MacDiarmid Access Grid Seminar

Thursday 6 August 12.15pm

Michele Governale,
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Spin and charge pumping through interacting quantum dots

Pumping is a transport mechanism which induces dc charge and spin currents in a nano-scale conductor in the absence of a bias voltage by means of a time-dependent control of some system parameters. Theoretically, its interest lies in the possibility to investigate non-equilibrium phenomena induced by the explicit time-dependence of a nanoscale quantum system. For systems where the electron-electron interaction can be neglected, there is a well established formalism, based on the scattering approach to mesocopic transport, to compute the pumped current. The situation is more complicated when the interaction between the electrons becomes important, since the scattering approach cannot be employed any longer. As a paradigmatic system to investigate pumping in the presence of electron-electron interaction we consider a spin-degenerate single-level quantum dot with Coulomb repulsion, tunnel-coupled to non-magnetic and ferromagnetic leads. We analyze the pumped charge and the pumped spin both in the adiabatic limit and for finite pumping frequencies up to the tunneling rates. As a striking signature of non-adiabaticity, we find frequency-dependent phase shifts in the charge and spin currents, which open up the possibility to control charge and spin currents by tuning the pumping frequency.

and

Justin Hodgkiss
School of Chemical and Physical Sciences, Victoria University of Wellington

Time-resolved photocurrent generation in organic solar cells

Printable organic solar cells offer the potential to realize the goal of competitively priced solar energy. However, they are currently restricted in their application owing to poor efficiency, but the mechanistic nature of the loss mechanisms remain controversial. We have developed transient absorption techniques to spectroscopically resolve each step of organic solar cell operation spanning over nine decades in time resolution – from light absorption to charge collection or recombination. For a range of polymer:polymer and polymer:fullerene devices, interfacial charge transfer is resolved across heterojunctions on a picosecond timescale and related to nanometer scale phase separation. Photocurrent generation is determined to proceed via the electric field-assisted dissociation of bound interfacial electron-hole pairs. Overall, we find that the efficiency of interfacial charge pair dissociation is the key determinant of device efficiency. This work draws from a range of materials and blend morphologies to generalize strategies for improved charge separation and help inform the route to cost-effective photovoltaic power generation.

Venues

Victoria University of Wellington, Room RB 106
University of Canterbury, Level 1 Psychology Building
University of Otago, Teaching Facilities, Information Services Building
University of Auckland, 23 Symonds St, Rm 411, Chemistry Building 301

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