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Real-time detection and localization of magnetic island used for neoclassical tearing mode control and disruption mitigation

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It is well known that the neoclassical tearing modes (NTMs) can be destabilized by the perturbed bootstrap current, reducing the plasma confinement and even leading to a major disruption in both standard ELMy H–mode and advanced tokamak scenarios. In order to stabilize the NTMs with electron cyclotron resonant heating (ECRH) and electron cyclotron current drive (ECCD), the magnetic island is required to be localized accurately and then the EC beam power is deposited exactly inside the island. For the NTMs suppression on EAST tokamak, a real-time system to detect the magnetic island and trace its radial location has been developed. In this system, the diagnostic signals from electron cyclotron emission (ECE) and Mirnov coil measurement are acquired and processed in real time to obtain the frequency and amplitude of magnetic perturbation as well as the mode radial location; as an alternative, the soft-x ray signals are taken to deduce the mode location instead of the ECE diagnostic in the case that the low hybrid wave is applied to plasma heating and current drive. The construction and the algorithm implementation of the real-time system is introduced in this paper.
As the outputs of the real-time system, the mode radial location is provided to the ECRH launcher to determine the angle of EC beam injection. The island amplitude is used to control the gyrotron power on and off, and meanwhile involves in the feedback control of the ECCD deposition position with respect to the island position. Furthermore, the island amplitude is also monitored to generate a disruption alarm to activate the massive gas injection valve for the disruption mitigation, since in some cases the NTM suppression by the ECCD could fail due to an ineffaceable misalignment, the insufficient EC power for the mode stabilization and so on, and then the magnetic island would grow further leading to a major disruption. An integrated control strategy available to both NTM control and disruption mitigation is being developed and is expected to be presented.

Eligible for student paper award?

No

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