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Studies of Lower Hybrid Current Drive towards Long-pulse Plasma with High Performance in EAST

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Aiming at a fusion reactor with lower hybrid current drive (LHCD), effective current drive and optimizing current profile at high density must be solved for LHCD. Effort has been done to improve current drive capability at high density in EAST in recent two years.

The wave-plasma coupling experiment with 2.45GHz and 4.6GHz was performed by changing the distance (Gap_out) between the plasma and lower hybrid (LH) antenna. The cut-off density of the 4.6GHz LHCD antenna is 3.5 times higher than that of the 2.45GHz antenna. It results that the 2.45GHz antenna is operated at much higher normalized density $n_{e,cut\text{-}off}$. Effect of outer gap, LH power and recycling on the coupling will be discussed for the two launchers. The effect of the source frequency (2.45GHz, 4.6GHz) on LHCD at high density was investigated. Studies show that high LH frequency is preferred for LHCD experiments at high density. The discrepancy in current drive capability indicated by the loop voltage increases with density. The reduction in parametric instability with the 4.60GHz wave seems one of the candidates for the improvement in driving current at higher frequency, possibly demonstrating the role and mitigation of parasitic effects of the plasma edge in LHCD. Experiments of effect of LH spectrum and density on plasma current profile were performed， demonstrating the possibility of profile control by adjusting LH spectrum and plasma density for high performance. Repeatable H-mode plasma is obtained by LHCD and the maximum density during the H-mode with the combination of 2.45GHz and 4.6GHz LH wave is up to $4.5\times10^{19}m^{-3}$. The synergy experiments between LHCD and electron cyclotron resonance heating (ECRH) is preliminarily performed, and long pulse with high Te0 (100s/4.5keV) with LHCD and ECRH has been obtained. By means of LHCD, ECRH, and ion cyclotron resonance heating (ICRH), fully non-inductive H-mode discharges with Vloop~0V over 1 minute have been achieved.