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Transient heat flux control by Ne-SMBI during ELMs in EAST

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The future magnetic confinement fusion reactors will work in the high-confinement mode (H-mode). The high-confinement mode (H-mode) is characterized by formation of an edge transport barrier (ETB) in pedestal reducing of transport near the edge plasma, manifested in profiles which typically exhibit high density and temperature gradients [1]. These strong gradients are routinely observed to trigger edge localized modes (ELMs) in the standard H-mode regime [2]. ELMs can eject a lot of particles and energy from plasma to divertor targets, which can cause significant erosion [3]. Thus, it is crucial to develop control tools which can reduce the transient heat flux to acceptable values while maintaining good confinement.

SMBI was proposed as a fueling technique on EAST tokamak, it has been developed to become a useful method which has higher fueling efficiency than gas puffing. In EAST by seeding a sequence of short neon (Ne) impurity pulses with the SMBI from the outer mid-plane, the radiated power of the bulk plasma can be well controlled [4]. Experimental results in several tokamaks suggested that SMBI is a promising technique for transient heat flux control during ELMs.

During EAST 2018 experiment campaign, the type-I ELM has been mitigated and suppressed by Ne-SMBI seeding during H-mode discharges. During ELM suppression there is no energy decrease, and the energy decreased about 10% during ELM mitigation. The MCM turbulence has been observed during ELM suppression by Ne-SMBI seed, this maybe the main particle transport channel during ELM suppression. During Ne-SMBI injection the pedestal electron density profile increased, and edge radiated power increase which could decrease the divertor heat flux. The pedestal profiles change appears sufficiently to trigger small transport events and mitigate large ELMs. During EAST 2022 experiment campaign, by adjusting the SMBI injection amount of Ne, stable 2s length ELM suppression was achieved by Ne-SMBI injection. During ELM suppression, a 250 kHz coherent mode was present.

References

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[4] K. Wu et al. 2018 Nucl. Fusion 58 056019

Figure xx

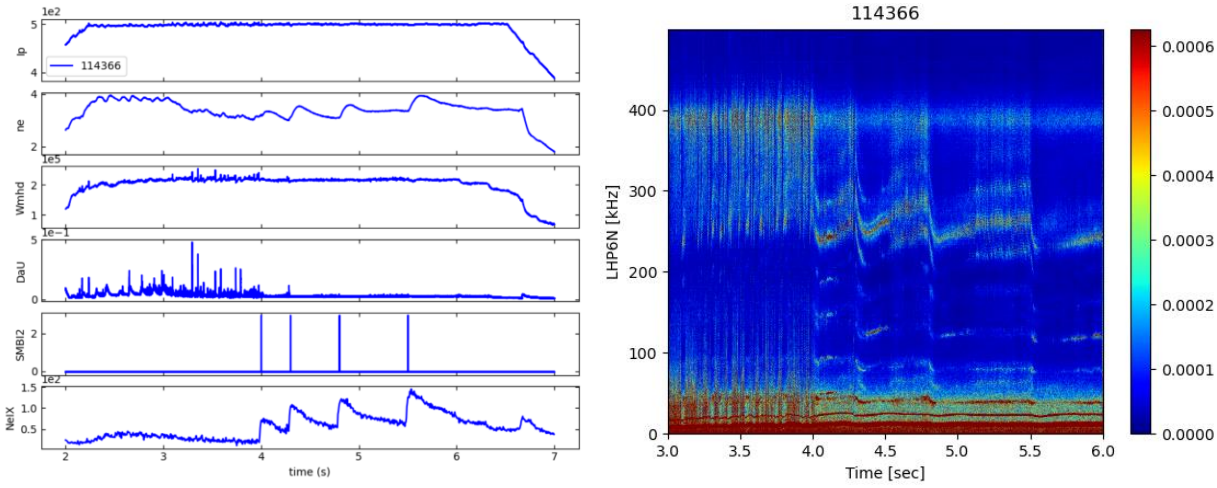

Figure 1. 2s ELM suppression by Ne-SMBI injection, during ELM suppression there is no decrease on plasma energy and a 250 kHz coherent mode was present.