Electromagnetic field simulation for ICRF antenna and comparison with experimental results in LHD

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ICRF antenna optimization in helical system, especially in heliotron configuration, is an important research issue to launch high power in plasma core region. Basic design of present ICRF antenna in LHD is derived from a few experiments of small size heliotron devices. The experiment in LHD is the only experimental trial for antenna optimization in a large scale device for which the high energy ion confinement is not a serious problem.

The antenna characteristic of plasma coupling is one of the important issues for the optimization. Sufficient loading resistance is a necessary condition for high power injection. Another important point is well suited electromagnetic field distribution near the antenna structure. In this paper, the electromagnetic field distribution is calculated using 3 dimensional finite element simulation code (HFSS), and the results are compared with the experimental results. Realistic antenna, chamber wall and plasma configurations, they have three dimensional helical structure, are included in the calculation. Moderate local electric field strength is an important factor to withstand RF field which is needed for high power injection. The temperature increase of antenna structure measured by IR camera during the steady state operation is compared and well explained by the calculation results. The local damage of antenna central strap by arcing are also compared with the calculation results. The plasma coupling resistance using simple plasma model is simulated and compared with the experiment. These results show that 3-D calculation code is useful to explain the experimental results and also for the optimization design of advanced antenna in the LHD.