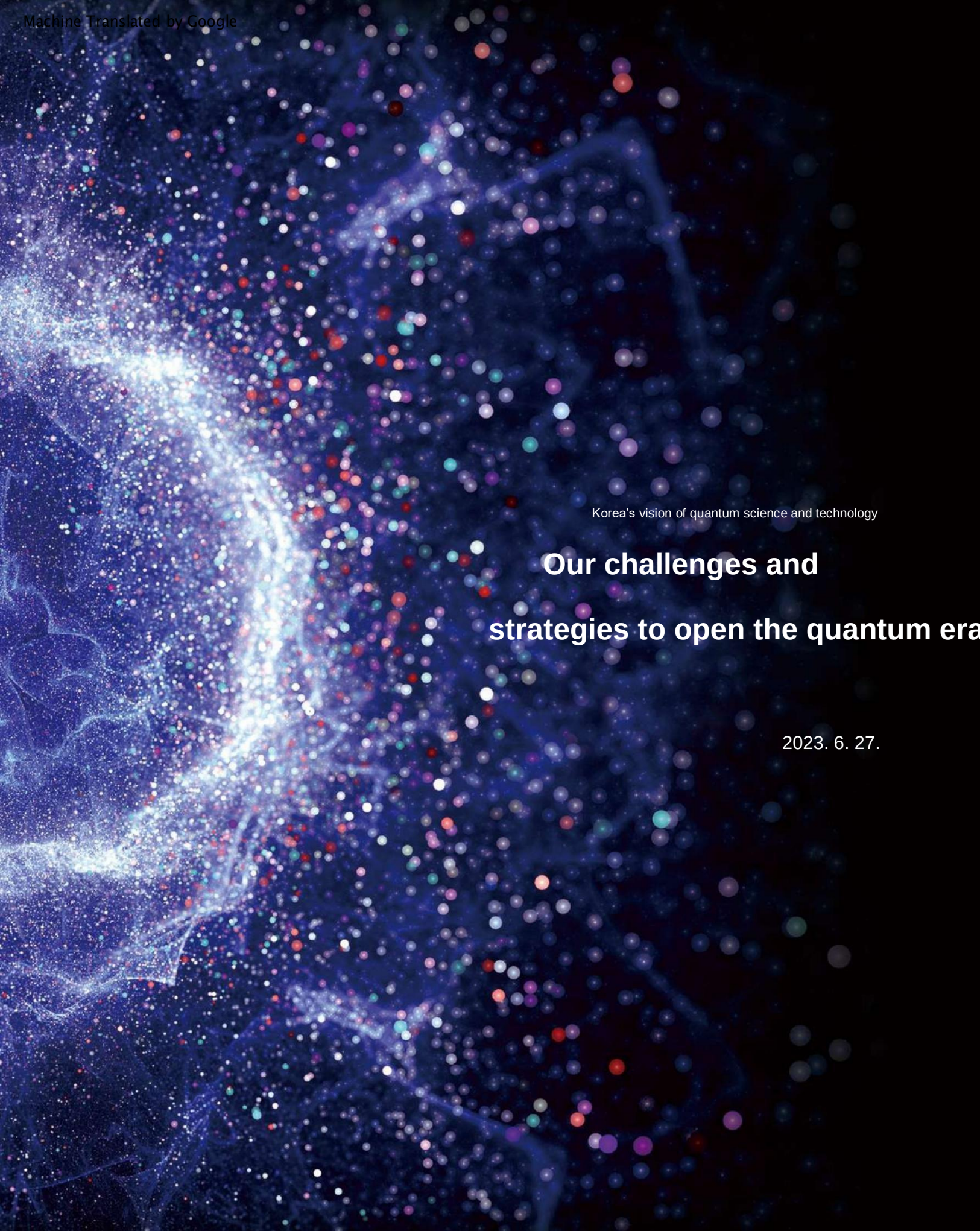

Korea's vision of quantum science and technology

Our challenges and strategies to open the quantum era

2023. 6. 27.

index

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vision statement

VISION

“By 2035, Korea will stand tall as a global quantum economic ce

Korea’s new quantum jump with the people

There is a term in quantum mechanics called “Quantum Jump.” When energy is applied to an atom, the energy level increases discontinuously, as if climbing stairs, as electrons orbiting the nucleus in a low orbit jump to a higher orbit. This concept of change, which looks like instantaneous movement, is more often used as an expression to explain rapid innovation and development in a short period of time.

Since its founding, the Republic of Korea has achieved unprecedented success in world history, thanks to its excellent national capabilities and insight, and world-leading science and technology and industry, and has become the only country in the world to move from a developing country to a developed country. And now, with the opening of the quantum era, another new quantum jump is beginning.

Science and technology are the most powerful source of power that leads human civilization to a completely different level than before. Among them, quantum science and technology have not been well known to the general public, but have already had a significant impact on every corner of human life for a long time. Understanding the microscopic world of atoms is the foundation of almost all advanced civilizations in the 21st century, from smartphones and laptops that accompany most of modern people's daily work, to electronic devices and lighting, chemical materials, life sciences, medical technology, lasers, and telecommunications. It's taking its place. We are already
We live in a world where we cannot take a single step forward without quantum science and technology.

What is even more encouraging is that the quantum revolution, which will overcome the global crisis of the 21st century and become a breakthrough for a new human civilization, is not complete but has just begun. It is true that it is the prelude to the curtain rising on the stage. All sciences that humanity can imagine, from basic research that uncovers the source of life and the origin of the universe, to climate crisis response and human safety, overcoming incurable diseases and extending human lifespan, discovery of new energy sources, and exploration of unknown space.
It is expected that it will provide the starting point for technological innovation.

Accordingly, the Republic of Korea declares 2023 as the first year of national quantum science and technology.

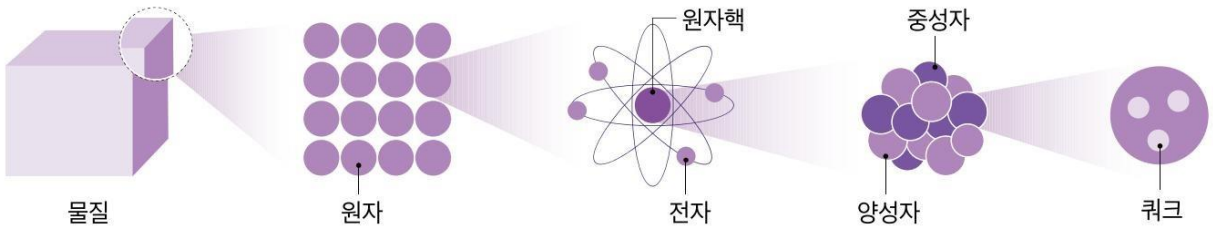
Our efforts toward innovation in quantum science and technology go beyond securing a new future growth engine for the Republic of Korea and are the surest way to contribute to the freedom and prosperity of the human community and further raise the nation's status and national prestige. It is a difficult and long journey, but we hope that you will support with one mind the bold challenge of the Republic of Korea, which is tightening its shoelaces once again at the starting point of the road that must be taken.

Basic concepts of quantum science and technology

What is Quantum? It refers to the

overall phenomenon of discontinuous physical quantities, such as energy and momentum, of entities

that simultaneously have discontinuous particle properties and wave properties that can overlap.



ÿSmall physical quantity that can observe quantum phenomenaÿ

One of the misconceptions about quantum is to interpret it as a particle.
In quantum mechanics, quantum does not refer to a particle.

What is Quantum Science & Technology? Technology that enables “ultra-fast computation,” “ultra-reliable

communication,” and “ultra-precision measurement” by applying quantum physics characteristics to information technologies such as computing, communications, and sensors.

Our challenges and

strategies to open the quantum era

PART.ÿ

Why quantum technology?

Quantum

entanglement is the property of two quantum entities being correlated even if they are far apart.

1st generation quantum computer

Korea

01 Reasons to pay attention to quantum science and technology

More than 120 years have passed since the concept of quantum appeared, and more than 100 years have passed since the beginning of modern quantum physics. The 'first quantum revolution' refers to the 20th and early 21st centuries when semiconductor technology based on quantum physics brought about revolutionary changes in human civilization.
It is called an era.

The advent of the second quantum revolution

The coming era of the 'second quantum revolution' is defined as an era in which high-dimensional quantum physics phenomena such as superposition and entanglement are utilized more freely. can do. Beyond the existing basic unit of information, the bit, which takes either 0 or 1, a new basic unit of information, the qubit, which can take on both 0 and 1 at the same time using the property of superposition, and interconnection between qubits Through this, quantum computers, which have computational capabilities that surpass those of existing supercomputers, will be used in earnest to advance artificial intelligence, research new drugs and new materials, and solve difficult problems in energy, space, and mathematics.
am.

The emergence of quantum computers also means the collapse of the prime factorization-based encryption system, which could not be solved by existing digital computers.
Accordingly, countries around the world are developing quantum technologies that can dramatically increase security by using quantum phenomena such as overlap, entanglement, and information changing according to observation.
We are also putting our lives at risk in developing cryptography and network technology. In addition, a technological competition has begun to apply quantum sensor technology with precision and sensitivity that exceeds the fundamental limitations of existing sensors to high-tech industrial fields that require advanced detection capabilities, including national defense.

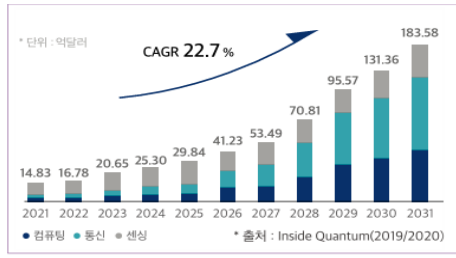
Toward the era of the second quantum revolution
Competition for global technological hegemony

The global quantum market is currently valued at $2.1 billion ($2.7 trillion). but is expected to grow at an average annual rate of more than 20 per cent.

Quantum cryptography is already in early commercialisation, quantum sensors are expected to reach commercialisation in the next seven to nine years, and quantum computers in the next 10 to 15 years. Quantum computers are expected to be commercially available in 10 to 15 years.

Major powers such as the United States, Europe, Japan, and China are ahead of us. Focusing on the universality and disruptive power of quantum science and technology, they have developed national development strategies and have made large-scale R&D investments.

In Korea, quantum science and technology has recently been listed as one of the 12 National Strategic Technologies and the 15 New Growth 4.0 Strategies and one of the key areas of the 15 projects of the New Growth 4.0 Strategy and is striving to close the gap with developed countries through human resource development and aggressive investment.



