Attached Table 2 Research Outline of Research Areas Showed on Attached Table 1

When applying for Publicly Offered Research, the applicant should note the following points.

- Research period is 2 years (Application of research period other than this period is not subject to screening).

- The Principal Investigator cannot set up a team of project members together with a Co-Investigator. (However, Research Collaborator is allowed to participate in research project when necessary.)

- Please be aware that the maximum application amount listed is not the total amount for the research period (two years) but the amount equal to a single fiscal year.

- Please note that in principle, the allotted amount is in units of 100,000 yen.

- It is possible to apply and receive grants for up to 2 projects in Transformative Research Areas (A) (Publicly Offered Research) at the same time.
  For example, in case that grants have been received for 1 project continuation of which will be in FY2027 in Transformative Research Areas (A) (Publicly Offered Research), it is possible to apply for only 1 project in Transformative Research Areas (A) (Publicly Offered Research) for FY2027.

- Please refer to the website of each research area for the details of application contents.

Research Outline of Research Areas

The past, present, and future of "misbehaving climate" and humans
https://www.ritsumei.ac.jp/research/abbarel/

Number of Research Area	:	24A101	Term of Project :	FY2024-2028
Head Investigator	:	NAKAGAWA Takeshi		
Research Institution	:	Research Centre for Palaeoclimatology, Ritsumeikan University		

1. Details of Research Area

Climate has three dynamic modes. The first is gradual climate change, such as so-called global warming. The second is extreme events, such as rare episodes of intense rainfall. The third is a state in which the climate becomes persistently unstable, and events that were formerly rare begin to occur frequently: in other words, a "misbehaving climate".

This Research Area focuses on this third mode, the "misbehaving climate". The IPCC, the United Nations and other bodies have reported that climate instability and the increasing frequency of disasters associated with global warming have already caused, or are expected to cause, human impacts on the scale of several million people over the coming decades, as well as economic losses amounting to hundreds of trillions of yen. Recognising this situation as a serious threat, this Research Area will undertake comprehensive and empirical investigations across the boundaries of the humanities and sciences into the realities and mechanisms of a "misbehaving climate", its impacts on past civilisations and contemporary society, and the adaptation strategies that may be available in the future.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Chronology Group (A01) invites a broad range of proposals concerning the development of new dating techniques, including positive-ion mass spectrometry for radiocarbon dating (PIMS), as well as studies that actively apply such techniques to chronological research in palaeoclimatology and archaeology. We particularly welcome research that pursues the high temporal resolution and chronological precision required to elucidate a "misbehaving climate". For projects involving technical development, we would also like to provide opportunities to use the PIMS instrument.

Palaeoclimate Group (A02) invites proposals for studies that reconstruct the patterns and frequency of terrestrial disasters, such as wildfires and floods, by analysing existing varved sediment samples, including those from Lake Suigetsu. Varved sediment samples will be provided. To properly assess the impact of disasters on human history, data density high enough to detect "human timescales" of several years to several decades is required. We therefore welcome applications from researchers who are willing to take on this challenging task.

Japanese Archaeology Group (B01) invites archaeological research proposals that use data on climate change recorded in varved sediments from Lake Suigetsu and other archives, as well as data on volcanic disasters and related phenomena, to examine whether correlations existed between environmental change and human activities during any period from the Palaeolithic to the Yayoi period. We particularly welcome studies that seek to clarify the relationships between human activity and major environmental transitions, including the Last Glacial Maximum, rapid post-glacial warming, and cooling following the Jomon marine transgression.

Maya Archaeology and History Group (B02) invites proposals for research in archaeology, history and cultural anthropology that extend the perspective of a "misbehaving climate" beyond the Maya region to other parts of Mesoamerica. For studies requiring substantial expenses, such as excavation projects, the upper limit for applications is 3 million yen per fiscal year. For other studies, the upper limit is 2 million yen per fiscal year.

We welcome research topics that contribute to a diachronic environmental history of civilisation in Mesoamerica, with a focus on archaeology, public archaeology, environmental archaeology, zooarchaeology, archaeological science, historical studies of the colonial, modern or contemporary periods, and cultural anthropology concerning contemporary Indigenous cultures.

Climate Modelling Group (C01) invites proposals for studies that, based on palaeoclimate model intercomparison frameworks such as PMIP, conduct comparative analyses of climate simulation experiments for the past 2,000 years and examine the spatial extent, synchronicity and causal factors of the "misbehaving climate" reconstructed from varved sediments. We welcome research that quantitatively evaluates the contributions of external forcing and internal variability through comparisons between proxy data and model outputs.

Impacts and Adaptation Group (C02) invites proposals in two areas. The first concerns studies that examine the possibility of implementing adaptation measures for a "misbehaving climate" through policy-science analyses of disaster prevention and mitigation measures, as well as land-use policies, in the event that an era of climatic instability returns. The second concerns studies that investigate the psychological foundations of human responses to water-disaster risks caused by a "misbehaving climate", including adaptation efforts and evacuation behaviour.

We welcome research projects that will collaborate with planned research groups and other publicly offered research projects, and that will actively communicate policy-relevant recommendations to society.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Development of high-precision dating techniques for investigating a "misbehaving climate"	8	4
A02	Reconstruction of disaster frequency and landscape change on land using varved sediments	2.5	4
B01	Comparison between climate change and human activities from the Palaeolithic to the Jomon and Yayoi periods		
C02	Policy-science research on land use and disaster response in an era of "misbehaving climate"		
B02	Collaboration with archaeology, history and cultural anthropology in Mesoamerica	3 (excavation-related projects) 2 (other projects)	1 2
C01	Model intercomparison of climate simulation experiments for the past 2,000 years	4	2
C02	Changes in risk perception regarding water disasters caused by a "misbehaving climate"	7.5	2

Research Outline of Research Areas

Materia-Mind: Constructing a New Human Historical Science of the Co-creation of Material and Mind
https://materiamind.ridc.okayama-u.ac.jp

Number of Research Area	:	24A102	Term of Project : FY2024-2028
Head Investigator	:	MATSUMOTO Naoko	
Research Institution	:	Research Institute for the Dynamics of Civilizations, Okayama University	

1. Details of Research Area

A crucial key to human evolution, the formation of civilization, and our future is the co-creative relationship between humans and objects. This Research Area will attempt to elucidate the mechanisms of the intertwining of environmental construction by humans and changes in human cognition, body, and behavior through trans-disciplinary collaborative research that transcends the boundaries of the humanities and sciences, based on quantitative, experimental, and advanced analysis using archaeological data spanning tens of thousands of years. By conceptualizing the state of things as "*materia*" as sensed and experienced by people, we will create a new Research Area that goes beyond the dualism that separates matter and mind in order to focus on materiality as the mother of the mind. From the perspective of the formation of the "*materia-mind*," we will clarify how the major shift in cognitive abilities prompted the construction of complex societies or civilizations, a phenomenon unique to humans, pursue the limits and possibilities of human cognitive abilities, and propose a new model for an integrated understanding of where humanity came from and where it is going.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

We aim to achieve the integration of related fields essential to elucidate the mutually constructed relationship between material, mind, and body and to create a new view of human beings, culture, and history. We seek empirical and theoretical research that complements and reinforces the following research groups and introduces new perspectives. A01: Case studies and innovative theoretical and methodological research centered on archaeology, anthropology, and other humanities and social science fields on the relationship between "technological innovation," "dynamics in arts and social complexity," and related "cognitive processes" in human history. The geographic area of study is not restricted. A02: Archaeology, natural geography, cultural anthropology, history, and other related areas that focus on ecological and social changes interconnected with natural disasters, migration, technological innovation, and cross-cultural contact. B01: Research on the relationship between the transformation of natural ecological environments and cultural landscapes and human activities and their historical changes, using GIS and remote sensing, etc.; research on the cognitive structures of people living in local societies and their transformations through ethnographic research. B02: Cognitive scientific research that explores the causal relationship between creative artifacts, songs, music, and other artistic expression and environment, cognition, and individual characteristics (cognitive archaeology, cross-cultural comparison, developmental and animal studies, statistical causal modeling research, etc.). C01: Genetic, neurophysiological, cognitive, and behavioral studies in humans and non-human animals on the interaction between genes and the social environment. Studies that contribute to the construction of theoretical models are also welcome.C02: Research on innovative analytical methods related to 3D data or the construction of evolutionary models based on 3D data. Publicly Offered Research will be assigned to the most closely related Research Group, but we also encourage active collaboration and joint research with other Research Groups.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Mutual Construction of Objects and Humans: Empirical and Theoretical Study of the Materia-Mind (Material & Mind Group)	1.5	4
A02	Diachronic Studies of Entanglement and Enchainment between Environment and Humans through Interdisciplinary Fieldworks across the Pan-Pacific (Human & Environment Group)	2	8
B01	Elucidation of the "Cultural Evolution" Mechanism of Cognitive Behaviors in Human History through Ethnographic Studies (Behavior & System Group)	3	2
B02	Collaboration between Cognitive Science and Human History to Elucidate the Process of Creative Artifact Creation (Art & Emotion Group)	4.3	3
C01	Construction of a Materiamind Evolution Model Integrating Life Science and Material Cultural Studies (Genes & Culture group)		
C02	Exploring Cultural Evolutionary Dynamics via Multi-Dimentional Representation and Modeling of Archaeological and Anthropological Data (Representation & Modeling Group)		

Research Outline of Research Areas

Ion Jamology: Materials design transformation by understanding non-equilibrium and collective ion flow
http://ion-jamology.jp

Number of Research Area	:	24A201	Term of Project :	FY2024-2028
Head Investigator	:	HITOSUGI Taro		
Research Institution	:	The University of Tokyo		

1. Details of Research Area

Ion jamology reveals the collective motion of ions in solids and develops new materials. In this Research Area, researchers in **materials science and mathematical science collaborate to establish material design guidelines for controlling the flow of ions.** Furthermore, we aim to advance mathematical sciences by tackling new challenges in modeling theories. We are developing high-performance batteries, catalytic materials, and hydrogen storage materials that will contribute to a carbon-neutral society.

We focus on jamology, which exemplifies the application of mathematical science. We employ mathematical models for particle interactions, such as the asymmetric simple exclusion process (ASEP) and cellular automata. We also apply principles of non-equilibrium statistical physics, e.g., jamming transitions, to gain insights into materials and promote the application of mathematical science to a wide range of fields in materials science. The initial step involves integrating this knowledge with research on batteries, catalytic materials, and hydrogen storage materials.

We are advancing three projects to foster this interdisciplinary research. We aim to promote mutual understanding of Planned Research A01, A02, and A03 through these projects.

1. Collective flow of ions (micro to mesoscale)
2. Pathway networks (meso and macroscale)
3. Overall optimization (connecting micro to macroscale)

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

- Researchers pursuing experimental research are *not* necessarily required to incorporate mathematical sciences at the application stage. We expect proposals that elucidate issues involving the collective motion of ions in fields such as batteries, ionics, catalysis, and hydrogen storage. Finally, we seek research topics that will contribute to establishing ion jamology through modeling and quantitative verification.
- Researchers in the mathematical sciences are encouraged to explain the relationship between mathematics and ionic flow in ways that are understandable to experimentalists. Research proposals based on materials simulations are also welcome.

We look forward to receiving the following proposals.

A01・Computation and Mathematics: Research on applying mathematical sciences, represented by materials simulation, graph theory/discrete geometry, statistical machine learning, stochastic processes, etc. We strongly hope for many applications from mathematical scientists interested in materials science.

B01・Materials Synthesis: (a) Synthesis of model materials to obtain precise physical properties and structural information, (b) Development of batteries, solid catalysts, and hydrogen storage materials using new synthesis methods, (c) Development of composite materials by controlling hierarchical structures such as bulk, surfaces, and interfaces.

Advanced Measurements: Measure collective ionic motion in solid ionic conductors, battery materials, catalysts, and hydrogen storage materials. For instance, (d) Development of *operando* measurement techniques for clarifying ionic, electronic, and lattice interactions, (e) Advanced measurements to complement planned research, (f) Development of measurement and analysis infrastructures.

We expect proposals that actively promote joint research. We also welcome applications from young researchers enthusiastic about exploring new fields.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Mathematical and computational simulation analysis for the construction of ion jamology	1.8	6
B01	Creation of new materials and development of new functions based on ion jamology (Including advanced measurements)	4	11

Research Outline of Research Areas

Integrated Science of Synthesis by Chemical Structure Reprogramming
https://srep.kuchem.kyoto-u.ac.jp/

Number of Research Area	:	24A202	Term of Project :	FY2024-2028
Head Investigator	:	TOBISU Mamoru		
Research Institution	:	Osaka University, Graduate School of Engineering		

1. Details of Research Area

This research area aims to pioneer the innovative concept of **Chemical Structure Reprogramming (SReP)** as a new paradigm-shifting approach to crafting intricate substances. SReP is defined as methodological framework facilitating the modification of molecular architectures by substitution, insertion, or elimination of atom(s) on demand. The implementation of SReP holds promise of streamlining the synthesis of diverse chemical structures, which circumvents the tedious processes of traditional synthesis, and unlocks avenues to previously inaccessible molecular configurations. Within this research domain, we aim to advance and refine SReP methodologies through interdisciplinary collaboration spanning organic chemistry, inorganic chemistry, polymer chemistry, and supramolecular chemistry.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

This research area seeks to forge a SReP methodology by fostering collaborative endeavors among researchers specializing in diverse domains: organic chemistry (A01), inorganic chemistry (A02), macromolecular chemistry (A03), and physical chemistry (A04). To reshape the landscape of synthetic science without the constraints of conventional academic boundaries, we invite publicly offered research from multifaceted backgrounds. We invite proposals that offer clear and specific insights into the synthetic methodologies and their innovative contributions to the SReP of target substances. We encourage applicants to propose the distinctive synthetic methods and to elucidate their novelty. Furthermore, recognizing the transformative potential of collaborative synergy, we urge researchers to include feasible collaboration avenues with peers in related fields.

The objective of **Group A01** is to pioneer SReP methodologies tailored to organic molecules. We invite proposals aimed at innovating new reactions that challenge the confines of conventional organic synthesis. These may include skeletal editing via elimination, insertion, or substitution of atom(s), isomerization and rearrangement of molecular skeleton, epimerization independent of thermodynamics, isotope labeling of molecular skeleton, among others. We welcome diverse approaches to realizing the SReP method, which spans homogeneous or heterogeneous catalysis, photochemical reactions, electrochemical reactions, and beyond.

