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Fowler-Nordheim, Field Emission and Field Enhancement

Nearly 90 years after the theoretical formulation of the field emission equation by Fowler and Nordheim, field emission and the associated physics continues to play an important role in current research and technology areas. Field emission cathodes find applications ranging from field emission displays, x-ray machines, communication electronics, radars and electronic warfare systems, to particle accelerators. The “workhorse” equation to describe these cathodes consists of the Fowler-Nordheim equation, which is applied and misapplied by researchers in a variety of research disciplines. Although this fact is a testament to the robustness of the theory, making further improvements to cathodes requires understanding the details of the equation and where it fails. In this talk, we explore two basic cathode physics issues. First, we examine the field enhancement factor through a study of an array of two and four fiber field emitters in a carefully controlled geometry that reduces the influence of two of the three variables in the Fowler-Nordheim equation. Then, we look at the application of agent based modeling, a technique with wide application in the social sciences, to modeling field emitter arrays.

About the Speaker: Don Shiffler received the BS in Physics (1986) from North Carolina State University, and MS (1988) and PhD (1990) in Applied Physics from Cornell University. In graduate school he researched the physics of high power traveling wave tube amplifiers operating in the X-band. He served a post-doctoral appointment from 1990 to 1992 at Duke University in the area of infrared free electron lasers. Dr. Shiffler then became of member of the Electrical and Computer Engineering Faculty at the University of New Mexico, pursuing research in novel high current cathodes. In 1995 Dr. Shiffler moved to the Air Force Research Laboratory where he began work in the areas of L-band high power microwave sources, high power microwave induced breakdown, and field emission physics. He currently works in the areas of high current field emission cathodes, in particular studying the effects of shielding and field enhancement in situations ranging from DC emission to laser induced electron emission.