PRESS RELEASE

"There is no way around Thuringia on the future quantum highway"

New hub for quantum communication in Germany is being built in Erfurt / New research project Q-net-Q launched

Erfurt / Jena / Nordhausen / Sundhausen / Berlin / Frankfurt am Main (Germany)

The Free State of Thuringia wants to become an important hub for the German quantum network. With various projects, the state, the federal government and the European Union are driving forward the expansion of a network for quantum communication in Germany. Existing test links for researching quantum-secured fiber links between Erfurt and Jena are now to be extended by new sections in the direction of Nordhausen and, in perspective, Berlin and Frankfurt am Main. A visit by Thuringia's Science Minister Wolfgang Tiefensee to the Fraunhofer Center in Erfurt on Thursday marked the start of further route expansion, which is being carried out as part of the new Q-net-Q research project.

In the heart of Germany lies the Free State of Thuringia. And at its center, in turn, the state capital Erfurt. Due to this geographical location alone, Erfurt is predestined to become a central hub for a future quantum network in Germany. The Free State of Thuringia has recognized this potential and is funding a wide range of projects that advance research into quantum communication as well as quantum computing.

On Thursday, Thuringia's Science Minister Wolfgang Tiefensee visited the Fraunhofer Center in Erfurt to review the progress of existing research projects and to give the go-ahead for the expansion of the quantum network in Germany. "Thuringia is one of the leading locations in the field of quantum communication. As a state, we have been making targeted investments for years in expanding the expertise and infrastructure required for this. The expansion of the existing test link is another major step in this direction. In this way, we are creating the conditions for a secure quantum communications infrastructure throughout Germany. Thuringia, with its research institutions and companies, will form a central hub in this in the future," he explained during his visit.

Existing fiber link to be extended to over 150 kilometers

With funding from the state, an optical fiber test link has already been established between the Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena and the Fraunhofer Center in Erfurt. Here, quantum keys have already been

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successfully exchanged between Thuringia's metropolitan cities over a distance of 75 kilometers - as part of the QuNET initiative funded by the German Federal Ministry of Education and Research (BMBF).

The special highlight here: For the test link, it was possible to use an existing infrastructure of conventional telecommunications fiber optics. This means that no new, expensive infrastructure had to be installed. The current subject of research is how the latest systems for so-called quantum key distribution can be integrated into these existing networks and made usable for various fields of application.

To address this issue, an extension of the test is planned, which is now moving forward: The Thuringian communities of Nordhausen and Sundhausen will be connected to the existing link between Jena and Erfurt by 2024. Furthermore, within Jena, the University Hospital will also be connected to the test link. This will extend the fiber-based test route to a total length of more than 150 kilometers. Further sections are planned as far as Berlin and Frankfurt am Main by the end of 2024.

The hub of this planned network will be the Fraunhofer Center in Erfurt. "There is no way around Thuringia on the future quantum highway," commented Prof. Dr. Andreas Tünnermann, director of Fraunhofer IOF, in Erfurt on Thursday. The network expansion and the associated development of strategic cooperations in the field of communication and information technology will take place within the framework of a new research project called Q-net-Q.

Extended fiber link tested initially for the exchange of patient data

In the Q-net-Q project, led by Nordhausen University of Applied Sciences and with the participation of Fraunhofer IOF, the application potential of high-security quantum communication for telemedical software will initially be tested as an example.

The guiding idea behind this: Rural regions in particular often suffer from a serious shortage of (specialist) physicians. A faster and more confidential exchange of patient data between urban and rural areas could therefore not only make medical care more convenient and efficient in the future, but it could even save lives. Against this backdrop, the Thuringian community of Sundhausen will also be connected to the new fiber-optic test link as an example of a rural region. The first concrete use cases for the new section between Sundhausen and the Jena University Hospital will be in the area of follow-up care (e.g., post-inpatient hospitalization) for post-COVID patients on the one hand, and in early neurological detection using digital tests (e.g., dementia detection) on the other.