Group A02 is dedicated to advancing SReP methodologies tailored to inorganic materials, encompassing metal complexes, metal clusters/nanoparticles, and oxide clusters. We seek proposals that confront the longstanding challenge of precisely controlling metal species, geometric arrangements, and nucleus numbers, which would enable post-synthesis editing of inorganic materials. We particularly encourage proposals exploring SReP methods grounded in molecular chemical approaches, which are poised for collaboration with Group A01.

Group A03 is tasked with pioneering SReP methodologies tailored to a diverse array of macromolecular groups, spanning proteins, nucleic acids, sugars, biopolymers, synthetic polymers, coordination polymers, supramolecules, and two-dimensional layered materials. While conventional methods like the click reaction enable modification of macromolecules at their terminal site and their side chains, we invite proposals focused on substructural transformations of the macromolecular backbone itself—a challenge often elusive to traditional approaches.

Group A04 serves as a catalyst for the advancement of SReP within Groups A01-A03, leveraging cutting-edge measurement techniques, analyses, and simulations. We encourage proposals aimed at unraveling the intricate chemical structures and reaction mechanisms of newly developed SReP methods through the application of innovative physicochemical methods. This includes but is not limited to, time-resolved spectroscopic measurements (e.g., XAFS), large-scale quantum chemical calculations, high-resolution TEM imaging, advanced measurements (e.g., STM), and catalyst design utilizing informatics.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Organic Chemistry Group	2.5	11
A02	Inorganic Chemistry Group		8
A03	Macromolecular Chemistry Group		5
A04	Physical Chemistry Group		4

Research Outline of Research Areas

Habitable Japan: Sustainability of atmospheric and oceanic environment as a survival basis of island country Japan
http://hotspot3.aori.u-tokyo.ac.jp/en/

Number of Research Area : 24A203 Term of Project : FY2024-2028
Head Investigator : OKA Eitarou
Research Institution : Atmosphere and Ocean Research Institute, The University of Tokyo

1. Details of Research Area

Under global warming, in the region surrounding Japan where the ocean warms at twice the global average rate, the Kuroshio large meander and marine heat waves (MHWs) persist long, extreme heat/rainfall and typhoons are intensifying, and marine ecosystems are changing. Will mild climate and abundant water/fisheries resources persist as a basis of survival for those of us living in Japan in the future? To address this question, using state-of-the-art observations and numerical modeling, we will elucidate variations and changes of atmospheric/oceanic (A/O) circulation near Japan that can be sustained through local processes involving interactions of the surrounding ocean/land, but also through remote impacts coming from the tropics and from the Arctic, unveil their influence on extreme/abnormal weather, marine ecosystems, and fisheries resources, and explore the predictability. We will also clarify the impact of A/O variations near Japan on climate over the North Pacific and over the globe. We will further refine processes of heat/material exchanges between the atmosphere and the ocean across the sea surface and biological production/decomposition at the ocean surface. Through these efforts, we will create integrated A/O science and build a foundation for future predictions and projections.

Research Group A01 clarifies variations/changes of ocean currents around Japan and their impact on coastal MHWs and marine ecosystems (A01-1). We have conducted shipboard observations in the Japan Sea (Jan. 2026) and in the North Pacific off the Sanriku coast (Jun.-Jul. 2025 & 2026) and in the East China Sea southwest of Kyushu (Jun.-Jul. 2026) to clarify the influence of oceanic fronts and MHWs on atmospheric circulation, rainfall, and marine ecosystems (A01-1/A01-2). We will also be clarifying the mechanism sustaining large-scale A/O heat and cold waves around the East Asia and the North Pacific (A01-3). Research Group A02 will deploy profiling floats around the Kuroshio Extension to clarify biological production/decomposition (A02-4). We are also conducting continuous observations at land stations on both the Japan Sea and Pacific sides to clarify the influence of aerosol particles generated from wave spray on heat/material exchanges across the sea surface (A02-5). We will additionally be creating a new data assimilation method that overcomes many discontinuities in the A/O fields to reproduce A-O-marine ecosystems coupling processes in the models (A02-6). Research Group A03 will evaluate the predictability of extreme oceanic events such as the Kuroshio large meander and MHWs, and clarify their impact on fisheries resources (A03-7). We will also take on prediction of monsoon modulating under global warming and that of extreme weather such as heavy rainfall/snowfall inherent in monsoon (A03-8). We will also further clarify variability and future change of mid-latitude climate that interact with the tropics and polar regions from a global perspective (A03-9).

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Publicly Offered Research projects in this Research Area are expected to share the above question with Planned Research projects (A01-1 ~ A03-9), to conduct research in cooperation with one or more of them, and to complement and expand their research, thereby enriching research of the whole Research Area. Preferred themes include 1. Study to clarify mechanisms and make predictions regarding the impact of coastal to global oceanic variations/changes on marine ecosystems including fisheries resources, 2. Study on the influence of large-scale A/O variations on local weather such as the Fehn, the Yamase winds, and urban weather, 3. Study on the impact of meso- to large-scale oceanic variability on local marine environments such as coastal areas and islands, 4. Study on interaction between mid-latitude oceanic/tropospheric variations and stratospheric variations, 5. Study on rainfall over the ocean using satellite, shipboard, and float observations, 6. Observation sharing platforms with Planned Research projects to deepen understanding of basic processes, and 7. Data analysis, parameter estimation, and prediction for the atmosphere and the ocean using data assimilation and machine learning.

To apply results from this Research Area to society, we welcome studies regarding a survival basis on land that is not the direct target of Planned Research projects: 8. Study on the impact of A/O variations and changes on terrestrial resources and needs of human society (hydrology, terrestrial ecosystems, agriculture, health, energy, societal systems, etc.) and its prediction.

We seek to recruit 16 Publicly Offered Research projects. Four projects of up to 6M yen/year will be assumed to conduct observations. (The other 12 projects of up to 2.5M yen/year may also conduct observations.) Applications from early-career and female scientists are strongly encouraged.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Understanding of mid-latitude A/O variability under global warming	6 2.5	4 12
A02	Development of new methods and identification of basic processes		
A03	Prediction and sustainability evaluation of mid-latitude A/O variability		

Research Outline of Research Areas

Chimera Quasiparticles for Novel Condensed-Matter Science
https://chimera-qp.ee.es.osaka-u.ac.jp/en/

Number of Research Area	:	24A204	Term of Project :	FY2024-2028
Head Investigator	:	MURAKAMI Shuichi		
Research Institution	:	Department of Applied Physics, the University of Tokyo		

1. Details of Research Area

The discovery of various "quasiparticles" (quantum mechanical entities that behave like particles in matter) is one of the most important achievements in condensed matter physics, which has enabled us to understand complex physical phenomena in terms of a small number of quasiparticles. Phenomena related to crystal vibration, light, magnetism, polarization, and plasma can be described by phonons, photons, magnons, polaritons, and plasmons, respectively. If we can create a new species by combining various quasiparticles, we can freely realize desired physical properties and functions, which will bring about new developments in materials science. However, in most cases, quasiparticles behave independently due to differences in time and space scales. In this Research Area, we will create "chimeras" (hybrids) by "chemical reactions" between quasiparticles that have been studied independently, by introducing various schemes such as artificial structures, material design, and symmetry design, and clarify physical properties and functions of chimera quasiparticles. This will revolutionize the basis of physical properties research and form a new foundation for the realization of highly functional electronic, optical, quantum, and energy devices. The goal of this research field is to establish chimera quasiparticle science. Chimera quasiparticle science will drastically increase the number of combinations of quasiparticles, and enable the transfer of the properties of a single quasiparticle to another quasiparticle and the response of different physical quantities to an external field (cross response), which will enable discoveries and proposals of new physical phenomena that cannot occur with a single quasiparticle.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

We are widely inviting research plans that contribute to the construction of chimera quasiparticle science as Publicly Offered Research. We ask that research plans include an explanation of how the plan will contribute to the objectives of the Research Area. We will not limit our research to the fields of the Planned Research, but will call for proposals from a wide range of fields. The main fields of research that are envisioned are: condensed matter physics, materials engineering, electrical and electronic engineering, nano-micro science, applied physical properties, applied physical engineering, physical chemistry, organic chemistry, polymer organic materials, inorganic materials science, information science, information engineering, and many more. We aim to broaden the scope of this research area through collaboration among different fields.
In addition, we welcome challenging proposals based on novel and original ideas. We also actively invite research that is complementary to the Planned Research, that promotes collaboration between research groups, and that spans multiple research groups. We also hope that active exchanges and discussions with researchers in the Research Area during the research period will lead to new research ideas that were not anticipated even at the time of application.
The Planned Research in this research area consists of five Research Groups listed below, and the Publicly Offered Research will belong to one of these five groups. However, this does not limit the content of the Publicly Offered Research. If it is difficult to decide which research item number your proposal belongs to, please tentatively specify one of the research item numbers.
Group A01: Propose a new theory of chimera quasiparticles, and provide interpretations and proposals to experiments.
Group B01: Explore the possibility of metamaterials as reaction fields for the generation of chimera quasiparticles.
Group B02: Investigate physics of chimera quasiparticles, in particular transport properties and kinetics.
Group B03: Conduct chimera quasiparticle science utilizing the properties of molecules and interfaces in molecular science.
Group C01: Elucidate the functionality of chimera quasiparticles from the viewpoint of electronics applications.
We call for experimental research with a larger budget (up to 3 million yen per year), as well as small-scale experimental, theoretical, and preparatory research based on new and original ideas with a small budget (up to 2 million yen per year).

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Chimera Quasiparticles: Theory	3	11
B01	Chimera Quasiparticles: Architecture	2	11
B02	Chimera Quasiparticles: Physics		
B03	Chimera Quasiparticles: Molecular Science		
C01	Chimera Quasiparticles: Electronics		

Research Outline of Research Areas

Investigation on the Origin and Evolution of Matter in the Universe by Extremely Rare Events: Frontire of Creating a New Insight on the Matte in the Universe

https://www.lowbg.org/ugrp/

Number of Research Area : 24A205 Term of Project : FY2024-2028
Head Investigator : KISHIMOTO Yasuhiro
Research Institution : Research Center for Neutrino Science, Tohoku University

1. Details of Research Area

The Universe has evolved from the high-temperature, high-density fireball state immediately after its birth into its present form. In this evolving Universe, the origin of matter and subsequent evolution remain unknown. In particular, we still do not know the answers to the following questions: "Why has antimatter disappeared while matter remains?", "What is dark matter, which is about five times more abundant than the ordinally matter?", "How were heavy elements that did not exist in the early Universe crated and diffused?" Thus, the origin of nearly all matter around us remains unsolved.

In this research area, we aim to clarify these fundamental mysteries by searching for extremely rare events with the world's highest sensitivity, such as neutrinoless double beta-decay, direct searches for dark matter, and supernova neutrino observations. By addressing these questions, we seek to obtain new insights into matter itself, which we often take for granted, and to establish a new perspective on matter.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

The goal of this research area is to conduct research into fundamental mysteries of cosmic matter, such as "matter creation in the early universe", "light neutrino mass", "dark matter", "the synthesis and diffusion of elements", "supernova explosions", and "supernova neutrinos". At the same time, we integrate these mysteries into a consistent understanding throughout the history of the universe. Toward this goal, based on a common foundation of technologies to detect extremely rare events without missing them (extremely rare event technology), we will experimentally and theoretically promote studies on the Majorana nature of neutrinos, dark matter searches, and neutrino observations from supernovae and astronomical objects, and construct theoretical models and cosmological frameworks that serve as the background to these studies.

At the same time, we will build a solid foundation for future research by deepening and developing extremely rare event technologies for measuring extremely rare events, with a focus on ultra-low radioactivity techniques. In this research area, the introduction of technologies from related research fields and the broader applications of rare event technologies into other research area are also being pursued: for example, incorporation with research in the field of Earh and Environmental science into D01. In this broad sense, we also welcome research fields related to the mysteries of matter in the Universe.

For the research items listed below, we expect proposals that promote collaboration with each planned research project, strengthen collaboration among the planned research projects, and address research not covered in the planned research.

Specifically, we welcome:

(1) experimental research utilizing existing extremely rare event technologies (e.g., ultra-low radioactivity environments and high-sensitivity technologies),
(2) exploratory development and research aimed at expanding and developing extremely rare event technologies,
(3) experimental and theoretical research, including machine learning, to improve the accuracy of relevant physical quantities and model calculations,
(4) development and research aimed at collaboration with and application to neighboring fields, and
(5) research aimed at developing theoretical studies and promoting cross-disciplinary and field expansion.

A representative of the relevant planned research project will be assigned as a contact person for each accepted Publicly Offered Research proposal. We expect active applications from researchers who are motivated to further promote the field through active discussions and joint research within the area. In the case of research that encompasses multiple research items, the most closely related research item should be selected.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Probing the origin of matter particles by a large liquid scintillator detector	Large-scale experimental and theoretical studies5.0 Experimental studies, relatively large theoretical studies3.5 Theoretical studies, small-scale experimental studies1.5	3 8 16
A02	Development of high-sensitive detector system for double beta decay measurements		
B01	Opening the Frontier in the Search for Dark Matter Axions with High Magnetic Field, Microwave, and Superconductivity Technologies		
B02	Exploring the nature of dark matter with the large liquid xenon detector		
B03	Direction Sensitive Dark Matter Search with High Precision Tracking Detector		
C01	Opening the Frontier of the Rare Event Universe by Universal Supernova Neutrino Detector		
D01	Deployment of Ultra-Low Radioactivity Technology		
E01	Theoretical research to elucidate the origin of matter and the evolution of the universe		
E02	Theoretical study of supernova neutrinos using all neutrino flavors		

Research Outline of Research Areas

Plasma-driven Seed Memory Operation: Frontiers in Molecular Dynamics in Seeds driven by Plasma
https://plasma-seed-science.plasma.ed.kyushu-u.ac.jp/en/

Number of Research Area	:	24A206	Term of Project : FY2024-2028
Head Investigator	:	KOGA Kazunori	
Research Institution	:	Kyushu University, Faculty of Information Science and Electrical Engineering	

1. Details of Research Area

Plants have difficulty moving from where they are rooted, so they have a high adaptive capacity to environmental shift. They are stored as a memory in the DNA modification of seeds and passed on to the next generation. When parental generations are stressed by elevated temperatures, it results in the deterioration of seed quality. Low-temperature plasma converts external electrical energy into electron kinetic energy, producing light, ions, and chemically active molecules (reactive species) through electron collision with atoms/molecules. It has attracted much attention because of its ability to irradiate reactive species at high flux without damage. So far, we have found that three minutes of air plasma irradiation to seeds can recover the damage caused by high temperature through alteration in the DNA methylation that turns gene expression on and off. These results suggest that plasma irradiation for a short time scale can selectively modify memories stored in seeds.

