Effects of electron cyclotron resonance heating on Alfvenic ion temperature gradient modes in the HL-2A plasma

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Electromagnetic modes driven by pressure gradient in the core plasma can not only restrict plasma confinement, but also cause energetic particle loss. The kind of instability has become a major concern in the present and future fusion devices, especially for which operate with reactor-relevant parameters. To reveal underlying effects of electron cyclotron resonance heating (ECRH) on core-localized pressure gradient driven Alfvenic ion temperature gradient (AITG) modes, a series of experiments have been carried out on HL-2A tokamak. It is found that only when ECRH and NBI are simultaneously injected into the low density plasma, those electromagnetic modes can be driven unstable, shown as Fig.1. Moreover, decline in density fluctuation induced by AITG modes is also observed during high power heating. Theoretical analysis based on general fishbone-liked dispersion relation (GFLDR) suggests that there are three thresholds of η_i, T_e/T_i and S for the mode excitation. The NBI heats thermal ions and improves ion temperature, then results in η_i exceeding the critical value of $\eta_{i,crit} > 5.4$. The off-axis ECRH enhances the AITG modes mainly by increasing T_e and causing a drop in T_i. A low electron density induced by the pump-out effect is also favourable for destabilization of AITG modes. Besides, high-power ECRH may change safety factor and then contribute to mitigation of AITG modes. The new findings can not only enrich scientific knowledge for pressure gradient driven instability, but also be beneficial to active control of core-localized electromagnetic modes in the future fusion devices.

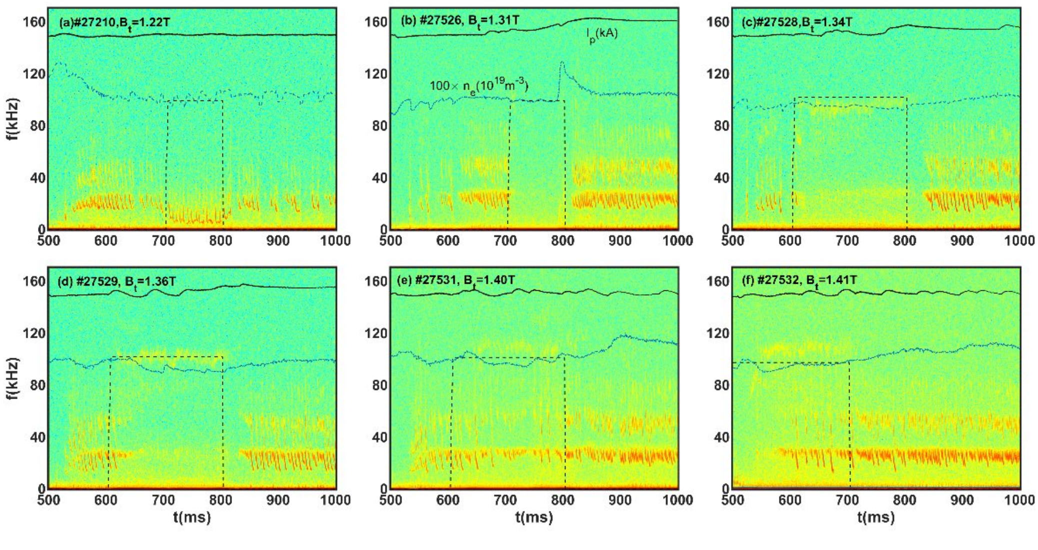

Fig.1. Dependence of the AITG mode excitation on ECRH.

Reference

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