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Information theory applied to numerical simulations of resistive drift-wave turbulent in tokamak plasmas

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Turbulence dominates the radial transport at the edge region of tokamak plasmas, reducing magnetic confinement in fusion experiments, and its control remains a challenge in physics and engineering. Information theory can provide useful tools to quantify the degree of order/disorder of turbulent fluids and plasmas. In this work we analyze numerical simulations of a simplified nonlinear model of turbulence induced by drift waves in tokamak plasmas. By varying a control parameter we construct a bifurcation diagram of a transition from a turbulent regime to a regime dominated by zonal flows, in which turbulence is mostly suppressed. This transition is then characterized by computing the normalized spectral entropy of the turbulent patterns observed in the numerical simulations. Our results show that the turbulent regime displays a higher degree of entropy, the regime dominated by zonal flows is characterized by lower values of entropy, and the transition from the low-to-high confinement occurs abruptly. This work demonstrates that information theory can improve our understanding of the turbulent fluctuations that arise in the edge region of tokamak plasmas.

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