Experiments using ICRF Heating Antenna with Toroidal Phase Control Capability on LHD

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In the last 14th experiment cycle (2010) a new one pair of ICRF heating antennas was installed in LHD [1]: This pair consists of two antennas arrayed in the toroidal direction and the wave number along the magnetic field line $k_{//}$ can be controlled with changing the phase difference between two RF generators connected to two antennas. The plasma sustained with only the ICRF heating consisted of the helium ions as a majority with the hydrogen ions as a minority. Several experiment results were obtained and compared with those obtained using the previous poloidal array (PA) antenna (no ability of changing $k_{//}$). It was found that the higher electron density could be sustained with (0, π) phasing than with (0, 0) phasing, in which the plasma performance was almost the same as that using the PA antenna. Then the plasma heating efficiency η was measured using the ICRF heating power (P_{ICH}) modulation method and it was found that η was higher in (0, π) phasing. But the plasma loading resistance in (0, π) was smaller. The plasma of $n_e=0.6\times10^{19}m^{-3}$ was sustained for 90 seconds with (0, π) phasing with P_{ICH}=0.8MW and with the Electron cyclotron Heating (ECH), P_{ECH}=240kW. The temperature increase in the divertor plates during the operation was observed to be smaller that with the PA antenna.

[1] H.Kasahara, et al., J. Plasma Fusion Res., Vol. 5, S2090 (2010).