Coupling between turbulence and flows during the L-H transition

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The dynamics of turbulence and plasma flows has been studied experimentally by means of Doppler reflectometry [1] during the transition from low to high confinement mode in the TJ-II stellarator.
Experiments performed using the full available NBI power to heat the plasma ($P_{NBI} \leq$ 900 kW) have shown that, at the L-H transition, E_r becomes more negative and a pronounced E_r-shear develops together with a reduction in plasma turbulence. The time evolution of both, E_r-shear and density fluctuations, indicates that the reduction in density fluctuations precedes the increase in the mean E_r-shear but is simultaneous with the increase in the low frequency oscillating sheared flow [2]. These observations, together with the amplification of long-range spatial correlation in the potential fluctuations [3] are consistent with L-H transition models predicting plasma bifurcations triggered by zonal flows.
Further experimental evidence has been recently observed when operating close to the L-H transition threshold conditions. Pronounced oscillations in E_r and density fluctuation level show up at the transition [4]. The oscillations appear right inside the ExB shear layer but not outside. The time evolution of both, E_r and density fluctuation level, shows a characteristic predator-prey behaviour, with E_r (predator) following the density fluctuation level (prey) with 90º phase delay. These experimental observations are consistent with L-H transition models based on turbulence induced sheared/zonal flows [5].

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