Whenever a small, fluctuating system is continuously, passively and perfectly observed, classical stochastic thermodynamics provides a successful theory to describe its thermodynamics far from equilibrium. The problem that not even classically it is well understood how to include, e.g., disturbing or incomplete measurements, has also hindered progress in formulating a quantum version of the theory.

Based on the recently developed process tensor, which describes a quantum stochastic process with arbitrary experimental interventions (a quantum causal model), I will define internal energy, heat, work and entropy along a single trajectory. These definitions fulfill a first law at the trajectory level and a second law on average. As a guiding example throughout the talk, I will use the photon number stabilization experiments performed in the group of Serge Haroche.
Position type: PhD position in Theoretical Condensed Matter Physics (FPI fellowship).
Topic: Nanoscale thermal transport.
Duration: 4 years.
Principal Investigator: Juan Carlos Cuevas (http://webs.ftmc.uam.es/juancarlos.cuevas/).
Requirements: Graduate in Physics that have completed a Master in Condensed Matter Physics or related areas.
When to apply: from 8 to 29 October (2018).
How to apply: via sede electrónica del Ministerio Ciencia, Innovación y Universidades: https://sede.micinn.gob.es/portal/site/eSede/
Approximate starting date: February 2019.
For more info: contact me at juancarlos.cuevas@uam.es
Description of the project:

The general goal of this project is the theoretical study of several fundamental aspects of nanoscale thermal transport. In particular, we want to improve our current understanding of the radiative heat transfer and thermal radiation in nanoscale systems. We also want to elucidate the fundamental physical mechanisms that govern the heat conduction in atomic-scale junctions. Additionally, we intend to study the energy dissipation and, in particular, the thermoelectric cooling in molecular junctions. All these issues are of fundamental importance for many different fields and disciplines such as thermal sciences, nanoelectronics, nanooptics, and condensed matter physics. Moreover, these problems are key to developing novel technologies like near-field based thermal management, thermophotovoltaics, and nanoscale energy conversion.
Radiative Heat Transfer

Thermal radiation is one of the most ubiquitous physical phenomena, and its study has played a key role in the history of modern physics. The understanding of this subject has been traditionally based on Planck’s law, which in particular sets limits on the amount of thermal radiation that can be emitted or exchanged. However, recent advances in the field of radiative heat transfer have defied these limits, and a plethora of novel thermal phenomena have been discovered that in turn hold the promise to have an impact in technologies that make use of thermal radiation. Now, in an article published by ACS Photonics, the IFIMAC researchers Juan Carlos Cuevas and Francisco J. García-Vidal review the rapidly growing field of radiative heat transfer, paying special attention to the remaining challenges and identifying future research directions. In particular, they focus on the recent work on near-field radiative heat transfer, including (i) experimental advances, (ii) theoretical proposals to tune, actively control, and manage near-field thermal radiation, and (iii) potential applications. They also review the recent progress in the control of thermal emission of an object, with special emphasis in its implications for energy applications, and in the comprehension of far-field radiative heat transfer. Heat is becoming the new light, and its understanding is opening many new research lines with great potential for applications.

Reference:
Radiative Heat Transfer, Juan Carlos Cuevas and Francisco J. García-Vidal, Published in ACS Photonics, September 19th (2018). DOI: 10.1021/acsphotonics.8b01031 [URL]