

Title:	<i>Stochastic Thermodynamics in Open Quantum Systems</i>
Lecturer:	G. Guarnieri
Duration:	30h
CFU:	4
Period:	April - June 2024
Content:	<p>Out-of-equilibrium processes are ubiquitous in Nature, ranging from bio-molecular motors in our cells to financial markets and quantum computers. First of all, they all entail a certain amount of irreversible entropy production, a phenomenon known as dissipation. Moreover, at the microscopic scale, all measurable quantities display significant fluctuations, that ideally must be minimised for reliable outcomes. Understanding universal properties of these fluctuations and their precise relationship with dissipation has been the overarching goal of the field of Stochastic Thermodynamics, which has now entered the realm of Quantum physics.</p> <p>The course will give an overview of this emerging and interdisciplinary field of research, starting from providing definitions of heat, work, entropy production and of the Laws of Thermodynamics in open quantum systems, and arriving to their stochastic characterisation along single quantum trajectories. This will lead to quantify their fluctuations and introduce milestone results such as (i) the fluctuation-dissipation theorem in linear response theory; (ii) the fluctuation relations and (iii) the Thermodynamic Uncertainty Relations.</p> <p>The main purpose of this course is to give a solid foundation for analysing the energetics of these systems using state-of-the-art notions and techniques that are at the forefront of research in this field, critically assessing their regimes of validity and limitations and highlighting open research directions.</p>
Notes	The evaluation will be based on the presentation of a topic treated during the course, or a small project developed with the tools learned during the course.