

2024

QUEST Officially Launched with a Kick-Off Meeting in Montpellier

On **9 September**, the QUEST project officially began with its **kick-off meeting in Montpellier**.

The mission of QUEST is to enhance the scientific excellence and innovative potential of **Eötvös Loránd University (ELTE)** through collaboration with its Twinning partners – **Linköping University, Loughborough University, Aalto University, JustInMind SL, and Intelligentsia Consultants SARL**.

Over the next three years, the project aims to develop a **quantum reservoir computing (QRC) system** utilizing **silicon carbide (SiC) defect qubits**, focusing on five main objectives:

- Conduct pioneering research to realize a QRC system based on SiC defect qubits.
- Foster knowledge exchange through researcher mobility, seminars, and training.
- Support the career development of early-stage researchers at ELTE and partner institutions.
- Strengthen ELTE's administrative capacity in managing European R&D projects.
- Enhance the academic visibility and research reputation of ELTE and its partners.



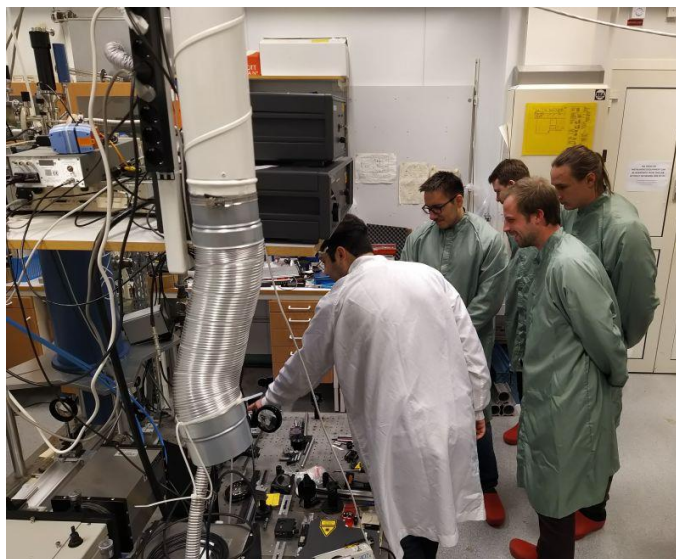
The meeting brought together experts from across Europe, including participants from **ELTE**, **Linköping University**, **Loughborough University**, **Aalto University**, **JustInMind SL**, **Intelligentsia Consultants**, and the **University of Montpellier**, marking the start of an ambitious collaboration toward advancing quantum technologies.

Collaborative Insights: ELTE Researchers visited Linköping University

Researchers from **Eötvös Loránd University (ELTE)** spent a week at **Linköping University** for intensive knowledge exchange and hands-on learning.

The visit included **lab tours** focused on measurement techniques, material fabrication, and polarization protocols—complementing ELTE’s theoretical work with valuable experimental insight. The team also attended a **symposium on solid-state physics and 2D materials**, gaining new perspectives through discussions with experts.

The visit strengthened collaboration and provided **networking opportunities** for early-stage researchers, reflecting QUEST’s mission to advance scientific excellence through joint research and knowledge sharing.



Collaborative Research Visit

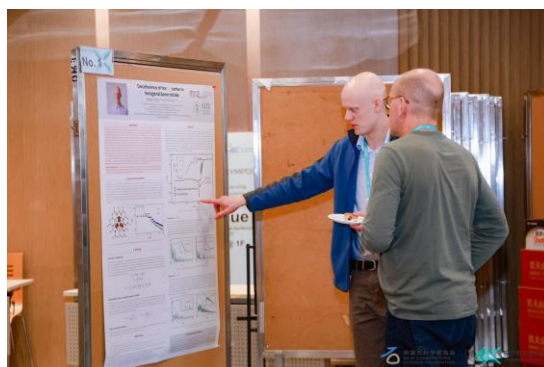
From **3–9 November 2024**, **Tapio Ala-Nissilä** (Aalto University) carried out a **collaborative research visit** at **Loughborough University, UK**, supporting ongoing scientific exchange within the QUEST project.

QUEST at the Quantum Sensing Symposium in Hong Kong

Viktor Ivády Project Coordinator and his student András Tárkányi from **Eötvös Loránd University** attended the **Quantum Sensing – Fundamentals, Functions, and Fun** symposium in Hong Kong.

The event brought together leading experts to discuss advances in **quantum sensing** and **quantum reservoir computing**, with applications spanning life sciences, materials science, and beyond. Presentations highlighted the importance of **quantum coherence**, **entanglement**, and **machine learning** in next-generation sensing technologies.

