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EX/10-3: Zonal Flows as the Trigger Event for the L-H Transition

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The kinetic energy transfer between shear flows and the ambient turbulence is measured for the first time in the EAST, DIII-D and HL-2A tokamaks. In EAST as the plasma is heated and approaches the L-H transition, the rate of energy transfer from the turbulence into the zonal flow increases. Finally, when this rate becomes comparable to the energy input rate into the turbulence, the transition into the H-mode occurs. Work in DIIID focuses on turbulence-zonal flow energetics during intermediate confinement regime characterized by a limit cycle behavior of the turbulence energy and zonal flow and shows, for the first time, modulation in turbulent Reynolds stress and nonlinear energy transfer into the modulated zonal flow. Finally, in HL-2A as ECH heating power is increased in L-mode we observe an increase in the nonlinear coupling of turbulence energy to the zonal flow found at the plasma edge. Taken together the results show the key role that zonal flows play in mediating the transition into H-mode, and provide a route to a physics-based understanding of the L-H transition and of the macroscopic scaling of the transition power threshold.

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