To clarify this mechanism, three research groups were set up: A01 'plasma', A02 'seeds', and A03 'omics'. We will build physical and chemical reaction network models to elucidate the molecular mechanism of DNA modification induced by plasma irradiation. The established field of "plasma seed science" aims to manipulate the plant memories that underlie seeds through plasma treatment.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

The following describes the research groups and expectations for the publicly offered research established in plasma seed science.

[A01 'Plasma' Group: Science for the selective generation of reactive species]

Research group A01 'Plasma' aims to improve reproducibility in plasma irradiation of seeds and to realize selective irradiation of active species and localized irradiation to seeds. To achieve this objective, it is essential to understand the physics and chemistry of complex molecular gas discharges. The publicly offered research is expected to contribute to understanding the reactions and transport of reactive species in gas phase from low pressure to atmospheric pressure, to creating new principles for controlling reactive species synthesis, to developing diagnostics and modeling to clarify phenomena in gas phase and interface, and data science approaches to realize reactive species generation and control biological activity.

[A02 'Seed' Group: Science for delivering reactive species inside seeds]

Research group A02 'seeds' aims to understand and control plasma-driven molecular transport from the seed husk to the cytoplasm through the cell wall and cell membrane. The expected publicly offered research includes model studies supporting molecular transport analysis, as well as the modeling of biomolecular reactions (such as epigenetics and the dynamics of biomolecules involved in germination) together with experimental and biophysical studies that contribute to these models. In addition, research using model plants to deepen understanding of intercellular signaling and molecular transport mechanisms, and novel approaches using animal cells or microorganisms to deepen the knowledge of plants.

[A03 'Omics' Group: Science for applying reactive species to DNA modification]

Research group A03 'omics' aims to create a foundation for seed memory manipulation based on understanding omics variation from DNA modification-related molecular mechanisms to phenotypes caused by plasma irradiation. The expected publicly offered research includes studying transomics related to DNA modifications through chemical reaction network analysis or bioinformatics; research aimed at newly discovering molecular dynamics within plant transomics, where many aspects remain unclear; machine learning that bridges plasma irradiation and omics changes; and studies investigating growth promotion effects induced by plasma irradiation other than those involving DNA modification changes (such as effects under environmental fluctuations or harsh environmental conditions).

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Plasma: Science for the selective generation of reactive species	3.5	25
A02	Seed: Science for delivering reactive species inside seeds		
A03	Omics: Science for applying reactive species to DNA modification		

Research Outline of Research Areas

Generative design to unlock the potential of protein function
https://p-func.kuchem.kyoto-u.ac.jp

Number of Research Area	:	24A207	Term of Project :	FY2024-2028
Head Investigator	:	HAYASHI Shigehiko		
Research Institution	:	Kyoto University, Graduate School of Science		

1. Details of Research Area

We aim at establishing design principles that enable conversion and creation of the molecular functions of proteins in a generative manner. To exploit the high potential of protein molecular functions, a methodology for molecular design of protein functions that follows given requirement definitions of the novel functions will be developed. To this end, more universal physicochemical approaches which are not constrained by evolutionary information are introduced. Namely, the transiently formed functional states that determine molecular functions are directly observed and analyzed by physicochemical approaches, and then the novel functions are designed based on the molecular understanding. A new field of research will be created by integration of theoretical predictions based on molecular simulations and data science, state-of-the-art spatiotemporal measurements such as time-resolved X-ray crystallography and spectroscopy, and creation of protein molecules through biochemistry and protein engineering. The development of novel functional proteins such as biomedical tools and useful enzymes will be demonstrated. Furthermore, the functional design scheme will be applied to artificial de novo proteins that do not exist in nature to endow them with completely novel molecular functions.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

We actively invite research proposals using methods other than the approaches in the Planned Research. Furthermore, while the protein function design in this research area primarily focuses on approaches based on physicochemical molecular models, we also welcome proposals that fall outside this framework, e.g., complementary research proposals employing approaches such as machine learning not based on physicochemical models, or molecular directed evolution experiments. In addition, we welcome proposals for molecular evolution research aimed at functional design, which is essential for establishing the scientific principles of molecular function design. The details of the research for each research item are described below.

[D01: Protein function analysis and design led by theoretical and computational sciences]

We invite computational chemistry-based functional analysis and design research using molecular simulations, data-driven research such as functional design through data-assimilated molecular modeling of experimental data or machine learning, and theoretical/experimental research on functional protein design utilizing artificial protein structural design technologies.

[E01: Elucidation and design of functional states through protein structural and functional analysis experiments]

We invite research on the development and application of time-resolved protein structural analysis experiments using XFEL and other techniques to elucidate functional states, e.g., research on spatiotemporal dynamics observation using biophysical methods such as spectroscopic measurement, high-speed AFM, NMR, HDX-MS, and single-molecule measurement, and research on functional design through protein structural analysis (X-ray crystallography, cryo-electron microscopy, NMR, etc.). In the research proposals, it is desirable that the strategy is thoroughly considered, not only regarding how the functional states will be elucidated, but also how they will be connected to functional design.

[F01: Experimental research on the creation of significant protein functions]

We invite experimental research on the creation of significant protein functions, e.g., research on chemical genetics, such as the development of designer ligands and protein receptors, functional design through the control of protein-protein interactions, including the analysis and control of intrinsically disordered regions, design of reporters and sensor proteins to observe intracellular state, design of optogenetic tool proteins, and functional design of useful enzymes, including synthetic chemical research such as the development of caged compounds. We also welcome interdisciplinary research proposals combining protein science with synthetic or coordination chemistry, where chemically synthesized, highly functional catalysts or complex molecules are integrated with proteins. In the research proposals, it is desirable that the strategy is thoroughly considered, not only regarding what remarkable functions will be achieved, but also how they will be realized.

Furthermore, we welcome research plan proposals demonstrating high efficiency that ensures work-life balance.

3. Research Group, Upper Limit of Annual Budget and Number of Research Projects Scheduled to be Selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
D01	Analysis and design led by theoretical and computational sciences	3	7
E01	Protein structural and functional analysis experiments	3	6
F01	Experimental creation of significant protein functions	3	9

Research Outline of Research Areas

Manipulating Genomes of Intracellular Symbiotic Organelles: Advancements in Technology, Applications for Fundamental Sciences, and Beyond.

https://www.agr.kyushu-u.ac.jp/cytoplasmicgenomeregulation/

Number of Research Area	:	24A301	Term of Project : FY2024-2028
Head Investigator	:	ARIMURA Shin-ichi	
Research Institution	:	University of Tokyo, Graduate School of Agricultural and Life Sciences	

1. Details of Research Area

Endosymbiotic bacteria and organelles derived from them, such as mitochondria and chloroplasts, possess their own genomes, referred to here as cytoplasmic genomes. These genomes are central to fundamental biological processes, including respiration, cell death, sex determination, and photosynthesis. However, the difficulty of modifying them has long hindered both mechanistic understanding and application. This research area has achieved genome editing and gene introduction in plant organelles and is advancing world-leading technologies in this field. By applying these technologies, we will promote three research programs: A01, development of versatile cytoplasmic genome control technologies across diverse organisms; B01, comprehensive understanding of the molecular basis of cytoplasmic genome maintenance, dynamics, and expression; and B02, elucidation and application of key biological phenomena governed by cytoplasmic genomes. Through these programs, we aim to advance organelle biology across technology, basic science, and application.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

This research area covers organisms with endosymbiotic organelles, namely all eukaryotes, and welcomes proposals from a wide range of species, perspectives, and disciplines. The scope is not limited to mitochondria and chloroplasts, but also includes host–bacterial systems that establish intracellular symbiotic relationships. Publicly offered researchers may receive support from the area's research support teams, including genome editing, gene introduction, single-organelle analysis, physiological measurement of respiratory activity, photosynthetic and respiratory activity measurement, bioinformatics analysis, and protein structural analysis. We expect such support to promote collaborations with planned research groups and to advance interdisciplinary, area-wide research. In Research Program A01, we invite proposals for developing and providing new technologies targeting cytoplasmic genomes. Keywords include "genome editing," "molecular delivery," "gene introduction," "selection," and "mutagenesis." We welcome both proposals that address bottlenecks in genome editing, molecular delivery, and genetic transformation, and those based on entirely new approaches. Research Program B01 promotes basic research on cytoplasmic genome inheritance, including replication, dynamics, segregation, transmission, repair, elimination, expression, and epigenetic regulation of cytoplasmic genomes and nucleoids. We particularly encourage proposals that elucidate mechanisms of cytoplasmic genome maintenance and functional expression in diverse organisms, together with their physiological roles at the organelle, cellular, and whole-organism levels. Keywords include "gene expression," "maternal inheritance," and "heteroplasmy." Research Program B02 covers basic and applied studies on phenotypic traits caused by cytoplasmic genomes and traits with major societal impact. Keywords include "mitochondrial disease," "photosynthesis," "sex differentiation/control," "cytoplasmic male sterility," and "functional enhancement." We welcome proposals aimed at disease understanding and clinical research through mitochondrial genome control, as well as studies contributing to the SDGs through cytoplasmic genome control. Each project will be funded at 3.5 million yen per fiscal year, and approximately 15 projects will be selected in total across A01: Control Technologies, B01: Understanding Inheritance, and B02: Applied Development, without fixed quotas for each category. This research area aims to operate openly in order to maximize interaction and outcomes across the entire group. We therefore seek to provide opportunities to participate in area meetings and related activities whenever possible, regardless of selection as a publicly offered research member. We strongly encourage applications from researchers with diverse backgrounds, including women and early-career researchers. Publicly offered researchers are expected to actively engage in discussions and collaborations with planned research groups toward the shared goal of elucidating key biological phenomena involving cytoplasmic genomes and advancing their applications.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Development of cytoplasmic genome regulation technology	3.5	15
B01	Molecular basis of cytoplasmic genome behavior		
B02	Impact of cytoplasmic genomes on life processes and their applications		

Research Outline of Research Areas

Biological cluster: dynamic assembly and functional properties of supramolecular complexes in cells
https://www.cluster-biology.f.u-tokyo.ac.jp/

Number of Research Area	:	24A302	Term of Project :	FY2024-2028
Head Investigator	:	FUKAGAWA Tatsuo		
Research Institution	:	University of Osaka, Graduate School of Frontier Biosciences		

1. Details of Research Area

I In cells, protein complexes are clustered into a higher order structure called "supramolecular complexes", in the context of various cellular functions. In recent years, with advances in cryo-electron microscopy (EM) techniques, many studies have identified the structures of molecular complexes reconstituted in vitro, but such studies alone have a limitation to understand how complexes function *in cells*. This is because in vitro complexes do not necessarily reflect with in vivo supramolecular complexes functioning in cells. In vitro complexes sometimes make condensates. However, they are often disordered and do not reproduce the organized supramolecular complexes formed in cells. In this Research Area, we define "Biological Clusters" as functional "supramolecular complexes" and aim to clarify their formation mechanisms and functional properties, and to understand how they generate cellular functions. The Planned Research will focus on supramolecular complexes constituting kinetochores, centromeres, chromosomes, and centrosomes, but the Publicly Offered Research will not be limited to these but will cover a wide range of supramolecular complexes formed in cells. The research will be conducted by analyzing the ultrastructure and molecular dynamics of supramolecular complexes, measuring physical quantities, and developing theoretical and computational science. Our goal is to establish a new cellular view of Biological Clusters by clarifying the mechanisms of formation of various Biological Clusters and the relationship between their acquired properties and cellular functions.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Research Group A01 aims to elucidate the molecular basis of various supramolecular complexes, from the structure of their basic units to the regulation of supramolecular complex formation and their cellular functions. The Planned Research will focus on kinetochores, centromeres, chromosomes, and centrosomes, but we welcome research that targets a wide range of important supramolecular complexes, including those involved in transcription, replication, various organelles, and nuclear membrane. Research on supramolecular complexes that function in special environments, such as neurons, aging and stress responses, and diseases, is also eligible.

Research Group A02 focuses on advanced high-precision imaging analysis to visualize the structure of supramolecular complexes and elucidate their properties and molecular dynamics. In addition to cryo-ET (electron tomography) and super-resolution imaging, we encourage technologically advanced research for analyzing supramolecular complexes, such as atomic force microscopy, NMR, crosslinked mass spectrometry, deuterium exchange mass spectrometry, development of probes applicable to fluorescence microscopes and new techniques, and methodologies not envisioned in the Planned Research.

In research Group A03, we will feature physical quantities of supramolecular complexes and conduct mathematical analysis in parallel, to address the functional properties of clusters and the elements involved in their formation. In particular, we envision research that attempts to explain complex formation based on simulations that recapitulate the intracellular environment and research that describes the physical properties of supramolecular complexes. We also welcome research challenging proposals that attempt to demonstrate physical theories that could be applied to cell biology.

