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

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We propose a wavelet-based method to extract coherent structures out of turbulent signals. After projecting the signal onto an orthogonal wavelet basis, one filters out the wavelet coefficients whose modulus is smaller than a given threshold, which is recursively evaluated without requiring any adjustable parameters. The signal is split into two orthogonal components, a coherent and an incoherent one, whose properties are then independently studied. The extraction method is applied to ion density signals measured in the scrape-off layer of the tokamaks Tore Supra in Cadarache, France, and Castor in Prague, Czech Republic. We find that coherent stuctures contain most of the density variance, are intermittent and long-time correlated with non-Gaussian statistics, while the incoherent background noise is much weaker, non-intermittent and almost decorrelated with quasi-Gaussian statistics [1]. Statistical diagnostics based on the wavelet representation are introduced to compare the scaling behaviour and intermittency of the total signal and its coherent and incoherent components. Finally we show that fluxes are dominated by their coherent contributions.

[1] Marie Farge, Kai Schneider and Pascal Devynck, 2006
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*Papers can be downloaded from the web site: //**wavelets.ens.fr***

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