Results of a Wideband 2nd Harmonic Gyro-Amplifier (Phigtron) Experiment

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A new member of gyrotron family, a "phase coherent, harmonic-multiplying, inverted gyrotwystron" (phigtron), has been experimentally characterized operating as a high performance, powerful, millimeter wave amplifier. This novel device consists of a gyro-TWT as prebunching input section operating at the fundamental cyclotron resonance and a two cavity, second harmonic output section. Optimization of operating parameters was conducted. Frequency doubling peak power of 430 KW was achieved in the TE03 mode with a bandwidth of about 0.85%, gain of 35 dB, phase fluctuation (due to beam voltage variation) of 0.026 degree per volt and efficiency of 32% at center frequency of 33.4 GHz. This measured performance considerably advance the state-of-the-art for millimeter wave gyrotron amplifiers.A upgraded design of the phigtron , which uses a new extended interaction cavity (EIC) as an output section , is also presented. Fig.1 shows the configuration of the EIC and the simulated mode structure (TE02-->TE03→TE04) at one of the cavity resonance's which correspond to the frequencies f1, f2, f3, f4, f5 shown in Fig.2. Due to these resonance's which can overlap each other and cover the amplification range provided by the input gyro-TWT, the operating bandwidth of the tube is expanded to more than 2% . Thus far it has been demonstrated that this new amplifier features high gain, high efficiency, good phase stability and potentially high average power as well as wide bandwidth. At the same time, operation is advantageously characterized by the harmonic multiplying feature which results in a low magnetic field requirement and low drive frequency.

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