2022.4

National Institutes for
Quantum
Science and
Technology

National Institutes for Quantum Science and Technology

QST

Creation of Harmonious Diversity

President, National Institutes for
Quantum Science and Technology

Hirano Toshio

"Wa-Kei-Sei-Jaku" It is a word that expresses the basic philosophy of the Japanese tea ceremony meaning the four most important elements, harmony, respect, purity and tranquility. When I handle a tea set in front of this word, I would think of "harmony" and "diversity". I would sense all spaces with diversity harmonizing into one, by softening mutual hearts and respecting each other beyond the different positions of the host and guest, keeping the people, things and deeds, namely the people's hearts, the items and the atmosphere in the tea room, in purity and tranquility. I believe that it is necessary to promote the "creation of harmonious diversity" by overcoming the barriers of diversity in order to develop a human society in which a wide variety of people around the world are living peacefully, enrichingly, and respecting each other.
The National Institutes for Quantum Science and Technology (QST) have been builting a world-class platform for quantum science and technology research and development that promotes the innovation in human society through challenging to elucidate the fundamental principles of life phenomena, in addition to realizing health and longevity, clean energy, and innovative materials and devices. We contribute to the development of a peaceful and spiritually-rich human society through the "creation of harmonious diversity" utilizing quantum science and technology.

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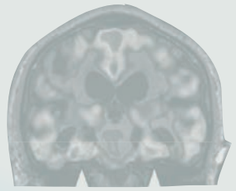
Creation of harmonious diversity through quantum science and technology



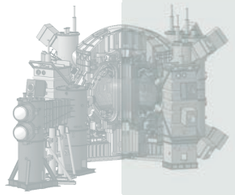
QUANTUM LIFE and MEDICAL SCIENCE DIRECTORATE

Quantum Medical Science Area

Building a healthy and long-lived society with zero cancer deaths

Quantum Life Science Area

Unraveling the mystery of life with quantum eyes and hands

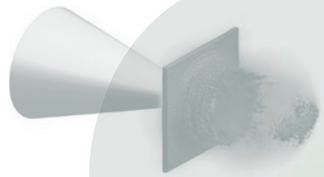


FUSION ENERGY DIRECTORATE

Quantum Energy Science and Technology Area

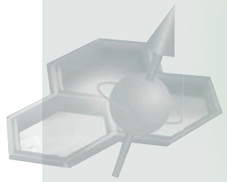
Creating a Sun on Earth!!
-Realizing future energy-

QST aims to build a word-class platform for quantum science and technology research in three divisions.



The Quest for Future by Lasers

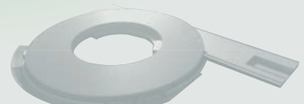
Quantum Optics Area



QUANTUM BEAM SCIENCE RESEARCH DIRECTORATE

Quantum Materials Science Area

Create Innovation with Quantum Beams and Materials Science



Intelligent use of radiation to protect human life and the future

Radiation consists of high-energy particles that can penetrate and interact with matter deep within an object. Modern medicine makes use of these properties in diagnostic imaging methods such as X-rays, CT and PET. Radiation is also used in the treatment of cancer.
To help build a healthy and long-lived society with zero cancer deaths, the Quantum Life and Medical Science Directorate is forging ahead with research and development for innovative medical uses of radiation. A major focus is heavy ion beam and targeted-isotope therapies for cancer, as well as imaging-based diagnosis and treatment of dementia and other diseases. We are also contributing to the protection of life and livelihood by performing research into safe and beneficial ways for radiation to be used within society. We study the adverse effects of radiation on health, and how to effectively respond to radiation accidents and nuclear disasters.

1

2

3

1 | **Heavy ion beam treatment room with rotating gantry**

This is a heavy ion radiotherapy room that reduces the physical burden on patients during cancer treatment. The gantry allows the orientation of the heavy-ion beam to be optimized so that a high dose can be applied to the affected area while avoiding the spinal cord and other important organs.

2 | **Heavy ion accelerator**

This is a device that accelerates heavy ions to 70% of the speed of light to reach cancer cells deep within the body. Aiming to popularize the technology, we are working to reduce the size of the accelerator and other irradiation equipment while also improving treatment quality and lowering costs.

3 | **QST Hospital**

Continuing the mission of its predecessor, the National Institute of Radiological Sciences Hospital, QST Hospital is a research hospital centered on heavy ion radiotherapy of cancer. Starting from 1994, over 14,000 patients have received heavy ion radiotherapy.

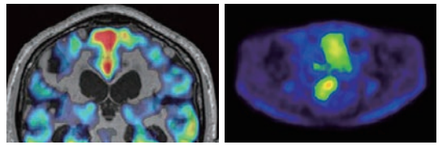
Radiation Safety Area / Quantum Medical Science Area

QUANTUM LIFE and MEDICAL SCIEN CE DIRECTORATE

"Curing"

cancer and brain disease

To develop precise irradiation of cancer lesions and maintain a high quality of life, we are working to advance heavy ion therapy and develop targeted radiopharmaceutical isotope treatments. We also conduct research on methods for the early diagnosis and treatment of dementia and other diseases.



To help clarify the pathology and develop diagnostic and therapeutic methods, we are working on various proteins that accumulate in the brain of dementia patients and novel radiopharmaceuticals that selectively accumulate in cancers.

"Protecting"

your life

We are contributing to radiation protection and risk assessment by collecting data on the effects of exposure. In addition, as a Japanese government designated core support center for advanced radiation emergency medicine, we are engaging with related organizations to establish a nationwide medical system for radiation accidents and disasters.

In the event of a radiation accident or nuclear disaster, we will dispatch a team of experts to support the initial medical care. In addition, to aid accurate risk assessment we collect exposure data and develop various technologies for dose measurement.

"Connecting"

to the next generation

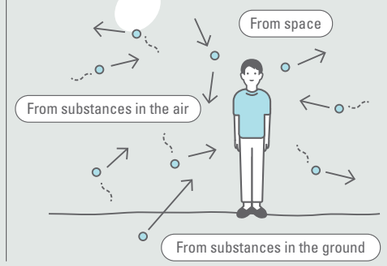
We provide a variety of training on radiation medicine, protection and safety for students and other people involved in medical care, disaster prevention and education. We also provide radiation education for the next generation through specialized programs including facility tours, practical training and hands-on learning.

