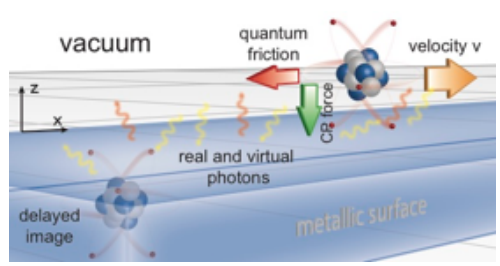
Research assistant for "Nonequilibrium atom-surface interactions with unconventional materials"

The motion of objects in vacuum has fascinated scientists for centuries. Especially after the advent of quantum electrodynamics, the understanding of the physics at work has wide implications, not only for fundamental purposes but also for the opportunities and the challenges of modern quantum technologies. One of the most astonishing predictions of quantum electrodynamics and quantum mechanics is indeed the existence of irreducible fluctuations which permeate every system even in its state of minimal energy. They are responsible for a panoply of effects, the most celebrated being the van der Waals/Casimir forces.
On this front, the last ten years have witnessed an increasing number of investigations addressing how fluctuations and in particular quantum fluctuations affect the dynamics of two or more objects set in relative motion in vacuum. A prominent example of this nonequilibrium interactions is quantum friction, i.e., a contactless drag force hindering the motion of the objects even when the whole system is at zero temperature. Studies revealed not only that quantum electromagnetic fluctuations in vacuum can behave as a viscous medium but also that the associated viscosity can be engineered via the optoelectronic properties and geometries of the materials comprising the system. This opens the way, on the one hand, to tailoring the interaction and, on the other hand, to a better understanding on how models of quantum mechanics, quantum electrodynamics and photonics as well condensed matter theory merge in the microscopic and mesoscopic world. The study of these phenomena becomes even more interesting as soon as materials with unusual properties (such as graphene, superconductors, non-reciprocal materials, carbon nanotubes, topological insulators) are considered, since they offer additional leverages to reveal the underlying physical processes and to engineer the corresponding effects for applications in nanotechnology and cold-atom physics.



The project aims to an extensive theoretical investigation of quantum friction in systems involving unconventional materials and complex geometries. Specifically, the fundamental and quantum-technological relevant configuration where an atom is moving relatively to macroscopic bodies will be considered. The successful candidate must possess a solid knowledge of and interest in theoretical physics, good mathematical skills and knowledge of at least one programming language. One of the key elements of analysis is the electromagnetic Green tensor characterizing the system. This quantity, which depends on the system's geometry and material composition, will be thoroughly investigated both analytically and numerically.

The work builds upon many years of research in this area of physics as well as on a large experience in theoretical physics and advanced analytical and numerical techniques. The Theoretical Optics & Photonics group offers a rich stimulating and synergic background to the candidate's activities. In addition, the jobholder will be given the opportunity to interact with a large network of theoreticians and experimentalists at international institutions.

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