PhD Position in Quantum Sensing with Levitated Nanoparticles

Faculty/Department	Faculty of Applied Sciences/Department of Quantum Nanoscience
Job type	PhD-position
Scientific field	Quantum Mechanics
Desired level of education:	MSc

Join us at TU Delft to levitate nanoparticles and use their quantum states of motion for ultrasensitive force sensing applications, from gas detection to revealing possible dark matter!

Job description

Quantum technology encompasses all new technologies that require quantum physics to work. Sensors based on oscillating mechanical systems are an important class of these emerging technologies. They are promising candidates to improve current technology such as positioning systems, inertial navigation and force sensing; and to advance fundamental research, such as the search for the quantum nature of gravity. For these vibrating systems to enter the quantum realm, a high degree of decoupling from the environment is required. One viable way is to use electromagnetic radiation to levitate these objects in vacuum. Levitation also has other advantages, such as a high degree of dynamic control and a sensor mass range spanning several orders of magnitude, from femtograms to nanograms. In the recent years, we have made great progresses in controlling the motion of such levitated systems down to the level of single quanta. This has allowed us, for example, to generate non-classical states of the surrounding electromagnetic environment. The next challenge is to extend quantum control to sensing applications.

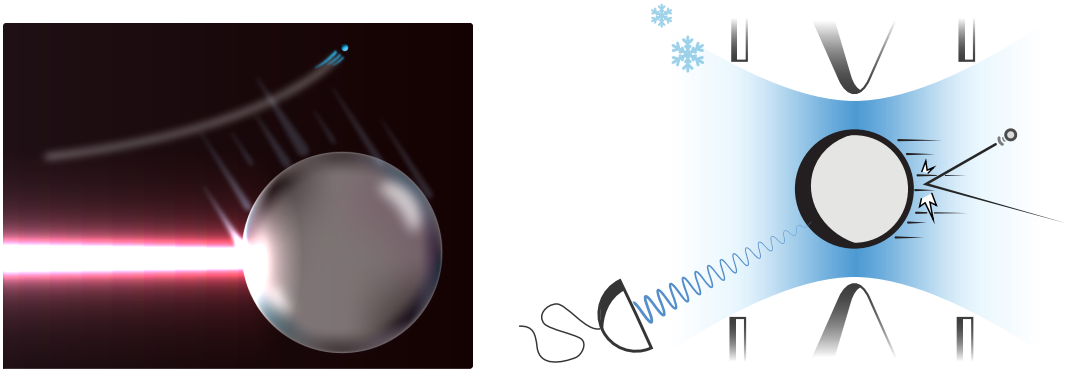

Figure 1. Left: *an artistic sketch of a levitated nanoparticle interacting with an external particle.* Right: *experimental concept of the project.*

As a PhD student in our team, you will answer the question “How can quantum measurements and control techniques be used in macroscopic sensors?” You will set up a table-top experiment using optical tweezers to trap nanospheres in vacuum, a quantum-limited detector to measure their motion and opto-electrical control actuations to generate the motion ground state. Then, you will implement new control schemes to generate non-classical motional states, in order to enhance our sensitivity to detect forces of both coherent and impulsive nature. With your work, you will enrich the family of quantum sensors and open up new applications for levitated systems, such as gas sensing and fundamental searches of new physics beyond the Standard Model.

You will join a diverse and motivated team of academic staff and students in Delft. We foster an inspiring, friendly and supportive environment and meet regularly to share ideas and knowledge or socialize. As a PhD student, you will develop your levitation apparatus, run the

lab, analyze the data, gain experience with modelling, coding, programming and operating complex equipment in our state-of-the-art lab. You will also receive all the training you need to develop as a scientist in this fast-moving field. This will give you great prospects for a professional career in the future.

Job requirements

As a highly motivated researcher, you want to work at the cutting edge of science. You have a particular affinity for nanofabrication, quantum mechanics and enjoy discussing its intricacies. Driven by curiosity, you are creative, independent and eager to take the initiative. And you have the planning skills to deal with a very complex PhD project. You also have:

- An MSc degree in physics, or a closely related field.
- Knowledge of laser and optics, nanofabrication, electron optics is an advantage.
- General experience of experimental physics is preferred.

The outcomes of this project will be disseminated to the scientific community and a general audience through presentations at (inter)national conferences and through publications in peer-reviewed journals. You will also participate in English-taught Doctoral Education courses and write scientific articles and a final thesis. In addition, you may be involved in training and teaching BSc and MSc students. A certain level of English proficiency is therefore required, as well as the social skills to deal with many stakeholders.

We are committed to building a diverse and inclusive research environment, where different perspectives drive innovation. We strongly encourage applications from female researchers and individuals from underrepresented groups in physics—your ideas and talents are essential to shaping the future of this field!

If you would like more information about this role, please contact Massimiliano Rossi, project PI, by email at m.rossi-1@tudelft.nl. You can find more information about our lab on our website (https://rossilab.tudelft.nl).

Apply now!

Are you interested in this vacancy? Please prepare the following documents and send them via email to m.rossi-1@tudelft.nl and specifying “PhD Quantum Sensing Levitodynamics application” in the subject.

1. Cover letter, including (1) a brief personal introduction, (2) an explanation of how your previous studies and experience have prepared you for this position, and (3) why you are interested in this position. The maximum length is one page.
2. Detailed CV.
3. Copies of your BSc and MSc degrees and transcripts.
4. Names and contact information of at least two relevant references. We will not contact references without your consent.