Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

Laboratory name: **ONERA - DPHY**
Internship director' surname: **Sylvain Schwartz**
e-mail: **sylvain.schwartz@onera.fr** Phone number: **01 80 38 61 63**
Web page: www.onera.fr
Internship location: **Palaiseau, France**

Thesis possibility after internship: **YES**
Funding: **YES** Type of funding: **ONERA, DGA...**

Rydberg atom arrays for the quantum metrology of electromagnetic fields

Since the pioneering work of the Grangier group in the early 2000s, it has become possible to trap, manipulate and control cold atoms at the individual level using tightly focused optical tweezers, which can contain one atom at most. This technique allows the on-demand construction of synthetic many-body quantum systems assembled atom by atom. In conjunction with strong dipolar interactions obtained by placing the atoms in highly excited states (or Rydberg states), those systems proved to be very successful at performing various quantum simulation and quantum information tasks in the last few years.

Our project aims at exploring a new application of Rydberg atom arrays, namely the detection and analysis of electromagnetic fields. The general idea is to combine the high sensitivity of Rydberg atoms to electromagnetic fields with the great degree of control offered by atom arrays to outperform the limits of conventional electromagnetic field sensors in terms of sensitivity and spatial resolution, with potential applications to the fields of medical imaging, signals intelligence or to the analysis of electronics components. Our platform could also be used to explore the role of entanglement created by Rydberg interactions for the quantum metrology of spatially dependent electromagnetic signals beyond the standard quantum limit.

The internship will take place in the physics department of ONERA (DPHY/SLM), where the cold atom group is already broadly known for its expertise in portable inertial sensors based on matter-wave interferometry. You will join a small team of experimentalists there to contribute to the development of this new atom array platform, with the possibility to pursue this work within a PhD.

Successful candidates should be highly motivated by experimental quantum physics and the practical applications of quantum technologies. A previous experience (e.g. internship) in experimental physics would be an asset. Technical skills of interest include quantum physics, optics, electronics and programming. Candidates are also expected to be able to work autonomously, and to integrate smoothly in a team. A reasonably good English proficiency is required.

Condensed Matter Physics: **YES** Soft Matter and Biological Physics: **NO**
Quantum Physics: **YES (preferred)** Theoretical Physics: **YES**