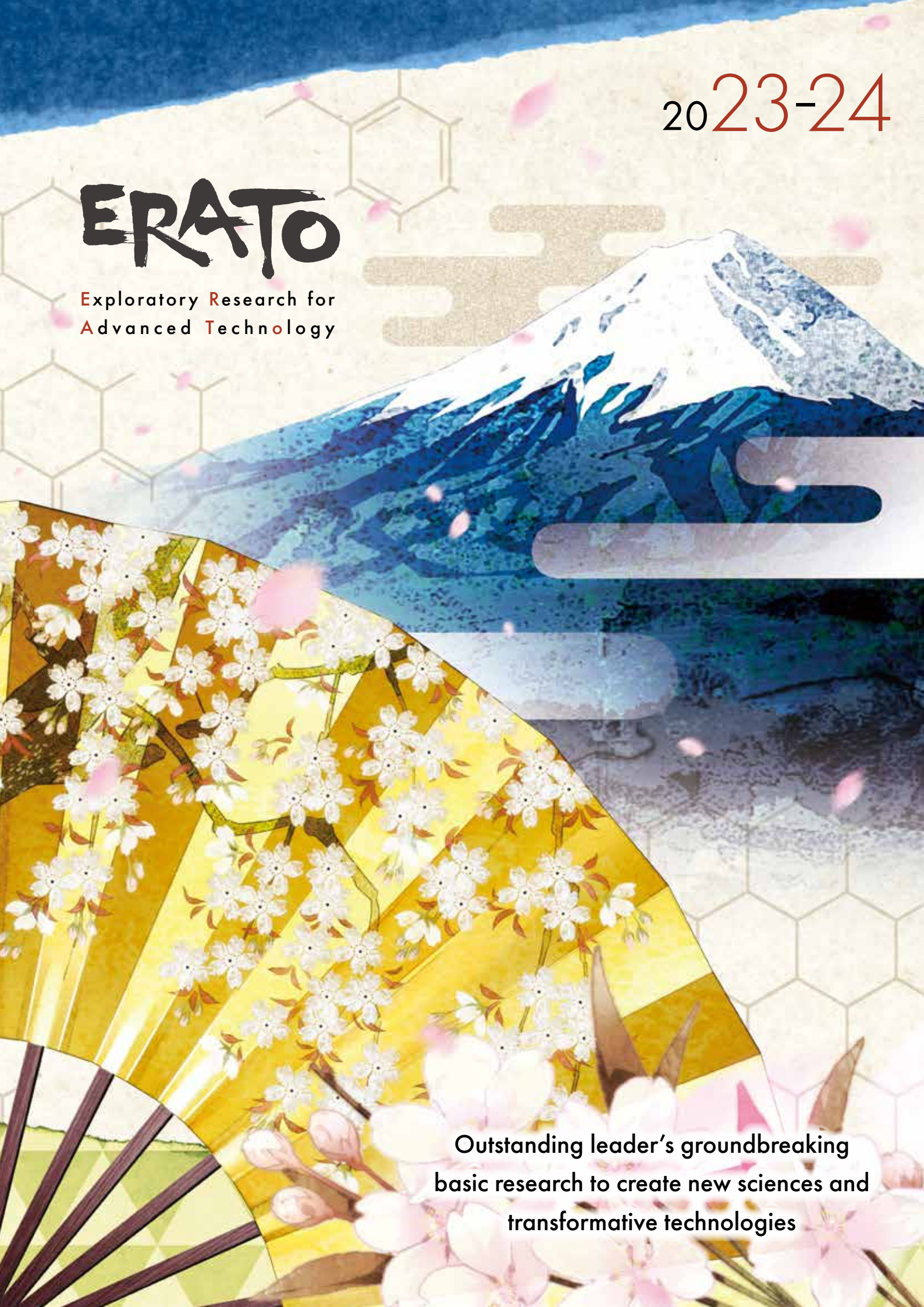
2023-24

ERATO

Exploratory Research for Advanced Technology



Outstanding leader's groundbreaking basic research to create new sciences and transformative technologies

ERATO

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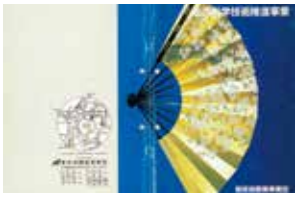