Publicly Offered Research proposals are expected to be complementary to the Planned Research and to promote mutually beneficial research through collaborations. Up to 5 million yen per year will be allocated for an experimental research and up to 3 million yen per year for an exploratory research. Theoretical research projects will also be selected, with funding of up to 3 million yen per year.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Elucidation of the molecular basis of Biological Clusters and their relationship to cellular functions	Experimental study: 5 Exploratory experimental or theoretical study: 3	10
A02	Visualization of Biological Clusters and their molecular dynamics		7
A03	Formation and characterization of Biological Clusters by physical and mathematical analysis		

Research Outline of Research Areas

Co-evolutionary emergence of extended phenotypes
http://www.extended-phenotype.org/english/

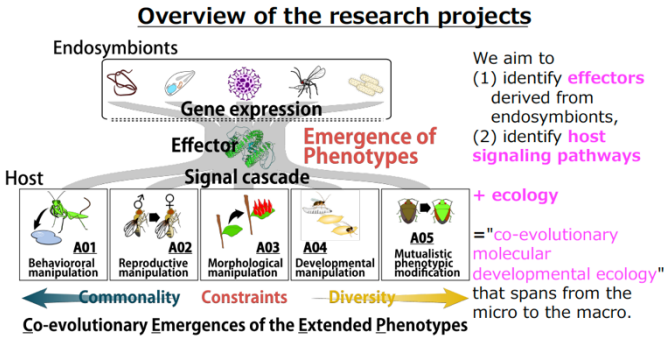
Number of Research Area	:	24A303	Term of Project :	FY2024-2028
Head Investigator	:	KATSUMA Susumu		
Research Institution	:	The University of Tokyo, Graduate School of Agricultural and Life Sciences		

1. Details of Research Area

Conventional biology generally assumes that phenotypes (such as body shape and behavior) of an individual organism are determined by its own genetic information. On the other hand, there are many interesting phenomena in nature in which the genetic information of one organism can manipulate the phenotypes of different organisms. For example, a praying mantis parasitized by a hairworm jumps into the water, or a lepidopteran insect larva infected with a baculovirus climbs to the top of the tree; these are examples of parasites or viruses manipulating the behavior of the host for their benefit. The phenomenon, called "Extended Phenotypes," proposed by Richard Dawkins, should be realized through interactions between the operating and manipulated organisms based on their mutual genetic information across species. However, the molecular mechanisms underlying these phenomena are poorly understood. This Research Area will focus on the molecular mechanisms of "Extended Phenotypes" hidden in the interactions between various organisms. We will elucidate the delicate and diverse mechanisms of phenotypic regulation that are difficult to access through conventional biology. Overall, we aim to establish a new academic field called "co-evolutionary molecular developmental ecology" that spans from the micro to the macro.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

"Extended phenotypes," which are the phenotypes created in another organism by the genetic information of one organism, have been attractive to not only scientists but also the general public, and there have been many reports on this phenomenon for a long time. However, many of these phenomena are observed in non-model organisms that are not amenable to molecular-level research, making it difficult to investigate the molecular mechanisms. In this Research Area on endosymbiont-induced "Extended Phenotypes," we aim to (1) identify effectors derived from endosymbionts, (2) identify host signaling pathways, and (3) elucidate the emergence of novel phenotypes. Research Groups fall into five categories: A01. Behavioral manipulation, A02. Reproductive manipulation, A03. Morphological manipulation, A04. Developmental manipulation, and A05. Mutualistic phenotypic modification. We call for Publicly Offered Research focused on endosymbiont-induced "Extended Phenotypes." You can submit your application to one of the Research Groups most closely related to your research subject. Research proposals to uncover the molecular mechanisms underlying unique biological phenomena via inter-organism interactions are highly welcome, even if the research subject has not yet been approached through molecular biology or biochemical methods. We also invite research proposals beyond experimental biology, including theoretical and mathematical approaches. Administrative Group is equipped to support foundational techniques for research advancement, such as various omics analyses, genome editing, recombinant protein production, and imaging analysis, with a strong emphasis on molecular biology approaches related to inter-organism interactions in non-model organisms. Collaborations with Planned Research are also encouraged.



In this Research Area, all Planned Research and Publicly Offered Research collaborate to advance 'Trans-Scale Biology,' aiming to create a new academic discipline that extends beyond individual organisms and comprehends the diversity of nature beyond the scope of conventional biology. We welcome applications from researchers who share this concept and are willing to promote it alongside Planned Research. Additionally, we enthusiastically encourage proposals from young and female researchers to promote diverse and inclusive science.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Behavioral manipulation	4.5	12
A02	Reproductive manipulation		
A03	Morphological manipulation		
A04	Developmental manipulation		
A05	Mutualistic phenotypic modification		

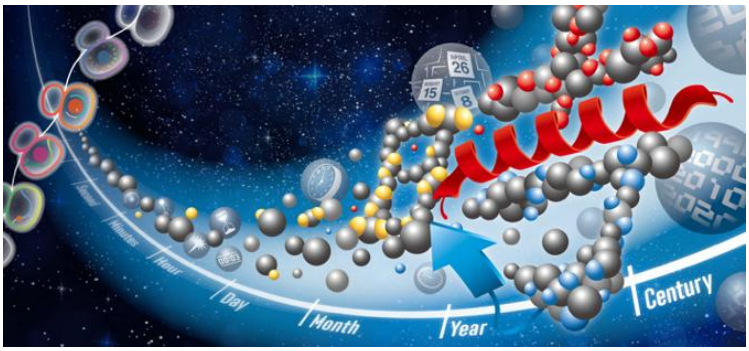
Research Outline of Research Areas

chronoproteinology: Protein Machinery that drives "time" on various time scales
https://chronoproteinology.org

Number of Research Area	:	24A304	Term of Project :	FY2024-2028
Head Investigator	:	YOSHITANE Hikari		
Research Institution	:	Tokyo Metropolitan Institute of Medical Science		

1. Details of Research Area

The two former transformative research areas (B) "Chrono-Proteinology" and "Parametric Translation" have been combined into the transformative research areas (A) "Chrono-Proteinology". Biological rhythms are observed on different ranges of time scales from seconds to years (or centuries), such as the circadian rhythm with a 24-hour cycle, heartbeat, segmentation clock, seasonal response, and bamboo mass flowering. In this research area, we focus on rhythmic phenomena and timer-like mechanisms and aim to elucidate the molecular mechanisms that count the "times" in various processes. Particular attention is paid to protein dynamics, such as physical properties of specific proteins, enzyme activities, protein-protein interactions, post-translational modifications, conformational changes, and translational controls; given that, we have named this research area "Chrono-Proteinology". Researchers working on this topic across diverse species and a wide range of time scales are welcome to join.



2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Research group A01, " Chrono-Proteinology for circadian rhythms", will understand the molecular mechanisms that count the "time" and determine the 24-hour period in the circadian clockwork. We expect applications to explore the autonomous oscillation mechanism that does not depend on transcription and the period-determining mechanism that counts 24 hours in a temperature-compensatory manner.

Group A02, " Chrono-Proteinology for non-24-hours rhythms", will approach "time" on various time scales from seconds to years (or centuries). We look forward to applications not only for the description of biological rhythms and timers, but also for applications that explore the molecular mechanisms that count "time." We also welcome research proposals that span the A01 and A02 areas and focus on the relationship between 24-hour and non-24-hour rhythms.

Group B01, " Technologies for decoding various time scales, aims to develop technologies based on the perspective of "parametric control" developed by Group A03, " Parametric Translation for supporting Chrono-Proteinology". The unique approach of measuring and controlling translation efficiency provides a technical basis for research projects in this area. It is generally accepted that transcription factors and RNA levels determine the amount of protein synthesis. However, recent studies have shown that the protein amount produced from a single copy of RNA is dynamically regulated at the translation level. Considering that clocks counting days and years receive to temporal and seasonal cues from noisy and slowly changing environmental cycles, the translation control can tune the clocks to respond to the cues, as shown by Transformative Research Area (B) "Parametric Translation". We are looking for researchers who will pioneer technologies to decode the "time". The scope of technological development is not limited to quantification and manipulation of translation, but includes imaging techniques, functional analysis of protein structure and properties, information science and mathematical analysis.

Translated with DeepL.com (free version)

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Chrono-Proteinology for circadian rhythms	3.2	8
A02	Chrono-Proteinology for non-24-hours rhythms	3.2	8
B01	Technologies for decoding various time scales	3.2	4

Research Outline of Research Areas

Emergence of brain functions from the dynamic connectome
https://plaza.umin.ac.jp/dynamic-brain/

Number of Research Area	:	24A305	Term of Project :	FY2024-2028
Head Investigator	:	IMAI Takeshi		
Research Institution	:	Kyushu University, Graduate School of Medical Sciences		

1. Details of Research Area

The connectome of the brain is not static but continuously changes during development and learning. Brain functions are achieved as "emergent phenomena" by which the information processing is qualitatively altered as a result of the dynamic changes in the connectome. However, the principles underlying these phenomena remain unknown. In this Research Area, we aim to quantitatively and comprehensively understand the dynamic changes in the connectome and the resulting functional changes at the level of neurons and neural circuits. We then use reconstitutive approaches to understand the principles and mathematical laws behind these changes.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Many studies have focused on the "elementary processes" of structural changes and functional changes in neural circuits. However, it remains unknown how the structural changes of neuronal circuits as a whole lead to functional changes. In this area, we will use high throughput connectomics technologies to elucidate the relationship between dynamic changes in the connectome and the emergent brain functions. Through quantitative, comprehensive, mathematical, and reconstitutive understanding of connectome and brain function data, we aim to understand the principles that govern emergent brain functions. Therefore, we welcome researchers who have conducted research on neural circuit development, synaptic plasticity, and brain function and behavior.

The Publicly Offered Researchs are expected to take advantage of the various platforms and resources provided by the support teams to advance their own research. Proposals for collaborative efforts with and/or complementary approaches to the Planned Research are highly encouraged.

A01 and A02 will experimentally approach the emergent functions in the brain. Research topics will include dynamic changes of the connectome and functions during postnatal development, learning and plasticity, life events (e.g., pregnancy, birth, and rearing), adaptation to disease, aging, stress, etc. Our Research Area also includes systemic neuronal functions (e.g., visceral sensation and autonomic nervous system) and abnormalities found for neurological and psychiatric disorders. We also welcome research using a variety of model organisms other than the mouse. We strongly encourage studies that combine structural and functional changes of the neuronal circuits. We also welcome challenging approaches and technology development aimed at achieving our research goals.

In A03, we aim to reconstitute emergent brain functions based on the concept of "dynamic connectome". In addition to mathematical approaches at neuronal and circuit scales, our Research Area welcomes pioneering approaches incorporating theory, brain-inspired AI studies, and/or cultured systems.

The Publicly Offered Research with a maximum amount of 5 million yen will be awarded to projects that have already obtained results related to the emergent brain functions based on the dynamic connectome based on comprehensive measurement of brain functions, and are expected to make significant progress by joining this Research Area. The maximum amount of 3 million yen will be awarded to projects that are either novel or challenging, such as research that links (dynamic) connectome and emergent brain functions, or research related to technology development.

For the sake of convenience, the call is divided into the following three categories, but proposals that cross over into other categories are also welcome.

A01 aims to understand emergent functions at the neuronal level focusing on the control of synaptic strength and distribution, the regulation of spontaneous neural activity, and dendritic integration. A02 studies emergent functions at the circuit level, focusing on stepwise circuit reorganization in motor learning, spatial learning, and song learning. In A03, we aim to reconstitute the emergent brain functions using neural organoids and simulations.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Emergence of neuronal functions	5	6
A02	Emergence of circuit functions	3	17
A03	Reconstitution of emergent brain functions		

Research Outline of Research Areas

Deciphering the epicode of chromatin, which controls cell fate decisions in organisms
https://www.bioreg.kyushu-u.ac.jp/ext/epicode/home-en/

Number of Research Area	:	24A306	Term of Project :	FY2024-2028
Head Investigator	:	TACHIBANA Makoto		
Research Institution	:	Graduate School of Frontier Biosciences, Osaka University		

1. Details of Research Area

The aim of this research area is to show that the higher-order structure of chromatin, which was defined by multilayered parameters such as histone modifications, 3D arrangement of genomic DNA, and enhancer-promoter interactions, in other words, the "epigenetic code" (epicode), plays a fundamental role in cell fate determination. By this research activity, we would like to change the role of chromatin from the basis of transcription to a medium for cell fate control.

It has been revealed that chromatin, consisting of DNA and histones, is closely involved in the regulation of gene expression. However, how the changes in the higher-order structure of chromatin during organismal development and cell differentiation control stage-specific gene expression and determine cell differentiation direction is still not well understood. Recently, it has been shown that not only nuclear factors such as DNA-binding proteins but also various external factors such as signals from adjacent cells, hormones, and metabolic products dynamically change chromatin structure. However, research elucidating the relationship between cell differentiation and chromatin structure at the organismal level has not progressed sufficiently due to the limitations of analytical techniques.

Therefore, this research area aims to construct new chromatin analysis technology platforms that dramatically improve comprehensiveness and spatiotemporal resolution, such as live imaging of transcription and histone modifications, single-cell and spatial omics. Using these platforms, we will elucidate the roles of chromatin epicodes in various life events throughout life (nutritional environment response, long-term memory and aging, transgenerational information transmission, early embryo fate). By using diverse model organisms such as mice, zebrafish, fruit fly, and fission yeast, we will explore the universality and specificity of epicodes, and connect them to molecular-level structural analysis and mutant creation through *in vitro* reconstitution. This research area aims to open new horizons in life sciences by elucidating the epicodes of chromatin and clarifying the basis of cell fate determination mechanisms.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

We expect participation in publicly offered research focusing on life events beyond the scope of the planned research and new methods of chromatin analysis to accelerate the achievement of our goal. We have already selected mice, zebrafish, fruit fly, and fission yeast as model organisms representing mammals, fish, invertebrates, and the simplest eukaryote with chromatin structure. In publicly offered research, to further explore the universality and specificity of epicodes, we welcome proposals targeting various species beyond these models. To elucidate the epicodes throughout the entire life cycle, we welcome proposals not limited to the life phenomena targeted by the planned research. Research proposals aiming to uncover the mechanisms of disease onset, unique life phenomena specific to certain organisms, or advance cutting-edge chromatin structure analysis techniques are welcome. The publicly offered research also aim to identify and nurture the next generation of researchers who will lead the field of epicode research. In this regard, we particularly welcome innovative and challenging research proposals from young researchers. We also emphasize gender equality and especially welcome applications from female researchers. Specific examples of the expected publicly offered research include: 1) Research on organisms not used in the planned research, such as plants or non-model organisms; 2) Research to decipher the epicodes involved in disease onset; 3) Research focusing on nuclear structures not targeted in the planned research; 4) Development of *in situ* chromatin analysis platforms with improved deep-tissue reach and resolution; 5) Research using AI to analyze diverse layers of chromatin structures; 6) Research using mathematical models to simulate cell fate determination by epicodes; 7) Research developing drugs to manipulate epicodes using natural or synthetic compounds; 8) Research aiming to develop or improve live-cell imaging technologies for epicodes; 9) Research developing innovative methods to introduce epicodes into organisms. These examples are not exhaustive, and we look forward to a wide variety of research proposals.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Decioherting the epicode of chromatin, which controls cell fate decisions in organisms	3.8	15

Research Outline of Research Areas

Multicellular neurobiocomputing: Understanding and advancing towards biological supremacy
https://www.mnbc.riec.tohoku.ac.jp/en/

Number of Research Area	:	24A401	Term of Project : FY2024-2028
Head Investigator	:	YAMAMOTO Hideaki	
Research Institution	:	Tohoku University, Research Institute of Electrical Communication	

1. Details of Research Area

"Biological supremacy" refers to "the ability of a biologically-inspired system to solve a particular problem with learning efficiency, energy efficiency, and adaptability that are difficult to attain with conventional computing." Our brains are composed of bioelements called neurons. Despite their instability, the brain autonomously and adaptively performs advanced computations with high energy efficiency. This property does not manifest in a single cell and cannot be explained by the linear summation of cell properties. Brain functions are generated only when diverse neurons are intricately arranged and wired to form a multicellular network. In this Research Area, we aim to understand the physical substrate of such information processing through experiments on model animals and cultured cells, formulate the observations as mathematical models, and link this information to system applications. Focusing on sensory-motor control, which involves processing sensory inputs and generating time-series signals to control motor outputs, we aim to achieve results that are scientifically universal and technologically impactful.

