2C36

Random Attractors and ELMs

Eugene R. Tracy[1], John M. Finn[2], Wei Yang[1], and Bill Cooke[1]

[1] College of William and Mary

[2] Los Alamos National Laboratory

Abstract

It is important to be able to distinguish between different low dimensional models for Type I ELMs in order to predict scaling to larger devices and to design a system to control the ELMs. Here we consider the possibility that the ELM dynamics is influenced by fluctuations in the core of the tokamak, which might be modelled as noise. Typically, in doing nonlinear time series analysis, the first step is to determine whether the time series is from a linear stochastic system or from a nonlinear deterministic system. Motivated by the ELM issues, we have constructed a second order nonlinear system with noise in which the noise contributes in a fundamental way. Specifically, the deterministic system amplifies the effects of the noise so that the system can occupy a region of its state space far from any attractor of the underlying deterministic system, and this *random attractor* behaves much like a chaotic deterministic attractor. This type of behavior appears not to have been observed in previous nonlinear dynamical studies. We plan to develop methods of nonlinear time series analysis to distinguish this type of behavior from that of a deterministic system, because the methods of control will be fundamentally different for the two cases. For the system we have studied, there is a range of parameters for which the dynamics consists of a series of large localized bursts separated by quiescent time intervals, and both the burst amplitudes and intervals appear to be chaotic, similar to ELMs in tokamaks. We have found that there is a strong nonlinear correlation between the burst amplitudes and the succeeding time intervals, but the time intervals are decorrelated from the succeeding burst amplitudes. This is a possible signature for this type of noise amplified behavior. We will show experimental results from a nonlinear circuit having some of these characteristics.