The fan on the cover was inspired by a pamphlet from the early days of the project, commemorating ERATO's more than 40 years of existence

History of ERATO

ERATO is a historic research funding program which has been developing new science and technology trends through its unique research promotion system. In the 1970s, Japan experienced significant economic development but basic research within Japan was understrength to create original intellectual properties to develop new industries. Against this backdrop, ERATO was established in 1981 to pioneer innovative basic research. ERATO focuses on "people," respecting the originality and leadership of Principal Investigators (Research Directors), and builds a desirable environment for researchers. ERATO demonstrated a brand-new method of research promotion and eventually influenced other funding organizations. To date, a total of 149 ERATO projects have contributed to the development of researchers who are leaders in their academic fields, as well as to excellent research achievements.

Development of ERATO

ERATO established

Exploratory Research for Advanced Technology (ERATO) is set up under JRDC, the predecessor of JST. The abbreviation "ERATO," which is also the name of the Greek Goddess of romantic poetry, has since become widely known.

ERATO reorganization

Strategic Basic Research Programs is created to respond to the demands of a new era, and ERATO is reorganized to play a role in it.

ERATO's current status

ERATO has carried out as many as 149 projects contributing to the development of science and technology. Former ERATO researchers are still pursuing and deepening their themes via basic research basic research or developing new technologies to the stage of application.

History of JST

1957 Japan Information Center of Science and Technology (JICST) is established.

1961 Research Development Corporation of Japan (JRDC) is established.

1981

1996 JICST and JRDC are merged to create the Japan Science and Technology Agency (JST).

2002

2003 JST is reorganized to become an independent administrative institution.

2015 To enhance its functions, the status of JST is changed from an "independent administrative institution" to a "national research and development agency."

2023

Japan Science and Technology Agency

What Is ERATO?

Exploratory Research for Advanced Technology (ERATO) is a research funding program of the Japan Science and Technology Agency (JST), which aims to lead science and technology-based innovations through novel, unique, and transformative basic research. In an ERATO project, the Research Director together with diverse team members devote themselves to challenging themes that drive forward new areas of science and technology. ERATO greatly values the leadership and originality of Research Directors and builds project systems with a focus on “people.”

Outline

Objective	To achieve a significant advance in science and technology through novel and unique basic research, and ultimately contribute to science and technology-based innovation that shapes the future society and economy.
Research System	Each Principal Investigator of ERATO (Research Director) establishes an original project named after him/herself. The project is implemented in collaboration between the host institute and JST for the research period.
Research Period	Approximately 5 years
Research Expenses	A maximum of 1.2 billion yen (direct cost) per project
Research Venues	Research Director sets up an exclusive research venue in his/her affiliated research institute for his/her ERATO project composed of a headquarters in charge of planning and promotion of the project and several reseach groups.

Features

Research Director designs his/her ERATO project based on own unique concepts, brings together researchers with various expertise and backgrounds, organizes around three to four research groups of different scientific fields or functions, and supervises the project to develop new fields in science and technology.

Selection of Research Directors

JST identifies prospective Research Directors through surveys and references from outside experts rather than through a public call for proposals.

Collaboration framework

The host research institute and JST build a collaboration framework to support the ERATO project.

Research venues

A research venue will be set up to accommodate human resources and facilities necessary for the ERATO project within the Research Director's research institute.

Diverse and open project team

Research Director establishes several research groups by recruiting human resources with different scientific fields from domestic and overseas research institutes and industries.

Flexible project management

ERATO projects are flexibly managed enabling revision of the research plan and budget allocation based on the progress of the project.