This Research Area consists of the four Research Groups: Information Science (A01), Bioengineering (A02), Systems Neuroscience (A03), and Hardware Applications (A04). Collaborations between the Groups are organized under the following three domains: (1) Multicellular Modelling, (2) Multicellular Hardware, and (3) Multicellular Wetware. Furthermore, we establish four Shared Platform Centers to accelerate each research and the collaborations between them. Through these efforts, we aim to build a theoretical foundation for information representation and processing in multicellular networks and pursue biological supremacy for future generations of information communication technology.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

The Publicly Offered Research consists of four groups. The first group is the theoretical and data science group, which invites proposals on, for example, neural network models and estimation of functional connectivity dynamics based on data-driven modeling; research on biologically-plausible recurrent neural networks and their learning rules; neural data analysis to understand and model multicellular dynamics, including spontaneous activity; software development for general-purpose simulators and remote biological experiments; and machine learning applications of mathematical models. The second group is the bioengineering group, which invites innovative research proposals related to the manipulation of cultured neurons; brain organoid technology; bioelectronics research for measuring neural activity with high sensitivity and/or ultralow power consumption; and computing and drug discovery applications of cultured neuronal networks. The third group is the biology group, which invites research on novel topics, including physiological studies on synaptic plasticity and neural circuit development as the neural basis of learning in multicellular systems; research on the functional linkage between the neocortex and subcortical regions; research on behavioral control using diverse types of synaptic transmission; and systems-level studies on multisensory integration and sensory-motor control that can also lead to robot control. Research on multicellular neurobiocomputing using model animals such as nematodes, flies, and zebrafish is also invited. The fourth group is the hardware group, which invites wide-ranging research on the implementation of multicellular models on FPGA, ASIC, and analog circuits; device and material research for model implementation; physical reservoir applications; applications to autonomous control of robots; and control of external devices based on neural activity at the cellular level. Finally, research proposals aiming at the realization of biological supremacy that concerns topics other than the abovementioned ones, and those that span multiple items, are also invited.

In all the groups, we expect proposals that lead to collaboration with members of the Planned Research belonging to the same or different Research Groups.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Theory of Multicellular Neurobiocomputing	2.5	5
A02	Multicellular Neurobiocomputing in Artificial Systems	5	14
A03	Multicellular Neurobiocomputing in Biological Systems		
A04	Hardware Applications of Multicellular Neurobiocomputing		

Research Outline of Research Areas

Global Antarctic Science: connecting the chain of changing huge ice sheet and global environments
https://glaces.lowtem.hokudai.ac.jp

Number of Research Area	:	24A402	Term of Project :	FY2024-2028
Head Investigator	:	AOKI Shigeru		
Research Institution	:	Hokkaido University, Institute of Low Temperature Science		

1. Details of Research Area

On-going global warming may locally destabilize the Antarctic ice sheet beyond a critical threshold, causing the global sea level rise beyond a rate previously thought. The disintegration of the Antarctic ice sheet could be the first domino to fall, leading to cascades of global tipping point elements. Conversely, the atmosphere, which has become wetter on a global scale, can increase the amount of snowfall on the Antarctic ice sheet, counteracting the mass loss. The time scales required for the changes in these components are completely different; hundreds to tens of thousands of years for the ice sheets and a few hours to a few years for the atmosphere. The complexity of the interactions among phenomena of such different spatial and temporal scales is a factor that prevents improvements in the future predictions. In this Research Area, we focus on the "short-term" from post-Industrial Revolution and "long-term" from hundreds of thousands of years ago. We elucidate the processes by which Antarctic change and its global cascades are activated in various climatic conditions. By combining innovative observations, sample analysis and numerical simulations, we aim to establish a new Research Area of "Global Antarctic Science" that comprehensively studies the interactions between the Antarctic ice sheet and the global climate system over a wide time range into the near future, thereby contributing to new developments in climate and environmental science.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

In Publicly Offered Research, we welcome proposals that will directly collaborate with the Research Groups of A01-A03. Research Area focuses on the various processes among Antarctic ice sheet and surrounding ocean/sea ice and atmosphere. This includes research on the formation and changes of Antarctic Bottom Water and research on cycles of materials such as nutrients and iron. We welcome research using sample analysis and numerical experiments to investigate the actual state and mechanism of the historical changes in the Antarctic and global environment on the long-term scale.

We also welcome proposals for the following Research Groups of B01-B03, which complement and/or expand on A01-03.
B01: In order to clarify the climate system interaction in the Antarctic region and its global impact, comparative research with the Arctic region is effective. We look forward to research that will clarify the commonality and uniqueness of the interaction process, as well as the mutual influence between the two poles.
B02: We welcome research using satellites remote sensing and new analysis algorithms. We also hope for proposals of new models with isotope, ecosystem, earth system, etc., and laboratory experiment and theoretical research from new perspectives.
B03: Environmental research in Antarctica requires innovative development and application of methods based on new ideas. We hope that the development of in-situ observational methods without constant human instructions and the creation of unprecedented paleoenvironmental indicators will lead to research breakthroughs.

We set two categories of budget: one for theoretical and/or relatively small-scale research and one that requires more costs for equipment, analysis, personnel expenses, etc. We welcome proposals from a wide range of researchers; from experienced researchers in the Antarctic-related research to young researchers who will conduct related research for the first time. For proposals that require observations in the Antarctic region, however, please bear in mind that acceptance or rejection in this Publicly Offered Research does not imply whether they can be implemented in the Japanese Antarctic Research Expedition.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Revealing key processes and multi-sphere interactions driving the present variability of Antarctic Ice Sheet		
A02	Under-ice observations using oceanic autonomous robotic system		
A03	Revealing the variability and interaction of Antarctic Ice Sheet and global climate on long time scales	5	3
B01	Comparative study of the northern- and southern-hemisphere polar regions and oceans	2	14
B02	Various satellite observations, theories, laboratory experiments, and numerical modeling		
B03	Development and application of innovative method and technique		

Research Outline of Research Areas

The Creation of Humanities of Infectious Diseases and Recommendations for the Next Pandemic
https://www.tm.nagasaki-u.ac.jp/hid/

Number of Research Area	:	26A101	Term of Project :	FY2026-2030
Head Investigator	:	IIJIMA Wataru		
Research Institution	:	Nagasaki University		

1. Details of Research Area

This research area aims to prepare for a potential future pandemic through re-examining the relationship between human society and infectious diseases in depth from the perspectives of the humanities. Although the main focus of this area is COVID-19, it also explores other infectious diseases, especially re-emerging infectious diseases and neglected tropical diseases (NTDs). This area also emphasises interdisciplinary collaboration, not only among the humanities but also with public health and the social sciences, to include, broaden, and develop diverse research perspectives and methodologies.

This area has three objectives: (A) to articulate issues that infectious diseases pose to human society and modern civilisation; (B) to establish 'Humanities of Infectious Diseases' as a new research field and build knowledge for a society that 'coexists' with infectious diseases; and (C) to enhance societal resilience and propose acceptable countermeasures. Nine Planned Research projects are currently being conducted within this area: A01–A03, B01–B03, and C01–C03. Please see the website for details.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Each Publicly Offered Research should (1) belong to one of the four Research Groups, (2) contribute at least one of the three objectives of this area, and (3) collaborate with at least one of the nine Planned Research.

D01: Archival and Museological Research on Infectious Diseases

We invite proposals for research that, in collaboration with A01, B01, C01, C03 and others, examines how materials relating to COVID-19 and other infectious diseases are collected, preserved and made accessible in archives, museums and other collections. Whilst placing emphasis on fieldwork, this call also covers research into the mechanisms and ethical aspects surrounding the selection, preservation and public access of records.

D02: Quantitative Research on Political, Social, and Economic Situations under the COVID-19 Pandemic

We invite proposals for quantitative research that, in collaboration with A03, C03, and others, integrates existing data, open data, and data used by these groups to analyse political decision-making processes, policy responses, changes in public behaviour, impacts on economic activity and socio-economic conditions, and phenomena such as exclusion, prejudice, and social divisions during the COVID-19 pandemic. We welcome studies employing social surveys, socio-informatics approaches, interdisciplinary methodologies, and AI as an analytical tool.

D03: Humanities and Social Sciences on COVID-19 outside Japan

We invite proposals for humanities and social science research, in collaboration with A02, C01, C02 and others, addressing social experiences, ethical issues, and societal reactions to policies surrounding the COVID-19 pandemic in other countries. We also welcome comparative cultural studies in literature, pop culture, art and design that focus on people's imagination and expression during the COVID-19 pandemic. For studies in law, public administration and political science, a comparative perspective with Japan is desirable.

D04: Field Implementation Research for Infectious Disease Response

We invite applications for empirical and applied research, in collaboration with B01, B02, B03 and others, conducted at the frontlines of infectious disease control. Particular emphasis will be placed on research concerning infectious disease control measures that take into account zoonotic diseases, livestock diseases and links to climate change, as well as policy analysis.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
D01	Archival and Museological Research on Infectious Diseases	2	4
D02	Quantitative Research on Political, Social, and Economic Situations under the COVID-19 Pandemic	2	4
D03	Humanities and Social Sciences on COVID-19 outside Japan	2	4
D04	Field Empirical and Applied Research for Infectious Disease Response	2	4

Research Outline of Research Areas

Copresence study: Building a framework to understand and practice new ways of 'being together'.
https://copresence.jp

Number of Research Area	:	26A102	Term of Project :	FY2026-2030
Head Investigator	:	SENJU Atsushi		
Research Institution	:	Hamamatsu University School of Medicine, Research Center for Child Mental Development		

1. Details of Research Area

With the rapid development in ICT (Information and Communication Technology), robotics, and AI (Artificial Intelligence), as well as the rapid changes in society, the reality of being together—copresence—is changing dramatically. We create a new research field, the "Copresence Study" to address this rapidly changing social world. The concept of "copresence" first appeared in the textbook of sociologist Goffman (1963), referring to a state in which "(self and others) are accessible, available, and subject to each other. The Copresence Study Area aims to create a new knowledge about "copresence", through the integration of multiple academic areas such as sociology, anthropology, regional studies, ethics, philosophy, social psychology, developmental psychology, social neuroscience, ICT technologies, and robotics/AI technology. The goal is to establish a new academic area that will lead to a new understanding and reinterpreting humanity and society.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

To achieve this objective, this research area has the following structure, targeting (1) the social and developmental foundations of copresence (Research Group A: Copresence Basis), (2) the extending and diversifying forms of copresence in contemporary society (Research Group B: Copresence Extension) and (3) the theories and the concepts of "copresence" (Research Group C: Copresence Theory). Copresence Basis group consists of two teams: empirical research on (1) the nature of copresence in contemporary society (**Copresence in Society, A01**) and (2) the developmental contexts (**Copresence during Development, A02**). Copresence Extension group focuses on two examples epitomizing the rapid transformation of copresence in contemporary society: the spatiotemporal extension of copresence through ICT technology (**Copresence across Space and Time, B01**) and the extension to actors beyond humans (**Coexistence beyond Human Actors, B02**). Each team will reference cultural, regional, historical examples, to better understand copresence extension. **Copresence Theory (C01)** group will work closely with A and B to understand, organize, and theorize the concept of copresence, and to construct a theoretical framework for copresence study as an academic discipline.

Publicly Offered Research are expected to cover societal and technological contexts, as well as methodologies for theoretical approaches, which complements and extends those covered in Planned Research. Proposals are expected to commit to the theoretical framework of "Copresence", beyond the importance as individual research. We particularly welcome proposals for theoretical approaches from diverse academic backgrounds, in addition to empirical and practical approaches, to achieve organic integration of theoretical, empirical and practical research. All the proposals are expected to closely collaborate with relevant Planned Research, to achieve original understanding and practice of copresence, through the integration and coordination of diverse societal and technological contexts, as well as diverse methodologies and academic disciplines.

Research Group A01 and A02 will also welcome empirical and practical approaches which focuses on societal, cultural and developmental contexts not fully covered in Planned Research (e.g. home, workplace, local government, sociocultural minority). Research Group B01 and B02 will welcome both the humanity and social sciences approaches to study cases for copresence extension (e.g. sociology, cultural anthropology, psychology, neuroscience), and constructive approach for novel forms of copresence extension (e.g. ICT, VR, metaverse, robots, avatars, agents). Research Group C01 will welcome theoretical approaches from wider academic disciplines, as well as those from academic disciplines covered in Planned Research (e.g. cognitive neuroscience, communication study, anthropology, philosophy and ethics). Last but not least, we particularly welcome early career researchers, female researchers, researchers with career break and those with social minority background, to apply for Publicly Offered Research, which will help warrant the diversity of Japanese research community.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Copresence in Society	5(Empirical or Practical Projects)	8
A02	Copresence during Development	3(Empirical or Practical Projects)	10
B01	Copresence across Space and Time	1(Theoretical Projects)	10
B02	Copresence beyond Human Actors		
C01	Copresence Theory		

Research Outline of Research Areas

Photokineticism: Multiscale Kinetics of Excited States and Innovative Optical Functions
https://pkism.jp

Number of Research Area	:	26A201	Term of Project :	FY2026-2030
Head Investigator	:	KAJI Hironori		
Research Institution	:	Institute for Chemical Research, Kyoto University		

1. Details of Research Area

Many natural phenomena consist of multiple sequential and competing elementary processes. Experimentally, observations reflect outcomes in which all processes are convoluted, whereas theoretical and computational studies have typically focused on only selected processes. A fundamental understanding, however, requires elucidating both all elementary processes involved and the overall system that integrates them.

We have recently developed a quantum chemical method that enables comprehensive and quantitative prediction of emission processes in organic molecules based on their constituent elementary steps (*Nat. Commun.* **2024**, *15*, 4723). Experimentally, while "visible processes" have been extensively studied, "invisible processes" have remained largely unexplored; we are developing spectroscopic techniques to quantitatively probe these processes (*J. Phys. Chem. Lett.* **2019**, *10*, 2475; *Anal. Chem.* **2019**, *91*, 11987).

By integrating computational and experimental approaches, complex phenomena can be understood in terms of elementary processes and unified through rate constants. Building on this emerging framework, we aim to drive innovation across diverse fields describable by rate constants. Inspired by the concept of "*kineticism*" in the arts—where an entire process is divided into rhythmic elements and employed in the construction of a painting—we have termed this research field "*photokineticism*," aiming to establish an "*-ism*" grounded in the principles of "*kinetics*" with "*photo* (light)" as its central focus.