The insights gained at the symposium will help guide future research directions within the QUEST project.



Loughborough at the Alan Turing Institute's PhD Connect 2024

Jordan McConnell, PhD student at **Loughborough University**, took part in **The Alan Turing Institute's PhD Connect 2024** event in Leeds.

The event gathered doctoral researchers in **data science and AI** for workshops, keynote talks, and discussions on innovation and collaboration.

Dr. Piotr Mirowski (Google DeepMind) delivered a keynote on human-machine collaboration in sustainability and climate applications, while a panel of experts from academia and industry explored how to translate research into real-world impact.

PhD Connect provided an inspiring platform for early-career researchers to exchange ideas and strengthen the network of future **data science and AI innovators**.



ELTE Students Shine at the TDK Scientific Conference

Four **ELTE students** closed the year with excellent results at the **Scientific Students' Conference (TDK)**.

They earned **two second places, two third places**, and the **Morgan Stanley**

Special Prize—a strong recognition of their talent and hard work.

Congratulations to all participants for their outstanding achievements!



2025

Strong Start to the Year: a Joint Meeting at ELTE

The new year began with the **QRC-4-ESP & QUEST Meeting** held at **Eötvös Loránd University (ELTE)** in Budapest.

The event brought together early-stage and senior researchers for a week of **scientific exchange, collaboration, and networking**.

Highlights included:

- Research presentations on **superconducting qubits, SiC experiments**, and **exploratory quantum projects**.
- **Collaborative discussions** shaping future directions in quantum technologies.
- **Networking opportunities** connecting young researchers with established experts.
- A **Danube boat tour** offering an informal setting to continue scientific discussions.

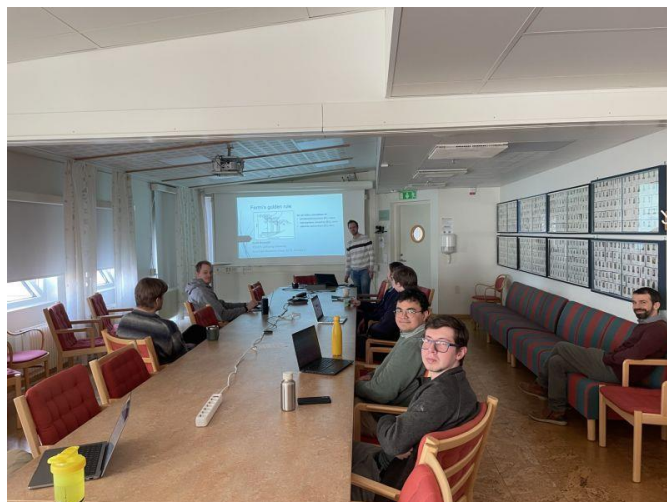
The meeting set the tone for a productive and collaborative year ahead for the QUEST community.



Advancing Quantum Research Through Collaboration

In February, **Zsolt Benedek** from **Eötvös Loránd University** visited **Linköping University** to collaborate with the **Theoretical Quantum Defect Group** led by **Oscar Bulancea Lindvall** and **Igor Abrikosov**. His work focused on *modelling quantum state transition rates* to better understand the dynamics and performance of *point-defect systems* for quantum technologies.

The visit sparked several new developments and concluded with a **seminar at the Department of Theoretical Physics**, where Zsolt presented his recent progress and ideas.



Participation in Workshop on Many-Body Quantum Physics

On **11–12 February**, **Tapio Ala-Nissilä** (Aalto University) participated in a **Workshop on Many-Body Quantum Physics** held in **Coventry, UK**, contributing to discussions on current developments in the field.

QUEST Partner Contribution at the Sweden–Japan Academic Network Seminar

On **February 17**, **Professor Igor A. Abrikosov** (Linköping University) delivered a talk titled “*Knowledge-Based Materials Design: New Opportunities for a Sustainable World*” at the **13th Sweden–Japan Academic Network (SJAN) Seminar: Materials for Sustainability and Sweden–Japan Academic Partnership**.

The seminar brought together Swedish and Japanese researchers, JSPS alumni, and members of the scientific community interested in materials research for sustainability. The **Ambassador of Japan to Sweden** was also present, highlighting the importance of international academic collaboration.

The event was organized by the **Royal Swedish Academy of Sciences**, the **Embassy of Japan in Sweden**, the **JSPS Stockholm Office**, and the **JSPS Alumni Club in Sweden**.

