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Inter-Digital Magnetron and Rippled-Field Magnetron: Two Remarkable Reincarnations of a Voltage-Tunable Magnetron*

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Originally all magnetrons were nonrelativistic [1]. The inter-digital magnetron (IDM) [2] is, perhaps, the most peculiar magnetron variant, operating at anode voltages $\leq$ 5 kV. The rippled-field magnetron (RFM) [3], another variant, is relativistic, operating at voltages $\geq$ 1 MV. It came to our attention that the RFM [3] is the relativistic analog of the IDM [2].

The IDM consists of a cathode and two sets of interleaving anode fingers (teeth, vanes) joined alternately to opposite faces of a cylindrical cavity. When voltage is applied to the cathode, the electrons initially circle in crossed radial electric E_r and axial magnetic B_z fields, and are intercepted by the inter-digital anode. The resulting interleaving anode current flowing along each anode finger in opposite axial directions produces a B_r varying in the θ-direction, superimposed onto B_z.

One may replace both cathode and anode interleaving fingers of the IDM [2] with a corresponding set of interleaving anode and cathode permanent magnets, also oriented alternately in the z-direction in such a manner that results in B_r varying in the θ-direction, and superimposed onto B_z. Assuming that the set of interleaving cathode permanent magnets may be covered by an electron emitting smooth surface and, correspondently, the set of interleaving anode permanent magnets may be covered by the electron absorbing smooth surface with both covers facing the magnetron interaction space, one may effectively have a RFM [3].

Theoretical analyses and particle-in-cell simulations of both the IDM and RFM will be presented, which should provide for wide frequency tuning by varying the voltage.

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2. J.F. Hull and A.W. Randals, "High-Power Interdigital Magnetrons," Proc. IRE, vol. 36, 1357 (1948).
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