

Development of 77 GHz-1 MW ECRH system for LHD

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ECRH plays a key role in controlling the local plasma parameters by local heating or toroidal current drive with a high spatial resolution. Thus, it is substantial to develop gyrotrons with a capability of high-power generation at long pulse for effective utilization of ECRH as a plasma control knob and extension of parameter regime of long-time sustained plasma. In the Large Helical Device (LHD), the enhancement of the output power per gyrotron was planned to extend the plasma operational regime. From 2006, the development of a new 77 GHz gyrotron of the design value 1 MW/ 5 s and 300 kW/ CW for LHD has started as the joint program between NIFS and University of Tsukuba in collaboration with Japan Atomic Energy Agency and Toshiba Electron Tubes and Devices, based on the design of the ITER gyrotron [1, 2]. The replacement of the existing gyrotrons by the 77 GHz, 1 MW tubes is in progress. Two 1 MW tubes have been installed in LHD up to now. Since the last experimental campaign, one of them has been already used for the plasma heating and its property has been evaluated. We have continued the conditioning and attained the operation of 1.07 MW/ 20 ms, 460 kW/ 5 s and 810 kW/ 3.6 s. The power loss in the transmission line was about 20 %. The polarization state of the transmitted millimetre wave controlled by two polarizers showed good agreement with the calculation indicating high controllability of polarization state. The absorption power to plasma was estimated as more than 80 % and effective plasma heating by 2nd X-mode ECRH was confirmed. The other 1 MW tube was delivered this May. We have finished the arrangement of the peripheral components including the transmission line and the test of 1 MW for short pulse. This presentation will consist of the details of the 77 GHz ECRH system, discussion about the results of the performance evaluation and the future operation plan.

[1] K. Sakamoto, M. Tsuneoka, A. Kasugai, T. Imai, T. Kariya, K. Hayashi and Y. Mitsunaka, Phys. Rev. Lett. **73**, 1994, pp3532-3535.

[2] A. Kasugai, K. Sakamoto, K. Takahashi, K. Kajiwara and N. Kobayashi, Nucl. Fusion **48**, 2008, 054009.