Contribution ID: **229**　　Type: **Oral**

Role of stationary zonal flows and momentum transport for L-H transitions in JET

Thursday, 20 October 2016 09:30 (20 minutes)

Unraveling the conditions that permit access to H-mode continues to be an unresolved physics issue for tokamaks. The scaling of the L-H transition power threshold, P_LH, to future devices has considerable uncertainty. Experiments have been performed in JET, with the ITER-like W/Be wall, to investigate the dependencies of P_LH and also to probe the underlying physics of the transition including newly available Doppler Backscattering (DBS) measurements of turbulence and flows. We report results from experiments characterizing P_LH, turbulence, and edge flows as a function of density, both above and below the minimum of the dependence of P_LH on density. Result from new experiments characterizing dependencies of P_LH on Ip in both the high and low density branch of the transition will be reported, at high Bt (3.0-3.4 T) and Ip (2.2-3.2 MA), with scans keeping either I_p or q_95 constant.

We observe fine-scale structure in the radial electric field inferred from DBS, with observations consistent with zonal flows (ZFs). The zonal flows are observed at the bottom of the edge E_r well before the L-H transition. In the low density branch of the transition the ZFs disappear after NBI heating is added, well before the L-H transition, while in the high density branch they disappear only following the L-H transition. Also in the high density branch, the E_r profile builds up after NBI is added into the core at a constant gradient, concomitant with a suppression of density fluctuation levels before the L-H transition. Fluctuation levels are then suppressed further following the transition. These observations point to the need to understand the role of momentum transport for the transition and not just heat transport, and also separate necessary conditions for sustaining the H-mode pedestal from the causes of the L-H transition and its effects, and aid in discriminating between models for the transition.

Paper Number

EX/5-2

Country or International Organization

United Kingdom

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Session Classification: Transport & LH Transition

Track Classification: EXC - Magnetic Confinement Experiments: Confinement