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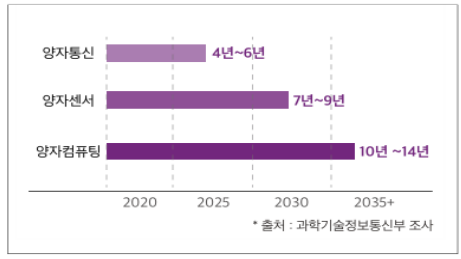
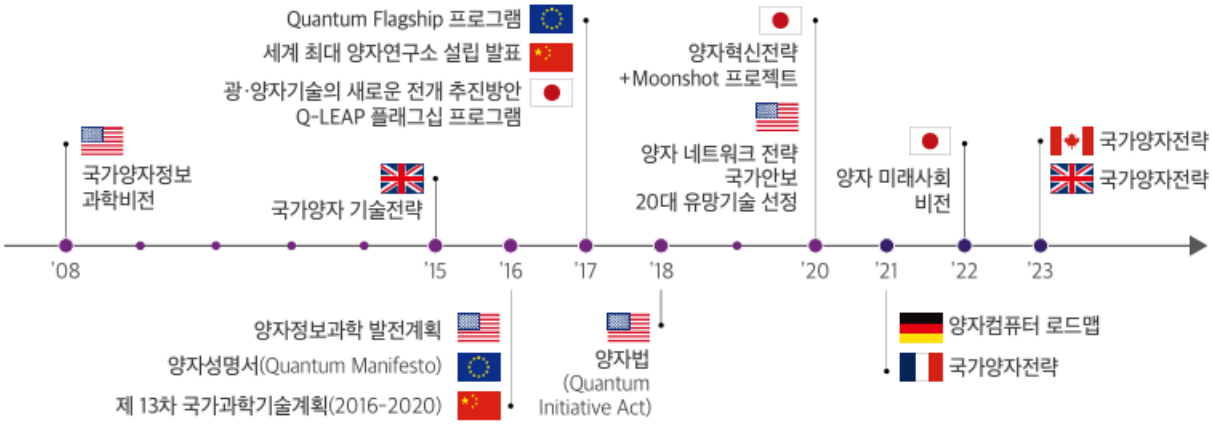


< 양자 시장 형성 시점 전망 >

< 각국의 양자과학기술 정책 현황 >



In a semiconductor powerhouse

02 As a leader of the quantum revolution

Some key source technologies in the quantum field have already passed the initial verification stage. However, a variety of candidate technologies are competing with the dominant technology not yet standing out, and as no country has yet reached the level of completion, full-scale competition is underway.

You could say it starts now.

'No. 1 DNA' of the world's best semiconductor and display industry country

Korea has achieved global success in various high-tech manufacturing fields such as semiconductors, automobiles, shipbuilding, steel, and petrochemicals through highly compressed growth and rapid catch-up. In particular, the human and material capabilities of the semiconductor industry ecosystem have driven the growth of the global semiconductor industry corresponding to the first quantum revolution and are an important driving force that will lead the era of the second quantum revolution that will soon arrive. Korean companies possessing world-class semiconductor processing technology are likely to remain leaders in the development and mass production of quantum processors and semiconductor optical devices, which are core technologies in the quantum economy era.

The world's best IT and service test bed

Korea is leading the world not only in manufacturing but also in cutting-edge service markets such as logistics, transportation, medical care, and finance. In addition, we are securing all the key resources necessary to implement the era of quantum science and technology, including excellent software personnel. Korea will once again become an international testing ground where new, never-before-seen added values are created through the convergence of existing industries and quantum science and technology.

Quantum era strategy led by Korea

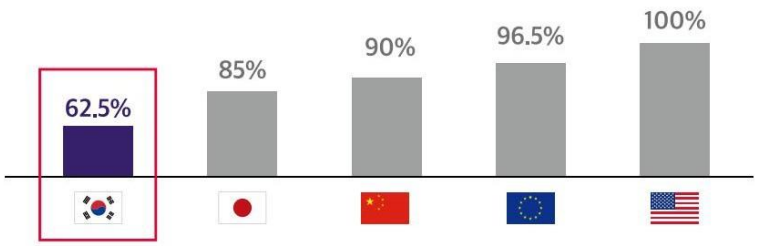
The science and technology and industrial capabilities and ICT infrastructure that we have accumulated so far are creating new opportunities and synergistic effects called quantum science and technology. It will be a new springboard for the quantum jump that elevates Korea to the forefront of the quantum era. Accordingly, in 2035, the 90th anniversary of the founding of the Republic of Korea, we present a vision and strategy for Korea's quantum science and technology that will transform Korea into a more fair, safe, prosperous, and happy nation.

I want to do it.

Current status of quantum science and technology in Korea

Technology

level is **62.5%** compared to the leading country



* Source: 2020 Technology Level Assessment/KISTEP, '21

manpower

Domestic quantum manpower is around 384 as of 2022 core manpower.

대학	총 511명	핵심 123명	**교수** : 80명 **포스닥** : 43명 석·박사과정 : 388명
출연연	총 284명	핵심 189명	**박사** : 189명 석사 : 61명 학사 : 34명
기업	총 256명	핵심 72명	**박사** : 72명 석사 : 89명 학사 : 95명

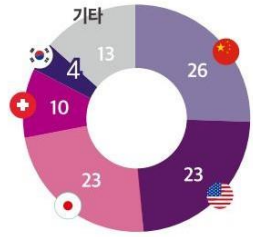
* Source: 2022 Quantum Information Technology White Paper/Ministry of Science and ICT

Patent Application Status

(2010~2019 cumulative, %)

「양자 컴퓨팅」

「양자 통신」



「양자 센서」

· Source: Korean Intellectual Property Office (2021)

Our strengths/weaknesses

SWOT

Strengths

Top-notch ICT infrastructure and semiconductor capabilities
- High policy priorities, including designation of national strategic technologies
* Enactment of a quantum law, establishment of an intergovernmental quantum committee, etc.
- Promoting strategic roadmaps and large-scale R&D projects
Promote rapid development of elemental technologies and system construction
- Automotive, semiconductor, shipbuilding, etc. where quantum technology will be applied
Developed manufacturing and service industries
- Highly educated and skilled domestic workforce

Weaknesses

Shortage of key personnel in quantum science and technology
- Lack of an industrial ecosystem to develop quantum science and technology
- Low R&D investment compared to other major countries,
Insufficient device process infrastructure

Opportunities

- Strengthening export controls to prevent the flow of munitions and strategic goods
Tighter export controls and restrictions on technical cooperation
- Increased overseas demand for bioengineers
-Concerns about brain drain

Threats

Shortage of key personnel in quantum science and technology
- Lack of an industrial ecosystem to develop quantum science and technology
- Low R&D investment compared to other major countries,
Insufficient device process infrastructure

Korea's quantum science and technology

03 Footsteps walked

~2018

2014. 12.
Establishment of mid- to long-term
strategy for quantum information communication

2016. 6.
Sejong-Daejeon LTE network
(30km) Quantum cryptography communication
Apply (SKT)

2018. 12.
Preparation of quantum information
and communication technology roadmap

2019

2019. 3.
Seoul-Daejeon-Daegu 5G network
Quantum cryptography communication at (360km)
Apply (SKT)

2019. 4.
quantum-only government
New R&D program established
(computer, sensor)

2020

2020. 4.
Commencement of construction of quantum
cryptography communication pilot infrastructure

2020. 6.
Launch of "Galaxy Quantum," a mobile phone
using quantum random number chip (SKT)

2020. 6.
Quantum Information Week
(Quantum Week) First held in 2020

2020. 8.
Quantum Information Research Support Center
place

2021

2021. 3.
World's highest quantum gravity
Secure sensor source technology (Korea
Research Institute of Standards and Science)

April 2021
Quantum technology research and development
Establishment of investment strategy

2021. 6.
Addition of quantum information and communications to the
"Special Act on Promotion and Convergence
of Information and Communications, etc."

2021. 10.
Under the National Science and Technology Advisory Council
Establishment of a special committee on quantum technology

2022

2022. 1. Quantum
Industry Ecosystem Support Center opened

2022. 3.
Heterogeneous quantum cryptography applied to Seoul-
Busan (KT)

2022. 6. Quantum
cryptography communication introduced to 33 organizations in the
national convergence network (pan-government national communication network)

2022. 6. Start of
development of 50-qubit quantum computing

2022. 6. Designated
as a quantum internet research base
(ETRI, KIST)

2022. 6. Designated
as a quantum computing research base
(Korea Research Institute of Standards and Science)

2022. 7. Launch of
the world's 3rd quantum cryptography service (SKT/KT)

2022. 7. Launch of
the world's first quantum-resistant encryption service (LGU+)

2022. 9. Establishment
of the Korean Quantum Information Society

2022. 9. Korea-US
Bilateral Technology Cooperation Center opened

2022. 10. Designated
as one of the 12 national strategic technologies

2022. 11. Establishment
of the Quantum Computing Leading Companies Association

2022. 12. Establishment
of quantum science and technology strategic roadmap

2022. 12. Establishment
of a plan to secure quantum experts

2022. 12. Designated
as one of the top 15 New Growth 4.0 projects

2023

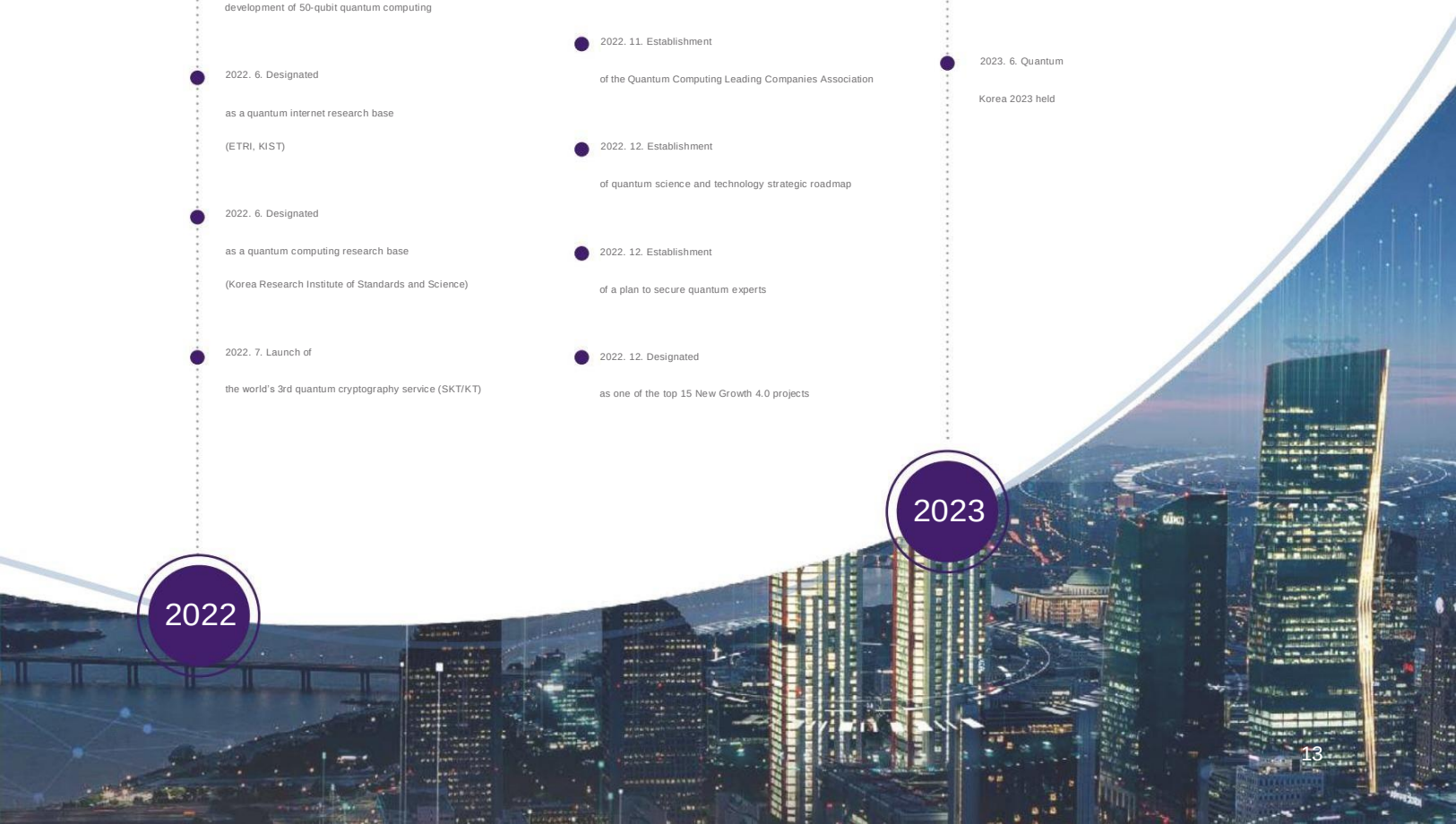
2023. 3. Application
of wireless quantum cryptography system to commercial
network (Jeju International University) (KT)