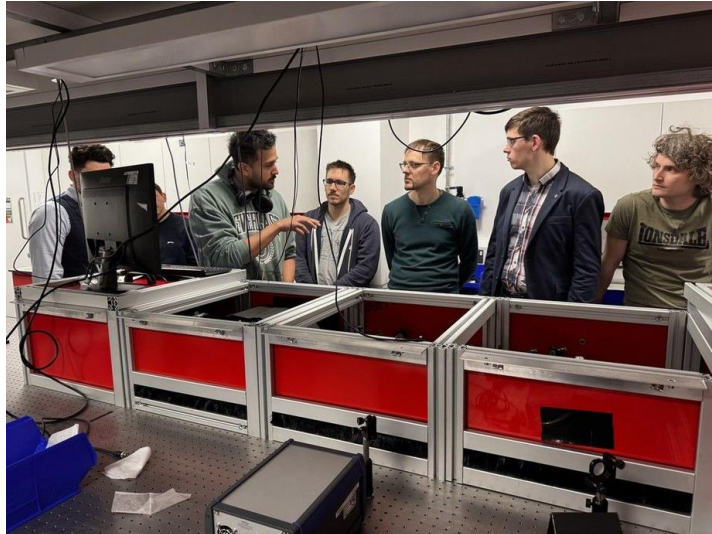
ELTE Researchers Visit Loughborough University

In early **April**, PhD students, postdocs, and senior researchers from **Eötvös Loránd University** visited the **Department of Physics at Loughborough University** as part of the **QUEST Twinning project**.

The team toured several laboratories, including the **Emergent Photonics Research Centre**, where they explored ongoing work on **micro-comb lasers**.

and **neuromorphic photonics**—key technologies for future quantum and photonic systems.

The visit strengthened collaboration and provided valuable hands-on insights into experimental photonics research.



Publication in *Physical Review B*

On **2 April**, our paper “*Evolution of the optically detected magnetic resonance spectra of divacancies in 4H-SiC from liquid-helium to room temperature*” was published in *Physical Review B*.

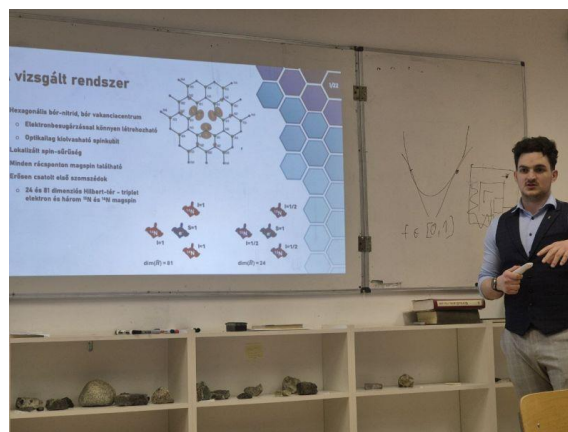
<https://journals.aps.org/prb/abstract/10.1103/PhysRevB.111.165201>

ELTE Students Present at the 26th Eötvös Conference

Roland Weismüller and **Adalbert István Tibiássy** from the **ELTE Group** presented their research on **April 5, 2025**, at the **26th Eötvös Conference**, organized by the **Eötvös József Collegium**.

This prestigious annual event provides a platform for students to showcase their independent research across a wide range of disciplines.

Congratulations to both researchers for their excellent presentations and valuable contributions.



Research Visit and Seminar on Quantum Materials

From **22–25 April 2025**, **Tapio Ala-Nissilä** (Aalto University) visited the **University of Genova, Italy**, for a **research visit** and delivered a **seminar on quantum materials**, strengthening scientific collaboration within the QUEST network.

ELTE Group Success at the National Scientific Students' Associations Conference (OTDK)

Five members of the **ELTE Group**—**Adalbert István Tibiássy**, **Anett Simon-Zsók**, **András Tárkányi**, **Dominik Márk Lévai**, and **Roland Weismüller**—presented their research at the **National Scientific Students' Associations Conference (OTDK)**, held on **April 22–25, 2025**.

