

# Annual Report | 2025

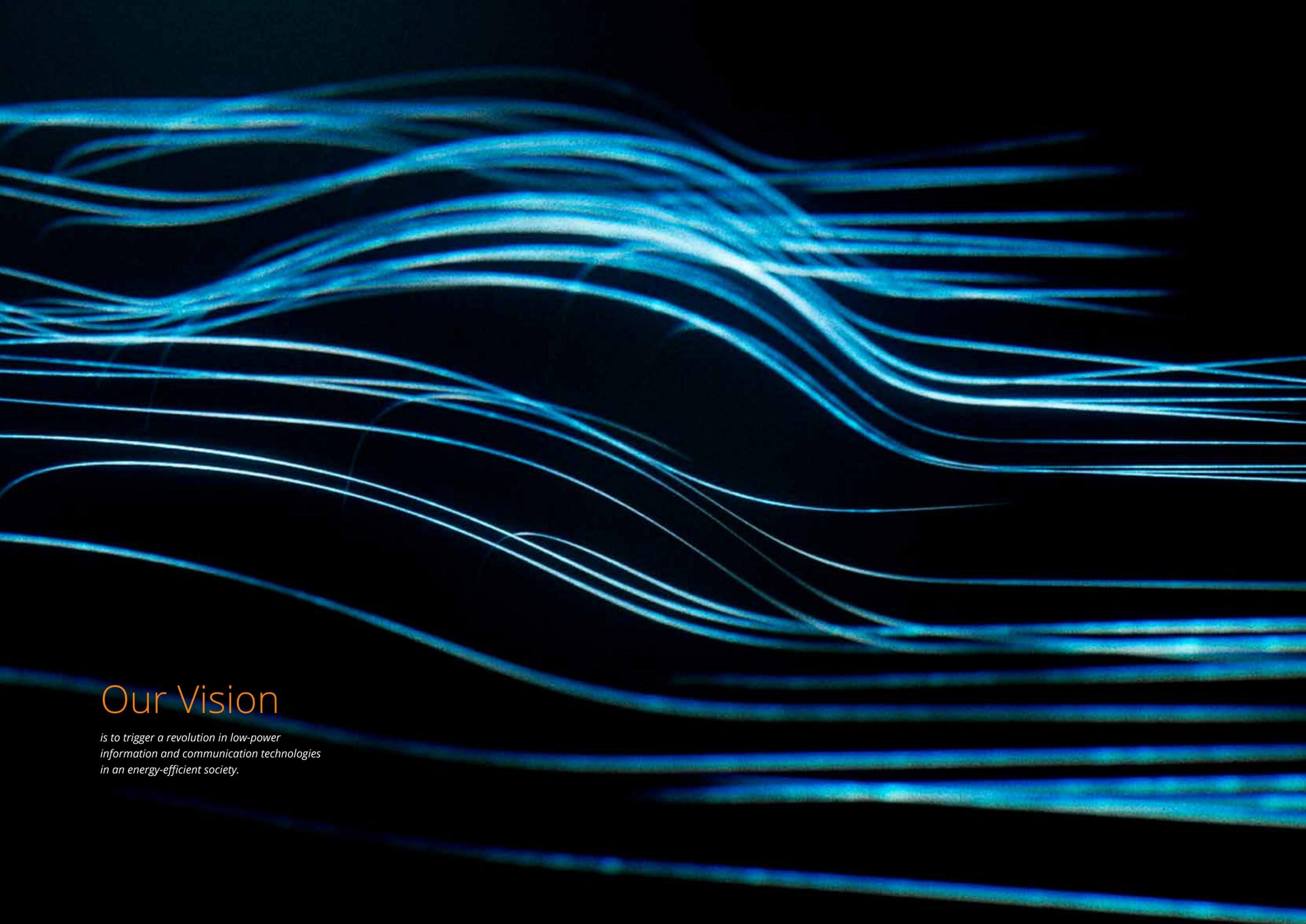
Center for Quantum Spintronics



Norwegian  
Centre of  
Excellence



Norwegian University of  
Science and Technology

The background of the slide is a dark, almost black, space filled with numerous glowing blue lines. These lines are of varying thickness and are arranged in a complex, overlapping pattern that suggests movement and energy. Some lines are straight, while others are curved or wavy, creating a sense of dynamic flow. The overall effect is reminiscent of a fiber optic network or a complex data stream.

# Our Vision

*is to trigger a revolution in low-power  
information and communication technologies  
in an energy-efficient society.*

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## CENTER DIRECTOR PROFESSOR ASLE SUDBØ

# Foreword



Quantum spintronics represents a frontier at the intersection of quantum science and technology, devoted to exploring and exploiting the intrinsically quantum nature of the electron's spin degree of freedom. By leveraging fundamental phenomena such as spin coherence, spin-orbit coupling,

and quantum entanglement, this field enables the coherent generation, manipulation, and detection of spin states with unprecedented precision. These capabilities lay the conceptual and technological foundations for revolutionary approaches to quantum information processing, energy-efficient electronics, and high-density, high-speed information storage.

Rooted in the unification of quantum mechanics and condensed matter physics, quantum spintronics transcends conventional charge-based electronics by encoding information in spin rather than charge. This paradigm shift promises ultra-low-power operation and enhanced functionality, while opening pathways to novel device concepts that operate beyond classical limits. The delicate interplay between spin, orbital motion, and symmetry in engineered materials provides a rich platform for discovering emergent quantum phenomena and tailoring them for technological use.

By seamlessly integrating theoretical insight with experimental advances in materials synthesis, nanoscale fabrication, and quantum control, quantum spintronics aspires to reshape the landscape of modern electronics. Its progress is expected to catalyze breakthroughs in scalable quantum computation and inspire the realization of next-generation spin-based devices, thereby contributing fundamentally to the evolution of quantum technologies and our understanding of quantum matter.

In June 2025, QuSpin organized its seventh international conference involving all members of the Center, including associate PIs and members of their groups at the Universities of Mainz, Utrecht, and Cambridge as well as a number of other internationally recognized researchers. The tradition of organizing these successful international conferences will be upheld through the duration of the

Center. In October, we organized a successful internal collaboration workshop involving the same members.

In 2025, as in previous years, QuSpin was able to keep up the excellent publication rate of high-quality research in the world's premier research journals in the field of condensed matter physics. The Center continues to consistently educate MSc students and PhD candidates and postdocs for the benefit of the global science community. And this year we had ten PhD candidates successfully finishing their PhD defense. We expect them to make significant societal impact in the years to come, especially in developing emerging quantum technologies in Norway.

In addition to educating PhD candidates, we offer stays abroad through our Mobility Grant, and we continue to invite young female students to cafes and offer mentoring programs to our female PhD candidates as part of our effort to recruit a higher number of them to our research field.

The work of our researchers was recognized by the RCN this year as well. Professor Asle Sudbø is PI in the RCN Fripro project called "Nanoscale imaging of magnetic skyrmions in thin film devices (NIMSKY). The project is headed by Associate Professor Magnus Nord at the Department of Physics. Professor Jacob Linder and Research Professor Alireza Qaiumzadeh each received a grant in the RCN Coordination and Support Activity/Support for Researcher Mobility program («Toppforskerprogrammet»).

Master student Andreas Solberg Stapnes received the award for « Best Technology Master 2025», and Åsmund Vågslid was awarded "Best Science Master 2025", both at the Faculty of Natural Sciences (NV) at NTNU. Jostein Negård Kløgetvedt received the 2025 biennial Martin Landrø's award for "An excellent master's thesis in physics" from Norsk Fysisk Selskap.

Co-PI Professor Dr. Mathias Kläui is one of the Highly Cited Researchers 2025, having demonstrated significant and broad influence in his field of research (Source: Clarivate).

Four researchers at QuSpin, Asle Sudbø, Jacob Linder, Arne Brataas og Alireza Qaiumzadeh, were among Norway's most published in 2024 and 2025.

“By seamlessly integrating theoretical insight with experimental advances in materials synthesis, nanoscale fabrication, and quantum control, quantum spintronics aspires to reshape the landscape of modern electronics.”

By using the quantum spin to convey information, rather than on an electric charge, QuSpin aims at radically reducing energy loss in materials used for sensing, transporting and storing data.

# Center of Excellence

QuSpin, recognized in 2017 as one of ten new Centers of Excellence by the Research Council of Norway, carries the responsibility to provide the resources and space for international researchers, to delve into and unravel the beautiful complexities of condensed matter physics to further our understanding and control of quantum physics in the pursuit of innovations.

By the end of 2025, our Center had a fifty-people strong team with members from eleven different countries. QuSpin has now nine permanent professors and associate professors, three researchers, two postdocs, thirteen PhD students, seventeen master's students, and one administrator. In addition, we have one 25%-position for a finance controller, two Co-Principal Investigators, one professor II, and two lab engineers.

In addition to performing excellent basic research presenting scientific results in leading international journals, we are searching for closer collaboration with industry partners. We are seeking collaborations in developing competence within the main areas of data analysis, smart materials, sensing, and communication – areas in which we foresee the potential of contributing to great societal impact.

Our annual three-day conferences in Trondheim attract high-profile international research speakers, and QuSpinners have been invited to high-profile conferences and workshops abroad. Our PhD candidates are highly attractive within Academia as well as the industry and organisations such as SINTEF, The Norwegian Defence Research Establishment (FFI), Kongsberg Defence & Aerospace, The Norwegian National Security Authority (NSM), Det Norske Veritas (DNV), DNB (finance), and consulting businesses.

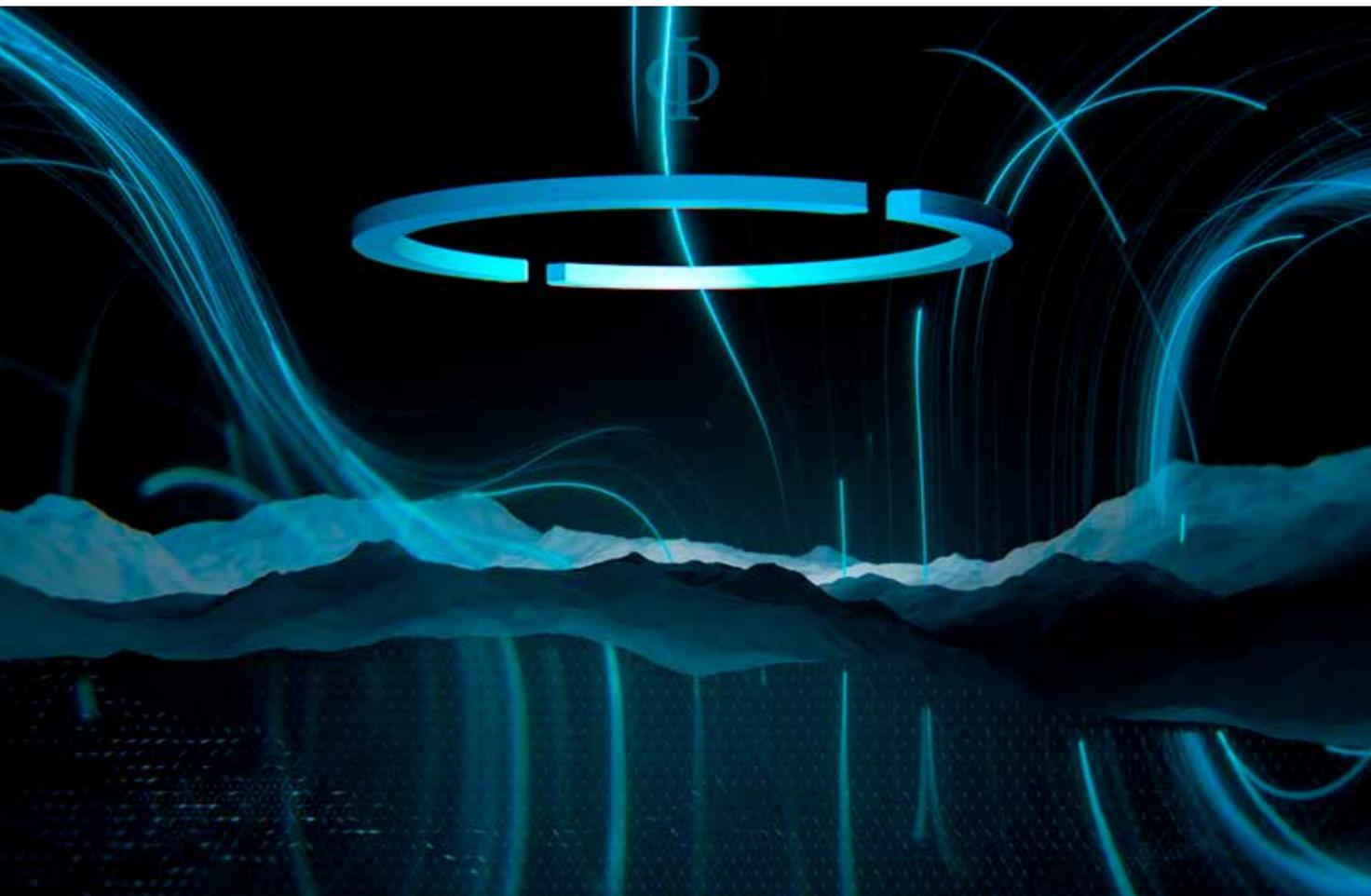
As an international research center, QuSpin values its highly professional international advisory board of



*SFF QuSpin's Principal Investigators (from left): Asle Sudbø, Arne Brataas, Hendrik Bentmann and Jacob Linder.*

researchers as well as an experienced board with senior researchers from NTNU.

In bringing together Norwegian experts with their international counterparts, the Center puts Norway at the forefront of quantum spintronics research. In turn, our research will enable innovative applications.



*Quantum sensors can enhance precision in medical imaging, navigation and geological exploration.*

OUR QUSPINNERS 2025



# QuSpin and the International Year of “Quantum 2025”

Our Center constitutes a nationally and internationally visible research environment at the forefront of condensed matter physics and emergent quantum-based technologies. In 2025, pronounced “*The International Year of Quantum Science and Technology (IYQ)*” by the United Nations in commemoration of the centennial of Heisenberg’s seminal 1925 paper on the Quantum-Theoretical Reinterpretation of Kinematic and Mechanical Relations (the Umdeutung paper), the Center’s scientific activities were particularly well aligned with the historical legacy and future trajectory of quantum science.

*Written by Center Director Asle Sudbø and Deputy Director Jacob Linder*



*Built for speed, quantum computing takes on society’s toughest problems, like effective development of new medicines and problem solving using artificial intelligence*

QuSpin’s core research program is devoted to the exploration of quantum states of matter arising from the interplay of symmetry (e.g. magnetism and superconductivity), topology, electron correlations, and spin-orbit coupling. On the theoretical front, the Center has delivered key contributions to the understanding of spintronics, unconventional superconductivity—including pairing mechanisms beyond the BCS paradigm—as well as topological superconducting phases with relevance for fault-tolerant quantum computation. Parallel efforts address topological states of matter more broadly, elucidating novel bulk-boundary correspondences, symmetry-protected phases, and transport phenomena driven by nontrivial band topology.

A defining strength of the Center is its leadership in spintronics and unconventional magnetism. In particular, QuSpin researchers have played a prominent role in the theoretical formulation and implications of altermagnetism, a recently identified magnetic phase that combines compensated magnetic order with spin-split electronic bands. This work establishes new conceptual frameworks for spin transport and spintronics without net magnetization, opening pathways toward energy-efficient quantum and spin-based devices.

Complementing theory, QuSpin has developed a strong experimental profile, with recent key contributions in the physics of topological band structures and magnetic textures. Experimental research includes advanced studies of magnetic skyrmions and skyrmion lattices, focusing on their stabilization, dynamics, and controlled manipulation using external fields and currents. These investigations address both fundamental questions and application-driven challenges related to topological spin textures. Furthermore, the Center has built up leading capabilities in spin- and angle-resolved photoemission spectroscopy (spin-ARPES), providing insights into electronic structure, correlation effects, and topological characteristics of quantum materials. QuSpin also holds a strong experimental competency in growth of semiconducting and semimetallic compounds.

The Center is also deeply engaged in the development of spin-based qubits for quantum information processing. Theoretical research explores spin coherence, control protocols, and materials platforms relevant for scalable quantum computing architectures, thereby contributing directly to second-generation quantum technologies. QuSpin also holds a strong position in superconductivity-based spintronics, utilizing strain and proximity effects to achieve improved cryogenic functionality with relevance for areas such as thermoelectricity and qubits based on the Josephson junction.

Beyond research, QuSpin demonstrates a strong commitment to education, outreach, and societal engagement. The Center is Norway’s primary university-based research environment educating highly qualified MSc students and PhD candidates in fields central to emergent and second-generation quantum technologies, supplying expertise to both the national and international research and innovation ecosystem. Outreach activities in recent years include international lecture tours, notably in Australia, presentations of the Center’s activities to the Norwegian Ministry of Education, and contributions to high-level symposia at the Norwegian Academy of Science and Letters marking 100 years of modern quantum mechanics.

*“In the International Year of Quantum 2025, the Center for Quantum Spintronics has stood as a key contributor to advancing fundamental quantum science, honoring its foundational principles while shaping the conceptual breakthroughs and potential technologies for the decades to come.”*

# Main Research Themes, Goals and Activities

The principal goal of the Center is to describe, characterize and develop recently identified quantum approaches to control electric signals in advanced nanoelectronics, conceptually different from those existing today.

The research focuses on three judiciously chosen low-dissipation systems: magnetic insulators, topological insulators, and superconductors which correspond to three research themes: insulator spintronics, topological matter, and super spintronics.