2023. 3. Designated
as a bilateral national technology strategy center (Korea
Research Institute of Standards and Science)

2023. 4.
Implementation of the world's first quantum cryptography
communication security verification system

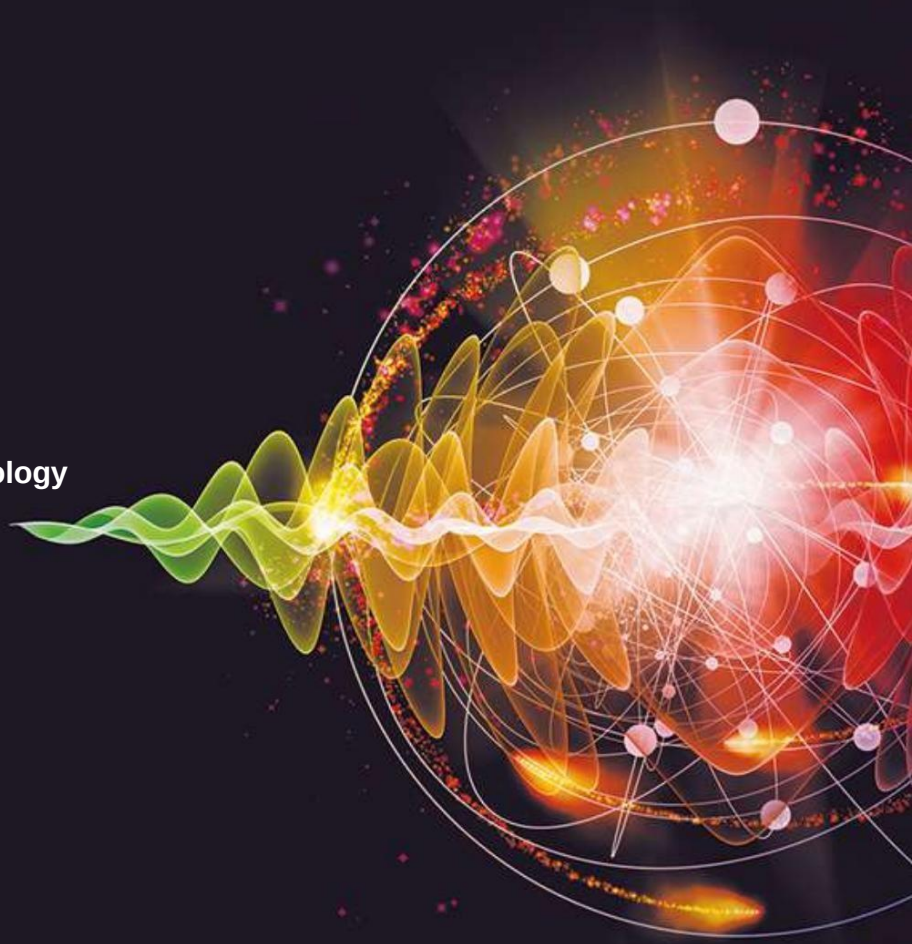
2023. 4. Start of
preliminary feasibility study for quantum science and technology
flagship project

2023. 6. Quantum
Korea 2023 held



Our challenges and

strategies to open the quantum era



PART. ÿ

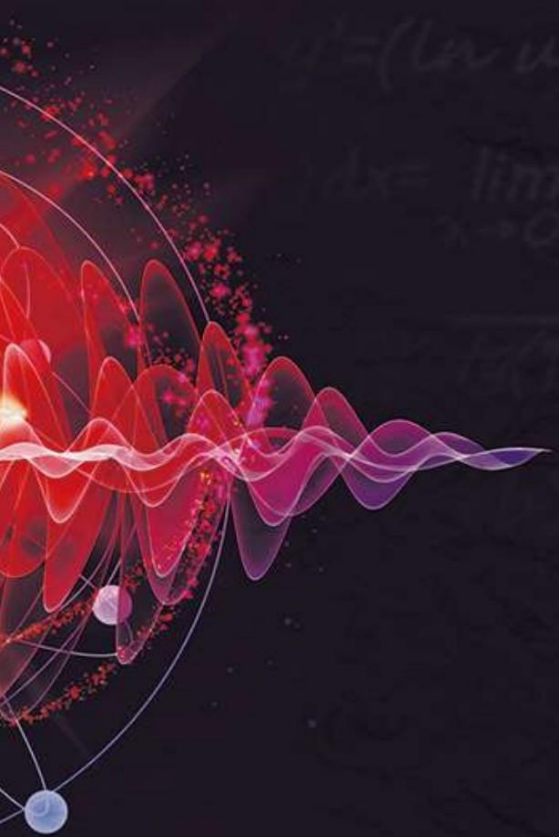
A vision of the future achieved

through quantum science and technology

Quantum

overlap The property that quantum states exist simultaneously with probability distributions

and phases, and only probabilistic predictions are possible for measurement results.



01 A vibrant quantum economy

Quantum Economy

Global competition is intensifying in the country's key industries such as semiconductors, automobiles, shipbuilding, steel, and petrochemicals, which have led the growth of the Korean economy. In a situation where there is an urgent need to secure super-gap technology that does not allow competitors to overtake, quantum science and technology will become a lever for strengthening competitiveness and improving productivity.

Driving the “super gap” in Korea’s five major industries

The combination of quantum science technology and advanced manufacturing technology, such as optimization of semiconductor manufacturing and production based on quantum computing, innovation in ultra-fine process design such as quantum sensor-based autonomous driving technology and batteries, and measurement of micro defects, can dramatically improve production yield across domestic industries. I will do it.

Acceleration of “high-tech industries” such as artificial intelligence and biotechnology

Crude oil 'data' in the 21st century is an essential commodity for future high-tech industries such as bio, robots, and artificial intelligence, which require high-speed, large-capacity data processing and advanced data security. Quantum science technology-based calculation, detection, and security capabilities will completely overcome the limitations of existing digital systems and accelerate the development of these high-tech industries. Quantum computers will analyze DNA consisting of more than billions of base pairs and process vast amounts of sequence mutation data, opening the way to innovative disease treatment technologies and new drug development. From hundreds of billions to trillions

It will accelerate the development of ultra-large artificial intelligence that processes parameters and hasten the emergence of human-like robots.

A great leap forward in “new basic industries” such as space, resources, and energy

Problems that require a global response, such as depletion of Earth's resources and asteroid collisions, are becoming more frequent, and closer international cooperation and cooperation are required in various fields such as space, resources, and energy. Quantum computers will provide a starting point for solving major issues in the international community, and quantum navigation technology will expand humanity's horizons beyond Earth and enable the development of space resources. Quantum computers are large-scale experiments that reveal the secrets of the creation and evolution of the universe.

and will be used for calculations. In addition, if the principle of nitrogen fixation is identified through quantum simulation, it is expected to reduce the enormous energy costs of fertilizer production worldwide and provide a starting point for solving global energy issues.

02 A secure quantum society

Quantum Safety

"What happens if your spear pierces your shield?" The old idiom contradiction is also a story about the near future in which a fierce competition will be held between quantum computers that penetrate everything and quantum cryptography technology that blocks everything.

High-speed information society free from hacking and leaks

As e-commerce and IT information services become more widespread, security capabilities against personal information leaks, hacking, and wiretapping are becoming a core function of maintaining order in our society. Information processing technologies based on quantum cryptography communications, which cannot be eavesdropped or hacked, will fundamentally block the risk of personal information leakage such as communication security, financial transactions, and medical data. Quantum currently being applied to some smartphones and automobile security systems As cryptographic security modules such as random number generators expand and evolve on a system basis, new security industries utilizing quantum science technology will be created in the future. Services will be actively created.

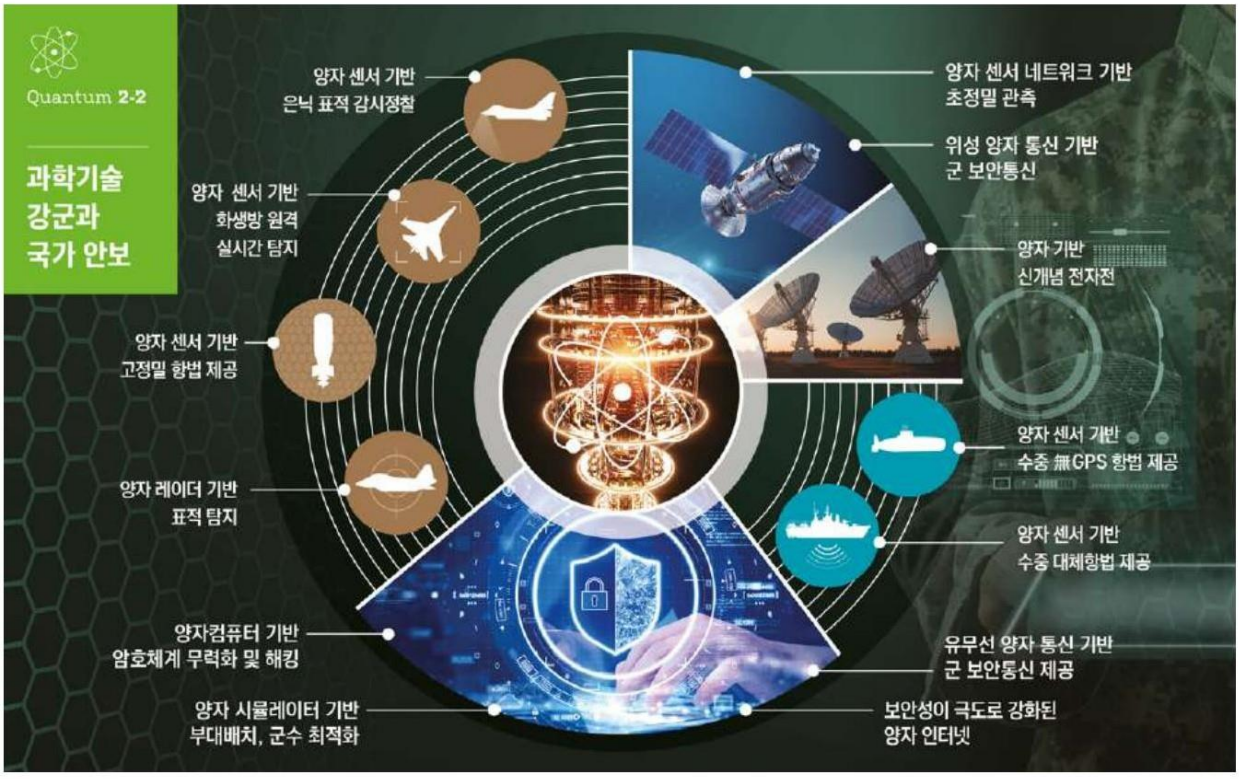
Strong science and technology and national security

In a complex international situation, countries around the world are currently engaging in a new arms race based on cutting-edge technology. Quantum computers that can neutralize the other party's encryption system, quantum cryptography technology that changes the information detected in real time when eavesdropping or eavesdropping is attempted, and unmanned Interest and research are focused on new weapon systems, such as quantum radar that remotely detects low-reflective objects such as aircraft, and submarine/aircraft navigation systems that can be used in deep sea or wartime situations without GPS location information. Our country is also cutting-edge in the field of national defense and security.

