Real-time determination of magnetic island localization on HL-2A

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Neoclassical tearing mode (NTM) is a type of resistive magnetohydrodynamic (MHD) instability, which grows from seed island triggered by internal perturbations in the plasma and maintained by the associated perturbed bootstrap current. The growth of the m/n = 2/1 NTM can result in a locked mode and even lead to a plasma disruption. It is therefore important to control or eliminate the growth of the NTMs to improve the plasma performance and guarantee operational stability, such as ITER.

The presence of a magnetic island can be detected by its magnetic perturbation or the effect of the island on the temperature profile. Electron cyclotron waves (ECW) can suppress the magnetic islands, both by driving non-inductive current in the island region and by heating the island. For this purpose, a steerable mirror is used to direct the ECRH beam to the desired deposition location in the plasma. Therefore, accurate detection and supression of rotating magnetic islands in real-time it is a vital part for control the NTMs.

The NTMs induced by different excitation mechanisms were observed on HL-2A. Therefore, active control of NTMs is one of the urgent tasks for the HL-2A tokamak (R/a = 1.65/0.4 m) to achieving high performance plasmas. The perturbations measurement from Mirnov coils and electron cyclotron emission (ECE) diagnostics are employed to monitor the modes-onset, to characterize its poloidal and/or toroidal mode number (m/n) and to track its radial position. For this purpose, the motivation of this work is to test and demonstrate proper plasma diagnostics that can be used in real-time detection of magnetic island locatizaion on the HL-2A.

References

[1] M. Maraschek, 2012 Nucl. Fusion 52 07400