

## High Power ICRF Experiments in the Large Helical Device

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The Large Helical Device (LHD) is suitable for studying steady-state-discharge which is important for realization of helical reactors. Plasma duration time reaches 54 min using ion cyclotron range of frequencies (ICRF) heating in 2006. At this discharge injection energy of ICH and ECH reaches 1.6 GJ. During the steady-state-operation, the energy of ion tail is extended to 1.5 MeV. For achieving to high performance plasma, high power and long pulse ICRF experiment was tried in 2007. When total injection power was exceeded in 1 MW, the duration time was extended to 8 min. The high energy ion tail was achieved to 2.6 MeV, and the energy was consistent with the collisionless orbit calculations. As ICRF power was increased for same plasma density, heat flux to carbon divertor plates was large, and sparks were observed, finally plasma was terminated by radiation collapsed.

For steady-state operation, high power RF supplying, real-time impedance matching and heat flux handling are important issues. Antenna-plasma coupling is gradually changed during steady-state-operation, and feedback control of impedance matching is required for stable high power injection. In the LHD, liquid stub tuners are adopted for real-time impedance matching while high power RF is injected. The reflection ratios are reduced to almost less than a few percent within 20 sec. When antenna coupling resistance is small, voltage of standing wave between antenna strap and liquid stub tuner is extremely high. When this voltage is exceeded in 40 kV, safety circuit is well worked and transmission line is protected from arching. However in sometimes arching is occurred with the lower voltage, it is difficult to distinguish between sudden changes of antenna-plasma coupling and arching event. To detect the arching event of transmission line, fast response pressure monitors are installed in 2007. When arching is occurred in closed region of transmission line, an increment of pressure is estimated a few percent by one arch, and arch events can be identified. In this meeting, recent high power ICRF experimental results, the problems and the upgrade points for steady-state-operation are discussed.