Our specialists in various fields, such as medicine, biology, physics, engineering, chemistry, pharmacology and nursing, are in charge of training.

Radiation is everywhere

Detailed research will show us how to use it safely and correctly

Background radiation that is generated naturally in the air and the ground cannot be reduced to zero. Therefore, all living things on the Earth must have some natural resistance to radiation. However, inappropriate doses and handling may cause unwanted effects, so it is important to use radiation safely and correctly.

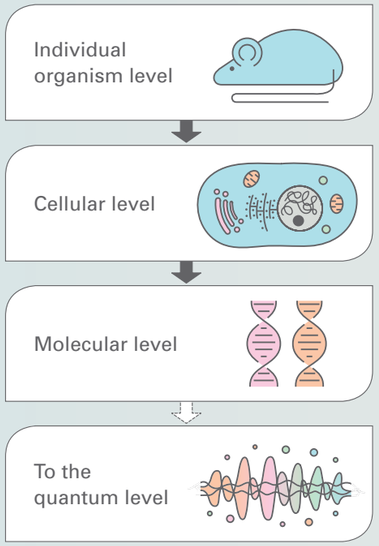


Unraveling the mystery of life with quantum eyes and hands

The birth of quantum mechanics in the first few decades of the 20th century led to the development of revolutionary technologies, such as semiconductors and lasers, that have dramatically transformed the world around us. This is called the first quantum revolution. In the 21st century, research and development for quantum computing and measurement technologies that actively utilize the bizarre properties of fundamental particles continues at an ever-increasing pace. We are now at the dawn of a “second quantum revolution”. In 2019 QST established the Institute for Quantum Life Science to study the mysteries of life with quantum eyes and hands, i.e. quantum technology.
It is expected that this approach will lead to many breakthroughs in life science. Quantum technology will allow us to observe the details of life phenomena with unprecedented accuracy and sensitivity. We will be able to deepen our understanding of the quantum effects involved in biological processes like photosynthesis, enzymatic reactions, and geomagnetic sensing by living organisms. With the principles of quantum mechanics guiding our research, we aim to unravel the mysteries of life and apply that knowledge to innovate fields such as medicine, agriculture, ecology and energy.

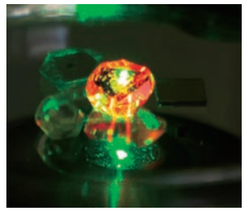
Life science enters the quantum era

Throughout most of history, life has been regarded as only occurring at the level of an individual organism. However, due to progress in technologies of observation and analysis (e.g., microscopes), life is now understood to be a complex system of much smaller cells and molecules. We are further exploring the basis of life at the most fundamental level using cutting-edge quantum technologies for measurement and evaluation. Our goal is to understand the hierarchy of biological processes from the quantum level up to the level of the entire lifeform.



Detecting cellular function with diamond nanosensors

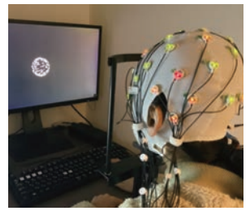
Tiny diamond crystals with trapped NV centers that are sensitive to the surrounding environment can make high-precision measurements of intracellular temperature, electric field, and acidity. Nanosensors such as these can be used to accurately monitor complex life phenomena such as aging, cancer proliferation, and neural activity.



Diamond with quantum sensor function

Exploring how the brain and body work

Hyperpolarisation of probe molecules dramatically increases the sensitivity and stability of MRI to observe the brain and body *in vivo*, thereby advancing medical and life science. At the same, development of novel data-analysis methods based on quantum-probability and quantum- information theories will facilitate study of the mechanisms by which the mind arises from the brain.



A quantum cognitive experiment

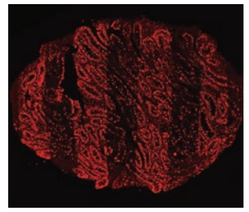
Understanding how living things work

The functional mechanism of proteins and other biomolecules will be clarified by analyzing the structure and dynamics with highly accurate quantum measurement technology and computer simulations. In addition, we will explore the role of quantum effects in biochemistry and take on the challenge of creating useful new molecules such as artificial enzymes.

A neutron diffraction experiment using the IBARAKI Biological Crystal Diffractometer (iBIX)

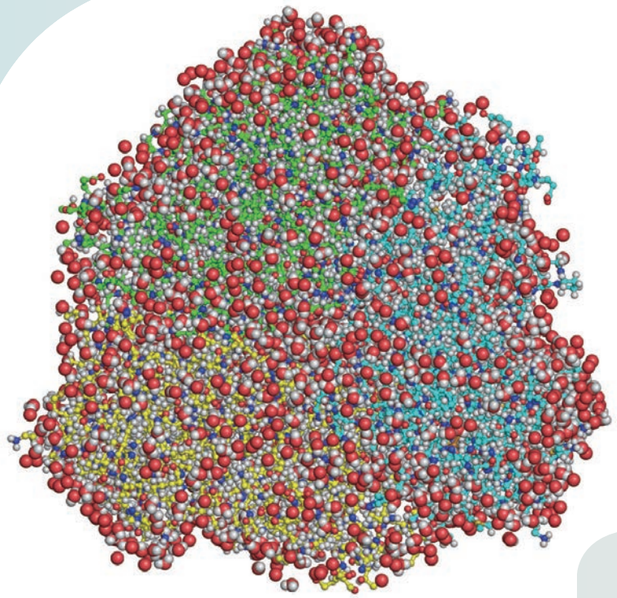
Effects of radiation on life

We will apply quantum technology to understand how radiation affects life. We also intend to clarify the mechanisms by which radiation damages DNA, from the quantum level up to the level of the individual lifeform, resulting in mutations and cancer.



