Postdoc position in AMO physics

Project title

Quantum metrology on a trapped atom clock on a chip

Spin squeezing is a quantum technology that uses many-particle entanglement to redistribute measurement uncertainty away from the observable of interest and into the complementary variable which is not measured. Its principle has been demonstrated experimentally by several methods, but these proof-of-principle experiments were not intended to reach any metrologically relevant performance. The next, exciting step is now to apply spin squeezing in a true metrological context, where it becomes important for real atomic clocks and atom interferometers. In addition to the real-life relevance, new many-body quantum effects are likely to appear in this regime. Spin squeezing is particularly promising for atomic clocks using trapped atoms, such as recently developed, compact clocks intended for inertial navigation, satellites and field applications.

The proposed research activities of this postdoctoral project will be carried out in an experimental setup resulting from a long-standing collaboration between SYRTE at Observatoire de Paris and the LKB at the Ecole Normale Supérieure [*Phys. Rev. Lett.* **105**, 020401 (2010), *Phys. Rev. A* **92**, 012106 (2015)]. It is based on a Trapped Atom Clock on a Chip (TACC), which employs atom chip technology for compactness. This setup is the new generation of TACC, which is now starting to produce the first results. The atomchip includes an optical fiber-based microcavity to create spin squeezing and entanglement. The cavity also gives access to other quantum enhancements such as nondemolition clock interrogation. The goal of this experiment to reach a stability in the 10^{-13} $s^{-1/2}$ range, which would be a four orders of magnitude improvement over the squeezing-enhanced clock operation demonstrated in [*Phys. Rev. Lett.* **104**, 250801 (2010)]. It would also represent an order of magnitude better than the best commercial compact clocks. Moreover, it allows creating spin squeezing in an unexplored regime of high precision, where new quantum effects are likely to appear.

The hired young researcher will contribute to this project by developing a laser system that will improve the coherence time of the atoms under measurement by compensating the light shift of the cavity probe field. This offers a great opportunity for an early-stage researcher to acquire and reinforce a comprehensive set of skills in ultracold atomic physics, cavity quantum electrodynamics, laser optics, metrology, theoretical modeling and data analysis.

The position is based on a full-time employment. The interested candidate should address a CV, a motivation letter and reference letters to Dr. Carlos L. Garrido Alzar (carlos.garrido@obspm.fr) and Prof. Jakob Reichel (jakob.reichel@ens.fr).

Nationality eligibility condition: None

Profile of candidates: We are looking for outstanding candidates, preferably with experience in any of the following fields: cold atoms; atom chips; quantum optics; quantum information. Fluent in English, knowledge of French would be an asset. Used to autonomous work as well as part of a team, with analytical and interdisciplinary thinking.

Application deadline: None

Job starting date: As soon as possible