By applying quantum science and technology, we will further strengthen our position as a science and technology powerhouse.

Disaster and accident prevention

With its dramatically improved sensitivity, precision, and resolution, quantum sensors will detect and prevent social risk factors such as natural disasters, harmful gas leaks, and large-scale fires that continuously threaten people's lives in real time. In addition, quantum sensors sensitively capture minute signals from the lower surface of the earth to detect various urban disasters such as urban sinkholes in advance and prevent damage to life and property due to volcanic and earthquake activities.
It is expected to contribute to reducing it.



03 happy quantum life

Quantum Life

Quantum science and technology overcomes the limitations of medical, meteorological, and transportation technologies that are closely related to people's daily lives, allowing all citizens to enjoy safer and healthier lives. The introduction of quantum computers and quantum sensor technology, which are capable of analyzing various variables and deriving optimal solutions, will not only secure quick and accurate optimal solutions to social problems, but also enable enormous cost savings.

Developing innovative new drugs and providing high-quality medical services

The combination of quantum technology and artificial intelligence enables more accurate disease diagnosis and treatment. High-performance artificial intelligence technology based on quantum computing will provide clinical data and treatments optimized for the patient's disease. In addition, the development of quantum sensor technology provides more precise image scans and analysis results than CT and MRI, enabling ultra-fine cancer diagnosis, and assisting in the development of new mechanisms of treatment through observation of living viruses, advancing cutting-edge medical technology. It will open up new possibilities.

Sophisticated weather and climate predictions

Global climate change is having a more direct impact on people's daily lives, including food production, residential environments, and the occurrence of new and variant infectious diseases. In the future, more precise data will be secured through quantum sensors, and the ultra-fast, large-capacity computing power of quantum computers will be utilized for real-time processing and analysis of highly volatile weather data. Through this, we will increase the reliability of providing weather and climate information, find solutions to weather disasters, and enable a healthier and more comfortable daily life for the people.

Providing optimized transportation services

Quantum lidar and quantum time sensors will contribute to opening an era of more perfect and fully autonomous cars, ships, and aircraft with accurate location information and surrounding sensing capabilities. Analysis of various variables and real-time predictions of the metropolitan transportation system, which is expanding not only on the ground but also in urban air transportation (UAM) and purpose-based mobility, will provide the public with a safer and more convenient transportation daily life.

Our challenges and

strategies to open the quantum era

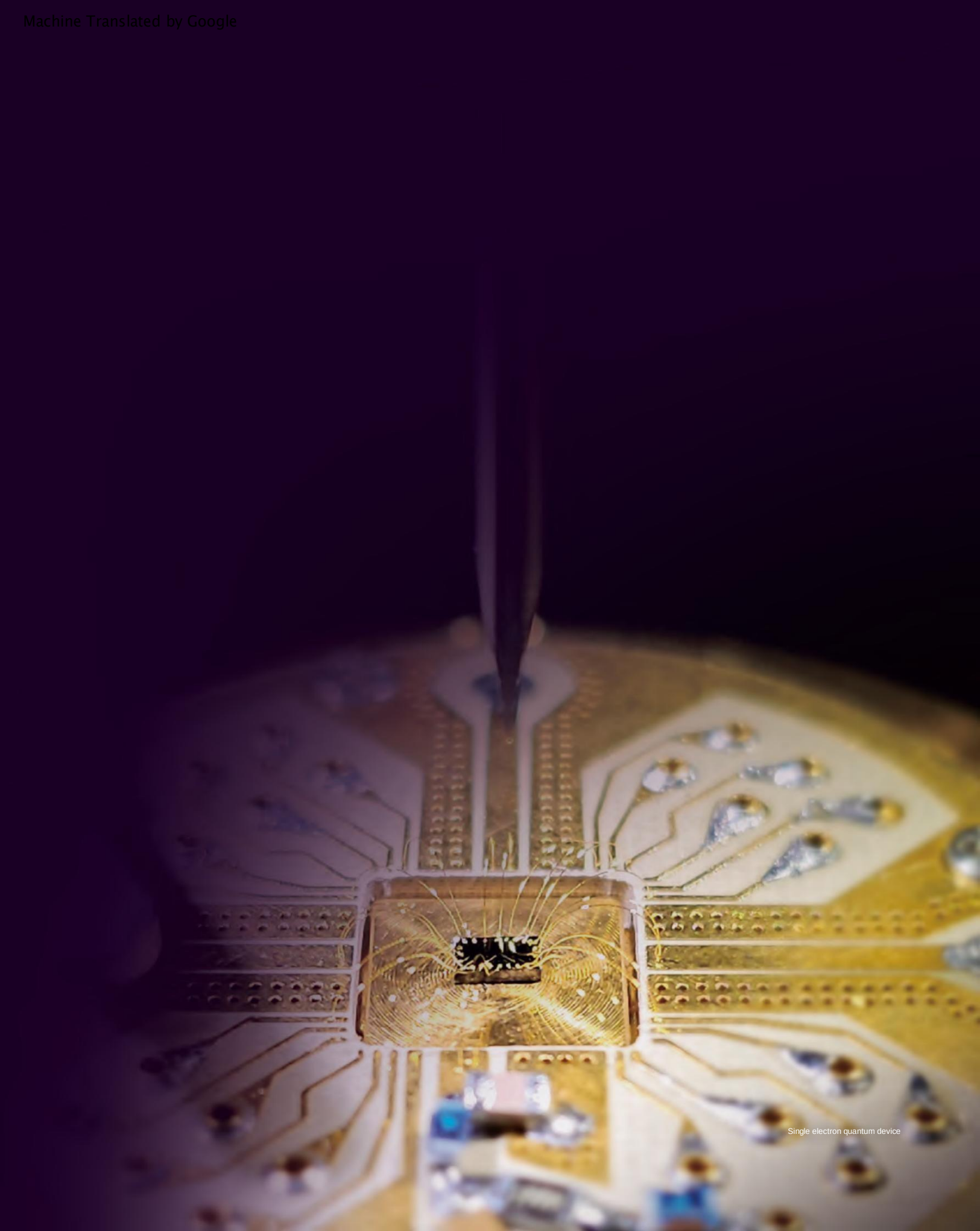
PART. ÿ

Vision and policy goals of quantum science and technology in Korea

Quantum uncertainty:

Measurement results for quantum physical quantities are given as probabilities,

and there are cases where two or more physical quantities cannot be measured accurately at the same time.



Single electron quantum device

Vision and policy goals of quantum science and technology in Korea

VISION

In 2035, Korea

will stand tall as a center for the global bilateral economy

policy goals

with our technology

quantum computer

development utilization

In an internet powerhouse

quantum internet

Leap to power

highest level

With quantum sensor

Dominate the global market

strategic tasks

Entanglement

Creating an **entanglement** ecosystem

2,500 bilateral core talents, 500 global personnel rotations

- Nurturing quantum convergence talent - Expanding quantum device and process infrastructure - Enhancing quantum materials, parts, and equipment - Securing a technological alliance supply chain

Quantum Jump

Leap quantum science and technology development

Technology level 85%

Quantum computing 80%, Quantum communication/sensors 9

- Korean quantum computer service - Demonstration of early quantum network - World's best quantum sensor prototype - Support for basic quantum research

Superposition

nesting Technology-Industrial Convergence

10% global market share, 1,200 quantum-utilizing supply companies

- Creation of demand for quantum utilization - Support for quantum startups and industrialization - Application to national defense and security - Development of quantum concentration areas

invest

Public-private collaborative investment of more than

KRW 3 trillion (basic research + industry/application) [Government] KRW 2.4 trillion (2023-2035), [Private] KRW 600 billion (2023-2027)

Key Key Indicators

Science and technology industry market international cooperation investment

01 Technology level

today 62.5%

2035 85%

(Quantum computing 80% level,
Quantum communication/quantum sensor level of 90%)

02 Training of key personnel

today 384 people2)

2035 2,500 people 3)

03 Quantum field manpower

today 1,000 people

2035 10,000 people

04 Quantum market Share

today 1.8%World 10th place4)

2035 10.0% world 4th level

05 Quantum technology supply and utilization company

today 805)

2035 1,200 6)

06 Global human resources circulation

today 53 people '19~'22 government bilateral exclusive project standard

2035 500 people '23~'35, government

07 International cooperation investment scale

today 13 billion won7) '19~'22 government bilateral exclusive project standard

2035 210 billion won '23~'35, government

1) 2020 Technology Level Survey (KISTEP, 2021)

2) Quantum Information Technology White Paper (Future Quantum Convergence Forum, 2022)

3) Number of key bilateral human resources trained through government human resource training support projects such as bilateral graduate schools and overseas dispatch/training (cumulative value)

4) Mind Commerce, as of 2022 (USA (21.4%), China (11.2%), Canada (7.8%), Japan (7.3%)

5) Number of domestic quantum science and technology supply companies, quantum materials management companies, and quantum product and service companies registered with the Future Quantum Forum and the Association of Quantum Computing Leading Companies.

6) Total number of businesses in the medical/pharmaceutical, semiconductor, computer, communication equipment, home appliance, precision equipment, fine chemistry, aviation, automobile, information/communication, finance/insurance industries where quantum science and technology can be utilized.
(about 250,000 units in 2020) at the level of 0.5%

7) International cooperation (international joint research, human resource exchange) budget (accumulated value) among government bilateral projects

