/e, when the chaos disappears, as indicated by a rapid drop in correlation dimension, and very bursty behavior. Additionally, detached edge "blobs" are observed in cathode plasmas, but appear to be absent from helicon discharges, even when other operating parameters (magnetic field, background pressure) are identical. Experimental results and comparisons with theory are described.