Experimental Study on Performance of Slow Cyclotron Maser in Weakly Relativistic Region

K. Bansho, K. Ogura, H. Oe, Y. Kazahari, H. Iizuka, A. Sugawara

Graduate School of Science and Technology, Niigata University, Niigata 950-2181, Japan

e-mail address : f08e078g@mail.cc.niigata-u.ac.jp

Microwaves at moderate-power level or high-power level are demanded for widespread applications including plasma heating, plasma diagnostics and radar systems. Slow-wave microwave devices such as backward wave oscillators (BWOs) have been studied extensively as a candidate for high or moderate power microwave sources. In order to increase the operation frequency and the power handling capability, oversized devices are used successfully. K and Q band oversized BWOs operating in the weakly relativistic region less than 100kV are reported in Ref. [1] and their improved performances in Ref. [2]. Although the radiations based on the conventional Cherenkov interaction are predicted to be independent of the magnetic field strength, some a strong magnetic field dependence of output power can be seen. The electromagnetic field properties of beam (flowing plasma) in a finite strength magnetic field are still far from being fully elaborated. And the magnetic field dependence of slow-wave device is a still unsettled issue. An important role of the slow cyclotron interaction in the BWO operation is pointed out [1, 3, 4].

In this work, we investigate how operating characteristics of slow-wave devices are depend on the magnetic field from a viewpoint of slow cyclotron interaction. The beam voltage is in a weakly relativistic region from about 30 kV to 100 kV. The slow-wave structure is rectangularly corrugated oversized waveguide, whose target operation frequency due to the Cherenkov mode is in K-band as shown in Fig.1. The slow cyclotron mode depends on the axial magnetic field B_0. By adjusting B_0, the Cherenkov interaction can synchronize resonantly with the slow cyclotron interaction. This is a slow cyclotron maser operation. We study experimentally the performance of slow cyclotron maser at the fundamental and at the higher harmonics.

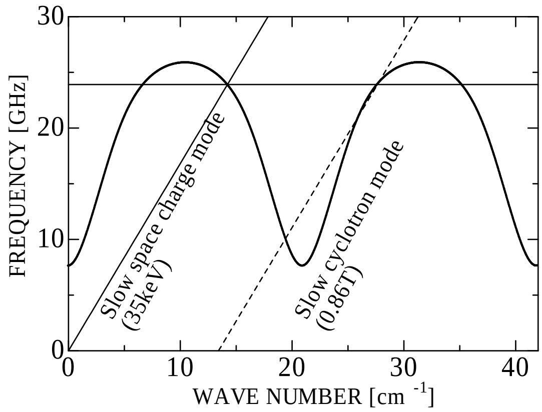

Fig.1 Dispersion characteristics

[1] K. Ogura et al., IEEJ Trans. FM, **125** (2005) 733.
[2] S. Aoyama et al., Trans. Fusion Sci. Tech. **51** (2007) 325.
[3] Md. R. Amin et al., J. Phys. Soc. Jpn., 64 (1995) 4473.
[4] Y. Takamura et al., Plasma Fusion Res. 3 (2008) S1078.