ECE Distinguished Seminar Series

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Transistors: The Ultimate MOSFET and Beyond

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After forty years of advances in integrated circuit technology, microelectronics is undergoing a transformation to nanoelectronics. Modern day MOSFETs now have channel lengths less than 50 nm long, and billion transistor logic chips have arrived. Moore's Law continues, but the end of MOSFET scaling is in sight. Many researchers are exploring new materials and devices that might extend CMOS scaling, complement ultimate CMOS, or enable entirely new applications. My objective in this talk is to describe a new approach to the analysis of nanotransistors and then to use this approach to examine the ultimate silicon MOSFET, the carbon nanotube MOSFET, and the possibility of molecular transistors.

This talk will begin with a quick review of the standard electrical engineering view of the MOSFET. I'll then describe a very general and very simple way to understand nanoscale transistors and mention how it is generalized to the non-equilibrium Green's function approach to quantum transport at an atomistic scale. Using these approaches, we'll examine the device physics of 10nm-scale silicon MOSFETs and what new channel materials, such as III-V semiconductors might provide. I'll then use the same, general approach to briefly examine one-dimensional transistors made from carbon nanotubes, and finally will take a brief look at molecular transistors. I hope to convey some understanding of the physics of nanoscale MOSFETs and to introduce a new way of thinking about small electronic devices.

MARK LUNDSTROM is the Don and Carol Scifres Distinguished Professor of Electrical and Computer Engineering at Purdue University where his teaching and research center on the physics, technology, and simulation of electronic devices. Lundstrom is the founding director of the NSF-funded Network for Computational Nanotechnology, which has a mission of research, education, leadership, and service to the nation's National Nanotechnology Initiative. He serves on the leadership councils of the NASA-funded Institute for Nanoelectronics and Computing and the MARCO Focus Center for Materials, Structures, and Devices. Lundstrom's work has been recognized by several awards, most recently, in 2005, from the Semiconductor Industry Association in recognition of his career contributions to the semiconductor industry.

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