Robbie Elbertse

Researcher

Maryland, 25-11-1992

Profile

Curious and creative scientist with a strong interest in quantum mechanics, data analysis, automation and experimental design. I enjoy translating difficult concepts into easy ones and I am interested in a career in science or research & development.

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Hard Skills

STM, UHV, Cryogenics, RF

Soft Skills

Working well in a group and alone. Public speaker. Stress-resilient. Flexible. Creative. Mentoring.

Coding

Python, LabVIEW, Matlab, COMSOL

Languages

Dutch, English, Spanish, German

Interests

Quantum Physics, RF Engineering, Scientific Simulation, Game Design

Selected Achievements

First-Author PRL Publication (*Editor's Suggestion* and Featured in *Physics)*

Co-developed ESRSTM setups across Europe, Asia and the US.

Developed novel STM-based membrane detection technique.

Work Experience and Research

PostDoctoral Researcher (2024 – Present) [NIST]

Supervisor: Joseph Stroscio

I helped commision the latest Electron Spin Resonance Scanning Tunneling Microscope (ESRSTM) which uniquely uses a dilution refrigerator (DR) and cryogenic switches to yield best-of-the-world resolution. Experiments are currently ongoing, studying the interplay between radio frequency (RF) signals and superconductors and studying various decoherence sources on qubit systems.

Co-Authored: ***Roadmap on atomically-engineered quantum platforms***
In Progress: ***Untitlted Review Scientific Instruments paper***

PhD Researcher + PostDoc (2018 – 2023) [Delft University of Technology]

Promotor: Sander Otte

I performed experiments using a Scanning Tunneling Microscope (STM) at cryogenic temperatures (1-4K) in Ultra High Vacuum (UHV) to study single atoms on surfaces. These atoms are magnetic and their spin properties are observed. Based on my research proposal, I went to Center for Quantum Nanoscience, Seoul, South Korea to perform further experiments. Additionally I proposed a new measuring technique for metal and superconducting membranes, which we used to study the Casimir effect.

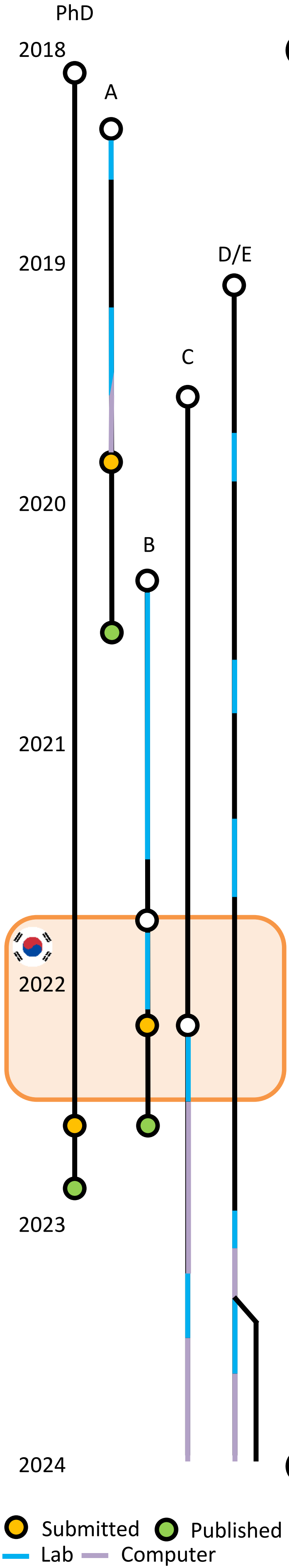
First Author: ***Remote detection and recording of atomic-scale spin dynamics***
First Author: ***Long-lived magnetization in an atomic spin chain tuned to a diabolic point***
Co-Authored: ***Development of a scanning tunneling microscope for variable temperature electron spin resonance***
Published: ***Lifetime of Atomic Spin Chains*** (PhD Manuscript)
In Preparation: ***Measuring Casimir Force Across a Superconducting Transition: Detection of Nanomechanics via Tunneling Microscopy***
In Preparation: ***Detection of MEMS Acoustics via Scanning Tunneling Microscopy***

Education

MSc. Applied Physics (2014 – 2017) [Delft University of Technology]
Track: Quantum Nanoscience under supervision of Sander Otte

BSc. Applied Physics (2010 – 2014) [Delft University of Technology]

BSc. Applied Mathematics (2010 – 2014) [Delft University of Technology]



Research Contributions

A. Remote detection and recording of atomic-scale spin dynamics

doi: 10.1038/s42005-020-0361-z

Fe adatoms on a monolayer islands Cu_2N on top of Cu(100) provide excellent opportunities for nanodevices, owing to their large magnetic anisotropy, stable position, ease of manipulability and strong bonding to neighbouring adatoms. One such nanodevice is presented in this paper, which consists of 3 chains of atoms (length 3, 8 and 3 atoms) in a row. Through this choice of length and parity of each chain precisely, the centre chain responds as a sensor to incoming spin waves on either side-chain. We study the behaviour of this nano-sensor and corroborate the results with theoretical simulations. The experiment, including data acquisition automation, was performed from start to finish by me under supervision of a senior colleague. Simulations and manuscript writing were done primarily by me, with supervisory help from my PI.

