Scientific Area	cold atoms exp., scalable q. systems, q. dynamics
Topic title	Compact Rubidium cold beam for testing and sensing: Matter-wave diffraction in 2/ 3D
Main host institution	University of Amsterdam www.uva.nl
Supervisor/institution	Philippe Bouyer https://www.uva.nl/en/profile/b/o/p.bouyer/p.bouyer.html
Co-Supervisor/institution	S. Whitlock, Uni Strasbourg https://isis.unistra.fr/en/cesq/whitlock-exotic-quantum-matter/
Mentor[1]/institution	TBC
Secondment institution	TBC

Topic description

Atom interferometers are quantum sensors that exploit the wave-particle duality of matter to achieve exceptional sensitivity to inertial forces such as acceleration and rotation. Their performance now rivals, and in some domains surpasses, that of classical systems in gravimetry, gradiometry, and gyroscopy. However, most current implementations are pulsed and sequential, limiting their bandwidth, robustness, and scalability. Achieving continuous operation in a compact format remains a major challenge—particularly for real-world applications where size, weight, power consumption, and long-term stability are critical. This project aims to overcome these limitations by integrating recent advances in laser cooling, matter-wave optics, and coherent atom sources. It will build on the ongoing development of a continuous atom laser at the University of Amsterdam, which provides a steady, phase-coherent stream of ultracold atoms ideally suited for continuous interferometry.

The PhD candidate will design and construct a compact rotation sensor using a Rubidium atomic beam generated by a 2D-MOT, achieving mean velocities around 20 m/s and enabling interferometer baselines on the order of 20 cm. The interferometric architecture will be inspired by [Phys Rev Lett, vol. 78, no. 11, 1997] but adapted for modern low-SWaP operation, including Raman-based beam splitting and large momentum transfer techniques. The candidate will characterize the sensor's performance—such as sensitivity, scale factor, and stability—while exploring advanced quantum control protocols to enhance atom-optical element fidelity. A key long-term goal will be to integrate the continuous atom laser into the system, enabling true continuous-wave operation. This work will contribute to the development of a new class of compact, high-performance inertial sensors, paving the way toward practical quantum sensing platforms for mobile and embedded applications.

Recommended applicant's profile

Minimum requirements:

- at least 8 months of master project in experimental ultracold atom or trapped ion group
- strong letter of recommendation from master project supervisor

[1] Mentor: The primary role of the mentors will be to identify and facilitate specific training objectives, advise on any problems faced by the DC, including career matters with an external perspective and provide mediation in the case of disputes.

The Gen-Q programme has received funding from the European Union's Horizon Europe research and innovation programme under the Marie Skłodowska-Curie grant agreement number 101217386.

- good team working skills
- good English skills
- Experience with laser systems, vacuum technology, and control software (e.g., LabVIEW, Python) is highly desirable.
- Interest in precision sensing applications will be key to success.

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