Study on the dispersion relation and the discrete spectrum of drift wave pattern

Yang Xiaoyi[1], Zhang Yiyao[1], Huang Purui[1], Liu Chang[1], Xu Tianchao[2], He Renchuan[2], Zhou Tianchun[1], Guo Zhibin[2], Chen Yihang[3], Xiao Chijie[2], Wang Xiaogang[1,2]

[1] School of physics, Harbin Institute of Technology,

[2] School of physics, Peking University

[3]Southwest Institute of Physics

e-mail: yxy6180566@sina.com

Drift wave turbulence is one of the most important transport mechanisms in magnetic confinement fusion devices [1]. It will become more important once self-consist fusion reaction is achieved as it plays important role in fueling and ash discharging. Drift wave pattern, which has been observed in linear devices is one of the most proper and economy carrier to realize efficient transport of Helium as and fuel because of strong spatial and temporal coherence as well as the modifiable relation between physical variables [2,3].

In this work drift wave pattern has been studied both experimentally and theoretically. The discrete spectrum and pattern structure are clear observe and separated to temporal eigen vectors using fast camera, and the polarization and transport characters are studied by probe matrix. Interactions by non-linear phase evolution has also observed in the experiments. The dispersion relation has been theoretically obtained using Schrodinger's-like equation to match the experimental results. The linear and non-linear phase-dynamic interaction between the eigen modes is one of the major mechanisms of pattern non-rigid deformation. The transport mechanism of the drift wave pattern is proved to be the electric potential well trapping and weak coherent scattering which is different from the non-coherent turbulence. The result shows a new view to study coherent turbulence and may promote transport regulation in the fusion reactor.

Reference

[1] Champeaux S, Diamond P H. Physics Letters A, 2001, 288(3-4): 214-219.

[2] Yamada T, Itoh S I, Inagaki S, et al. Physical Review Letters, 2010, 105(22): 225002.

[3] Xu, T., C., et al. Nuclear Fusion 60. 1 (2020): 016029.

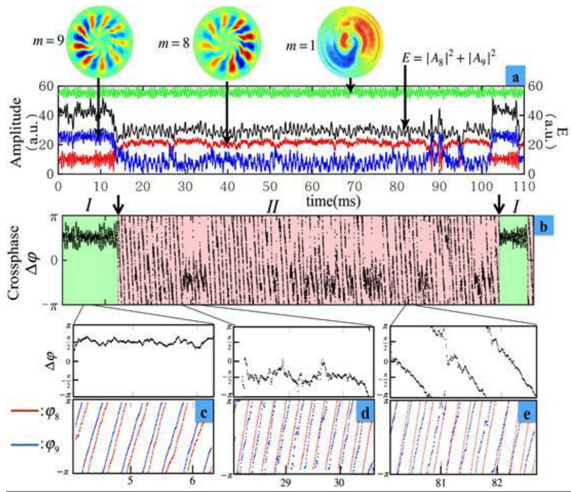

Figure 1 non-linear interaction between drift wave patterns