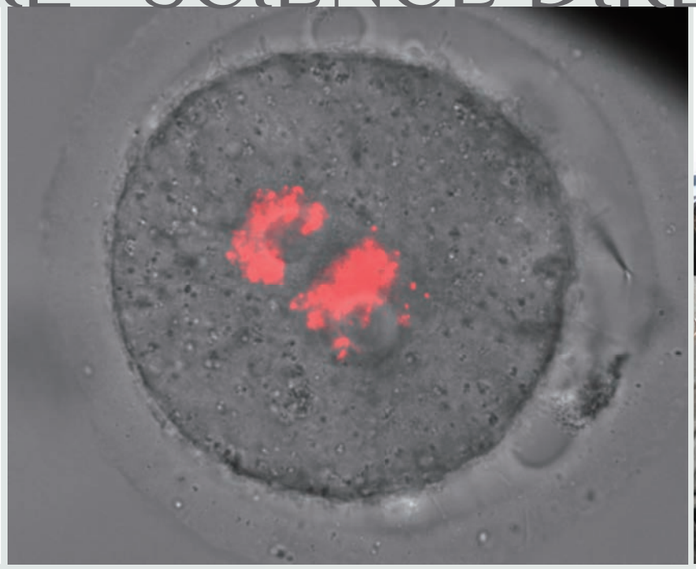
Testicles irradiated with radiation in stripes. Double-strand breaks in DNA occur in the red areas.

QUANTUM LIFE and MEDICAL SCIENCE DIRECTORATE



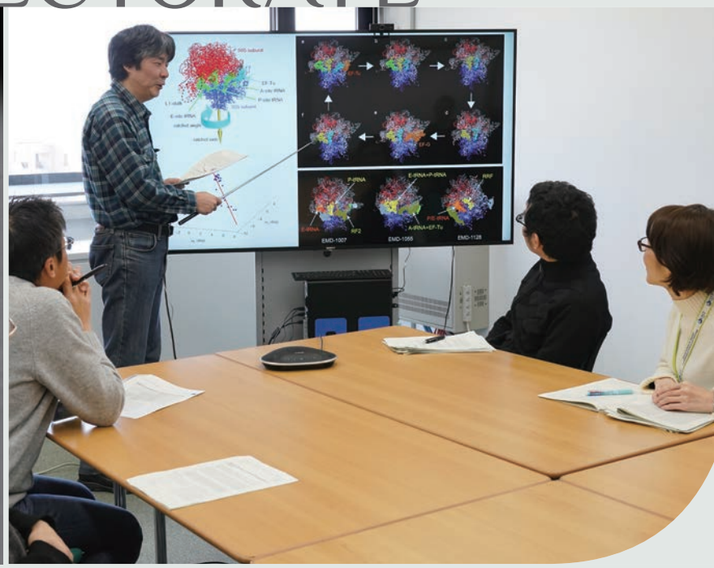
1 | **Structure of enzyme molecules**

Visualization of the ionic bond state at the chemical reaction center of an enzyme. Images like this, which are based on atomic structural information measured with ultrahigh-definition quantum technologies, have made it possible to understand the flow of the electrons and the detailed reaction mechanisms within enzymatic molecules.



2 | **Intracellular quantum sensors**

It is possible to quantitatively evaluate the internal state of living cells by measuring temperature and pH using quantum sensors that glow red.

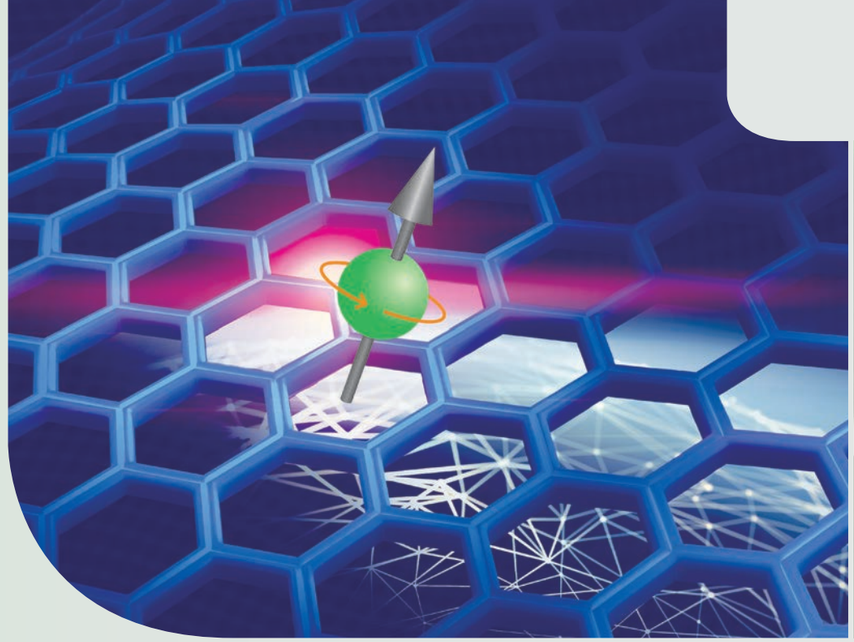


3 | **Discussion forums**

Researchers from a wide range of fields intensely discuss and analyse their results every day.

Pursuing innovative technology to support society

Quantum beams are formed by generating quanta (for example electrons, photons, or ions) and bundling them into powerful streams. Quantum beams enable the observation and processing of substances at the atomic and molecular levels. Since different types of quanta have different masses and charges, the equipment used to make and use them also differs. The Quantum Beam Science Research Directorate operates a wide variety of quantum beam facilities and equipment, and actively collaborates with other institutions, providing an optimal environment for cutting-edge technology development and research. We make full use of this environment to develop innovative materials and devices, and to explore the frontiers of science. Since 2019, we have also been developing a new "Next Generation Synchrotron Radiation Facility" to promote scientific innovation using quantum beams and the implementation of these technologies in a wide range of fields.



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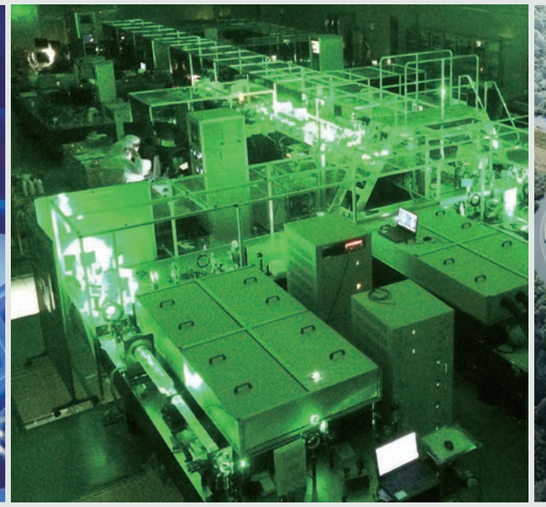

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Quantum Optics Area / Quantum Materials Science Area

QUANTUM BEAM SCIENCE RESEAR CH DIRECTORATE

"Creating"

new electron control technologies

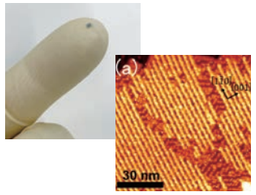
By organically connecting the latest quantum technology with our existing expertise, we are working to establish the new technology of "spin photonics", which uses the magnetic property of electron spin instead of conventional current control, and consumes little power for signal input and/or output.

