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Can Plasma Microwave Devices Revitalize and Broaden the Scientific and Technological Base of Microwave Sources?*

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The birth of plasma microwave electronics dates back to 1949 when several authors¹ discussed the excitation of electromagnetic waves in a plasma through the beam-plasma instability. Numerous attempts to use this interaction for the generation and amplification of electromagnetic waves have been only marginally successful, partly because a plasma is a very complicated medium for the propagation of electromagnetic wave, especially when immersed in a magnetic field. One serious problem was associated with coupling of the electromagnetic waves into and out of the plasma. Since plasma waves are characterized by slow phase velocities (quasi-electrostatic), they are mostly trapped within the plasma. Over the years, these difficulties generated considerable skepticism regarding the usefulness of plasma microwave devices.

Plasma microwave electronics has enjoyed renewed interest and considerable success in the last few years. We shall review new results, both in the US and abroad, demonstrating that the presence of a low density background plasma in microwave tubes actually lead to (a) enhanced interaction efficiency, (b) a great reduction or complete elimination of the guiding magnetic field amplitude, (c) high gain, extremely wide band bandwidth amplification, (d) CW operation, and (e) a high degree of spectral purity. Some of these new devices are unique in the sense that their operation is based on hybrid plasma-resonator structures and have no analogue in the field of vacuum microwave devices.

We plan to discuss future trends, difficulties, and topics open for further investigation.

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¹A. I. Akhiezer and Ya. B. Fainberg, Dokl. Akad. SSSR **65**, 55 (1948); D. Bohm and E. Gross, Phys. Rev. **75**, 595 (1949).