2-D ECE temperature measurements inside tearing modes, revealing the suppression mechanism by ECRH at TEXTOR.

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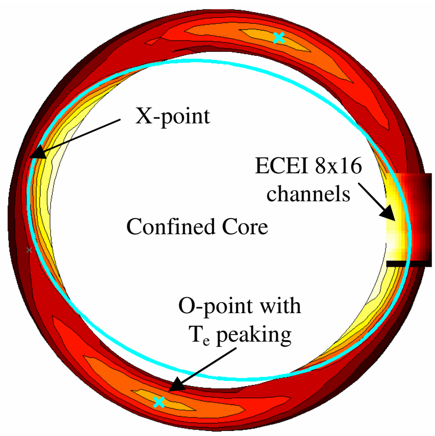
Neoclassical tearing modes are thought to pose a limit on the reachable β (ratio of plasma pressure over magnetic pressure) in ITER, so it is important to develop techniques to control or suppress these instabilities. One of the most promising suppression techniques is to drive current inside the tearing mode using (localized) ECRH or ECCD. On the TEXTOR tokamak, tearing modes (m/n=2/1) can be induced in a very predictable and controllable way by the perturbation field of the Dynamic Ergodic Divertor (DED) [1]. ECRH experiments using an 800kW, 140GHz gyrotron have been shown to successfully suppress these DED induced tearing modes [2]. High resolution 2-D measurements of the electron temperature profile inside the island using the ECE-Imaging diagnostic [3] reveal the suppression mechanism.

In these experiments the DED is used to generate a 1kHz rotating perturbation field. The strong m/n=2/1 component of this perturbation field drives a m/n=2/1 tearing mode unstable which is locked to the perturbation field and hence has a known rotation frequency and phase. By rotating the steerable launcher of the 140GHz gyrotron, ECRH power is deposited at the same minor radius as the tearing mode. Both continuous (CW) and modulated (in phase with the known mode rotation) power deposition is possible. The evolution of the tearing mode is observed by ECE-Imaging, which measures the electron temperature in a 2D array of 8 by 16 sampling volumes, covering about 8cm (radial) by 16cm (vertical) in the plasma. A rotational reconstruction is used to visualize the mode structure (in the form of a movie) and to determine the width and temperature of the island as a function of time.

The ECEI data shows that after switch on of ECRH the temperature inside the island (at the O-point) increases on a timescale of about 10 ms. The temperature at the O-point becomes typically 25% higher than the temperature at the island's separatrix. Once the temperature in the island is peaked, the island width starts to decrease at a slower timescale of about 50 ms. Depending on the amount of power deposited inside the island, its width saturates on typically half the initial width. These observations are consistent with the conclusion [2] that the main effect leading to the suppression is the heating of the island, leading to the formation of a temperature peaking inside the island. The higher temperature leads to a lower resistivity, which in turn leads to an increased parallel current.



ECE-Imaging measurement of island with temperature peaking (frame of movie)

References

[1] Special Issue, *Fusion Eng. Design* **37** (1997) 335.
[2] E. Westerhof, *this conference*
[3] H. Park et al., *Rev. of Sci. Instrum.* **74**, 4239-4262 (2004).