Further link expansion planned in 2024 to Berlin and Frankfurt am Main

The further planned link sections to Berlin and Frankfurt am Main, data exchange between data centers and in high-speed connections will be the focus of research in perspective. "Within the framework of the Q-net-Q project, we basically want to research how the physically securely generated quantum closures from QKD systems can be efficiently integrated in today's Internet to secure communication paths," says Prof. Dr. Thomas Hühn from Nordhausen University of Applied Sciences, explaining the overall project goal.

Around 12 million euros in funding for Q-net-Q from EU and BMBF

The Q-net-Q project is being implemented as part of the European program EuroQCI. The EU and the BMBF are funding the project with a total of 11.8 million euros.

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In addition to Fraunhofer IOF and the Nordhausen University of Applied Sciences, which is acting as consortium leader, the Q-net-Q research association includes five other academic partners: the Technical University of Munich, the Technical University of Berlin, the Friedrich Alexander University of Erlangen-Nuremberg and the Fraunhofer HHI. Furthermore, two industrial partners, Utimaco GmbH and DE-CIX Management GmbH, are also involved in the project.

Further information

- More about the Q-net-Q project: https://www.forschung-it-sicherheit-kommunikationssysteme.de/projekte/q-net-q
- More about the European program EuroQCI: https://digital-strategy.ec.europa.eu/de/policies/european-quantum-communication-infrastructure-euroqci

FAQ: Questions and answers around quantum(-communication)

What are quanta anyway?

The world is a quantum world. That means: Everything consists of quanta, as long as we look at sufficiently small systems. Because quanta are the smallest and indivisible units

that cause physical interactions. Photons, i.e. particles of light, are therefore also tiny quantum objects.

These quantum objects have fascinating properties that researchers are exploiting in the development of cutting-edge quantum technologies. One special property is the entanglement of quantum objects. Entanglement here means that pairs of entangled particles (e.g., photons) are created. Each particle always knows the exact state of its "twin" - even if the twin is far away.

How can we use quantum to protect our data and communications?

Our modern world is highly networked and therefore particularly vulnerable to cyber-attacks. Attacks, for example, on critical infrastructures such as nuclear power plants can endanger not only sensitive data, but potentially lives. Currently, our communication systems are encrypted using cryptographic algorithms based on solving certain numerical problems. However, the expected emergence of quantum computing - i.e., next-generation high-performance computers that can solve computational problems that would take conventional computers several years to solve, within seconds - as well as potential breakthroughs in mathematics pose a long-term threat to the security of this method. For this reason, new approaches are needed to ensure the long-term security of our data today.

And what are quantum keys or quantum key exchange (QKD) in this context?

Communication using quanta promises a completely new level of security. In contrast to conventional cryptographic methods, quantum cryptography is based on physical principles. The technological basis for this is the so-called quantum key distribution, or QKD for short. QKD enables the sharing of random keys between legitimate users by guaranteeing special security based on the laws of quantum mechanics rather than on the computing power of an adversary.

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About Fraunhofer IOF

The Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena conducts application-oriented research in the field of photonics and develops innovative optical systems for controlling light - from its generation and manipulation to its application. The institute's range of services covers the entire photonic process chain from opto-mechanical and opto-electronic system design to the production of customer-specific solutions and prototypes. At Fraunhofer IOF, about 400 employees work on the annual research volume of 40 million euros.

For more information about Fraunhofer IOF, please visit: http://www.iof.fraunhofer.de/

About Nordhausen University of Applied Sciences

Nordhausen University of Applied Sciences (HSN) is a young university in Thuringia and an attractive location for new, innovative study programs and forms of teaching and learning. A total of 30 degree programs are offered in the two departments of Engineering and Business & Social Sciences. Sustainable technologies, future-oriented research and socially relevant subject areas are just as much a part of Nordhausen's portfolio as classic scientific fields. Nordhausen University of Applied Sciences stands for a well-founded education rooted in the respective subject area, combined with interdisciplinary seminars and practical and foreign language courses. As a research and third-party funded university of applied sciences in the north of Thuringia, we offer an excellent basis for numerous projects with the regional and national economy.

For more information about Nordhausen University of Applied Sciences, please visit:
http://www.hs-nordhausen.de/

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