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Investigation of LHW-Plasma Coupling and Current Drive Related to H-Mode Experiments in EAST

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LHW-plasma coupling and high density are two important issues in achieving LHCD H-mode plasma in EAST. Firstly, effects of LHW on the density at the grill mouth are investigated by a Langmuir probe installed in the top of the LHW antenna. Results show that the measured density with anti-clockwise Bt is lower than those with clockwise Bt, suggesting the asymmetric density behaviour in SOL. Simulation with a diffusive-convective model suggest that such asymmetry is mainly due to E×B drift.
Secondly, high density experiments with LHCD are further analyzed by means of simulation, showing that parametric instability (PI), collision absorption (CA) in edge region, and density fluctuation could be responsible for the low current drive (CD) efficiency at high density. (i) Frequencies and growth rates of coupled modes could be identified near the antenna and the LCFS. Modelling results show that the line broadening of the operating LH frequency and the downshifted sidebands, observed during the experiments, could be produced by PI effects driven by ion-sound and ion-cyclotron (IC) quasimodes, respectively, near the plasma edge in the low field side. The growth rates are larger in the case of poor lithiation, consistently with the observed reduced CD efficiency. Simulations also show that the growth rate peak of the IC sideband occurs near the LCFS, and, in case of poor lithiation, has a smaller frequency shift from the pump, in agreement with the RF probe spectra. (ii) The fraction of LH power calculated with GENRAY code indicates that more LHW power is absorbed in SOL by collision in the case of poor lithiation, whether at low density or high density, making some contribution to the low CD efficiency in this case. (iii) Modification of spectrum due to density fluctuation makes the power deposition and driven current profile predicted by C3PO/LUKE ray-tracing and Fokker-Planck move inward, but the total value of driven current decreases (˜30%). This may partly explain the small CD efficiency in the case of SMBI.
In addition, CD efficiency with considering bootstrap current and hot electrical conductivity has been investigated in EAST H mode. Results show the efficiency maximum locates at n_e ˜ 2.2×10ˆ19mˆ-3, above which the efficiency drops significantly with density increase, nearly consistent with the above HXR emission. Further study will be continued.

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