Characterization of edge quasi-coherent mode in H-mode discharge on the HL-3 tokamak

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The H-mode is generally considered the preferable operational regime for a fusion reactor due to its high confinement properties. However, edge localized modes (ELMs) in H-mode can cause unacceptably high heat loads on the divertor plates when extrapolated to large-scale machines. Thus, achieving a small or ELM-free H-mode is highly desirable for future fusion reactors such as ITER.

In the latest HL-3 experimental campaign, H-mode with no/small ELMs has been widely observed. In this work, the edge fluctuation of H-mode plasmas on the HL-3 tokamak has been studied. It has been observed that the edge fluctuation is suppressed during the H-mode. while a quasi-coherent mode (QCM) with a frequency of approximately 20 kHz has been detected, as shown in Fig-1. This mode is primarily located in the pedestal region. It is electromagnetic and propagates in the electron diamagnetic direction, with a poloidal wavenumber of k_θ~0.5 cm^{-1}. Bi-spectrum analysis indicates that there is non-linear interaction between the QCM and ambient turbulence. Furthermore, this mode can also be observed via divertor Langmuir probes, suggesting that it plays a role in particle transport.

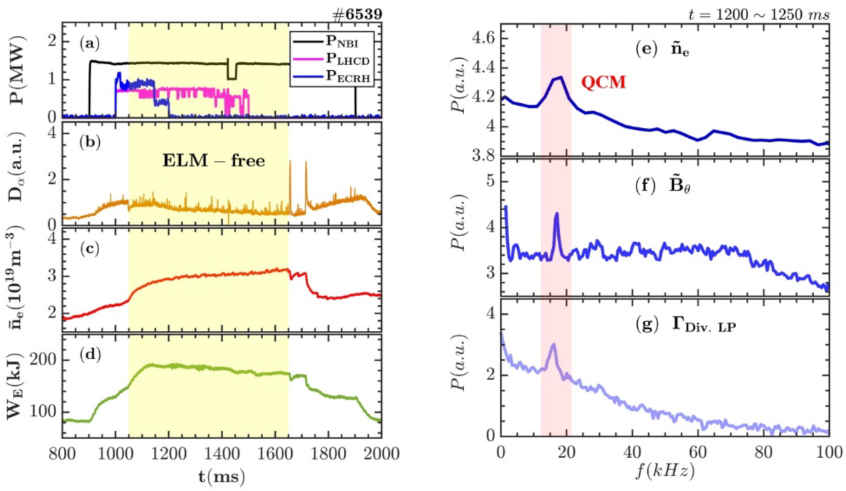

Fig-1. (a) NBI, LHCD, and ECRH heating power, (b) D_α signal, (c) line-averaged electron density, (d) plasma stored energy, and power spectra of (e) density fluctuation, (f) magnetic fluctuation, and (g) divertor Langmuir probe.