Stages of ERATO Project

Selection of Research Directors

- Seeking suitable candidates through surveys and public calls for nominations
- Narrowing down candidates with cooperation from outside experts (Panel Officers)
- Inviting selected candidates to submit a research proposal for review to decide new Research Directors

See our website for details:

ERATO nomination

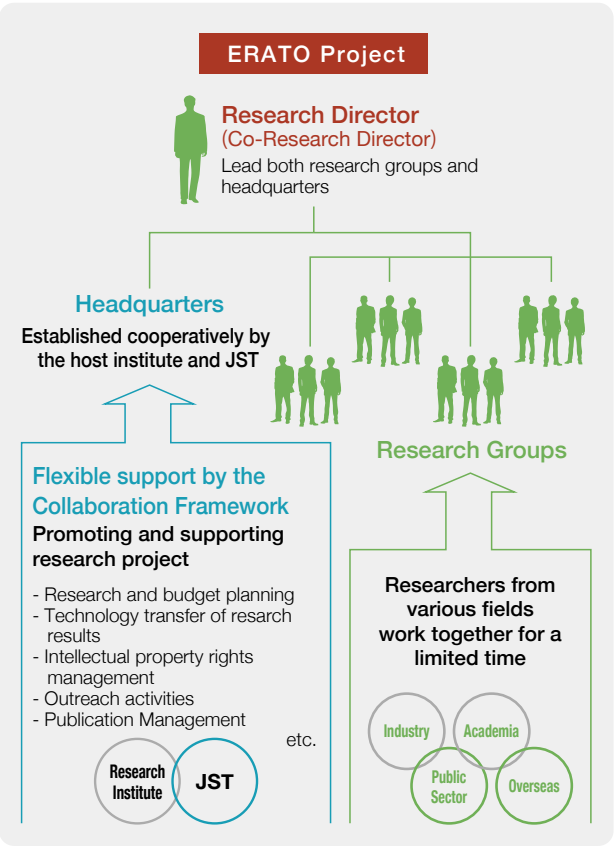
Period for preparation

- Forming research groups
- Setting up headquarters and laboratories
- Designing a project website

Research period

- Carrying out research
- Research promotion
  Headquarters will assist the Research Director regarding budget, schedule control, intellectual property management, outreach activities, etc.
- Site Visit
  Review on the project's progress and advice to the project by Panel Officer and outside experts (subcommittee).
- Mid-term evaluationn
  Mid-term evaluation will be conducted at a certain point of the project to assess the achievement of the project's objectives and review the project's status.

See page 5 for details about on-going projects.



Additional Support Period

- Additional Support Period may be granted depending on the project's progress and institution's commitment.

See page 15 for details about Additional Support Period.

Completion of project

- Final evaluation
  Final evaluation will be conducted right before or right after the end of the project.
- Transition to more extensive basic research or transfer of research results to practical applications
- Follow-up evaluation

See page 20 for details about completed projects.

On-going Projects

ERATO projects provide a rich environment where researchers with different values come together from diverse disciplines, inspire each other, create a new way of thinking, and pursue innovative science and technology.

*Affiliation and position of the Research Directors are as of November 2023.
*2015 is shortened to '15. Same for following years.
*Research fields are lined up in order of the most relevant one from the left.

List of Research Projects

Inauguration year	Project Title / Research Director / Title and Affiliation	Research Term '15–'28	Research Field	page
2023	**KOJIMA Market Design Project** **Fuhito KOJIMA** Professor, Department of Economics, The University of Tokyo			6
	SAGAWA Information-to-Energy Interconversion Project **Takahiro SAGAWA** Professor, Graduate School of Engineering, The University of Tokyo			7
	SATO Organoid Design Project **Toshiro SATO** Professor, Keio University School of Medicine			7
	SEKIGUCHI Three-nucleon Forces Project **Kimiko SEKIGUCHI** Professor, School of Science, Tokyo Institute of Technology			8
2022	**UCHIDA Magnetic Thermal Management Materials Project** **Ken-ichi UCHIDA** Distinguished Group Leader, Spin Caloritronics Group, Research Center for Magnetic and Spintronic Materials, National Institute for Materials Science			8
	SHIBATA Ultra-atomic Resolution Electron Microscopy Project **Naoya SHIBATA** Professor, Institute of Engineering Innovation, School of Engineering, The University of Tokyo			9
2021	**ARITA Lipidome Atlas Project** **Makoto ARITA** Professor, Keio University Faculty of Pharmacy / Team leader, RIKEN Center for Integrative Medical Science			9
	KATAOKA Line X-ray and Gamma-ray Imaging Project **Jun KATAOKA** Professor, School of Advanced Science and Engineering, Faculty of Science and Engineering, Waseda University			10
	NOZAKI Resin-Degradation Catalyst Project **Kyoko NOZAKI** Professor, Graduate School of Engineering, The University of Tokyo			10
2020	**UEDA Biological Timing Project** **Hiroki R. UEDA** Professor, Graduate School of Medicine, The University of Tokyo / Team leader, RIKEN Center for Biosystems Dynamics Research			11
	SUZUKI RNA Modification Project **Tsutomu SUZUKI** Professor, Graduate School of Engineering, The University of Tokyo			11
	YAMAUCHI Materials Space-Tectonics Project **Yusuke YAMAUCHI** Distinguished Professor, Department of Materials Science and Engineering, School of Engineering, Nagoya University / Professor, The University of Queensland / MANA Principal Investigator, National Institute for Materials Science			12