1 | 2

1 | Confocal microscope to detect spin using light
2 | Using synchrotron radiation to perform detailed observations of electron spin states

What's Next?

Within the next five years, we will succeed in developing a prototype memory device which uses light to read and record electron spin states. We will demonstrate the basic performance of spin photonics technology, with the future goal of achieving ultra-high-speed devices that do not require charging

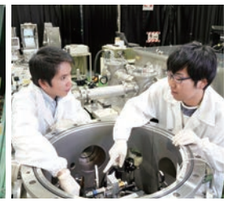


"Opening up"

new scientific fields with cutting-edge lasers

We will open up new scientific fields by developing high-intensity lasers with world-leading performance which enable new advances in academic research that were not previously possible. Furthermore, we will make use of this new technology in the industrial and medical fields.

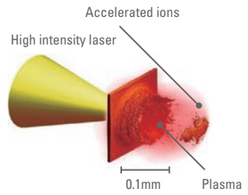
1 | 2



1 | Development of high-intensity lasers
2 | Laser particle accelerator experimental equipment

What's Next?

We will establish "laser particle acceleration technology" as one of the cutting-edge sciences enabled by high-intensity lasers, and apply this technology to realize a compact, next generation, high-performance heavy ion radiotherapy device called a "Quantum scalpel".



"Discovery"

at the new synchrotron radiation facility

The synchrotron radiation facility is a "giant microscope" that uses the "synchrotron radiation" generated when the trajectories of electrons which have been accelerated to speeds close to the speed of light are bent by a magnetic field. We will develop a synchrotron radiation facility optimised for observing the functions of materials, and advance studies of these functions in a wide range of materials.

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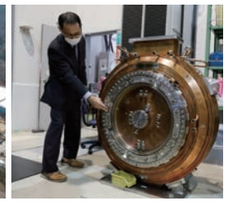
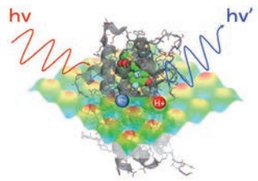


1 | The "Next-Generation Synchrotron Radiation Facility" about completion (Aobayama new campus, Tohoku University)
Image courtesy of: Photon Science Innovation Center
2 | The completed main parts of the accelerator (TM020-mode RF accelerating cavity)

What's Next?

Synchrotron radiation in the soft x-ray region can be used for observing light elements and visualizing electronic states. By constructing the "Next-Generation Synchrotron Radiation Facility," we will lead the world and dramatically strengthen Japan's research and development capabilities.



1 | **Spin Photonics Material Research**

By making full use of the quantum function enabled by the magnetic property that is electron spin, we will pursue materials development research aimed at developing ultra low-power devices enabled by using light to manipulate this spin.

2 | **Cutting-edge equipment for cutting-edge science**

In addition to J-KAREN (see image), which is the world's highest performance high-intensity laser, we also make use of various other facilities and equipment, including ion irradiation research facilities, electron / gamma ray irradiation facilities, and synchrotron radiation beamlines.

3 | **A new facility developed by a new public-private-regional partnership**

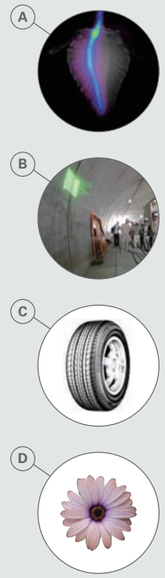
As a national entity, QST will promote the construction of new facilities in cooperation with related regional and industry organizations, such as the Photon Science Innovation Center, leading to the further development of quantum technology.
Image courtesy of: Photon Science Innovation Center

It is all around you

Quantum beam technology in daily life

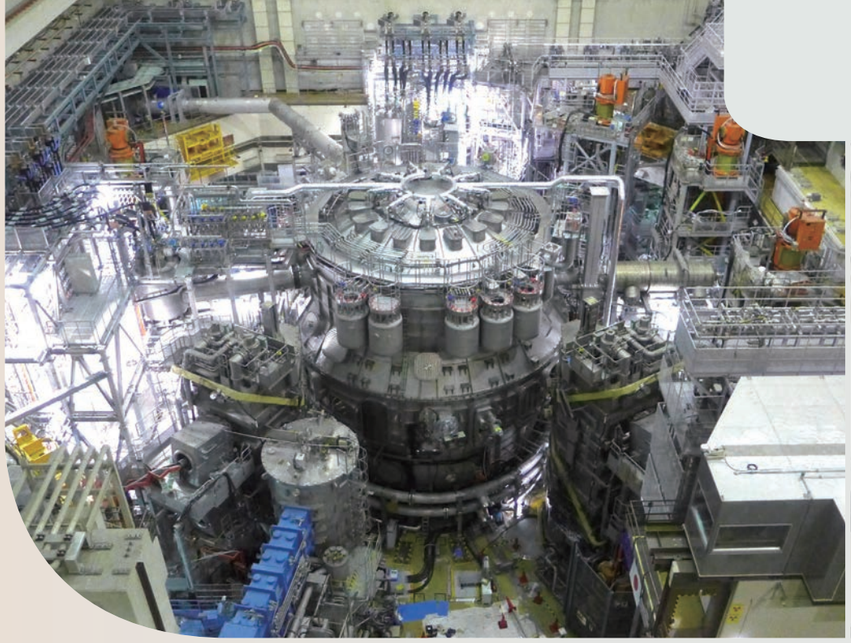
In fact, technology using quantum beams developed by QST is already made use of in our daily lives, and various technologies will continue to play bigger roles in the future.

