Core plasma confinement improvement by the suppression of high frequency density fluctuation on EAST tokamak

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A dedicated experiment was recently designed and conducted on EAST to investigate the impact of the turbulence transport on core plasma confinement under Boronization-coating wall conditions. Here W-band multichannel Poloidal Correlation Reflectometry (PCR) was used to monitor the density fluctuation behaviors. The sampling frequency of PCR is 2 MHz and the fluctuation components with frequency up to 1 MHz can be measured. Ar impurity seeding has been proven to effectively increase ion temperature in EAST H-mode plasmas. This work consists of two parts. First is experimental observation. Three adjacent H-mode discharges were specifically designed to have the same plasma density and the same NBI power as background heating, but different ECRH powers. It was observed that low (0-0.5MHz) and high (0.5-1MHz)-frequency density fluctuations exhibit different behaviors under different ECRH heating power platform. When the ECRH heating power is reduced, the amplitude of high-frequency density fluctuations increases, while the amplitude of low-frequency density fluctuations remains almost unchanged. Then the same amount of Ar impurity was injected into the plasma at different ECRH heating power platforms to enhance the ion temperature. We found that when the amplitude of high-frequency density fluctuations is low, injecting Ar impurities can effectively increase the ion temperature to improve core plasma confinement, while low-frequency density fluctuations seemed to offer little help. Additionally, during the process of ion temperature enhancement, it was observed that the amplitude of low-frequency density fluctuations gradually decreased, while the amplitude of high-frequency density fluctuations gradually increased, suggesting a competitive relationship between the two. Then these plasmas were simulated with the transport model TGLF, and the results are in good agreement with experimental observations.

This work proposes a new way to effectively enhance the ion temperature and improve core confinement by suppression the high-frequency density fluctuations through certain means. Additionally, we believe that the results in the work are also beneficial for understanding the underlying reason of plasma core confinement improved by turbulent transport.

Selected Topic 6: "Integrated core performance and heat/particle exhaust with edge transport barriers"