CURRENT PHASE CONTROL TEST BASED ON REAL-TIME MEASUREMENT OF IMPEDANCE MATRIX OF ICRF ANTENNAS

K. Saito, R. Kumazawa, T. Seki, H. Kasahara, M. Yokota, G. Nomura,

F. Shimpo, and T. Mutoh

National Institute for Fusion Science, Toki, Gifu, 509-5292, Japan

Corresponding author: saito@nifs.ac.jp

In the large helical device (LHD) a pair of new ion cyclotron range of frequencies (ICRF) antennas will be installed from upper and lower ports. These antennas are geometrically symmetrical. They are single current strap antennas, however the control of wave number parallel to the magnetic field line for the variation of the experiments is possible by locating the antennas side by side and adjusting the phase of the current on the straps. However, antenna impedance is not constant even if the plasma parameters remain constant when the current ratio or the phase is changed due to the mutual coupling between the two antennas. For efficient power injection and the protection of tetrode tubes, the parameters of impedance matching devices must be adjusted together with the current ratio and phase.

During real-time operation, the antenna impedance for the next step can be calculated by identifying impedance matrix of antennas using the data of former step assuming the geometric symmetry and the reciprocity of the two antennas or ignoring non-diagonal term of the impedance matrix i.e. mutual coupling term. Therefore, control parameters are determinable for the next step, i.e. parameters for impedance matching device e.g. liquid length in the liquid stub tuner used in LHD, and power balance and phase difference of generated forward waves between two transmission lines.

We successfully conducted the real-time phase control test together with the impedance matching by using a pair of mock-up ICRF antennas which are the simplified half scaled model of new ICRF antennas. The phase difference between two antennas measured by a magnetic probe was well agreed with the designated phase difference.