

A background image for the 'Energy' section featuring glowing orange and yellow light trails and particles, suggesting energy or a dynamic system.

Energy

A background image for the 'Digital' section showing a blue digital space with falling binary code (0s and 1s) and a glowing green horizontal line.

Digital

A background image for the 'Space' section depicting a cosmic scene with a bright, colorful nebula or galaxy in shades of blue, purple, and pink.

Space

A background image for the 'Risk' section showing a night-time cityscape with many illuminated buildings, with the Tokyo Tower prominently visible in the center.

Risk

A background image for the 'Wildlife' section featuring a green, textured sphere resembling a virus or a cell, surrounded by other similar but blurred spheres.

Wildlife



Organization for
Transformation CONNECT

Headquarters for International Industry-University Collaboration University of Tsukuba

Organization for Transformation CONNECT

Leveraging the University of Tsukuba's strengths and distinctive characteristics in cutting-edge fields, the Transformation Connect Organization promotes collaborative partnerships with domestic and international educational and research institutions, companies, and other entities in areas such as research, human resource development, and industry-academia collaboration.

Its objective is to enhance the diversity and excellence of research in these advanced fields and integrate the results into education, thereby developing the university into a world-class hub for education and research in these areas.

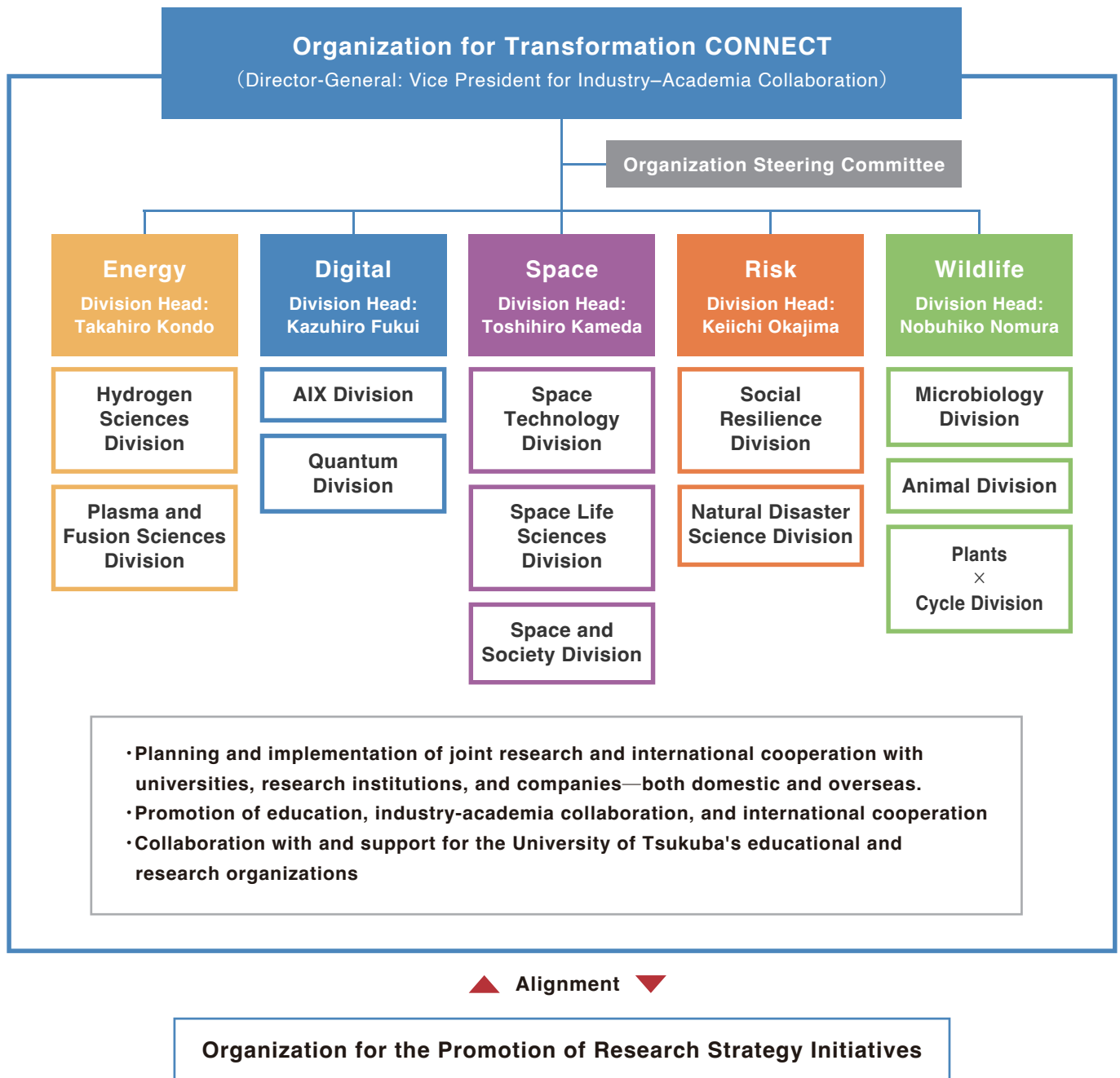


Director, Transformation Connect Organization, University of Tsukuba
Vice President (Industry-Academia Collaboration), University of Tsukuba
Yasushi Nakauchi

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体制図



Hydrogen Sciences Division

Realizing a Zero-CO₂ Emission Society through Innovative Materials for Efficient Hydrogen Production, Storage, and Utilization