Ⓐ : We have succeeded in visualizing the flow of nutrients in strawberries using quantum properties. We will make use of this technology to support the cultivation of various crops in the future.
Ⓑ : We will make possible the high-speed laser inspection of concrete structures such as tunnels.
Ⓒ : The elasticity of tire rubber has been increased, and more precise processing has become possible.
Ⓓ : A new color of Viento flamingo flowers was created by selective breeding using an ion beam.



Shaping the sustainable future energy

Nuclear fusion is a reaction in which light nuclei "fuse" each other into a heavier nucleus, and enormous energy is generated at this time. It is this fusion energy that keeps the sun shining. Fusion energy, which does not emit carbon dioxide in the process of power generation and has abundant fuel in seawater, is the ultimate energy source for humankind, being highly safe and unaffected by natural conditions.
"Creating a Sun on Earth!!" Under the slogan, we are promoting research and development centered on the ITER (experimental fusion reactor) Project, a large-scale international joint project in which seven Members from around the world participate and Broader Approach (BA) activities that are being promoted in collaboration with Japan and Europe for early power generation demonstration.



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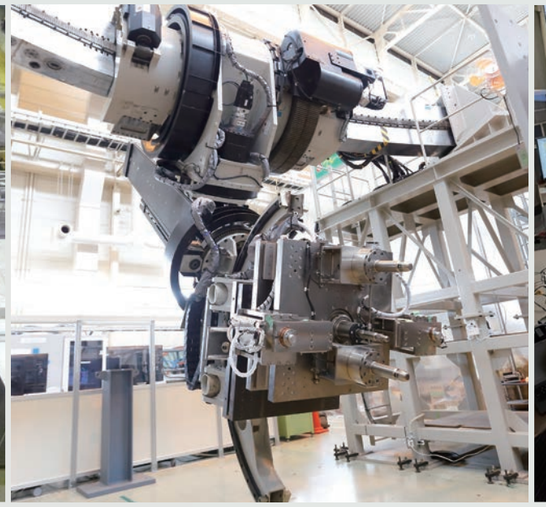

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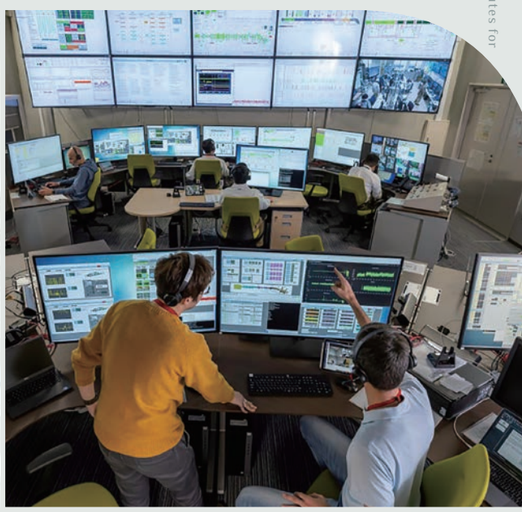


3

1 | **JT-60SA**

The Naka Fusion Institute is operating JT-60SA in cooperation with Europe.

2 | **Remote handling equipment for ITER**

This is one of the devices that QST is developing for ITER. This device is a manipulator that can grab a block of about 6 meters in size and 4 tons in weight, and operate in places where people cannnot enter. In addition, QST is developing and manufacturing seven components in total for ITER.

3 | **An international team**

Researchers and engineers from various countries such as Europe are participating. In order to ensure a long-term stable supply of energy and overcome environmental problems, research and development is underway by bringing together the wisdom of humankind beyond the borders.

Quantum Energy Science and Technology Area

FUSION ENERGY DIRECTORATE

"Demonstrating"

fusion energy

In the ITER Project, fusion power generation of 500,000 kW will be maintained for hundreds of seconds to demonstrate the scientific and technical feasibility of fusion energy through the construction and operation of the experimental reactor. Japan is in charge of the development and manufacture of major equipment such as superconducting coils, and QST is implementing procurement activities for the equipment as the domestic agency in Japan.

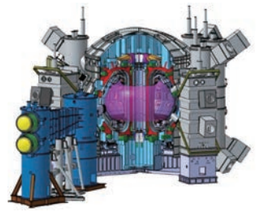
The ITER site is in southern France. Japan, Europe, the United States, Russia, South Korea, China, and India are participating, and equipment, researchers, and engineers from each country are taking part. Assembly of the ITER tokamak began in July 2020.
Image: courtesy of ITER Organization (image of the ITER and the ITER construction site)

"Controlling"

a plasma of over 100 million degrees

In order to generate fusion energy stably, it is necessary to heat the hydrogen the fuel to temperature exceeding 100 million degrees into a plasma state and to control it by the force of a magnetic field. We will develop the control technology to maintain stable plasma with high-temperature and density with the superconducting tokamak device JT-60SA equipped with controling equipment that enhances plasma stability.

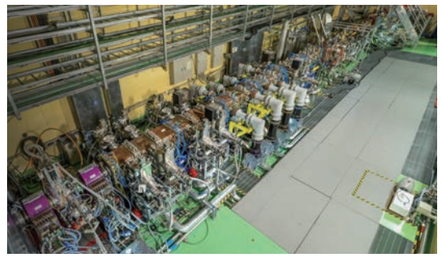
JT-60SA is contributing to the world-leading advanced research and human resource development such as ITER support and development of high-performance plasma for power generation.



"Supporting"

steady energy generation

Generating fusion energy steadily requires materials that can endure the high heat and high-energy neutron irradiation generated by fusion reaction. We are developing materials and fusion based neutron sources for that purpose. We are also conducting the design of the future power plants and prediction of plasma performance using supercomputers.



The Rokkasho Fusion Institute has been developing an accelerator for fusion neutron sources. The prototype accelerator under development is one of the world's high performance accelerators for steady-state operation.

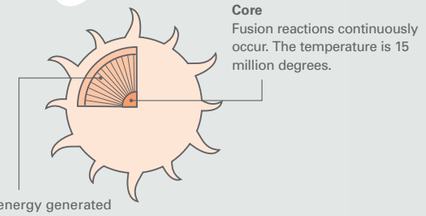
The apparatus for validation of breeding blanket function

The dedicated supercomputer for fusion research (JFRS-1)

Solar energy

Nuclear fusion is actually a familiar energy source

Our sun is a huge plasma, and fusion reactions contniuously occur in its core. The light and electromagnetic waves emitted by these fusion reactions are also the basic energy source supporting all life on earth. The development of fusion energy is a major challenge to bring the blessings of the sun to the earth.



