Nonlinear electromagnetic stabilization of ITG microturbulence by ICRF-driven fast ions in ASDEX Upgrade

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$^3$He minority heating is one of the ICRF heating schemes foreseen for ITER. Experiments with this scheme were recently carried out on the ASDEX Upgrade (AUG) tokamak [1]. By adding 3 MW of ICRF power tuned to the central $^3$He ion cyclotron resonance to 4.5 MW of deuterium NBI, the radial gradient of the $T_i$ profile reached locally values up to 50 keV/m and the normalized logarithmic ion temperature gradients $R/L_T$ of about 20, which is unusually large for AUG. Changes in $T_i$ profiles were accompanied by an increase in the toroidal rotation, thought to be associated with microturbulence stabilization similar to radially-sheared toroidal rotation stabilization. Our linear simulations performed with the GENE code [2] demonstrate that the observed large core ion temperature gradient could be explained in terms of fast ions stabilization [3]. In particular, we find that the addition of fast ions generates a reduction in the ITG linear growth rate and decreases the beta threshold of the hybrid Kinetic Ballooning Mode and Beta Alfven Eigenmode (KBM/BAE). In this paper we deepen our analysis by separating the impacts of the electromagnetic and fast-ion effects on stabilizing the ITG turbulence, following the methodology in [4] [5]. Our final aim is to carry out nonlinear simulations in a KBM stable regime, to allow a comparison of the simulated and experimental ion and electron energy fluxes.

References