7th Asia-Pacific Conference on Plasma Physics, 12-17 Nov, 2023 at Port Messe Nagoya

Simulations on edge localized modes mitigation with impurity seeding in the HL-2A tokamak

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Abstract

Impurity seeding has been confirmed to be a potential way for edge localized modes (ELMs) to be mitigated in tokamaks[1]. By combining the integrated equilibria reconstruction framework and edge simulation codes such as BOUT++, this study's aim is to dive deeper into the mechanism of the ELM mitigation by impurity injection[2]. On the one hand, impurity injection changes the pedestal pressure and current profiles that are closely related to ELM activities. The nonlinear simulation result shows that ELM size decreases by a factor of 2 to 4 when the current exceeds a threshold after impurity injection. On the other hand, the decrease of E_r shear is supposed to cause a larger ELM size for a less stabilized effect. However, ELMs are mitigated with smaller E_r shear as observed in the HL-2A experiment. This indicates that changes in the profiles of pressure gradient and hence the current density may play a more important role than E_r shear in this ELM mitigation process. In contrast to the high n modes destabilized by the pellet pacing[3], metallic impurity seeding leads to more unstable low n modes. The simulation results indicate that the combination of changes in pressure/current and E_r shear is a plausible explanation for the ELM mitigation by metallic impurity seeding.

Key words: impurity seeding, edge localized mode, integrated simulation, E_r shear

References

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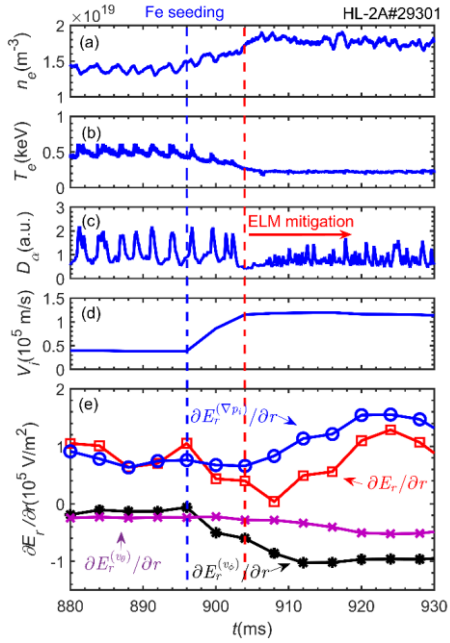

Figure 1. Evolutions of key parameters in HL-2A experiments after impurity seeding.

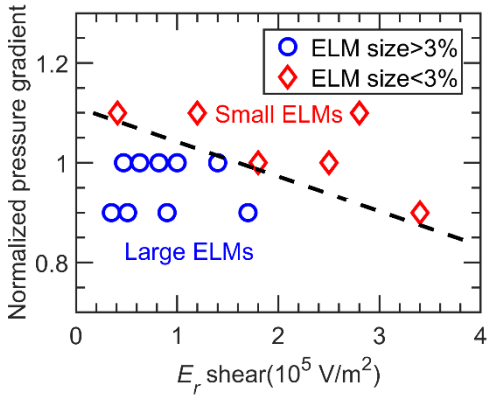

Figure 2. Change of ELM size with normalized pedestal pressure gradient and E_r shear.