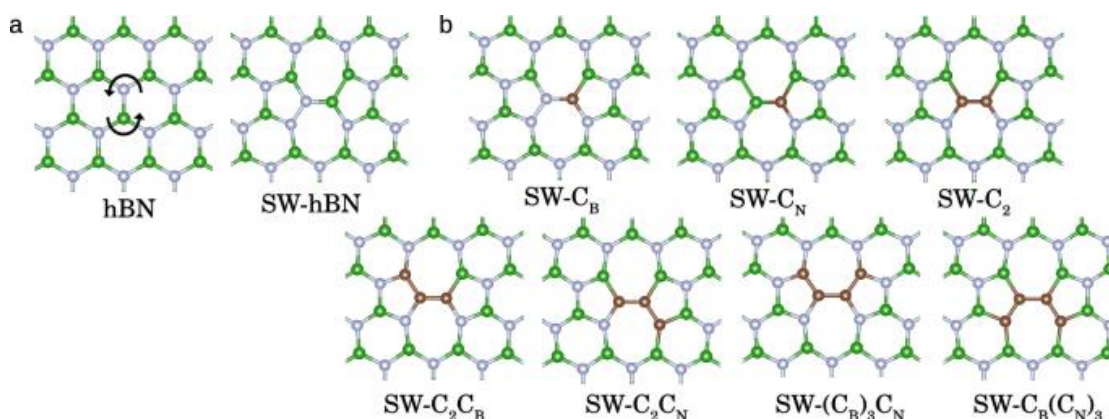
Special congratulations to **Anett Simon-Zsók** (1st place), **András Tárkányi** (2nd place), and **Dominik Márk Lévai** (special award) for their outstanding achievements and recognition of excellence.

New Publication by QUEST Coordinator Viktor Ivády

Viktor Ivády, Coordinator of the **QUEST Project**, published a paper titled “Carbon-contaminated topological defects in hexagonal boron nitride for quantum photonics” in *npj 2D Materials and Applications* on 30th of April.

The work contributes to advancing our understanding of defect-based quantum photonics in two-dimensional materials.

<https://www.nature.com/articles/s41699-025-00559-z>



Research Visit and Workshop Participation in Edinburgh

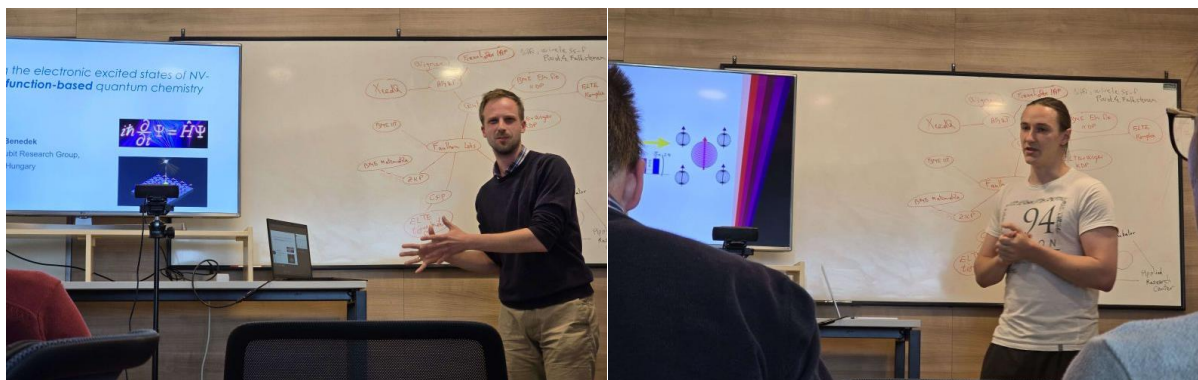
From **5–8 May**, **Tapio Ala-Nissilä** visited the **University of Edinburgh** for a **research visit** and participated in a **Quantum Physics workshop**, engaging with ongoing research activities and exchanging ideas with the local community.

NV Café Workshop in Budapest

On **May 8**, researchers from Budapest working on **point-defect-based quantum technologies** gathered at **NV Café**, a half-day workshop organized by **András Pályi**, **Győző Egri**, **Péter Boross**, and **Viktor Ivády**, Coordinator of the **QUEST Project**.

Roland Weismüller and **Zsolt Benedek** from **ELTE** also presented their research during the event.

The event, hosted and supported by **Faulhorn Labs**, provided an inspiring setting for discussions and collaboration within the local quantum research community.



ELTE Researchers at the 2025 Boron Nitride Workshop

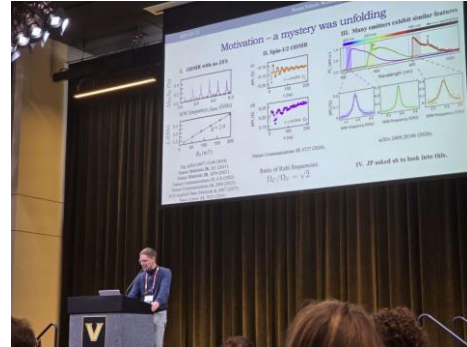
From **May 12–16, 2025**, researchers from **ELTE** participated in the **Boron Nitride Workshop 2025** in **Nashville**, joining the international community to discuss the latest developments in boron nitride research.

