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Abstract
A gyrotron backward wave oscillator is a promising source of coherent millimeter wave radiation based on the electron maser instability on a backward waveguide mode. However, the requirement on phase coherence is strict for applications. Controlling the phase and frequency of a gyrotron backward-wave oscillator (gyro-BWO) by means of injection-locking techniques is of practical importance. Using a nonlinear self-consistent time-independent code and analyze of stability to delineate the drive curve. The simulation results of gyro-BWO driven by an external signal show that there are three roots exist. The operating regimes of a gyro-BWO driven by an external signal are analyzed using nonlinear oscillation theory, linear theory, nonlinear code, and Adler's curve. When the beam current is below free-running start oscillation current, the results of the nonlinear simulation are consistent with the results of the amplifier's linear theory. This is an amplifier regime. When the beam current is above start oscillation current, there are three different operating regimes, amplifier regime, mode competing regime and phase-locking oscillation regime in a gyro-BWO driven by an external signal. There are three possible mode, amplifier mode, unstable mode and phase-locking oscillation mode in the mode competing regime. Due to nonlinear oscillation theory the solutions of the unstable mode are the steady-state solutions, but aren't stable solutions.
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