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EX/P4-20: Control of Sawteeth Periods by Pulsed ECH and ECCD in FTU Tokamak

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The neoclassical tearing modes (NTMs) are resistive instabilities degrading the high beta plasma confinement with loss of plasma energy. As the NTMs can be triggered by long sawteeth crashes, the control of the sawteeth periods (tau_ST) is a key physics issue in fusion devices: the tau_ST shortening can avoid the NTMs onset allowing to achieve high plasma performances. A powerful tool for the sawteeth control is the highly localized electron cyclotron heating (ECH) and current drive (ECCD) capable to modify the plasma current density with effect on sawteeth period. In FTU tokamak EC power modulation has been investigated as trigger of sawtooth crashes to test conditions for an a-priori constant tau_ST using 1-2 gyrotrons up to 0.8 MW in view of the real time EC system working soon. ECH/ECCD modulations at 20Hz (20% , 80% d.c.) and 125Hz (50% d.c.) were performed in plasma with magnetic field ramp to move the EC deposition from inside to outside the minor inversion radius r_inv at q=1 surface. Irregular tau_ST, smaller than 6.4ms ohmic value, have been obtained, as expected, by ECH&coECCD 20Hz modulation at r<r_inv. Conversely, a new interesting evidence was found inside q=1 using 125Hz 50%d.c. modulation: for EC_on phase of 4 ms less than the ohmic 6.4ms the tau_ST increases up to 8ms EC pulse period with unforeseen sawteeth stabilization remaining quite constant in the EC absorption location 0.4<r_dep/r_inv<0.6. This coupling between modulation and sawtooth crashes suggests an interesting strategy to set an a-priori constant and further reduced tau_ST using faster EC pulses, as 500Hz/1KHz. Transport calculations have been carried out to simulate these behaviours by using the JETTO code where the crashes are described by the model based on the change of magnetic shear. A predictive analysis is in progress to confirm the coupling between faster modulations (>125Hz) and constant tau_ST.

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