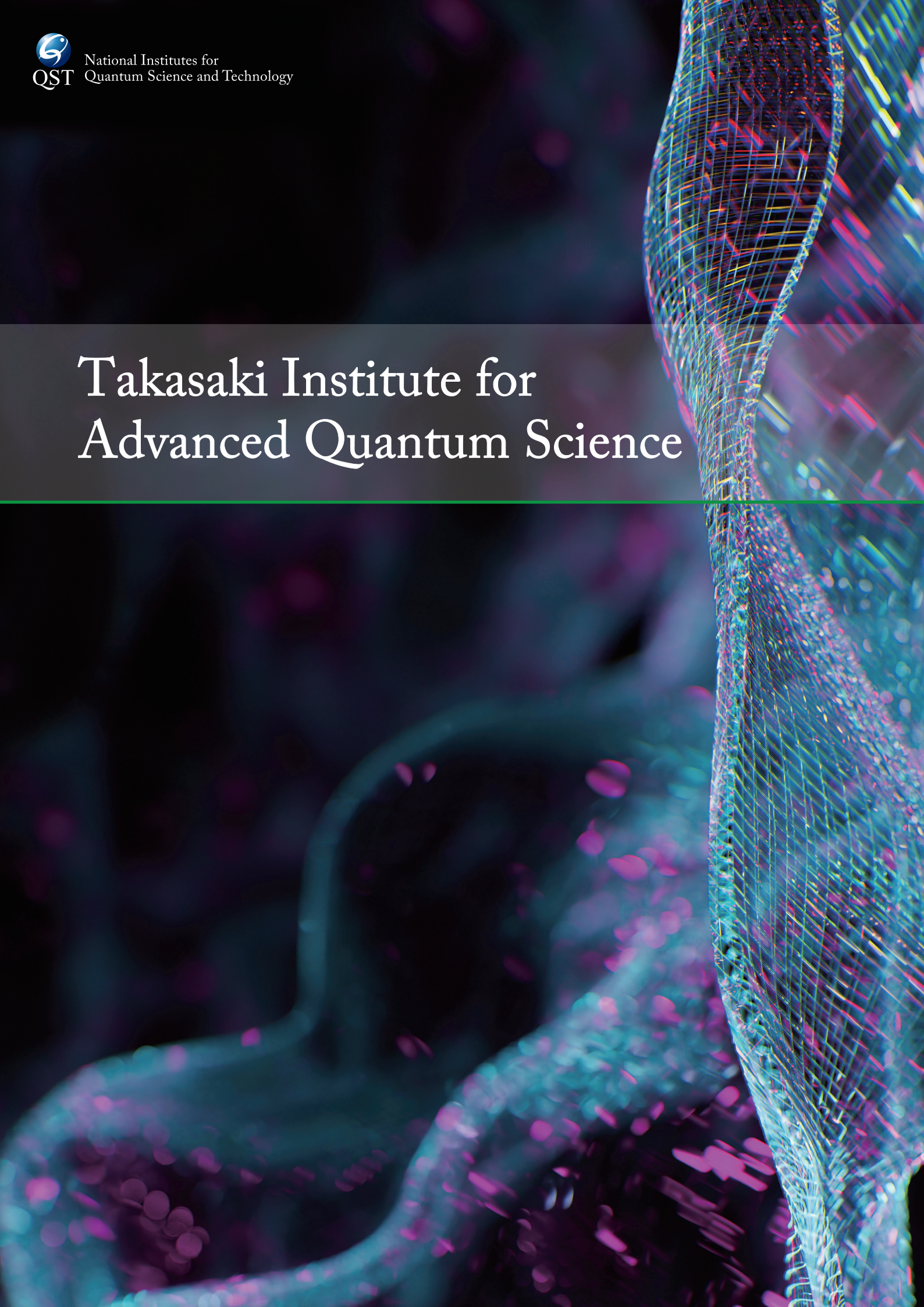
QST National Institutes for Quantum Science and Technology

