Burst statistics of fluctuations in a simple magnetized torus configuration

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In a toroidal plasma confined by a purely toroidal magnetic field the plasma transport is governed by electrostatic turbulence driven by the flute interchange instability on the low-field side of the torus cross section.

In this presentation we revisit experimental data obtained from the Blaamann torus at the University of Tromsø previously presented in [1]. On time-scales shorter than the poloidal rotation time the time series of potential and electron density fluctuations measured on stationary Langmuir probes essentially reflect the spatial poloidal structure of the turbulent field (Taylor hypothesis). On longer time-scales one mainly observes global fluctuations of the plasma state.

On the short time scales the time-series to the lowest approximation have the character of a self-similar non-stationary process (a persistent fractional Brownian motion). However, both power spectra and variograms reveal marked deviations from this monofractal structure which is interpreted as clustering of bursts in the signals.

We quantify these deviations by computing the multifractal spectra of the time series, and study the multifractal statistics of waiting-time between bursts, and compare this to intermittency properties observed in other toridal devices [2].

We also perform similar analysis on the slow temporal time-scales, and contrast this to analysis aimed to detect low-dimensional chaos in the temporal bursts of global transport.

References

[1] K. Rypdal, and S. Ratynskaia, Phys. Plasmas **10**, 2686 (2003).

[2] V. P. Budaev, S. Takamura, N. Ohno, and S. Masuzaki, Nucl. Fusion **46**, S181 (2006).