Fraunhofer IAF

FRAUNHOFER INSTITUTE FOR APPLIED SOLID STATE PHYSICS IAF

PRESS RELEASE

BMBF funds quantum computing project "SPINNING" with over €16 million

Using diamond to realize a hybrid quantum processor "made in Germany"

On the way to applied quantum computers: In the "SPINNING" project, national experts from science and industry are working on a compact, scalable quantum processor based on spin qubits in diamond that can be connected to classical computers. With this approach, the project aims for an important contribution to the German quantum technology ecosystem. The BMBF is funding "SPINNING" with €16.1 million. Fraunhofer IAF is coordinating the project in which 28 partners are working together.

The joint project "SPINNING" (diamond spin-photon-based quantum computer), launched in January, aims to develop the demonstrator of a quantum processor "made in Germany" as well as the peripherals needed to connect the processor to classical computer systems. The project duration is three years. Compared to today's quantum computers, the planned hardware features longer operation times and smaller error rates as well as low cooling requirements. The quantum processor will initially be able to compute with 10, and subsequently with 100 qubits and more, and would thus be able to predict the products of complex quantum chemical reactions.

Quantum computers have the potential to solve computational problems that classical computers can only solve with simplifications, approximations, or in very long computing times. The computing power depends on the central hardware element, the qubit. Although nowadays there are various approaches to realize qubits and quantum computers, their development is still in an experimental stage. Therefore, innovative approaches for compact and scalable quantum processors are crucial on the way to a reliable application of quantum computers.

Spin photon based quantum processor for hybrid systems

Within the framework of "SPINNING", the project partners are exploring and demonstrating a scalable, universal quantum processor based on spin qubits in diamond. This features a novel networked and hybrid design. "One of the goals of our work is to ensure reliable operation of such an innovative quantum computer and to create a periphery to make the computing power available to a broad group of users, for example via cloud computing," explains Prof. Dr. Rüdiger Quay, project coordinator of "SPINNING" and executive director of Fraunhofer IAF.

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Outstanding connectivity and flexible configurability

In simple quantum circuits, the quantum volume is used to compare the performance of platforms. It results from the number of qubits, their error rate, and their connectivity. The latter is an often-neglected key parameter, which indicates the number of directly addressable neighboring qubits and the possibility of coupling qubits over large distances.

"SPINNING" also considers this parameter and provides a design that features unprecedented connectivity and flexible configurations. In addition, the quantum processor is able to operate with low cooling requirements and thus may be implemented in close proximity to classical computer systems.

Project partners

Fraunhofer IAF, based in Freiburg, is leading the "SPINNING" consortium consisting of six universities, two non-profit research institutions, five industrial companies (SMEs and spin-offs), and fourteen associated partners (ten of them are companies). All participants are highly active in the field of pre-competitive hardware, firmware, and software development.

- Fraunhofer Institute for Applied Solid State Physics IAF (coordinator)
- Fraunhofer Institute for Integrated Systems and Device Technology IISB
- Forschungszentrum Jülich GmbH
- Karlsruhe Institute of Technology (KIT)
- University of Konstanz
- Heidelberg University
- Technical University of Munich
- Ulm University
- Diamond Materials GmbH, Freiburg im Breisgau
- NVision Imaging Technologies GmbH, Ulm
- Qinu GmbH, Karlsruhe
- University of Stuttgart
- Quantum Brilliance GmbH, Stuttgart
- Swabian Instruments GmbH, Stuttgart
- 14 associated Partners from science and industry

The German Federal Ministry of Education and Research funds the "SPINNING" project (funding code: 13N16209).

About Fraunhofer IAF

The Fraunhofer Institute for Applied Solid State Physics IAF is one of the world's leading research institutions in the fields of III-V semiconductors and synthetic diamond. Based on these materials, Fraunhofer IAF develops components for future-oriented technologies, such as electronic circuits

for innovative communication and mobility solutions, laser systems for real-time spectroscopy, novel hardware components for quantum computing as well as quantum sensors for industrial applications. With its research and development, the Freiburg research institute covers the entire value chain – from materials research, design and processing to modules, systems and demonstrators.

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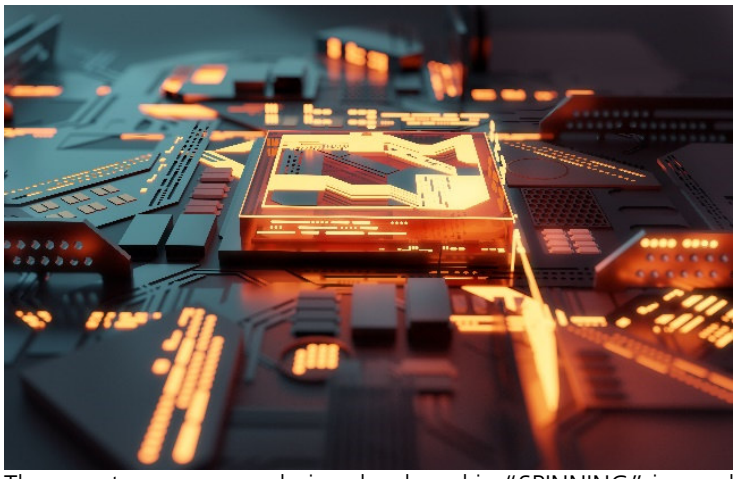
Images:



The quantum processor being developed in "SPINNING" is capable of operating with low cooling requirements. Thus, it may be implemented in close proximity to classical computer systems, enabling scalable and hybrid computer architectures.
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