Our challenges and

strategies to open the quantum era

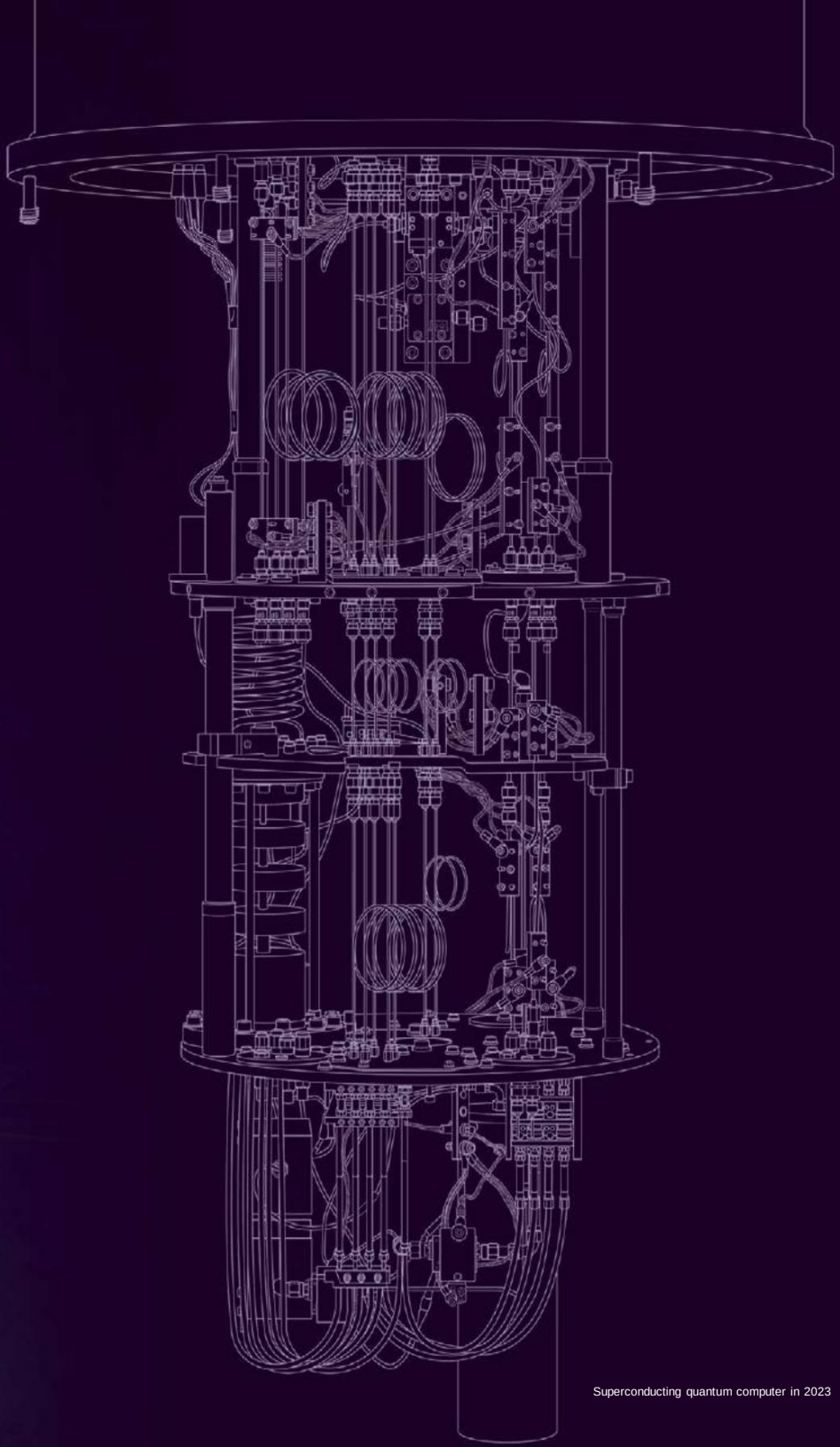
PART. ÿ

To realize the quantum economy

3-step development strategy

Particle-wave duality is the

property in which all substances have both particle and wave properties at the same time.



Superconducting quantum computer in 2023

To realize the quantum economy

3-step development strategy

division	today	Stage 1 '23~'27	Stage 2 ÿ28~ÿ31	Stage 3 ÿ32~ÿ35
		Quantum sensor·Quantum cryptography Promotion of telecommunication industrialization	quantum computing system and service localization	global quantum A first-class national leap forward
core personnel (accumulate)	384 people	700 people	1,400 people	2,500 people
quantum computing	10 qubit level quantum computer	50 qubit level Establishment of quantum computer and launch of cloud service	1,000 qubit level (Error rate less than 0.5%) Building a quantum computer and Cloud service launch	Quantum computer commercialization
quantum communication	Entered commercialization of quantum cryptography communication	quantum network Element technology development (Quantum transmission, quantum memory source technology)	Initial demonstration of inter-city quantum networks (Quantum memory-based quantum repeater prototype)	Based on nationwide network Quantum Internet pilot construction
quantum sensor	quantum sensor Original technology	Commercialization of quantum sensors for use in high-tech industries such as secondary batteries	Development of a world-class quantum sensor convergence system (prototype) utilizing defense/ medical/semiconductors	Laying the foundation for quantum industry with quantum sensors
infra	Quantum fab (single) operation	Expansion of public open* quantum fab and intensive training of process personnel (*direct use by researchers)	Public specialized production quantum fab (Foundry) construction and operation	Private specialized production Proliferation of quantum fabs (foundries)

quantum device
(Quantum computing-
communication-sensor)
Link verification

Level 1

2023-2027

Intensively creating a basic quantum ecosystem and promoting the industrialization of quantum sensors and quantum cryptography communications

Bring together the capabilities of domestic industry, academia, and research institutes to derive national missions to be implemented as a priority. To achieve this, mission-oriented research and development will be promoted to improve Korea's technological level in the quantum field from the current level of 62.5% to 70% compared to the most developed countries.

We will develop a 50-qubit superconducting quantum computing system in 2027 and support various attempts to explore the economic and social potential of quantum computers. Both have entered the early stages of commercialization

Expanding cryptographic communication, quantum network core such as memory for storing quantum information and quantum transmission Secure technology. Continuing to develop the four major quantum sensors (inertial, time, electromagnetic field, and imaging) source technology Meanwhile, quantum sensors that can be used in high-tech industries such as secondary batteries are developed and commercialized.

By expanding quantum graduate schools and education and research base centers (ITRC, SRC/ERC, etc.), the number of high-level core personnel from the current level of 380 will increase to around 700, and basic quantum research will also be continuously supported. We will build infrastructure to support various research activities, such as an open public quantum fab that researchers can directly use, and focus on nurturing device processing experts.

Step 2

2028-2031

Promoting local production of quantum computing systems and becoming a quantum science technology and industrial powerhouse

By promoting system-level research and development (R&D) through integration of element technologies, the technological level will be raised to 80% compared to the most developed countries. By 2031, we will develop a 1,000-qubit quantum computer with world-class reliability and a quantum memory-based quantum repeater that converts and stores quantum information to promote the initial demonstration of an inter-city quantum network.

We are developing a world-class quantum sensor convergence system that can be used in fields such as national defense, medicine, and semiconductors. In addition, we will continue to support quantum theory and basic research, which are the source of new innovation, and foster core personnel to 1,400 people by expanding the human resources base, such as upgrading quantum education courses. In addition, in order to industrialize the results of quantum science and technology research and development, we are strengthening various institutional supports such as commercialization, start-up support, and regulatory improvement, while researching and developing high-quality quantum devices. We also operate an advanced specialized production quantum fab (foundry) to provide industrial use. In order to develop domestic quantum science and technology and protect the supply chain, the materials, components, and components that make up the quantum system We promote research and development and industrialization of equipment and thereby support the transition to a quantum economy.

Step 3

2032-2035

Leading the world's quantum economy and creating a defense powerhouse based on leading the global quantum system

Through balanced development of basic resources and industrial application R&D, we will reach 85% of the level of quantum science and technology compared to advanced countries, secure international leadership, and realize significant socioeconomic benefits.

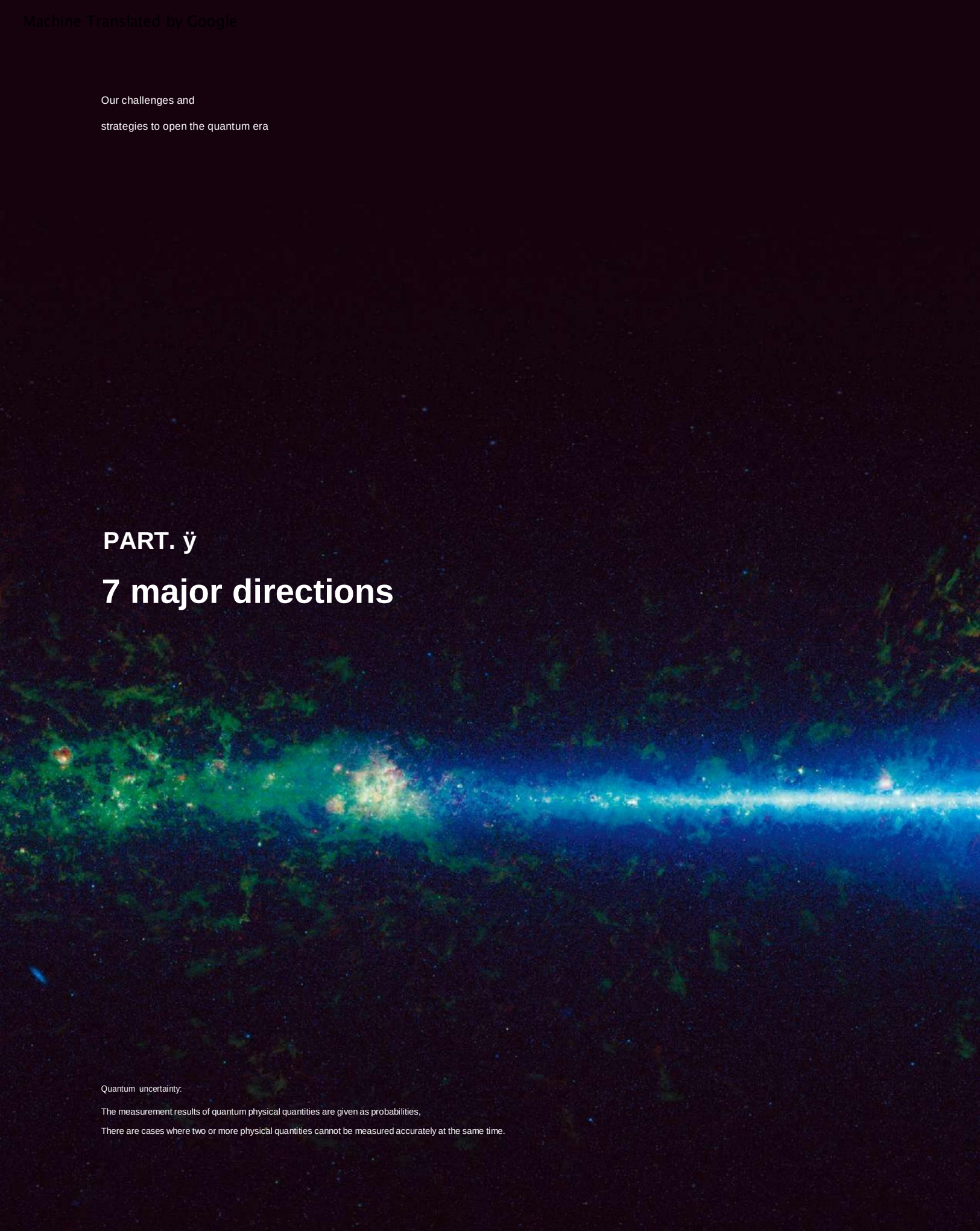
It drives destructive innovation in quantum science and technology by demonstrating the connection between quantum computers and quantum sensors, or quantum devices that connect multiple quantum computers through a quantum network. To maintain continued global competitiveness, the size of the bilateral core workforce will be expanded to 2,500. Through the full-scale commercialization of quantum science and technology, a solid quantum industry ecosystem will be established and private-led quantum device foundries will spread, establishing Korea as a global top-tier quantum country.

Our challenges and

strategies to open the quantum era

PART. ÿ

7 major directions



Quantum uncertainty:

The measurement results of quantum physical quantities are given as probabilities,

There are cases where two or more physical quantities cannot be measured accurately at the same time.

quantum attraction

01 Securement is a top priority

The success or failure of quantum science and technology in Korea depends on securing excellent quantum science and technology talent. For balanced development of quantum science and technology, human resources (quantum core personnel) who have a deep understanding of quantum physical principles and phenomena and various engineering based on electrical/electronic, ICT, and system/control engineering who can systematically implement and operate them. All human resources (quantum engineers) must be secured.

Currently, there are about 380 key domestic quantum personnel in universities, research, and industry, and there is a significant shortage of professional quantum engineering personnel. High academic difficulty, poor industrial ecosystem, and lack of factors to attract high-quality human resources are obstacles to securing talent.

Promoting talent development in quantum science and technology

By 2035, we will intensively train 2,500 key personnel in quantum science and technology.

The government is expanding quantum graduate schools to provide integrated quantum science and technology theory-practice-projects for master's and doctoral programs, and designating quantum education and research centers at universities and research institutes such as ITRC, and providing overseas dispatch and training to provide core quantum knowledge. Train manpower. In addition, institutional support is provided to facilitate the establishment and expansion of quantum-related departments at universities and graduate schools. In addition, it provides various growth paths for quantum engineers by operating quantum education programs and supporting quantum convergence projects for related departments such as electrical and electronics, computers, and information and communication. Such Through our efforts, we will secure approximately 10,000 quantum human resources including researchers, HW/SW/system engineers, and other manufacturing and utilization industry workers by 2035. do.

