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P5.1058 ECCD-driven temperature crashes at W7-X stellarator

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The optimized stellarator W7-X generates its rotational transform by means of 70 superconducting coils. Therefore, no toroidal current is necessary for plasma confinement. Up to 10 gyrotrons can be used for electron cyclotron current drive (ECRH) and, in case of oblique beam injection, it is possible to drive a net current (electron cyclotron current drive or ECCD). The ECCD is a flexible tool, which could be used to guarantee safe divertor operation, because residual plasma currents of several tens of kA can lead to a shift of the strike line on the divertor targets [1] or locally affects MHD stability. Due to the low toroidal current, W7-X itself is a perfect testbed for ECCD experiments. Since the ECRH and ECCD deposition is well localized, a relevant local change of the rotational transform (ι) is possible, thus producing low order rational values. Such values are associated with repetitive crashes of the electron temperature that were observed during ECCD experiments. In such experiments, with strong current drive, even a total loss of plasma confinement was observed. Toroidal current modeling shows that in these case with coECCD, $\iota = 1$ was reached on a time scale of hundreds of milliseconds and resistive MHD calculations suggest the existence of a double tearing mode, corresponding to two neighboring flux surfaces with $\iota = 1$. In this work, an overview of the effects these crashes have on the plasma is presented, in order to evaluate the effect of crashes on discharge performances. A first attempt of mode analysis, using magnetic diagnostics, soft x-rays tomography and ECE, is presented to verify the theoretical predictions.

[1] Gao , “ECCD effects on the divertor power distributions on W7-X”, this conference

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