Takasaki Institute for Advanced Quantum Science



Preface

Director General,
Takasaki Institute for Advanced Quantum Science

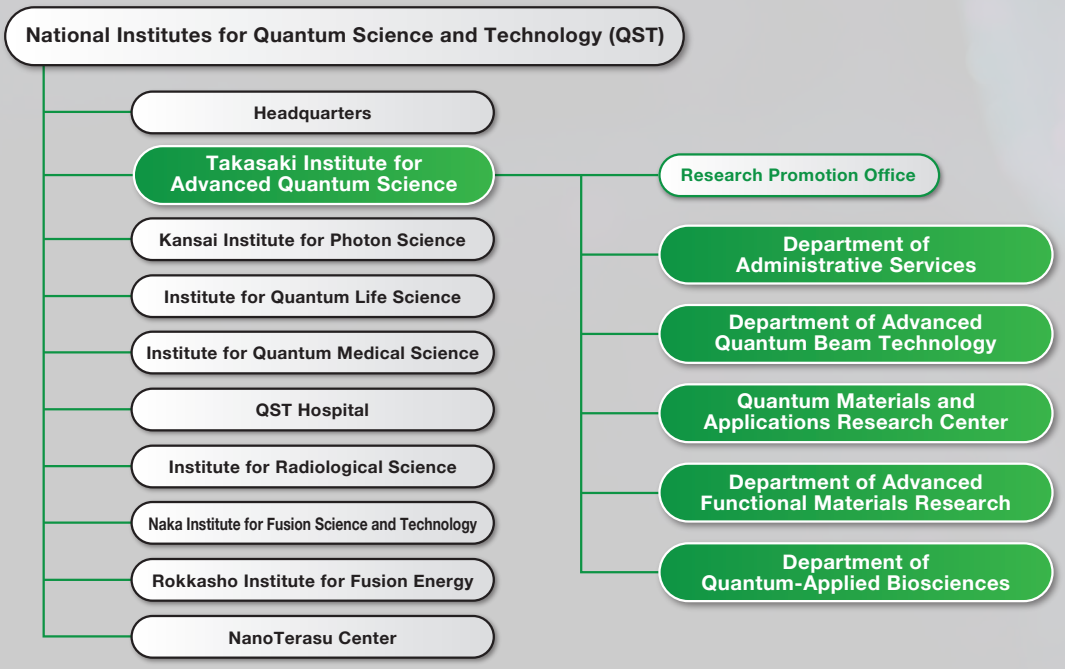
MAEKAWA Yasunari

Takasaki Institute for Advanced Quantum Science is a core R&D site for quantum beam science and technology, which are the main missions of the National Institutes for Quantum Science and Technology (QST). We have been conducting innovative researches on radiation/quantum-beam application research for more than 60 years including the predecessor institutes, Takasaki Radiation Chemistry Research Establishment of the Japan Atomic Energy Research Institute (JAERI) and Takasaki Advanced Radiation Research Institute of the Japan Atomic Energy Agency (JAEA).

Since the establishment of QST in 2016, it strongly promotes fundamental research on quantum technology, such as the creation of quantum functional materials that contribute to the realization of quantum sensing and quantum computers. QST has been nominated as one of the Quantum Technology Innovation Hubs (QIH) in Japan. As a QIH activity, we supply high-quality quantum materials to companies, and provide the training course for corporate researchers. In addition, materials and devices for energy and environment such as next-generation storage batteries have been developed as application of quantum technology, that contribute to a carbon-neutral and circular society. Development of biomaterials with quantum beams, medical/agricultural applications using radio isotopes are also performed for realization of healthy society and future bioeconomy, respectively.

Through these efforts, we aim to innovate advanced quantum science and technology for promoting industry toward the realization of the Sustainable Development Goals (SDGs) of the United Nations and Society 5.0, the vision of Japan's future society. We would appreciate your support for our activities at Takasaki Institute for Advanced Quantum Science.