Support the stable settlement of quantum science and technology personnel in the country.

Considering that the domestic quantum industry ecosystem is not yet mature, we will initially support the establishment of related career paths and an environment for research immersion for quantum personnel. By designating relevant universities and government-funded research institutes as quantum research bases and promoting large-scale government research and development projects in the quantum field, the public sector will lead the creation of quantum research jobs. Next, we will also support the settlement of the private sector by promoting bilateral projects in which the industry participates and supporting the recruitment of bilateral human resources from the industry.

Establishing a virtuous cycle system for global quantum science and technology talent

It provides opportunities to secure quantum science and technology capabilities through dispatching domestic researchers overseas.

Expand support for overseas joint research, exchange, and cooperation between domestic master's, doctoral, and postdoctoral researchers. We operate an education and training program that dispatches industrial workers and master's and doctoral students who wish to utilize domestic quantum science technology to leading global quantum companies, striving to strengthen self-reliance in absorbing and utilizing advanced knowledge in the quantum field. Specifically, we will secure a global technology exchange channel by providing dispatch and exchange opportunities for about 500 bilateral personnel by 2035.

Attract outstanding quantum scientists and engineers from overseas and promote international joint research and exchange.

In order to attract outstanding overseas researchers, the current project to attract outstanding overseas scientists will be expanded and reorganized. We strive to attract global talent by providing opportunities to excellent foreign researchers to lead projects or perform tasks. We support joint research with major advanced countries in quantum science and technology, and provide expanded overseas training and joint research opportunities for new researchers. We promote regional international joint research centers, joint labs, and senior-level overseas researcher exchange programs operated overseas.

Expanding the base for nurturing elementary, middle, and high school human resources

We prepare for the future of the quantum era through customized education and experience programs for gifted students.

We support the operation of the curriculum so that gifted school and science high school students can select and study advanced subjects related to quantum science and technology so that they can grow into quantum science and technology experts at an early age.

Expand the base of quantum science and technology through education and experience programs for the general public and elementary, middle, and high school students.

We develop and distribute popular content that introduces quantum physics, mathematics, and computer science, as well as educational content teaching materials and textbooks for elementary and middle school students that make it easy to understand the basic concepts of quantum science and technology. We operate permanent education and experience programs centered around the National Science Museum, and

We are increasing public interest in quantum science and technology by holding a quantum hackathon competition in which the general public participates.

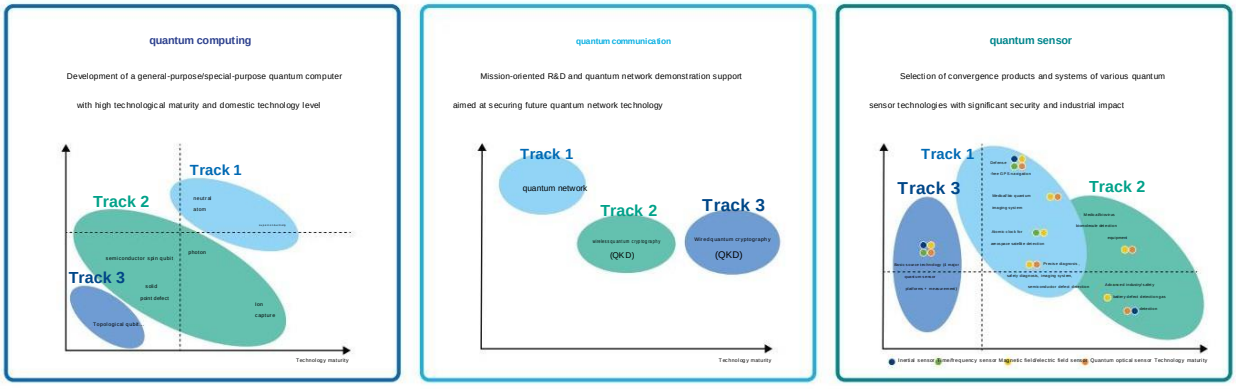
mission-oriented

02 Promotion of research and development

Quantum science and technology is a game-changing technology that will bring about innovation in the entire economy and society around the world. Moreover, countries around the world are strengthening export controls on quantum science technology and related key parts and equipment as it is a strategic technology with great utility in terms of national defense and security. The current domestic technology level is 62.5%* compared to the United States, the leading country, so there is an urgent need to secure our own capabilities.

* Based on ÿ2020 Technology Level Assessment (Korea Institute of Science and Technology Planning and Evaluation)ÿ

Accordingly, our government designated 'quantum' as a national strategic technology in 2021, and presented development goals, milestones, and support strategies for quantum computing, quantum communication, and quantum sensors through the quantum science and technology strategic roadmap in December 2022. Here, the support methods were presented in a typified manner taking into account the technological maturity of each detailed method and domestic technological level for each field, focusing on technologies (mission-oriented) that will be developed by setting a clear goal by 2031. We plan to promote “flagship projects” and support technological development for the remaining types by reflecting technological development trends and changes in the technological environment.



Securing quantum computing system technology and developing utilization technology

We will secure our own core technology with the goal of developing a 1,000-qubit quantum computer in the early 2030s. In the case of quantum computing technology, competition among various candidate methods (platforms 1)) is ongoing while the market-dominant technology has not been determined . The government has prepared a technology roadmap while keeping the innovation potential of each platform open, and is pursuing customized support by type according to technological maturity and domestic technology level.

1) Computer hardware structure that can be driven by software

First , we will focus on developing 1000-qubit superconductivity-based general-purpose quantum computer2) technology and building a system. In addition , we will seek to secure technological competitiveness more quickly through the development of a neutral atom quantum computer3) for special purposes . Through this, we secure the foundational technology for implementing a very large-scale system and achieve world-class reliability by focusing on securing initial error tolerance technology that minimizes errors in hardware calculations. do. Supports challenging research and development on various quantum computer methods (ion capture4), photon5), semiconductor spin6), solid point defect7) , etc. and promote systemized research by reflecting technological development trends. In order to promote the use of quantum computers in the near future by building efficient computing resources, we will also promote technology development for classical-quantum computer linkage (hybrid) methods.

Secure quantum software technology to dominate the quantum computing market.

Operate, control, and operate quantum computer hardware so that the quantum computer system can operate efficiently in conjunction with the quantum computing HW platform. We are promoting the development of quantum computer operation software (including interfaces, controllers, etc.) essential for processing. Research on quantum algorithms such as quantum optimization calculation and quantum AI that can be applied and verified across industries such as finance and medicine as an essential technology for the use of quantum computers. and promote quantum software development.

< (Left) Superconductivity-based quantum computer, (Right) Superconducting qubit device package (Korea Research Institute of Standards and Science) >

2) A quantum computer that performs quantum calculations by utilizing the superconductivity phenomenon in which electrical resistance becomes 0 at very low temperatures.

3) A quantum computer that performs quantum calculations by capturing, controlling, and measuring neutral atoms using laser technology.

4) A quantum computer that performs quantum calculations by trapping ion particles using electromagnetic force in a vacuum.

5) Quantum computer that performs quantum operations by assigning information to photons

6) Quantum computer that performs quantum operations by utilizing the spin state of particles trapped in a semiconductor structure

7) A quantum computer that performs quantum calculations using artificial atoms created from point defects existing in solids.

Implementation of the world's first highly secure and reliable quantum communication technology

We will develop 100 km quantum network technology in the 2030s and promote inter-city verification.

Technology that can transmit quantum signals over long distances is essential for the commercialization of safe and reliable quantum communication. We will develop and secure core quantum network technologies, such as quantum memory8), quantum repeater9), and quantum satellite communication technology, which have a large industrial and security impact, and build and demonstrate a quantum entangled quantum network between cities more than 100 km away . Furthermore, the quantum Internet era will be realized in the mid- to long-term by demonstrating not only quantum network technology as a communication technology, but also connectivity between various quantum devices such as quantum computers, quantum sensors, and multiple quantum computers.

The public and private sector will jointly promote the verification and expansion of nationwide wired quantum cryptography communication.

In order to increase the usability of wired quantum cryptography communication, which has entered the early stage of system commercialization, efforts will be made to improve performance, transmission speed, and distance to implement nationwide wired quantum cryptography communication over 500km without a repeater. We promote mission-oriented research and development applicable to defense and medical fields that require high security, and link it with public-private joint investment and verification. In order to expand the network scalability and scope of use of quantum cryptography communication networks, we will secure core technologies for long-distance wireless quantum cryptography communication for mobile and satellite by supporting R&D projects centered on collaborative research between academia, research institutes, and industry.

< (Left) QKD equipment (Coweaver, KT), (Right) Superconducting nanowire single-photon detector (IDQ) that can be used for QKD and quantum communication >

Development of ultra-high precision quantum sensors for world-class defense and high-tech industries

We secure our own cutting-edge defense and space exploration capabilities with GPS-free navigation and satellite-mounted atomic clocks.

We will secure the world's best quantum sensor technology, focusing on non-GPS navigation technology that can be applied in the defense and public sectors and the Korean Satellite Navigation System (KPS). We develop non-GPS navigation technology based on quantum science technology that can be used in situations where the operation of various weapon systems is restricted, such as underwater, tunnels, or GPS jamming situations where GPS signals do not reach. In addition, we have developed a high-precision atomic clock to be mounted on the Korean Positioning System (KPS), Korea's independent satellite navigation system, and have developed high-precision atomic clocks to be installed in high-precision areas near the Korean Peninsula.

Contributes to providing navigation

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8) A device that can convert information between quantum devices and store data in a quantum state, like the memory of a classical computer.

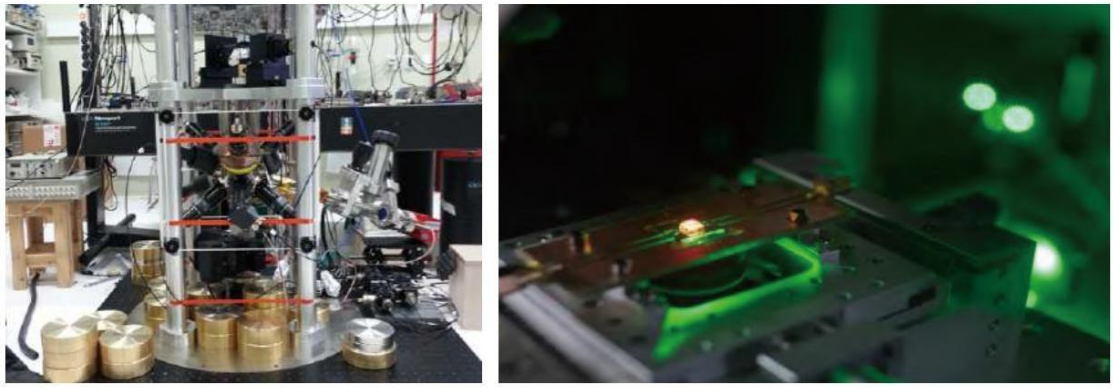
9) A device composed of quantum memory, etc. to expand the quantum transmission distance limit (tens of kilometers or less)

10) Korea's independent satellite navigation system (KPS, Korean Positioning System), which is scheduled to be built, provides ultra-precise local navigation near the Korean Peninsula

We secure competitiveness in cutting-edge future industries by developing batteries, semiconductors, and medical quantum sensors.

