

Inward transport accompanied with the coherent modes in the HL-2A H-mode plasma

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The inward transport fluxes accompanied with the coherent modes on the HL-2A tokamak, i.e. the long-lived mode (LLM)¹ and the high frequency coherent mode (HCM), have been observed by the edge Langmuir probe array during the H-mode². The sign changes of cross phases between poloidal electric field fluctuation and electron density fluctuation in each mode frequency have been confirmed as the direct reason which led to the radial inward transport fluxes. Due to the strong correlation between the core soft x-ray signal (or the electron cyclotron emission diagnostic signal) and edge probe diagnostic signals, the phase shift of poloidal electric field fluctuation in the LLM frequency and HCM frequency region is proved to be the key reason which led to the sign changes of the cross-phase term. Furthermore, the radial velocity gradient has been found that it cannot only suppress the turbulent transport flux but also change the transport direction of certain coherent modes. The radial velocity gradient of different intensities has different effects on various coherent modes, which indicates each mode has different thresholds of velocity gradient to change its transport direction. These results indicate the close connection between inward transport flux and the Kelvin-Helmholtz instability, and they may also confirm the existence of inhomogeneity of the velocity space directly induced the inward transport mode, which can gain energy from the ambient turbulence or the density gradient³. In addition, the inward heat conduction accompanied with LLM reconfirms the positive gradient of radial velocity plays an important role during the entire transport direction changing process. The poloidal electric field fluctuation, or the radial velocity fluctuation, and the inward transport flux are possibly related. And the intrinsic connection between them still needs more work in the future experiments.

References

1. W. Chen, *et al*, *Nuclear Fusion* **49** 075022 (2009).
2. J. Wu, *et al*, *Physics of Plasmas* **27** 012304 (2020).
3. S. Inagaki, *et al*, *Scientific Reports* **6** 22189 (2016).