

Study of LHCD capability improvement with extended range of plasma currents at high density in EAST

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Previous LHCD experiments with moderate plasma current in EAST show that lithiation and higher frequency are useful to improve LHCD efficiency at high density due to the mitigation of edge parasitic effect. Recently, efforts improving LHCD capability with 2.45GHz and 4.6GHz waves were further continued by varying plasma current over a broad range (300 kA to 700 kA), extending the effective current drive regime up to the line-averaged density of $\sim 4.3 \times 10^{19} \text{ m}^{-3}$. It is observed that increasing plasma current results in higher current drive efficiency and smaller density fluctuations in the SOL. Such tendency in efficiency is clearer with 2.45GHz wave at high density. Also, as the plasma current increases, the power deposition moves outward. As a result, a broadened current profile indicated by internal inductance is observed to be sustained in the higher current operation, demonstrating one pathway toward optimized scenario development with off-axis current drive.

The effect of plasma current on LHCD is possibly due to its influence on the turbulence and density in SOL, which could be explained by the lower hybrid wave scattering due to turbulence in SOL indicated by the spectrum broadening measurement. Another possible candidate could be a role of DC electric field on the fast electron acceleration since loop voltage is higher at higher current. Furthermore, investigation of lithiation effect on LHCD suggests that it is more effective at lower plasma current ($I_p=300\text{kA}$) and such effect diminishes somewhat at high plasma current, possibly implying that the role of high plasma current in reducing turbulence is more dominant.