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A High Power Wide-band Gyro-BWO for Terahertz Operation[1]

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Terahertz waves have many exciting applications. If the frequency can be tuned these applications can be greatly enhanced with higher range resolution and improved sensitivity or selectivity. The potential of gyrotron backward wave oscillators (gyro-BWOs) as a high power (kW) coherent powerful microwave source with wide-frequency tunability, has hitherto been achieved only at frequencies well below the terahertz range. This abstract presents the first successful operation of a high power gyro-BWO with a wide frequency tuning capability in the low terahertz frequency range. A novel helically corrugated interaction region (HCIR) and 1.5 A, 40 kV thermionic cusp electron gun were used in the gyro-BWO. An "ideal" eigenwave, achieved from the resonant coupling of the modes in the HCIR, allows for broadband microwave amplification or wide frequency tuning. Stable single mode output was achieved in a wide frequency tuning band of 88-102.5 GHz by adjusting the cavity magnetic field with a maximum power of 12 kW and an electronic efficiency of 20%. The performance of the gyro-BWO is consistent with 3D particle-in-cell (PIC) numerical simulations. This method can, in principle, be extended to the higher terahertz range.

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