Guest Editorial
The Nineteenth Special Issue on High-Power Microwave and Millimeter-Wave Generation

MODERN high-power microwave and millimeter-wave generation remains an active area of research and development across the globe. This is because of their broad range of applications in radar systems, particle accelerators, nuclear fusion, space-based communication systems, electromagnetic warfare, and most recently in microwave-assisted catalysis, extreme depth drilling, and virus decontamination. Advances in materials, cathodes, surface treatments, and novel interaction circuits design, along with new theory, improved modeling capability, and emerging manufacturing techniques push this technology toward new levels of peak and average microwave power, high-frequency capability and waveform agility, power handling capability, and efficiency.

The publication of this nineteenth Special Issue on High-Power Microwave and Millimeter-Wave Generation continues the important heritage of the past Special Issues on High-Power Microwave dating back to 1985, with millimeter waves explicitly included in the issue title since the eighteenth Special Issue, in response to growing interest in higher frequency regimes. The present Special Issue consists of works in five general topics areas, including high-power electromagnetic source technology, microwave component design, electromagnetic coupling and its effects, metamaterials, and frequency agility.

The current volume begins with an article by Tripathi et al. [A1] on a new configuration of the reltron oscillator for long-pulse and high-power RF generation. Next is an article by Zhang et al. [A2] presenting the design and high-power experimental characterization of a wideband, high-power-capable, electronically reconfigurable phase shifter for high-power phased-array applications. In the article by Wu [A3], a Klystron-like Relativistic Backward Wave Oscillator is studied. Then, an article by Meng et al. [A4] numerically investigates the cavity IEMP (internal electromagnetic pulse) responses in a cylinder illuminated by transient X-rays by coupling the Monte-Carlo method and a proposed 3-D electromagnetic particle-in-cell (PIC) method. Qin et al. [A5] present PIC simulations of relativistic magnetron with axial symmetrical split output. Next, Mao et al. [A6] numerically and experimentally investigate the impact of high-power microwave pulses on three types of typical commercial unmanned aerial vehicles (UAVs). Their experimental results prove that the L-band narrowband high-power microwave has strong backdoor coupling effects on UAVs. The damage mechanism of UAVs by the HPM is studied by simulation. Then, Dubinov et al. [A7] perform a comparative traveling wave tube (TWT) PIC simulation based on a corrugated electrodynamic retarding structure with and without a magnetic mirror and find that there is a significant benefit of a magnetic mirror for the performance of TWT. Following is an article by Yang et al. [A8] exploring the method of reducing the guiding magnetic field of high band O-type high-power microwave generators for their development toward lightweight and miniaturization. Revolinsky et al. [A9] report the design, simulation, and experimental demonstration of a dual-frequency, harmonic, magnetically insulated line oscillator (HMILO), which is composed of two sequential slow-wave structures tuned for oscillation at different frequencies, each paired with a set of choke cavities and insulated by the self-generated magnetic field of the common cathode. The Special Issue concludes with an article by Liu et al. [A10] demonstrating frequency agility in the 24-cavity relativistic magnetron with diffraction output using rectangular void ring metamaterial.

This volume illustrates continuous improvement and new concepts in high-power electromagnetic source technology and emphasizes the emerging trends toward frequency capability and agility. The editors would like to express their appreciation to all the contributors to this Special Issue, and also to individuals who invested considerable time and effort in reviewing the manuscripts. The Guest Editors would also like to thank Dr. John Leopold and Dr. Steve Gitomer for their guidance and support throughout this process, and of course, the IEEE Editorial staff. Without the work of people such as Alexandra Johnson, this Special Issue would not be possible.

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APPENDIX: RELATED ARTICLES

[A1] P. Tripathi, A. Kumar, S. Dwivedi, and P. K. Jain, "Reltron oscillator for long pulse and high-power RF generation," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1841–1848, Jul. 2023.

[A2] Z. Zhang, M. Gao, M. M. Honari, J. Wu, J. H. Booske, and N. Behdad, "A wideband, 1-bit, electronically reconfigurable phase shifter for high-power microwave phased-array applications," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1849–1861, Jul. 2023.

[A3] Y. Wu, "An efficient klystron-like relativistic backward wave oscillator with a five-period slow-wave structure and a TM_{02} mode extractor," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1862–1868, Jul. 2023.

[A4] X. Meng, G. Li, L. Zhang, Z. Zhao, and J. Liu, "Parametric study of cavity IEMP responses in a cylinder by coupling Monte Carlo method and 3-D electromagnetic particle-in-cell method," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1869–1879, Jul. 2023.

[A5] Y. Qin et al., "Particle-in-cell simulations of relativistic magnetron with axial symmetrical split output," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1880–1884, Jul. 2023.

[A6] Q. Mao et al., "High-power microwave pulse-induced failure on unmanned aerial vehicle system," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1885–1893, Jul. 2023.

[A7] A. E. Dubinov, H. N. Kolesov, and V. P. Tarakanov, "The benefits of a magnetic mirror in a traveling wave tube: Computational experiments' results," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1894–1899, Jul. 2023.

[A8] C. Yang, H. Wang, J. Meng, and B. Deng, "The method of reducing the guiding magnetic field of high-band O-type high-power microwave generator," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1900–1904, Jul. 2023.

[A9] R. A. Revolinsky et al., "Dual-frequency, harmonic, magnetically insulated line oscillator," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1905–1916, Jul. 2023.

[A10] M. Liu et al., "Frequency agility in the 24-cavity relativistic magnetron with diffraction output using rectangular void ring metamaterial," *IEEE Trans. Plasma Sci.*, vol. 51, no. 7, pp. 1917–1922, Jul. 2023.