Poster 1

April 29 (Monday) / 15:10 ~ 16:30 / Capri room

Modeling

P1-1.1 / Temporal study of dual frequency single surface multipactor by multiparticle Monte Carlo simulations

Asif Iqbal (Michigan State University, USA), John Verboncoeur (Michigan State University, USA), Patrick Wong (Michigan State University, USA), Peng Zhang (Michigan State University, USA)

This work investigates the temporal physics of multipactor discharge on a single dielectric surface by one-dimensional multiparticle Monte Carlo (MC) simulator with adaptive time steps. The study shows that the presence of a second carrier frequency of the rf electric field changes the saturation level and temporal oscillation pattern of the normal surface field. It is found that the instantaneous normal surface field and the multipactor electron population remains at a lower value for a longer duration within an rf period for dual frequency operation than for single frequency operation.

P1-1.2 / 3-D EM PIC simulation study on low-frequency oscillation in a fusion gyrotron

Ming-Chieh Lin (Hanyang University, Korea), David N. Smithe (Tech-X Corporation, USA)

In a previous study, it was found that not only magnetic compression profile but initial thermal velocities of electrons play an important role in causing a low frequency oscillation (LFO) in the operation of a magnetron injection gun (MIG) employed in an MIT fusion gyrotron. An unphysical particle boundary condition, i.e., large initial thermal velocities of electrons, had to be assumed to produce the LFO in the 3-D electromagnetic (EM) particle-in-cell (PIC) simulation. In this work, we have included the gyrotron cavity along with the MIG as well as a large vacuum envelope representing the vacuum chamber similar to that employed in the MIT experiments. In the EM PIC simulation, it is found that the momentum of electrons is suppressed by the space charge due to the vacuum envelope. For the first time, without unphysical approximations, the LFO could be reproduced in the 3D time domain EM PIC simulations. The initial velocity spread at the cathode temperature is assumed in this simulation in contrast to an unphysical larger velocity spread formerly used.

P1-1.3 / Analysis of High Frequency Characteristics of Sheet Beam Rectangular Waveguide Grating Operating in High-Order Mode

Xiaofei Li (University of Chinese Academy of Science / Chinese Academy of Science, China), Qianzhong Xue (University of Chinese Academy of Science / Chinese Academy of Science, China), Ding Zhao (Chinese Academy of Science, China)

For the rectangular waveguide grating slowwave structure, the dispersion relation was obtained by the eigen-function method. The coupling impedance and the Ohmic loss were derived from the relevant equations. Two theoretical models were studied by comparing their calculation results of the HF characteristics of the rectangular waveguide grating slow wave structure with those obtained by HFSS code and CST-MWS. The HF characteristics of the largersize SWS operating in the high order mode and the SWS operating in the fundamental mode were compared, and the results presented in this paper demonstrate the possibility of using the highorder mode in devices.

P1-1.4 / An Emission Model Considering the Thermal Velocity of Electrons Under the Constraint of Spherical Surface

Xiaobing Wang (University of Electronic Science and Technology of China, China), Quan Hu (University of Electronic Science and Technology of China, China), Yulu Hu (University of Electronic Science and Technology of China, China), Xiaofang Zhu (University of Electronic Science and Technology of China, China), Bin Li (University of Electronic Science and Technology of China, China)

In order to calculate the thermal velocity effects of electrons in TWT, this paper proposes a model that considers the spherical cathode to constrain the discrete macro electron trajectories calculated by the Lambert's law mentioned in MICHELLE[1]. The model uses the optics principle to correct the emission direction of the discrete trajectories of electrons. This paper will introduce the emission model and discuss some of its limitations.

P1-1.5 / Mechanics Simulator: An Advanced 3D FE Vibration Simulation Tool for Microwave Tubes

Junhui Yin (University of Electronic Science and Technology of China, China), Li Xu (University of Electronic Science and Technology of China, China), Zhonghai Yang (University of Electronic Science and Technology of China, China), Bin Li (University of Electronic Science and Technology of China, China)

The structures of microwave tube are very fine and complex. Small mechanical perturbations of structures can possibly lead to electrical failure of the microwave tube and even cause the structures of the microwave tube destroyed. Designers need to study the reliability and stability of microwave tube and understand their instabilities in current designs and predict material failure for future designs under all operatinzg environment conditions. In this paper, a three-dimensional mechanical vibration analysis numerical simulation software MCS, which consists of design environment, free vibration analysis simulator and random vibration analysis simulator, is developed based on finite element method and CAD/CAE integrated system. The developed software has been applied to traveling wave tubes design and been found to shorten the design cycle significantly compared with commercial software ANSYS.

P1-1.6 / A Three-Dimensional Model of Beam-Wave Interaction in a Coupled-Cavity TWT

Xinhe Wang (Chinese Academy of Science, China), Yu Fan (Chinese Academy of Science, China), Gang Wang (Chinese Academy of Science, China), Jirun Luo (Chinese Academy of Science, China), Min Zhu (Chinese Academy of Science, China), Wei Guo (Chinese Academy of Science, China)

A frequency-domain 3-D model of the beam-wave interaction in coupled-cavity traveling-wave tubes(CC-TWTs) is presented. The model provides self-consistent solutions of Maxwells equations with electron equations of motion. Some nonlinear effects in the interaction process could be revealed.

P1-1.7 / Research on Acceleration of a Electron Gun Simulation Module

Hang Du (Southeast University, China), Hehong Fan (Southeast University, China), Yanxiao Guo (Southeast University, China), Xiaohan Sun (Southeast University, China)

Simulation speed is a key performance for simulation software to be used practically, especially for used in optimizations and high-precision simulations. To accelerate simulation speed of our former electron gun simulation software module, EGunNoiseSim, a time domain simulation software module programmed based on MATLAB, we tried two methods to accelerate it. First the existing MATLAB-based program is translated into a C language program; then a parallel computing processing scheme based on CUDA is used to further improve its simulation efficiency. Simulation results show that the speed of the new simulation program based on C can be 2 times faster than the original program; and by using parallel computing technique, the simulation speed can be improved further to 4 to 14 times faster. To demonstrate the function of the simulation module, evolution of the particle distribution were shown, which proved the feasibility of the adaptation work.