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TST-2における低域混成波実験
Lower hybrid wave experiments in TST-2

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Plasma current start-up and sustainment using lower hybrid wave（LHW）with the frequency of 200 MHz have been studied in the TST-2 spherical tokamak. In order to understand the energy flow, current drive and particle flow, we have constructed an RF induced transport model. In the model, the time evolution of parallel velocity of each electron is described by

$$\Delta V_{||} = \widetilde{\Delta V}_{||} - \nu_{||} V_{||} \Delta t - \frac{eE}{m} \Delta t \ .$$

The terms in the RHS represent a random walk due to LHW, collisional slowing down and acceleration by self-inductive electric field. The change in velocity induces transport in real space. Using the model, some steady state quantities (the loss of fast electrons at the limiters, the collisional bulk electron heating power by fast electrons, fast electron's particle confinement time and etc.) are obtained under a given plasma current, an electron density and an LHW deposition power. The obtained quantities are reasonable and consistent with some measurement results.

The model is applied to the LHW power turn off situations. Figure 1 shows the comparison of the model results and the measured quantities (plasma current, electron density, lost electron energy flux or measured HXR energy flux) around the LHW power off timing. Three model cases (w/o and w/ self-inductive electric field) are shown. Here two coefficients for the magnitude of self-inductive field are used taking into account the ambiguity of the estimated coefficient. The model can reproduce the experimental behaviors, such as plasma current decay, density increase, abrupt decrease in HXR which is generated by the electrons hitting the limiters. The comparison suggests that the plasma current decay is affected by (i.e., slowed by) the self-inductive field. The largest quantitative difference between the model and the experimental results is the ratio of HXR fluxes (or electron lost fluxes) before and after the LHW power turn off. While the experimental ratio is 1/5, the model ratio is about 1/100. These indicates that the model lacks additional loss path, which may be caused by the loss of anti-parallel fast electrons.

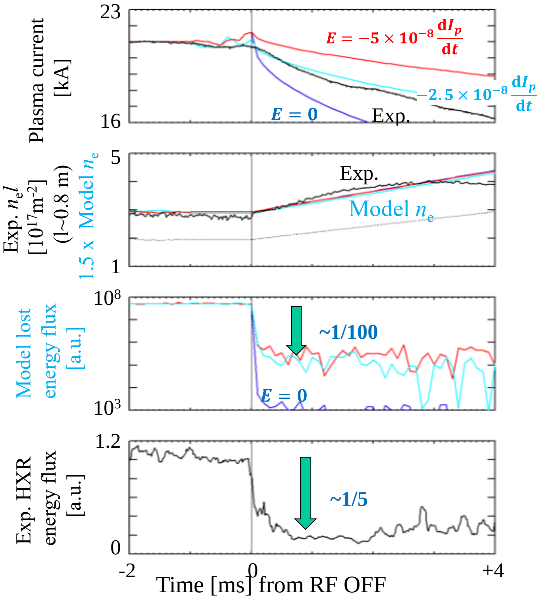

Fig. 1 Comparison of the model results and measured quantities (plasma current, electron density, lost electron energy flux or measured HXR energy flux) around the LHW power off timing.

In order to perform more detailed and direct comparisons, we installed a movable target system, by which the HXR generated by fast electrons hitting the target can be measured. The results suggest that a significant amount of fast electron exists in the outboard SOL region, and the electrons are lost when they reach the outboard limiter. These results are consistent with the above described model. On the other hand, the experiments also suggest a significant amount of anti-parallel electrons, which are not considered in the present model.

We will also report the results on LHW (2.45 GHz) experiments using a new antenna, the ion temperature measurement results, and a design study of another new LHW antenna.