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複合共振器搭載ジャイロトロンにおける超多周波発振の観測
Observation of Increased Number of Frequency Steps in Multi-Frequency Oscillations with a Complex-Cavity Gyrotron

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1. Introduction

The gyrotron has shown great promise as a high-power source for heating and diagnostic of fusion plasmas [1]. In recent years, the range of applications has widened in the field of material science and technology [2]. To enhance their practical utility, possibility of broad-band frequency tuning has been investigated. The frequency is varied in a stepwise manner by exciting different transverse modes in a cavity. The operating modes can be selected with magnetic field strength in the cavity. In the frequency range of 162-270-GHz, a fundamental harmonic gyrotron which is capable of changing the frequency in 10-GHz-steps and delivering hundred watts of powers with Gaussian-like radiations has been realized [3].

In the present study, two cavities connected in tandem as shown in Fig.1 are introduced in order to increase the number of operating modes and decrease their tuning step-widths. The coupled cavities were first proposed to avoid the competitions with parasitic modes and improve mode selectivity properties [4, 5]. In the mode-conversion concept, suppression of parasitic oscillations is expected in a condition where the operating mode in the first cavity can greatly couple with that in the second cavity. Therefore it is possible that the coupled cavities act as independent two single-cavities if they are operated in a condition away from the required one for the mode-conversion.

We have experimentally confirmed further multiple frequency oscillations by use of a two-cavity configuration shown in Fig. 1. The experiments have been performed using a demountable straight-output-type gyrotron installed in a 8-T superconducting magnet.

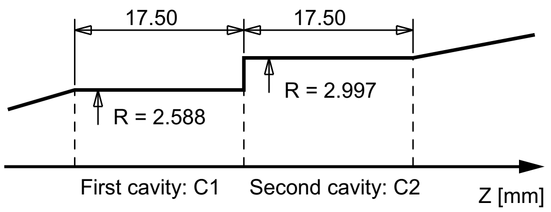

Fig. 1 Schematic drawing of a two-cavity configuration.

2. Experimental Results

The experimental results have shown the increase in the oscillation modes corresponds to each cavity (Fig. 2). The indices of fc, C1 and C2 shown in the figure denote cyclotron-frequency, the first cavity and second cavity, respectively. Frequency steps less than 10-GHz were realized. Additional oscillations are expected by optimizing the properties of the electron beams.

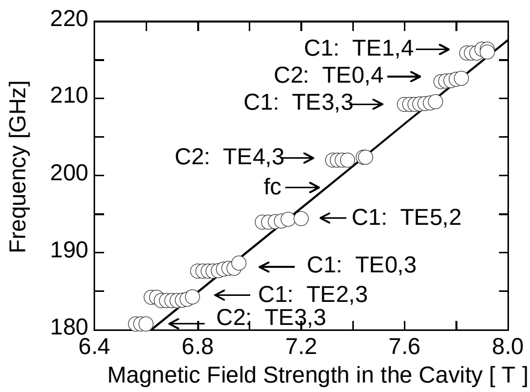

Fig. 2. Measured frequencies as a function of the magnetic field strength in the cavity.

3. Summary

A two-cavity configuration was employed to increase the number of frequency tuning steps in a gyrotron. The experimental observations showed that the different oscillation modes for each cavity can be selectively excited according to the changes in the magnetic field strength. It is predicted that a further multiple-frequency operation is possible with multiply connected cavities.

Acknowledgments

This study is partly supported by a research grant from the Murata Science Foundation.

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