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Structure Effect on Reflective Gyrotron Backward-Wave Oscillator

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Gyrotron devices, based on the principles of the electron cyclotron maser (ECM) instabilities, are powerful high-frequency microwave sources. In this study, we focus on specific type of reflective type gyro-BWO , which consist of several tapered section and can achieve a phenomenal output efficiency and bandwidth. This study investigates the effect of structural nonuniformities on the beam-wave interactions in the gyrotron backward-wave oscillator (gyro-BWO). Employing the effective-boundary method both upstream and downstream of the primary cavity, we examine the modulation effect resulting from end reflections. The gyrotron's beam-wave dynamics during backward wave and forward wave interactions are analyzed separately. The study reveals a significant modulation effect during the electron bunching stage of backward-wave interaction, influencing tunability positively or negatively. This modulation effect is contingent upon the acquired phase from upstream reflections. The influence of both upstream and downstream structural nonuniformities is elucidated. These findings not only provide valuable insights but also offer a clear physical understanding for optimizing current gyrotron devices.

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