Organization Chart



About Takasaki Institute

Takasaki Institute functions as a core institute for promoting quantum technology research at QST. We promote collaborative activities between industry, government and academia, including industrial applications of quantum technology, social infrastructure development, and education and training of experts in the quantum field.

Creating a Sustainable Future through Quantum Technologies

Ultra-smart society | **Resource-recycling society** | **Healthy and longevity society**

Pioneering of advanced scientific fields ⇧ **Realization of innovation in quantum technologies**

Takasaki Institute

Utilizing its strengths as an advanced quantum-beam facility, we are progressing with research and development in all fields, from basic research in quantum technologies to applications in business and industry.

QST Internal and External Collaborations

J-KAREN-P
(Kizu site)

SPring-8
(Harima site)

NanoTerasu
(Sendai site)

Quantum Life Science
(Chiba site)

QIH Quantum Innovation Hubs

Quantum Technology Innovation Hubs
(QIH)

Quantum STrategic industry Alliance for Revolution
(Q-STAR)

Bolstering of competitive prowess in R&D

Academic-Collaborative Satellite Labs.

Tokyo Tech

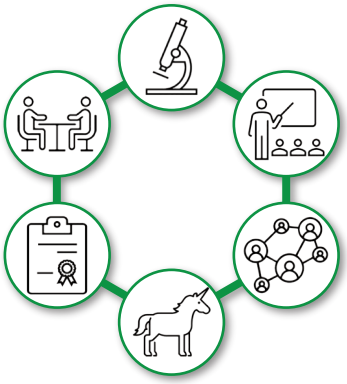
Tokyo Institute of Technology
Meguro Lab.

TOHOKU UNIVERSITY

Tohoku University
Sendai Lab.

Technology dissemination and human resource development

Industrial-Collaborative Open Lab.