The Hydrogen Sciences Division aims to establish a strategic research platform for realizing a zero-CO₂ emission society through innovative materials that enable efficient hydrogen production, storage, transportation, and utilization. We integrate the entire hydrogen value chain—from hydrogen production to storage, transportation, and utilization—to accelerate high-efficiency energy conversion and practical implementation. Particular emphasis is placed on developing high-performance electrode catalysts based on earth-abundant, non-precious elements to realize sustainable and cost-effective hydrogen production and fuel cell technologies. In addition, we will develop next-generation hydrogen storage materials that combine high volumetric hydrogen density with excellent safety, thereby advancing hydrogen transportation and supply infrastructure. By integrating diverse energy systems and promoting industrial and mobility applications, the division will serve as an international hub for collaborative research and become a global center leading the realization of the hydrogen society.

Overview and Mission

Hydrogen Production

- High-efficiency water electrolysis using **non-precious, earth-abundant catalysts**
- Maximization of catalytic performance through **electrode interface engineering and nanostructure control**
- Development of hydrogen production processes integrated with renewable energy



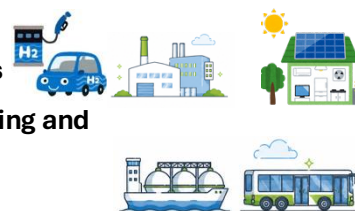
Hydrogen Storage & Transportation

- Development of **high-density hydrogen storage materials**, including boil-off suppression technologies
- Materials design emphasizing **safety, reversibility, and durability**
- System integration technologies compatible with hydrogen transportation and supply infrastructure



Hydrogen Utilization

- Fuel cell technologies based on **non-precious, earth-abundant catalysts**
- Maximization of reaction efficiency through **electrode interface engineering and nanostructure control**
- Applications to **mobility and distributed energy systems**



Organization & Members

Hydrogen Production	Hydrogen Storage & Transportation	Hydrogen Utilization
Yoshikazu Ito	Takahiro Kondo	Kenji Suzuki
Takashi Suemasu	Susumu Okada	Keiichi Okajima
Kaoru Toko	Eiji Nishibori	Hirohisa Aki
Takeaki Sakurai	Mina Maruyama	Yutaro Akimoto
Minoru Otani	Osamu Oki	
Masaya Fujioka	Koji Sakaki (collaborator)	
Ken Sakaushi (collaborator)		

Mission

- Lead the realization of a zero-CO₂ emission society through innovative materials research integrating hydrogen production, storage, and utilization.
- Develop high-performance materials based on earth-abundant, non-precious elements to achieve efficient and cost-effective hydrogen energy technologies.
- Establish a world-leading international research hub to optimize the entire hydrogen supply chain.

Plasma and Fusion Sciences Division

Advancing plasma science and contributing to the creation of a sustainable world through fusion energy development and reactive plasma application

This Area will focus on fusion energy development to address common challenges facing humanity, namely, securing sustainable energy and reducing greenhouse gases (GHG) emissions, while also pursuing research on carbon-negative plasma chemistry and plasma agriculture to harness plasma reactivity.

By jointly using the world's largest tandem-mirror device, which achieved an ion temperature of 100 million degrees (required for a $D-T$ thermonuclear fusion reactor at the end of the 20th century), and a high-magnetic-field linear device based on superconducting coils, this Area will pursue higher-density plasmas, deepen our understanding of the physical behavior of $D-T$ thermonuclear fusion reactor divertors, develop millimeter-wave and radio-frequency plasma heating methods for ultrahigh temperatures, and develop advanced plasma diagnostic methods, thereby leading the realization of fusion power generation.

Additionally, this Area will pursue interdisciplinary research by leveraging insights into plasma reactivity gained through our on-going research, with the aim of becoming one of the world's core centers for comprehensive plasma and fusion science.

Area Overview and Mission

World's Largest Tandem-Mirror Device



High-Magnetic-Field Linear Plasma Device



High-Power Gyrotron for Electron Heating

Research on Fusion Energy Development

- ✓ Taking advantage of the unique capabilities of the world's largest linear plasma device, this Area will conduct experimental, theoretical, and simulation research on divertors for $D-T$ thermonuclear fusion reactors and on advanced fusion.
- ✓ This Area will develop plasma-heating methods for increasing plasma temperatures to those required for fusion reactions and advanced plasma diagnostic methods for measuring plasmas at temperatures exceeding 100 million degrees.

Deepening and Advancing Research Using Advanced Devices

Expanding Interdisciplinary Research Based on Accumulated Insights

Applied Research Using Plasma Technology

- ✓ This Area will develop carbon-negative chemical-synthesis methods using low-temperature plasma technology and insights gained from fusion energy development.
- ✓ Using near-atmospheric-pressure, thermally non-equilibrium plasmas, this Area will promote crop growth and yield and establish the underlying scientific principles.

