Department of Physics
Condensed Matter Physics
Clarendon Laboratory, Parks Road, Oxford OX1 3PU

UNIVERSITY OF OXFORD

CONDENSED MATTER SEMINAR

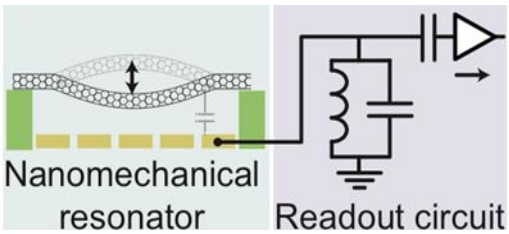
Thursday 15 February at 2.15pm

"Sensitive radio-frequency readout of quantum devices"

Dr Natalia Ares
Department of Materials, Oxford University

Measuring the quantum state of a device requires sensitive, fast, and non-invasive readout. In the first part of this talk, I will focus on radio-frequency readout of one of the most promising qubits in the solid-state. High-fidelity single-shot readout of spin qubits is hindered by poor impedance matching to the device. I will show controllable perfect matching with a high device impedance: a gate-defined GaAs quantum dot [1]. The achieved sensitivity is sufficient for single-shot readout of a singlet-triplet qubit without additional charge sensing devices, a key advance in device scalability.

In the second part of the talk, I will focus on radio-frequency measurements of displacement approaching the level of uncertainty necessitated by the Heisenberg uncertainty principle and near the phonon ground state. Nanotubes are ideal for exploring the boundary between classical and quantum motion, combining low mass (large zero-point motion), high stiffness (large mode spacing), and high quality factor (long coherence times). I will show sensitive optomechanical probing of the vibrations of a suspended carbon nanotube at milliKelvin temperatures [2]. By tuning the carbon nanotube into resonance with the radio-frequency signal, the mechanical signal is transduced efficiently to an electrical signal. Combining electrical and mechanical degrees of freedom, this optomechanical setup might also enable a key capability for experiments on quantum thermodynamics: direct measurements of work exchange in the quantum regime.



References

[1] N. Ares et al., Phys. Rev. Applied 5, 34011 (2016)
[2] N. Ares et al., Phys. Rev. Lett. 117, 170801 (2016)

Host: Prof Paolo Radaelli

Audrey Wood Seminar Room, Clarendon Laboratory