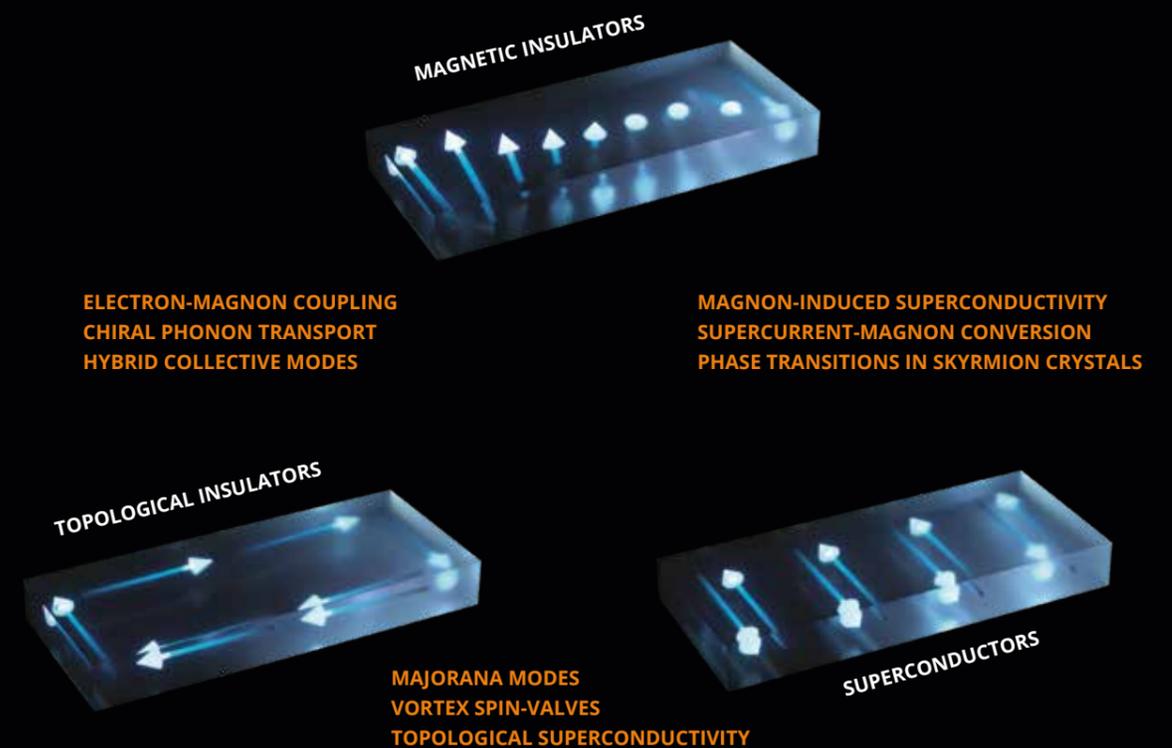
Our unique competitive edge is addressing the ultra-low power innovations by uniting expertise from insulator spintronics, topological matter, and super spintronics. Although these themes are individually exciting, we combine them to generate significant added value.

Electrons can move in free air. In materials, their motion can differ significantly. In metals, the collective flow of the electrons resembles that of particles, but with dramatically altered properties. Their mass, charge, and even spin can be modified. This dressed behavior resembles new particles, so-called quasi-particles, that require new models and new concepts.

We address how such quasi-particles can convey spin information with exceptional tiny energy losses. Also, we consider the dynamical evolution of the spin states for high-speed electronics. A supercurrent is a remarkable phenomenon where a current can flow in a supercurrent with no electrical resistance and no energy loss. New material combinations with such properties would revolutionize electronics and have a significant impact on society at large. We consider how spin can flow via supercurrents.

Successfully meeting these challenges has the potential to transform electronic data transmission, storage, and processing. Ultimately, dissipationless spin transport would solve the problem of energy waste to the environment with potential uses in disruptive technologies.

# Overlapping research themes within the different research areas



**MAGNETIC INSULATORS:** Magnetic insulators are excellent conductors of spin while forbidding the energy-consuming process of charge transport. In magnetic insulators, the quanta of the spin vibrations can act as new low power dissipation information carriers.

**TOPOLOGICAL INSULATORS:** Topological insulators allow ultra-low dissipation transport of charge and spin at the surface but inhibit lossy processes in the bulk. An important aspect is the exceptionally strong coupling between charge and spin signals.

**SUPERCONDUCTORS:** Superconductors have exactly zero electrical resistance and expel magnetic fields. Cleverly designed nanostructured superconductors in combination with magnetic materials exhibit intriguing new electrical and magnetic phenomena coupling charge and spin information.

ASLE SUDBØ

# Topological Quantum Matter



## Theme and goal

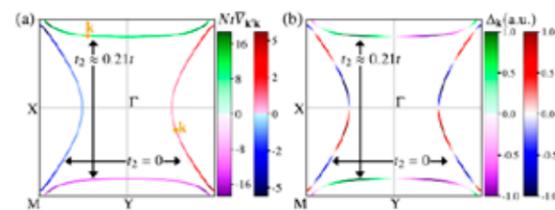
Topological quantum matter occupies an interface between quantum mechanics and topology, focusing on emergent electronic behavior in materials hosting intrinsically nontrivial quantum states. Central to this field is topological order encoded within electronic band structures, which gives rise to symmetry protected surface and edge modes. These states, reminiscent of quantum anomalies, remain robust against local perturbations and disorder, making them attractive platforms for fault tolerant quantum computation and information processing.

In superconductors, electrons bind into Cooper pairs and propagate without electrical resistance, enabling dissipationless current transport. This collective state promises transformative advances in power distribution and quantum device engineering. Superfluids analogously exhibit vanishing viscosity, permitting frictionless flow without energy loss, as realized in quantum liquids and ultracold atomic gases. Together, superconductivity and superfluidity exemplify how extreme conditions reveal nonclassical phases of matter and the counterintuitive principles governing the quantum realm.

Our research aims to elucidate how collective phenomena in quantum systems endowed with topologically protected properties, with or without strong electronic correlations, cooperate to generate novel emergent physics. Beyond fundamental significance, such insights may inform neighboring disciplines including high energy physics and unconventional superconductivity. We therefore investigate heterostructures combining topological insulators with magnetic insulators or superconductors, as well as intrinsic topological materials and chiral p-wave superconducting systems platforms experimentally.

## Activity in 2025

Altogether 11 scientific papers have been published in 2025. A principal research focus in 2025 has been to further explore novel quantum computing platforms leveraging quantum spin fluctuations within topological magnetic ground states. Building upon prior investigations from 2022, 2023, and 2024 into quantum skyrmion crystals and helical magnetic phases, our work extends to the domain of obtaining unconventional spin-polarized superconductivity with conventional mechanisms of superconductors anchored on unconventional magnetic systems, namely altermagnets. We predict phonon-mediated spin-polarized p-wave superconductivity, a first step towards topological superconductivity. Many-body effects in these systems have also been investigated in order to consider strong-coupling superconductivity in this system, and quantum geometric aspects of quantum Hall transport have been calculated, including quantum metric and Berry curvature. Another highlight is the collaboration with the Mainz-group on groundbreaking methods of manipulating topological quantum matter, skyrmion lattices, on the fly. Finally, we have co-authored a roadmap on superconducting science and technology moving forward from 2025.



Panel (a) shows effective phonon-mediated interactions for both spin-up (green and purple) and spin-down (red and blue) in an altermagnet. The values for  $\mathbf{k}$  are given in yellow and correspond to the maximum of the gap, while the position along the Fermi surface gives  $\mathbf{k}_\perp$ . Panel (b) illustrates the normalized superconducting gap in arbitrary units for both spin-up and spin-down with the same color coding as in (a).

ARNE BRATAAS

# Spin Transport and Spin Dynamics



## Theme and goal

An electron has a spin in addition to its charge. The mobile charge carriers are the basis of conventional electronics and spintronics. In metals and semiconductors, electric fields induce currents. In magnets, a spin current occurs as well. In superconductors in contact with magnetic materials, charge and spin can flow without dissipation. In insulators, there are no moving charges. Spin information can, nevertheless, propagate. While electrons are immobile in insulators, another entity conveys information. At equilibrium, the electron spins become ordered. In response to external forces, the ordered pattern of the spins can be disturbed. The disturbance can take forms like spin waves or other dynamical spin textures.

We aim to determine how spins in magnetic materials connect to mobile electrons in adjacent semiconductors, metals, or superconductors. One aspect is to replace moving charges with magnetic insulators' dissipation coherent and incoherent spin excitations. Another is to utilize superconductors in contact with magnetic materials to enable new ways of dissipationless flow of spin and charge. Additionally, coupling THz spin dynamics in antiferromagnets with conductors can facilitate new ways of creating THz electronics. In these systems, we can also enable unprecedented control of electron-electron, electron-magnon, and magnon-magnon interactions. These features can open doors toward creating new paths for magnon and exciton condensation, superfluidity, and superconductivity. Furthermore, since spin signals in these systems have extremely low power dissipation, overcoming the limitations can enable low-power technologies such as oscillators, logic devices, non-volatile random access memories, interconnects, and even quantum information processing.

## Key questions

We focus on the fundamental challenges facing quantum spintronics. Key questions are how spin can transfer from magnetic materials to conductors and superconductors, how far and how spin propagates in insulators, conductors, and superconductors, how we can control

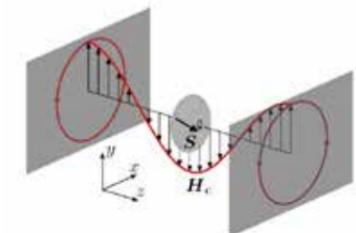
electron and magnon correlations that cause new states of matter, and how to detect these phenomena.

## Activity in 2025

We give two examples of our activity in 2025: Antiferromagnets can host quasiequilibrium magnon Bose-Einstein condensates, but only if the condensate consists of two interacting components. In a uniaxial easy-axis antiferromagnet with Rashba-type Dzyaloshinskii-Moriya interaction, two degenerate finite-momentum condensates form and are (meta)stable only when they are populated symmetrically, creating a zero-sound-like Goldstone mode. In a biaxial antiferromagnet without Dzyaloshinskii-Moriya interaction, the degeneracy is lifted, the condensate becomes unstable, and the work suggests this is a common fate for single-component quasiequilibrium quasiparticle condensates.

We calculate the exact second-order photon correlations in ultrastrongly coupled magnon-cavity systems beyond the rotating-wave approximation. Our results show that counter-rotating interactions produce significant quadrature squeezing of the cavity field. By adjusting anisotropic magnon-cavity couplings, the squeezing can be enhanced through modified hybrid-mode level repulsion without increasing the cavity photon number. Ferromagnetic cavities exhibit more squeezing as coupling asymmetry increases, while in antiferromagnets, opposite-chirality magnon modes suppress quantum effects and create a baseline on correlations. This offers a practical approach to optimize photon blockade for quantum information.

We have published six papers: five in the Physical Review B and one in Nature Communications.



A simple microwave cavity consisting of two polarized conducting plates supporting a cavity mode with a circular polarized magnetic field, which couples via the Zeeman-interaction to the uniform Kittel mode of an enclosed ferromagnet.

JACOB LINDER

# Superconducting Spintronics



## Theme and goal

In classical physics, matter exists as a gas, liquid, solid, or plasma. However, this classification is too crude to capture the fascinating physics that emerges within each of these states. For instance, not all solid states behave the same way. According to quantum physics, various solid materials will behave very differently. Some are magnetic, some do not conduct electric currents, while others can carry currents of not only charge but also a property known as spin. This property is closely related to magnetism and is a fundamental trait of most elementary particles.

It turns out that some materials can conduct electric currents without any energy loss: so-called superconductors. The origin of superconductivity is quantum mechanical, but that does not mean superconductivity only occurs at microscopic length scales invisible to the naked eye. Large chunks of materials can be superconducting, making this phenomenon a macroscopic manifestation of quantum physics. Magnetism is another example of a phenomenon which originates from quantum physics. When different materials such as superconductors and magnets are combined, new physics can emerge that is more than just the sum of properties of the materials. This is one of the motivations behind the field of superconducting spintronics where one studies spin-dependent quantum effects in superconductors.

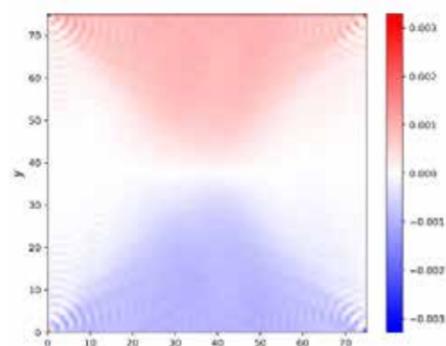
Two main goals guide our research. The first one is to discover new quantum phenomena that transpire when combining superconductors with materials that have fundamentally different properties, such as magnetic ones. Secondly, we focus on discovering phenomena that are relevant to the development of cryogenic information transfer, generation, and storage based on superconductors. This is closely related to the transport of charge, spin, and heat in hybrid structures. We use a variety of analytical and numerical tools to address the research questions above, depending on which method is the most appropriate for the system at hand. Some of our theoretical approaches include lattice models, quasiclassical Keldysh theory, Green function techniques, scattering theory, and Landau-Lifshitz-Gilbert phenomenology.

## Key questions

The main research problems we are focusing on solving are related to the functional properties of materials and how they can be controlled and altered by combining several materials or by applying external stimuli. For instance, is it possible to use magnetic materials to control when superconductivity appears and even enhance its properties? How can one use superconductors to generate and detect transport of not only charge, but also other degrees of freedom such as spin and heat, with minimal energy loss? Finally, we are interested in understanding the quantum dynamics of various types of long-range order in solid-state systems when quenches are applied in interaction parameters, to see if novel meta-stable quantum phases can be accessed.

## Activity in 2025

Our research this year covered a range of topics in modern condensed matter physics, including orbitronics, triplet superconductivity, p-wave magnetism, and spin-diode effects. We predicted the conditions under which p-wave magnetism and superconductivity can coexist intrinsically and in bilayers. We demonstrated how supercurrents can be used to design spin lattices and electrically controllable magnon gaps. In collaboration with experimentalists, we demonstrated tunable, large thermoelectric effects in superconducting spin-valves and possible observation of intrinsic triplet Cooper pairs in NbRe. We published 11 papers in 2025, including papers in Physical Review Letters, PRX Energy, and PRB Letters.



Fully quantum mechanical simulation of spin accumulation due to the spin-splitter effect in altermagnets using non-equilibrium Green functions on a lattice. From Phys. Rev. B **111**, 174431 (2025).

HENDRIK BENTMANN

# Spectroscopy of Quantum Materials



## Theme and goal

The recent decades have seen the rise of modern information and communication technologies, largely based on the use of semiconductors in transistors and integrated electronic circuits. This era is sometimes referred to as the “silicon age”, highlighting the importance of the material silicon in this context. The properties of silicon are well understood on fundamental grounds. However, there are classes of materials whose physical behaviour is vastly more complex and less understood, including superconductors, magnets, and topological systems. In these „quantum materials“ the quantum-mechanical nature of the electrons and their mutual interactions come to the forefront and remain manifest over a wider range of energy and length scales. Researchers envision that proper control of these quantum effects and resolving some of their puzzles could enable new technologies beyond the silicon age. Understanding the physics of quantum materials is challenging, however, and involves the development and application of sophisticated experimental and theoretical techniques.

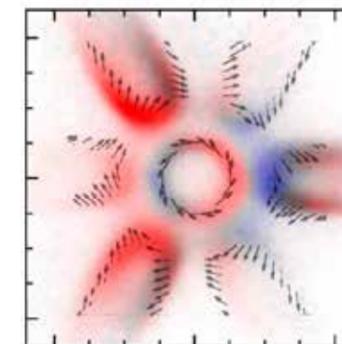
We use a method called spin- and angle-resolved photoelectron spectroscopy (spin-ARPES) to investigate magnetic and topological materials. Spin-ARPES is based on the photoelectric effect, i.e. the excitation of photoelectrons at a material surface upon irradiation with monochromatic light. The effect has long been known and constitutes one of the key observations that paved the way from classical electrodynamics to quantum mechanics. Use of modern spectrometers and light sources allows us to study the spatial, angular and spin distributions of photoemitted electrons as well as their dependence on energy and polarization of the exciting light, providing detailed information about electronic and magnetic properties. With this, our goal is to contribute to the discovery and to a refined microscopic understanding of quantum states in new and complex materials.

## Key questions

Our primary focus lies on the investigation of electronic states with so-called topological properties which give rise to unusual spin textures in momentum space. We are interested in how topological properties and spin textures are related to or modified by ferromagnetic or antiferromagnetic order, specific crystalline symmetries, quantum confinement in atomically thin crystals and proximity coupling in heterostructures. Spin-ARPES allow us to directly address these points experimentally. Our experiments are performed in the laboratory at NTNU and at international synchrotron radiation facilities, such as PETRA III at DESY (Hamburg).

## Activity in 2025

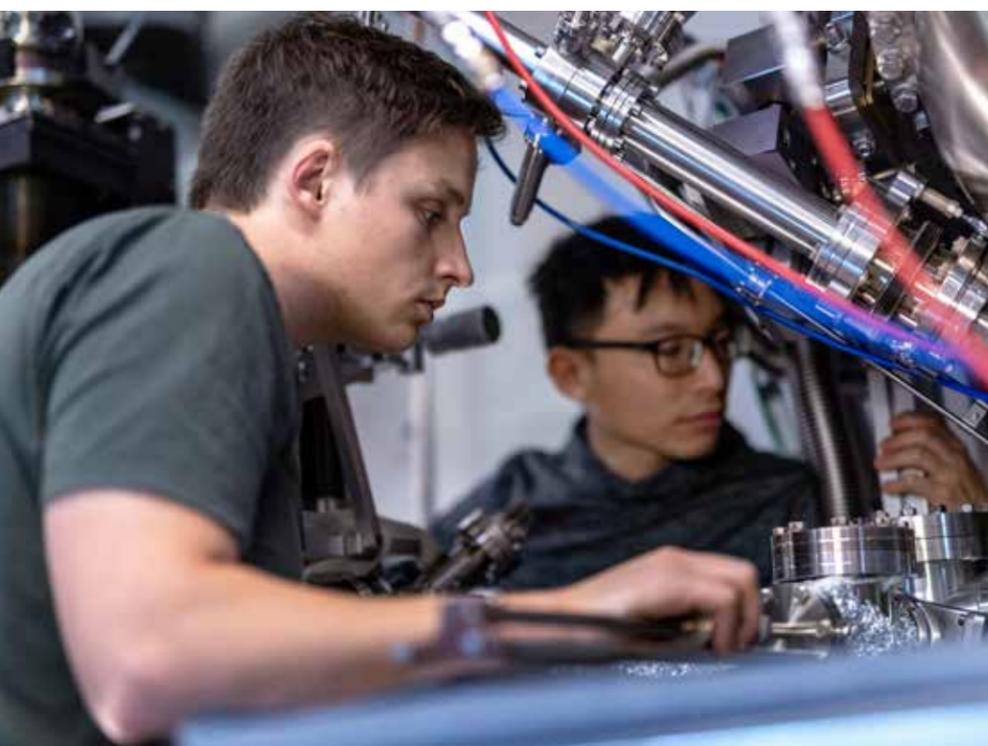
This year we characterized and commissioned the imaging spin filter of our photoelectron momentum microscope. We conducted first high-quality experiments, imaging the spin texture in a topological material across the full 2D Fermi surface. Furthermore, we commissioned a frequency-converted UV laser as a new light source at our momentum microscope, which provides high photon flux and polarization tunability. In addition to our in-house experiments, we carried out beamtimes at synchrotron radiation facilities, namely at PETRA III (Hamburg) for soft X-ray ARPES and at the Bloch beamline of Max IV (Lund) for high-resolution and spin-resolved ARPES. We studied the electronic structure of topological superconducting and chiral materials. An article was published in Phys. Rev. X and a perspective article was published in Nature Physics.



