

Extraction of coherent bursts in turbulent edge plasma in magnetic fusion devices using orthogonal wavelets

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A new method to extract coherent bursts out of turbulent signals will be presented. It is based on wavelet denoising and does not require any adjustable parameter. The signal is projected onto an orthogonal wavelet basis, a thresholding is applied to the wavelet coefficients, and the denoised signal is reconstructed in physical space. The signal is thus split into two orthogonal components, a coherent and an incoherent one, whose statistical properties can be studied independently. Statistical diagnostics based on the wavelet representation are also introduced to compare the scaling behaviour and intermittency of the total signal and its coherent and incoherent components. We apply this wavelet-based nonlinear filtering to study the ion density of edge plasma measured in the scrape-off layer of the tokamak Tore Supra, Cadarache, France. We show that this procedure disentangles the coherent bursts, which contain most of the variance, are intermittent and long-time correlated with non-Gaussian statistics, from a background noise, which is much weaker, incoherent, non-intermittent and almost decorrelated with quasi-Gaussian statistics.

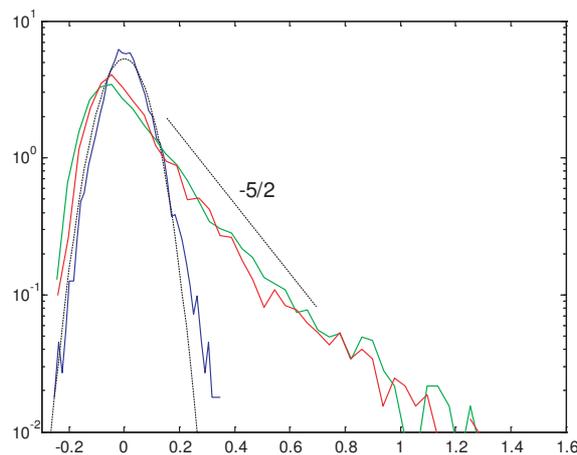


Figure 1: Probability density function of the ion density fluctuations, for the total signal (green), the coherent bursts (red) and the incoherent noise (blue), together with a Gaussian fit (black dotted line). We observe that the coherent bursts have the same non-Gaussian behaviour as the total signal, while the remaining incoherent noise is quasi-Gaussian.

References

- [1] To download papers: <http://wavelets.ens.fr>