PRESS RELEASE

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DR FLORIAN KAISER AWARDED FNR PEARL CHAIR FOR GROUNDBREAKING QUANTUM COMPUTING PROJECT

The project is set to receive €4 million in funding for the next five years.

Dr Florian Kaiser, who leads the Quantum Materials group at the Luxembourg Institute of Science and Technology (LIST), has been awarded the FNR PEARL Chair by the Luxembourg National Research Fund (FNR) for his project focused on enhancing the performance of quantum computers. The project, named AQuaTSiC, (Advanced Quantum Technologies with Silicon Carbide) is set to receive €4 million in funding for the next five years via the FNR PEARL programme, which offers competitive grants to attract leading researchers in strategic research fields to Luxembourg.

Enhancing the promise of quantum computers

Quantum computing represents a significant shift in the field of information technology due to its unique ability to efficiently store vast amounts of data. To put this in perspective, just 53 quantum bits or "qubits" can encode the equivalent of 1 Petabyte (equal to 1000 Terabytes) of data, which is an enormous volume of information. Moreover, quantum computers excel at processing substantial data sets in parallel, offering the potential to significantly accelerate data-intensive tasks. Some key applications for quantum computing include improving machine learning, discovering new materials, advancing medicine, enhancing data encryption security, and making better financial market decisions.

“However, the current state of quantum technology faces challenges in achieving the necessary hardware enhancements to effectively support these applications,” says Florian Kaiser. “In this context, AQuaTSiC aims to develop a unique quantum computing platform using the industry leading 3rd generation semiconductor material, silicon carbide. Silicon carbide already powers your electric cars, and our goal is to benefit from these technological advances to develop better performing materials for quantum computing.”

Improved performance and scalability

In traditional computers, tasks are split between several specialized processing units, think about the seamless interplay between the processor and the graphics card. Information between these units is exchanged via electric signals.

Today’s quantum computers only involve single units, similar to early traditional computers. Scaling up qubit numbers beyond a few dozen is difficult due to an increased sensitivity against decoherence. This means that quantum computer performance is generally based on compromises, which challenges the demonstration of a quantum advantage.

The goal of AQuaTSiC is to maximize the number of qubits by connecting multiple systems. Contrary to standard approaches, “our strategy emphasizes the creation of small qubit registers of superior quality,” adds Kaiser. The project, which is slated to commence in the beginning of 2024, aims to integrate two small-scale quantum computing units on a photonic chip, akin to the way processors work on modern computer chips. This innovative approach allows for efficient communication between quantum computing units.

To address the challenge of connecting quantum computers using photons instead of electrical wires (as is in the case of traditional computers), “we will employ silicon carbide waveguides. Photons, the fundamental particles of light, travel along these waveguides, facilitating seamless communication between the quantum components.” explains Kaiser.

"The ultimate goal of the AQuaTSiC project is to develop the best quantum materials and fabrication processes for quantum computing. One of the key differentiators of the project is its focus on scalability. Unlike other specialized quantum computing systems that require custom engineering for each chip, our approach ensures that the fabrication of quantum chips can be easily scaled up through collaborations with industrial partners, and mass-produced, promising widespread accessibility and democratisation of quantum computing technology," he concludes.

Dr Damien Lenoble, director of the Materials Research and Technology department at LIST said, "The competition in the field of quantum computing technology has significantly intensified in recent years, with multiple materials technologies vying for the top place. AQuaTSiC presents a unique opportunity to establish Luxembourg as a leader in this technology niche, capitalizing on the nanofabrication expertise available at LIST. This initiative has the potential to position LIST and Luxembourg at the forefront of the global effort to develop quantum computing chips based on the precise engineering of single defects in high-quality Silicon-Carbide (SiC) layers.

The applications of this technology hold tremendous promise, and achieving the milestone of demonstrating the first quantum operations utilizing SiC-qubits could have far-reaching strategic implications for Luxembourg and its financial sector. We are deeply honoured that the expert panel and the board of FNR have recognized the strategic merit of this research and the scientific excellence that Dr Kaiser brings to this endeavour."

About LIST

The Luxembourg Institute of Science and Technology (LIST) is a research and technology organization (RTO) under the auspices of the Ministry of Higher Education and Research, and its mission is to develop competitive and market-oriented prototypes of products and services for public and private stakeholders.

With nearly 680 employees, 77% of whom are researchers or innovators from all over the world, LIST is active in the fields of information technology, materials, space resources and the environment, and works across the entire innovation chain, from basic and applied research to technology incubation and transfer.

By transforming scientific knowledge into intelligent technologies, data and tools, LIST:

- helps European citizens make informed choices
- helps public authorities make decisions
- encourages companies to develop

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