Viktor Ivády, Coordinator of the **QUEST Project**, gave a talk titled *“Microscopic Model for Optically Addressable Spin Defect Pairs in hBN.”*

During the poster session, **András Tárkányi** and **Adalbert István Tibiássy** presented their work:

- *“Understanding the Decoherence of the VB^- Center in Hexagonal Boron Nitride”*
- *“Nuclear Spin Dynamics of Driven VB Centers”*

The workshop provided an excellent opportunity to connect with leading scientists in the field, including **Hannah Stern (University of Oxford)**, **Islay Robertson (RMIT University)**, and **Stephanie Fraser (University of Cambridge)**.



Plenary Talk at the Trends in Magnetism Meeting

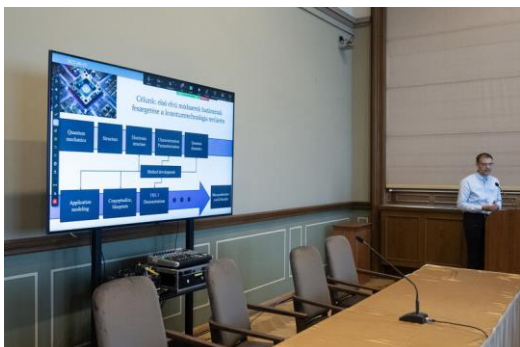
From **15–19 June**, **Igor Abrikosov** (Linköping University) attended the **Trends in Magnetism** meeting in **Uppsala, Sweden**. He delivered a **plenary talk** titled *“Spins Associated with Defects in Wide Band Gap Semiconductors: Solid State Qubits for Quantum Computing, Sensing and Communications”*, contributing key insights to the conference’s scientific programme.

Talk at the “Recent Advances in the Physics of Condensed Matter” Symposium

On **June 19**, **Viktor Ivády** gave a talk at the symposium **“Recent Advances in the Physics of Condensed Matter”**, held at the **Hungarian Academy of Sciences**.

His presentation, *“First-Principles Methods Extended: From Structure to Applications,”* was part of a program highlighting some of Hungary’s most

significant recent results in condensed matter physics. The event showcased the wide range of research conducted at Hungarian universities and research institutes.



High School Student Joins QUEST Research Through the ELTE TTK Talentum Program

On **June 27**, **Emese Piroska Moravcsik**, a high school student from the **Eötvös Loránd University Apáczai Csere János Practice Secondary School and Dormitory**, joined the **Semiconductor Quantum Technology Research Group at ELTE** through the **ELTE TTK Talentum Program**.

Under the mentorship of **Viktor Ivády**, she explored quantum research topics and presented her work in a talk titled:

“Dynamics of Rydberg Atoms on the Aquila Quantum Processor.”

Her involvement reflects the program’s mission to support talented students as they engage with university-level research.

Publication in *Optica Quantum*

On **3 July**, our paper “*Broadband Fourier transform spectroscopy of quantum emitters photoluminescence with sub-nanosecond temporal resolution*” was published in *Optica Quantum*.

