Turbulence Regulation with Radial Wavenumber Spectral Shift Caused by LHCD Induced Velocity Shear during ELM Mitigation

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ELM mitigation with LHCD has been achieved in the HL-2A tokamak for high plasma density ($n_e \geq 2.5\times10^{19}\ m^{-3}$) and large LHCD absorbed power ($P_{LHCD} \geq 300\ kW$) [1]. The divertor peak heat load induced by ELM has been significantly reduced during the mitigation phase. A severe decrease of the pedestal velocity shear has been observed with LHCD switch on, while the k_r-spectrum of the pedestal turbulence is shifted toward the origin (Fig.1(d)). It has been found that the ELM mitigation is desynchronized with LHCD pulse, but it is closely correlated to the pedestal turbulence enhancement (Fig.1(e)).

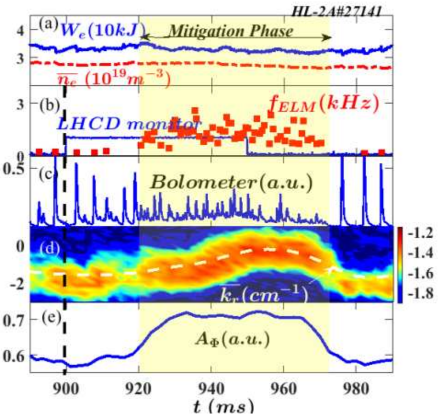

Fig.1 ELM mitigation with LHCD.

In order to understand the mechanism of the turbulence enhancement during ELM mitigation, a theoretical model, based on the regulation of the turbulence amplitude by its radial wavenumber spectral shift caused by external velocity shear, has been developed. A critical growth rate γ_0 for the turbulence regulation has been identified in this model. It has been found that the turbulence enhancement and ELM mitigation occur when the decrease of LHCD driven velocity shear exceeds a threshold value, which directly depends on γ_0. Good agreement has been found between experiment and theory for the regulation of the turbulence amplitude with its averaged radial wavenumber.

Reference

[1] G.L. Xiao *et al.*, Phys. Plasmas **24** (2017) 122507