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Recent experimental and modeling advances in the understanding of lower hybrid current drive in ITER-relevant regimes

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To explore lower hybrid current drive at reactor relevant, high density is an important issue. Collisional absorption (CA), parametric instabilities (PI) and scattering from density fluctuations (SDF) are considered as possible candidates for the current drive (CD) efficiency decreasing faster than theory prediction. A multi-machine assessment, including experiments and modeling in EAST, C-Mod and JET, has been continued under the ITPA-IOS coordination.
Experiments in EAST show that LH waves (LHW) at 4.6GHz has better CD capability than at 2.45GHz.By means of 4.6GHz/2.45GHz LHCD, H-mode plasma obtained at relatively high density shows part of the current is driven by LH waves. The role of the spectral broadening produced by PI at the plasma edge in affecting the LHCD efficiency will be further assessed. On Alcator C-Mod, the deposition of LH wave power at high density was analyzed using power modulation techniques, showing that an increasing fraction of LH power is absorbed in the edge with increasing density and reduced CD efficiency.
Modeling of PI, CA and SDF in EAST have shown that these mechanisms could be responsible for the reduction of CD efficiency at high density. PI modeling using the LHPI code and the code from MIT are nearly consistent with the measured RF spectra from a probe. The existence of a "tail"in the launched power spectrum due to SDF, considered in C3PO/LUKE, significantly improves consistency between modeling and experiments when the spectral gap is large in EAST and C-Mod. Using GENRAY/CQL3D, CA simulation results suggest that SOL plasmas could have impact on current drive. Results from the improved SOL plasma model in GENRAY/CQL3D taking into account more realistic geometry can reproduce the experimental trend in all range of LHCD densities on C-Mod. The effect of the LH frequency (2.45 GHz and 4.60 GHz) on PI in EAST has been considered, showing that the ion sound quasi-mode growth rate is slightly smaller (˜ 25%) with 4.60 GHz, hence producing a less pronounced broadening of the launched spectrum for the case of 4.60 GHz LHW. The driven current profile using LHstar code with different frequency will be presented.
In JET, a new Ray Tracing/Fokker-Planck package has been developed for the LH power deposition analysis. Results are in a very good agreement with experimental data at lower density, whereas it is not at high density.

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