The activities of QST

While actively promoting industry-academia-government collaboration, we will distribute the results of our research and development through various initiatives that contribute to a peaceful and prosperous society.

State-of-the-art heavy ion radiotherapy

QUANTUM SCALPEL PROJECT

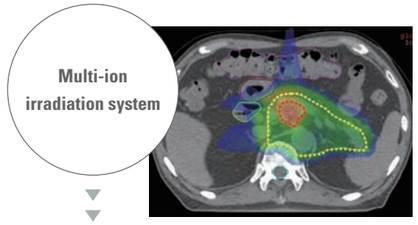
With the aim of popularising heavy ion radiotherapy in Japan and overseas, we are working on a project in cooperation with industry to develop a compact, next generation, high-performance heavy ion radiotherapy device called a "Quantum Scalpel". The project combines the technological expertise of each QST directorate to miniaturise and enhance the performance of current heavy ion beam and radiotherapy equipment.

Treatment is possible for almost all types of cancer

The heavy ion beam irradiation technology of the Quantum Life and Medical Science Directorate has been improved by introducing multi-ion irradiation combining carbon, oxygen, and helium. The technique provides more effective irradiation while reducing side effects and the number of irradiations required, and enables treatment without hospitalization. Our aim is to minimize disturbance of a patient's quality of life.

Compact enough to be installed in an existing hospital building

By applying the high-intensity laser technology of the Quantum Beam Science Research Directorate and the superconducting technology of the Fusion Energy Directorate, we have managed to reduce the size of the injector, synchrotron and rotating gantry. The reduced size and cost mean that more hospitals will be able to install a "Quantum Scalpel". Our aim is to create a society where more hospitals can provide safe and effective cancer treatment.

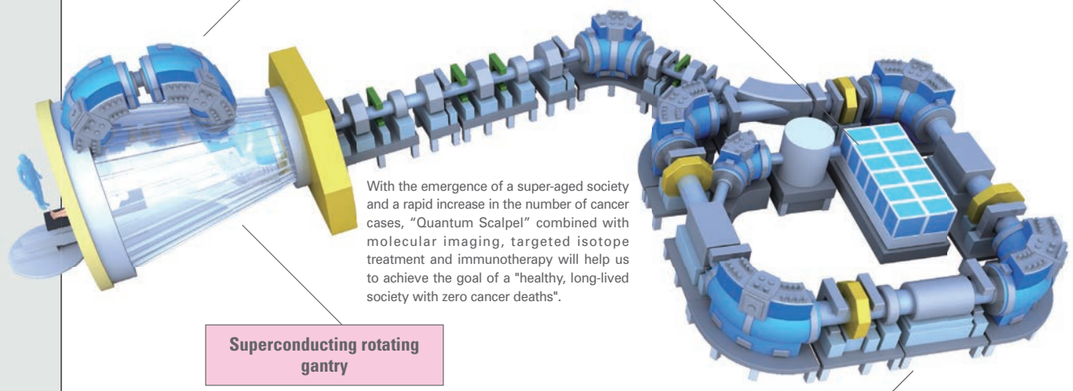


Optimization of irradiation distribution

Laser for particle acceleration

Multi-ion irradiation

Laser-accelerator injector



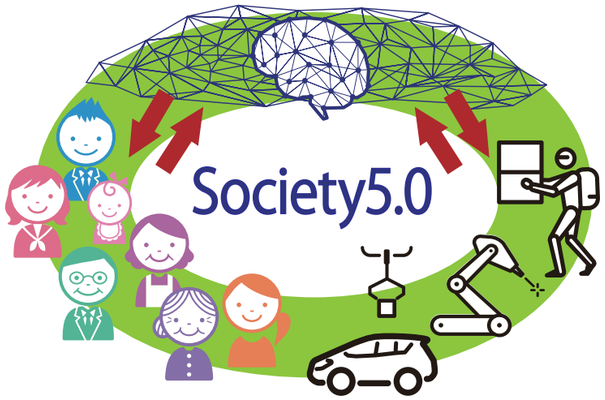
Superconducting technology

The superconducting coil for ITER

Contribution to the SIP Project “Photonics and Quantum Technology for Society 5.0”

MANAGEMENT OF SIP PROJECT

We are supporting to carry out the Cabinet Office's Strategic Innovation Creation Program (SIP) "Photonics and Quantum Technology for Society 5.0" as a management entity. A cyber-physical system (CPS) is the key to realizing Society 5.0 and the SIP will leverage Japan's strengths in photonics and quantum technologies. From among these technologies, the SIP has carefully selected important and high-priority technologies in laser processing, photonic quantum communication, and photonic and electronic information processing. The SIP will accelerate to realize a vigorous, comfortable, and high-quality society.



Innovation creation through collaboration and competition

QST ALLIANCE FRAMEWORK

In order to create innovations by solving technical issues in the industry, we are promoting the QST alliance framework in which QST and a "group" of companies in specific fields jointly conduct research and development. In this framework, QST together with multiple companies solve common issues in a coordinated manner that might be a risk in case of a single company development. Jointed companies in the collaboration area of the framework use the solutions, and then, they develop each subject independently. The QST alliance framework gathers multiple companies which are competitive each other. It tries to raise the stage level of the entire specific field. It is currently underway with four themes and is attracting attention as a new form of collaboration for “open innovation” between industry and research institutes.

Overview of the flow of the QST alliance framework

Competitive area	Stage 3	Commercialization and promotion of the technology
Collaboration area	Stage 2	Development of common basic technology
	Stage 1	Extracting issues and determining priorities

The QST alliance framework is a new form of collaboration that allows QST to tackle technical issues in an integrated manner with potential rival companies by appropriately concluding intellectual property and non-disclosure agreements according to each stage.

