

CEA - Saclay 91191 Gif-sur-yvette Cedex
Service de Physique de l'Etat Condensé
SÉMINAIRE

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Orme des Merisiers SPEC Salle Itzykson, Bât.774

Electronic transport in one-dimensional mesoscopic systems

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One-dimensional electron systems have been predicted to be fundamentally different from those in higher dimensions, particularly with respect to the way in which interactions are screened. While theoretical work on these systems dates back to the 1950s, it has only been since 1990 that the fabrication and investigation of truly one-dimensional systems on the nanometer scale have been made possible by advances in chemistry and molecular beam epitaxy. During my Ph.D. in the group of David Goldhaber-Gordon, I performed transport measurements on three systems - carbon nanotubes, carbon nanotube peapods and 'cleaved edge overgrowth' GaAs hole wires - each of which enables the investigation of a different aspect of one-dimensional physics. For this presentation I shall give a brief introduction to one- and zero-dimensional physics and then — due to time constraints — discuss primarily the peapod measurements in three parts: (1) We found, rather unexpectedly, that the periodically intercalated C60 molecules do not significantly modify the nanotube's electronic structure near the Fermi level. (2) We were able to carefully study in these devices the evolution of the spin-1/2 Kondo effect in a magnetic field, on which there has been some theoretical controversy. We find that existing theories agree with the experimental data qualitatively but not in their details. (3) We observed an underscreened spin-1 Kondo effect. Performing the first tuning of the transition between singlet and triplet ground states independently with a gate voltage and magnetic field, we find that for the most part our data are explained by a simple model; however, some puzzles remain.

I shall also briefly touch upon the measurements of carbon nanotubes and CEO quantum wires. (Further details for these may be provided in a future Quantronics Group seminar.)