PhD Position in Electron Control of 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 control their motion using electron beams, an innovative and multidisciplinary approach to explore how the macroscopic world can behave quantum mechanically!

Job description

Quantum physics has revolutionized the way we live—just think of the billions of transistors working to enable you to read this advert. Yet, quantum phenomena typically dominate only at the "small" scale of atoms and molecules. Imagine extending effects like quantum superposition and entanglement to "large" objects that we usually think of as classical particles. This is exactly what you will do at TU Delft.

As a PhD student in our teams, you will investigate how to interface electron beams with the motion of a levitated solid object containing billions of atoms. By combining techniques from electron optics and optical levitation, you will achieve displacement sensing and control with unprecedented sensitivity.

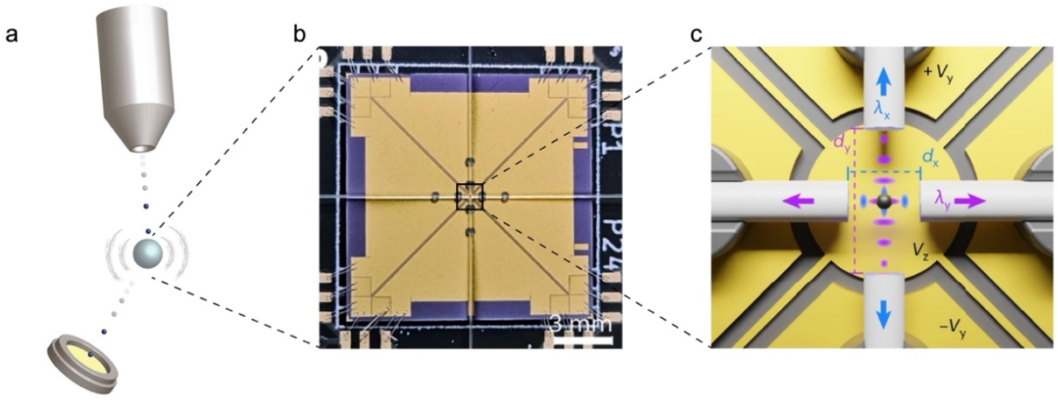

Figure 1. Experimental concept. ***a****, an e-beam is used to interrogate a levitated nanoparticle.* ***b, c*** *On-chip fiber-based optical trap, from Melo et al., Nature Nanotech. (2024).*

You will carry out pioneering research at the intersection of two distinct areas of physics. You will develop a chip-based levitation system that can be embedded in state-of-the-art electron microscopes—providing a unique platform to detect electrons after interacting with the moving nanoparticle. This setup will enable you to apply strong nonlinear forces to the particle. When combined with the quantum-limited control capabilities of optical tweezers, this platform holds the potential to create nonclassical motional states of levitated nanoparticles—one of the open challenges in the field. Your research will contribute to advancing our understanding of macroscopic quantum mechanics, from probing the quantum-to-classical transition to investigating the quantum nature of gravity.

You will be jointly supervised by the Rossi Lab and the Conesa-Boj Lab, and become part of a diverse and motivated team of academic staff and students at TU Delft. We offer an inspiring, friendly, and supportive environment, with regular meetings for scientific exchange and social activities. As a PhD candidate, you will design and build your levitation system, operate and maintain the experimental setup, analyze data, and gain experience in modeling, coding, and running complex equipment in our state-of-the-art laboratories. You will also receive

comprehensive training to support your development as an independent scientist in this rapidly evolving field—opening strong prospects for a successful future career in academia or industry.

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 and Sonia Conesa-Boj, by email at m.rossi-1@tudelft.nl and s.conesaboj@tudelft.nl. You can find more information about our lab on our websites (https://rossilab.tudelft.nl, https://conesabojlab.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 s.conesaboj@tudelft.nl and specifying “PhD Electron control 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.