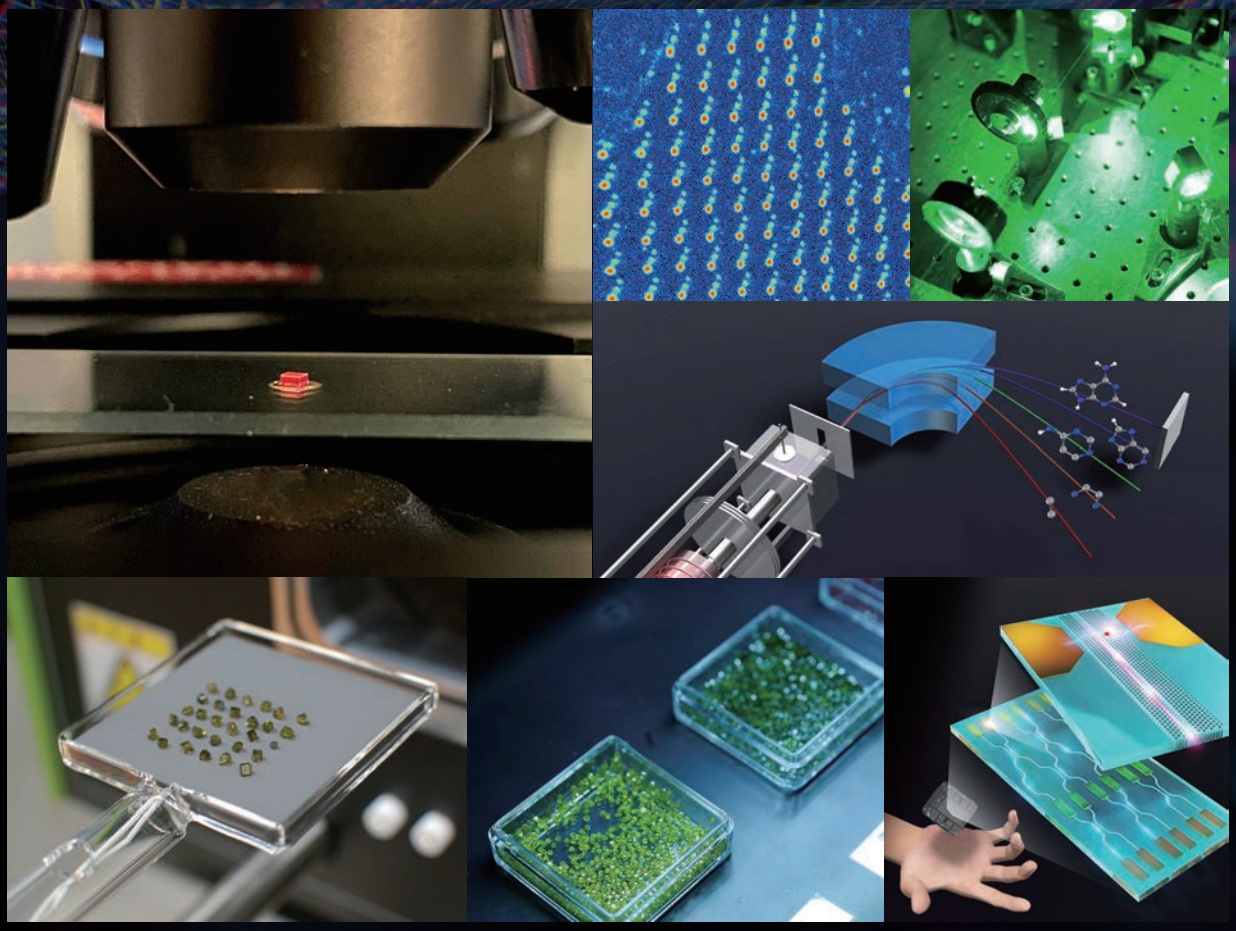


- Use of test beds
- Support desk
- Creation of new products

Acceleration of social implementation

Research on Quantum Materials and Applications

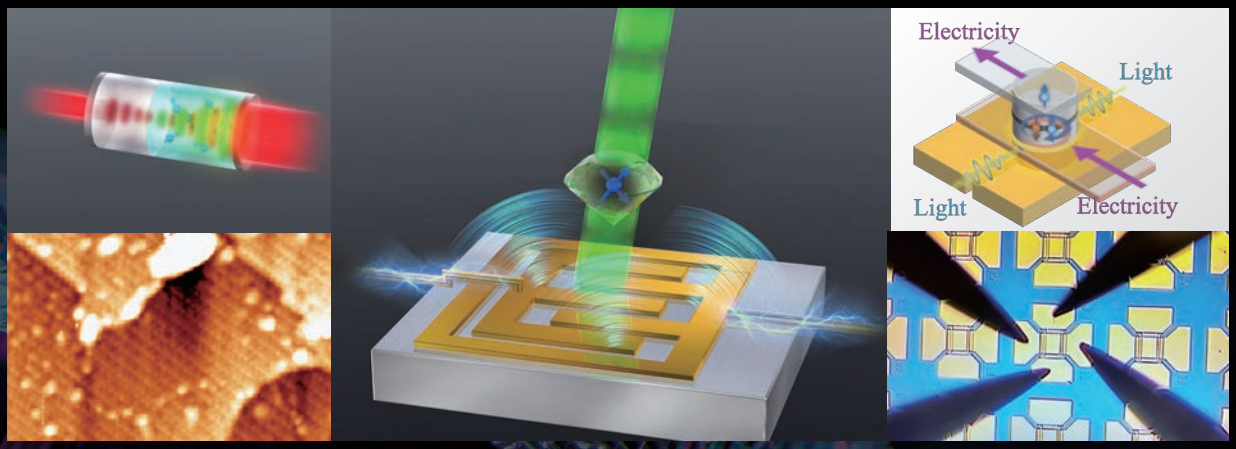
Using quantum beams, we strive to understand materials science at the nano-scale level. This knowledge serves as the basis for creating and producing advanced quantum materials and devices indispensable for the realization of an ultra-smart society.