Chemistry・Materials Physics Life Sciences Informatics・Mathematics

Inauguration year	Project Title / Research Director / Title and Affiliation	Research Term '15 '16 '17 '18 '19 '20 '21 '22 '23 '24 '25 '26 '27 '28	Research Field	page
2019	**KURUMIZAKA Chromatin Atlas Project** **Hitoshi KURUMIZAKA** Professor, Institute for Quantitative Biosciences, The University of Tokyo			12
	FUKATSU Evolving Symbiosis Project **Takema FUKATSU** Prime Senior Researcher, Bioproduction Research Institute, National Institute of Advanced Industrial Science and Technology (AIST)			13
	MAEDA Artificial Intelligence in Chemical Reaction Design and Discovery Project **Satoshi MAEDA** Director, WPI-ICReDD / Professor, Faculty of Science, Hokkaido University			13
2018	**IKEGAYA Brain-AI Hybrid Project** **Yuji IKEGAYA** Professor, Graduate School of Pharmaceutical Sciences, The University of Tokyo			14
	HAMACHI Innovative Molecular Technology for Neuroscience Project **Itaru HAMACHI** Professor, Graduate School of Engineering, Kyoto University			14
2017	**MIZUSHIMA Intracellular Degradation Project** **Noboru MIZUSHIMA** Professor, Graduate School of Medicine, The University of Tokyo			15
2016	**HASUO Metamathematics for Systems Design Project** **Ichiro HASUO** Professor, Information Systems Architecture Science Research Division, National Institute of Informatics			16
2015	**YAMAMOTO Atom Hybrid Project** **Kimihisa YAMAMOTO** Professor, Laboratory for Chemistry and Life Science, Institute of Innovative Research, Tokyo Institute of Technology			16

KOJIMA Market Design Project

2023 ▸ 2028

Fuhito KOJIMA

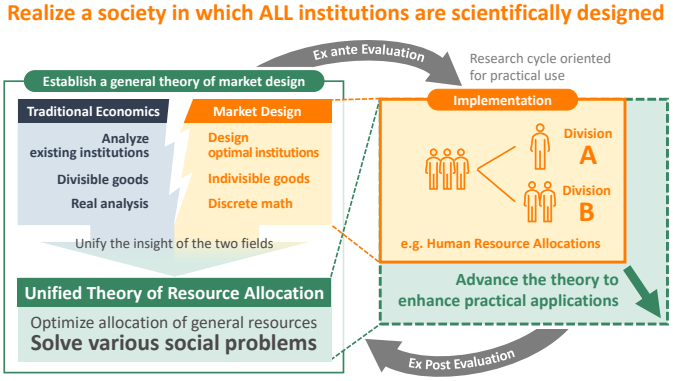
Professor, Department of Economics, The University of Tokyo

Photo: Toru Hasumi

Research Groups	Economic theory / Empirical economics / Computer science / Discrete mathematics / Implementation
WEBSITE	https://www.jst.go.jp/erato/en/research_area/ongoing/jpmjer2301.html

The recent development of market design has allowed us to design institutions for various resource allocation problems. However, compared to its great potential, the number of successful practical applications is still limited because a highly versatile general theory has not been established and rigorous evaluation of policy effects is often unavailable.

This project aims to address these issues. We pursue a unified theory of resource allocation that integrates insights from traditional economics and market design. We develop a cycle that puts the theory into practice and then feeds the empirical evidence back into the theory. In doing so, we establish a broadly applicable theory of market design and engineering methods for implementing scientifically designed institutions.