Spin-resolved Fermi-surface map of a topological surface state in momentum space.

## EXPERIMENTALISTS AT WORK

Our researchers in action in the ARPES lab.



CHRISTOPH BRÜNE

# Molecular Beam Epitaxy of Antiferromagnets



## Theme and goal

At the MBE Lab we work to develop new materials with exciting magnetic and topological properties, using molecular beam epitaxy (MBE) as our central technique. MBE allows us to create exceptionally high quality crystalline thin films, which form the foundation for detailed studies of electronic, magnetic, and structural behavior. Access to such high quality materials is essential for advancing fundamental understanding and for finding future technological applications.

## Key questions

Our research currently centers on antiferromagnetic materials, and much of our effort is directed toward two particularly promising classes: antiferromagnetic semiconductors and antiferromagnetic Kagome materials.

Antiferromagnetic semiconductors offer a unique opportunity to merge concepts from spintronics with the electrical tunability familiar from traditional semiconductor technology. The possibility of manipulating magnetic and electronic properties through electric fields opens a path toward seamlessly integrating semiconductor processing with spin based devices. Our primary material in this area is  $\text{CuFe}_2\text{S}_2$ , an antiferromagnetic semiconductor with a remarkably high Néel temperature of 823 K. This work is carried out in close collaboration with Arne Brataas', Alireza Qaiumzadeh's and Mathias Kläui's groups at QuSpin, and supported by optical and structural studies in collaboration with Morten Kildemo and Magnus Nord.

The second major direction in our lab concerns Kagome materials, which have attracted considerable interest because of their unusual electronic band structures and their frustrated magnetic behavior. The Kagome lattice naturally supports phenomena such as Weyl and topological surface states, flat bands, and van Hove singularities, creating a rich landscape of correlated electron and topological effects. At the same time, the magnetic structure of these compounds allows for skyrmions and helimagnetic phases, further expanding their scientific potential. Despite this promise, synthesizing high quality antiferromagnetic Kagome materials—

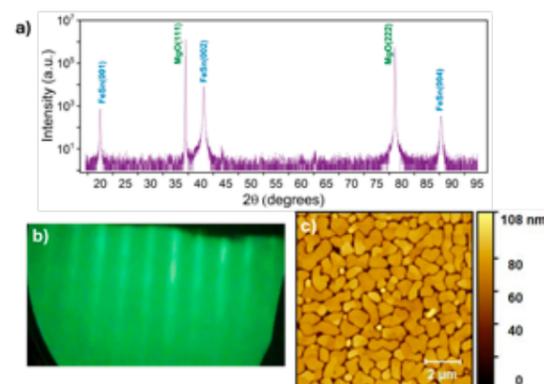
especially in thin film form—remains a significant challenge. We are therefore investing considerable effort into the growth of  $\text{FeSn}$  and  $\text{Mn}_3\text{Sn}$  thin films, two antiferromagnetic metals in which the iron or manganese atoms form a Kagome lattice. This work benefits from close collaboration with the group of Dennis Meier.

## Activity in 2025

In 2025, three PhD candidates in our group - Payel Chatterjee, Matthias Hartl and Longfei He - successfully defended their theses and we managed to further optimize the growth of the Kagome materials. This resulted in two publications:

- Longfei He *et al.* *Tailoring MBE growth of  $c\text{-Mn}_3\text{Sn}$  directly on  $\text{MgO}$  (111) from islands to film.* npj Quantum Materials. **10**, 42 (2025).
- Payel Chatterjee *et al.* *Challenges and insights in growing epitaxial  $\text{FeSn}$  thin films on  $\text{GaAs}(111)$  substrate using molecular beam epitaxy.* J. Vac. Sci. Technol. A **43**, 022701 (2025)

For the antiferromagnetic semiconductors, we established new collaborations with the German collaborative research center 1636, especially with Matias Bargheer's group. We also started collaboration with Ingrid Gullikstad Hallsteinsen, focusing on first transport investigations of  $\text{CuFe}_2\text{S}_2$  thin films.



*Growth of single crystalline  $\text{FeSn}$  on  $\text{MgO}$  111: We realized high quality single crystalline  $\text{FeSn}$  layers growth with flat surfaces and quasi 2D-growth. A) shows the x-ray characterization, b) the RHEED pattern during growth and c) the AFM micrograph of such a layer.*

JEROEN DANON

# Semiconductor-based Quantum Technologies



## Theme and goal

We do theoretical research on solid-state quantum devices, including semiconductor spin qubits, certain types of superconducting qubits, topologically protected qubits, gate-tunable Josephson junctions, and superconducting diodes.

The long-term goal in this field is the realization of disruptive quantum technologies such as fault-tolerant quantum computing and more accurate quantum sensing.

In many solid-state quantum devices, an important role is played by semiconducting components. The precise control over the carrier density that most semiconductors offer, combined with the often strong and tunable spin-orbit coupling they induce, makes them versatile building blocks for a plethora of applications: In the ultra-low-density regime, single electrons or holes can be isolated for the purpose of using their spins as qubits; in this context the presence of strong spin-orbit coupling provides efficient ways of electrical qubit control. In combination with superconducting elements, semiconductors can be used to create highly tunable Josephson junctions, where the spin-orbit coupling can yield an unconventional current-phase relationship (potentially useful for creating protected superconducting qubits and superconducting diodes), or to realize effective topological superconductivity, which should host non-Abelian anyonic excitations that could be used to encode topologically protected quantum information.

Our goal is to understand the complex dynamics of cutting-edge semiconductor-based quantum devices, often in collaboration with world-leading experimental groups, and try to use that understanding to predict, design, and develop new functionalities in the next generation of devices. In parallel, we started investigating machine-learning techniques for tuning and control of more complex quantum devices as well as for quantum sensing applications.

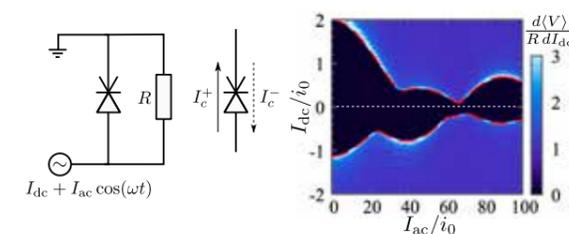
## Key questions

The questions my group is currently working on are quite diverse, a few examples are the following: How can we improve quantum coherence properties of spin qubits or superconducting qubits, by smart choice of material platform, advanced device design, or machine-learning-assisted operation methods? How could we scale up so-called “artificial Kitaev chains” to a size that yields topologically protected zero-energy end modes? What kind of new quantum-device functionalities could result from using hybrid structures including superconductors and lower-dimensional hole gases?

## Activity in 2025

The most important contributions from my group in the past year are (i) a detailed understanding of the superconducting proximity effect in lower-dimensional hole gases, (ii) a theoretical description of the diode response of a biharmonically driven Josephson junction, (iii) the development and experimental testing of ultrafast Bayesian quantum sensing methods for superconducting qubit stabilization, and (iv) the development of advanced machine-learning methods for automated tuning of quantum devices, including a first experimental demonstration.

All our work from the past year was published in high-profile journals, including PRX Quantum and Physical Review Letters.



*The IV-characteristics of a harmonically driven superconducting diode reveal a strong tunability of the diode efficiency through the driving strength.*

JOHN OVE FJÆRESTAD

# Frustrated Quantum Antiferromagnets



## Theme and goal

Our group's research centers around lattice models of quantum antiferromagnets, especially models with competing (aka "frustrated") interactions. In combination with strong quantum fluctuations, frustration may prevent magnetic order and instead lead to other, magnetically disordered, phases that possess more exotic types of order that are of great fundamental interest.

Of particular interest are phases known as quantum spin liquids, whose order is not described by broken symmetries but may instead be of a topological nature. In recent years, new materials have been discovered which exhibit evidence of unconventional behavior pointing towards spin-liquid physics.

In recent years it has also become clear that various concepts and quantities originating in quantum information theory, like entanglement entropy and fidelity, may be very useful for characterizing quantum many-body phases and the quantum phase transitions between them. Different types of order may give rise to characteristic "signatures" in such quantities and their behavior as a function of various parameters.

The overall goal is to get a better understanding of the "zoo of phases" that may arise in frustrated quantum antiferromagnets, and contribute towards their description and classification.

## Key questions

Key questions include whether/where quantum spin liquids arise the phase diagram of various lattice quantum spin models, what types of quantum spin liquids can arise, and how various types of order can manifest themselves through signatures in quantities like entanglement entropy (including both orders that are and are not described by broken symmetries).

## Activity in 2025

In collaboration with Huan-Qiang Zhou at Chongqing University and others, the activities included studies of the entanglement entropy of the 1D ferromagnetic Tasaki model and an entanglement perspective on fractals in various models with spontaneous symmetry breaking with type-B Goldstone modes. Other activities, in collaboration with master students, included a group-theoretical description of the ground-state order in the toric-code and double-semion models and an ongoing investigation of the entanglement entropy in Kitaev models.

ERIK WAHLSTRÖM

# Probing Local and Global Magnetodynamic Properties



## Theme and goal

Our primary theme is to probe and understand excitations in the charge, spin and lattice, and their interactions at the atomic scale.

Our primary method is through developing excitation spectroscopy techniques, primarily scanning-based probe techniques and other experiments that provide insights into the fate of charge and spin in materials.

Our short-term goal is to explore the magnetoelectronics and magnonics of oxide ferromagnets and antiferromagnets. In a more applied context, the long-term goal is to understand and control coupling in the thermal energy scale in order to contribute to the use of thermal energy to communicate information. The long-term goal on the method side is to develop STM-based point-contact techniques to explore mesoscopic and magnetodynamic physics at a very local scale.

## Key questions

We primarily study the excitations and coupling between magnons, phonons and charge carriers at an energy scale that ranges from sub-thermal energies to electron volts. In the spin domain, the prime motive is to understand magnons, and the expression in the form of propagating magnons and their interaction with charge and phonons. In the phonon regime, we are interested in understanding size and material control and tunability in coupling to the charge and spin excitations.

We are primarily investigating model systems in oxide materials, developing an understanding of perovskite-type ferromagnets and antiferromagnets, mainly seeking collaboration with groups on the material synthesis side to address our key questions.

## Activity in 2025

We continued our project on phonon-magnon coupling in oxide heterostructures. Travis Gustafsson was the first to join our team as a PhD candidate. He has focused on establishing a versatile platform for electric measurements on combined surface acoustic wave and magneto dynamic wave mixing. The staffing up of the project continued with the hiring of Payel Chatterjee in 2024 to increase the activity within film-growth and our planned collaboration around optical characterization with Professor Chiara Ciccarelli in Cambridge and magnetic characterization with Uppsala University (Roland Mathieu). During the spring of 2025, Shubankar Mishra and Oleg Kurnosikov finalised the first design of point-contact/RF/STM dip-stick STM for our PPMS system. This has already produced first results, and a revision of the Pre-amp is due during 2026. Work that has been done jointly with Associate Professor Toshu An in JAIST, Japan during 2025 also expanded the project portfolio starting up a collaboration with the photonics group at NTNU (Ass. Prof. Johann Riemensberger). This collaboration is based on extending our system to a lithium Niobate nano-oscillators. So far, one PhD student, Marius Holen, has started on this project, which is run together with Nils Johan Engelsen at Chalmers University of Technology, with main emphasis on designing and producing nano-mechanical oscillators for exploring magneto-mechanical excitations.

## EXPERIMENTALISTS AT WORK

Our researchers in action in the MBE lab.



DENNIS MEIER

# Topological Spin Textures



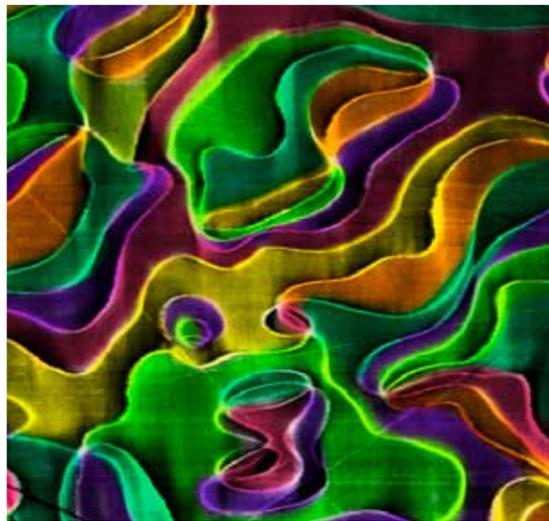
## Theme and goal

Topological spin textures, such as domain walls, magnetic dislocations and skyrmions, exhibit emergent physical phenomena and hold great promise as functional nanoscale systems for low-energy information processing and data storage. Application opportunities range from logic gates and memory

devices to innovative concepts for unconventional computing. Our research studies the fundamental physics that give rise to the unique properties and dynamical responses of topological spin textures in ferroic materials. We are particularly interested in the unusual local responses of these special magnetic entities, and how they can be utilized in future devices.

## Key questions

Many developments in the field have occurred only recently, and it has become clear they only scratched the surface regarding topological textures that form in magnetically ordered materials. Specifically, controlling such textures remains a major challenge. We investigate new magnetic materials that host topological spin



Network of topological defects in multiferroic hexagonal manganites.

textures at the nanoscale, with a focus on spin-spiral systems. For this purpose, we apply micromagnetic simulations in combination with different microscopy and nanostructuring methods, such as magnetic force microscopy (MFM) and focused ion beam (FIB), working towards first proof-of-concept devices. For example, we use FIB to shape materials of interest into device-relevant structures. Based on these structures, we study, e.g., the impact of reduced physical dimensions on the magnetic order and how electrical currents and magnetic fields control the position and movement of individual spin textures. Ultimately, we want to understand the new degrees of flexibility topological spin textures can offer and demonstrate new opportunities that arise for future applications, including Green-IT (i.e. low-power technologies) and modern concepts for unconventional computing.

## Activity in 2025

In 2025, our work was strongly shaped by the Marie Skłodowska-Curie Actions Doctoral Network TOPOCOM (Topological Solitons in Ferroics for Unconventional Computing) which we are coordinating, funded through the European Union's Horizon 2020 research and innovation programme. The network brings together 11 international doctoral candidates from seven countries, creating a vibrant, interdisciplinary research community. A major event of the year was the TOPOCOM workshop in Heraklion, Greece, which fostered scientific exchange and strengthened collaboration across the consortium. The TOPOCOM team published several manuscripts presenting the first scientific results of the project. Together with our academic and industrial partners, we continued to build a dynamic training environment that equips our doctoral candidates with expertise in modern materials science and computing. The scientific programme (Training through Research) is complemented by advanced transferable-skills training (Training for Life), offering a unique combination of technical, business, and cultural competencies at the forefront of unconventional computing based on electric and magnetic solitons. Notable achievements in 2025 included two publications led by doctoral candidates Duc Minh Tran and Nikhil Vijayan, both selected as Editors' Picks, as well as poster awards for Krishna Patel and Memoona Ismail.

SOL H. JACOBSEN

# Triplet Spintronics



## Theme and goal

Superconducting spin-polarized triplets carry coherent quantum information. A component of their correlation does not decay in either ferromagnets or superconductors, even with impurities. This makes them a primary candidate for low-dissipation information transport in spintronics. We examine the interplay of magnetism and superconductivity in emerging spintronic systems, using theoretical and numerical techniques.

## Key questions

Our research considers atypical geometries and model setups for examining the conversion mechanisms, manipulation and detection of superconducting singlets and triplets in spintronic devices, including magnets. We primarily consider the effect of curvature and/or strain, as well as cavity-mediated effects, which may enable new superconducting spintronic device design and control.

## Activity in 2025

It has been a year of extraordinary highs and lows. While we expected to start our new SuperFlex project this year, it has been delayed until 2026 due to the tragic death of Dr. Pierre Vallet. We send our deepest condolences to all who knew him. Academic achievements pale in significance against such a loss, but this year we can report some very interesting findings in both our thematic areas. Firstly, we investigated the role of bending-strain in superconductors, and found that such a strain gradient stabilizes equal-spin triplet superconductivity. Extraordinarily, this can induce a magnetization response in the normal metal of an SNS Josephson junction (see Fig.1) [1]. In reflecting-wall cavities, we find strong photon coupling to antiferromagnetic magnons via topological insulator surface states, which has been a long-standing problem (see Fig.2) [2].

More than anything, this International Year of Quantum Physics has been a year of public and professional outreach. I was humbled to receive the Australian Institute of Physics Women in Physics Lecturer Medal, in connection with which I undertook a lecture tour of Australia, giving over 25 public and school presentations around the country. It was an extraordinary privilege, and sparked many great conversations with quantum-curious people

from all walks of life. I appeared on Australian radio twice, gave interviews to both Australian and Norwegian press, and was a guest on two international popular science podcasts: "That's What I Call Science" and "Clear as Quantum". All links are available on my group website below. I briefed the higher education minister on quantum physics, gave 9 invited conference presentations, and 3 keynote addresses. This makes me hopeful we are entering a period of renewed interest in and funding for quantum physics.

The year closed with the happy news that our article on electrical control of a superconducting spin valve, published in Applied Physics Letters, was selected to appear in their Rising Stars Collection [3]. We have also been joined by Master students Eirik Skoglund on geometry, and Olav Henanger on cavities and look forward to interesting collaborations.

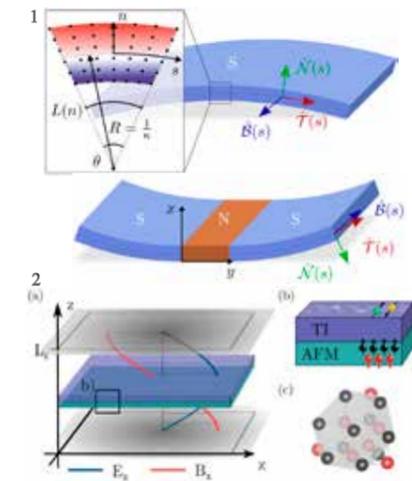


Fig.1: Bending-strain in superconductors and junctions [1].

Fig.2: Strong photon coupling to an antiferromagnet mediated by topological insulator surface states [2].

[1] *npj Spintronics* 3 (1), 18 (2025).

[2] *Phys. Rev. B* 112 (2), L020411 (2025).