<https://opg.optica.org/opticaq/fulltext.cfm?uri=opticaq-3-4-335>

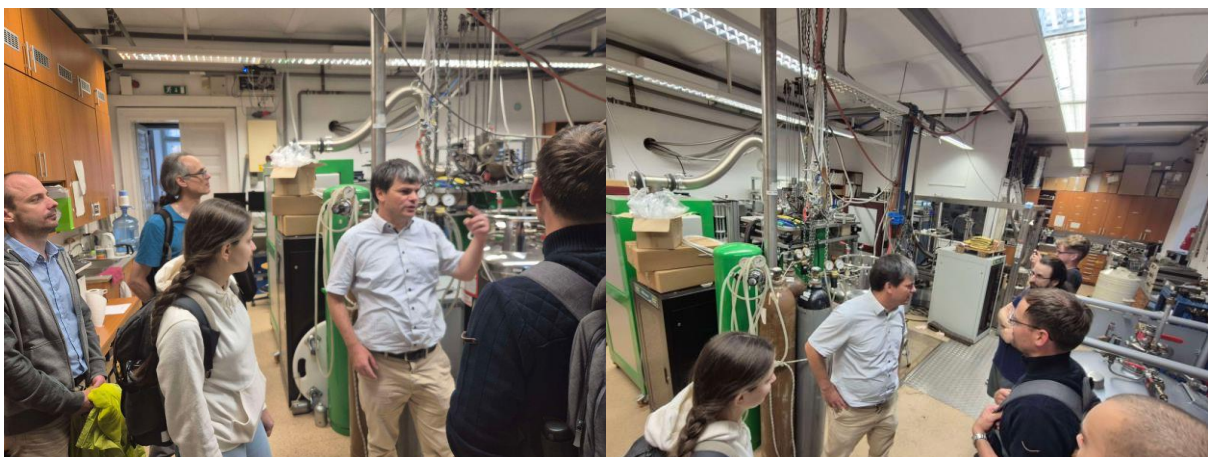
Visit from Emmanuel Rousseau at ELTE

As part of the **QUEST Twinning Project**, **Emmanuel Rousseau** (Laboratoire Charles Coulomb, University of Montpellier) visited **ELTE** for five days in **mid-July**.

During his stay, he met with students, discussed research directions, and explored opportunities for collaboration in quantum science and technology.

The visit also included a tour of **András Halbritter’s lab** at the **Budapest University of Technology and Economics (BME)**, where the group learned about ongoing research in **memristor-based reservoir computing**.

The visit exemplified the collaborative spirit of the QUEST consortium, strengthening connections within the European quantum research community.



QUEST & QRC-4-ESP Summer School at Aalto University

From **18–22 August**, researchers from across Europe gathered at **Aalto University** for the **Summer School on New Directions in Quantum and Quantum Reservoir Computing, Quantum Devices and Related Technologies**. The event was organised by the **Horizon Europe–funded QUEST Twinning Project**, with additional support from the **QRC-4-ESP** project.

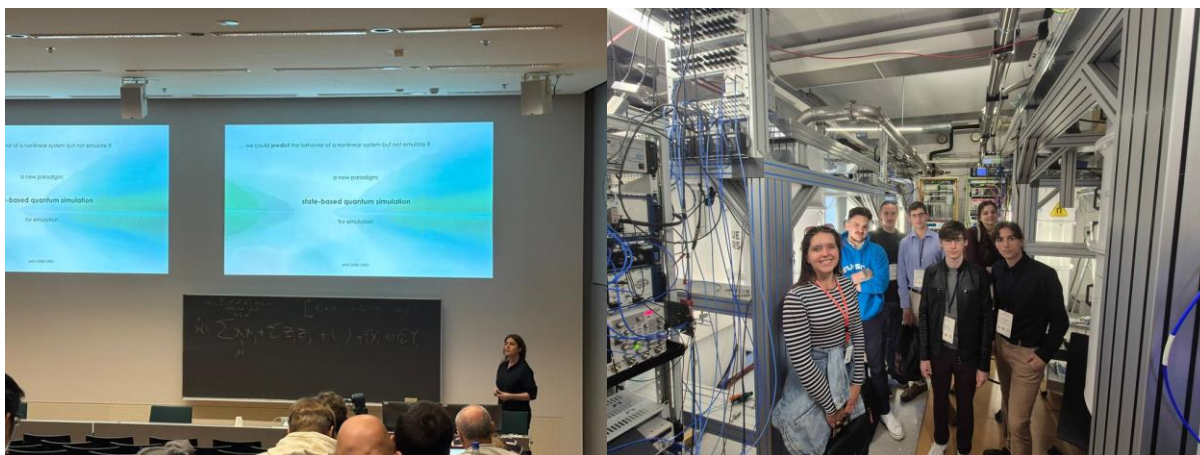
The week featured:

- Lectures on **NISQ computing, quantum reservoir computing, open quantum systems, and many-body physics**
- **Lab tours** at Micronova
- **Tutorials** on scientific writing and presentations
- **Poster sessions**, discussions, and active networking

Participants also enjoyed social activities, including a visit to **Suomenlinna**, making the week both scientifically rich and community-building.

The summer school provided valuable training and strengthened collaboration across the European quantum research community.





Conference Participation at Psi-k 2025 and TMAG2025

From **24 August to 6 September**, **Igor Abrikosov** (Linköping University) participated in the **Psi-k 2025** conference in **Lausanne, Switzerland**, and the **TMAG2025** meeting in **Bari, Italy**.

He delivered two oral presentations titled:

- *“Defects in Wide Band Gap Semiconductors: Solid State Qubits for Quantum Computing, Sensing and Communications”*
- *“SiC-Based Solid State Qubits for Unconventional Quantum Computing and Quantum Communications”*

These presentations contributed to international discussions on emerging approaches in quantum technologies.