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SAGAWA Information-to-Energy Interconversion Project

2023 ▸ 2028

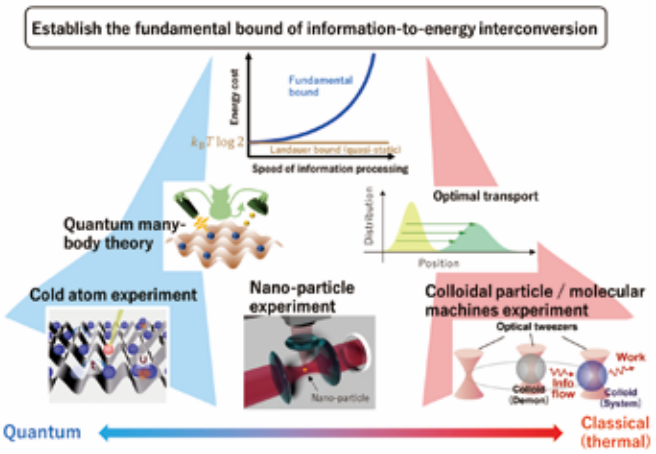
Takahiro SAGAWA

Professor, Graduate School of Engineering, The University of Tokyo

Research Groups	Information thermodynamics theory / Optimal transport theory / Quantum many-body theory / Molecular machine experiment / Nano-particle experiment / Ultracold atom experiment
WEBSITE	https://www.jst.go.jp/erato/en/research_area/ongoing/jpmjer2302.html

Currently available computers consume much more energy than the fundamental bound, and the increase in energy consumption associated with computation is a serious problem.

This Research Project sets the problem of how to simultaneously achieve fast information processing and high energy efficiency, which are in a trade-off relationship. The research will be conducted both theoretically and experimentally from the perspective of thermodynamics of information, which has been pioneered by the Research Director. Specifically, we will establish a theory of the fundamental bound of energy required for fast information processing. Experimentally, interconversion between information and thermodynamic energy will be verified through control of thermal and quantum fluctuations. The obtained results would lead to new design principles of computers in the future.



SATO Organoid Design Project

2023 ▸ 2028

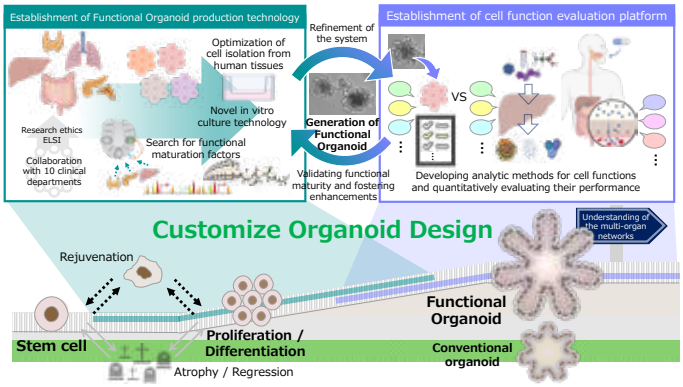
Toshiro SATO

Professor, Keio University School of Medicine

Research Groups	Organoid development / Structure analysis / Metabolic analysis / Informatic analysis
WEBSITE	https://www.jst.go.jp/erato/en/research_area/ongoing/jpmjer2303.html

Organoids are structures that mimic living tissue and are established by culturing stem cells in specific environments. Organoids enable us to recapitulate gene expression and the self-organization of tissues. However, achieving functional maturation in organoids has proven extremely challenging, creating a bottleneck in our understanding of the multi-organ networks regulating human homeostasis.

Our project is dedicated to the development of 'functional organoids' that possess mature, organ-level functions at the cellular level. We are accomplishing this by developing novel cell culturing methods and a technological breakthrough for analyzing the physiological and biochemical functions of human tissues. Functional organoids hold the promise of advancing research into various biological phenomena and have significant potential for clinical applications, including drug development and regenerative medicine.