Mission

- Fusion Energy Development to Address Global Energy and Global Warming Challenges
- Pioneer Advanced Plasma Chemistry and Plasma Agriculture by Harnessing Plasma Reactivity

Area Members (Research Fields)

Haruhiko Himura (Plasma Physics; Plasma Applications)
 Mizuki Sakamoto (Divertors; Plasma-Wall Interactions)
 Masayuki Yoshikawa (Advanced Plasma Diagnostics)
 Naomichi Ezumi (Plasma Sources; Divertor Development)
 Ryutaro Minami (Millimeter-Wave Plasmas; Electron Heating in Plasmas)
 Mafumi Hirata (Radio-Frequency Plasmas; Ion Heating in Plasmas)
 Junko Kohagura (Advanced Plasma Diagnostics)
 Tomoharu Numakura (Plasma Physics)
 Satoshi Togo (Theory and Simulation)
 Dogyun Hwangbo (Plasma-Material Interactions)

Selected Recent Research Topics

MEXT Project for the Development of Infrastructure for a Fusion DEMO Reactor (QST-Commissioned Research)
 "Investigation of a Steady-State High-Density Plasma Experimental Device" (FY2024 and FY2025)

Special Joint Research Program (Kyoto Fusioneering Ltd.)
 "Joint Research Program on Gyrotron Performance Enhancement" (FY2024–FY2026)

Program for the Formation of Joint Usage/Research Systems (FY2025–)
 Program for the Formation of Interdisciplinary Frontier Hubs
 "Interdisciplinary Frontier Hub for Low-Temperature Plasma Science and Genetics to Enhance Global Resilience"

AIX Division

We empower researchers across all disciplines to harness artificial intelligence (AI), accelerate scientific discovery, and advance research excellence, while supporting the human-centered translation of research outcomes into societal impact.

We are building a shared, AI-driven research foundation that connects and transforms disciplines across the university, including the humanities and social sciences. Through our AI for Science program, SPReAD, we bring together AI researchers and domain experts, support exploratory and interdisciplinary research, and strengthen partnerships with leading universities and industry partners worldwide. Our goal is to establish a globally recognized hub for AIX research and innovation.

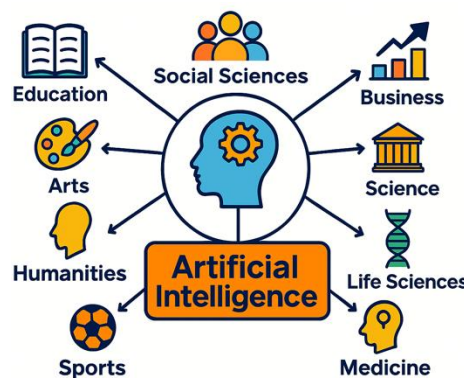
Overview and Mission

Catalyzing the Growth of the AIX Ecosystem

- ✓ Catalyzing the Growth of the AIX Ecosystem
- ✓ Accelerating the Development of AIX
- ✓ Driving the Growth of AIX
- ✓ Advancing the Frontiers of AIX
- ✓ A Catalyst for AIX Innovation and Growth

Industry Collaboration

- ✓ Amazon and NVIDIA
- ✓ NEC, Toshiba, and KIOXIA
- ✓ New AI research facility



Strengthening University-Wide Collaboration

- ✓ Collaborating with the ABI (Artificial Brain & Intelligence) Center to advance foundational research in Science for AI
- ✓ Strengthening coordination across centers

International Collaboration

Advisors

- ✓ Prof. Roberto Cipolla (University of Cambridge)
- ✓ Prof. Atsuto Maki (KTH)
- ✓ Dr. Katsushi Ikeuchi (Microsoft Research)

Computing Infrastructure

Comprehensive support for both on-campus and external computing resources

Members

C-AIR

Director: Kazuhiro Fukui
Executive Research Director: Tetsuya Sakurai

Mission

Build and advance a shared AI research infrastructure that connects and transforms all academic disciplines, including the humanities and social sciences. Facilitate cross-disciplinary collaboration and support exploratory, seed-stage projects that generate novel ideas and future breakthroughs. Establish a world-leading international hub for AIX research and innovation, inspired by the MIT Media Lab model.

Quantum Division

Beyond Computation: Quantum Software Meets Quantum-HPC

In the "quantum" division, we will advance cutting-edge research in quantum software, quantum-enabled scientific applications, and the integration of quantum computing with supercomputing (Quantum-HPC). Through a university-wide interdisciplinary research framework, we aim to establish a globally competitive next-generation computing infrastructure. In particular, we seek to establish a new computing paradigm that seamlessly integrates quantum computing and supercomputing, to systematize quantum algorithms and quantum software, and ultimately to realize quantum advantage and accelerate the deployment of quantum technologies in real-world applications.

Through close collaboration with the research institutes and industrial partners located in Tsukuba-city, we will promote fundamental research on quantum technologies and Quantum-HPC, as well as their applications to frontier scientific domains including materials science, chemistry, and information science. Furthermore, we will establish methodologies for effectively utilizing quantum computing to advance scientific discovery and address societal challenges. By doing so, we will build a continuous research and innovation ecosystem that spans fundamental research, technology transfer, and industrial deployment, thereby establishing ourselves as a world-leading international research hub.

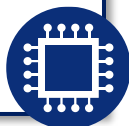
In addition, we will foster the next generation of researchers and engineers who possess interdisciplinary expertise spanning quantum information science, computational science, and supercomputing. By cultivating an active research and technical community capable of integrating these disciplines, we aim to nurture globally competitive talent that will lead future advances in quantum computing and Quantum-HPC.

Overview and Mission of the Area

Quantum-HPC

We will advance computational capabilities by integrating supercomputers and quantum computers, and by developing efficient methods for their combined use.

**Beyond
Computational
Limits**



Quantum-Software

We will advance quantum algorithms for high-performance computation and establish secure cryptographic technologies resilient to future quantum computing threats.

