Session 4. Gyrotrons

April 29 (Monday) / 13:30 ~ 15:10 / Room 1

Session Chair: EunMi Choi (Ulsan National Institute of Science and Technology, Korea)

13:30 ~ 13:50

4.1 / [Keynote] Developments of terahertz large-orbit highharmonic gyrotrons at IAP RAS

Ilya Bandurkin (Russian Academy of Sciences, Russia), Vladimir Bratman (Russian Academy of Sciences, Russia), Yuriy Kalynov (Russian Academy of Sciences, Russia), Vladimir Manuilov (Russian Academy of Sciences, Russia), Ivan Osharin (Russian Academy of Sciences, Russia), Andrei Savilov (Russian Academy of Sciences, Russia)

We describe high-harmonic gyrotrons with axisencircling electron beams developing on the basis of two experimental setups. The 30 keV / 0.7 A CW gyrotron is developed for the spectroscopy applications. Recently, selective operation at the second (0.267 THz) and at the third (0.394 THz) cyclotron harmonics were observed in a series of experiments. Quasi-regular cavities with periodic phase correctors are designed to improve the operation at the third harmonic, as well as to achieve the fourth-harmonic operation at frequencies of up to 0.65 THz. The pulsed 80 keV / 0.7 A gyrotron is aimed to provide high-power (hundreds Watts) microwave pulses at the third cyclotron harmonic at frequencies close to 1 THz. Recently, a sectioned cavity with a decreased diffractive Q-factor was experimentally tested at this setup. Now we study possibilities to increase the peak level of the output power up to the level of several kW in order to usethis gyrotron in plasma applications.

13:50 ~ 14:10

4.2 / Development of the Second Harmonic Dual Mode Gyrotron for OAM Beam Generation

Ashwini Sawant (Ulsan National Institute of Science and Technology, Korea), Ingeun Lee (Ulsan National Institute of Science and Technology, Korea), EunMi Choi (Ulsan National Institute of Science and Technology, Korea)

A novel scheme of orbital angular momentum (OAM) beam generation in radio frequency (RF) range using gyrotron is demonstrated. The gyrotron generates few kilowatts of power at 190 GHz frequency in a second harmonic mode-pair $TE_{8,3}/TE_{17,2}$ from 33/37 kV, 7A electron beam. It incorporates the two sinusoidal perturbations in the cylindrical cavity to eliminate the fundamental mode competition. These high-power OAM beams can be used for free space RF communication and RF beam plasma interaction.

14:10 ~ 14:30

4.3 / Mechanisms of Intense Pulses Generation in Gyrodevices

Irina Zotova (Institute of Applied Physics RAS, Russia), Alexey Fedotov (Institute of Applied Physics RAS, Russia), Alexander Sergeev (Institute of Applied Physics RAS, Russia), Vladimir Manuilov (N.Novgorod State University, Russia), Naum Ginzburg (Institute of Applied Physics RAS, Russia), Roman Rozental (Institute of Applied Physics RAS, Russia), Valdislav Zaslavsky (Institute of Applied Physics RAS, Russia), Valdimir Bratman (Institute of Applied Physics RAS, Russia)

We study theoretically and experimentally two mechanisms of generation of intense pulses trains under cyclotron resonance interaction of electromagnetic radiation with electron beams. The first mechanism is based on transformation of CW radiation into a train of SIT-solitons when an electron beam is initially rectilinear (absorbing). The second mechanism realizes in a gyrotron, operating with high excess of an electron current over the starting conditions. Results of corresponding Ka-band experiments are presented. Both mechanisms are of interest as methods of frequency-comb generation in microwave electronics.

14:30 ~ 14:50

4.4 / Second Harmonic 527 GHz Gyrotron for DNP-NMR

Sudheer Jawla (Massachusetts Institute of Technology, USA), Ivan Mastovsky (Massachusetts Institute of Technology, USA), Michael A. Shapiro (Massachusetts Institute of Technology, USA), Richard J. Temkin (Massachusetts Institute of Technology, USA)

We have built a frequency tunable 527 GHz gyrotron for an 800 MHz DNP-NMR spectrometer. The gyrotron is designed at the second harmonic ($\omega=2\omega_c$) of the electron cyclotron frequency. It produces ~10 W continuous microwave power at 527.12 GHz frequency using a diode type electron gun (V ~ 16.5 kV, I_b~110 mA). The gyrotron is tunable within ~ 0.5 GHz by combining voltage and magnetic field tuning. The gyrotron comprises an internal periscope assembly to internally convert a Gaussian beam to an HE11 mode in a 12 mm i.d. corrugated waveguide. The corrugated waveguide transmission line system is built including 3 m long 16 mm i.d. waveguide and a corrugated taper from 12 mm to 16 mm i.d. waveguide.

14:50 ~ 15:10

4.5 / Study of X-Ray Spectra Energy Distribution Excited by Spent Electrons in an X-Band Gyrotron Traveling Wave Tube

Yue Wang (University of Electronic Science and Technology of China, China), Guo Liu (University of Electronic Science and Technology of China, China), Wei Jiang (University of Electronic Science and Technology of China, China), Jianxun Wang (University of Electronic Science and Technology of China, China), Yong Luo (University of Electronic Science and Technology of China, China), Guoxiang Shu (Shenzhen University, China)

In this paper, theoretical and PIC simulation of the bremsstrahlung X-ray produced by an X-band gyrotron traveling tube (gyro-TWT) is analyzed with CST Particle Studio, which are used to investigate the X-ray spectra of the collector. X-rays flux spectral density and dose are obtained with theoretical Kramers law when the gyro-TWT operates with saturated output power of 136.9 kW at 9.6 GHz. Studying the X-ray spectra is of great importance for the X-ray protection of the gyro-TWT collector.