

PHYSICS DEPARTMENT COLLOQUIUM

" NMR in Flatland, and With Too Few Spins"

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Since its development in the 50's, nuclear magnetic resonance (NMR) has emerged as a powerful technique to probe the local field distribution in liquid and solid matter as well as providing important information on spin and vortex dynamics. Although much progress has been achieved in NMR spectroscopy, particularly in chemistry and biology, conventional NMR remains limited to systems with a relatively large number of nuclear spins, $> \sim 10^{17}$. In contrast, low-dimensional nanostructured systems have far fewer nuclear spins; for example, a typical single quantum well has $\sim 10^{15}$ spins, a quantum dot $\sim 10^8$, and a carbon nanotube $\sim 10^3$. However, an appealing alternative to the conventional NMR exist, the so-called resistive NMR (RDNMR), and allows us to study "en finesse" quantum wells and possibly other nanoscaled systems. In this talk, I will first review the transport properties of the two-dimensional electron gas (2DEG) confined inside ultra-high quality quantum wells. New results suggesting the occurrence of an insulator-insulator quantum phase transition will be presented, together with RDNMR spectra showing a possible transition to a Skyrme crystal (i.e. lattice of spin topological defects). Last, I will propose a set of RDNMR experiments aimed at elucidating some of the most remarkable properties of the 2DEG, i.e. chiral superconducting states and non-abelian quantum statistics, together with probing other systems such as carbon nanotubes from the nucleus point-of-view.

It's just NMR, but with too few spins....

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