Quantum Sensing

・Takasaki site ・Meguro Lab. ・Sendai Lab.

We are moving forward on innovative R&D for highly precise sensing by use of solid quantum sensors with spin-defects. Specifically, these include highly efficient synthesis of Nitrogen-Vacancy (NV) centers in diamond, online and non-contact measurement of inside of SiC power device, noise cancellation using quantum protocol, etc.



Quantum Devices for ICT

・Takasaki site ・Sendai Lab.

To realize of quantum devices that enable both ultra-high-speed processing and huge energy savings, we are developing spinphotonics technology, precision control technology for electron spin and quantum states, ultrafine lithography, etc.

Quantum Computing

・Takasaki site ・Meguro Lab.

We are developing the social infrastructure necessary for the widespread use of quantum computers that take cooled ions captured in an ion trap as quantum bits and algorithms that can push the capabilities of quantum computers to their maximum levels.

Quantum Materials and Applications Research Center
https://www.qst.go.jp/site/quarc-en/

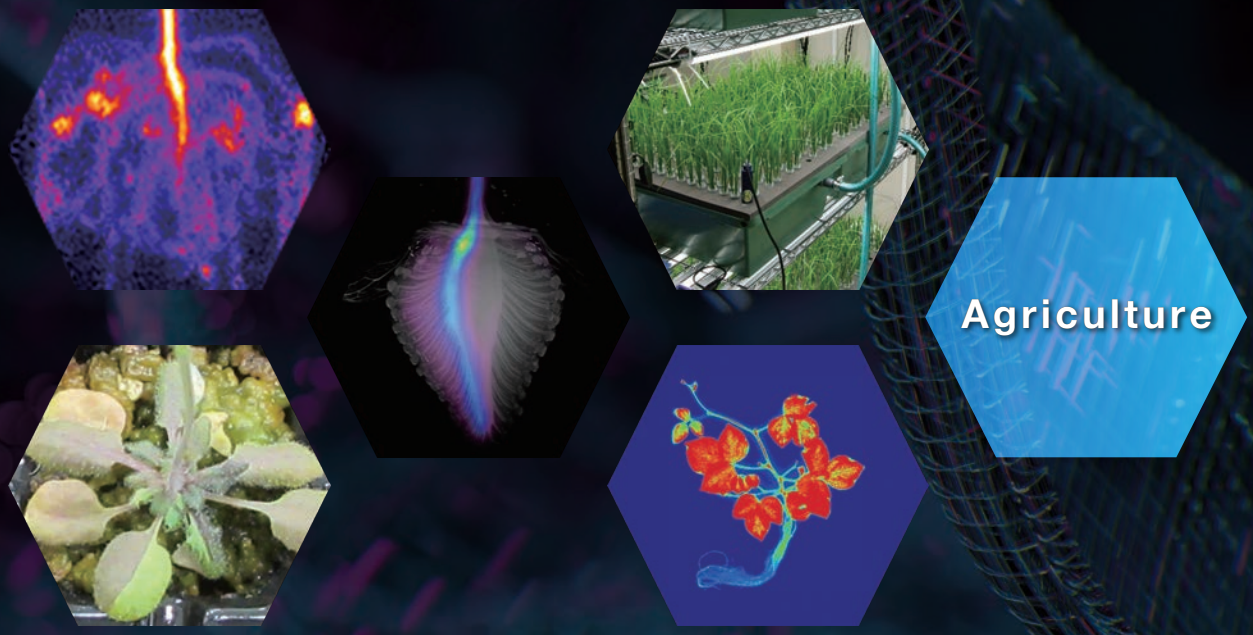
Research on Advanced Materials and Biological Sciences

Using the excellent characteristics of quantum beams, we are conducting research to create energy materials, environmental materials, next-generation medical materials, new drugs, and agricultural biotechnology that are essential to realizing a sustainable future for the Earth.

