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Role of Lagrangian vortices in numerical simulations of resistive drift-wave turbulence in tokamak plasmas

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We perform numerical simulations of a simplified nonlinear model that describes drift-wave turbulence in tokamak plasmas. By changing the value of a control parameter related to adiabaticity, the numerical solutions display a transition from a turbulent regime, into a regime dominated by zonal flows, in which turbulence and radial transport are greatly reduced. This transition can be regarded as a low-to-high (L-H) confinement transition, in which the low confinement regime is related to the turbulent regime, and the high-confinement regime is related to the zonal flow regime. The chaotic mixing properties of the flow are characterized by means of Lagrangian coherent structures (LCS). We compute the finite-time Lyapunov exponent of the calculated velocity field derived from the electrostatic potential to better characterize the chaotic mixing of the turbulent and zonal flow regimes. These results can contribute to the understanding of turbulent transport processes in magnetic confinement fusion plasmas

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