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2P10 - Simulation of an Industrial Magnetron Using Cathode Modulation

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Magnetrons can be phase-locked using external systems. Previous 2-D PIC simulations of a rising sun magnetron[1] have shown that phase-locking is possible using modulated electron injection to control the spoke formation. An experimental setup using Gated Field Emission Arrays (GFEAs) for the modulated electron injection offers a potential solution to this problem by permitting the injection of electrons into the interaction space. Current work focusses on extending previous simulation results into 3-D. A commercially available industrial cooker magnetron (the L3 CWM-75kW) has been successfully simulated by using the 3-D PIC code VSim under the magnetron's typical operating conditions (18kV, 5A, 1900G, 896-929MHz). The simulation generated results that are consistent with known experimental results in terms of power and frequency. Cavity oscillation starts within 100ns using 20ns of RF priming at half of the typical power. Preliminary results have shown that modulated electron injection has a significant effect on the working mechanisms of the magnetron in terms of spoke formation and start-up time, acting as a form of "cathode priming."It has been experimentally shown by L3 technologies that this magnetron is capable of operating at ˜9kV, 150 mA, and 900G. Future work will focus on the simulation of the magnetron under the aforementioned low-voltage-low-current conditions as well as further exploration of the effect of modulated electron injection on start-up and phase.
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1. S. Fernandez-Gutierrez, J. Browning, M. Lin, D. N. Smith, and J. Watrous. "Phase-Control of a Rising Sun Magnetron Using a Modulated, Addressable, Current Source."Journal of Vacuum Science Technology, vol. B 33, pp. 031203. 2015.

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