Abstract for an Invited Paper
for the DPP01 Meeting of
The American Physical Society

Characterization of Avalanche-Like Events in a Confined Plasma[1]

P.A. POLITZER, General Atomics

One mechanism for transport of energy and particles in a plasma is through discrete, intermittent, uncorrelated events, often called avalanches. This paper presents observations and quantitative characterization of avalanche events in a magnetically confined plasma, under conditions where they are the dominant transport process. The observations are primarily of electron temperature fluctuations. Avalanches are identified by their intermittency, spatial scales up to the system size, propagation in the outward direction, and scaling or self-similar behavior in the probability distribution function, the frequency spectrum, and the autocorrelation function. The two-point cross-correlation function allows determination of a characteristic velocity, typically a few hundred meters per second. The radial speed determined in this way varies from several hundred m/s in the outer part of the plasma, to zero or even inward near the axis. This can be interpreted as resulting from the prevalence of negative avalanches (i.e., holes) near the axis. Preliminary measurements show an increase in the effective avalanche speed with increased plasma heating power. The presence of a long-tailed probability distribution is indicated by a Hurst parameter close to 1. Density fluctuation spectra from the plasma core and edge, as well as the edge particle flux, also show self-similar behavior. An estimate of the power transport is that at least 2/3 of the heat flux is carried by the avalanche events under conditions with no MHD activity. These observations are qualitatively similar to results of modeling calculations based on drift wave turbulence. It is reasonable to infer that avalanches are the macroscopic manifestation of turbulence which inherently has a small spatial scale, and thus allow a local, gyroBohm scaling process to show global Bohm-like behavior.

[1]Work supported by U.S. Department of Energy under Contract No. DE-AC03-99ER54463.