By applying the ultra-high-precision detection capabilities of quantum sensors to detect defects in the production process of batteries and semiconductors, an increase in yield can be expected. Quantum sensor technology in the bio field, such as virus detection and biomolecule analysis, is a catalyst for the development and introduction of new treatments. industry

Based on actual demand, we support quantum sensor research and development with a focus on market utilization. In technology fields with relatively low technological maturity or industrial utilization, basic research will be supported to secure quantum sensor source technology.

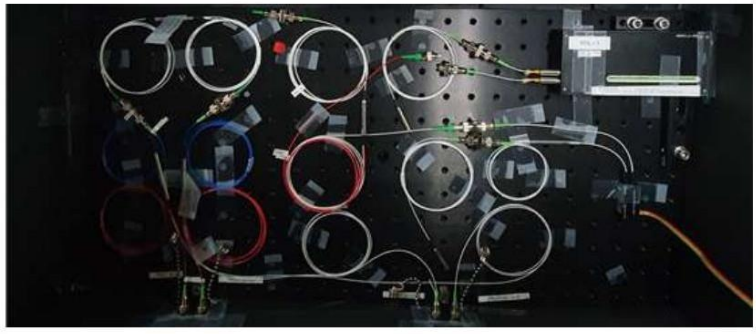


< (Left) Quantum gravimeter, (Right) Quantum imaging sensor >

Continued support for various basic quantum research

We foster innovative technologies by supporting various basic research in quantum science and technology.

In addition to quantum computing, quantum communication, and quantum sensors, which have proven industrial applicability, we also support exploratory research on emerging quantum science and technology methods to encourage the development of a broad spectrum of domestic quantum science and technology. We will continue to support various basic quantum research centered on basic science research institutes and universities in the fields of quantum information theory, quantum material research, and quantum control, to discover new possibilities and develop technologies.



< Quantum frequency conversion source technology (Pohang University of Science and Technology, Nanophotonics, 2022) >

Quantum research and industry

03 Infrastructure advancement

Quantum devices used in quantum application systems such as quantum computers, quantum communication, and quantum sensors undergo a process similar to the semiconductor device process. It is made through a process that deals with quantum phenomena that occur in the extreme microscopic world, so it requires sophisticated device processes, materials, parts, and equipment of the highest level in existence (so-called “Quantum Grade”). Currently, much of the semiconductor industry is dependent on overseas
The supply chain issues that are occurring may be reproduced in the quantum industry in the future.

Korea has excellent semiconductor device processing capabilities, and the equipment industry that has developed into the semiconductor downstream industry has the potential to grow into the quantum component and equipment industry such as low-temperature and high-vacuum chambers. Here, large-scale science such as space, nuclear fusion, and heavy ion accelerators
The know-how and industrial base accumulated during the project implementation process can also serve as a catalyst for the growth of the quantum prefabrication industry.

However, because the size of the quantum industry market is not yet large and it is difficult to predict the timing of activation, the technology and infrastructure that can be directly utilized in quantum science and technology are poor, and companies are also hesitant to invest. We provide a research infrastructure environment so that our researchers can conduct creative and challenging quantum science and technology research, and based on our strengths, we provide a technology base so that we can become a strong player in the global quantum foundry and materials, components, and equipment markets in the mid to long term. The roles of both the government and the private sector are required to build .

Strengthening and industrializing quantum device and process infrastructure

Expand researcher-led open quantum fab infrastructure and support quantum foundry industrialization.

The government is expanding the construction and operation of public fabs as a stepping stone until companies with semiconductor device processing capabilities enter the quantum field in earnest. Based on public nanofabs and fabs operated by universities, open quantum fabs specialized for each platform will be expanded to provide an environment in which researchers can conduct challenging quantum device production and experiments led by researchers. In the mid- to long-term, public quantum foundries for promising platforms will be additionally expanded to provide high-quality quantum devices for research and industrial use.

The Quantum Fab functions as a support hub to not only secure packaging and measurement equipment technology, but also provide various development, demonstration, and industrial support. Operate to do so. We will support the conversion and inflow of semiconductor device processing personnel into quantum device processing experts and become a key bridgehead for nurturing quantum industry experts. In order to utilize the capabilities of our semiconductor companies, we have established a public-private cooperation model in the operation of a quantum fab.
In the mid- to long-term, the country will develop into a future global quantum foundry center by expanding private sector-led quantum foundries.

< Quantum Fab (Korea Research Institute of Standards and Science, Electronics and Telecommunications Research Institute) >

Securing quantum material and component manufacturing technology

We will secure quantum material and component manufacturing technology that supports the development of quantum science and technology and foster it as an industry.

As major countries' control of materials, components, and equipment, which are the basis for quantum science and technology innovation, is gradually being strengthened, we are building a technology base for materials, parts, and equipment that will be the basis for domestic quantum science and technology innovation, and utilizing the strengths of the domestic semiconductor and equipment industry. We take on the challenge of creating a value-added industry. We provide information and incentives on major quantum-related items in each sector, including cryogenic electronic components, low-temperature high-vacuum equipment, qubit control support components, quantum signal measurement devices, and optical crystal and dielectric materials, making us a quantum supplier to domestic semiconductor, electronic equipment and component companies. induce entry do. For items of high importance and urgency, the government supports technology development and seeks to strengthen competitiveness by providing opportunities for domestic small and medium-sized companies to participate in the procurement of various infrastructure related to quantum science and technology.

Towards a quantum economy

04 Establishment of industrial foundation

Quantum science technology is a destructive innovation, but it is expected to take a considerable amount of time to be commercialized. Therefore, full-scale commercialization
In order to continue the driving force of development, spiral innovation in which technology and industry develop in parallel is essential. Countries around the world are promoting strategic investment and support to foster quantum industries that have various utilities in terms of economy, security, and industry. In the United States, not only large IT companies such as Google and IBM, but also nearly 100 quantum startups have emerged, participating across the entire industrial ecosystem.
is active. In comparison, the creation of a domestic quantum industry ecosystem and investment in startups are at an initial level. Therefore, government support and a priming role are important for early establishment of a quantum industrial ecosystem and improvement of international competitiveness.

* US quantum startups: 60 quantum computing, 19 quantum communication, 13 quantum sensors (McKinsey&Company, as of June 2022)

* Starting in 2022, support for quantum commercialization and foster businesses through the Quantum Industry Ecosystem Support Center.

Support for exploring the use of quantum science and technology

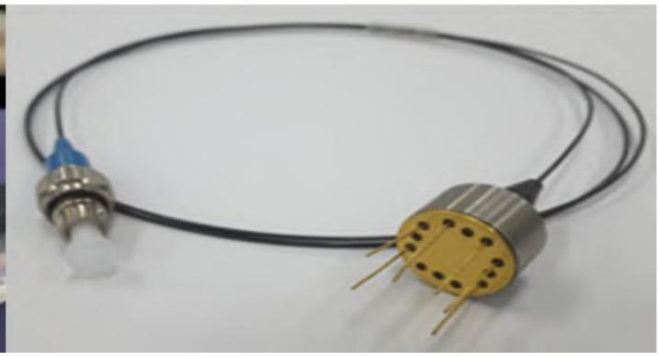
We support entry into the quantum industry through quantum gain exploration and quantum empirical research.

Considering the uncertainty of the scale of socioeconomic value that can be obtained through the use of quantum science and technology, the government
We support quantum gain exploration research that can identify potential usefulness in this area. We support the creation of corporate business models through public-private joint development and empirical research, and provide algorithms and software that operate quantum computers according to each purpose of use.
We support quantum computer cloud services for development.

* Quantum Advantage: The point at which quantum science and technology, rather than simply being functionally ahead, are applied academically and industrially and have practical utility.

** Starting in 2020, the Quantum Information Research Support Center has been providing services by establishing an overseas quantum computer cloud joint utilization system.

< (Left) Samsung Galaxy A Quantum smartphone equipped with QRNG chip (Samsung Electronics/SKT), (Right) QKD equipment applied to KOREN network (Woori Net) >



< (Left) Simultaneous counting generator (SDT), (Right) Single photon detection device (Woriro) >

Nurturing quantum startups led by cutting-edge technology and creating unicorn companies

We foster bilateral companies through startup development projects and policy financing support.

New industries in quantum science and technology by utilizing technology-based promising venture development support programs such as the Super Gap Startup 1000+ project.

is starting to discover promising startups. Through this, scale-up is supported through R&D and technology commercialization funding, policy funds, guarantees, and export linkage support, while corporate-led bilateral R&D and commercialization is supported by guarantees on R&D funds and investment support through policy funds. promote Over the next five years, we will invest KRW 1.5 trillion in innovation growth funds to support small and medium-sized businesses in 15 innovative growth areas, including quantum.

Supports the creation and growth of venture companies.

* Super gap startup 1000+ projects

- New industry startup development project: Select startups with core technologies and support technology commercialization, R&D, etc.
- Deeptech TIPS: The government provides matching support, including R&D and commercialization funds, to excellent startups selected by private venture capital (VC).

Creating a bilateral intensive development area and strengthening the institutional foundation

Create a bilateral intensive development area to concentrate capabilities and create synergy.

In order to develop and commercialize quantum science technology, it is necessary to bring together the capabilities of a wide group of industry, academia, and research experts from basic research to commercialization.

do. The government is promoting the creation of a quantum intensive training area where research and development, human resource training, and startup growth can be carried out in a complex manner through the integration of government-funded research institutes, base universities, and companies and the establishment of a global bilateral human resources network.

Establish an institutional foundation for the industrialization of quantum science and technology at an early stage.

Promote industry participation in the field of quantum science and technology, a new technology area, and establish an institutional foundation for revitalizing public-private joint projects. The mandatory matching ratio granted when a company participates in government research and development projects in the quantum field is relaxed, and exclusive use rights are granted to patents generated from bilateral R&D investments. In addition, we provide proactive and timely support to revitalize the quantum industry through strategic support for certification and evaluation technology, measurement technology, and standardization at the government level. By legislating these contents, we provide a stable investment environment.

National Defense/Security

05 Promotion of introduction

Quantum science and technology is a destructive innovation that goes beyond the classical limitations of existing technologies, and countries around the world are intensively fostering quantum science and technology as one of the top technologies for national security. In particular, it is predicted that the next-generation quantum weapon system, which goes beyond the limitations of existing classical defense technologies, will determine battlefield superiority, and attention is being paid to its utility at the national security level, such as neutralizing existing encryption systems and blocking wiretapping and hacking. Moreover, in the case of defense technology that requires a high degree of complementarity, the necessity and urgency of securing our own technology is even greater. Meanwhile, the development of advanced quantum computing technology can cause serious security threats such as leakage of important information, impossibility of identity verification, and collapse of data trust. As leading countries such as the United States and the EU are already conducting technology contests to standardize Post Quantum Cryptography (PQC) and announcing transition scenarios, Korea also needs to systematically respond to the transition to a quantum-resistant cryptography system.

Cultivating a strong scientific and technological force based on quantum science and technology

We lead the future battlefield through strategic investment and technology development in quantum science and technology in the defense field.

The government selects quantum science and technology as a strategic defense technology through the basic plan for defense science and technology innovation, and expands investment in the field of quantum science and technology to prepare for existing threats and future battlefields. In particular, we will introduce private technologies that are developing ahead of time through civil-military cooperation in quantum science and technology, and promote the creation of a challenging research and development environment and training of human resources so that our country can lead the future battlefield with quantum science and technology.

Establishing a quantum security ecosystem to lead national security technology

Support the creation of a quantum security market by expanding the security suitability verification system for quantum cryptography communication equipment.

