§21. Workshop on "Development and Reactor Application of ICRF Heating Device"

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Ion cyclotron range of frequencies (ICRF) heating is an important tool to heat core ions of large size plasma in reactor. To enhance the ICRF heating technology we held the fourth workshop on February 17th in 2015 at NIFS. Thirty researchers, students and technical staff joined the workshop. We exchanged the information on the ICRF heating technology including LHW. The following topics were presented and discussed.

1. "Recent ICRF heating experiment in LHD" presented by S. Kamio.
In LHD, ICRF heating power reached 4.5MW for the discharge of 0.1s and 3.9MW for the discharge of 30s. Due to ICRF heating, maximum beta value increased by 0.2% at the magnetic field on axis of 1T.

2. "3D full-wave simulation of ICRF wave with AORSA" presented by N. Tsujii.
Quantitative analysis of ICRF wave measured with microwave reflectometer in LHD was conducted, where the ICRF wave was simulated with AORSA and the microwave for reflectometer was simulated with COMSOL.

3. "Development of impedance matching system for ICRF heating in LHD" presented by K. Saito.
Impedance transformers were installed at two ports of ICRF antennas in LHD. The loading resistance was increased by 1.5-2 times. As the result the maximum voltage decreased and input power increased.

4. "Ion heating experiment on the RT-1 magnetosphere plasma" presented by M. Nishiura.
The purpose of three-turn loop antenna in RT-1 shown in Fig. 1 is the excitation of slow wave and the increase of ion beta value. The measured electric field excited from the antenna agreed well with the calculation. The initial data of ion probe were obtained.

5. "Analysis of the couplings between ICRF waves in the GAMMA 10 central cell" presented by R. Ikezoe.
Non-linear Coupling between Alfvén ion-cyclotron (AIC) waves which were excited by the anisotropy of ion temperature and the ICRF wave from antennas were analyzed using bi-spectral technique in GAMMA 10. The strong coupling between AIC waves is observed in plasma core.

6. "Distribution of divertor strike points in LHD" presented by T. Watanabe.
Mitigation of the divertor heat flux is important issue for the long pulse discharge in LHD. Scanning of rotational transform was proposed to disperse high heat flux.

7. "Plasma current start-up experiments using LHW in TST-2" presented by T. Shinya
Non-inductive current reached 18kA with CCC antenna in TST-2 shown in Fig. 2. Since simulation showed that upper launching is effective, the upper launcher will be developed.

8. "Development of ICRF wave propagation and heating evaluation code, TASK3D/WM" presented by R. Seki.
The status of full wave code TASK3D /WM was presented. The calculated results are not realistic with a hot plasma model. To avoid the non-realistic results, the potential formulation was substituted for the electric field formulation.


Fig. 1 3-turn loop antenna in RT-1


Fig. 2 CCC Antenna in TST-2