PREFACE

The gyrotron traveling wave tube (gyro-TWT) amplifiers offers a unique opportunity to fill a long-standing gap in the generation of high-power coherent millimeter and sub millimeter wave radiation with its promise of broadband amplification. The gyro-TWT amplifier has emerged out as an efficient and stable high power, wide band amplifier which develops CW as well as pulse power that could not be done by the conventional microwave tubes or quantum mechanical devices. In recent years, there is renewed interest toward research and development of the gyro-TWT amplifier due to its requirement in the systems for the applications, such as high-resolution radar, high information density communication, satellite communication, material processing, weaponry, remote sensing, industrial heating, hyperthermia, linear accelerators, waste remediation, *etc*. Another major area of development is the possibility of exploiting the world leading gyro-TWT amplifier to be used in Electron Paramagnetic Resonance (EPR) and Dynamic Nuclear Polarization (DNP) spectroscopy which is currently hampered by the lack of high-power sources and especially broadband amplifiers of terahertz radiation.

Author is fascinated by various applications of high-frequency high-power gyrotron amplifiers. However, the inherent instability problem of gyro-TWT due to various source of oscillations limits the output power gain and efficiency. The existing single mode analysis fails to give the mutual effect of operating and oscillating modes on the performance of the device. These issues have motivated the author to investigate the multimode nonlinear beam-wave interaction of lossy dielectric loaded gyro-TWT using nonlinear analytical equation and numerical simulation tool by considering more than

one mode in the operation. The lossy dielectric loading effectively suppresses the potential oscillations by providing them attenuation.

The other issues such as sensitivity to beam velocity spread, high-magnetic field requirement are also limiting the performance of the gyro-TWT to meet the practical application requirement. The author has also studied the design and simulation of low velocity spread diode and triode magnetron injection gun to improve the electronic efficiency. The design and simulation study of other subassemblies of gyro-TWT such as input coupler, output window and beam collector has been described. The author has investigated the second harmonic higher order mode operation to reduce the requirement of high magnetic field by a factor of 2.

The author has reported the present work in different parts at national and international conferences as well as in referred journals, namely, IEEE Transaction on Electronic Devices and IEEE transaction on Plasma Science.

The author will consider his modest effort as a success if it would be useful to the community of microwave tube designers and researchers.