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Experimental Investigations of MARFE and Density Limit on J-TEXT Ohmic Plasma

Peng Shi[1], Li Gao[1], Ge Zhuang[1], Yinan Zhou[1] and J-TEXT team
[1]International Joint Research Laboratory of Magnetic Confinement Fusion and Plasma Physics, Huazhong University of Science and Technology, Wuhan 430074, China (times, 12pt)
[2]School of Physical Sciences, University of Science and Technology of China, Hefei, Anhui 230026, China
e-mail (speaker): dionysus.shi@gmail.com

Multifaceted asymmetric radiation as well as strong poloidal asymmetry of the electron density from the edge, dubbed as 'MARFE', has been observed in high electron density Ohmic plasmas on J-TEXT tokamak. The effects of MARFE on both equilibrium and transport have been investigated. Equilibrium reconstruction based on the measured data from the 17-channel FIR polarimeter–interferometer indicates that an asymmetric plasma current density distribution forms at the edge region and the plasma current shrinkage locates at the MARFE affected region. Localized plasma current shrinkage at the MARFE region is considered to be the direct cause for the density limit disruptions. Combining with numerical simulation, it is proposed for the first time that the plasma current locally shrinking induced by MARFE products radial magnetic field at the q=2 resonant surface, thus triggers the 2/1 tearing mode and leads to density limit disruption. Besides, it is found that the global confinement degrades during MARFE developing, owing to the local enhancement of turbulent transport at MARFE affected region. In addition, a quasi-coherent mode (QCM) with characteristic frequency 50~100 kHz is found to be strongly related with MARFE onset. The QCM shows a sudden increase before MARFE appearance. Thus, it is predicted to be the main drive for edge cooling and thermal instability.

References

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