UNC CHARLOTTE

Department of Electrical and Computer Engineering Seminar

Discrete Electron Capacitance

Date and Time: Friday, February 20 at 3:30 PM
Place: CHHS 155
Speaker: Dr. Ray Tsu

Abstract: The textbook description of capacitance is in fact quite wrong in the regime where: (1) continuous charge density cannot represent individual electrons with Coulomb repulsion, (2) the interaction between electrons involves induced polarizations at the dielectric interfaces. We, T. LaFave, J. Zhu and I have computed the capacitance of a dielectric sphere including all the interactions between electrons as well as the induced polarizations and self-polarizations. The most important discovery is the role of symmetry change each time an additional electron is added into the system. For example, a single electron at the origin gives the same classical result and obeys Gauss law. However, two electrons push each other towards the boundary. If the dielectric constant of the sphere $\varepsilon > \varepsilon_0$, the induced charges at the boundary is of the same sign, therefore repulsive, pushing the electron inward. This is really the mechanism known as dielectric confinement. For three electrons, the minimum total interaction energy of the system results in three electrons arranged in an isosceles triangle, and for four electrons, a tetrahedron, etc. What is importantly different is the fact that each additional electron defines a change of symmetry, thus mono -phasic. The system leads to the essential feature of the periodic table of the elements. Needless to say that Gauss law does not apply because Gauss law is another manifestation of the Coulomb's inverse square law. Needless to say, the DEC applies to Nanometer regime as well as conventional devices.

Biography: Professor Ray Tsu, a Distinguished Professor of ECE Department of UNCC, is the one who introduced the *Man-made Superlattice and Resonant Tunneling in Quantum Wells* with Professor L. Esaki.