High power microwave tube verification and design using the ICEPIC 3D parallel, electromagnetic PIC code.

P. J. Mardahl[1], K. L. Cartwright[1], A. D. Greenwood[1], T. Murphy[1],
M. D. Haworth[1], M. Lopez [2]

[1] *Air Force Research Laboratory*
Directed Energy Directorate
Kirtland AFB, NM 87108
[2]*University of Michigan, Ann Arbor*

At high power levels, relativistic effects and device nonlinearities mean that analytic techniques often do not provide sufficient insight into device behavior to produce a workable design. Because of this, we are turning increasingly to the use of computer models to predict device behavior before building an experiment. These models provide also illumination into results obtained from current experiments, reducing the number of experimental revisions needed as well as quickly eliminating failed designs.

We are currently using ICEPIC (Improved Concurrent Electromagnetic Particle In Cell), a 3D parallel code developed at the Air Force Research Laboratory (AFRL), for the verification and design of relativistic magnetrons and verification of designs of high power gyrotron devices.

We will present an overview of ICEPIC's design and features, including its first-principles EM-PIC algorithm, parallel operation, dynamic load balancing, numerical filtering methods, and physics models such as wave absorbing and emitting boundary conditions, field emission, and collisions with various types of background gas.

We will also show application of ICEPIC to two experiments. First, we will show a comparison of ICEPIC simulations to the University of Michigan's MELBA-C high power magnetron experiment: output power and pulse length show good agreement. Next, we will show a comparison of ICEPIC simulations of the interaction region of a 95GHz gyrotron to an experiment: operating mode and frequency agree well.

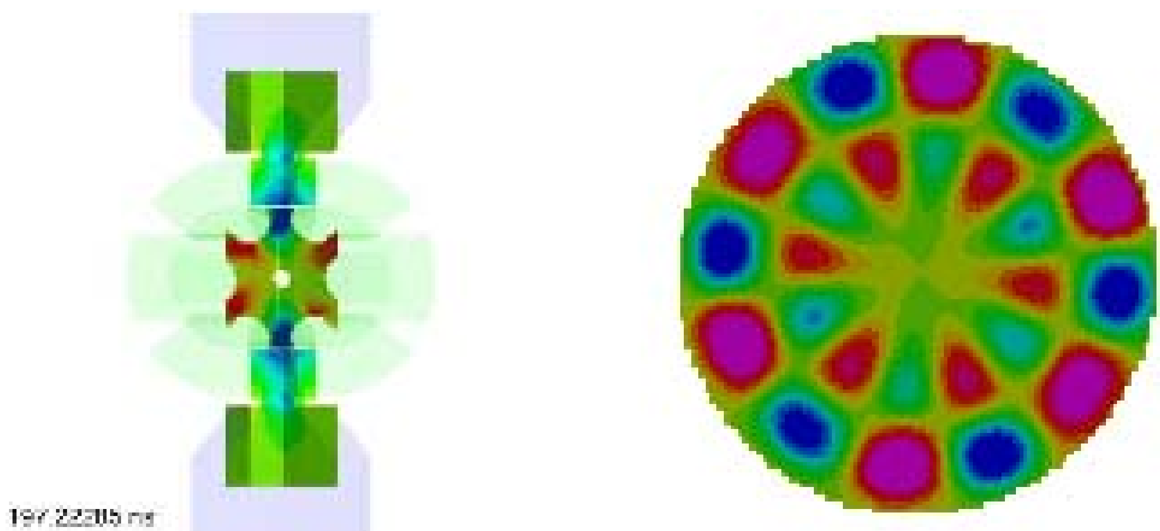

Figure 1: Shown at the right is azimuthal electric field from a simulated TE_{621} mode in a 95GHz gyrotron. At the left is azimuthal electric field in a simulation of Michigan's MELBA-C magnetron experiment.}