7P99

# Analysis of wave-induced instabilities in Lower-Hybrid wave-maintained plasmas of TST-2 spherical tokamak device

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In the TST-2 spherical tokamak device, efficient non-inductive plasma current drive using Lower-Hybrid Wave (LHW) has been studied. However, the drive efficiency is lower than expected by calculations, and there may be a factor that is not taken into account in the calculations. Therefore, it is necessary to investigate this factor to raise the efficiency of the current drive: the waves excited by applying LHW may reduce the power of LHW for current drive, which may worsen its drive efficiency. Therefore, it is necessary to improve the current drive efficiency at LHW by clarifying the conditions and characteristics of wave excitation by nonlinear coupling.

Figure 1 shows the magnetic field fluctuations measured with the high-frequency magnetic probe in the TST-2 experiment. The magnetic field fluctuation when LHW (200.1 MHz) is applied is shown. In addition to the peak at $f_0$= 200.1 MHz, which is the frequency of the injected LHW, three other peaks were newly identified. These peaks fluctuated in their seed wavenumbers with time, and their respective frequencies were $f_1$ ~ 7 MHz, $f_2$ ~ 193 MHz, and $f_3$ ~ 207 MHz, and their values oscillated abruptly. These frequencies always satisfy the relationship $f_0$ ~ $f_1$+$f_2$ and $f_3$ ~ $f_0$+$f_1$, confirming frequency matching in three-wave coupling. Correlation analysis also showed a strong correlation between these frequency variations.

These fluctuations are thought to be caused by wave excitations due to nonlinear coupling of waves. The wave excitation by

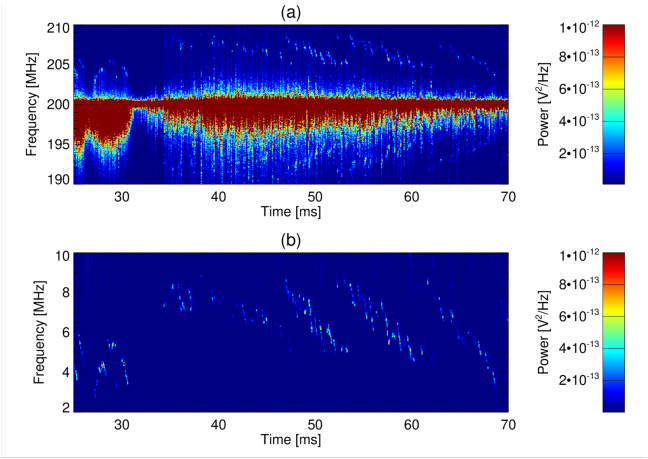


Figure 1. Spectrum of the signal measured at a certain discharge, showing the magnetic field fluctuations during the application of LHW in TST-2. A similar frequency change to that (a) near 193 MHz and 207 MHz was observed near (b) 7 MHz
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parametric decay instabilities (PDI) and the wave excitation by the velocity distribution gradient of energetic electrons are considered as candidates for the excitation mechanism.

Such wave excitation may deprive the power of the LHW applied for current drive and the energy of the fast electrons responsible for the plasma current, which may be a possible cause of the reduced efficiency of plasma current drive. Therefore, the purpose of this study is to clarify the excitation conditions and characteristics of the excited waves for more efficient current drive.

In order to confirm the wavenumber matching required by PDI, we plan to perform wavenumber measurements and investigate the wave excitation mechanism.