[3] *Appl. Phys. Lett.* 125, 062602 (2024).

Website: [sites.google.com/view/soljacobsen](https://sites.google.com/view/soljacobsen)

Social Media: @SpintronicMum

ALIREZA QAIUMZADEH

# Emergent Phenomena in Quantum Matters



## Theme and goal

Our group conducts fundamental research across a broad range of theoretical and computational condensed matter physics, including quantum spintronics and magnetism (topological magnetic textures, superconducting spintronics, and neuromorphic spintronics); quantum transport phenomena; topological phases of quantum matter; ultrafast and nonequilibrium phenomena; and quantum field-theory of many-body systems. Our goal is to understand and engineer emergent and exotic phenomena in novel quantum materials, such as 2D magnetic materials and topological quantum materials. We are also interested in investigating potential application of these phenomena in quantum technology. Novel quantum materials have exotic and interesting behaviours. For example, in 2D systems, quantum fluctuations and interactions are usually strong and cannot be neglected. On the other hand, in novel 3D topological materials, such as Weyl semimetals, emergent low-energy massless quasiparticles provide a testbed for investigating new phenomena beyond conventional relativistic quantum field theory and the Landau Fermi liquid paradigm. Developing theories to predict and explain exotic equilibrium and nonequilibrium states of novel quantum materials with an ultimate application beyond the state-of-the-art quantum devices are among our goals.

## Key questions

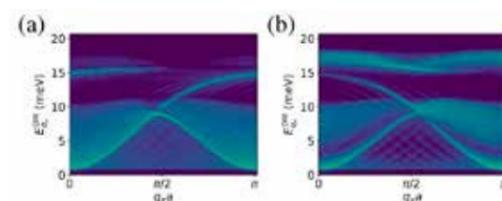
The interplay between charge, spin, orbital, and lattice degrees of freedom, along with hybridization and scattering among quasiparticles and collective excitations, such as magnons, spinons, phonons, and plasmons, drives a wide range of emergent phenomena in quantum materials. Understanding these phenomena at the microscopic level is a fundamental challenge in theoretical physics, requiring advanced analytical and computational techniques. Our research aims to uncover the role of quantum and thermal fluctuations in stabilizing nontrivial magnetic phases, exploring exotic transport properties, and discovering novel functional intelligent materials and exotic phases of matter.

## Activity in 2025

In 2025, our group published seven papers and presented the results in six international conferences, as either invited or contributed talks. Furthermore, our group has been awarded NOK 9M (€775k) under the RCN's Support Activity funding scheme for the period 2026–2029 to recruit a talented researcher from outside Europe and one PhD candidate.

Our former master's student, Jostein Kløgetvedt, received the 2025 biannual Martin Landrø Award from the Norwegian Physical Society for his excellent master's thesis on topological magnons. In addition, one master's thesis from our group was submitted in June, and our group hosted a master's student from Institut Polytechnique de Paris. In February, our PhD candidate Verena Brehm successfully defended her PhD theses on magnon transport in 2D systems.

In collaboration with PhD student Vemund Falch and Prof. Arne Brataas, we investigated hybrid magnonic cavity QED in two papers. Together with our MSc student and PhD candidates, we proposed the stability of chiral magnon BEC in antiferromagnets. In collaboration with two researchers in Chile, we studied the hydrodynamic regime of antiferromagnetic magnons. Furthermore, in two papers on collinear nonrelativistic spin-splitting antiferromagnets, so-called altermagnets, we explored magnon Hall transport in one study, together with our MSc student and Prof. Asle Sudbø; and uncovered the origin of A-type antiferromagnetism and chiral split magnons in MnTe in the other, in collaboration with researchers from Russia and Iran. Finally, in collaboration with our PhD student and a researcher from Poland, we analyzed the spin Nernst effect and chiral edge modes in van der Waals ferromagnetic insulators in the presence of Dzyaloshinskii-Moriya and Kitaev interactions – see figure below.



Response of the spin system to a temperature gradient. (a) and (b) Topological magnons. [Phys. Rev. B 111, 144415 (2025)]

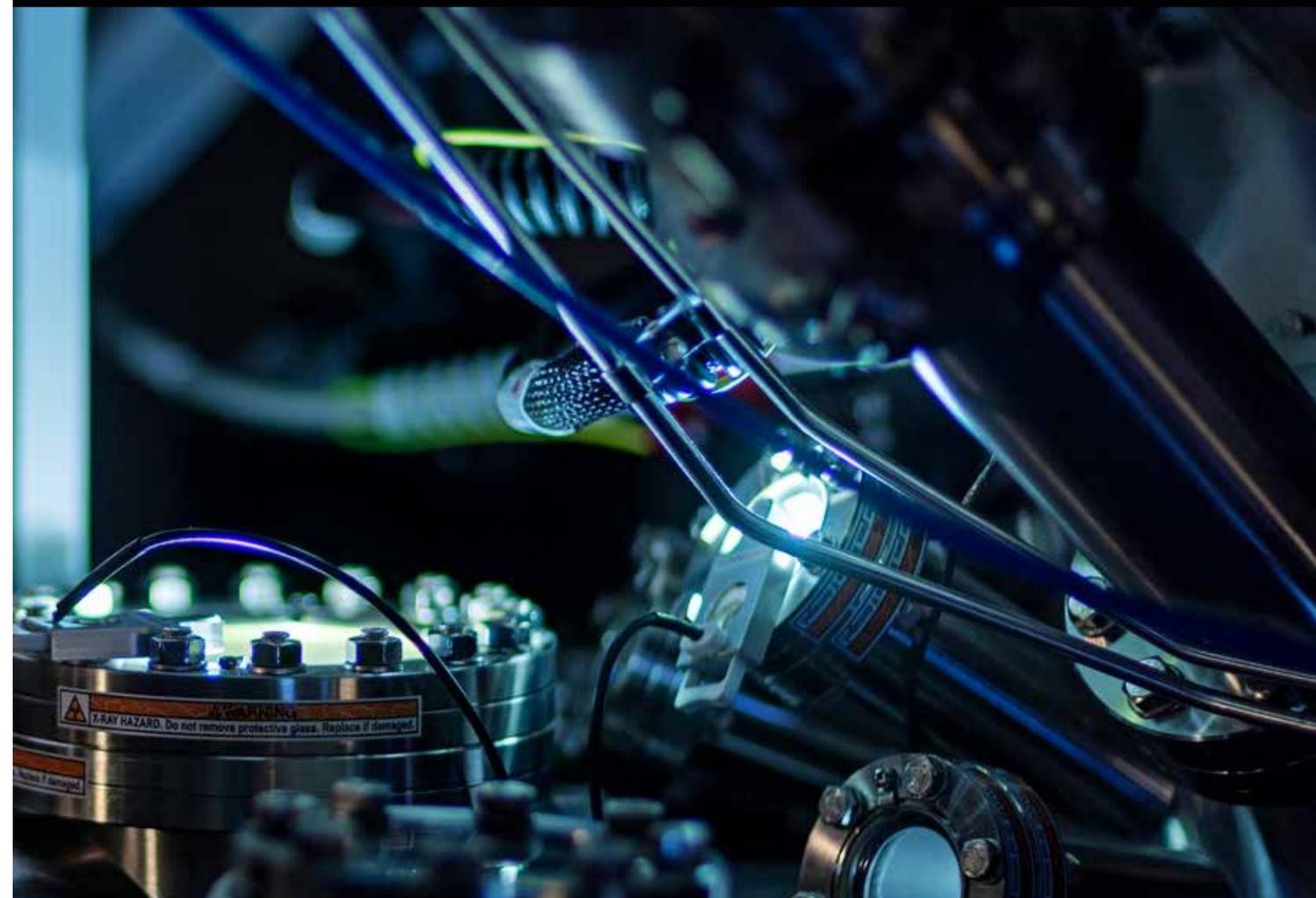


Photo from the ARPES lab showing viewports on the NanoESCA instrument.

## EXPERIMENTALISTS AT WORK

Our researchers in action in the Quantum Magnonics Lab.



# International Partners and Research Network

We are continuing the long-term collaboration with our Co-Principal Investigators and their groups, Professor Mathias Kläui at the Institute of Physics at Johannes Gutenberg University of Mainz in Germany, and Professor Rembert Duine at the Institute for Theoretical Physics at the University of Utrecht in the Netherlands, and our Prof II Chiara Ciccarelli from Cambridge University in the UK.



Professor Mathias Kläui

Professor Mathias Kläui is a leading experimental scientist, and a Professor II at QuSpin. A central theme of the collaboration has been spin transport in antiferromagnetic and altermagnetic insulators, where we have established fruitful synergies between experimental and theoretical developments. Combining the work of young and dynamic experimentalists in Trondheim and Mainz, with the support of our excellent theory activity, QuSpin is taking its experimental activity to the next level. In particular, the collaboration with JGU Mainz gives QuSpin access to state-of-the-art materials growth, characterization and transport measurements. Recently, exciting predictions on magnetic 2D materials have been corroborated in joint activities between Mainz and Trondheim. To strengthen our collaboration, joint PhD work where students from Mainz spend some time in Trondheim has started further support from a joint EU project between QuSpin members in Trondheim and Mainz.



Professor Rembert Duine

Professor Rembert Duine is a leading theoretician scientist in the quantum many-body physics of spin transport and spin excitations, and a Professor II at QuSpin. Landmark publications by Rembert Duine and his collaborators have led to the opening of new subfields of physics, such as magnetic skyrmion spintronics, antiferromagnetic spintronics, and cold spintronics. The insights gained in these developments give QuSpin complementary expertise in theoretical developments on magnetic insulators and topological matter. Most of the collaboration over the past year have focused on orbital magnetization.



Professor Chiara Ciccarelli

Professor Chiara Ciccarelli is a Professor of Physics at the University of Cambridge and Professor II at QuSpin since January 2025. In the past year, she has started some fruitful collaborations at QuSpin on spin transport in antiferromagnetic orthoferrites and ultra-fast superconducting spintronics. In 2024 her project PICaSSO has been awarded a ERC Consolidator grant, and since then a major focus of her research has been on applying THz/optical pump-probe techniques to study non-equilibrium effects in interfaced superconductors. This research has found fertile ground at QuSpin, a major leader on the theory of superconducting spintronics. The application of ultra-fast spectroscopy techniques available in Cambridge is shedding new light on the interplay between spintronics and superconductivity, further advancing the field into new exciting directions from both the fundamental and applications points of view.

The QuSpin Center is grateful for its opportunities to host visiting researchers that allow for interactions on a personal level, bolstering the professional work and exposure to new, ongoing, and past projects. In addition, we collaborate with internationally leading theoretical and experimental groups in many places around the world (See map next page).



**THE RESEARCH TEAM OF PROFESSOR MATHIAS KLÄUI** is part of the Institute of Physics at Johannes Gutenberg-Universität Mainz with more than 50 faculty members and more than 300 members in total. The Kläui lab group has 10 permanent staff and about 50 members including junior researchers and staff in total.



**THE GROUP OF PROFESSOR REMBERT DUINE** at the Institute for Theoretical Physics (ITP) is part of the Department of Physics, at the Science Faculty at the Utrecht University. The ITP hosts over 10 faculty members and 70 members including junior researchers in total. Professor Duine's group has one permanent staff, one Postdoc and 4 PhD candidates, as well as master and bachelor students.

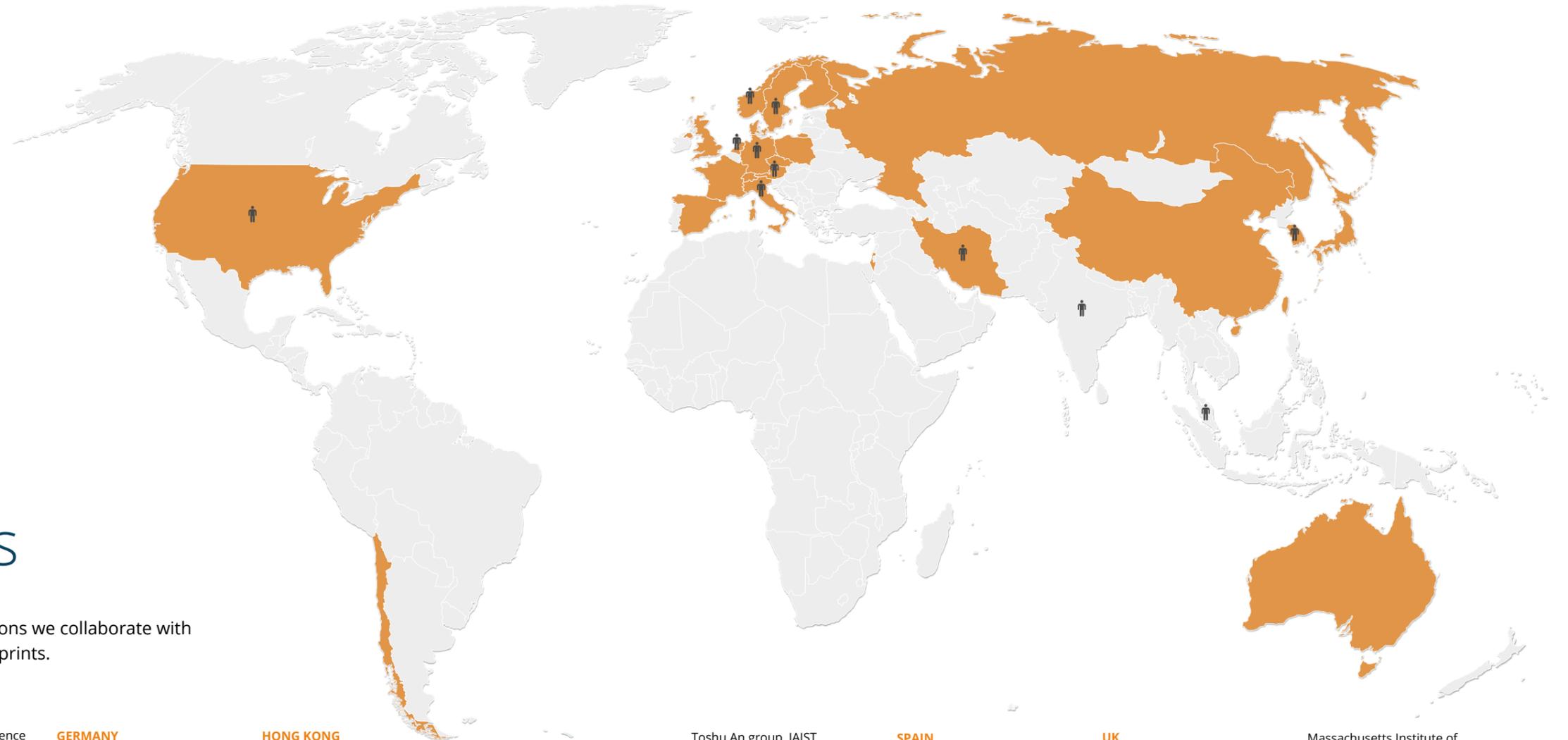


**THE GROUP OF PROFESSOR CHIARA CICCARELLI** is part of the Cavendish Laboratory at the University of Cambridge. Professor Ciccarelli's group has one permanent staff, 3 Postdocs and 6 PhD candidates.

 Countries with collaborators

 Nationality of our staff members

- Austria
- Germany
- India
- Iran
- Italy
- Malaysia
- Norway
- South-Korea
- Sweden
- The Netherlands
- USA



# Collaborators

The list below is an overview of the institutions we collaborate with as co-authors on published papers and preprints.

**AUSTRIA**  
Graz University of Technology, Graz

**CHILE**  
Universidad Adolfo Ibáñez, Santiago

**CHINA**  
Beijing University of Technology, Beijing  
Central South University, Changsha  
China Academy of Engineering Physics, Beijing  
Chinese Academy of Sciences, Beijing  
Chongqing University, Chongqing  
Jiao Tong University, Shanghai  
National Tsing Hua University, Hsinchu  
Shenzhen University, Shenzhen  
State Key Laboratory of Micro-nano Engineering Science, Tsung-Dao Lee Institute & School of Physics and Astronomy, Shanghai

Southern University of Science and Technology, Shenzhen  
University of Chinese Academy of Sciences, Beijing  
Wuhan University of Technology, Wuhan

**CZECH REPUBLIC**  
Czech Academy of Sciences, Prague

**DENMARK**  
University of Copenhagen, Copenhagen

**FINLAND**  
Department of Applied Physics, Aalto University, Aalto

**FRANCE**  
Nancy Université, Nancy  
Unité Mixte de Physique CNRS/Thales, Palaiseau  
Université de Strasbourg, Strasbourg  
Université Grenoble Alpes, Saint-Martin-d'Hères  
Université Paris-Saclay, Saint-Aubin

**GERMANY**  
Deutsches Elektronen-Synchrotron (DESY), Hamburg  
Fritz-Haber-Institute of the Max-Planck Society, Berlin  
Johannes Gutenberg University Mainz, Mainz  
Karlsruhe Institute of Technology, Karlsruhe  
Leibniz Institute, Dresden  
TU Kaiserslautern, Kaiserslautern  
Technical University of Munich, Munich  
University of Augsburg, Augsburg  
University of Cologne, Cologne  
University of Kiel, Kiel  
University of Konstanz, Konstanz  
University of Regensburg, Regensburg  
University of Würzburg, Würzburg  
Waltherr Meissner Institute for Low Temperature Research, Munich

**HONG KONG**  
The Hong Kong Polytechnic University, Hung Hom, Kowloon

**IRAN**  
Institute for Advanced Studies in Basic Sciences, Zanjan  
Institute for Research in Fundamental Sciences, Teheran  
University of Tehran, Tehran

**ISRAEL**  
Hebrew University of Jerusalem, Jerusalem

**ITALY**  
CNR-SPIN, Salerno  
Università di Milano-Bicocca, Milan  
University of Bologna, Bologna  
University of Genova, Genova  
University of Salerno, Fisciano

**JAPAN**  
Keio University, Tokyo  
RIKEN Center for Emergent Matter Science, Saitama

Toshu An group, JAIST, Kanazawa

**NORWAY**  
University of Oslo, Oslo

**POLAND**  
Adam Mickiewicz University, Poznań  
Institute of Nuclear Physics, Polish Academy of Sciences, Krakow

**ROMANIA**  
Technical University of Cluj-Napoca, Cluj-Napoca

**RUSSIA**  
Russian Academy of Sciences, Moscow  
Skolkovo Institute of Science and Technology, Moscow

**SINGAPORE**  
Department of Physics, National University of Singapore

**SPAIN**  
Donostia International Physics Center, Donostia-San-Sebastian  
Instituto de Ciencia de Materiales de Madrid (CSIC)  
Instituto de Física Fundamental, Madrid  
Universidad Autónoma de Madrid, Madrid

