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Model investigation of Low-to-High Confinement Transition Mediated by Turbulence Radial Wavenumber Spectral Shift in a Fusion Plasma

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The fast turbulence suppression during the low-to-high (L-H) confinement transition has attracted significant attention recently, stimulated by the ITER requirement for H-mode operation in the initial phase with only limited power available. Toward this study, a series of experiments and model analysis have been carried out on the EAST superconducting tokamak to understand the mechanism behind the L-H transition[1-3].

In a recent experiment it was demonstrated that the L-H transition can occur spontaneously mediated by a shift in the radial wavenumber spectrum of turbulence, as evidenced, for the first time, by the direct observation of a turbulence radial wavenumber spectral shift and turbulence structure tilting tens of milliseconds prior to and across the L-H transition at the plasma edge, by direct probing. In order to understand the physical mechanism behind, here a simple model analysis is presented. The model results are consistent with the experimental results, and indicate that the spectral shift appears to be correlated with the time evolution of edge radial electric field shear. These observations provide the critical evidence for the theory of turbulence suppression by the mean flow shear. Meanwhile the poloidal momentum transport driven by Reynolds stress is also investigated to modulate the edge flow shear.

References

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