**Quantum Execution &
Critical Information
Infrastructure
Protection**



Quantum Application

We will advance scientific discovery through quantum computing and Quantum-HPC integration, while exploring the potential of quantum information and developing innovative quantum applications for real-world impact. We will push the boundaries of information processing.

**Science and Industrial
Applications: Materials,
Drug Discovery, Finance,
Optimization, and
Demonstration of
Quantum Advantage**



Mission

Enhancing the Quantum-HPC infrastructure

Scientific challenges expected to benefit from quantum computing

Quantum algorithms for noisy and fault-tolerant quantum computers development

Member Faculty

Quantum-HPC R&D

TSUJI Miwako
FUJITA Norihisa
YAMAGUCHI Yoshiki
KOJIMA Takuya
SUGIURA Keisuke

Quantum Software R&D

TAKAHASHI Yasuhiro
KUNIHIO Noboru
MIYAMOTO Masayuki

Quantum Wide Application

SHIGETA Yasuteru
NAKATSUKASA Takashi
TOKURA Yasuhiro
KOIZUMI Hiroyasu
AKIYAMA Shinichiro
SHIKANO Yutaka
IMAI Satoya

From recent research themes



JST Center of Innovation-type Community-led Ecosystem with
Partners (COI-NEXT
「Center of Innovation for Sustainable Quantum AI」



次世代エッジAI半導体研究開発事業

Next-generation Edge AI Semiconductor
Research and Development Project



ASPIRE 先端国際共同研究推進事業
Adopting Sustainable Partnerships for Innovative Research Ecosystem

Development of design framework of
VLSI circuit with advanced process
node

Space Technology Division

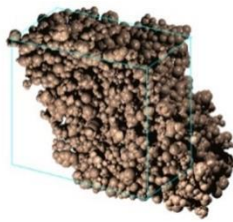
Expanding humanity's space frontier through interdisciplinary science and technology

This group fuses engineering, agriculture, and physical education to expand humanity's frontier, applying new cross-disciplinary technologies to propose innovative systems. Through the Tsukuba Research and Education Organization (tentative)—including a graduate school with JAXA—we actively pursue talent development and joint research.

Overview & Mission

Space Exploration Engineering

Develops the engineering that lets humans enter and operate in space, aiming to accomplish missions in uncharted regions.



Space Sports

Studies how to maintain fitness effectively under microgravity and develops new sports possible only in micro- / low-gravity.



Space Utilization

Creates new achievements using the space environment—from studying microgravity fluid phenomena to producing media art.



Space Agriculture

Researches extraterrestrial crop cultivation to support long-term human stays in space.



Mission

- Construction technologies for lunar development
- Improving living qualities for long-term space activity
- Generating results on post-ISS research platforms
- Food-supply technologies for extraterrestrial environments
- Creating and leading an interdisciplinary space-development engineering field
- Cultivating integrated-engineering talent with a global perspective

Faculty Members

Space Development Eng.
Toshihiro Kameda
Takashi Matsushima
Yu Daimon
Takayasu Fujino
Shigeru Yokota
Seiji Tsutsumi
Atsushi Okamoto
Tadahito Mizutani

Space Utilization
Hiroaki Yano
Hassan Modar
Satoshi Matsumoto
Tatsuki Fushimi
Yoichi Ochiai

Space Sports
Hideyuki Takahashi
Seiji Ono
Takashi Matsui

Space Agriculture
Tofael Ahamed
Mito Kokawa
Naoya Fukuda

Space Life Sciences Division

Unraveling the Plasticity of Life Through Space Research

Building Fundamental Science to Support the Survival of Humanity and Earth's Ecosystems

The **Space Life Sciences Initiative** integrates and expands the life science research jointly developed by the **University of Tsukuba** and **JAXA** through studies aboard the International Space Station (ISS). Centered on the Transformative Research Area "**Life in Space**" and the JAXA flagship project "**Astronaut Digital Twins**," the initiative brings together interdisciplinary research in space biology, artificial hibernation, and space psychiatry, creating an international hub for space life science research.

Using extreme environments - including microgravity, space radiation, and isolated and confined habitats - as experimental platforms, we investigate both the plasticity and the limits of life. The knowledge gained will contribute not only to space exploration but also to terrestrial medicine and solutions to societal challenges. Ultimately, we seek to understand biological adaptation and the sustainability of future civilizations on the Moon and Mars while establishing a globally recognized center for expanding humanity's capacity to thrive beyond Earth.

Overview & Mission

Space Environmental Responses

Building upon discoveries from mouse spaceflight experiments conducted aboard the ISS, we investigate how living organisms respond to environmental factors such as microgravity and space radiation.

Mouse Spaceflight Research



Space Psychiatry

We investigate psychological adaptation and mental health in isolated and confined environments associated with space missions.

Mental Health in Long-Duration Space Missions



Sleep & Hibernation

We study metabolic regulation and artificial hibernation technologies for future space exploration. Our goal is to develop countermeasures against sleep disorders while translating hibernation biology into terrestrial medicine.

Artificial Hibernation for Space Exploration



Predictive Space Medicine

Using multi-omics analyses together with cellular models, we develop personalized approaches for predicting individual health risks during spaceflight.