Our government has expanded the security compliance verification system, which was applied to existing information protection and network equipment, to quantum cryptography communication equipment for the first time in the world, enabling rapid introduction to government ministries and public institutions. In order to ensure that this system leads to the practical introduction and spread of quantum cryptography systems, such as quantum communication encryption equipment, quantum key management equipment, and quantum key distribution equipment, the government provides detailed guidance.

Establish a line and support testing and verification. Starting with the introduction of government and public institutions, the accumulated references are

It will serve as a foundation for the early establishment of the security market and the advancement of our quantum communication companies into the global market.

In accordance with the development of quantum science and technology, a master plan for quantum-resistant encryption conversion at the national level will be established and phased conversion will

be promoted. To prepare for the threat of collapse of the current encryption system due to the development of high-performance quantum computers, the government jointly developed a quantum cryptography-resistant encryption system with related ministries.

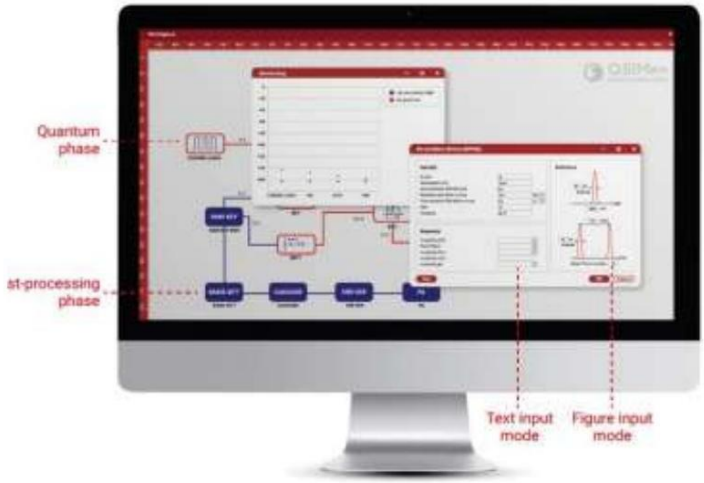
A national password conversion system master plan will be established within the year that includes the conversion procedure, timing, priorities, and step-by-step goals. Also, this

In order to support this, we will secure the Korean-style quantum-resistant cryptography (KpqC) algorithm through contests, etc., and in the process, enhance technological competitiveness in the domestic quantum-resistant cryptography field through talent training and research promotion. In addition, quantum

We support commercialization by establishing and providing a test bed environment that can test the performance and safety of resistant passwords.

Furthermore, a conversion guideline containing identification methods for encryption system conversion targets and quantum-resistant encryption application procedures for each ICT industry sector such as finance, manufacturing, and communications was prepared, and based on this, a step-by-step implementation was implemented targeting national, public institutions, and major private infrastructure according to priority. National encryption system conversion

Implement the process.



< SW for quantum cryptography communication design verification (QSIM Plus) >

< Transmission equipment using quantum-resistant cryptography (PQC) technology (LG U+) >

global quantum

06 Securing leadership

Recently, as the possibility of industrial use of quantum science and technology has begun to become visible, each country is competing to research and develop quantum science and technology.

We are increasing our investments in global markets and strengthening international cooperation with “like-minded” government and industrial partners. Leading countries in quantum science and technology, such as the United States, the United Kingdom, France, Germany, and Japan, have opened a web page called “Entanglement Exchange” to share their investment and research status and introduce human resource exchange opportunities, and Korea is also participating in this. In addition, from the early stages of forming a quantum industrial supply chain, efforts are being made to expand the ecosystem through cooperation by forming national groups. As major countries around the world are recognizing the seriousness of security-related global supply chain issues for quantum science and technology and the shortage of related manpower, the importance of strategic international cooperation and cooperation is becoming increasingly important.

Creating an environment for international cooperation by strengthening strategic technological solidarity

Strengthen strategic solidarity at the national level.

The government promotes strengthening international cooperation with governments and industrial partners of major bilateral countries around the world, such as the US and EU, in order to improve national competitiveness in quantum science and technology and create synergy between countries. Close investment and research into quantum science and technology, which is at a relatively early stage globally By preparing a development strategy, we will strengthen all-round cooperation and cooperation at the national level, including technology and human resource exchange. In addition, we actively participate in bilateral and multilateral consultative bodies and international discussions between countries to strengthen strategic and diplomatic cooperation with leading countries in bilateral science and technology. do.

We actively participate in human resource exchange and research cooperation to enhance the competitiveness of quantum science and technology and create synergy.

In order to strengthen and support international cooperation to quickly improve domestic quantum science and technology capabilities to the level of leading countries, the government will invest 210 billion won in international cooperation in the bilateral field by 2035. Create a system and environment so that international collaborative research can be carried out in research projects in all fields of quantum science and technology, and foster quantum science and technology manpower through practical joint research and exchange through personnel dispatch.

Expand the foundation of education to the entire world. We promote active exchanges with world-class research groups to lower barriers to international cooperation and improve the quality of research results.

Establishing a robust technology supply chain for national security and protecting technology and industry

We respond to global supply chain issues by securing major core technologies.

Quantum application products are an integration of system technology and consist of core technologies such as numerous materials, parts, equipment, and application software. quantum science

Among the core technologies, domestic technologies that can be secured as unrivaled global technologies are selected and supported first. Secured key technologies

Based on this, we support the establishment of core capabilities and systems that can always respond to global supply chain issues in the quantum industry. Monitoring relevant international discussion trends and strategic international discussions to enable timely response to the impact of the international export control system on domestic research and industry We are building a cooperation system.

Promote industrial cooperation to become part of the global supply chain.

In the early stages of the formation of the quantum industry, when active industrial participation begins, we strengthen mutual cooperation with countries around the world and encourage the participation of Korean industries. Actively encourage. We promote various strategic projects so that domestic industries can participate in international cooperation and demonstrate leadership in quantum science and technology and the overall industry, while discovering business models and supporting them to occupy a strategic position at the time of forming a global supply chain.

< (Left) A conversation with a quantum scholar on the occasion of a visit to the ETH Zurich, Switzerland (January 19, 2023), (Right) A joint statement on Korea-US bilateral science and technology cooperation (April 25, 2023) >

< (Left) Korea-US Quantum Round Table (May 17, 2023), (Right) Quantum Korea 2023 held (June 26-29, 2023) >

sustainable

07 Establishment of support system

Quantum science and technology is a game-changing technology that has a significant impact on all areas of society, including industry, national security, and international diplomacy. So far, Korea's quantum science and technology research has been focused on basic research in the early stages of technology, but recently, the need and urgency to secure it as a national strategic technology is growing. As the dominant technology has not yet been established and the opportunity for technological catch-up is open, we are building a comprehensive support system now so that Korea can stand tall as a global quantum technology and industry center at the time of full-scale commercialization.

There is a need for long-term support from the public and private sectors together.

Enactment of quantum law to lead the second quantum revolution

Comprehensively foster quantum science and technology through the enactment of the "Quantum Science and Technology Development and Industry Promotion Act."

Korea enacts the "Quantum Science and Technology Development and Industry Promotion Act," the world's second quantum law after the United States. This law governs quantum technology and Establishment of strategies to intensively foster the industry, development of technology, promotion of commercialization, training of human resources, establishment of research bases and clusters, international cooperation, etc. It contains a support system to comprehensively foster the ecosystem. Once this law is enacted, our country will focus on quantum science and technology based on it.

A system will be established to present the original direction, division of roles between ministries, and support plans, and to check and feedback the results of their implementation.

* The United States enacted the National Quantum Initiative Act in December 2018

Strengthening national bilateral governance

Strengthen the policy coordination function related to quantum science technology and industry across ministries.

As a comprehensive planning tower for quantum science and technology, we will operate the "Quantum Technology Special Committee" and expand and strengthen the public-private joint committee to strengthen the pan-ministerial policy coordination function in the future. The committee deliberates and coordinates major policies and development strategies in the bilateral field, including investment, human resources, specialized infrastructure, and industrialization support, and discusses cooperation and role division between various entities. In addition, quantum science is used in all industrial, public, and defense fields.

We will strengthen policies for the utilization and diffusion of technology and strengthen the institutional foundation to prepare for the transition to the quantum industrial era. In addition, strategic support is supported by adding expertise to the quantum science and technology administrative system, such as the introduction of a national bilateral PM system and the designation of a national technology strategy center in the quantum field.

* Currently, the "Quantum Technology Special Committee" under the National Science and Technology Advisory Council consists of a total of 21 members, including private experts from industry, academia, and research and members from 6 government ministries. (Chairman: Director of Science and Technology Innovation Division, Ministry of Science and ICT)" in operation

We foster research institutes in the field of quantum science and technology to accumulate long-term and stable technology and secure excellent human resources.

Quantum science and technology to secure independent quantum science and technology capabilities and to secure technologies that need to be secured at the national level at an early stage.

We will promote the development of research institutions. We foster an open research hub that connects various research entities such as universities, research institutes, and companies conducting quantum-related research.

Based on this, we provide human resources, research facilities, and institutional support so that research and development in the field of quantum science and technology, which is challenging and has a large impact, can be

carried out quickly and systematically.

We promote strengthening public-private cooperation by activating private organizations such as academic societies and councils in the bilateral field.

Quantum science and technology-related academic societies, associations, and councils will take the lead in revitalizing the private sector-led research and industrial ecosystem. We promote information exchange, human resource

exchange, and cooperative research through active networking between various entities such as companies, universities, and research institutes.

Expanding strategic investment in quantum science and technology

We will build a strategic quantum science and technology investment base and invest 3 trillion won jointly with the public and private sectors by 2035.

In Korea, the field of quantum science and technology, which was treated as a basic research field, started with KRW 10.6 billion in 2019 when a dedicated project was established, and will grow by 2023.

It expanded more than 9 times to 96.8 billion won. To strengthen investment strategy, the government announced the 'Quantum Technology Research and Development Investment Strategy' in 2021 and prepared the 'Quantum

Science and Technology Strategy Roadmap' the following year. Through this, based on analysis of technology maturity, domestic technology level, industrial and security ripple effects, etc., a technology roadmap for 15 detailed

fields in quantum computers, quantum communication, and quantum sensors and 41 material, component, and equipment technologies to support them are developed. presented.

The quantum field is a field where technological evolution is occurring rapidly, with the dominant technology that will influence the market at the time of future commercialization not yet certain and various candidate technologies

competing. Reflecting this, the government plans to invest through periodic redesign of the strategic roadmap.

Ensure that strategy is maintained. Recently, interest in the development and use of quantum science technology in the private sector has increased significantly around the world.

In Korea as well, companies are seeking to secure human resources and increasing investment, and the number of start-ups is also on the rise. this atmosphere

The government and the private sector will jointly invest more than 3 trillion won in the field of quantum science and technology by 2035 to advance the development of quantum science and technology and

Prepare for the transition to the economy.

We promote strategic, mission-oriented, large-scale research and development.

Moving away from small-scale research focused on element technology, the public and private sectors will work together on large-scale integrated research and development projects according to the strategic roadmap. ÿquantum

Localization of computer systems and cloud services, ÿquantum Internet verification and commercialization, ÿnew market with four quantum sensors that break the limits of classical sensors

By assigning a clear national mission such as creation and promoting mission-oriented research and development that unites industry, academia, and research centers around this,

Leading the quantum jump in quantum science and technology in Korea.

Related ministries

Hosting department

과학기술정보통신부

Participating ministries

교육부 외교부 대한민국 국방부 산업통상자원부 중소벤처기업부 국가정보원 방위사업청

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Korea's vision of quantum science and technology

Opening the quantum age

Our challenges and strategies