Scientific Area	cold atoms exp., scalable q. systems, q. dynamics
Topic title	Rb-Sr mixtures
Main host institution	University of Amsterdam www.uva.nl
Supervisor/institution	Klaasjan van Druten staff.fnwi.uva.nl/n.j.vandruten / or www.uva.nl
Co-Supervisor/institution	L. Idoumghar, Uni Haute-Alsace www.mage.fst.uha.fr/idoumghar/
Mentor[1]/institution	TBC
Secondment institution	TBC

Topic description

With this project, you will join a team of experimental quantum physicists at the Van der Waals-Zeeman Institute of the University of Amsterdam. We are using ultracold atoms and trapped ions as a means to investigate and utilize fascinating phenomena in quantum physics. We are particularly interested in developing novel platforms for quantum information science, quantum many-body physics, quantum sensing, and optical atomic clocks.

When atoms are cooled to nanokelvin temperatures, their quantum-mechanical wave properties become evident. At densities where their de-Broglie wavelengths overlap, a quantum-degenerate gas is formed, either a Bose-Einstein condensate (for bosons) or a degenerate Fermi gas (for fermions). At the University of Amsterdam we are exploring a unique mixture of atomic species, namely Rb and Sr. The long-standing goal is to bring these species together and form RbSr molecules. A key milestone in this regard was the discovery and characterization of so-called Feshbach resonances in this mixture [Nat.Phys 14, 881 (2018)]. Since then, we have developed several key insights and new tools, see Rev.Sci.Instr. 94, 073202 (2023) and the recent PhD thesis of Premjith Thekkeppatt.

Your goals will be to explore the opportunities that we have identified in the RbSr mixture. We will employ the recently demonstrated stabilization of the 87Rb-87Sr (Bose-Fermi) resonantly interacting mixture under confinement in an optical lattice. We will study the effects of further reduction in dimensionality by additional optical trapping in the form of optical lattices and/or optical tweezers. We have developed a high-resolution multi-wavelength objective that will be used to achieve better sensitivity for both species. We aim to create weakly bound RbSr molecules through the use of confinement-induced resonance. From there, we will be able to create ground-state molecules by optical adiabatic state-transfer techniques. Another avenue we will explore is the physics of strongly interacting Bose-Fermi mixtures in our system.

This project is embedded in the ultracold atom part of the QDNL programme, and will allow you to learn about many interesting projects related to your PhD, in particular those of the strontium BEC group and of the Hybrid atom-ion group. Your PhD project will profit from synergy with all these activities.

Recommended applicant's profile

Minimum requirements:

- at least 8 months of master project in experimental ultracold atom or trapped ion group

[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.

- strong letter of recommendation from master project supervisor
- good interpersonal skills
- good English skills
- experience with at least a few of the following skills: experimental work with optics, lasers, electronics, experiment control software

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.