ELM control by LBO-seeded impurity in the HL-2A tokamak

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H-mode is characterized by a steep plasma pressure gradient at the plasma edge, i.e., edge pedestal, which leads to strong self-driven plasma currents that together result in an MHD instability referred to as edge-localized mode (ELM). A large quantity of particles and energy are lost from the plasma during ELMs, which can constitute a serious threat to the first wall lifetime by erosion and melting from the strong heat load and deteriorate the plasma performance by producing a source of impurities in the plasma. Therefore, understanding the pedestal transport and controlling ELMs are important and urgent issues for present-day tokamak experiments.

In 2016 HL-2A experimental campaign, the ELM control has been achieved by means of laser blow-off (LBO) system. The injected impurity is tungsten. The information of the impurity deposition can be obtained by means of the bolometer arrays. The impurity particles penetrate the edge plasma and are mainly deposited in the pedestal region. Figure 1(b) and (c) show the time evolution of the density fluctuation power spectra in pedestal top and foot. The time evolution of the plasma radiation power density profile was measured with the bolometer array for ELM mitigation shot 29305, as shown in figure 1(c). The LBO-seeded impurity particles penetrate the edge plasma and are mainly deposited in the pedestal region. Following the impurity injection, the density fluctuation in the pedestal is obviously decreased. Then, the ELM is significantly suppressed. Thus ELM control may be achieved by the turbulence suppression due to the impurity deposition in the pedestal.

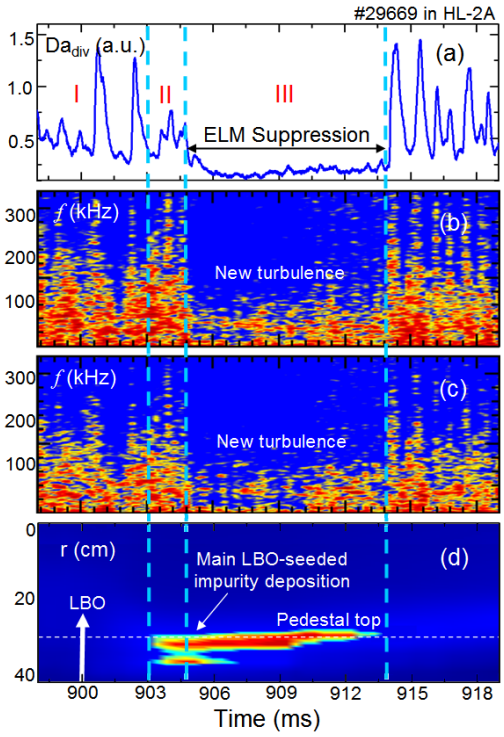

Figure 1. The density fluctuation power spectra in pedestal top (a) and pedestal foot (b). (c) The frequency spectrogram of Mirnov coil signals. (d) Coherent coefficient between magnetic fluctuation and density fluctuation.