Organization

National Institutes for Quantum Science and Technology

Takasaki Institute for Advanced Quantum Science

Quantum Materials and Applications Research Center

- Quantum sensing project
- Spin-photonics in 2D materials project
- Laser-cooled ion research project
- Quantum optical and spin state control project
- Quantum materials theory project
- Rare-earth quantum device project
- Quantum materials ultrafine fabrication project

Quantum Materials and Applications Research Center

https://www.qst.go.jp/site/taka/

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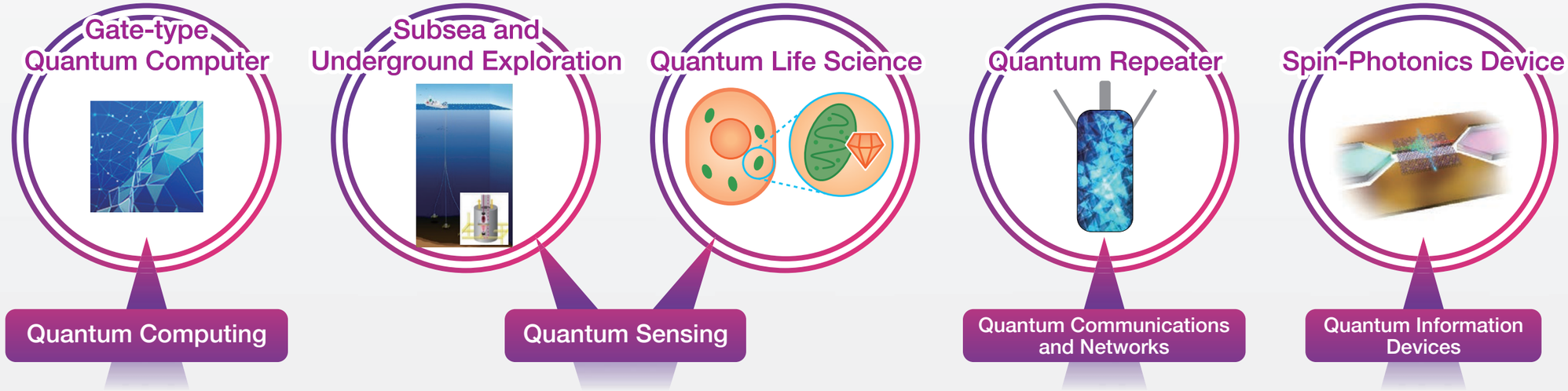
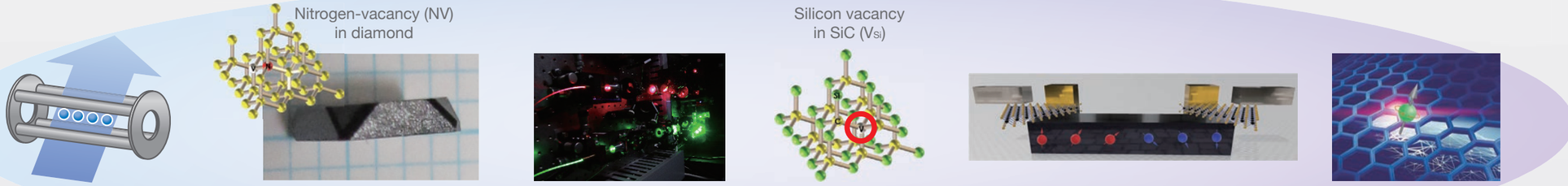
QST
National Institutes for Quantum Science and Technology
Takasaki Institute for Advanced Quantum Science

Contributing to the realization of Society 5.0 through the creation of QX (Quantum Transformation) technology



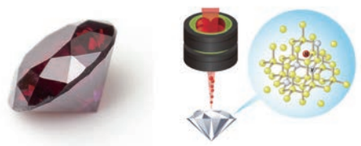
Exploration of solid-state spin qubits, spin-photonics and quantum state control technology utilizing QST original research



World-leading research on the development of quantum materials and applications

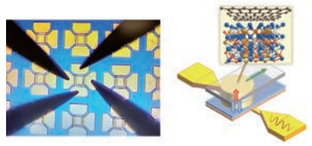
Quantum sensing project

This project investigates the creation of spin defects which act as quantum sensors in wide bandgap semiconductors such as diamond and silicon carbide using ion and electron beams. We explore quantum sensing based on such spin defects to establish extremely high sensitive sensing technology for magnetic field and temperature measurements.