ELTE Early-Stage Researchers Visiting Linköping University

From **30 August to 29 September**, **Adalbert István Tibiássy** and **Roland Weismüller**, early-stage researchers from **Eötvös Loránd University**, spent a month at **Linköping University** as part of the QUEST Twinning collaboration.

Their visit supported ongoing research exchange and provided opportunities to connect with colleagues across the Linköping research community.



Science Outreach at the MindFormers Festival

From **28–30 August**, **Anett Simon-Zsók** of the **Semiconductor Quantum Technology Research Group (ELTE)** participated in the **MindFormers Festival** in Sepsiszentgyörgy, Transylvania.

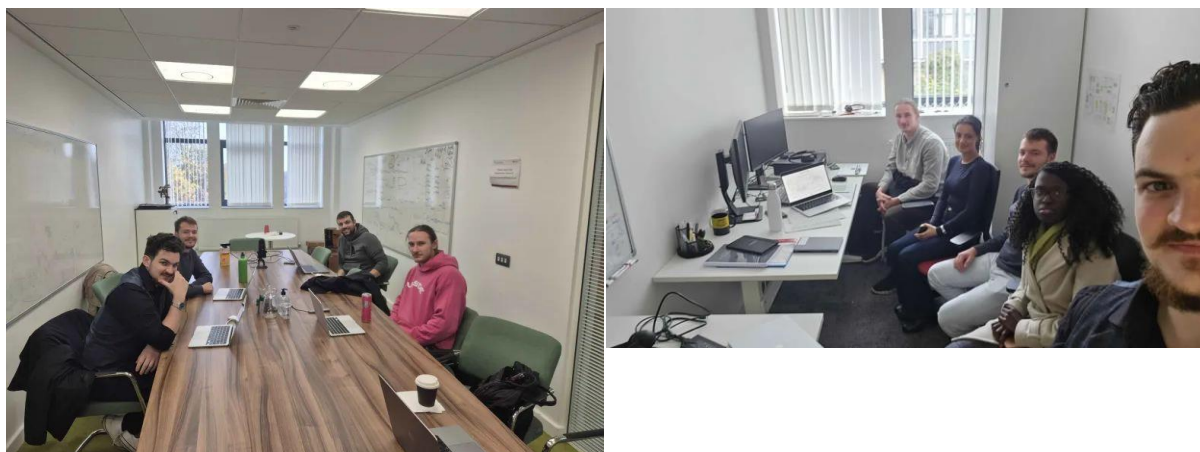
Together with a former high school classmate, she presented physics demonstrations and took part in a **career-orientation discussion**, speaking about university life and the early stages of a scientific career. Students had the opportunity to ask questions and gain insight into pursuing studies and research in physics.

Events like this highlight how scientific engagement and personal experience can inspire curiosity and motivate the next generation of researchers.



Research Visit to Loughborough University

Dániel Tibor Pozsár, **Roland Weismüller**, and **Adalbert István Tibiássy** spent five weeks at **Loughborough University**, where they deepened their knowledge in **quantum computing** and **quantum reservoir computing**. The visit provided valuable opportunities for scientific exchange, discussions with local researchers, and exposure to new approaches relevant to the QUEST project.



Research Visit to the University of Oxford

Adalbert István Tibiássy visited the **University of Oxford**, where he delivered a talk titled “*Spin Dynamics of Boron and Silicon Vacancies for Quantum Applications*” for **Hannah Stern’s group**. During his stay, he also explored the group's laboratory facilities and exchanged ideas with researchers working on related topics in quantum materials and defect physics.



QTech Budapest Workshop at the Hungarian Academy of Sciences

At the **QTech Budapest Workshop**, held at the **Hungarian Academy of Sciences** from **22–25 September**, **Viktor Ivády**, **András Tárkányi**, **Zsolt Benedek**, and **Gergely Barcza** presented their recent results. The workshop brought together experts from across the Hungarian quantum research community and provided a strong platform for scientific discussion, collaboration, and exchange of new ideas.



Science Communication Activities

Eszter Papp, Dissemination Work Package Leader, gave several presentations on **quantum biology** at **Bolyai College**, **Researchers' Night**, and **Wigner Jenő College**. These events engaged students and contributed to raising awareness of emerging research directions within this new field.



Outreach

From **28–30 October**, **Eszter Papp** took part in **Science Expo**, where she joined panel discussions and presented colourful physics demonstrations, contributing to an energetic and engaging programme for visitors. Her participation supported QUEST's mission to promote scientific curiosity and connect with broader audiences beyond academia.



