§25. ECE Diagnostics in CHS

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The electron cyclotron heating (ECH) is carried out with 53.2GHz gyrotron in CHS. The typical magnetic field at the center of vacuum vessel is 1.76T for the fundamental heating and is 0.88T for the second harmonic heating.

The X-mode fundamental electron cyclotron emission(ECE) was measured by the heterodyne radiometer which was originally constructed to receive the second harmonic ECE for 0.88T.
The spectrum in the frequency space had a sharp peak at the center of the plasma. Except for the frequency range near 53.2GHz, the radiation temperature profile was similar to the electron temperature profile measured by the Thomson scattering. Nonthermal emissions which are attributed to the multi-reflected and scattered part of the injected ECH power were observed near 53.2GHz.

Because the optical depth was thin for X-mode fundamental electromagnetic waves, the emitted waves passed through the plasma many times by multi-reflection on the vessel wall. So the radiation temperature has the information of the cyclotron emission not only along the line of sight but also along the trajectory of radiation wave passed. By such a reason, it was very difficult to get the electron temperature profile from the ECE measurement in the range of fundamental ECE for 1.76T operation.

To solve this problem, superheterodyne system is under construction. The electron temperature profile in the radial direction is obtained by switching the local oscillators of 72 and 90GHz.

As the preliminary experiment, the ECE data analysis during ECH power modulation, fundamental ECE was used during the 1kHz modulation of the fundamental ECH power. The fundamental ECE signal and modulated ECH power are shown in Fig.2. From this figure, the noise level of the ECE signal is considerably high. To reconstruct a meaningful information from such noisy signal, the signals were superimposed for 25 modulation periods shot by shot. Using this method, phase delay and amplitude decay of the heat wave induced by the modulated ECH can be determined.

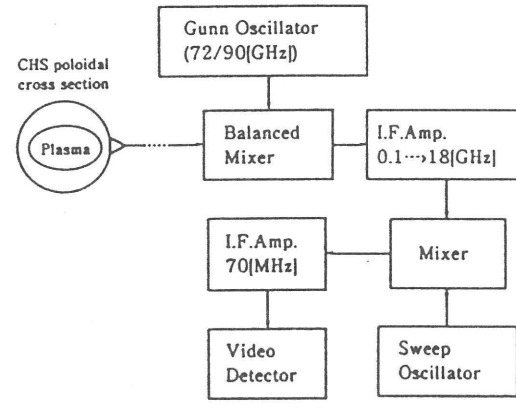

Fig.1 Superheterodyne system to measure the second ECE for 1.76T operation

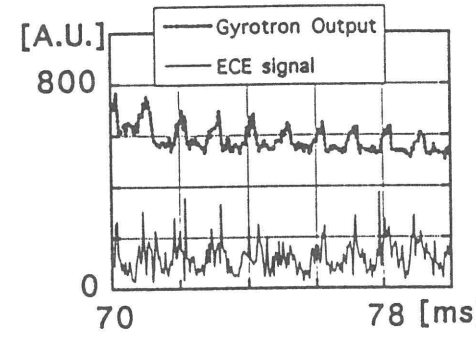

Fig.2 Modulated ECH power and ECE signal

Reference

1) Idei,H., et al., Jpn.J.Appl.Phys.33(1994)1543.