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## ICRF Heating Experiment Using the Faraday Shield Less Antenna and New High Power Antenna in LHD

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In ICRF heating experiments, impurity influx has been a serious problem from the early phase of fusion research. It was thought that the RF electric field parallel to the magnetic field line near the antenna caused the impurity influx, and Faraday Shield (FS) was thought to be necessary to shield out such an electric field. If the FS is possible to be removed, the design and the construction become much easier. It will have an impact on the designing of the antenna for the steady-state devices. On the other hand, high-power injection is an important subject in the reactor, which limits the number of the ports for the heating devices. The results presented in this research provide important guideline for the design of the ICRF antenna for future devices. Some experiments without FS have been carried out in short pulse length in tokamak devices. The results were different from the device-to-device and high-power and long-pulse experiments have been awaited. Faraday Shield of one strap of ICRF antenna was removed in LHD. The loading resistance without FS antenna was increased twice or more than that of with FS antenna. It means the higher power can be injected from the FS less antenna when the same power is supplied from the transmitter. Behaviors of the impurities and radiation loss power were almost same. Heating efficiency is lower in the without FS antenna. The power, which is not contributed to the plasma heating, may cause harmful effect in the plasma periphery in high power and steady-state operation. However, there is no serious problem in LHD experiment so far.

Aiming at a high-power and steady-state heating, new antenna was installed in LHD. The strap is tilted and Faraday Shield is aligned to the magnetic field line (Field-Aligned). Impedance Transformer is incorporated between the antenna head and the vacuum feedthrough. Then, we named this antenna FAIT antenna. This is designed to increase the loading resistance and reduce the RF voltage of the transmission line and feedthrough. The loading resistance was compared with the existing antenna, which had the same structure at the antenna head. It was more than twice higher and higher power was easily injected in FAIT antenna. It means the impedance transformer is working well as we expected. FS less and FAIT antennas were used for high power and steady-state experiment without any problem.

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