This framework will be extended from single-molecule systems to interacting systems and ultimately to heterogeneous aggregates, particularly amorphous systems, to understand their spatiotemporal evolution from first principles. Given the universal importance of rate constants, broad interdisciplinary applications are expected. Ultimately, this research aims to enable quantitative prediction of phenomena without experiments.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

The research organization (research components) consists of three groups: A01: "Photokineticism Design and Calculation," A02: "Photokineticism Measurement and Analysis," and A03: "Photokineticism Function."

A01 focuses on establishing a theoretical framework for rate constant prediction, which serves as a central pillar of this research area. This framework will be developed primarily through quantum chemical approaches and ultimately extended to multiscale simulations, enabling a unified and predictive understanding of various phenomena based on rate constants.

A02 conducts physicochemical analyses applying original and advanced methodologies to evaluate a wide range of materials and devices in both model and emerging systems. Achieving a comprehensive understanding and predictive capability of the phenomena requires integrated theoretical and experimental approaches spanning broad temporal and spatial scales. Based on this concept, open-call research proposals will be invited in A01 and A02.

A03 aims to create new functionalities across a broad range of fields. It will provide model molecular systems that directly contribute to functional development to A01 and A02, thereby supporting the construction of the theoretical framework. At the same time, A03 will promote application-oriented research through the creation of new molecules and devices based on the established principles, leading to the exploration of diverse and advanced functionalities. Open-call proposals in A03 will be solicited with an emphasis on both fundamental research and future practical applications.

Proposals that contribute to the core theoretical framework of this research area are welcome, whether they reinforce the planned research or originate from entirely different disciplines. We expect open-call projects to collaborate with and complement the planned research, thereby strengthening the overall program. In particular, we strongly encourage ambitious, unconventional, and highly original ideas that transcend existing frameworks, and we actively welcome applications from early-career and female researchers.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Photokineticism Design and Calculation	4	5
A02	Photokineticism Measurement and Analysis	4	5
A03	Photokineticism Function	4	5

Research Outline of Research Areas

Dynamical materials science: beyond quantum and classical frameworks
https://dms.phys.s.u-tokyo.ac.jp/index_en.php

Number of Research Area	:	26A202	Term of Project :	FY2026-2030
Head Investigator	:	TAKEUCHI Kazumasa		
Research Institution	:	The University of Tokyo, Graduate School of Science		

1. Details of Research Area

The research area "Dynamical Materials Science" aims to integrate two streams of non-equilibrium physics: one rooted in soft matter and statistical physics (hereafter called "soft classical systems") and the other in solid state and quantum physics (called "solid quantum systems"). By combining the knowledge, techniques, and materials developed in these fields, we will explore novel emergent phenomena in non-equilibrium systems and establish their universal frameworks.

To confront this challenge, our research plan consists of three pillars, namely "pattern materials science" (group A), "active materials science" (group B), and "quasiparticle hydrodynamic materials science" (group C). This is an attempt to fuse the frameworks of "pattern formation," "active matter," and "hydrodynamics," which have mainly developed in soft classical systems, with solid-state quantum systems. These three pillars are not independent of one another; rather, through their fusion and integration, we will seek unified frameworks. In this process, publicly offered research will play a crucial role in further deepening and expanding the foundations of Dynamical Materials Science by incorporating diverse physical systems, phenomena, and methods that cannot be fully covered by the planned research.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Publicly offered research is called for to deepen and expand the foundations of Dynamical Materials Science by incorporating diverse physical systems, phenomena, and methods that cannot be fully covered by the planned research, and by generating synergistic effects through organic collaboration with planned research. Since investigation from both classical and quantum systems is essential, two research categories have been made: D01 "Frontiers of Dynamical Materials Science advanced from soft classical systems," and D02 "Frontiers of Dynamic Materials Science advanced from solid quantum systems." The target number of selected proposals for each category is set to be equal to ensure a balanced distribution of projects and researchers. It is desirable that proposals in D01 describe cooperations and synergies with solid quantum systems, and those in D02 describe cooperations and synergies with soft classical systems. We welcome research proposals that demonstrate an understanding of the concepts and objectives of Dynamical Materials Science and exhibit high levels of originality and cutting-edge innovation. Examples of topics suitable for publicly offered research include the following:

D01 "Frontiers of Dynamical Materials Science advanced from soft classical systems"

[Examples of topics that deepen Dynamical Materials Science synergistically with planned research] soft matter, pattern formation, active matter, hydrodynamics, phase separation, nonlinear oscillators, foundations of statistical mechanics, molecular dynamics simulations, optical manipulation and measurement, microfluidic systems, etc.
[Examples of topics that expand Dynamical Materials Science] chaos, random systems, glasses, rheology, fluid engineering, biophysics, fluctuating thermodynamics, stochastic processes, networks, information theory, data-driven science, etc.

D02 "Frontiers of Dynamic Materials Science advanced from solid quantum systems"

[Examples of topics that deepen Dynamical Materials Science synergistically with planned research] strongly correlated electron systems driven out of equilibrium, photo-induced phase transitions, laser processing, cold atoms, Bose-Einstein condensation, topological condensed matter, non-Hermitian systems, phonon engineering, coordination chemistry, supramolecular chemistry, molecular machines, real-space real-time measurements, etc.
[Examples of topics that expand Dynamical Materials Science] open quantum systems, measurement-induced phase transitions, Floquet engineering, time crystals, moiré materials, electron hydrodynamics, transport phenomena, quantum thermodynamics, quantum geometry, quantum information, skyrmions, spintronics, tensor networks, first-principles calculations, neutron scattering, materials science, etc.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
D01	Frontiers of Dynamical Materials Science advanced from soft classical systems	4: mainly experimental 2: mainly theoretical	5 5
D02	Frontiers of Dynamical Materials Science advanced from solid quantum systems	4: mainly experimental 2: mainly theoretical	5 5

Research Outline of Research Areas

Superatomic Materials: Creation of Innovative Materials Composed of Artificial Atoms as Building Blocks
https://www.superatomic-materials.jp/en/

Number of Research Area	:	26A203	Term of Project :	FY2026-2030
Head Investigator	:	TSUKUDA Tatsuya		
Research Institution	:	The University of Tokyo		

1. Details of Research Area

Humanity has leveraged vast chemical knowledge and technology to develop a diverse range of functional materials and pharmaceuticals from only dozens of elements, achieving prosperous and healthy lives. However, to overcome the energy, resource, and environmental challenges of the modern era, material development based on a fundamentally new perspective is indispensable. This Research Area defines atomic clusters with well-defined geometric structures and discrete electronic states as nanoscale "artificial atoms (superatoms)." We aim to establish a new field of material science centered on "superatomic materials" that utilize these superatoms as fundamental building blocks. By exploiting the diversity of superatom types and their interactions, we explore unknown properties within a chemical space that remains inaccessible via conventional chemistry. Our mission is to create innovative materials that contribute to solving social issues through the emergence of unique functions. As a specific strategy, we will first expand the library of superatoms and develop techniques for their bottom-up bonding and integration while maintaining their structural integrity. Furthermore, we will utilize advanced measurement techniques to clarify structure-property relationships and theoretically elucidate the mechanisms behind the emergence of unique properties in superatomic materials. By precisely designing and creating superatomic materials based on the design principles, we will realize a paradigm shift from conventional, atom-based material science.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

To establish a new paradigm in materials science based on superatomic materials, it is essential to create breakthroughs that transcend the boundaries of individual research frameworks, through cross-disciplinary collaboration, while sharing a core inquiry: "What functions can be achieved exclusively through superatomic materials?" Applicants are encouraged not only to focus on their individual projects but also to explore potential opportunities for concrete collaboration with researchers in the Planned Research groups. Examples of specific research topics of interest are listed below, though we welcome challenging proposals that extend beyond these examples.

[A01: Synthesis Group] Creation of novel superatoms with distinctive characteristics using various metals, compound semiconductors, chalcogenides, metal oxides, carbon, silicon, etc. Synthesis of superatoms incorporating interactive sites (e.g., exposed sites) and of unprecedented properties using high-energy processes such as plasma. Bottom-up synthesis of superatomic materials and quasicrystals through the precise control of bonding and assembly between superatoms.

[A02: Properties and Functions Group] Development and application of superatomic materials with the following characteristics: (1) High robustness coupled with superior catalytic performance for various chemical reactions; (2) Excellent light absorption and emission properties, particularly in the near-infrared to infrared regions; (3) Unique guest adsorption, magnetism, ion/electron conductivity, redox activity, or emergent functionalities arising from their combination.

[A03: Analysis and Prediction Group] Elucidation and prediction of functional mechanisms in superatomic materials through advanced measurement, theoretical science, and data science. Development of cutting-edge gas-phase spectroscopy, ultrafast time-resolved spectroscopy, and microscopy techniques to deepen the concept of superatoms.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Expanding Superatom Libraries and Pioneering Bonding & Integration Technologies	5 3	5 12
A02	Exploring Physicochemical Properties and Emergence of Functions in Superatomic Materials		
A03	Elucidating and Predicting Structure-Property Relationships in Superatomic Materials		

Research Outline of Research Areas

What is the physical mechanism of the origin of the Universe? - challenges over transcending scales through the integration of theory, observations, and experiments

https://member.ipmu.jp/Cosmogenesis/index.html

Number of Research Area	:	26A204	Term of Project :	FY2026-2030
Head Investigator	:	MURAYAMA Hitoshi		
Research Institution	:	The University of Tokyo, Kavli Institute for the Physics and Mathematics of the Universe		

1. Details of Research Area

The Universe, now 13.8 billion years old, continues to expand, but immediately after its birth it was smaller than 10^{-26}cm and existed entirely in a quantum state. Addressing the ultimate question of the origin of the Universe requires the integration of observational astronomy, particle physics, ultra-sensitive quantum measurement technologies, AI for extracting information from big data, and theoretical studies to construct new physical laws. By leveraging Japan's strengths and past investments, this project aims to achieve a unified understanding of physics across more than 30 orders of magnitude in experimental/observational scales and nearly 60 orders in length scales, including tabletop experiments.

To address the ultimate question - the origin of the Universe - we will transcend disciplinary boundaries and establish a new research field through four approaches: (I) probing signals from the early Universe, (II) simulators using analogue systems of the early Universe, (III) exploring time variation of physical laws, and (IV) theoretical studies of the early Universe. The world-leading observational projects B01 (Subaru PFS) and B02 (CMB) will form the core of this research area by investigating multiple physical phenomena through diverse approaches. In addition, we establish the experimental projects C01 (atomic clocks), C02 (laser interferometers), C03 (microwave quantum measurements), and C04 (superconducting-circuit cosmology) to promote integration with fields that have traditionally had limited connections to astrophysics, while advancing novel experimental technologies and tackling ambitious research challenges. The theoretical groups A01 (cosmology) and A02 (particle physics) will integrate these efforts and play leading roles toward understanding the origin of the Universe.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

This program aims to establish a new interdisciplinary field by integrating theory, observations, and experiments across diverse areas beyond existing disciplinary boundaries. Because the relevant research fields and topics extend beyond cosmology to include quantum information, quantum measurement, condensed matter physics, and AI/ML, this solicited research projects should include both strategically organized top-down projects and bottom-up projects based on free and original ideas of individual researchers. We encourage participation by early-career researchers with innovative ideas, as well as by researchers from fields outside astrophysics who are pursuing interdisciplinary integration. The following categories are envisaged:

E01: Theoretical research using methods from particle physics and astrophysics

The topics include, for example, quantum gravity and string theory; lattice simulations of the early Universe; production mechanisms of primordial gravitational waves over a wide range of frequencies and relic particles such as axions; dynamical dark energy; and AI/ML-based analysis methods.

E02: Observational and experimental research on the origin and physics of the early Universe

For example, observations, experiments, and R&D beyond the scope of the above core projects, including new wavelength ranges and methodologies.

F01: Theoretical research through integration with condensed matter, quantum science, and AMO

For example, the quantum mechanics of black holes that exhibit similarities to quantum systems during inflation, as well as studies that apply methods from condensed matter, statistical and mathematical physics, and AMO to the physics of the early-Universe.

F02: Observational and experimental research through integration with condensed matter, quantum science, and AMO physics

For example, R&D studies on the application of broadly defined quantum technologies to astrophysics beyond the scope of the core projects, research aimed at improving the sensitivity of quantum/precision measurement technologies, and studies based on applications of AMO.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
E01	Theoretical studies using particle physics and astrophysical approaches	1	6
E02	Observational and experimental studies using particle physics and astrophysical approaches	5	5
F01	Theoretical studies integrating condensed matter, quantum science, and AMO physics	1	4
F02	Observational and experimental studies integrating condensed matter, quantum science, and AMO physics	5	3

Research Outline of Research Areas

New Horizons in Negative Muon Science: A Transdisciplinary Integration of Knowledge Bridging Matter, the Universe, and Humanity

http://mu-horizons.kek.jp

Number of Research Area	:	26A205	Term of Project : FY2026-2030
Head Investigator	:	SHIMOMURA Koichiro	
Research Institution	:	High Energy Accelerator Research Organization, Institute of Materials Structure Science	

1. Details of Research Area

In 21st-century science and technology, the negatively charged muon (negative muon) is highly anticipated as a new fundamental particle to succeed the electron. Utilizing Japan's world-leading high-intensity muon facilities (J-PARC MUSE and RCNP MuSIC), this research area aims to create a new academic framework, "Negative Muon Integrated Science." This framework is centered on two key physical phenomena induced by negative muons in matter: muonic atom formation and nuclear muon capture.

