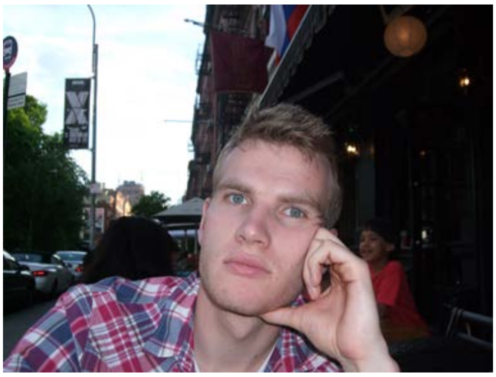
School of Physics and Astronomy

COLLOQUIUM



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Quantum stochastic thermodynamics

The framework of classical stochastic thermodynamics can be regarded as our most advanced thermodynamic theory today. For small, strongly fluctuating systems far from equilibrium it even equips a single trajectory observed in an experiment with consistent notions of internal energy, heat, work, and entropy. Moreover, powerful exact symmetry relations, known as "fluctuation theorems", have been discovered that severely constrain the fluctuations in dissipation and entropy production. Many of its theoretical predictions have been also experimentally verified in diverse platforms such as molecular motors, colloidal particles, single molecule pulling experiments, or quantum dots in the sequential tunnelling regime. Yet, a satisfactory extension to the quantum regime has so far turned out to be an elusive endeavour because the meaning of a "stochastic trajectory" is a priori not clear in quantum mechanics.

In this talk, I start by reviewing some essential elements and remarkable results of classical stochastic thermodynamics. Afterwards, I analyse previous attempts to generalize the theory to the quantum regime. Arguments are presented that show that those attempts are "semi-classical" because they describe a quantum system undergoing a classical stochastic process. At the end, I present my own approach, which I call "operational" quantum stochastic thermodynamics. It is built on a rigorous notion of a quantum stochastic process (or quantum causal model), where all external interventions are explicitly modelled. This allows for the first time to analyse Nobel-prize-winning experiments carried out in the group of Serge Haroche from a consistent thermodynamic perspective. Remarkably, the efficiency to prepare pure photon number states is remarkable high in these experiments.

Date:	Wednesday 4 March
Time:	2pm
Venue:	L1, Seminar Room 107 10 College Walk, Clayton