Impact: Novel technique for studying atomic spin dynamics, generating interest in discussions within the STM and quantum magnetism community.

B. Development of a scanning tunneling microscope for variable temperature electron spin resonance

doi: 10.1063/5.0096081

In Delft I worked on designing and calibrating an antenna to support radio frequency (RF) capabilities in one of our STMs to perform Electron Spin Resonance (ESR)-STM measurements for qubit operations. Building on this experience, in Seoul I helped with the measurements of a similar ongoing project. There, I also led the COMSOL simulations, used in the paper to further substantiate the claim on the difference between two antenna designs. Contribution [F] follows in these footsteps.

Impact: Contributed to establishing two functioning ESRSTM systems that continue to produce experimental results and serves as well-characterized reference platforms.

C. Long-lived magnetization in an atomic spin chain tuned to a diabolic point

doi: 10.1103/PhysRevLett.133.166703

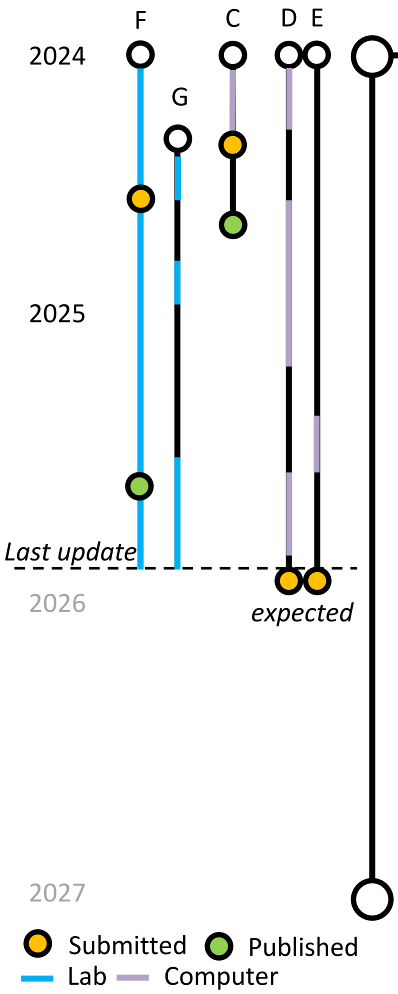
Using a similar experimental bedrock as in Contribution [A], Fe on Cu_2N/Cu(100) is used to study chains of magnetic adatoms. For such chains, the ground state and first excited state are defined mainly as a linear combination of two opposing magnetic states. Due to their superposition, the lifetime of these two energy states is limited. Here we show that under application of a strong transverse magnetic field, this superposition can be quenched, thereby increasing the lifetime by several orders of magnitude. I lead the entire project in Seoul, South Korea, due to technical limitations in Delft, with technical and scientific help being provided on-site.

Impact: Demonstrated a mechanism to dramatically increase spin-state lifetimes using topology, with relevance across physics, mathematics and chemistry.

D/E. Homodyne Detection of Metal Membranes

In collaboration with the Norte Lab we explore methods of measuring the eigenfrequencies of ultra-thin superconducting membranes to study Casimir effects. In an iterative process throughout we settled on a technique initially inspired by ESRSTM. The experimental design of the technique was proposed by me and subsequent proof-of-concept experiments have also been performed by me in close collaboration with the Norte lab. After several years, this project has been split up in two, with one focusing on the novel methodology (First Author), and the other focusing on the ultra-thin membrane and resulting Casimir experiment (Shared First Author). All data acquisition, data analysis, model set up and manuscript writing of the methodology paper has been lead by me. In the Casimir paper I have played a supportive role in data acquisition and manuscript writing. Papers to be submitted to Nature Nanotechnology and Nature Sensors.

Impact: Developed a minimally invasive technique for studying membrane dynamics.



Research Contributions

F. Development of scanning tunneling microscope with cryogenic RF switches in a dilution refrigerator

At NIST I helped commission, calibrate and upgrade the latest multimodal ESRSTM. While the main work was done prior to my arrival, I performed the necessary calibration and subsequent upgrade to include cryogenic RF switches for minimal electronic noise. This project is currently ongoing as we are acquiring benchmarking data for this machine. Some of the ideas behind this work are captured in our Roadmap contribution:
doi: 10.1088/2399-1984/ade6b7.

G. Explorative work

Several ideas are currently explored using the latest ESRSTM at NIST. Further details will follow later.

Invited Talks and Awards

- Invited Talk: George Mason University Colloquium (2025) *[Approx. Attendence: 30-40]*
- Invited Talk: AVS-71 (2025) *[Approx. Attendence: 50-100]*
- Award: 31st NIST Sigma Xi Early-Career Poster Competition (2024): Most Outstanding Poster
- Award: Article in Dutch Physics Magazine (2021): 3rd Place "Best Article by Young Scientists"