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Laboratory study of avalanches in a magnetized plasma[1]

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Results of a basic heat transport experiment[2,3] involving an off-axis heat source are presented. Experiments are performed in the Large Plasma Device (LAPD) at UCLA. A ring-shaped electron beam source injects low energy electrons (below ionization energy) along a strong magnetic field into a preexisting, large and cold plasma. The injected electrons are thermalized by Coulomb collisions within a short distance and provide an off-axis heat source that results in a long, hollow, cylindrical region of elevated electron temperature embedded in a colder plasma, and far from the machine walls. It is demonstrated that this heating configuration provides an ideal environment to study avalanche phenomena under controlled conditions. The avalanches are identified as sudden rearrangements of the pressure profile following the growth of fluctuations from ambient noise. The intermittent collapses of the plasma pressure profile are associated with unstable drift-Alfvén waves and exhibit both radial and azimuthal dynamics. After each collapse the plasma enters a quiescent phase in which the pressure profile slowly recovers and steepens until a threshold is exceeded, and the process repeats. The use of reference probes as time markers allows for the visualization of the 2D spatio-temporal evolution of the avalanche events. Avalanches are only observed for a limited combination of heating powers and magnetic fields. At higher heating powers the system transitions from the avalanche regime into a regime dominated by sustained drift-Alfvén wave activity. The pressure profile then transitions to a near steady-state in which anomalous transport balances the external pressure source.

[1]Performed at the Basic Plasma Science Facility at UCLA, supported jointly by DOE and NSF.
[2]In collaboration with G. J. Morales, J. E. Maggs and R. D. Sydora
[3]B. Van Compernolle *et al*, Phys. Rev. E 91, 031102(R) (2015)