We are developing compact and lightweight next-generation batteries for motor vehicles toward the realization of a carbon-neutral, sound material-cycle society. We are also working to create low-cost, high-performance hydrogen absorption and storage materials, environmentally friendly materials derived from biomass, highly efficient material development methods using AI technology, etc.

Department of Advanced Functional Materials Research
https://www.qst.go.jp/site/adv-func-mat-e/

We are developing advanced biodevices such as microchips reproducing the human body's internal environment and mini-organs, next-generation radioactive drugs for effective cancer cell therapy, real-time visualization technology for particle beam therapy, etc., with the aim of realizing a healthy and longevity society.



We are developing radioisotope (RI) imaging techniques and conducting research on the use of quantum beams for useful plant resources and disease nematode control, etc., with the aim of realizing sustainable agriculture.

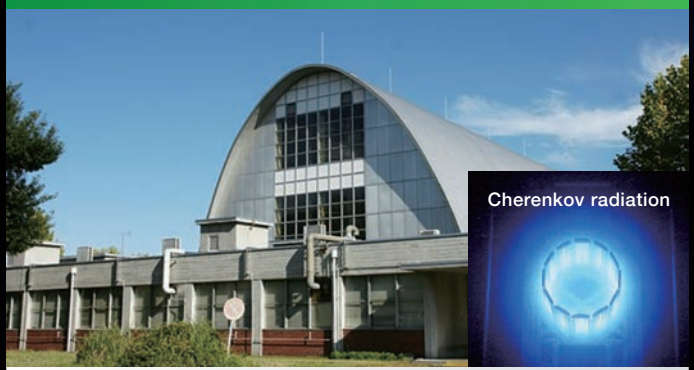
Department of Quantum-Applied Biosciences
https://www.qst.go.jp/site/radiation-applied-biology-e/

Quantum-Beam Facilities

We have three irradiation facilities for comprehensive R&D of cutting-edge quantum beams. Together with this R&D, quantum-beam technologies are also being developed to generate seeds for new types of R&D.

1. Cobalt 60 Gamma-ray Irradiation Facilities
2. Electron-beam Irradiation Facility
3. Ion-Irradiation Research Facility (TIARA)

1. Cobalt 60 Gamma-ray Irradiation Facilities



Wide range of dose rates

Our facilities are the only gamma-ray irradiation facility for research use in Japan with a wide range of dose rates from 0.2 to 8 kGy/h.

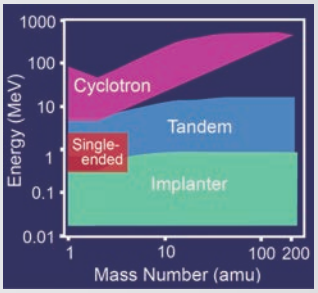
2. Electron-beam Irradiation Facility

Large area & continuous irradiation

The electron accelerator can irradiate a wide area with a width of 120 cm.
The maximum acceleration voltage and beam current are 2.0 MeV and 30 mA, respectively.

Four types of ion accelerators for quantum materials and for biotechnology

The accelerators of TIARA provide a great variety of ion species (from atoms to molecules such as proton, carbon, gold, fullerene, nucleic acid, etc.) with a wide range of ion energies from keV to MeV.