**SWEDEN**  
KTH Royal Institute of Technology, Stockholm  
Uppsala University, Uppsala

**SWITZERLAND**  
ETH Zürich, Zürich

**SOUTH KOREA**  
Center for Multidimensional Carbon Materials, Ulsan

**THE NETHERLANDS**  
Radboud University, Nijmegen  
University of Groningen, Groningen  
Utrecht University, Utrecht

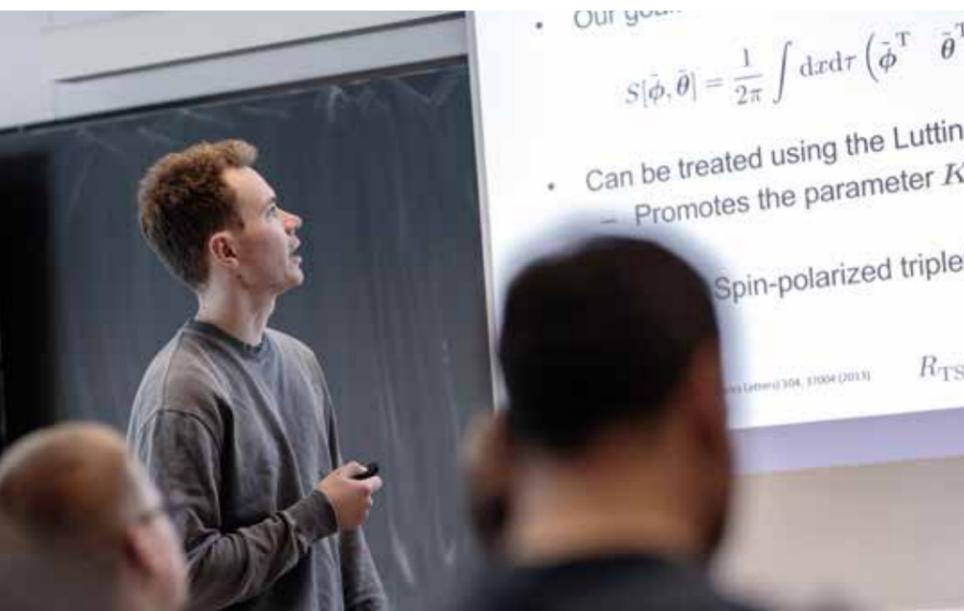
**UK**  
Cambridge Graphene Centre, Cambridge  
Hitachi Cambridge Laboratory, Cambridge  
Loughborough University, Loughborough  
Swansea University, Swansea  
University of Cambridge, Cambridge  
University of Central Lancashire  
University of Edinburgh  
University of York, York

**USA**  
Cubic Carbon Ceramics, Huntington  
Department of Electrical Engineering and Computer Science, MIT, Cambridge, Massachusetts  
Department of Physics, MIT, Cambridge, Massachusetts  
Department of Physics and Astronomy, University of Missouri  
Harvard University, Cambridge, MA

Massachusetts Institute of Technology, Cambridge  
National High Magnetic Field Laboratory, Tallahassee  
Lincoln Laboratory, MIT, Lexington, Massachusetts  
Research Laboratory of Electronics, MIT, Cambridge, Massachusetts  
University at Buffalo, State University of New York  
University of California, Berkeley  
University of California, Riverside  
University of Central Florida, Orlando  
University of Chicago, Chicago

# Research Training of our PhD candidates and Postdocs

We wish to train the next generation of researchers within our field so that they can take on leadership for new projects of their own, as well as gain experience by co-supervising our PhD candidates and Master's students.



*Glimpses from various collaboration settings at our center.*

We organize a range of workshops and seminars at the Center where the speakers present their work, share ideas and discuss the challenges they face. Our regular Journal Club provides training in presenting a scientific article and its essence for discussion. These are valuable experiences in the process of their work and in writing articles for publication as well as giving talks at international conferences and workshops.

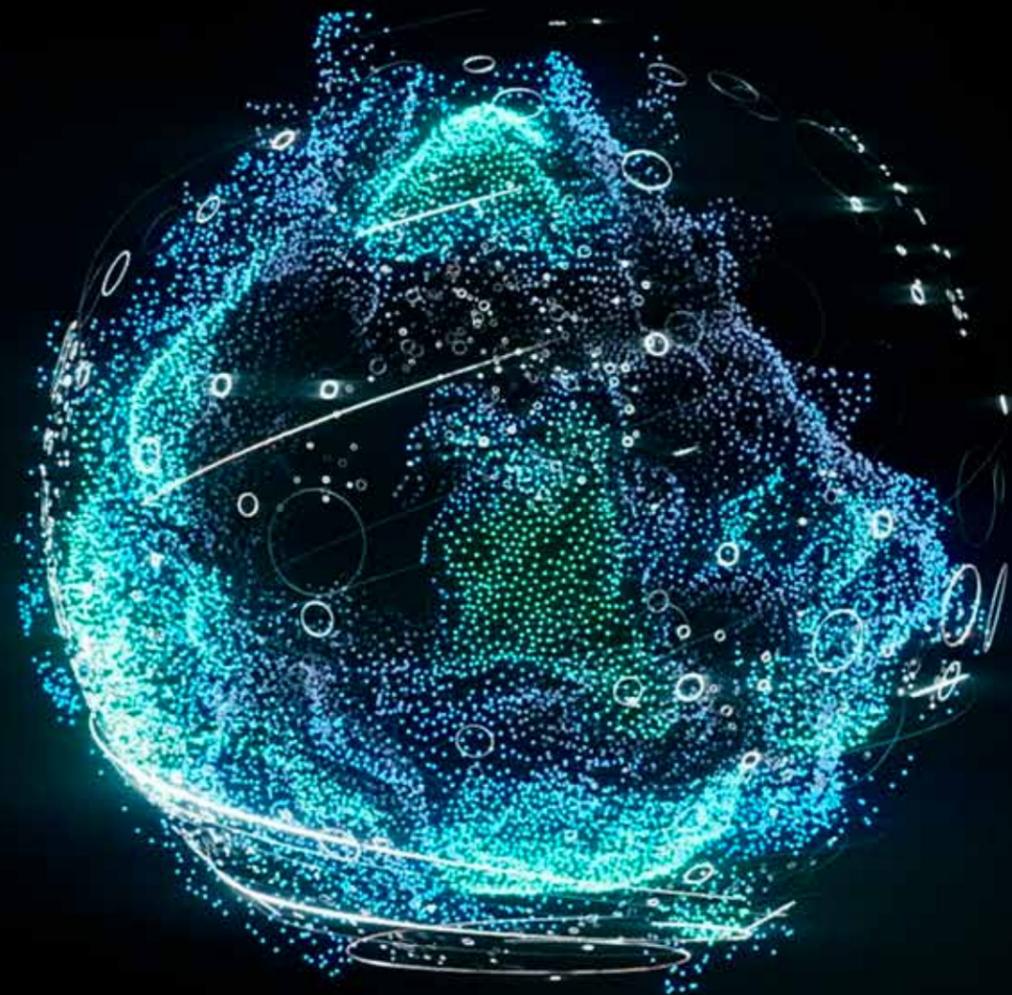
In addition, interesting talks by guest researchers give us an opportunity to extend our understanding of ongoing work by colleagues, and opportunities for fruitful collaborations.

In the self-organized Idea Forum, younger researchers share projects, ideas, and research challenges, stimulating collaboration across the theoretical and experimental fields, as well as between PhD candidates, Postdocs and researchers.

Excellent research deserves excellent communication. Scientific presentations should be understandable, engaging and memorable. In 2025, we offered all levels of staff at QuSpin, from professors to PhD candidates, intensive workshops where they trained on all aspects of public speaking and practised giving constructive feedback to each other. The goal was to strengthen their creative

confidence and to encourage them to develop their own unique, personal presentation style – always with the memorability factor in mind.

The professors' teaching, supervision, and curriculum remain the primary source for each PhD candidate's research training. However, we see that all the other activities have a significant added value.



# The QuSpin Mobility Grant

Encouraging our PhD candidates to seek international research experience, broaden their cultural outlook and extend their network.

In 2022 we established the QuSpin Mobility Grant which our PhD candidates can apply for in connection with research stays abroad if their application provides a clear explanation on how the research stay will benefit their current project and QuSpin.

The purpose of this grant is to learn and transfer research methods or techniques relevant to the project and QuSpin as a whole. We emphasize that these research stays should create stronger professional relationships between the host, the PhD candidate and QuSpin, and that it should result in a joint publication.

The grant will typically cover travel and accommodation costs. Candidates can apply for financial support for up to three months for a research stay. After the completion of the research term the applicant is required to present findings and experiences during the annual research conference. In addition, a presentation will be required at the Center and on our webpage.

One PhD candidate received the Mobility Grant 2025/2026. Johanne Bratland Tjernshaugen is visiting professor Karsten Flensberg at the Center for Quantum Devices at the Niels Bohr Institute in Copenhagen for three months from 1. November 2025 to 31. January 2026. Her project is to study protected Andreev spin qubits.

*We encourage our students to engage with our global research network.*

# Mentoring



## Monthly cafes for female students

Facilitating QuSpin cafes started in 2022. During the spring of 2025, we reached out to female students from year one at the Department of Physics—by email, poster and one-to-one contact—to invite them to our QuSpin cafes. The goal of these cafes is for female role models to present the research at QuSpin and inspire and attract more female students to our field of physics, within both theory and experimental activities.

During spring 2025 we had a around 20 students participating. Their feedback showed how important it is for them to meet role models, to be presented to our field of science, and to get information about opportunities within the study and research fields, and about career possibilities.

The cafes allowed for valuable discussions amongst the participants around questions and experiences related to diversity and inclusion in their study environment and working life, as well as career challenges and opportunities.

According to the study advisors, these cafes have been an important recruitment arena to the studies within our field.

We have continued the Balance program 2021-2022, offering mentoring to our female PhD candidates—to researchers pursuing a career within academia and in the industry alike.

Some examples of issues in the interaction between mentor and mentee in our program have been:

- What should be one's academic priorities in pursuing an academic career, and how to combine this with family life?
- How to balance research opportunities with challenges in professional and personal life?
- How to make the transition from academia to the industry, writing applications and being prepared for a different working culture?
- How to handle a new role in a new working environment and tackle challenges that come with it?
- How to find support in the career development process and increase visibility in the research community?
- How to write job applications in Academia and work on extending your research network?

In 2025, Johanne Bratland Tjernshaugen was mentored by Professor Jason Robinson at Cambridge University and Stefanie Brinkman by Signe Haver from 3B, Oslo.

Here they share some of their experiences:



## PHD JOHANNE B. TJERNSHAUGEN

### My background for choosing physics

I have always been curious about how nature works, and already in lower secondary school, I started dreaming of a research career. Although I enjoyed

all the natural sciences, it was physics that really caught my interest. In particular, I found quantum physics fascinating because its rules are so different from our everyday world. I wanted to better understand the laws and implications of quantum mechanics, so I decided to do my master's degree in condensed matter theory, and then I continued with a PhD at QuSpin.

### Doing a PhD at QuSpin and the research environment

There are several reasons why I enjoy doing a PhD at QuSpin. Firstly, the people here are nice and engaged, always happy to discuss physics, and this creates an excellent atmosphere for learning, exploring, and developing new ideas. Secondly, QuSpin has a large network that enables collaborations with experimentalists and theoreticians abroad. Moreover, QuSpin supports research stays abroad through the Mobility Grant, which is an excellent opportunity to gain international experience. Thirdly, I get valuable career advice on navigating academia through conversations with QuSpin members and through the mentor program.

### Experiences from being a mentee and from career development

In our regular meetings, my mentor gave me concrete advice on how to make the most out of conferences, how to expand my scientific network, and what I should and should not do to prepare for a career in academia. I also got the opportunity to visit my mentor's group for five days. As a theoretician, it was interesting to stay with a group of experimentalists whose work is thematically close to mine. It gave me insight into the possibilities and constraints they meet when designing experiments, as well as many new contacts on the experimental side, which will be invaluable for my future research.



## PHD STEFANIE BRINKMAN

### My background for choosing physics

I chose physics because I wanted to study something fundamental and challenging. I like the idea that physics provides a relevant basis that can be applied to many different fields. Initially, I was

more drawn to its medical applications, but as I learned more about quantum phenomena, I realized this could be interesting as well, especially considering the potential for energy-efficient devices.

### Doing a PhD at QuSpin and the research environment

After getting a taste of PhD life during my master's project at QuSpin, I decided to apply. What I like about our ARPES research group is that we collaborate very closely – we meet regularly, and everybody is usually up to date on each other's projects. This helps a lot when you get stuck. Regarding the research environment, I think QuSpin as a whole and our research group would benefit from having more women. Research (e.g. from VHTO) shows that visible female role models are very important in order for women to choose a career in STEM. Even though I'm not always thrilled about being asked to contribute to promotional content for QuSpin, I do see how useful it can be to make women in STEM more visible to those who struggle to picture themselves in such a career. In this regard, I also hope that initiatives such as the QuSpin cafes for female physics students will be continued.

### Experiences from being a mentee and from career development

I had a good experience as a mentee in the program. Signe helped me navigate the job application process and think about life after my PhD. By connecting me with others in her network, I was able to hear personal experiences from women in positions similar to mine.

Both mentors Jason Robinson and Signe Haver have been very generous in their roles as mentors by being accessible, listening, offering their advice, sharing their network, and connecting this year's with previous years' mentees and their experiences.

# Our Annual International Conference



The speakers at the conference. From left: Daniel Agterberg, Johan Åkerman, Caroline A. Ross, Yaroslav Tserkovnyak, Libor Šmejkal, Kjetil Hals, Dominik Kriegner, Tomas Löfwander, Karin Everschor-Sitte, Tero Heikkilä, Hendrik Bentmann, Annika Johansson, Giorgio Sangiovanni, Angelo Di Bernardo, and Pavlo Sukhachov.



Speakers and some of the participants.

It is vital for our researchers to gather with leading international professionals outside QuSpin. Targeted conferences spark inspiring dialogues around current challenges and findings and are the ideal breeding ground for a creative environment for focused peer discussions.

From 4-6 June 2025, we had the pleasure of organizing our annual three-day conference once more at Scandic Nidelven, nicely located by the river and in walking distance from the city center and the Trondheim fjord.

Fifteen speakers, representing the theoretical and the experimental areas alike, shared their perspectives and work with around sixty-five participants present at the conference center. The various talks on state-of-the-art research were very inspiring to us all. The size of the conference, with its open and rather informal atmosphere, invited to interaction on many levels.

It is important for QuSpin to not only offer a stage to senior scientists but also give younger researchers in the early phase of their careers the opportunity to gain presentation training and get feedback and have discussions on their scientific work.

In our conferences, we also include poster sessions presenting work from our center and other participants. This creates a basis for many fruitful and enjoyable discussions among fellow researchers and results in concrete collaborations between international researchers. The Best Poster Award 2025 was handed out on the last day of the conference.

Every year we present a taste of what our city has to offer on the historical and cultural levels. This time, we invited everyone to a guided walk through the old parts of the city with its famous cathedral Nidarosdomen, the old warehouses along the river, and the narrow alleys with their characteristic low wooden houses.

An exciting, high-speed tour in RIB boats up the Nidelven river and out in the fjord allowed the participants to experience our historical city from the water.

The conference dinner was held at Dokkhuset Scene, an old wharf which now holds the center of the vibrant classical and jazz scene in our student town. Three internationally renowned classical string musicians performed beautiful pieces of music.

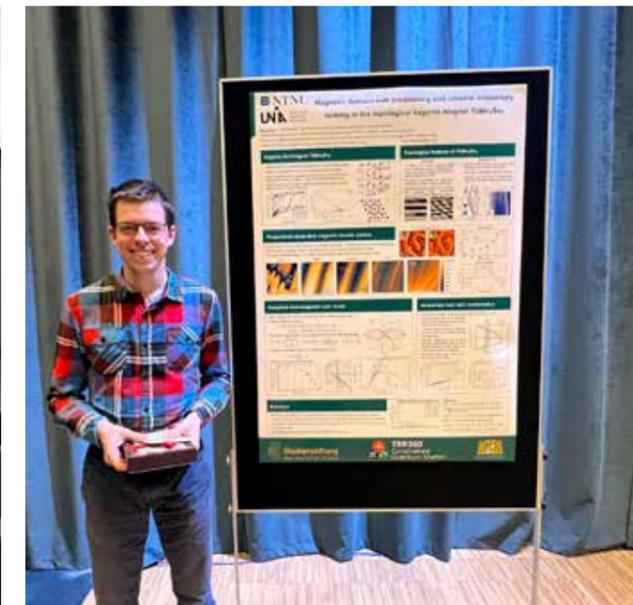
We look forward to our next three day conference which will take place from 2-4 June 2026.

See more info on the talks, see conference program on our <https://www.ntnu.edu> or scan the QR code below.



## QUANTUM SPINTRONICS 2025

Here are some glimpses from the conference showing researchers at work as well as enjoying social activities.



# International Collaboration Workshop at Øyna

Our 2025 international collaboration workshop took us to Øyna Kulturlandskapshotell at Inderøya, 110 km north of Trondheim. We were forty participants from QuSpin, Cambridge University, the Johannes Gutenberg University in Mainz, and the University of Utrecht.

We enjoyed three engaging days of presentations from our younger scientists from all four research groups, which gave us an excellent overview of the latest cutting-edge research and laid the basis for new ideas and collaborations.

The location was perfect for social interactions through work as well as play, and was an important contribution to strengthening our research network.

It is deeply impressive to experience how strong our younger researchers are—both academically and in their ability to communicate. In meetings like these, we see how collaboration develops ideas further and drives the field of research forward.



## QUSPIN COLLABORATION WORKSHOP 2025

Here are some glimpses from the workshop showing researchers at work as well as enjoying social activities.



# PhD Defenses and Completed Master Theses

We congratulate our PhD candidates who successfully completed their defenses and our Master's students who completed their theses. We wish them all the best in the next phase of their journey!

## COMPLETED PHD'S

**Benestad, Jacob.** PhD defense August 29th, 2025.  
Title: *Hamiltonian estimation and automated tuning in solid-state quantum devices.*  
Supervisor professor Jeroen Danon, NTNU. Co-supervisor professor Evert van Nieuwenburg, Leiden University, the Netherlands.

