UCD Gyro-TWT Program: 94-GHz TE_{01} Gyro-TWT and 44-GHz Third-Harmonic Slotted Gyro-TWT

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Two high performance gyro-TWT amplifiers are being constructed at UCD. A high power CW-capable gyro-TWT operating in the low-loss TE_{01} mode will be driven by a 100 kV, 5 A, $v_\perp/v_z$=1.0 MIG electron beam with $\Delta v_z/v_z$=5%. The three-stage amplifier is predicted by our large-signal simulation code to generate 105 kW at 94 GHz with 21% efficiency, 45 dB saturated gain and 5% constant-drive bandwidth. Linear theory has been used to determine the threshold start-oscillation beam current for absolute instability and the critical section lengths for the potential harmonic gyro-BWO interactions. A novel, lossy mode-selective circuit is being considered for increasing the section lengths in order to remove one sever and further increase the efficiency.

In addition, a third-harmonic gyro-TWT amplifier will be tested at 44 GHz. A slotted interaction circuit is utilized to achieve strong amplification near the third cyclotron harmonic frequency. The start-oscillation conditions were determined by linear theory. The dominant threat to the amplifier's stability is from a third-harmonic peniotron backward-wave interaction. Our large-signal simulation code predicts the three-section, slotted third-harmonic gyro-TWT will yield an output power of 20 kW with an efficiency of 20%, a saturated gain of 40 dB and a constant-drive bandwidth of 2%. The 50 kV, 2 A, $v_\perp/v_z$=1.4, $\Delta v_z/v_z$=6%, axis-encircling electron beam will be produced by a 70 kV, 3.5 A Cusp gun on order from Northrop Grumman.

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