Specifically, we will promote cross-disciplinary and collaborative research—ranging from particle and nuclear physics to Earth and planetary science, quantum sensing, medicine, and the humanities—centered on two innovative approaches: non-destructive elemental analysis and selective transmutation. Through these efforts, we aim to establish an innovative research foundation that connects the resolution of fundamental questions in natural science to the challenges of human society.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

This research area invites creative and original research proposals that will broaden and deepen the "New Horizons in Negative Muon Science" presented by our Planned Research projects. In particular, we welcome the introduction of new perspectives and technologies that extend beyond the current scope of the Planned Research. Examples of expected research topics include:

- Advancement and Expansion of Muon Utilization: Research on accelerator and measurement technologies contributing to next-generation muon science, as well as techniques for the generation, cooling, and trapping of exotic quantum systems.
- Expansion Toward Societal Implementation: Engineering applications of muon-induced nuclear transmutation; development of radiopharmaceuticals using novel radiotheranostic isotopes; further transdisciplinary (Humanitics) research with cultural heritage studies; and new developments in Earth and planetary sciences.
- Deepening of Theory and Analysis: Development of new analytical methods using muonic X-rays and induced gamma rays; collaborative theoretical and experimental research with unstable nuclear science.
- Fostering the Next Generation: Promotion of muon science to younger generations (elementary, middle, and high school students) and proposals for next-generation education and training programs.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Elucidation of Negative Muon-Induced Nuclear Reaction and Establishment of Nuclear Data for Applications		
A02	Cooling and Precision Measurements of Negative Muon		
B01	Exotic Nuclear Physics with Negative Muons		
B02	Physical Observation and Simulation of Negative-Muon-Induced Soft Errors		
C01	Research on Fundamental Symmetries Using Laser-Cooled Heavy Elements Produced by Negative Muon Nuclear Capture Reactions	2 5	8 6
C02	Investigation of the evolution of the solar system through negative muon elemental analysis		
D01	Exploration of medical radionuclides produced by negative muon capture and development of target chemistry for radiotheranostics		
D02	Unraveling the Wisdom of Human Technology via Muonic X-ray Spectroscopy		

Research Outline of Research Areas

Sex-chromosome cycle: Principle of sex maintenance driven by sex-chromosome turnover
https://s-chromosome-cycle.hiroshima-u.ac.jp/

Number of Research Area	:	26A301	Term of Project :	FY2026-2030
Head Investigator	:	NOZAWA Masafumi		
Research Institution	:	Tokyo Metropolitan University		

1. Details of Research Area

In organisms with sex, stably maintaining males and females is essential for species persistence. Sex determination by sex chromosomes is a common mechanism because it stabilizes sex ratios. However, due to their unique evolutionary properties, sex chromosomes tend to degenerate over time, creating a paradox: they sustain sex but also risk its eventual loss. To resolve this paradox, we propose the concept of a "sex chromosome cycle," in which organisms maintain sex by repeatedly replacing sex chromosomes during evolution. This research aims to elucidate the mechanisms and biological significance of maintaining sex at each stage of this cycle through integrated approaches combining observation, theory, and experimental validation.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

[Research area A03: Diverse sex chromosomes across organisms]

Planned Research focuses on organisms such as the Amami spiny rats, frogs, *Drosophila*, *Silene latifolia*, humans, mice, medaka, sticklebacks, and guppies, while also welcoming Publicly Offered Research on a broader range of species. Research on diverse systems (e.g., XY, ZW, and UV), plants at different stages of the cycle, and fungi or yeasts with mating types is encouraged; however, we also welcome other diverse studies on sex chromosomes. Projects elucidating evolutionary mechanisms or aiming at applications in agriculture, livestock, and fisheries are also within scope.

[Research area B04: Diverse functions of sex chromosomes and their genetic basis]

In sex chromosomes with suppressed recombination, the genes linked to sex-determining loci are known to have diverse functions beyond sex determination, while accumulated transposable elements may have deleterious effects. We aim to tackle these advantages and disadvantages of sex chromosomes in Planned Research, and we also invite proposals addressing these aspects of sex chromosomes, including those with medical applications. Studies on autosomes are also welcome if they address mechanisms shared with sex chromosomes, such as structural variation, recombination suppression, linkage disequilibrium, epigenomic regulation, dosage compensation, and transcriptional regulation.

[Research area C04: Theory and empirical validation of the sex chromosome cycle and diverse systems of sex determination]

We invite proposals that experimentally demonstrate the sex chromosome cycle (e.g., experimental evolution or semi-natural experiments), as well as theoretical studies. Proposals estimating turnover rates or exploring ecological factors that determine the turnover rates are also encouraged. This research area also seeks the possibility that other sex-determination systems (e.g., environmental sex determination, haplodiploidy, and parthenogenesis) function as backups of the cycle. Therefore, we also invite proposals targeting diverse sex-determination systems that do not rely on sex chromosomes. Studies predicting the evolution and population dynamics of sex-determination systems under fluctuating environments or developing new methodologies (e.g., chromosome engineering or genome structure manipulation) are also welcome.

All proposals are required to clearly describe their relevance to the concept of the sex chromosome cycle. Contributions to the advancement of this research area through collaborations within the program are highly desirable. Across all research areas, proposals utilizing genome informatics and AI-based approaches are welcome. Applications from early-career researchers are strongly encouraged. Applicants should apply either for Experimental Research (4.3 million JPY/year), or for Theoretical/Informatics Research or Exploratory Experimental Research (2.2 million JPY/year) under one of the above research areas.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A03	Diverse sex chromosomes across organisms	Experimental Research: 4.3 Theoretical/Informatics Research or Exploratory Experimental Research: 2.2	10 5
B04	Diverse functions of sex chromosomes and their genetic basis		
C04	Theory and empirical validation of the sex chromosome cycle and diverse modes of sex determination		

Research Outline of Research Areas

Element based Biology: Transition and flexibility of elemental utilization by life
https://element-based-biology.jp/

Number of Research Area	:	26A302	Term of Project :	FY2026-2030
Head Investigator	:	FUJIWARA Toru		
Research Institution	:	Graduate School of Agricultural and Life Sciences, The University of Tokyo		

1. Details of Research Area

Life on Earth depends on chemical elements available in the environment. Elemental environment varies across space and time, and organisms have evolved mechanisms to acquire required elements and, when necessary, switch their usage to sustain biological functions. Conversely, life itself has reshaped Earth's elemental environment, as exemplified by oxygen production from early photosynthetic organisms. Thus, elemental environments and biological activities are tightly coupled, and organisms have selected specific elements to build their functions. However, why particular elements were selected and how diversity in elemental usage arose remain unclear.

Such diversity is closely linked to changes in Earth's environment and cannot be fully understood within conventional life science alone. It is essential to characterize elemental conditions in the specific environments where life evolved and to view them as interactions between life and Earth. While previous studies have mainly addressed global elemental changes, understanding element selection and flexibility requires precise estimation of local elemental distributions in biological habitats.

This research area integrates life and Earth sciences to establish a new concept: organisms flexibly modify their elemental usage depending on environmental conditions. Based on this, we aim to found a new discipline, "Element-based Biology." We focus on three key questions: the role of elements in evolution, mechanisms of element sensing and uptake, and regulation of biological functions by incorporated elements, corresponding to Adaptation and Evolution (A01), Sensing and Transport (A02), and Expression and Function (A03). In parallel, Elemental Environment Diversity (B01) will reconstruct spatiotemporal elemental conditions, enabling a comprehensive understanding of how organisms respond to environmental changes and select or modify their elemental usage.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

We invite proposals that complement and advance the establishment of "Element-based Biology" through integration of life and Earth sciences, in close collaboration with the planned researches. While the following topics are indicative, proposals are not limited to them; we welcome innovative and challenging ideas beyond the scope of the planned researches. Projects with strong potential for impactful outcomes in element-based biology are encouraged under the 3.5 million yen category, while a 2 million yen category is also provided to promote exploratory research by a wide range of early-career investigators.

A01: Studies on relationships between elemental environments and biological evolution, including organisms in extreme environments (e.g., hydrothermal vents, permafrost) or anthropogenic settings (e.g., heavy metal contamination, highly acidic or alkaline soils).
A02: Mechanisms of sensing, uptake, and transport of diverse elements, including those involved in biomineralization and toxic element handling.
A03: Effects of elements on gene expression and biomolecular structure and function, including metal interactions with non-protein biomolecules and exploration of novel functions using non-biological elements.
B01: Elemental distribution, cycling, and dynamics in Earth and planetary environments, including prebiotic chemistry, numerical simulations, and astrobiological studies.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Elemental Environments: Biological Adaptation and Evolution	3.5 2	2 19
A02	Elemental Environments: Biological Sensing and Transport		
A03	Elemental Environments: Biomolecular Expression and Function		
B01	Elemental Environments on Earth: Spatiotemporal Diversity	3.5 2	2 4

Research Outline of Research Areas

Scientific Dream Interpretation
http://dreamscience.jp

Number of Research Area	:	26A303	Term of Project :	FY2026-2030
Head Investigator	:	HAYASHI Yu		
Research Institution	:	The University of Tokyo, Graduate School of Science		

1. Details of Research Area

Dreaming has long been a fundamental question for humanity, yet its scientific systematization has remained limited due to its inherently subjective and ambiguous nature. This research area seeks to reconceptualize dreaming as a scientific object and to establish a new interdisciplinary field, "dream science."

As a foundation, we define dreaming as "a process in which an individual or system, during a state of inactivity, engages in sensory or cognitive simulation through spontaneous activity." Based on this definition, we integrate physiological and theoretical biological approaches and introduce a framework in which the definition itself can be refined as research progresses. This will enable the development of a quantitative and comparative framework for studying dreams across species, incorporating perspectives from information science.

Through elucidating both the mechanisms of dream generation and their functional significance, this research area aims to position dreaming as a fundamental physiological function of complex brains. The outcomes are expected to deepen our understanding of psychiatric and neurological disorders, advance knowledge of higher brain functions such as consciousness and creativity, and contribute to the development of novel control strategies and new principles of information processing.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

This research area places strong emphasis on incorporating diverse perspectives and methodologies through publicly offered research to expand the scope of dream research. One major reason for the limited progress in this field has been its reliance on subjective reports in humans, which has hindered objective and experimental validation. While this program incorporates approaches such as dream decoding and animal models of REM sleep behavior disorder to study dreams scientifically, these alone are insufficient to capture the full complexity of dreaming. We therefore expect publicly offered research to conduct innovative approaches that overcome these limitations from new angles.

Research targets may include human studies, animal models, and in silico approaches (including mathematical modeling and AI implementation), and methodologies may span physiology, information science, psychiatry, psychology, and neurology. In addition, ex vivo and in vitro systems, as well as unconventional models or approaches not traditionally associated with dream research, will not be excluded if they demonstrate clear originality. In human studies, we welcome research that tests findings from animal and theoretical studies to evaluate the validity of definitions and functional hypotheses of dreaming. Neurophysiological studies based on large-scale neural recordings, as well as information science approaches inspired by dream-related processes, are also of central importance. The latter may contribute to overcoming key challenges in current AI systems by elucidating mechanisms of information generation and reorganization during dreaming.

The definition of dreaming adopted in this program is not fixed but is expected to evolve as research progresses. Accordingly, proposals are not required to strictly adhere to this definition; rather, we actively evaluate ambitious studies that propose new concepts or alternative definitions. We also take the position that dreaming is not necessarily limited to sleep, and therefore do not restrict research to sleep-related phenomena. However, frameworks that equate dreaming with purely random spontaneous activity are not aligned with the aims of this research area.

Call for proposals will be organized under the three research groups listed below. However, given the interdisciplinary nature of dream research, proposals spanning multiple research groups are expected, and evaluation will not be conducted separately for each research group. We welcome proposals of high originality, feasibility, and potential contribution to the field.

Two funding tiers are available: approximately 5 million yen and 3 million yen per project. The 5 million yen tier is intended primarily for researchers with established independent research programs, supporting proposals expected to achieve substantial advances in understanding the mechanisms and/or functions of dreaming. The 3 million yen tier is open to a broader range of applicants and actively evaluate exploratory and challenging research. We expect applications from women researchers and early-career researchers at both funding levels.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Mechanisms and manipulation of dream generation	5	7
A02	Mechanisms by which dreams promote adaptability and creativity	3	15
A03	Innovative approaches to the elucidation and application of dreaming		

Research Outline of Research Areas

Organelle-Driven Sensors and Actuators Governing Plant Movement
https://www.nibb.ac.jp/pmov/

Number of Research Area	:	26A304	Term of Project :	FY2026-2030
Head Investigator	:	MORITA Miyo		
Research Institution	:	National Institute for Basic Biology		

1. Details of Research Area

Plants are sessile, yet they exhibit movement. The structures and operating principles of the sensors that perceive environmental factors influencing plant movement, along with the actuators that drive their movement, are entirely distinct from animal muscles and nerves, having evolved uniquely within plants. Among the diverse modalities of movement found in plants, tropism is characterized by altering the direction of organ growth upon recognizing the directionality of environmental stimuli, such as gravity, light, moisture, and nutrients. Tropism is widespread among land plants, serving as a universal and adaptive motor function that plays an indispensable role in optimizing plant growth.

In this research area, we will elucidate the mechanisms underlying environment-responsive organ movement, in which sensors and actuators operated by plant-specific organelles—such as plastids, cell walls, and central vacuoles—are linked via signal transduction pathways. To understand these mechanisms, it is essential to adopt a cross-scale approach that connects these microscopic dynamics to macroscopic organ movements. By developing interdisciplinary research in close collaboration with mathematical biology, biophysics, and mechanical engineering, we will decode the mechanisms of "plant movement regulation," in which environmental perception and factors ranging from organelles to organs are coupled across hierarchical scales. Ultimately, by demonstrating the plurality of perceptual and motile modalities in the living world, this research aims to bring about a paradigm shift and transformation in academic research.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Publicly Offered Research is expected to complement Planned Research and broaden the scope of research targets, while jointly driving the achievement of the research area's goals through collaborative research within the area and organic coordination with Planned Research. In particular, we actively solicit challenging research proposals that contribute to elucidating environmental sensors and signal transduction mechanisms involved in plant movement, the operating principles of cellular actuators, and the principles of movement emergence based on physical measurement, theory, and simulation.

To pursue the diversity and common principles of plant movement, research that complements the topics of Planned Research is highly welcome. For example, studies targeting diverse plant movements, such as nastic movements and circumnutation, as well as tropisms induced by external stimuli such as light, moisture, and mechanical stimuli, that are not covered by Planned Research, are envisaged. We especially welcome applications for challenging research projects that integrate wet engineering technologies and theoretical studies. We also welcome applications from researchers who possess unique imaging technologies, image analysis, and measurement technologies to capture cellular- and organelle-level dynamics involved in movement, cell and tissue deformation, and organ movement. Even if applicants do not currently possess these technologies, proposals that are expected to forge new developments through the support of the Administrative Group are welcome. We also welcome technological developments expected to bring breakthroughs in establishing the "cross-scale organ movement models spanning from organelles to organs" that this research area aims to achieve. For such technological development proposals, it is desirable to include a plan to verify their specific contributions through collaborative research within the area. Applications from early-career and female researchers with fresh, flexible perspectives are encouraged.

A01 " Sensors and Signal Transmission": Research on the mechanisms for sensing environmental stimuli and their signal transmission.

A02 " Driving Mechanisms of Cellular Actuators": Research on the control mechanisms of organelles, the cytoskeleton, cell walls, turgor pressure, etc., associated with driving movement, as well as the mechanisms of cell and tissue deformation.