**Brehm, Verena.** PhD defense February 14th, 2025.  
Title: *Magnonic Phenomena in Low-Dimensional Magnetic Insulators: Mechanisms and Applications.*  
Supervisor research professor Alireza Qaiumzadeh. Co-supervisor professor Arne Brataas.

**Chatterjee, Payel.** PhD defense January 28th, 2025.  
Title: *Exploring the Growth Dynamics of Kagome Lattice Thin Films by Molecular Beam Epitaxy.*  
Supervisor associate professor Christoph Brüne. Co-supervisor professor Dennis Meier.

**Falch, Vemund.** PhD defense September 1st, 2025.  
Title: *Quantum and classical dynamics of magnons coupled to plasmons, photons and phonons.*  
Supervisor professor Arne Brataas. Co-supervisor professor Jeroen Danon.

**Frostad, Therese.** PhD defense March 1st, 2025.  
Title: *Control of Magnon Condensates.*  
Supervisor professor Arne Brataas. Co-supervisor professor Justin Wells.

**Hartl, Matthias.** PhD defense May 12th, 2025.  
Title: *Epitaxial Growth of Chalcopyrite via Molecular Beam Epitaxy.*  
Supervisor associate professor Christoph Brüne. Co-supervisor professor Justin Wells.

**He, Longfei.** PhD defense April 25th, 2025.  
Title: *Growth Study of the Kagome Material Mn<sub>3</sub>Sn via Molecular Beam Epitaxy.*  
Supervisor associate professor Christoph Brüne. Co-supervisor professor Dennis Meier.

**Hodt, Erik Wegner.** PhD defense June 27th, 2025.  
Title: *Quantum phenomena in magnetically polarized and superconducting lattice models.*  
Supervisor professor Jacob Linder. Co-supervisor professor Asle Sudbø.

**Strand, Frode Sneve.** PhD defense February 13th, 2025.  
Title: *Advanced Photoemission Studies of Low-Dimensional Quantum Materials.*  
Supervisor professor Justin Wells. Co-supervisor researcher Simon Coill.

**Aase, Niels Henrik.** PhD defense June 20th, 2025.  
Title: *Emergent quantum effects in multicomponent fermionic systems.*  
Supervisor professor Asle Sudbø. Co-supervisor professor Jeroen Danon.



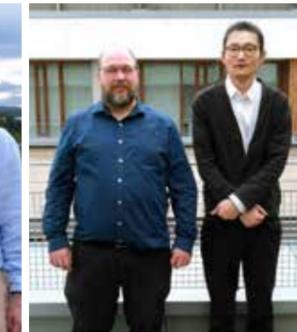
Jacob Linder and Erik W. Hodt.



Frode S. Strand and Justin Wells.



Vemund Falch and Arne Brataas.



Christoph Brüne and Longfei He.



Niels Henrik Aase and Asle Sudbø.



Christoph Brüne and Payel Chatterjee.



Therese Frostad and Arne Brataas.



Jacob Benestad and Jeroen Danon.



Alireza Qaiumzadeh and Verena Brehm.



Christoph Brüne and Matthias Hartl.

## COMPLETED MASTER THESES

**Hamre, Markus Tiller.** Title: *Transverse transport in antiferromagnets with magnon-phonon hybridization.*  
Supervisor professor Asle Sudbø.

**Karlsen, Eric Boström.** Title: *Spin-pumping with a triplet superconductor.* Supervisor Jacob Linder.

**Kulseng, Ola Tangen.** Title: *Reentrant resistance in superconducting spin valves.* Supervisor Jacob Linder.

**Myhre, Mathias.** Title: *Thickness dependence of magnon transport in antiferromagnetic insulators.*  
Supervisor researcher professor Alireza Qaiumzadeh.

**Sanchis, Ana Sempere.** Title: *Phonon-mediated hole-spin relaxation rate in Ge-based quantum dots.*  
Supervisor professor Jeroen Danon.

**Stapnes, Andreas Solberg.** Title: *Schwinger-Boson based Mean-Field Dynamics of a 2D Antiferromagnetic and Minimal Altermagnetic mode.*  
Supervisor professor Jacob Linder.

**Svae, Eivind.** Title: *Entanglement entropy in spin system ground states with fractal support. Subtitle: Numerical estimates for the one-dimensional Heisenberg ferromagnet supported on Julia sets.*  
Supervisor associate professor John Ove Fjærestad.

**Vågslid, Åsmund.** Title: *Entanglement entropy in systems with topological order. Subtitle: Exact and perturbative calculations on Kitaev models.*  
Supervisor associate professor John Ove Fjærestad.

# Honors and Grants

We had a great year with several honors and grants to our researchers. We highly appreciate the acknowledgment of our colleagues work, and the opportunities this represents for the further development of our center.



## RCN FRIPRO GRANT

**Professor Asle Sudbø is Primary Investigator** in a project that has received 12 MNOK 2026-2029 under the Norwegian Research Council Researcher Project for Scientific Renewal, Enabling Technologies with the title Nanoscale imaging of magneticskyrmions in thin film devices (NIMSKY). The Nanoscale project is run by Associate Professor Magnus Nord (project leader, Department of Physics) together with the PIs David Barrett (Department of Material Technology/Department of Electronical Systems), Sigurd Wenner (research scientist SINTEF/Materials and Nanotechnology) and professor Asle Sudbø (SFF QuSpin).



## RCN FRIPRO GRANT

**Professor Jacob Linder has received a RCN Fripro grant of 9 MNOK on the program** "Coordination and Support Activity/Support for Researcher Mobility 2026-2029". This is linked to his and professor Jeroen Danon's FriPro grant awarded in 2024, entitled "Superconducting orbitronics in hybrid systems". Dr. Pavlo Sukhachov from the University of Missouri, USA will be hired as researcher at QuSpin as well as a new PhD candidate.



## RCN FRIPRO GRANT

**Research professor Alireza Qaiumzadeh has received a RCN Fripro grant of 9 MNOK on the program** "Coordination and Support Activity/Support for Researcher Mobility 2026-2029". This is linked to his FriPro grant awarded in 2024, entitled "Unconventional Thermoelectric Quantum Transport in Novel 2D Magnetic Heterostructures (QTransMag)". Dr. Tohid Farajollahpour from Brock University, Canada will be hired as researcher at QuSpin as well as a new PhD candidate.



## AUSTRALIAN FEDERAL MEDAL FOR "WOMEN IN PHYSICS LECTURER"

**Senior researcher Sol Jacobsen received this award.** The award is made annually to recognise and publicise significant contributions by a woman to advancing a field of physics and to inspire future physicists. The award recipient receives a medal, a certificate, and appropriate support to provide a lecture tour across Australia. <https://www.aip.org.au/Women-in-Physics-Lecturer>



## HIGHLY RECITED RESEARCHER 2025

Co-PI Professor Dr. Mathias Kläui is one of the Highly Recited Researchers 2025 who has demonstrated significant and broad influence in their field(s) of research. Each researcher selected has authored multiple Highly Cited Papers™ which rank in the top 1% by citations for their field(s) and publication year in the Web of Science™ over the past decade. Source: Clarivate.



## MARTIN LANDRØ'S AWARD 2025

**MSc graduate Jostein Negård Kløgetvedt received 2025 biannual Martin Landrø's award** for an excellent master's thesis in physics from Norsk Fysisk Selskap. Jostein finished his master's thesis spring 2023 under the supervision of Research Professor Alireza Qaiumzadeh at QuSpin. The title of the thesis is "Topological Magnon-Phonon Hybrid Excitations and Hall Effects in Two-Dimensional Ferromagnets". Two articles published in Physical Review B journal are based on this thesis.



## AWARD BEST SCIENCE MASTER 2025

**Åsmund Vågslid has received the award for "Best Master's Student in Physics" at the NV Faculty, NTNU.** He has impressed his supervisor with his independence, initiative and analytical skills. Throughout his work, he has used several methods to analyze the entanglement entropy in ground states for Kitaev models. With a solid academic background and a unique ability to find relevant research articles and perform calculations on his own, he has stood out as an exceptionally capable student. Supervisor: Associate professor John Ove Fjærestad.



## AWARD BEST MASTER IN TECHNOLOGY 2025

**Master student Andreas Solberg Stapnes, a student at the Civil Engineering program in Physics and Mathematics, received the award for "Best Technology Master" at the NV Faculty, NTNU.** He has achieved top grades in all subjects except one and has demonstrated exceptional academic skills. His master's thesis on the time dynamics of altermagnetic systems under the influence of ultrafast laser pulses combines fundamental physics with technological relevance. His work has already formed the basis for a forthcoming research article in Physical Review B. Supervisor: Professor Jacob Linder.

# Talks and Presentations

One of our key goals is to make physics in general, and the research at our Center in particular, attractive to other researchers and students. And by sharing the work through accessible language and tangible examples, illustrating why our research is crucial and worth funding. This year our researchers were giving various talks, both locally and internationally. Here is a rough overview.

## JANUARY

### Mini-Symposium Cavity QED with many-body systems, University of Hamburg, Germany.

Talk by senior researcher Sol Jacobsen. Title: *Strong Cavity Coupling to High-Frequency Antiferromagnetic Magnons*.

### University of Seville Physics and Material Science Doctoral Day, University of Seville, Seville, Spain.

Talk by senior researcher Sol Jacobsen. Title: *Into the Light: Towards unified quantum optics and condensed matter computation*.

### NV Fakultetsdag 2025

Talk by professor Asle Sudbø. Title: *Fundamental Research and Disruptive Quantum Technologies*.

## FEBRUARY

### Advances in Magnetism (IEEE), Italy.

Talk by senior researcher Sol Jacobsen. Title: *Controlling superconductivity with curvilinear magnetism*.

### International Day for Women and Girls in Science outreach event, Grete Hermann Network, Ct.Qmat Excellence Cluster, Dresden/Würzburg (online), Germany.

Talk by senior researcher Sol Jacobsen. Title: *My route into theoretical quantum physics*

## MARCH

### DPG Spring Meeting of the Condensed Matter Section (SKM), Regensburg, Germany.

Talk by PhD candidate Kristoffer Leerand. Title: *Phonon-mediated unconventional superconductivity in altermagnets: A solid-state analog of the A<sub>1</sub> phase of superfluid Helium 3*.

### NTNUs meeting with the Minister of Education and Research, Sigrun Aasland, in Trondheim, Norway.

Talk by senior researcher Sol Jacobsen. Title: *Kvantefysikk – briefing*.

## APRIL

### 19th Capri Spring School, Italy.

Talk by PhD candidate Kristoffer Leerand. Title: *Phonon-mediated spin-polarized superconductivity in altermagnets*.

### International Conference on Superconductivity and Magnetism 2025 (Keynote presentation), ICSM, Fethiye, Tyrkey.

Talk by senior researcher Sol Jacobsen. Title: *Bending-strain effects in superconducting spintronics*.

### International Conference on Superconductivity and Magnetism 2025, ICSM, Fethiye, Tyrkey.

Talk by postdoctoral fellow Morten Amundsen. Title: *Dynamical spin-orbit coupling in superconducting hybrid structures*

### Theoretical quantum matter seminar, The Nordic Institute for Theoretical Physics, Stockholm, Sweden.

Talk by PhD candidate Erlend Siljåsen. Title: *Inverse Faraday effect in quantum Hall states*.

## MAY

### Hybrid Workshop on Collective Phenomena in Crystalline Materials, IPM (online), Iran.

Talk by research professor Alireza Qaiumzadeh. Title: *Exploring Topological Magnons and Hybrid Magnonic Systems in Layered van der Waals Magnetic Materials*.

## JUNE

### Fysikermøte 2025, Norwegian Physical Society, NTNU, Trondheim, Norway.

Talk by associate professor Christoph Brüne. Title: *Antiferromagnetic thin films grown via MBE*.

### Fysikermøte 2025, Norwegian Physical Society,

NTNU, Trondheim, Norway. Talk by PhD candidate Kristoffer Leerand. Title: *Phonon-mediated spin-polarized superconductivity in altermagnets*.

### Fysikermøtet 2025, Norwegian Physical Society, Trondheim, Norway.

Talk by PhD candidate Sondre Duna Lundemo. Title: *Quantum criticality of altermagnetism*.

### Fysikermøtet 2025, Norwegian Physical Society, Trondheim, Norway.

Talk by senior researcher Sol Jacobsen. Title: *Interacting with superconductors*.

### Fysikermøtet 2025, Norwegian Physical Society, Trondheim, Norway.

Talk by PhD candidate Johanne Bratland Tjernshaugen. Title: *Large tunable thermoelectric effects in superconducting spin valves*.

### Mini lecture series on superconductivity, University of Tasmania, Tasmania, Australia.

Talk by senior researcher Sol Jacobsen. Title: *Introduction to Superconductivity - mini-series*. Three lectures on the introduction to superconductivity.

## JULY

### 4th Sino-German Workshop on 2D materials & Topological Spintronics Mainz July 16-18, 2025.

Talk by professor Asle Sudbø. Title: *Phonon-mediated spin-polarized superconductivity in altermagnets*.

### 4th Sino-German Symposium on 2D materials and topological spintronics, Helmholtz Institut, Mainz, Germany.

Talk by professor Asle Sudbø. Title: *Unconventional superconductivity in altermagnets*.

### International Workshop on Unconventional Magnetism in Quantum Materials, IFW Leibnitz Institut Dresden and Kyiv Academic University, Kyiv, Ukraina.

Talk by professor Asle Sudbø. Title: *Phonon-mediated spin-triplet superconductivity in altermagnets*.

### School outreach seminar and discussion, Australian Institute of Physics, Launceston College, Tasmania, Australia.

Talk by senior researcher Sol Jacobsen. Title: *What does it take to be a quantum physicist?*

### School outreach seminar tour, Australian Institute of Physics, Rosny College and Elisabeth College, Tasmania, Australia.

Talk by senior researcher Sol Jacobsen. Title: *What does it take to be a quantum physicist?*

### School presentation, Australian Institute of Physics, Devonport College, Tasmania, Australia.

Talk by senior researcher Sol Jacobsen. Title: *What does it take to be a quantum physicist?*

### Marie Curie Lecture Hobart, Tasmanian Branch of Australian Institute of Physics, Hobart, Australia.

Talk by senior researcher Sol Jacobsen. Title: *Your Quantum Future*.

## AUGUST

### Norwegian Academy of Technological Sciences (NTVA), Trondheim, Norway

Talk by professor Asle Sudbø. Title: *Fundamental Research and Disruptive Quantum Technologies*.

### Presentation to the Ministry of Education and Research, Trondheim, Norway

Talk by professor Asle Sudbø. Title: *Center for Quantum Spintronics at NTNU*.

### Computational multi-scale materials society (COSY) Gemini Center event, Trondheim, Norway.

Talk by research professor Alireza Qaiumzadeh. Title: *Atomistic vs. micromagnetic spin dynamics simulations*.

### International Workshop on Innovation for Quantum Sensing Technologies, Svolvær, Norway.

Talk by research professor Alireza Qaiumzadeh. Title: *Light-matter interactions: spintronic-based cavity QED and Floquet engineering*.

### IOP Conference on Quantum Geometry in Quantum Material, IOP, Bath, UK.

Talk by research professor Alireza Qaiumzadeh. Title: *Uncovering the Microscopic Origin and Engineering of Topological Magnons in Layered van der Waals Magnets*.

### Claire Corani Memorial Lecture/Marie Curie Public Lecture, South Australia branch of Australian Institute of Physics, Adelaide, Australia.

Talk by senior researcher Sol Jacobsen. Title: *Your Quantum Future*.

### Marie Curie Public Lecture, Queensland branch of Australian Institute of Physics, Brisbane, Australia.

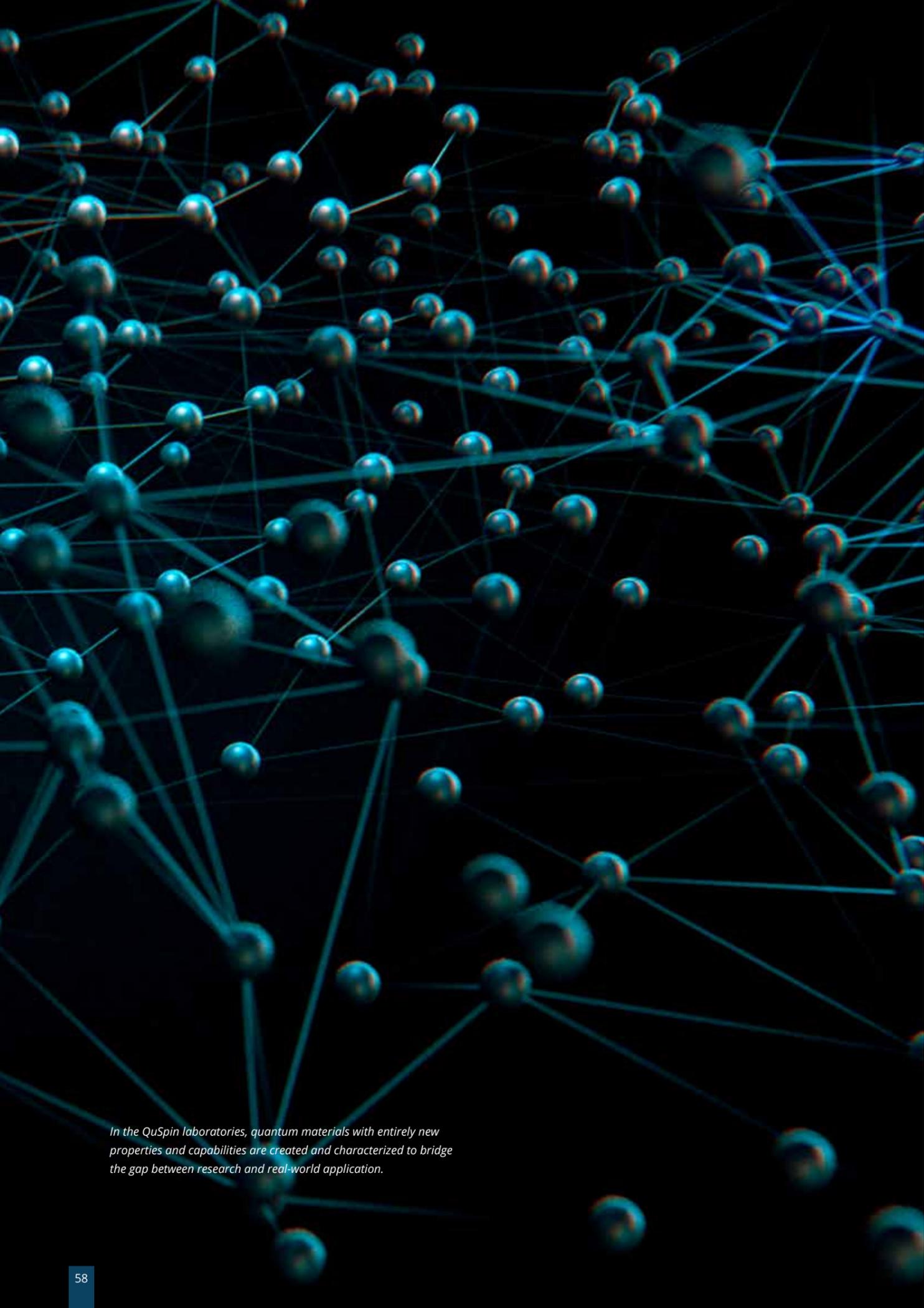
Talk by senior researcher Sol Jacobsen. Title: *Your Quantum Future*.