Realizing Japan’s quantum technology innovation strategy

QUANTUM LIFE SCIENCE RESEARCH HUB

To realize Japan’s quantum technology innovation strategy, we are bringing together researchers and engineers from domestic and overseas companies, universities, and research institutes to form a “Quantum Life Science Research Hub” that fuses quantum technology and life science and promotes industrialization of results. The hub will oversee everything from basic research to technology demonstration, intellectual property management, and human resource development in an integrated and consistent manner. Novel quantum measurement technologies will be developed and applied to life science and medicine with the aim of detecting quantum effects in life processes. Ultra-precise analysis of biomolecules will help confirm and clarify the quantum level mechanisms of biological functions. The results will be applied to innovate medical and environmental technology, with the ultimate goal being to solve the problems of the modern world and build a healthy, long-lived society.

Artist’s rendering of the new building, scheduled for completion in 2022, that will become the center of research and development.
(©2020,Takenaka Corporation)

Knowledge creation through collaboration with people all over the world

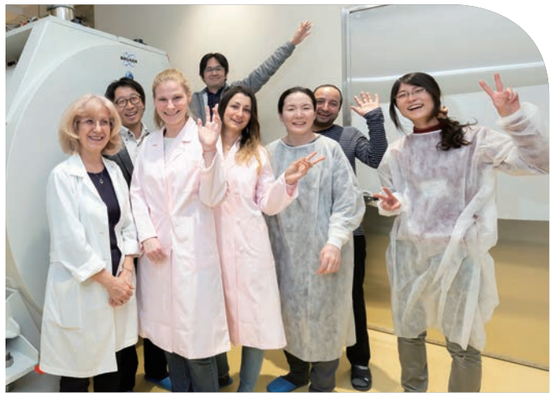
PROMOTION OF INTERNATIONAL COLLABORATIONS

We dispatch experts to represent Japan at the conferences of international organizations related to radiation safety, radiation medicine, and technical standards. In addition, as a Collaborating Center of both the IAEA and WHO and a participant in FNCA projects, we are engaged in activities to disseminate research results and exchange human resources. We also promote collaboration with overseas research institutes, universities, and industry through activities such as the "QST International Research Initiative" (currently 3 themes) and the QST International Symposium.

Increasing the diversity of the research environment

PROMOTION OF DIVERSITY

Diversity of human resources is important for the sustainable creation of excellent research results. Therefore, regardless of nationality, gender, age, disability, etc., we are promoting the realization of diversity in which various employees with different ideas and experiences can play an active role. Through "Development of a work environment in which the life events and work-life balance of employees are considered", "Activities to improve the research capabilities of female researchers", and "Active promotion of female staff to higher positions", we increase the diversity of the research environment from a medium- to long-term perspective.



Attaining a bright future

THE QST FUTURE FUND

The "QST Future Fund" is a framework to gain the understanding and support for QST's activities to open up the future of humankind, and to utilize your support for our research and development.

Donations are used for the following purposes:

- Research on cancer diagnosis and treatment
- Research on diagnosis and treatment of dementia
- Development of quantum sensors and novel materials
- Development of new energy
- Preparation of research environment
- Distribution of results and utilization of results

Communicating QST projects and achievements to society

COMMUNICATIONS

We are communicating information so that the research and development of QST and the efforts and results of our work can be widely known.

The Kids' Science Museum of Photons

The Kids' Science Museum of Photons in Kizugawa City, Kyoto Prefecture, is the only science museum in Japan with the theme of light. In addition to introducing QST's research and development activities, you can experience everything from the nature of light to cutting-edge technologies utilizing light through exhibitions, videos, experiments and crafts. While having fun, we nurture children's "scientific minds" and have the general public become familiar with science and technology.

Exhibition booth

At the QST exhibition booth at the Osaka Science and Technology Museum (Nishi-ku, Osaka City), you can learn about quantum and light in an easy-to-understand format on the exhibition panels. In addition, there are sections introducing some of QST's research activities.

Public relations and outreach, etc.

Information is distributed through the QST newsletter (issued four times per year), press releases, websites, social media, etc. In addition, we are engaged in various public relations activities such as exhibiting at science events, outreach activities, and an open house at each institutes.

OTHER INITIATIVES

We are engaged in activities such as human resource development by utilizing the QST summer school and research assistants for graduate students, promotion of practical application of intellectual property, and venture capital support.