A03 "Mechanisms Governing Movement Across Scales ": Research to integrate the data through theoretical research to reproduce and predict the process by which individual cell deformations converge to produce the bending of the entire organs.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Sensors and Signal Transmission	Experimental: 4	5
A02	Driving Mechanisms of Cellular Actuators	Experimental: 4	5
A03	Mechanisms Governing Movement Across Scales	Experimental and Theoretical: 4	5

Research Outline of Research Areas

Multidimensional glocal photobiology: Shedding light on unexplored frontiers of life phenomena
http://glocal-photobiology.pharm.okayama-u.ac.jp/

Number of Research Area	:	26A305	Term of Project :	FY2026-2030
Head Investigator	:	KOYANAGI Mitsumasa		
Research Institution	:	Osaka Metropolitan University, Graduate School of Science		

1. Details of Research Area

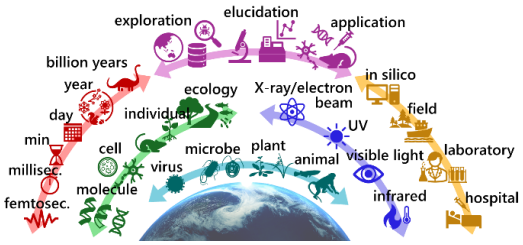
Since the origin of life, light has been a fundamental source of environmental information and energy. While animal vision and plant and microbial photosynthesis are well understood, recent advances in genomics, transcriptomics, and metagenomics have revealed the whole-body-wide and global distribution of photoreceptive proteins, including opsins—far beyond traditional model systems. Furthermore, research toward technological and medical applications, including optogenetics, is rapidly progressing. Thus, today, research on light utilization in living organisms is expanding significantly. Biological light utilization encompasses a multidimensional and wide-ranging research area spanning all directions: organisms (from viruses to humans), time scales (femtoseconds to billion years), biological hierarchy (atoms to ecosystems), and research scope (basic science to medicine). This research area aims to integrate diverse academic disciplines and promote conceptual transformation and expansion of photobiology—that is, the exploration of unexplored frontiers in life phenomena—to achieve a true understanding of "light and life" and "light and the Earth".

This research area is organized into three Research Groups:

Planned Research A01–A03: Local Photobiology — Discovery and understanding of unidentified light utilization in organisms

Planned Research B01–B03: Global Photobiology — Elucidation of unique and common principles underlying the roles and utilization of light at the global scale, including in ecosystems

Planned Research C01–C03: Glocal Photobiology — Exploration and expansion of light-utilizing mechanisms shaped by evolution, their application to optogenetics, and the integrated understanding and utilization of light signals together with other environmental signals



2. Call for Proposals and Expectations for Publicly Offered Research, etc.

This research area, focusing on biological light utilization, covers all taxonomic groups of life—including animals, plants, fungi, microorganisms, and viruses—and the photoreceptive molecules they possess. The research area is expected to comprise researchers from a wide range of disciplines, spanning microscopic to macroscopic perspectives and basic to applied research, and to actively promote interdisciplinary collaborative research.

For Publicly Offered Research, we invite proposals that expand and deepen the three Research Groups (Local, Global, and Glocal Photobiology); introduce innovative methodologies or technologies that advance the project; and present original and forward-looking ideas in which light and biological responses are indirectly linked (e.g., via luminescence, heat, rhythms, or interactions related to light responses in other organisms), aiming to develop this research area as models for environmental responses in living organisms and applications of biomolecules. Researchers without prior experience in photobiology are also encouraged to apply. To achieve a comprehensive understanding of light utilization, we particularly encourage proposals on photoreceptive molecules other than opsins and on light utilization in diverse organisms, including plants, that are not fully covered by the Planned Research. To support the continued growth of this research area and encourage research from diverse perspectives, we especially welcome applications from early-career and female researchers.

Examples include:

A01 "Local Photobiology": Elucidation of novel light utilization in living organisms

B01 "Global Photobiology": Elucidation of light utilization at ecosystem and planet scales; Technological innovations including cultivation/husbandry systems and genome editing for non-model organisms (including unculturable microorganisms)

C01 "Glocal Photobiology": Development and application of optogenetic tools; Understanding and utilization of biological responses indirectly related to light

Proposals aligned with the vision of this research area are broadly welcomed.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Local Photobiology	2.5	24
B01	Global Photobiology		
C01	Glocal Photobiology		

Research Outline of Research Areas

Integrated science of brain function recovery information linking molecules to society
https://strk-renaissance.sakura.ne.jp/recoveromics

Number of Research Area	:	26A401	Term of Project :	FY2026-2030
Head Investigator	:	SHICHITA Takashi		
Research Institution	:	Institute of Science Tokyo		

1. Details of Research Area

The brain is inherently capable of healing: even after damage, lost functions can be regained through medical and welfare services, because the brain has a natural recovery program that triggers molecular and cellular tissue repair, rewires neural circuits, and enables readaptation to social life. Yet how this repair actually unfolds—where, when, and how the human brain restores function—remains largely unknown, and a society enabling efficient recovery has yet to be realized. The biological, medical, and social information on recovery has grown enormously, and integrating it across disciplines can reveal the most fundamental mechanisms of human brain functional recovery. We have established an interdisciplinary framework that analyzes brain functional recovery as informatics across the molecular, cellular, organ, individual, and societal levels. By integratively understanding this multi-layered information, we will inform the design of medical and welfare services offering each person the optimal recovery, and of housing and facility environments, permeating brain science into life and society.

The planned research mainly uses stroke, where recovery is readily observable. It unites researchers measuring recovery information at the molecular, cellular, neural-circuit, individual, and societal levels with mathematical, information, and statistical scientists generating innovative analysis methods—creating a new field of brain functional recovery informatics, or "recoveromics" [recovery + omics]. The publicly offered research is expected to be distributed evenly across the framework of planned groups A01–A04. Beyond stroke, it will broadly engage researchers addressing diverse impairments such as neurological and musculoskeletal disorders, age-related decline, and frailty. Through bidirectional fusion of planned and publicly offered research, we will advance a comprehensive understanding of humans' integrated recovery capacity (recoveromics) and build the scientific principles for a society achieving sustainable functional recovery.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

B01 "Research on Recovery Mechanisms Using Animal Models": We invite projects combining readily observable recovery models, original findings, and advanced technologies across various impairment models (stroke, trauma, neurodegenerative disease, musculoskeletal disorders, etc.). Beyond molecular findings, analyzing how housing and social factors affect recovery and accelerating bidirectional animal–human translational research at the individual and societal levels are important.

B02 "Research on Human Functional Recovery Mechanisms": In parallel with the A02/A03 groups' work on recovery dynamics in stroke patients, we invite projects measuring and analyzing recovery from non-stroke impairments (neurodegenerative diseases, musculoskeletal disorders, frailty, etc.). We expect research measuring neural activity, movement, and daily-living function, comparing across individuals and environments, to help formulate guidelines for quantitatively evaluating recovery across physical/mental states, daily life, and social circumstances.

B03 "Analysis of Functional Recovery Information in Life and Society": Impairments in life and society are diverse, and recovery varies greatly with environmental factors. We invite projects measuring and analyzing recovery dynamics in such environments and identifying the factors that influence it.

B04 "Methodologies for Analyzing Diverse Brain Recovery Data": We broadly invite mathematical, information, and statistical science projects that help elucidate recovery mechanisms. From researchers strong in the basic theory and foundational technologies of data analysis, we expect analytical methods that longitudinally integrate recovery information from the molecular to the societal level.

For any research related to B01–B04, we actively welcome early-career, female, and international applicants. We will select proposals at 3 million yen per year for 20 projects (two calls), and promote planned–publicly offered collaboration spanning the molecular to the societal level.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
B01	Research on Recovery Mechanisms Using Animal Models	3	20
B02	Research on Human Functional Recovery Mechanisms		
B03	Analysis of Functional Recovery Information in Life and Society		
B04	Methodologies for Analyzing Diverse Brain Recovery Data		

Research Outline of Research Areas

Molecular Explorers: Adaptive Robots for Real-World Molecular Systems

molbot-ex.org

Number of Research Area	:	26A402	Termof Project :	FY2026-2030
Head Investigator	:	NOMURA Shinichiro		
Research Institution	:	Tohoku University, Graduate School of Engineering		

1. Details of Research Area

This research area undertakes frontier-crossing fundamental research to advance "molecular robots"—artificial systems designed at the molecular level—from proof-of-concept (PoC) to real-world application. Molecular robotics, a field Japan has led, imparts intelligence to matter by functionally integrating molecular components with sensor, processor, and actuator functions into a single system. We aim to realize molecular robots that operate safely, reliably, and robustly in biological environments (one week inside mammalian cells) and extreme environments (one week at 100°C and 100 atm), and we establish the scientific principles for building robots equipped with Self-X functions (self-repair, self-adaptation, and self-termination). More than 70 researchers across the life sciences, chemistry, engineering, and information science use an AI and data-integration platform to accelerate the Design-Build-Test-Learn (DBTL) cycle, aiming to achieve these goals.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

This research area comprises five Research Groups: Bio-Interface (A01), Extreme Environments (B01), Materials and Device Development (C01), Foundational Design Theory (D01), and AI and Data Integration (E01). In collaboration with the Planned Research projects, this call invites theoretical, exploratory, elemental-technology, and applied-technology research contributing to the real-world application of molecular robots. As the area is interdisciplinary in essence—its five Planned Research projects driving the DBTL cycle together—we especially welcome research that bridges multiple Research Groups, research from new perspectives beyond the Planned Research, and breakthroughs from collaboration crossing the boundary between Planned and Publicly Offered Research. The content anticipated for each Research Group is as follows.

Research Group A01 'Bio-Interface': molecular robots functioning in biological environments—biocompatible molecular systems, intracellular molecular robots, bio-interfaces, artificial cells, artificial muscles, artificial tissues, and multi-hierarchical bio-interactions.

Research Group B01 'Extreme Environments': components and materials of molecular robots operating in extreme environments—molecular materials for extreme environments, chemically modified biomolecules, mirror-image biology, molecular-chaperone engineering, ultra-thermostable molecular systems, and robust molecular design.

Research Group C01 'Materials and Device Development': foundational materials and devices of molecular robots—artificial nucleic acids, modified nucleic acids/peptides/lipids, DNA nanostructures, artificial metabolic networks, micro-TAS, and molecular nanomechanics.

Research Group D01 'Foundational Design Theory': design theory of molecular robots—molecular-system modeling, coarse-grained molecular dynamics, robust control theory, multiscale simulation, autonomous decentralized algorithms, and disturbance-response prediction.

Research Group E01 'AI and Data Integration': acceleration of molecular-robot research through AI and data science—DBTL-cycle optimization, generative-AI molecular design, explainable AI (XAI), de novo protein design, laboratory automation, and ELSI/RRI.

These examples are illustrative, not exhaustive. Through Publicly Offered Research the area widens its human network: selected researchers join area-wide activities (joint camps, boot camps, international symposia, lab visits) and promote inter-group collaboration across disciplinary boundaries. For the graduate students and technical assistants working with them, we support BIOMOD (the international student molecular-design competition) participation and short-term study abroad related to MolBot EX, developing next-generation talent including career advancement for technical assistants. We look forward to active applications from early-career and women researchers.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Bio-Interface	4	5
B01	Extreme Environments	4	5
C01	Materials and Device Development	4	5
D01	Foundational Design Theory	4	5
E01	AI and Data Integration	4	5

Research Outline of Research Areas

Deuterium Science 2.0
https://deut-switch.pharm.kyoto-u.ac.jp/

Number of Research Area	:	26A403	Term of Project :	FY2026-2030
Head Investigator	:	NAKA Hiroshi		
Research Institution	:	Kyoto University, Graduate School of Pharmaceutical Sciences		

1. Details of Research Area

Deuterium (^{2}H, D) is a stable, non-radioactive isotope of hydrogen. Although deuterium-labeled compounds often show chemical properties similar to their protium analogs, their physical properties can differ substantially, enabling pronounced isotope effects. In recent years, such effects have supported practical innovations including pharmaceuticals with improved safety and metabolic stability (deuterated drugs) and organic light-emitting diode materials with enhanced emission efficiency and durability (deuterated OLEDs). Building on the earlier Deuterium Science initiative (Transformative Research Areas (B), FY2020–2022), Deuterium Science 2.0 aims to establish a new interdisciplinary field, Deuterium Science, by integrating informatics, theoretical science, and experimental science (chemistry and biology). The goal is to systematically understand the properties of deuterated materials and to explore their applications for developing innovative materials beyond conventional technological limits.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

As academic disciplines related to deuterium span a wide range, this call is welcoming proposals from diverse fields. We particularly encourage submissions that are complementary to the planned research teams and that (i) advance new understanding and/or applications of deuterium and isotope effects, or (ii) leverage unique technologies to accelerate collaborative research across the Research Area. Examples of welcome proposals include (but are not limited to):

- Research addressing scientific and technical challenges unique to hydrogen isotopes (deuterium and tritium), such as development of synthetic methods for deuterated organic/inorganic materials, synthetic polymers, and biomacromolecules, understanding and mechanistic elucidation of isotope effects, separation and enrichment technologies.
- Diverse proposals that deepen understanding of, or expand applications for, deuterated materials and hydrogen-isotope-related science.
- Development and utilization of technologies based on hydrogen isotopes, including applications to pharmaceuticals (deuterated drugs), functional materials (e.g., deuterated OLEDs), catalysts, semiconductors, and advanced measurement/imaging (e.g., neutron-based analysis, DNP-NMR/MRI, NanoSIMS, CPL, IR/Raman and other vibrational spectroscopies), metabolomics/flux analysis, quantum computing, and other emerging directions. Proposals that create new value through unconventional applications are also welcomed.
- New concepts and methodologies in data-driven science, machine learning, and deep learning, as well as interdisciplinary deuterium-related research enabled by these approaches.
- Theoretical and experimental studies that generate large-scale, high-quality datasets to advance the informatics foundation of deuterium science, including comprehensive and high-accuracy theoretical calculations, automated synthesis, advanced measurements, and imaging/analysis, with emphasis on creation and analysis of data related to isotope effects.

Applicants are requested to choose the closest applicable category among the four domains (multi-domain proposals are welcome; proposals outside these categories are also encouraged if they contribute to establishing Deuterium Science): A01 Selection (Design & Prediction, Informatics, AI), A02 Understanding (Quantum Mechanics, Theoretical Chemistry), A03 Synthesis (Synthetic Chemistry, Synthetic Biology), A04 Measurement (Advanced Measurement, Functional Evaluation). Prior achievements specifically in deuterium-related research are not required. Applications from early-career researchers and women researchers are strongly encouraged.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
A01	Selection (Design & Prediction, Informatics, AI)	6 3	8 9
A02	Understanding (Quantum Mechanics, Theoretical Chemistry)		
A03	Synthesis (Synthetic Chemistry, Synthetic Biology)		
A04	Measurement (Advanced Measurement, Functional Evaluation)		