6th Asia-Pacific Conference on Plasma Physics, 9-14 Oct, 2022, Remote e-conference

Excitation of toroidal Alfvén eigenmode by barely circulating energetic electrons in low density plasmas

Tao Wang[1,2], Zhiyong Qiu[1,2], Xiang Zhu[3], Long Zeng[4]

[1] Institute for Fusion Theory and Simulation, Zhejiang University, Hangzhou 310027, China
[2] Center for Nonlinear Plasma Science and C.R. ENEA Frascati, C.P. 65, 00044 Frascati, Italy
[3] Advanced Energy Research Center, Shenzhen University, Shenzhen 518060, China
[4] Institute of Plasma Physics, Chinese Academy of Sciences, Hefei 230031, China
e-mail (speaker): t_wang@zju.edu.cn

Recently, in a series of EAST ohmic discharges where runaway electrons (RE) are generated by controlled ramping down the plasma density, rather unexpectedly, n=1 toroidal Alfvén eigenmodes (TAEs) were routinely observed and likely to be associated with the REs [1]. Hybrid MHD-gyrokinetic code [2] simulations are applied to analyze the excitation mechanism of the TAE by the moderately energetic REs. It is suggested that the barely circulating energetic electrons (EEs) whose transit frequency asymptotically vanishes at the phase space separatrix, could resonate with the TAE and provide instability drive. The resonance condition and drive mechanism prefer moderate EE energy and low plasma density, which could be achieved by REs in this scenario. Further nonlinear saturation analysis shows that the phase space resonance structure plays an important role in the TAE saturation amplitude, which explains why low-n modes is preferentially observed. This work enriches our present understanding on EE driven instabilities, it could also suggest a possible mechanism for runaway electron detection prior to disruption.

References

[1] X. Zhu *et al.*, Phys. Plasmas **29**, 062504 (2022);
[2] S. Briguglio *et al.*, Phys. Plasmas **2**, 3711 (1995);