ECE 793A/794 ECE GRADUATE SEMINAR
(Required for Electrophysics Area Graduate Students)

Everyone is invited to attend.

Joerg Appenzeller
IBM T.J. Watson Research Center, Yorktown, NY

Title: Logic devices and circuits on carbon nanotubes

Date: Thursday, September 21, 2006
Time: 2:30 p.m.
Place: Marston 132

Abstract:
Over the last years carbon nanotubes (CNs) have attracted an increasing interest as building blocks for nano-electronics applications. Due to their unique properties enabling e.g. ballistic transport at room-temperature over several hundred nanometers, high performance CN field-effect transistors (FETs) have become feasible. The successful improvement of CNFET performance however is not merely a result of the application of established concepts. It is indeed a consequence of the detailed study of the material specific properties that have guided the research on CN-based transistor applications. An example of this is the critical observation that CNFETs in fact behave as Schottky barrier devices. It was found that switching in nanometer size semiconductors, such as carbon nanotubes, contacted with source/drain metal electrodes is determined entirely by the metal/semiconductor interfaces and their field-dependence. Making use of this particular type of nanotube property, we have been able to relate the performance of nanotube devices with their diameters and recently successfully fabricated the first band-to-band tunneling CNFET. This device shows a much more abrupt switching behavior than can be obtained with any conventional transistor approach, evidence that nano-materials can be used to create drastically different and more efficient switches in principal. Our latest accomplishment is to combine carbon nanotube transistors in a CMOS-type 5-stage ring oscillator, an important demonstration that elevates nanotube applications from the devices level to the circuit level and allows for the more detailed study of their high frequency properties.

Bio:
J. Appenzeller received the M.S. and Ph.D. degrees in physics from the Technical University of Aachen, Germany in 1991 and 1995. His Ph.D. dissertation investigated quantum transport phenomena in low dimensional systems based on III/V heterostructures. He worked for one year as a Research Scientist in the Research Center in Juelich, Germany before he became an Assistant Professor with the Technical University of Aachen in 1996. During his professorship he explored mesoscopic electron transport in different materials including carbon nanotubes and superconductor/semiconductor-hybride devices. From 1998 to 1999, he was with the Massachusetts Institute of Technology, Cambridge, as a Visiting Scientists, exploring the ultimate scaling limits of silicon MOSFET devices. Since 2001, he has been with the IBM T.J. Watson Research Center, Yorktown, NY, as a Research Staff Member mainly involved in the investigation of the potential of carbon nanotubes for a future nanoelectronics.