Precision Medicine in Space



Digital Twins + AI-Integrated Physical Modeling

Mission

- Develop next-generation experimental platforms beyond the ISS
- Lead international collaborations with commercial space stations and lunar/Martian exploration programs
- Establish the scientific foundation of Predictive Space Medicine
- Build standardized data platforms for space life sciences
- Advance life-risk assessment for deep-space exploration

Faculty Members

Space Health Prediction

Masafumi Muratani

Space Environmental Response

Satoru Takahashi

Takashi Kudo

Ryo Fujita

Sleep & Hibernation

Takeshi Sakurai

Yuki Saito

Shingo Seiya

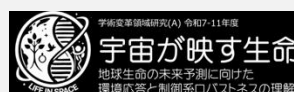
Space Psychiatry

Shinichiro Sasahara

Shotaro Doki

Daisuke Hori

Recent Research Programs



学術変革領域研究(A) (令和5~9年度)
冬眠生物学2.0
能動的低代謝の制御・適応機構の理解

Life in Space

Transformative Research Areas (A)

Understanding the robustness of environmental response and regulatory systems to predict the future of life on Earth.

JAXA Mouse Spaceflight Missions

MHU-1,4,5,8

JAXA Cell-Free Epigenome Mission

Hibernation Biology 2.0

Transformative Research Areas (A)

Mechanisms of torpor and hibernation.

Space and Society Division

This Domain researches advanced applications of satellite data, bringing together researchers from the social sciences, environmental studies, disaster prevention and agriculture to help realize a sustainable society. Governments and private companies in Japan and overseas are launching a wide range of satellites, a trend expected to transform the monitoring of economic, social and global environmental conditions. In particular, satellite data—used until now mainly for Earth observation—is expected to expand into new fields such as economic activity, population movement, urbanization and security. The Domain helps researchers in each field develop innovative applications of satellite data and thereby deepen and accelerate their research. To that end, we promote joint research among researchers and strengthen partnerships with relevant companies in Japan and abroad and with leading universities in Europe and North America.

Domain Overview and Mission

Tsukuba Collaboration

- ✓ Joint study sessions with JAXA's satellite data division
- ✓ Collaboration and joint research proposals with NIED
- ✓ Collaboration and joint research proposals with NIES
- ✓ Study sessions on launching new satellites for social observation

International Partners

- ✓ Joint research with the Univ. of Wisconsin-Madison
- ✓ Joint research proposal submitted with Curtin Univ.

Faculty Members

Prof. Hisahiro Naito (Humanities & Soc. Sci.)
 Prof. Kenichi Kashiwagi (Humanities & Soc. Sci.)
 Prof. Jun Asanuma (Life & Env. Sci.)
 Assoc. Prof. Koichi Ushijima (Eng., Info. & Systems)
 Lecturer Takehiro Morimoto (Life & Env. Sci.)
 Asst. Prof. Fatwa Ramdani (Humanities & Soc. Sci.)
 Asst. Prof. Yohei Kinoshita (Eng., Info. & Systems)



Industry Collaboration

- ✓ Proposing joint research to domestic satellite-launch companies

On-Campus Collaboration

- ✓ Exchange meetings between satellite-data users and technology developers
- ✓ Study sessions to lower the barrier to using satellite data
- ✓ Satellite data × AI research

Mission

- Joint research with companies in Japan and abroad, and joint funding acquisition
- Promoting researcher exchange and supporting exploratory, seed-stage research that takes on new ideas that may become the next seeds and shoots
- Building an international hub in the field of space, satellite data, society and the environment

Social Resilience Division

Enhancing the sustainability and resilience of society as a whole in the face of multiple risks in modern society

This area aims to improve the sustainability and resilience of society as a whole in modern society, which faces complex and interrelated risks such as the intensification of natural disasters, energy challenges that require both sustainability and stable supply, and increasingly sophisticated cyber threats. Social infrastructure such as urban functions, energy supply, and information infrastructure are closely interconnected, and the weakening of any one of them may have a serious impact on society as a whole. In this area, we will organically coordinate the three divisions of "urban disaster prevention and disaster resilience," "energy resilience," and "cyber resilience," and promote interdisciplinary research and practice. Through this, we will seek integrated solutions that go beyond responses confined to individual fields, while also aiming to strengthen response capabilities when crises occur and to enhance preparedness in normal times. In addition, by linking the outcomes of academic research to social implementation and policy proposals, and by advancing the accumulation of knowledge and human resource development through collaboration with related institutions in Japan and overseas, we will contribute to the formation of a global core hub that leads research on social resilience.

Overview and Mission of the Area

Urban Disaster Prevention and Disaster Resilience

Based on urban disaster prevention and mitigation measures and the strengthening of national infrastructure resilience, we will build urban and regional structures that enable the suppression of damage from natural disasters and early recovery.

Cyber Resilience

By cross-functionally linking the "Urban Disaster Prevention and Disaster Resilience" division and the "Energy Resilience" division, we will contribute to building the foundation of a safe and reliable social system through strengthening and advancing the resilience of the information infrastructure that forms the core of social infrastructure.

Enhancing social resilience against complex risks



Energy resilience

Aiming to achieve both sustainability and stable supply, we are working to create a resilience model for energy infrastructure that can maintain and recover its functions from normal times through emergencies.

Mission

- By integrating urban disaster prevention and national infrastructure, sustainable energy, and information resilience infrastructure, we will build an integrated social resilience model and demonstrate its effectiveness through social implementation.
- Form an international research center that leads social resilience research by promoting interdisciplinary research and fostering young researchers and highly specialized professionals.
- Play a central role in contributing to the development of a resilient society on a global scale by expanding research outcomes into policy recommendations, technical guidelines, and other outputs.

