SpinCaT

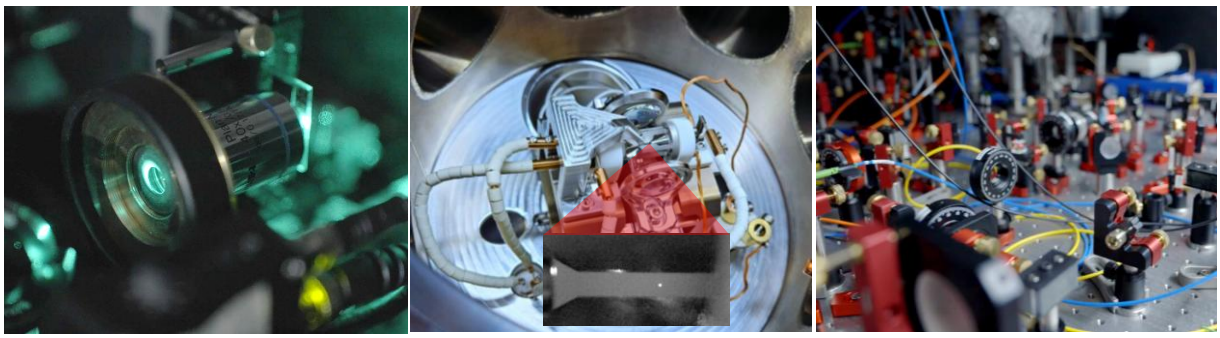
Explore Macroscopic Quantum Physics with Spin Levitodynamics

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Join us at the University of Innsbruck—a quantum hub in the heart of the Alps—to build a next-generation levitodynamics platform and push the frontier at the quantum–classical boundary!

We will levitate a nanodiamond containing a single nitrogen-vacancy (NV) centre and use its spin to both prepare and probe Schrödinger cat states of motion. The platform will enable landmark experiments at the quantum–classical boundary, opening new opportunities to test collapse models and investigate the limits of quantum mechanics at increasingly large mass scales.

The experimental core is a cryogenic ultra-high-vacuum Paul trap with high-numerical-aperture optical access, designed to minimise recoil heating and enable quantum-limited motional readout. Generous ERC funding supports the complete construction of this new platform at the University of Innsbruck.



The project addresses fundamental questions at the quantum–classical boundary: How large can we make quantum objects before quantum theory breaks down? Do fundamental mechanisms limit the preparation of macroscopic quantum states of motion? And is gravity a quantum entity?

What you will do

- Help build and operate a cryogenic ultra-high-vacuum Paul-trap experiment, including the integration of lasers, optics, control electronics, and Python-based automation.
- Contribute to key experimental milestones, with increasing independence, such as:
  - Deterministic loading and stable trapping of pre-characterised nanodiamonds containing single NV centres.
  - Resonant NV-spin control and high-fidelity readout in nanodiamonds at cryogenic temperatures.
  - Quantum-limited motional readout and feedback cooling towards ground-state preparation of centre-of-mass and librational motion.
  - Exploration of spin–motion coupling using Stern–Gerlach-type forces in strong magnetic-field gradients for the preparation of non-classical states of motion.
- Contribute to a collaborative lab environment; mentoring BSc/MSc students in day-to-day experimental work.

What we offer – *2 PhD and 1 postdoctoral position from 02/2027*

- The opportunity to be part of a dynamic, newly established group in a vibrant international environment.
- The resources and freedom to build a cutting-edge quantum experiment and explore quantum physics at the boundary between the quantum and classical worlds.
- A hands-on, supportive environment within Innsbruck's strong experimental-physics ecosystem, with clear goals and room for creativity in implementation.
- Direct mentorship from the principal investigator (PI) and a path toward scientific independence, offering strong prospects for a future professional career.

Candidate profile

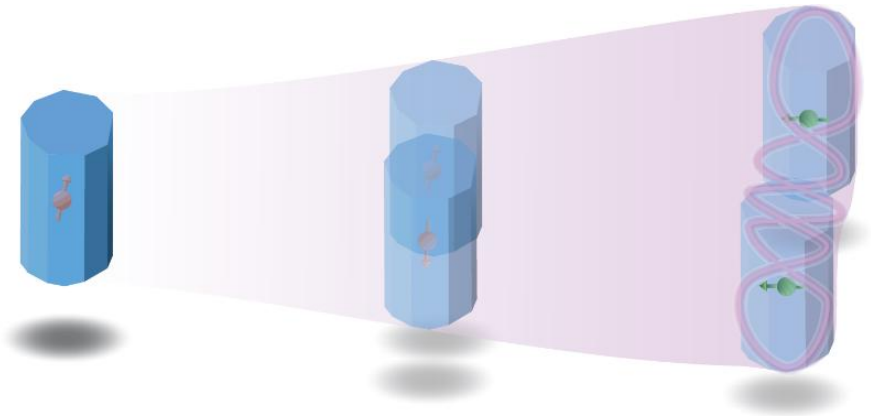
- An MSc/PhD in Physics: ideally quantum optics, atomic physics, or a closely related field.
- Strong motivation for experimental research and good problem-solving skills.
- Hands-on experience in an experimental physics laboratory.
- Experience with laser-based optical setups, including alignment and operation.
- Python skills for experiment control, data analysis or numerical modelling.
- Familiarity with cryogenics, vacuum systems, RF/microwave control, or clean-room nanofabrication would be an advantage.

Apply now!

If you are interested, please email your application to **simon.baier@uibk.ac.at** with the subject line: *SpinCaT PhD/Postdoc application – Your Name*
Include:

- Cover letter (max 1 page): including a brief introduction, why SpinCaT motivates you and how your background fits to the project
- Detailed CV
- For PhD candidates: Copies of your MSc transcript
- For Postdoc candidates: Publication list
- At least two references: names and contact information.

Join us to levitate a diamond—in two places at the same time.



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