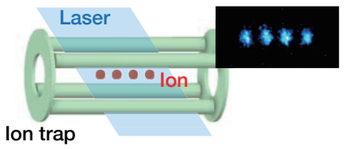
Spin-photonics in 2D materials project

This project aims to explore spin-photonics by developing novel quantum materials which enable efficient photon-spin interconversion and optically driven spintronic devices based on two-dimensional materials and advanced magnetic materials.



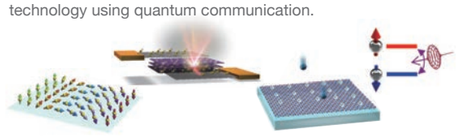
Laser-cooled ion research project

This project promotes research and development of quantum information processing technology by developing quantum computers that use laser-cooled ions trapped in an ion trap as qubits, and by developing ultra-precision ion implantation technology that uses an ion trap as an ion source.



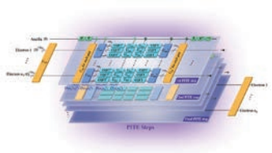
Quantum optical and spin state control project

This project focuses on the precise control and structural analysis of quantum states in semiconductor heterostructures and spin-related complex defects using advanced optical and electrical detection techniques. We are also developing new materials and verifying their spin and quantum-related functionalities in order to establish the fundamental technologies necessary for the next generation of information technology using quantum communication.



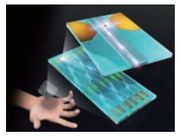
Quantum materials theory project

This project promotes theoretical research and development of novel quantum materials and devices, of algorithms for (gate-type) quantum computers, and of quantum error correction technology by utilizing first-principles (non-empirical) theoretical calculations.



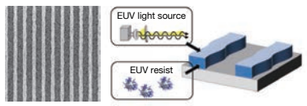
Rare-earth quantum device project

This project aims to develop new types of quantum devices using rare-earth ions in niride semiconductors as quantum bits, single photon sources, and quantum entangled light sources. This project also aims to develop new quantum sensing methods using the opto-electronic and spin properties of rare-earth elements.



Quantum materials ultrafine fabrication project

This project explore state-of-the-art device and quantum devices systems, through the application of new nanofabrication techniques. We aim to develop resist materials such as metal resists and block copolymers. One of the most important missions of this project is to promote the development of ultra-fine lithography technologies and ultra-fine 3D structure fabrication techniques based on basic research of materials and processes by applying quantum beams to our measurements and nanofabrication.



National Institutes for Quantum Science and Technology (QST), as the "Foundational Quantum Technology Hub", one of Japan's Quantum Technology Innovation Hubs (QIH), carries out R&D of foundational quantum technologies, and supports industry through the development of quantum materials with advanced quantum functionality by trial and assay of quantum materials and quantum technologies, and furthermore tailoring their properties to the environment in which they will be used. Additionally, by taking advantage of quantum beam and laser (photon) technologies, we are able to perform sophisticated manipulation of quantum states and realize advanced quantum measurements. We, the Quantum Materials and Applications Research Center (QUARC), as a core part of the QIH's "Foundational Quantum Technology Hub", are conducting a wide variety of research on quantum materials and their functionalization, from basic science to the applications of these materials. Using accurate and advanced techniques for spin and photon manipulation, as well as their entanglement, we carry out unique world-leading research. We play an important role as a R&D hub for quantum technology, promoting cooperation among government, academia and industry.

Quantum Materials and Applications Research Center

Director **Takeshi Ohshima**