Member Faculty

Energy Resilience	OKAJIMA Keiichi
	TAHARA Kiyotaka
	UENO Tsuyoshi
	HIENUKI Shunichi
	AKIMOTO Yutaro
Cyber Resilience	OMOTE Kazumasa
	NISHIDE Takashi
	HOSHIKAWA Naoto
	SHIMAOAKA Masaki
	TAKAHASHI Taisei
Urban Disaster Prevention and Disaster Resilience	UMEMOTO Michitaka
	USUDA Yuichiro
	SAKAI Naoki
	FUJIWARA Hiroyuki
	KINOSHITA Youhei

From recent research themes



Resilience Research and Education Promotion Consortium

Program for Supporting the Creation of Co-Creation Spaces (COI-NEXT)
A 5D-MaaS co-creation hub that realizes a "phase-free ultra-flexible society"

Natural Disaster Science Division

Understanding the mechanisms of natural hazards and advancing science for a more resilient society.

We study natural phenomena related to earthquakes, volcanic eruptions, tsunamis, climate and environmental change, the water cycle, and sediment dynamics to understand the processes that cause natural disasters. By integrating geoscientific observations, big-data analysis, and numerical simulations, we seek to clarify their mechanisms, occurrence conditions, and variability. Through collaboration across the three research groups, we promote interdisciplinary research and share our findings with society, contributing to scientific progress and strengthening the foundation for disaster prevention, mitigation, and rational disaster response.

Overview and Mission

Earthquakes, Volcanoes, and Tsunamis

We investigate the mechanisms of earthquakes, volcanic eruptions, and tsunamis by developing original methods to rapidly and accurately characterize complex earthquake rupture processes and by applying insights from petrology and sedimentology.

Through this research, we aim to strengthen the scientific foundation of hazard research, communicate our findings promptly to society, and contribute to disaster prevention and mitigation.

Climate and Environmental Change

We investigate the mechanisms driving climate and environmental change, carbon cycling, and ecosystem dynamics. Our research addresses monsoons, the East Asian rainy season, extreme weather, and the future evolution and predictability of extreme events. By integrating insights from exceptionally warm periods in Earth's history, we also contribute to long-term projections of environmental change under continued global warming.

Water Cycle and Sediment Dynamics

We investigate natural phenomena related to the water cycle and sediment dynamics, with the aim of understanding their underlying. We examine processes from precipitation, groundwater, and river runoff to slope failures and sediment transport across multiple spatial and temporal scales, integrating hydrology, geomorphology, and erosion and sediment control engineering to clarify watershed responses and strengthen the scientific foundation for disaster prevention and mitigation.

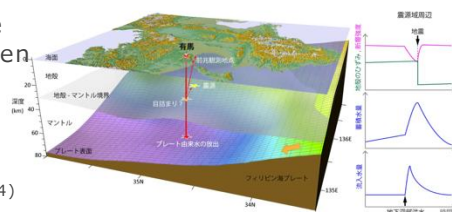
Mission

Understanding the mechanisms of natural hazards and advancing science for a more resilient society.

Promoting Interdisciplinary Research

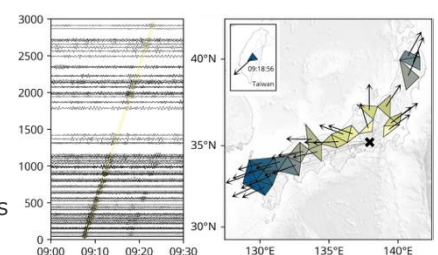
Understanding the relationship between deep fluids and earthquake generation

(Yamanaka & Adachi, 2024)



Using seismic waveforms to investigate sediment dynamics and identify landslides

(Okuwaki et al., 2021)



Members

Earthquakes, Volcanoes, and Tsunamis

Yuji Yagi
Kei Ikehata
Ryo Okuwaki
Shigehiro Fujino

Climate and Environmental Change

Hiroaki Ueda
Yoichi Kamae
Irina Melnikova
Hironao Matsumoto

Water Cycle and Sediment Dynamics

Taro Uchida
Takashi Matsushima
Yamanaka, Tsutomu
Tsuyoshi Hattanji
Yosuke Yamakawa

Selected Recent Research Topics

JSPS KAKENHI Grant-in-Aid for Scientific Research (B)

- Linked reverse-fault ruptures along the Sea of Japan coast
- Regional recurrence of Nankai Trough megathrust earthquakes
- Non-earthquake seismic sources and waveform noise
- Early Cretaceous global cooling driven by large-scale volcanism
- High-resolution water isotope data and water-cycle analysis across Japan
- Rainwater storage and drainage in accretionary-complex mountains

JSPS KAKENHI for Transformative Research Areas (A)

"Wild Climate" and Humanity's Past, Present, and Future"

