

## \$10. Study on a High-Power, High-Efficiency Backward Wave Oscillator Utilizing an Corrugated Slow Wave Structure

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Backward Wave Oscillator (BWO) utilizing corrugated Slow Wave Structures (SWS's) have been studied experimentally. This study is aimed at a stabilized high-power microwave sources and (i) an oversized BWO and (ii) tapered BWO have been investigated.

### i) Oversized BWO Experiments

In our experiments, an oversized slow wave structure intended for a high power operation has been used[1]. By optimizing the pitch length of the corrugation and its amplitude, the oversized BWO with the average diameter of 6 cm can be operated at a frequency about 20 GHz with a fundamental TM(01) mode. An annular beam with the diameter about 5.7 cm, the current of 200 A and the energy less than 70 keV was injected axially. The microwave output from the oversized BWO is less than 1 kW and the oscillation frequency is about 20 GHz. Plasma with a moderate density in slow wave structure has good effects on the Cherenkov oscillation. The output power of the plasma BWO is about 3-6 times that of the vacuum BWO. With the guiding magnetic field near the electron cyclotron resonance, the output power increases drastically, up to about 500 kW, as shown in Fig.1. The output efficiency of about 6% is obtained. It is noted that the the beam energy is less than 70 keV. The enhancement of the output power might be ascribed to the anomalous Doppler cyclotron resonance.

### ii) Tapered BWO

In general, high-power microwave sources driven by an axially injected electron beam become unstable above a critical current and the output wave form becomes spiky or intermittent. In order to realize a stabilized high-power BWO, we have

proposed tapered SWS. By using our linear and non-linear calculation codes, optimized tapered SWS's are designed, one is a simple tapered type and the other is the throttled one. The simple tapered resonator was often used in the free electron laser or gyrotron experiments. Throttled type SWS is an improvement on the simple tapered one. The dispersion characteristics are investigated and determined experimentally[2].

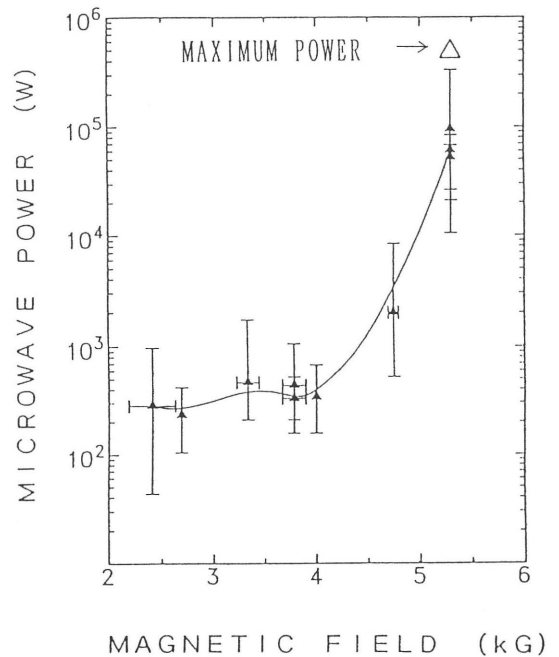


Fig.1. Dependence of output microwave power of the oversized BWO on guiding magnetic field.

### References

- 1) K.Ogura, K.Minami, et al., "Experiment on a Large Diameter Plasma Filled Backward Wave Oscillator", presented in Fifth International Toki Conference on Plasma Physics and Controlled Nuclear Fusion, Toki, November, 1993.
- 2) H.Inada, N.Kobayashi, et al., "Design Study of Tapered Backward Wave Oscillator", presented in the Meeting of IEE of Japan, Nagaoka, 1993. (in Japanese)