SEKIGUCHI Three-nucleon Forces Project

2023 ▸ 2028

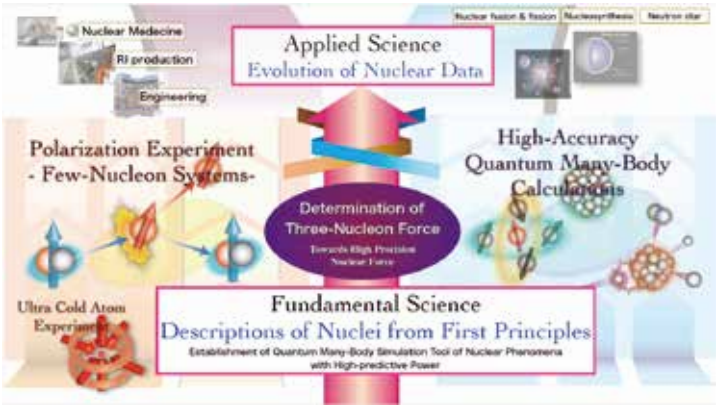
Kimiko SEKIGUCHI

Professor, School of Science, Tokyo Institute of Technology

Research Groups	Determination of three-nucleon force / Accurate quantum many-body calculations / Quantum simulation experiment of nucleon systems with cold atoms / Extension to the applied science - evolution of nuclear data -
WEBSITE	https://www.jst.go.jp/erato/en/research_area/ongoing/jpmjer2304.html

Understanding nuclear properties such as half-lives, reaction rates, etc., from first principles is a great dream of nuclear physicists. Nuclear properties are determined by forces that act between nucleons.

In the project, in order to establish accurate and precise nuclear interactions, the three-nucleon forces are determined from high-precision experiments on few-nucleon systems using chiral effective field theory. A precise quantum many-body calculation method based on the nuclear forces is established, which will allow us to compute nuclear properties with extremely high predictive power. Cold-atom systems are considered to validate the accuracy of the computational method. The newly established calculation framework for nuclear systems will be extended to applied science.



UCHIDA Magnetic Thermal Management Materials Project

2022 ▸ 2027

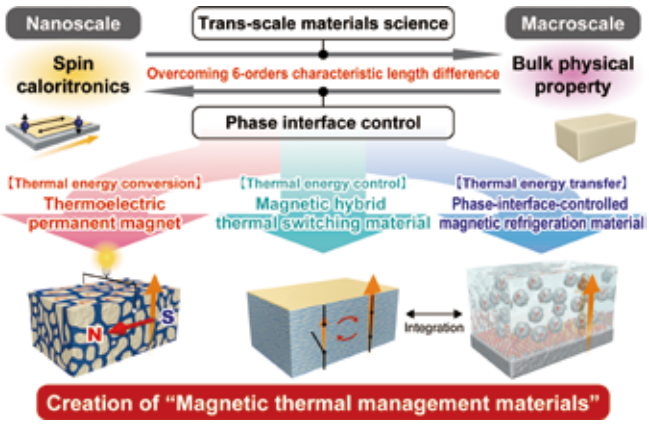
Ken-ichi UCHIDA

Distinguished Group Leader, Spin Caloritronics Group, Research Center for Magnetic and Spintronic Materials, National Institute for Materials Science

Research Groups	Thermal Management Principle and Functionality Development / Multi-hierarchical Structure Analysis / Magnetic Thermal Management Device / Hierarchy-controlled Material Synthesis / Spatiotemporal Thermal Measurement / Thermal Control Engineering Fusion /
WEBSITE	https://www.jst.go.jp/erato/uchida/en/index.html

Magnets are used in electric vehicle motors and power generators, and are essential materials for human life. The fusion research field on the interaction of electron spin (origin of magnetism), charge, and heat is called spin caloritronics. In this field, new phenomena are being discovered one after another, and are expected to lead to new energy-saving technologies. However, most of the spin-caloritronic phenomena are only observed at the nanoscale, and it has been difficult to use these phenomena in macroscale materials that contribute to energy applications.

Against this background, this research project creates “magnetic thermal management materials," a group of energy materials that realize highly efficient thermal energy conversion, control, and transfer. Magnetic thermal management materials are defined as a generic term for new magnetic hybrid/composite materials in which the thermo-spin conversion capability, which has been available only on the nanoscale, plays an essential role on the macroscale and the thermal management performance and functionality are improved through nanostructure and interface control. Through this project, we will develop materials science that links nanoscale spin physics and macroscale thermophysical properties, and bring about thermal energy device applications of spin caloritronics.



