Session 22. Gyro-devices

May 1 (Wednesday) / 13:30 ~ 15:10 / Room 1

Session Chair: Jagadishwar Sirigiri (Bridge12 Technologies, Inc., USA)

13:30 ~ 13:50

22.1 / Development of a THz Broadband Mini-Gyrotron

Chao-Hai Du (Peking University, China), Shi Pan (Peking University, China), Zi-Chao Gao (Peking University, China), Hui-Qi Bian (Peking University, China), Pu-Kun Liu (Peking University, China)

We are currently investigating about demonstrating gyrotron with the capability of super broadband operation in THz band. A strong-field pulse magnet is applied to provide a time-varying magnetic field, and the cyclotron frequency of the electron beam in the cavity changes accordingly. The electron beam efficiently excites a backward wave in a specially designed pre-bunching cavity. A broadband quasi optical converter and a Brewster window are installed in the tube to radiate out the broadband power. Theoretical study reveals that the gyrotron is potential to radiate peak power about 1 kW around 0.33 THz and a frequency tuning range about 10 GHz in each pulse. Further study predicts that when high-order whispering gallery modes are employed as the operation modes, this broadband mini-gyrotron is capable of sequentially jumping from one mode to another and finally radiates power covering the range of 350 GHz – 410 GHz.

13:50 ~ 14:10

22.2 / Experiments on W-band High-Gain Helical-Waveguide Gyro-TWT

S. V. Samsonov (Russian Academy of Sciences, Russia), A.A. Bogdashov (Russian Academy of Sciences, Russia), G. G. Denisov (Russian Academy of Sciences, Russia), I. G. Gachev (Russian Academy of Sciences, Russia)

Design, simulation results and first experimental results are presented for a W-band gyro-TWT using helically corrugated waveguides in its microwave circuit. The specific of this gyro-TWT is a sectioning (2 helical-waveguide sections separated by a sub-cutoff drift channel) which enables its operation at the second cyclotron harmonic with a high gain (45-50 dB) and high stability to the spurious oscillations. Using an available superconducting magnet with B-field of 1.9 T the tube was designed to be powered by a 40-kV 0.7-A electron beam with a pitch-factor of 1.3. The 3D PIC simulations predict the maximum output power of 3 kW at about 95 GHz and 1-kW-level bandwidth of 7.2 GHz when driving by a 100-mW input signal.

14:10 ~14:30

22.3 / Characteristic measurements of a wideband gyro TWA operating in W-band

Wenlong He (Shenzhen University, China), Liang Zhang (University of Strathclyde, UK), Craig R. Donaldson (University of Strathclyde, UK), Kevin Ronald (University of Strathclyde, UK), Alan D.R. Phelps (University of Strathclyde, UK), Adrian W. Cross (University of Strathclyde, UK), Peter Cain (Keysight Technologies UK Ltd, UK)

Following on from the successful operation of a broadband, high-power gyrotron traveling wave amplifier (gyro-TWA) in W-band, experiments were carried out to demonstrate the versatility of the gyro-TWA and investigate its tuning characteristics. When operating at a lower voltage of 40kV, 30 dB gain was achieved for a 1 GHz bandwidth frequency-swept input signal.

14:30 ~ 14:50

22.4 / Development of Ultrashort Pulse Generators based on Helical Gyro-TWT with Saturable Cyclotron Resonance Absorber in the Feedback Loop

Naum Ginzburg (Institute of Applied Physics RAS / Nizhny Novgorod State University, Russia), Grigory Denisov (Institute of Applied Physics RAS, Russia), Michael Vilkov (Institute of Applied Physics RAS, Russia), Alexander Sergeev (Institute of Applied Physics RAS, Russia), Sergey Samsonov (Institute of Applied Physics RAS, Russia), Irina Zotova (Institute of Applied Physics RAS, Russia), Alexander Bogdashov (Institute of Applied Physics RAS, Russia), Alexander Marek (Karlsruhe Institute of Technology, Germany), John Jelonnek (Karlsruhe Institute of Technology, Germany)

Presently, Ka-band ultrashort pulse (USP) generator is under development at Institute of Applied Physics RAS. Based on a time-domain model and direct PIC simulations we demonstrate that a periodic train of ultrashort microwave pulses can be generated in an electron oscillator consisting of a helically corrugated gyro-TWT and a saturable absorber based on cyclotron resonance interaction of radiation with an initially rectilinear electron beam. The gyro-TWT operates at the second cyclotron harmonic while in the absorber interaction at the fundamental harmonic should be realized. According to simulations with parameters of existing Ka-band gyro-TWT, the peak power of generated pulses with a duration of 200 ps and repletion frequency 1 GHz is about 400 kW.

14:50 ~ 15:10

22.5 / Design of a Broad-band Circular Waveguide TE°_{21} Mode Generator for Cold Test of Gyro-TWT

Yong Xu (University of Electronic Science and Technology of China, China), Hao Li (University of Electronic Science and Technology of China, China), Tinghui Peng (University of Electronic Science and Technology of China, China), Miao Sun (University of Electronic Science and Technology of China, China), Yong Luo (University of Electronic Science and Technology of China, China), Guo Liu (University of Electronic Science and Technology of China, China), Jianxun Wang (University of Electronic Science and Technology of China, China), Wei Jiang (University of Electronic Science and Technology of China, China), Zewei Wu (University of Electronic Science and Technology of China, China), Hongfu Li (University of Electronic Science and Technology of China, China)

In this paper, the design of a broadband circular waveguide $TE^{\bigcirc}_{21}$ mode generator for gyro-TWT cold test is presented. The proposed mode generator is constituted by a rectangular waveguide $TE^{\square}_{10}$ to rectangular waveguide $TE^{\square}_{20}$ mode converter, a rectangular waveguide $TE^{\square}_{20}$ to crossing waveguide TE^{+}_{22} mode converter and the converter from TE^{+}_{22} to TE^{o}_{21} mode. The linear gradient structure is adopted in each convert for easy fabricating. Simulation results reveal that the S_{21} parameter of the proposed $TE^{\bigcirc}_{21}$ mode converter is better than -0.037dB and the S_{11} parameter is below -28dB in whole Q-band. Cold test shows that the designed generator realizes high conversion efficiency (>96.6%) in whole Q-band.