Comparison of edge fluctuations in L-mode and H-mode plasmas in MAST

B D Dudson[1,2,3], R O Dendy[2], A Kirk[2], H Meyer[2] and G F Counsell[2]

[1]Clarendon Laboratory, Oxford University, Parks Road, Oxford OX1 3PU, United Kingdom

[2]Euratom/UKAEA Fusion Association, Culham Science Centre, Abingdon, Oxfordshire OX14 3DB, United Kingdom

[3]ben.dudson@ukaea.org.uk

Characterising the different behaviour of turbulent edge fluctuations in L-mode and H-mode plasmas is central to understanding the physical properties of these two confinement regimes in tokamaks. Here we study recent measurements from a reciprocating Langmuir probe in the Mega-Amp Spherical Tokamak (MAST), using a portfolio of nonlinear time series analysis techniques drawn from complex systems science. These edge fluctuation measurements are first characterised in terms of conventional measures, notably their probability density function (PDF), together with the autocorrelation function and Fourier power spectrum. Novel techniques are then applied. First, the Hurst exponent is computed, using a variety of algorithms; it is found to be well defined for these datasets, and differs significantly between L-mode and H-mode. Second, families of PDFs are constructed from each measured PDF using the differencing technique. These differenced PDFs are found to rescale over a significant range of timescales, suggesting the presence of only a few underlying nonlinear physical processes, which are quantitatively characterised by the rescaling parameters. Clear differences are found in the extent of correlation, measured by these methods, that is observed in edge fluctuations in L-mode and H-mode plasmas in MAST. Differencing and rescaling is found to be the most useful and robust method of analysis.

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