### Marie Curie Lecture Canberra, Australian Capital Territory branch of Australian Institute of Physics, Canberra, Australia.

Talk by senior researcher Sol Jacobsen. Title: *Your Quantum Future*.

### Marie Curie Public Lecture and Women In Physics Award Ceremony, Australian Institute of Physics, Wollongong, New South Wales, Australia.

Talk by senior researcher Sol Jacobsen. Title: *Your Quantum Future*.



In the QuSpin laboratories, quantum materials with entirely new properties and capabilities are created and characterized to bridge the gap between research and real-world application.

**School outreach seminar tour, Australian Institute of Physics, Canberra, Adelaide, Brisbane and Gold Coast schools and colleges, Australia.**

Talk by senior researcher Sol Jacobsen. Title: *What does it take to be a quantum physicist?*

**School of Mathematics and Physics Research Colloquium, University of Queensland, Brisbane, Australia.**

Talk by senior researcher Sol Jacobsen. Title: *Superconductivity for computation and communication using magnetism, light and strain.*

**Joint AIP-ANU Physics Director's research colloquium, Australian National University, Australian National University, Canberra, Australia.**

Talk by senior researcher Sol Jacobsen. Title: *Investigating superconductivity for computation and communication using magnetism, light and strain.*

**Marie Curie Girls in Physics Breakfast, University of Queensland, University of Queensland, St.Lucia campus, Australia.**

Talk by senior researcher Sol Jacobsen. Title: *Sol Jacobsen: Marie Curie Lecture.*

**SEPTEMBER**

**XIII International Conference on Magnetic and Superconducting Materials (MSM25), Yerevan, Armenia.**

Talk by research professor Alireza Qaiumzadeh. Title: *Electrically Controlled Crossed Andreev Reflection in Two-dimensional Antiferromagnets.*

**Nordic Conference on New Trends in Condensed Matter Physics, University of Copenhagen, Niels Bohr Institute, Copenhagen, Denmark.**

Talk by professor Asle Sudbø. Title: *Unconventional superconductivity in altermagnets.*

**Physics Seminar, Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany.**

Talk by senior researcher Sol Jacobsen. Title: *Proximity-effects of curvilinear magnetism and strain on conventional superconductivity.*

**OCTOBER**

**The Norwegian Academy of Science and Letters (DNVA)**

Symposium "Kvantemekanikken 100 år: Fra usikkerhetsrelasjonen til høyteknologi".  
Talk by professor Asle Sudbø. Title: *Quantum Physics and First Generation Quantum Technologies.*

**QuSpin Collaboration workshop, Øyna, Norway**

Talk by PhD candidate Sondre Duna Lundemo. Title: *Quantum criticality of altermagnetism.*

**QuSpin Collaboration workshop, Øyna, Norway**

Talk by PhD candidate Johanne Tjernshaugen. Title: *Designing lattice spin models and magnon gaps with supercurrents.*

**QuSpin Collaboration workshop, Øyna, Norway**

Talk by PhD candidate Anders Mathisen. Title: *Peierls-induced topological Weyl Semimetal in PtBi<sub>2</sub>.*

**QuSpin Collaboration workshop, Øyna, Norway**

Talk by PhD candidate Hans Gløckner Giil. Title: *Spin Seebeck Effect and Magnonic USMR: Spin Transport in the van der Waals Antiferromagnet CrPS<sub>4</sub>.*

**NOVEMBER**

**Soft xray workshop, Hamburg, Germany.**

Talk by PhD candidate Anders Mathisen. Title: *Peierls-induced topological Weyl Semimetal in PtBi<sub>2</sub>.*

**SPICE-SPIN + X Seminar (Digital)**

Talk by professor Jacob Linder. Title: *Superconducting spintronics with magnetically compensated materials.*

**DECEMBER**

**Friday Colloquium, Department of Physics, NTNU, Trondheim, Norway**

Talk by professor Asle Sudbø. Title: *The Nobel Prize in Physics 2025.*

**Trondhjem Polytechnic Society (TPF), Trondheim, Norway**

Talk by professor Asle Sudbø. Title: *Kvantedatamaskiner*

# Highlights

PhD Defense  
Payel Chatterjee



JANUARY

PhD Defense  
Therese Frostad



MARCH

"Nysgjerrigpoden"  
RCN Podcast  
Asle Sudbø



PhD Defense  
Longfei He



APRIL

QuSpin Annual  
International Conference



PhD Defense  
Matthias Hartl



PhD Defense  
Niels Henrik Aase



JUNE

RCN Fripro Grant  
Professor Asle Sudbø



RCN Fripro Grant  
Professor Jacob Linder



RCN Fripro Grant  
Research professor  
Alireza Qaiumzadeh



One of the 2025  
Highly Cited Researchers  
Professor Dr. Mathias Kläui



DECEMBER

FEBRUARY



PhD Defense  
Frode Sneve Strand



PhD Defense  
Verena Brehm

MAY



Award Best Master  
in Science 2025  
Åsmund Vågslid



Award Best Master  
in Technology 2025  
Andreas Solberg Stapnes

AUGUST



PhD Defense  
Jacob Benestad



PhD Defense  
Vemund Falch

SEPTEMBER



QuSpin Collaboration  
Workshop



Launch  
QuSpin Film

OCTOBER



Australian Federal Medal for  
"Women in Physics Lecturer"  
Senior reseracher Sol Jacobsen



PhD Defense  
Erik Wegner Hodt



Martin Landrø's Award  
Jostein Negård Kløgetvedt

# Scientific Publications

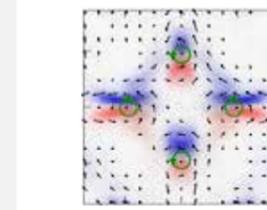
We are privileged to have the work of our researchers published in journals such as Nature Nanotechnology, Physical Review Letters, Physical Review X, Physical Review B, Nature, Nature Physics, Nature Materials and the following listed publications.

1. Raphael Gruber, Jan Rothörl, Simon M. Fröhlich, Maarten A. Brems, Fabian Kammerbauer, Elizabeth M. Jefremovas, Sachin Krishnia, Asle Sudbø, Peter Virnau, Mathias Kläui; *Real-time observation of topological defect dynamics mediating two-dimensional skyrmion lattice melting*. **Nature Nanotechnology** volume 20, pages 1405–1411
2. F. Colangelo, M. Modestino, F. Avitabile, A. Galluzzi, Z. Makhdoumi Kakhaki, A. Kumar, J. Linder, M. Polichetti, C. Attanasio et al.; *Unveiling Intrinsic Triplet Superconductivity in Noncentrosymmetric NbRe through Inverse Spin-Valve Effects*. **Phys. Rev. Lett.** 135, 226002. Editors suggestion.
3. Jacob Daniel Benestad, Torbjørn Rasmussen, Bertram Brovang, Oswin Krause, Saeed Fallahi, Geoffrey C. Gardner, Michael J. Manfra, Charles M. Marcus, Jeroen Danon, Anasua Chatterjee, Evert Van Nieuwenburg; *Automated in Situ Optimization and Disorder Mitigation in a Quantum Device*. **Phys. Rev. Lett.** 135, 216301
4. Maarten A. Brems, Tobias Sparrmann, Simon M. Fröhlich, Leonie-C. Dany, Jan Rothörl, Fabian Kammerbauer, Elizabeth M. Jefremovas, Oded Farago, Mathias Kläui, Peter Virnau; *Realizing Quantitative Quasiparticle Modeling of Skyrmion Dynamics in Arbitrary Potentials*. **Phys. Rev. Lett.** 134, 046701
5. T. Figgemeier, M. Ünzelman, P. Eck, J. Schusser, L. Crippa, J.N. Neu, B. Geldiyev, P. Kagerer, J. Buck, M. Kalläne, M. Hoesch, K. Rossnagel, T. Siegrist, L.-K. Lim, R. Moessner, G. Sangiovanni, Sante Di Sante, F. Reinert, H. Bentmann; *Imaging Orbital Vortex Lines in Three-Dimensional Momentum Space*. **Phys. Rev. X** 15, 011032
6. Fabrizio Berritta, Jacob Daniel Benestad, Lukas Pahl, Melvin Mathews, Jan A. Krzywda, Réouven Assouly, Youngkyu Sung, David K. Kim, Bethany M. Niedzielski, Kyle Serniak, Mollie E. Schwartz, Jonilyn L. Yoder, Anasua Chatterjee, Jeffrey A. Grover, Jeroen Danon, William D. Oliver, Ferdinand Kuemmeth; *Efficient Qubit Calibration by Binary-Search Hamiltonian Tracking*. **Phys. Rev. X Quantum** 6, 030335
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40. Mi-Jin Jin, Guang Yang, Doo-Seung Um, Jacob Wüsthoff Linder, Jason A. Robinson; *Interfacial Spin-Orbit-Coupling-Induced Strong Spin-to-Charge Conversion at an All-Oxide Ferromagnetic/Quasi-Two-Dimensional Electron Gas Interface*. **ACS Applied Materials & Interfaces** Vol 17/Issue 12
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44. Longfei He, Ursula Ludacka, Payel Chatterjee, Matthias Hartl, Dennis Meier, Christoph Brüne; *Tailoring MBE growth of c-Mn<sub>3</sub>Sn directly on MgO (111) from islands to film*. **npj Quantum Materials** volume 10, Article number: 42
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# Featured Articles

This was yet another year where QuSpin Researchers published groundbreaking results in the world's premier physics journals. We have chosen to highlight three of them: Two of the works are theoretical, and the third paper is an experimental work.

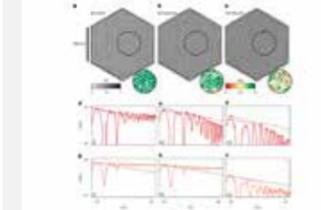


## Imaging Orbital Vortex Lines in Three-Dimensional Momentum Space

*Phys. Rev. X* 15, 011032  
Published 13 February, 2025  
T. Figgemeier, M. Ünzelman, P. Eck, J. Schusser, L. Crippa, J.N. Neu, B. Geldiyev, P. Kagerer, J. Buck, M. Kalläne, M. Hoesch, K. Rossnagel, T. Siegrist, L.-K. Lim, R. Moessner, G. Sangiovanni, Sante Di Sante, F. Reinert, H. Bentmann.

### Abstract

We report the experimental discovery of orbital vortex lines in the three-dimensional (3D) band structure of a topological semimetal. Combining linear and circular dichroism in soft x-ray angle-resolved photoemission (SX-ARPES) with first-principles theory, we image the winding of atomic orbital angular momentum, thereby revealing—and determining the location of—lines of vorticity in full 3D momentum space. We determine the core of the orbital angular momentum vortex to host an almost movable, twofold, spin-degenerate Weyl nodal line, a topological feature predicted to occur in certain nonsymmorphic crystals. These results establish bimodal dichroism in SX-ARPES as a robust approach to trace 3D orbital textures. Our findings constitute the first imaging of nontrivial quantum-phase winding at line nodes and may pave the way to new orbitronic phenomena in quantum materials.

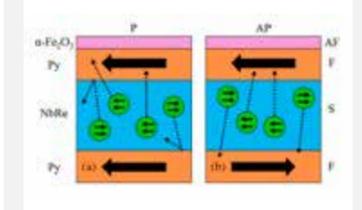


## Real-time observation of topological defect dynamics mediating two-dimensional skyrmion lattice melting

*Nature Nanotechnology*  
Published 4 August, 2025  
Raphael Gruber, Jan Rothörl, Simon M. Fröhlich, Maarten A. Brems, Fabian Kammerbauer, Maria-Andromachi Syskaki, Elizabeth M. Jefremovas, Sachin Krishna, Asle Sudbø, Peter Virnau & Mathias Kläui.

### Abstract

Topological defects are the key feature mediating two-dimensional phase transitions. However, both resolution and tunability have been lacking to access the dynamics of these transitions in the various two-dimensional systems explored. Skyrmions in magnetic thin films are two-dimensional, topologically nontrivial quasi-particles that provide rich dynamics as well as tunability as an essential ingredient for the control of their phase behaviour. With dynamic Kerr microscopy, we directly capture the melting of a confined two-dimensional magnetic skyrmion lattice in a Ta/CoFeB/Ta/MgO/Ta magnetic multilayer system with high resolution in real time and real space. By the applied magnetic field, we tune the skyrmion size and effective temperature on the fly to drive the two-step melting through an intermediate hexatic regime between the solid lattice and the isotropic liquid...



## Unveiling Intrinsic Triplet Superconductivity in Noncentrosymmetric NbRe through Inverse Spin-Valve Effects

*Phys. Rev. Lett.* 135, 226002  
Published 25 November, 2025  
F. Colangelo, M. Modestino, F. Avitabile, A. Galluzzi, Z. Makhdoui Kakhaki, Abhishek Kumar, J. Linder, M. Polichetti, C. Attanasio et al.

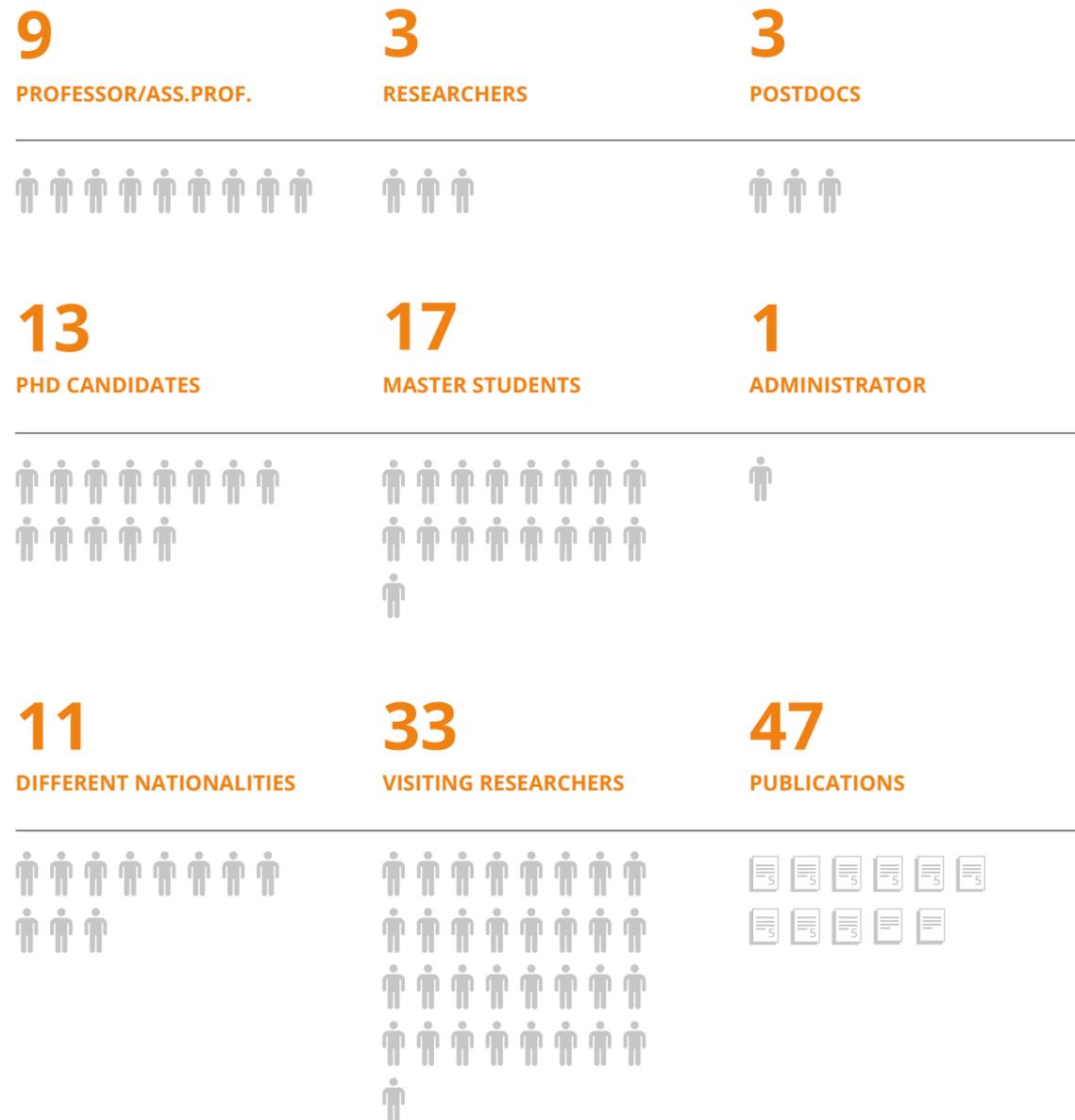
### Abstract

NbRe is a noncentrosymmetric superconductor that has been proposed as a candidate for intrinsic spin-triplet pairing. However, a conclusive demonstration of triplet pairing in NbRe is yet to be found. To probe the presence of spin-triplet Cooper pairs, we fabricated Py/NbRe/Py trilayers capped with an antiferromagnetic layer. Magnetic and electrical measurements reveal an inverse spin-valve effect, which could indicate equal-spin-triplet superconductivity. The minimal sample structure and the lack of *ad hoc* engineered interfaces clearly associate our observation to intrinsic triplet correlations of NbRe. The availability of NbRe in thin-film form and the simplicity of the heterostructure highlight its potential as a scalable platform for superconducting spintronics.

MBE lab: Heater stage for crystals.

# Facts

As of 2025.12.31.



\* Note: In addition we have a 25 % Finance Officer position, Head Engineer from the Department of Physics/NTNU, two Co-Principal Investigators in 17% and 20% positions, and one Prof. II position.

