

Department of Physics & NUS Nanoscience & Nanotechnology Initiative (NUSNNI) Joint Seminar

Carbon nanotubes and
semiconductor nanowires.

By Professor Poul Erik Lindelof

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Abstract:

1-dimensional electronic transport in a single wall carbon nanotube grown by chemical vapour deposition (CVD) can have mean free path of several μm at low temperatures. For submicron distance between electrical contacts they exhibit pronounced quantum effects, the nature of which depend on the contact material (metallic, superconducting, magnetic) and the contact resistance relative to $h/4e^2$. Another 1-dimensional electronic system that will be discussed is semiconducting nanowires with diameters in the range 20-50 nm and lengths of several μm , which we grow by molecular beam epitaxy (MBE). Contrary to the nanotubes this is not a molecular system, but the nanowires can be very perfect with precise hexagonal cross sections and long mean free paths (about a μm) at low temperatures. The nanowire growth allows heterostructure interfaces independent of lattice matching conditions. I shall review the structural and electrical properties of both type of 1-dimensional systems and in particular describe the transport properties in the quantum dot regime, the Kondo co-tunneling regime and the almost adiabatic (the so-called Fabry-Perot) regime. The combination of such regimes with superconducting and magnetic contacts yields a particularly rich realm of nanophysics. One particular fascinating application of such devices is in quantum information technology, where quantum dots are potential quantum information units (QUBITs) and can be exploited for single photon sources. As an example I shall describe a double quantum dot QUBIT formed by local gates along a single wall carbon nanotube

About Speaker

Professor Poul Erik Lindelof is a MSc and PhD (1969) from the Technical University, Lyngby. Sergeant in the Danish military (the air force) 1965-67 (2 years). Doctor of Science (dr.scient.) from University of Copenhagen 1981. Reader and later professor at the Niels Bohr Institute, University of Copenhagen. Vice-chairman for the Nano-Science Center (2002). Director (and founder) of the company Hytronics ApS (2005).

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