- Climate reconstruction of the past 2,000 years using climate models

Microbiology Division

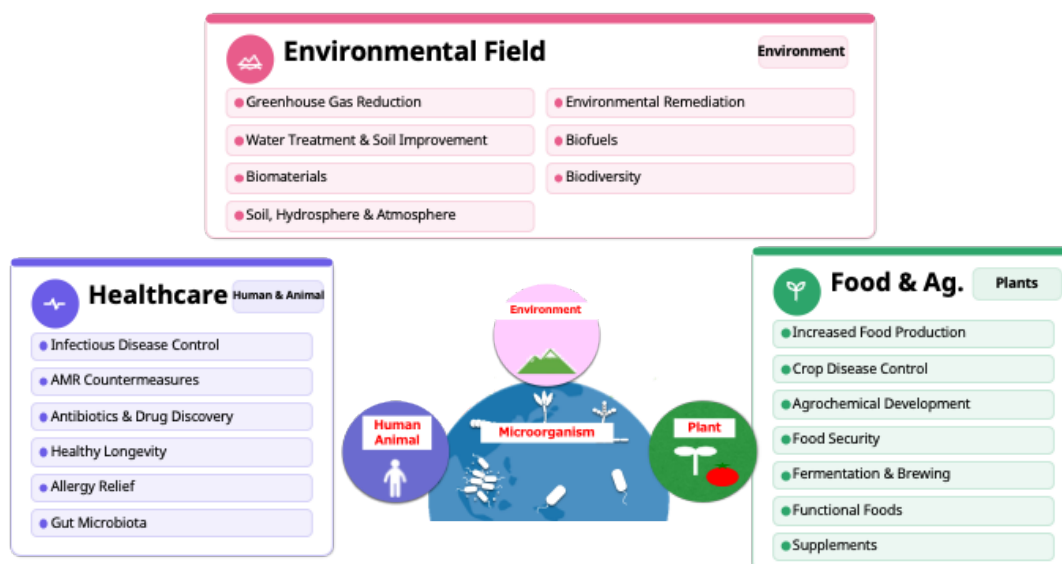
Advancing Microbial Research Across Disciplines—from Fundamentals to Applications—for a Sustainable Future

This research area focuses on microorganisms, which are deeply intertwined with the global environment and all life on Earth. By advancing cutting-edge research spanning both fundamental and applied science, we seek to deepen our understanding of microorganisms, drive the development of innovative technologies for their control and utilization, and contribute to solving a wide range of global challenges and building a sustainable society.

We also make our facilities, technologies, and expertise widely available to the broader community through open research facilities and consortia. In doing so, we support microbial research and foster the development of the next generation of researchers and professionals. Furthermore, by strengthening collaboration with research centers and institutions in Japan and around the world, we aim to serve as a hub that connects diverse fields of microbial research.

Overview and Mission

- Microorganisms play vital roles in humans, animals, plants, and the cycling of materials throughout the environment.
- By understanding, controlling, and harnessing microorganisms, we aim to address a wide range of societal and global challenges.



- We make our research facilities and technologies widely available to the research community, supporting microbial research while fostering the next generation of researchers and professionals.

Open Facilities Bio x AI



Photon Quantum microscopy Bio x Quantum



Biomanufacturing



Member

Area Director:
Nobuhiko Nomura
MiCS Faculty Members: 34

Recent Research



Grant-in-Aid for Scientific Research
(S): 1, (A): 2, (B): 7



Consortium Established



革新的GX技術創出事業

2



1



先進的カーボンニュートラル技術開発

2



創発的研究支援事業

4



日ASEAN 科学技術・イノベーション協定連携事業

1



1

Animal Division

Decoding the Laws of Life and Death

– Creating a Future of Planetary Symbiosis and Human Biological Transcendence

Life has spun an eternal history spanning approximately four billion years. Yet, if we focus on the individual, each lifespan is fleeting and strictly limited. Why, then, does life strive to live its finite time to the absolute fullest, despite inherently containing its own death? To approach this fundamental question, we shine a light on the unique individuality and behaviors of a diverse range of animals living in the wild.

Guided by Tinbergen's Four Questions [1], we seek a multi-layered understanding of animals' "drive to live" and aim to unravel the underlying laws of life and death. Understanding these rules hidden within the natural world will do more than just redefine the symbiosis between life and the Earth; it will serve as the very foundation for humanity to deeply recognize our own biological constraints—and ultimately create a new future that transcends them.

Overview and Mission of the Research Domain

Marine Animals Group

Unlocking the origins and evolutionary diversity of life through the analysis of marine environments and animal responses

Shunsuke Yaguchi, Ph.D.

Professor, Institute of Life and Environmental Sciences



Origin of life
Evolution

Arthropods Group

Paving the way for agriculture, ecosystem services, and biotechnology through understanding animal morphology, ecology, and behavior in response to environmental changes

Tomoyuki Yokoi, Ph.D.

Associate Professor, Institute of Life and Environmental Sciences



Agriculture
Ecosystem
Biotechnology

Vertebrates Group

Applying the behavioral principles and survival strategies of animals in response to environmental changes to innovative medicine, food production, and engineering technologies

Chikafumi Chiba, Ph.D.

Professor, Institute of Life and Environmental Sciences



Medicine
Food
production
Engineering

Structure & Members

Research is conducted by organizing subgroups for each specific project.