# Funding

## FUNDING 2025 (NOK)

The Research Council of Norway, Center of Excellence	15 593 000
Norwegian University of Science and Technology	8 400 000
<b>SUM</b>	<b>23 993 000</b>
The Research Council of Norway (Center of Excellence)	9 298 000
International Funding	6 551 000
Other Public	0
<b>SUM</b>	<b>15 849 000</b>
<b>TOTAL FUNDING</b>	<b>39 842 000</b>

# QuSpin Film

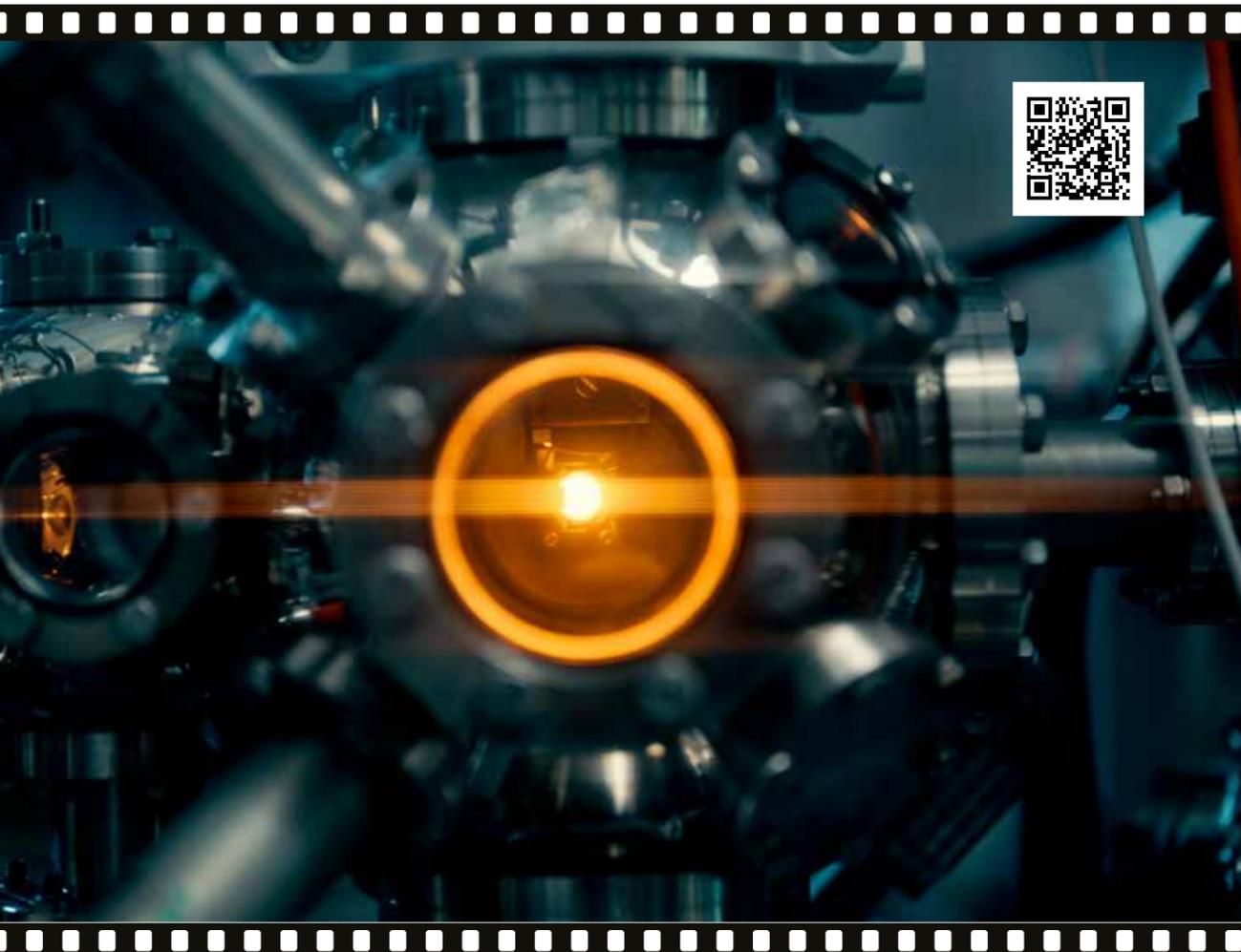
- A contribution to «The International Year of Quantum Science and Technology (IYQ 2025)»

One of our activities in the «International Year of Quantum» was launching a short video to share and visualize the research we are working on, and areas for potential future use.

The amazing 3D animations, together with the original film score and the voice-over were intended to create curiosity, interest and excitement amongst viewers such as colleagues, potential collaborators, students to be recruited, and funding agencies.

Our hope is that many people will watch this story and that it will help increase awareness of quantum mechanics, basic research and future quantum technology possibilities in society.

To watch the video, please go to <https://www.ntnu.edu/quspin> or scan the QR code below.



# In the Media

- ARTICLE**  
<https://gemini.no/2025/10/sann-kan-vi-fa-kvantedatamaskiner-som-faktisk-fungerer-skikkelig/>  
Article with professor Jeroen Danon and PhD candidate Jacob Benestad.
- <https://gemini.no/2025/10/nye-funn-bidrar-til-datamaskiner-som-minner-om-hjernen-din/>  
Article with professor Asle Sudbø.
- INTERVIEW**  
<https://www.adressa.no/nyheter/trondheim/i/zAd4Pr/forskere-i-kapploep-om-mystiske-krefter>  
With professor Asle Sudbø.
- [University of Tasmania Alumni Magazine feature article https://www.utas.edu.au/about/news-and-stories/articles/2025/norway-based-quantum-physicist-wins-australian-award](https://www.utas.edu.au/about/news-and-stories/articles/2025/norway-based-quantum-physicist-wins-australian-award)  
With senior researcher Sol Hernæs Jacobsen.
- <https://norwegianscitechnews.com/2025/02/ntnu-physicist-honoured-in-australia/>  
With senior researcher Sol Hernæs Jacobsen.
- PODCAST**  
"Nysgjerrigpoden"- Research Council Norway Podcast.  
"Nysgjerrige Norge - episode 4: På sporet av spintronikk og superledere med QuSpin"  
With professor Asle Sudbø.
- Episode 285: Into the Quantum Realm – That's What I Call Science**  
Podcast/streaming/local radio in Australia with senior researcher Sol Hernæs Jacobsen, Olly Dove and Georgia Stewart.
- <https://clearasquantum.transistor.fm/episodes/your-quantum-future>  
With senior researcher Sol Hernæs Jacobsen and Lachlan Rogers.
- PARTICIPATION IN RADIO AND TV**  
**Radio interview by ABC Radio Hobart**  
With senior researcher Sol Hernæs Jacobsen. "Investigating quantum phenomena and Superflex".  
<https://www.abc.net.au/listen/programs/sundayextra/marie-curie-lecture-danielle-holmes-sol-jacobsen/105602704>  
With senior researcher Sol Hernæs Jacobsen.
- FILM**  
<https://www.ntnu.edu/quspin>  
SFF QuSpin\_Our contribution to the « The International Year of Quantum Science and Technology (IYQ) by the United Nations». Idea/project leader Karen-Elisabeth Sødahl/QuSpin. Producer Helmet Film & Visual Effects.

# People Overview

Colleagues who left QuSpin before 2025.12.31 are marked with an \*

## QUSPIN LEADER GROUP



**Center Director  
Professor/Principal Investigator**  
Asle Sudbø



**Deputy Director  
Professor/Principal Investigator**  
Jacob Linder



**Professor/Principal Investigator**  
Arne Brataas



**Associate Professor/  
Principal Investigator**  
Hendrik Bentmann



**Center Coordinator**  
Karen-Elisabeth Sødahl

## ASSOCIATED MEMBERS



**Associate Professor**  
Christoph Brüne



**Professor**  
Jeroen Danon



**Associate Professor**  
John Ove Fjærestad



**Professor**  
Dennis Gerhard Meier



**Professor/Vice dean research and innovation,  
Faculty of Natural Sciences**  
Erik Wahlström

## RESEARCHERS



**Senior Researcher**  
Sol H. Jacobsen



**Research professor**  
Alireza Qaiumzadeh



**Researcher**  
Oleg V. Kurnikov\*

## PROFESSOR II



**Professor**  
Justin Wells\*



**Professor**  
Chiara Ciccarelli

POSTDOCS



Xin-Liang Tan



Morten Amundsen



Pavlo Sukhachov\*



Shubankar Mishra



Fabian Göhler (visiting researcher)

PHD CANDIDATES



Travis Gustavson



Erik Wegner Hodt\*



Jacob Daniel Benestad\*



Verena Brehm\*



Payel Chatterjee



Matthias Hartl\*



Niels Henrik Aase\*



Vemund Falch\*



Hans Gløckner Gii



Stefanie Brinkman



Frode Sneve Strand\*



Longfei He\*



Sondre Duna Lundemo



Christian Svingen Johnsen



Johanne B. Tjernshaugen



Anders Christian Mathisen



Maxim Tjøtta



Karl Bergson Hallberg

PHD CANDIDATES



Erlend Syljuåsen



Kristoffer Leraand



Markus Plautz



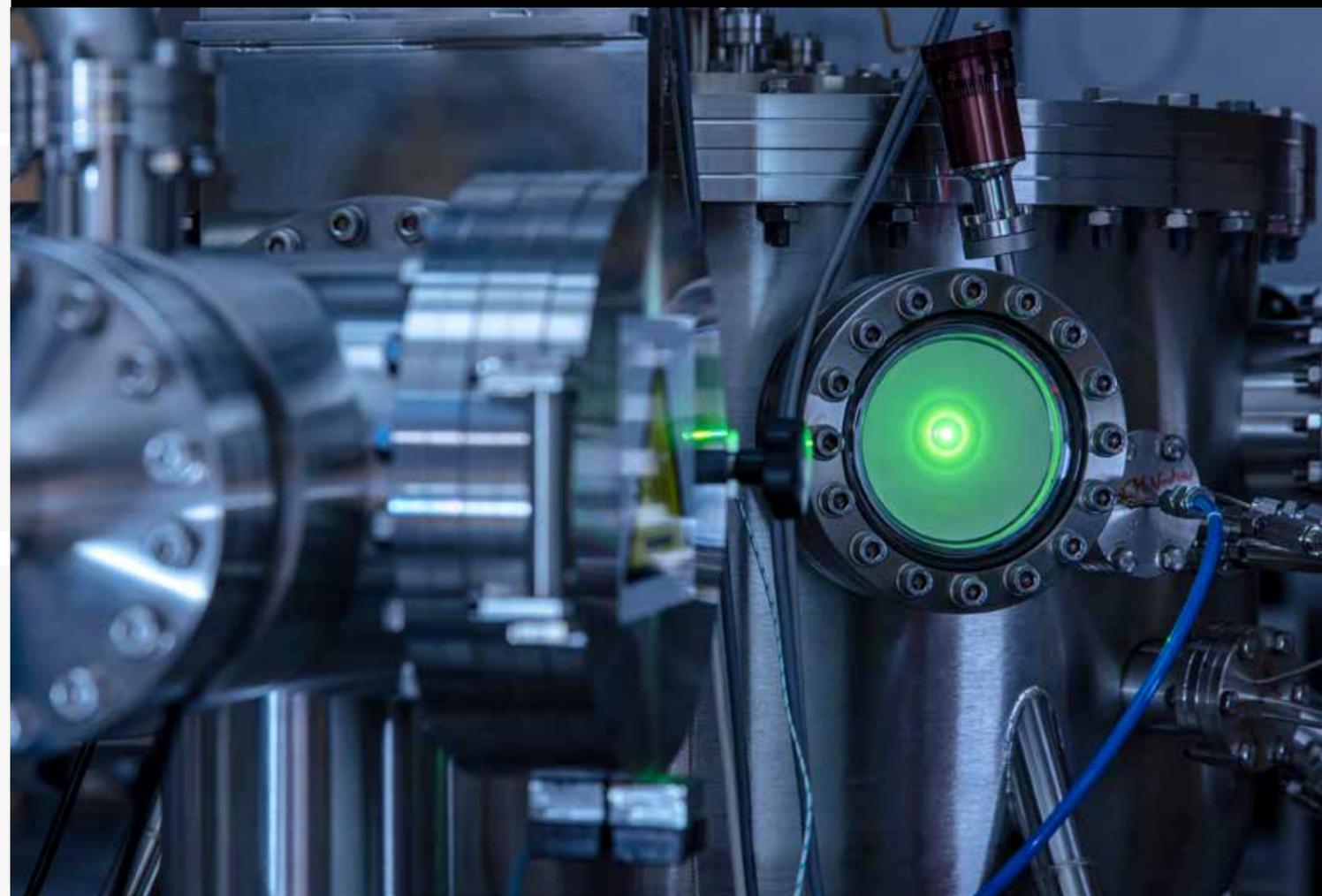
Marius Holen

MASTER STUDENTS

Astrid Søvik  
Einar Skoglund  
Emil Spasov  
Erik Haatuft  
Herman Barring Berggren  
Ida Buttingsrud Stokke

Ingve Aleksander Hetland  
Jonas Isern  
Kasper Rettedal Eikeland  
Mikail Mutu  
Morten Andersen Sørensen  
Olav Irgens Henanger

Riccardo Casanova  
Sara Westrum Færevåg  
Sebastian Siljuholtet Johansen  
Sigri Marie Sveen  
Øyvind Aas



MBE lab: Reflection high energy electron diffraction (RHEED). Electrons impacting a fluorescent screen.

CO-PRINCIPAL INVESTIGATORS



**Professor**  
Rembert Duine, University of Utrecht  
The Netherlands



**Professor**  
Mathias Kläui, Johannes Gutenberg  
University Mainz, Germany

LAB ENGINEERS



**Head Engineer ARPES lab**  
Chul-Hee Min  
Department of Physics, NTNU



**Head Engineer MBE lab**  
Geir Myrvågnes  
Department of Physics, NTNU

THE QUSPIN BOARD



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Faculty of Natural Sciences, NTNU



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Kavli Institute for System Neuroscience,  
NTNU



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Kathrine Røe Redalen  
Department of Physics, NTNU

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Tohoku University, Japan



**Professor**  
Daniela Pfannkuche  
University of Hamburg, Germany

# QuSpin Alumni

Here are the members of our QuSpin Alumni. They are previous researchers at our Center, who are now in new positions within academia, research institutions, industry and consulting businesses.



**Dr. Henning Hugdal**  
PostDoc 2022-24

Next position: Consultant in Trondheim Consulting AS, Trondheim, Norway.



**Dr. Chi Sun**  
PostDoc 2022-24

Next position: Postdoc at Interdisciplinary Center of Nanoscience of Marseille, France.



**Dr. Kristian Mæland**  
PhD 2024

Next position: Postdoc at University of Würzburg, Germany.



**Dr. Anna Cecilie Åsland**  
PhD 2024

Next position: Graduate Drilling and Wells Engineer, AkerBP, Stavanger, Norway.



**Dr. Bjørnulf Brekke.**  
PhD 2024

Next position: Engineer at the Det Norske Veritas (DNV), Oslo, Norway.



**Dr. Therese Frostad.**  
PhD 2024

Next position: Entrepreneur in Aether, Oslo, Norway.



**Dr. Lina Johnsen Kamra**  
PhD 2023

Next position: Postdoc at Freie Universität Berlin, Germany



**Dr. Jonas Lidal**  
PhD 2023

Next position: Researcher at Norwegian National Security Authority (NSM), Oslo, Norway



**Dr. Tancredi Salamone**  
PhD 2023

Next position: Postdoc at the French Alternative Energies and Atomic Energy Commission (CEA), Grenoble, France



**Dr. Håvard Homleid Haugen**  
PhD 2023

Next position: Researcher at Norwegian Meteorological Institute, Oslo, Norway.



**Dr. Eirik Holm Fyhn**  
PhD 2023

Next position: Reseracher at SINTEF Energy, Department of Gas Technology, Trondheim, Norway.



**Dr. Jabir Ali Ouassou.**  
PostDoc 2021-2023

Next position: Associate Professor, Western Norway University of Applied Sciences, Haugesund, Norway.



**Dr. Jinbang Hu.**  
PostDoc 2020-2023

Next position: Postdoc at Hunan University, Changsha, Hunan Province. China.



**Dr. Atousa Ghanbari Birgani**  
PhD 2022

Next position: Data Engineer at Kermit Tech AS, Asker, Oslo. Norway



**Dr. Jonas Blomberg Ghini**  
PhD 2022

Next position: Power engineering consultant at Multiconsult, Trondheim, Norway



**Dr. Håkon Ivarssønn Røst**  
PhD 2022

Next position: Postdoctoral Fellow at the Department of Physics and Technology, University of Bergen, Norway



**Dr. Jørgen Holme Qvist**  
PhD 2022

Next position: Research Scientist at Voca AS, Kristiansand, Norway



**Dr. Eirik Erlandsen**  
PhD 2022

Next position: Data Analyst at the Norwegian Bank (DnB), Oslo, Norway



**Dr. Andreas T. G. Jansønn**  
PhD 2022  
Next position: TBA



**Dr. Markus Althaler**  
PhD 2022  
Next position: Postdoc at the Stewart Blusson Quantum Matter Institute at UBC Vancouver, Canada.



**Dr. Marion Barbeau**  
PostDoc 2019-2022  
Next position: Researcher in Photonics for Health, Imec, Eindhoven, The Netherlands



**Akashdeep Kamra**  
Researcher 2021  
Next position: Professor at the RPTU Kaiserslautern, Germany.



**Dr. Vasil Saroka**  
PostDoc 2018-2021  
Next position: Marie-Curie Postdoctoral Fellow at Tor Vergata University of Rome, Italy.



**Dr. Mariia Stepanova**  
PostDoc 2019-2021  
Next position: Materials Engineer and Data Analyst, Norsk Titanium AS, Hønefoss, Norway



**Dr. Martin Fonnum Jakobsen**  
PhD 2021  
Next position: Researcher at the Norwegian Defence Research Establishment (FFI), Oslo, Norway



**Dr. Even Thingstad**  
PhD 2021  
Next position: Postdoctoral Fellow at Universität Basel, Switzerland



**Dr. Fredrik Nicolai Krohg**  
PhD 2021  
Next position: Security Analyst at Orange Cyberdefense, Norway



**Dr. Erik Nikolai Lysne**  
PhD 2021  
Next position: Fullstack Developer at Fink, Oslo, Norway



**Dr. Haakon Krogstad**  
PhD 2021  
Next position: Consultant at McKinsey, Oslo, Norway



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## ANNUAL REPORT PUBLICATION DETAILS

### Published by:

Center for Quantum Spintronics (QuSpin)

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### Layout:

Pitch Studio AS  
Karen-Elisabeth Sødahl/Center for Quantum Spintronics

### Print:

Skipnes AS



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