QST Basic Information

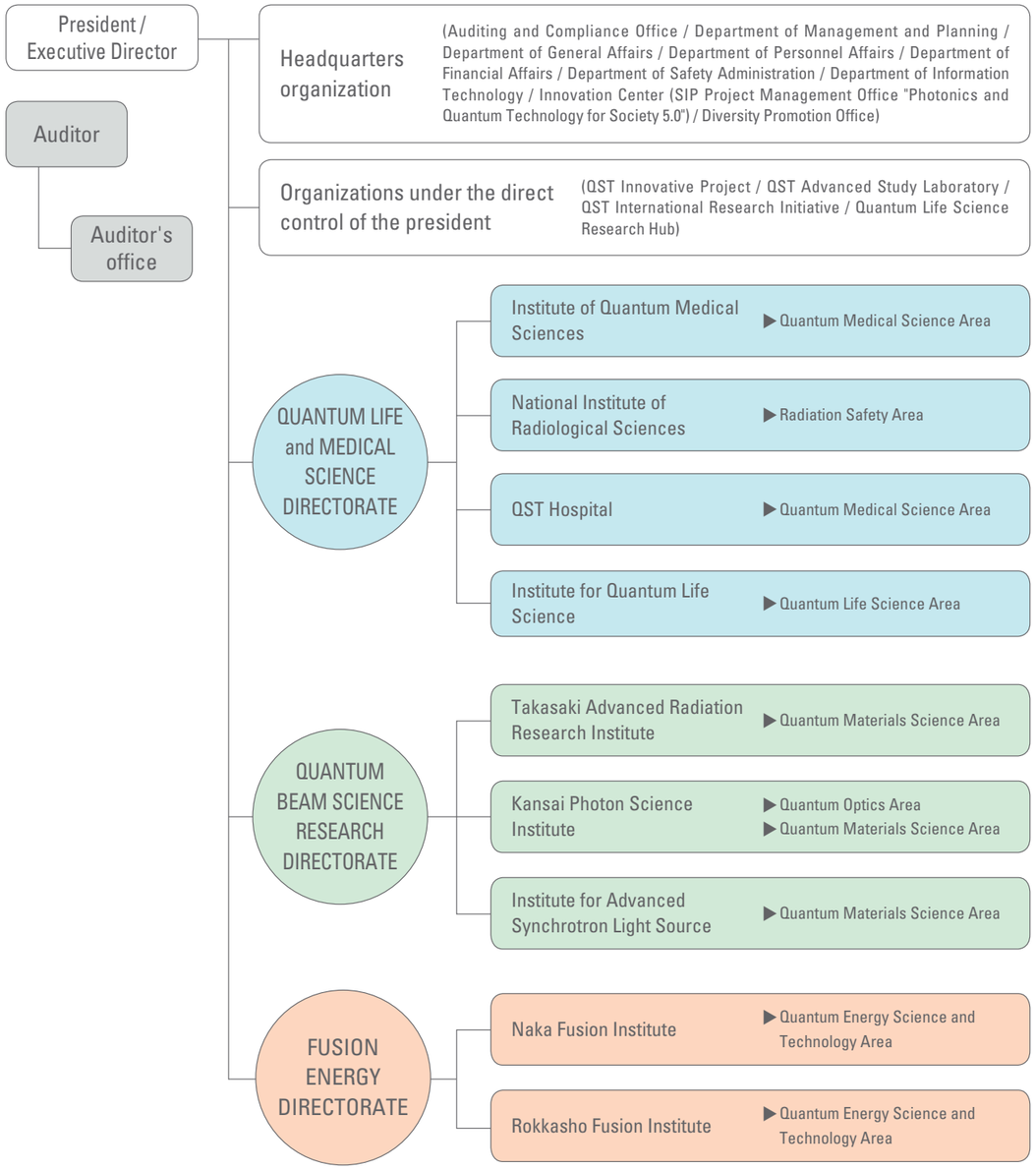
FY 2022

Overview

Annual budget **42.1 billion yen** Includes fusion-related and next-generation synchrotron radiation-related subsidies

Staff (approximate number) **1,300**

Organization chart



Location

Headquarters

4-9-1 Anagawa, Inage-ku, Chiba-shi, Chiba 263-8555 ✆043-382-8001 (main line)
[Tokyo Office] 2-2-2 Uchisaiwaicho, Chiyoda-ku, Tokyo 100-0011 Fukoku Seimei Building 22nd and 17th floors ✆070-3943-3364 (main line)

Chiba district

4-9-1 Anagawa, Inage-ku, Chiba-shi, Chiba 263-8555 ✆043-251-2111 (main line)
○Institute of Quantum Medical Science
○Institute of Radiological Sciences
[Fukushima Research Branch] 1 Hikarigaoka, Fukushima City, Fukushima 960-1295 (inside the Fukushima Medical University) ✆024-581-5150 (main line)
○QST Hospital
○Institute for Quantum Life Science

Takasaki district

1233 Watanukimachi, Takasaki-shi, Gunma 370-1292 ✆027-346-9232 (main line)
○Takasaki Advanced Radiation Research Institute
[QST Quantum Function Material Industry/Academia Collaboration Meguro Laboratory]
2-12-1 Ookayama, Meguro-ku, Tokyo 152-8550 (inside the Tokyo Institute of Technology) ✆070-3943-3397 (main line)
○Institute for Quantum Life Science

Kizu district

8-1-7 Umemidai, Kizugawa-shi, Kyoto 619-0215 ✆0774-71-3000 (main line)
○Kansai Photon Science Institute
○Institute for Quantum Life Science
○The Kids' Science Museum of Photons

Naka district

801-1 Mukoyama, Naka-shi, Ibaraki 311-0193 ✆029-270-7213 (main line)
○Naka Fusion Institute
[ITER-JADA Liaison Office] ITER Japan Domestic Agency, Route de Vinon-sur-Verdon, CS 90 046, 13067 St Paul Lez Durance Cedex, France

Rokkasho district

2-166, Oaza-Obuchi-Aza-Omotedate, Rokkasho-mura, Kamikita-gun, Aomori 039-3212 ✆0175-71-6500 (main line)
○Rokkasho Fusion Institute

Sendai district

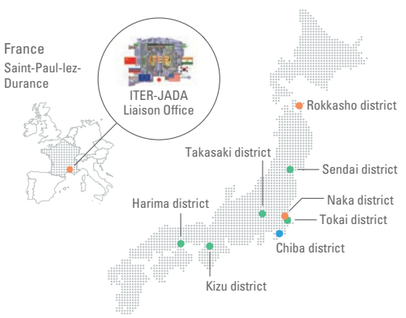
6-6-11-901 Aza Aoba.Aramaki.Aoba-ku.Sendai-shi.Miyagi 980-8579 ✆022-785-9480 (main line)
○Institute for Advanced Synchrotron Light Source

Tokai district

2-4 Oaza Shirakata, Tokai-mura, Naka-gun, Ibaraki 319-1106 ✆070-3943-3400 (main line)
○Takasaki Advanced Radiation Research Institute
○Institute for Quantum Life Science
○Rokkasho Fusion Institute

Harima district

1-1-1 Kouto, Sayo-cho, Sayo-gun, Hyogo 679-5148 ✆0791-58-0922 (main line)
○Kansai Photon Science Institute



Our future created by Quantum Science and Technology

The research carried out by QST may change our lives in the future. Find out where the four pictures on the right are.

Fusion facilities

Environment-friendly fusion energy supplies the electricity in the town.

Quantum Scalpel

With an ultra-compact, high-performance quantum scalpel available at your local hospital, cancer treatment as an outpatient is possible.

Terminals that do not require charging

Spin photonics technology will make recharge-free devices the norm.

Quantum Smart Cells

Cells that patrol inside the body to “detect” and “treat” any problems they find. You can always rest assured that your wearable device can communicate with the cells to monitor your condition.

Find out more on our website!

Pursue a dream to realize it

National Institutes for
Quantum Science and Technology

Public Relations Section, Department of Management and Planning

263-8555 4-9-1 Anagawa, Inage-ku, Chiba-shi, Chiba　Tel: 043-206-3026 (direct)　Mail: info@qst.go.jp　https://www.qst.go.jp

Commentary on the cover / By surrounding the apple, which is also a symbol of classical (Newtonian) mechanics, with quanta, we have expressed creation by means of quantum science and technology. Since quantum science and technology is a new research field, we respect the spirit of "green apples," which are immature and sour but full of hope for tomorrow.

2022.4