Publication in *Advanced Functional Materials*

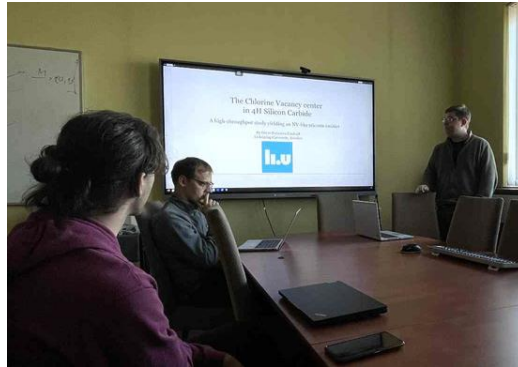
On **3 November**, our work appeared in *Advanced Functional Materials*.

This study employs state-of-the-art computational methods to investigate the decoherence of the V_B^- center in hexagonal boron nitride across a wide range of magnetic field values from 0 T up to 3 T. The provided in-depth numerical and analytical analysis reveals an intricate interplay of various decoherence mechanisms.

<https://advanced.onlinelibrary.wiley.com/doi/full/10.1002/adfm.202511300>

Research Visit and Seminar at ELTE

From **3–9 November 2025**, **Oscar Bulancea Lindvall** (Linköping University) visited **Budapest, Hungary** for a **research visit** and delivered a seminar titled “*The Chlorine Vacancy Center in 4H Silicon Carbide*”. The visit supported ongoing collaboration and knowledge exchange within the QUEST project.



Publication in *Nature Communications*

On **6 November**, our work was published in *Nature Communications*.

In this paper, we show using first-principles modeling that, by exploiting the interaction of surface-induced strain and weak dc magnetic fields, the spin coherence times of 1-nm-deep NV centers can be greatly improved near the spin-phonon-confined regime at room temperature in ^{12}C -rich diamonds. We also demonstrate that this protocol benefits ~10-nm-deep NV centers in natural diamond, enabling vector magnetometry at the nanoscale.

<https://www.nature.com/articles/s41467-025-64771-7>

Collaborative Research Visit to Loughborough University

From **10–20 November**, **Tapio Ala-Nissilä** carried out a **collaborative research visit** at **Loughborough University, UK**, continuing ongoing scientific exchange and discussions within the QUEST collaboration.

Publication in *Nature Physics*

On **19 November**, a collaborative paper involving researchers from **RMIT University** and the **University of Technology Sydney** was published in *Nature Physics*.

In this work we show that recent observations of optically addressed spins in some solids can be explained by a radical-pair mechanism, whereby a correlated spin pair is created via photoexcitation followed by charge transfer. In effect, we are bridging semiconductor physics and spin chemistry. We hope this new understanding will help researchers discover and study spin systems in other materials and harness their properties for application as quantum nanosensors, for example for materials research and biosensing.

<https://www.nature.com/articles/s41567-025-03091-5>

Publication in *npj Computational Materials*

On **20 November**, our paper “*Accurate and convergent energetics of color centers by wavefunction theory*” was published in *npj Computational Materials*.

The accurate description of in-gap states of point defects in semiconductors with significant multideterminant character presents a long-standing challenge for density functional theory (DFT) methods. In this study, we devise an ab initio methodology based on wavefunction theory (WFT) as a competing alternative approach. Specifically, we apply perturbation theory (NEVPT2) on top of a defect-localized many-body wavefunction (CASSCF).

<https://www.nature.com/articles/s41524-025-01813-0>

Publication in *npj Computational Materials*

On **20 November**, a collaborative paper with researchers from the **Department of Computer Engineering, TUM School of Computation, Information and Technology, Technical University of Munich**, together with **Viktor Ivády** from the QUEST team, was published in *npj Computational Materials*.

In this work, a parameter-free spin-dynamics model was developed that accurately captures T_1 relaxation in VB-1 of hBN. It was demonstrated that this defect constitutes a strongly coupled electron spin–nuclear spin core, which necessitates the inclusion of the coherent dynamics and derived memory effects of the three nearest-neighbour nitrogen nuclear spins. The T_1 behaviour was also mapped as a function of magnetic field from 0 to 2000 G.

<https://www.nature.com/articles/s41524-025-01859-0>

Group seminars

The MSP Group at Aalto University and the SQTRG Group at ELTE have been holding weekly group seminars on topics related to **quantum reservoir computing, quantum computing**, and other recent research themes connected to the QUEST project.