■ Marine Animals Group

- Institute of Life and Environmental Sciences: Shunsuke Yaguchi, Keisuke Sakurai, Yasunori Sasakura, Daichi Suzuki, Aoi Tsuyuki, Hiroaki Nakano, Ben Harvey, Yoshiaki Morino, Hiroshi Wada

■ Arthropods Group

- Institute of Life and Environmental Sciences: Tomoyuki Yokoi, Kazuharu Ohashi, Kazumu Kuramitsu, Keisuke Sakurai, Yukie Sato, Kyoichi Sawamura, Masaki Takenaka, Yosuke Degawa, Mari Fujita, Seiichi Furukawa, Shota Masumoto, Shigeru Matsuyama, Kensuke Yahata
- Tsukuba Advanced Research Alliance (TARA) / Life Science Center for Survival Dynamics: Yuko Shimada, Ryusuke Niwa, Shunta Yorimoto
- Institute of Human Sciences: Yoko Yamamoto

■ Vertebrates Group

- Institute of Life and Environmental Sciences: Takashi Kamijo, Masaki Takenaka, Yoshiaki Tsuda, Masanao Honda
- Institute of Art and Design: Kiyoto Sawada
- Institute of Systems and Information Engineering: Ikkyu Aihara, Takayuki Niizato

[Newt x Mammal Subgroup]

- Institute of Life and Environmental Sciences: Chikafumi Chiba, Martin Miguel Casco-Robles, Keisuke Sakurai, Shota Shiga, Fumiaki Maruo, Kensuke Yahata
- Institute of Medicine: Shinichi Fukuda, Ryo Fujita
- University of Tsukuba Hospital: Kuniharu Tasaki

Newt x Mammal Subgroup

R&D aimed at controlling self-regeneration, fibrosis, cancer, and lifespan (aging), as well as developing food production technologies, all based on the fundamental principles of newt regeneration.

Organ regeneration
driven by novel concepts



[1] Tinbergen's Four Questions:

Four analytical perspectives proposed by ethologist Nikolaas Tinbergen, essential for understanding biological phenomena. They comprise: how a reaction or behavior is triggered (**Mechanism/Causation**), when and through what developmental process it is formed (**Ontogeny/Development**), what meaning or function it holds for the individual (**Adaptive Value/Function**), and why that behavior was selected through the process of evolution (**Phylogeny/Evolution**).

Nikolaas Tinbergen, On aims and methods of Ethology. *Zeitschrift für Tierpsychologie* 20(4),410-433, 1963.

Plants X Cycle Division

Toward a Sustainable Circular Society

Building a sustainable circular society requires the effective use of the diverse functions and capabilities of plants. To achieve this goal, it is essential to explore not only well-studied model species but also the rich diversity of non-model and previously unexplored plants. Leveraging the University of Tsukuba's strengths in cutting-edge research on wildlife and non-model organisms, we seek to uncover the unique functions and capabilities of a wide range of plant species. Through these efforts, we aim to contribute to the realization of a sustainable, safe, and resilient circular society for the future.

Overview

We aim to establish a carbon-regenerative society that supports both human well-being and climate change mitigation by harnessing the power of photosynthetic organisms, including terrestrial plants, macroalgae, and microalgae (phytoplankton). Beyond converting carbon dioxide (CO₂) into valuable products through carbon transformation, we promote the conversion and long-term storage of naturally released organic compounds as recalcitrant organic matter, creating durable carbon sinks. Through this integrated approach, we seek to regenerate carbon while advancing a sustainable and prosperous society.

Regenerative Carbon



Circular Forest

Sustainable Circular Society

Plants, the photosynthetic foundation of life on Earth, sustain the global cycles of water, oxygen, and nutrients that support all living organisms. We seek to uncover the scientific mechanisms underlying these life-supporting cycles and make the value of food resources visible through science. By integrating advanced gene function analysis with field-based research, we elucidate the mechanisms that enable plants to thrive under environmental change and develop resilient plant varieties. Through these efforts, we aim to establish sustainable food production systems that enhance human well-being.

Forests are essential infrastructure for a sustainable society. We aim to make the values and functions of forest ecosystems visible through science, from the soil environment to the diverse communities of organisms they support. Based on this knowledge, we design and implement management strategies that enhance forest value while preventing ecosystem degradation. We also investigate how forest ecosystems respond to increasingly severe environmental change and envision the forests of the future through science-based prediction.

Everlasting Food

Mission

- We lead research to uncover the ecology of diverse wild plants and their roles in natural ecosystems.
- By discovering plant functions with the potential to benefit future society, we create innovations that contribute to building a sustainable circular society.

Members

- **Circular Forest**
Mitsuru Hirota, Maki Asano, Shota Masumoto, Kenlo Nasahara, Keiko Yamaji, Ken-ichiro Ishida, Takashi Kamijo
- **Regenerative Carbon**
Yoshiaki Maeda, Yuko Omori, Natsuko Kinoshita, Akiko Nakagawa, Yoshihisa Hirakawa, Iwane Suzuki, Sosaku Ichikawa, Ken-ichiro Ishida
- **Everlasting Food**
Kenji Miura, Naoya Fukuda, Takuya Suzuki, Hiroshi Shiba, Miyako Kusano, Chiaki Matsukura, Satoko Nonaka, Yosuke Yoshioka, Ning Wang

Recent Press Release



Uncovered the molecular evolution of the master factor regulating the root nodule symbiosis between plants and nitrogen-fixing bacteria



Succeeded to develop tomatoes with high sugar content, high GABA, and high vitamin C through genome editing



Discovery of a eukaryotic genome rich in "introns", non-coding DNA sequences



Ethanol spraying improves tomatoes' heat tolerance and sugar content



Revealed the differences in scaling relationships between individual respiration and weight in woody and herbaceous plants



Established a method to increase the expression level of recombinant proteins in lettuce



Organization for
Transformation CONNECT

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