Avoiding disruption via the locked mode control by the rotating RMP on J-TEXT tokamak

Da Li[1], Yonghua Ding[1,*],Feiran Hu[1], Tong Wang[1], Lizhi Zhu[1], Nengchao Wang[1], Bo Rao[1], Qiming Hu[2], Hai Jin[3], Zhuo Huang[1], Mao Li[1], Song Zhou[1], Ruo Jia[1], Lai Peng[1], Zebao Song[1], Ying He[1], Jiaolong Dong, Chengshuo Shen[1] and the J-TEXT team

[1]*International Joint Research Laboratory of Magnetic Confinement Fusion and Plasma Physics, School of Electrical and Electronic Engineering, Huazhong University of Science and Technology, Wuhan, 430074, China*

[2]*Princeton Plasma Physics Laboratory, Princeton NJ 08543-0451, USA*

[3]*College of Electrical and Information Engineering, Lanzhou University of Technology, Lanzhou 730050, China*

**E-mail: yhding@hust.edu.cn*

In a tokamak, one of the major causes of disruptions is locked mode (LM), a static tearing mode which usually grows to large amplitudes. Therefore, the active control of the LM is an important issue for future fusion reactors. Previously, we have reported the unlocking of the LM by rotating resonant magnetic perturbation (RMP), which rotated at several kHz [1]. In Ref. [1], the m/n = 2/1 LM was too small to induce disruption, where m and n are the poloidal and toroidal mode numbers, respectively.

In this paper, we will use rotating RMP to control the larger 2/1 LM and to avoid the disruption in J-TEXT tokamak. The electrode biasing (EB) could decelerate the tearing mode (TM) and cause the LM [2]. A major disruption usually occurred within 5 ~ 20 ms after the mode locking due to EB. The rotating RMP, applied once the appearance of a LM, could accelerate the LM to a few kHz and hence avoid the disruption. However, when the LM was quite large at lower q_a, it is really difficult to unlock the LM by rotating RMP. To improve the performance of the rotating RMP, it was applied once the TM was decelerated by the EB to a critical value. This control strategy could accelerate the TM, avoid the appearance of LM and disruption. Further experiments showed that rotating RMP at higher frequency had better performance in controlling the disruption.

[1] Hai Jin et al 2015 Plasma Phys. Control. Fusion 57 104007

[2] Hai Liu et al 2017 Nucl. Fusion 57 0160