Session 7. HPM and Relativistic devices

April 29 (Monday) / 16:30 ~ 18:10 / Room 1

Session Chair: Edl Schamiloglu (University of New Mexico, USA)

16:30 ~ 16:50

7.1 / [Keynote] Preliminary experimental investigations into an oversized coaxial relativistic klystron amplifier at Ka band

Shifeng Li (University of Electronic Science and Technology of China / China Academy of Engineering Physics, China), Zhaoyun Duan (University of Electronic Science and Technology of China, China), Hua Huang (China Academy of Engineering Physics, China), B. N. Basu (Indian Institute of Technology (BHV), India), Zhiwei Dang (University of Electronic Science and Technology of China / China Academy of Engineering Physics, China), Yu Bai (China Academy of Engineering Physics, China), Zhanliang Wang (University of Electronic Science and Technology of China, China), Yubin Gong (University of Electronic Science and Technology of China, China)

Preliminary experimental results on an oversized high-power coaxial relativistic klystron amplifier (OCRKA) at Ka band were presented. The measured values on the cold-test setup agreed with those predicted by simulation. An annular intense relativistic electron beam (IREB) was produced by an explosive emission cathode in a diode with beam transmission greater than 88%. The device output power of ~100 kW was demonstrated, using a 517 kV, 4.9 kA IREB. Larger output power could have been obtained with improved input coupler of lower values of insertion loss.

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7.2 / Enhancing the power of high power microwaves by using zone plate and investigations for the position of virtual cathode inside the drift tube

Sohail Mumtaz (Kwangwoon University, Korea), Jun Sup Lim (Kwangwoon University, Korea), Bhagirath Ghimire (Kwangwoon University, Korea), Suk Woo Lee (Kwangwoon University, Korea), Jin Joo Choi (Kwangwoon University, Korea), Eun Ha Choi (Kwangwoon University, Korea)

We have investigated the axial-typed vircator in our pulsed power generator, "Chundoong" (Max 600kV, 88kA, and 60ns), and simulated the vircator using the 3-D particle-in-cell simulation code called "MAGIC." We try to find out the position of the virtual cathode (VC) inside the drift tube and enhance the power of microwaves by focusing them at the focus point using the ring-typed zone plate with a focal length of 18.8cm. The dominant frequency is obtained as 3.5GHz measured by fast Fourier transform, which is in good agreement with simulation frequency. It is found that the mean position of the VC is almost the same as the A-K gap distance of 10mm, in which the virtual cathode oscillates from 7.9mm to 12.1mm

behind the meshed anode, as verified by the simulation results. The maximum output power without the zone plate is obtained as 0.66GW with the efficiency of 27%, which is maximized up to 1.22GW with the efficiency of 51% at the focus point by using the zone plate. The microwave emission mode from the vircator is the TM01 mode based on the simulation results.

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7.3 / Recent Advances in Relativistic MDOs

Edl Schamiloglu (University of New Mexico, USA), Mikhail Fuks (University of New Mexico, USA), Dmitrii Andreev (University of New Mexico, USA), Artem Kuskov (University of New Mexico, USA)

The relativistic magnetron is the most compact and efficient high-power microwave (HPM) source. It has been researched since Bekefi's pioneering work in 1975 at MIT. The performance of the relativistic magnetron did not dramatically improve until the 2000s when new cathode concepts were introduced independently by researchers at the University of Michigan and at the University of New Mexico. These advances demonstrably decreased the time for onset of oscillations and increased the efficiency. All of these earlier works involved relativistic magnetrons with radial extraction. Researchers at the University of New Mexico then revisited the magnetron with diffraction output and most recently have shown in particle-in-cellsimulations that its efficiency can exceed 90% when powered by a virtual cathode and leakage current is suppressed using a magnetic mirror. This paper summarizes our most recent advances.

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7.4 / Novel Schemes of High-Power Relativistic Vircators

Semen Kurkin (University of Saratov, Russia), Artem Badarin (University of Saratov, Russia), Alexey Rak (Belarusian State University, Belarus), Alexey Koronovskii (Saratov State University, Russia), Alexander Hramov (University of Saratov, Russia)

The following novel schemes of relativistic generators with virtual cathode were proposed and investigated in terms of enhancing output power, efficiency and generation frequency: multibeam vircator; vircator with elliptical resonator; vircator with photonic crystal. The carried-out analysis and obtained results have shown efficiency of the proposed vircator schemes.

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7.5 / High-power THz Wave Generation through Coherent Cherenkov Radiation based on a Plasma Dielectric Wake-field Accelerator using Relativistic Annular Electron Beam

Sun-Hong Min (Korea Institute of Radiological and Medical Sciences, Korea), Ohjoon Kwon (Institute for Basic Science Center for Axion and Precision Physics Research, Korea), Matlabjon Sattorov (Seoul National University / Seoul-Teracom, Inc., Korea), Seontae Kim (Seoul National University, Korea), Dongpyo Hong (Seoul National University, Korea), Chawon Park (Korea Institute of Radiological and Medical Sciences, Korea), Ilsung Cho (Korea Institute of Radiological and Medical Sciences, Korea), Bong Hwan Hong (Korea Institute of Radiological and Medical

Sciences, Korea), In Su Jung (Korea Institute of Radiological and Medical Sciences, Korea), Won Taek Hwang (Korea Institute of Radiological and Medical Sciences, Korea), Gun-Sik Park (Seoul National University, Korea)

Generally, as the operating frequency of the electromagnetic wave increases, the maximum output becomes smaller and the wavelength of the wave becomes smaller, so that the size of the circuit cannot but be reduced. Particularly, fabrication of a circuit with a high-power terahertz (THz) wave frequency band of kW or more is limited due to the problem of circuit size on the order of μm to mm. In order to overcome these limitations, this paper proposes a source design technique of 0.1THz-0.3GW levels with a cylindrical shape with a diameter of about 2.4cm. Modeling and computational simulation were performed to optimize the design of high power electromagnetic sources based on the Cherenkov radiation generation technology using the principle of plasma wake-field acceleration with ponderomotive force and artificial dielectrics. An effective design guideline has been proposed to facilitate the fabrication of large-power terahertz wave vacuum devices of large diameter that are less restricted in circuit size through objective verification.