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SHIBATA Ultra-atomic Resolution Electron Microsopy Project

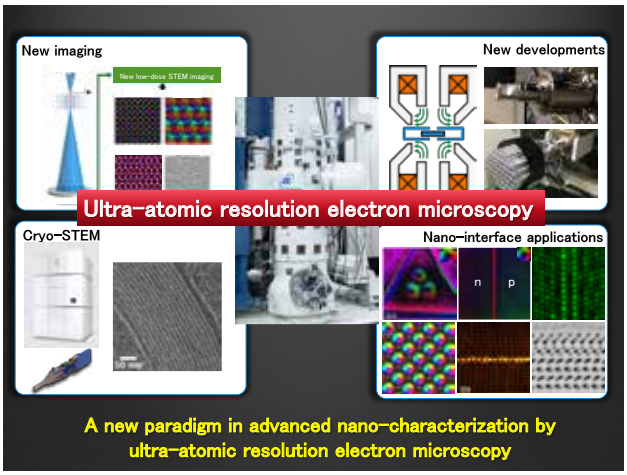
2022 ▸ 2027

Naoya SHIBATA

Professor, Institute of Engineering Innovation, School of Engineering, The University of Tokyo

Research Groups	Imaging method and application / Microscope development / Cryo-STEM / Quantum Thin Filme
WEBSITE	https://www.jst.go.jp/erato/shibata/en/index.html

We will develop an innovative electron microscope that enables direct observation of atomic-scale structures and phenomena directly related to material properties, but which have been impossible to observe using conventional microscopy techniques. Using this microscope, we will establish atomic-scale "direct observation" methods to elucidate the microscopic origin of physical and functional properties, from high temperatures all the way down to very low temperatures, and across a wide range of specimens from nanomaterials to biological samples. We will apply these methods to solving problems at the cutting-edge of the materials and life sciences, and so contribute to tackling society's most important issues.



ARITA Lipidome Atlas Project

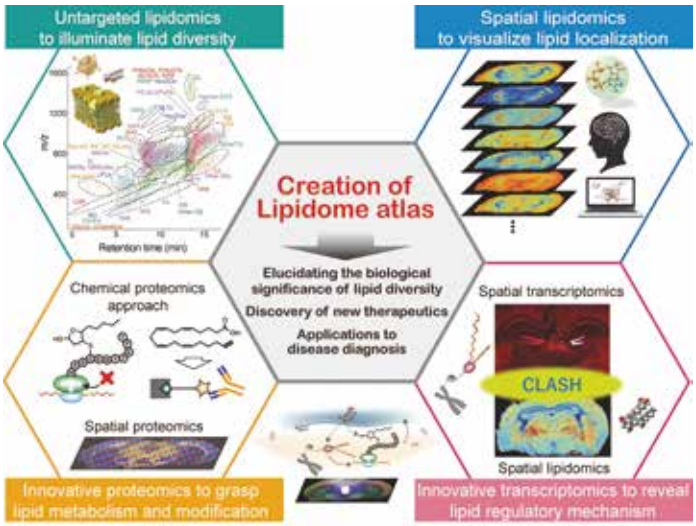
2021 ▸ 2026

Makoto ARITA

Professor, Keio University Faculty of Pharmacy /
Team leader, RIKEN Center for Integrative Medical Science

Research Groups	Lipid diversity and spatial lipidomics / Lipid-related functional genomics / Lipid-related proteomics / Lipid-related bioinformatics / Lipid biology
WEBSITE	https://www.jst.go.jp/erato/arita/en

In this project, we will create a "lipidome atlas" that captures lipid diversity, distribution, localization, and lipid modification in life as a whole. Based on the non-targeted lipidomics, we will build a basic technology that combines spatial lipidomics to investigate the localization of lipids, innovative proteomics to understand lipid metabolic enzymes and modifications, and spatial transcriptomics to elucidate the factors of lipid localization. In this way, we will visualize the effects of the local environment created by specific lipids on the dynamics and functions of multicellular systems. In addition, we will elucidate the mechanisms that regulate lipid diversity and its localization in vivo, to understand the biological significance of lipid diversity, and to elucidate diseases caused by its disruption.



