Postdoctoral position: multi-axis atom interferometry for inertial navigation

We offer a two-year Postdoctoral Research Associate position in the Cold Atoms in Bordeaux group at LP2N. The postdoc position is part of a collaboration between the research laboratories LCAR, LAAS and LP2N and technology company iXblue to advance quantum technology toward the first multi-axis interferometer with ultra-cold atoms using a hybrid atom chip.

Most atomic sensor measurements are one-dimensional, meaning they can measure only a single axis of rotation or acceleration at a time. For inertial navigation, reconstructing the trajectory of a moving body requires simultaneous measurements of accelerations and rotations along three mutually orthogonal directions—the basis of a full inertial measurement unit (IMU). The goal of this project is to realize a miniaturized cold-atom interferometer capable of measuring the full three-dimensional acceleration and rotation vectors. To simplify and miniaturize the multi-axis sensor, a diffraction grating will generate all the necessary beams using a single incident laser.

The candidate will bring his/her expertise to the design of a new atom chip architecture that hybridizes the grating with a microscale magnetic trap used as an ultra-cold atomic source.

To design the grating accelerometer, he/she will conduct simulations of the laser beam configuration expected to be produced from the grating. This will allow us to validate the principle of selecting different axes using velocity-sensitive Raman transitions, and it will give us the freedom to study the influence of different parameters (e.g. quantization axis, beam polarization, intensity ratio) in this complex architecture by controlling each beam independently.

On the pathway to a full quantum IMU, the candidate will also demonstrate the experimental implementation of new multidimensional inertial sensing methods with free-falling cold-atom interferometers (CAIs). Our method relies on a recently developed formalism for multidimensional atom optics and interferometer geometries that creates coherent superpositions of matter waves along three spatial directions and enables the simultaneous measurement of accelerations and rotations in 3D. This new arsenal of atom optical tools is based on two or three mutually orthogonal excitation beams that exchange momentum with atoms along more than one spatial direction at a time. After analysing the theoretical performance of an optimized multi-axis quantum sensor and comparing it to a commercial IMU, he/she will tackle the experimental challenges arising from these new atom optical tools, including the efficiency of the atomic mirrors and beam-splitters, the contrast of the interferometer, detection and signal extraction, and parasitic momentum transfer to the atoms.

Profile: Candidates must hold an internationally recognized PhD degree (or evidence of its completion in the nearest future) based on experimental work, preferably in the areas of ultracold quantum gases, atom interferometry or quantum optics. We seek a highly motivated candidate with experimental background and theoretical skills in modelling cold atoms experiments.

Position details: The postdoc position is funded with a grant of the Agence Nationale de la Recherche (French National Research Agency, ANR MiniXQuanta). We offer a 24-month fixed term contract starting immediately.
The research will take place on the campus of Université de Bordeaux, in Talence (Nouvelle Aquitaine, South-Western France) at Institut d'Optique d'Aquitaine, in the LP2N laboratory. LP2N is a joint laboratory of the CNRS, the University of Bordeaux and the IOGS engineering school.
The project takes place in the framework of a joint laboratory with the French technology company iXblue to develop quantum inertial sensors for navigation.

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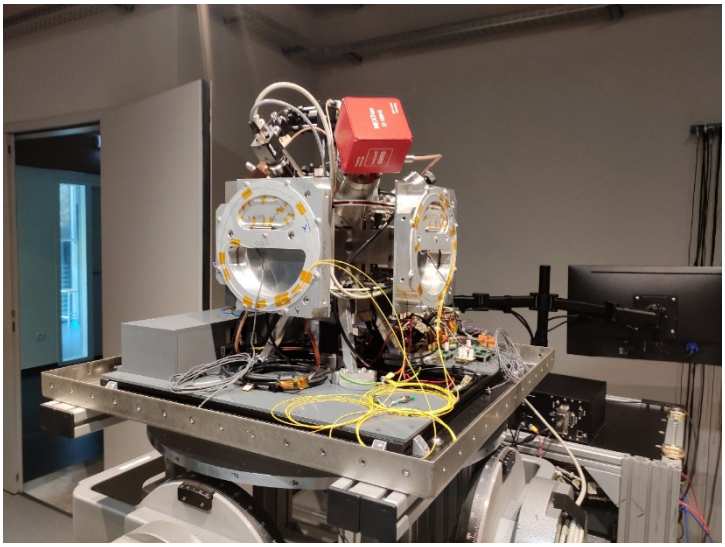

Figure 1: Picture of the current inertial navigation sensor head, mounted on a rotation platform for dynamic tests in the laboratory.

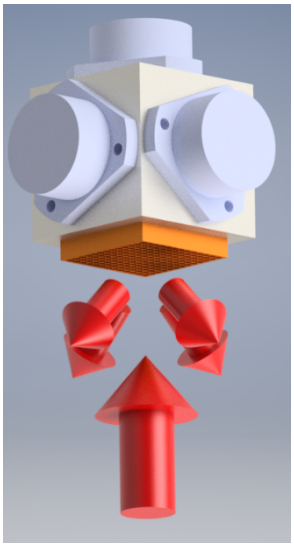

Figure 2: Representation of the diffraction grating.