Effects of electron cyclotron resonance heating on toroidal Alfvén eigenmodes in tokamak plasmas

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A set of dedicated ASDEX-Upgrade experiments was recently carried out in order to study the effects of localized electron cyclotron resonance heating (ECRH) on energetic-ion-driven toroidal Alfvén eigenmodes (TAE). It was found that for discharges with a monotonic profile of the safety factor, off-axis ECRH can make TAEs more unstable on timescales of a few milliseconds while the effect of on-axis ICRH is much weaker [1].

To understand the mechanisms responsible for this effect, detailed calculations were performed using the ideal MHD code MISHKA[2], and the recently upgraded hybrid MHD-drift-kinetic code CASTOR-K [3, 4]. The distributions of the energetic ion populations accelerated by ion cyclotron resonance heating (ICRH) were computed with the SELFO code [5]. A competition between the mechanics that drive and damp the TAEs modes will be shown to be sufficient to explain the observations.

To assess the stability of Alfvén eigenmodes different computer codes developed by different groups have to be integrated. One problem that arises is how to exchange the full particle distributions between them without appreciable loss of information. A new standard format to exchange energetic particle distributions has been recently proposed[6], based on generalised distribution functions in terms of the gyrocentre's constants of motion (energy, magnetic moment, and toroidal canonical momentum), and has recently been adapted by a set of codes such as ASCOT [7], CASTOR-K [3,4], HAGIS [8], and SELFO [5]. These recent upgrades not only improve the quality and robustness of the code interfaces, but more importantly they also increase the accuracy of the results.

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