Contribution ID: **227** Type: **Oral Presentation**

CST PARTICLE-IN-CELL MODELING OF A TUNABLE REFLEX-TRIODE VIRCATOR

Tuesday 5 June 2018 16:45 (15 minutes)

This study serves to describe three-dimensional particle-in-cell (PIC) simulations of a tunable reflex-triode virtual cathode oscillator (vircator). Experimental data from the compact hard-tube reflex-triode vircator developed at Texas Tech University (TTU) is used to validate simulated results. The vircator developed at TTU is capable of burst-mode operation at pulse repetition rates (PRFs) up to 100 Hz for a period of one second. The vircator is driven by a pulse energy of 158 J, and 600 kV (open circuit) pulse forming network (PFN) based Marx generator1. The vircator is comprised of a bimodal, carbon fiber cathode and pyrolytic graphite anode, with the ability to quickly change the distance between the anode-cathode (A-K) gap, backwall distance, and bottom plate distance between experiments. The PIC simulations have been performed using CST PIC Solver, by Dassault Systemes. The models detail virtual cathode formation and the subsequent extraction of radiated microwave power for a variety of cavity geometries. A working three-dimensional, relativistic, electromagnetic, particle-in-cell model of a vircator allows for quick, predictive results relative to building an experimental setup. The model is used to determine the necessary driving voltages, A-K gap distances, and cathode current densities to extract microwave radiation at a desired. Simulated results aid in identifying mode contributions. Voltage, current, and microwave data are presented and compared against experimental results at different operating conditions.

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Session Classification: Oral 8 - HPM, Analytical & Simulations

Track Classification: Analytical Methods, Modeling, and Simulation