AVF Cyclotron

Covering high-energy range

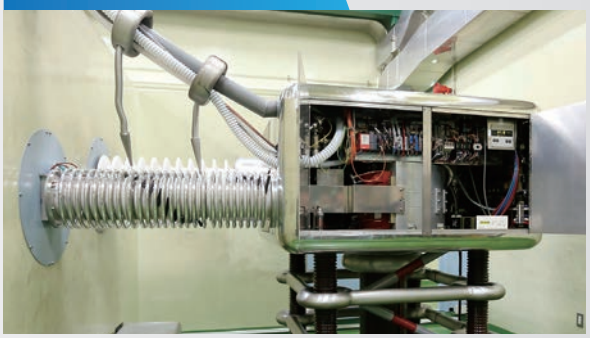
Tandem Accelerator

Outstanding accuracy and precision

Single-ended Accelerator

Focusing ion beam to less than 1 μm

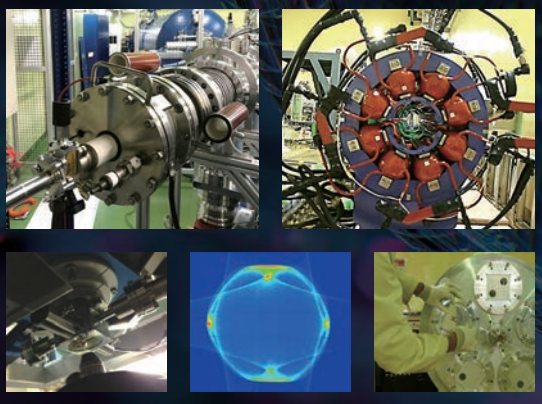
Ion Implanter



Covering low-energy range

Development of Quantum-Beam Technology

We are developing micro/nano beam forming technology, ultrastructural analysis and microfabrication technology, and innovative accelerators and ion sources.



Department of Advanced Quantum-Beam Technology
https://www.qst.go.jp/site/taka-shisetsubu-e/

Utilization of Takasaki Institute

We promotes the use of QST's unparalleled high-performance quantum beam facilities for researchers and engineers in Japan and overseas, as well as their utilization through joint research.

Shared Facility Use System

The shared facility use system allows external users to utilize the QST's facilities, which are designated in advance for shared use, for their own R&D and industrial use.
Private companies and other organizations can use the QST's facilities for a fee, even if they are not conducting joint research with QST.

Technology Transfer

To return to society the fruits of our research, QST is vigorously promoting and performing technology transfer.
Private companies and other organizations are encouraged to use the intellectual property, know-how, and other resources under the possession of QST.

Functional materials made with quantum beam technology

Extreme heat resistant SiC fiber "Hi-Nicalon®"

Shape memory resin (Radiation Education Kit)

Cesium removal apparatus "KranCsair®"

Optical hydrogen gas detector

Bio-resources created with quantum beam biotechnology

New Osteospermum varieties

Wall-greening plant for mitigating air pollution

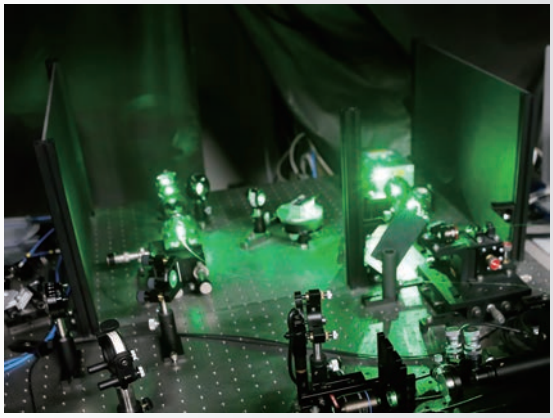
DNA repair-promoting protein reagent

New sake yeast producing sweet flavor

Human Resource Development and Exchange

To promote the development and exchange of quantum human resources, we have systems and programs to accept university students, company engineers, etc. We also offer educational and enlightenment activities for elementary, junior high, and high school students.

Academic-Collaborative Satellite Labs.



Satellite Labs. accelerate research in quantum technologies and strengthens our ability to foster human resources in quantum fields.

Joint Research

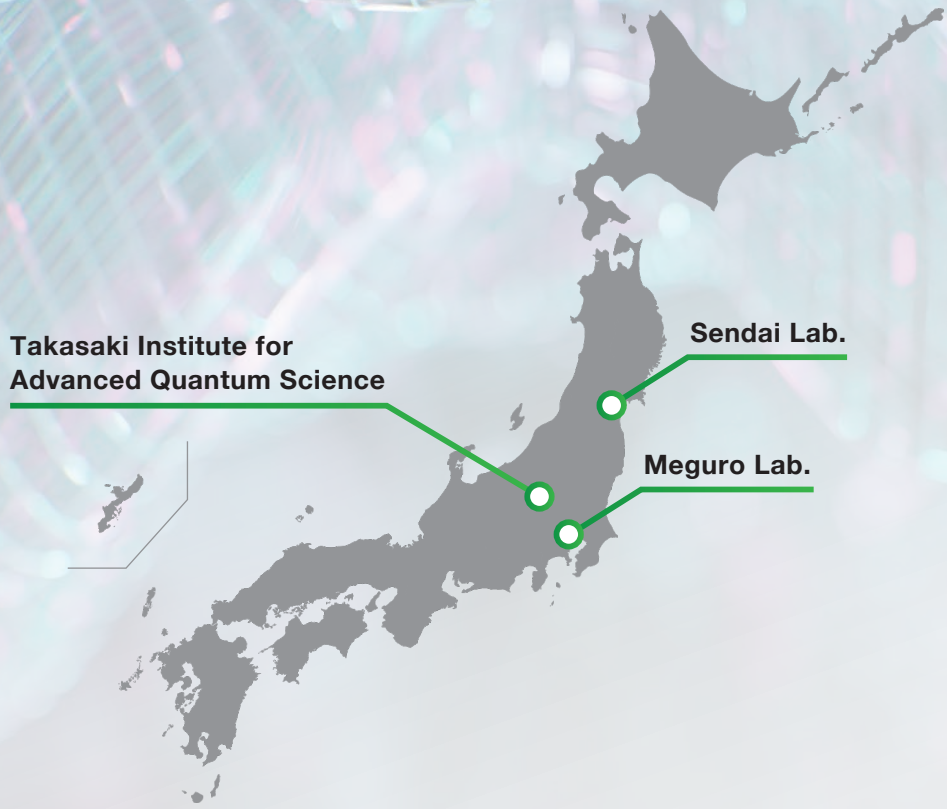
We actively promotes joint research with private companies and others in order to return to society the fruits of our research and intellectual resources.

International Cooperation

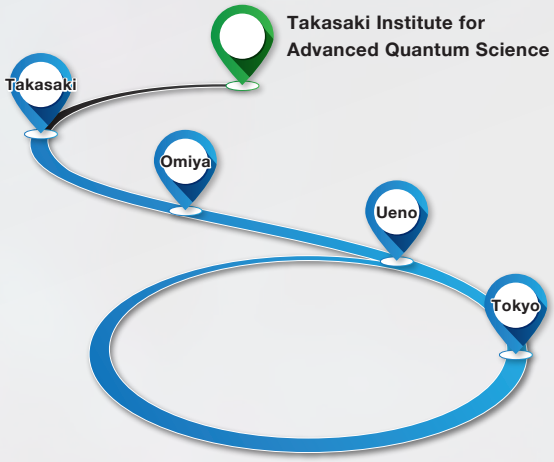
Through collaboration and partnerships with overseas universities and institutes, we promote the formation and strengthening of a global network on quantum technology.

Outreach Activities

We perform science education for elementary, junior high, and high school students, public open days, symposiums, and other events, to publicize the latest and foundational research results.



Access



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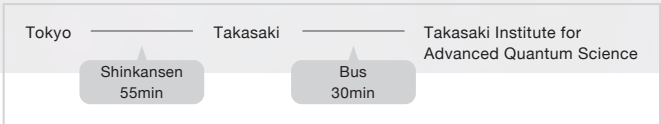
https://www.qst.go.jp/site/taka-english/



Academic-Collaborative Satellite Lab.

Meguro Lab.

(Location: Ookayama Campus, Tokyo Institute of Technology)

Sendai Lab.

(Location: Katahira Campus and Aobayama Campus, Tohoku University)