KATAOKA Line X-ray and Gamma-ray Imaging Project

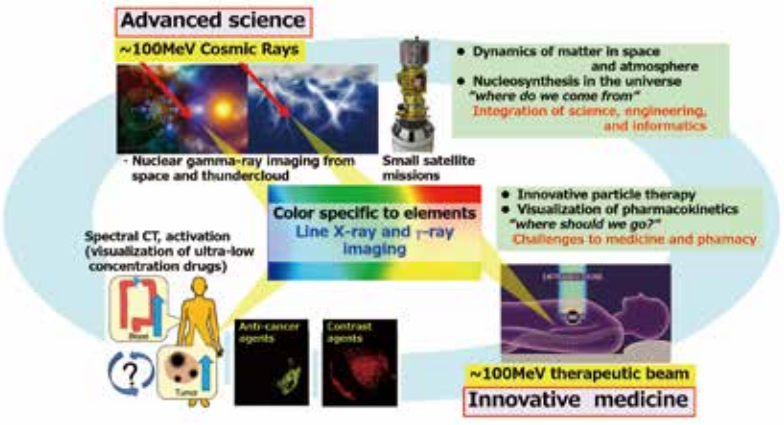
2021 ▸ 2026

Jun KATAOKA

Professor, School of Advanced Science and Engineering,
Faculty of Science and Engineering, Waseda University

Research Groups	Spectral photon counting CT / Nuclear medicine and particle therapy / Astrophysics and atmospheric physics
WEBSITE	https://www.jst.go.jp/erato/kataoka/?lang=en

Cosmic rays below 100 MeV are key to the origin of life and the evolution of stars, and they activate interstellar matter to emit spectral emission lines of X-rays and gamma rays specific to the elements. In this research, we will establish an imaging method to visualize line X-ray and gamma-rays from activated materials in general. We will expand this method to the fields of space, medicine, and pharmacology, and establish a new interdisciplinary framework for imaging “dynamics of materials” in a unified manner. We will make a breakthrough not only in space science but in particle therapy and pharmacokinetics of ultra-low concentration drugs to visualize their therapeutic effects.



NOZAKI Resin-Degradation Catalyst Project

2021 ▸ 2026

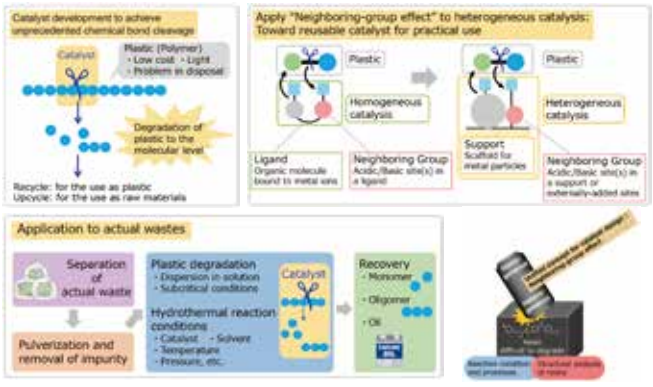
Kyoko NOZAKI

Professor, Graduate School of Engineering, The University of Tokyo

Research Groups	Degradation catalyst for persistent resins / Introduction of breakable bonds to polyolefins / Reaction system design / Structural evaluation / Biodegradability evaluation
WEBSITE	https://www.jst.go.jp/erato/nozaki/english/

Our modern life is supported by macromolecules made by connecting small molecules using "synthetic chemistry". Synthetic resin (plastic) thus created has rapidly become widespread. In spite of its enormous benefit, we face their disposal issues. To solve this problem, "degradation chemistry" is indispensable developing reactions to decompose macromolecules or tools (catalyst) to be used for decomposition.

In this project, we develop catalysts for degrading plastics for recycling and/or upcycling. We extend concept of “adjacent group contribution in catalysis”, commonly accepted in homogeneous catalysts (soluble in solution), to heterogeneous catalysts (insoluble in solution) widely used industrially. Through this project, we expect to develop a plastic reuse process for solving social issues and to build a new academic field "degradation chemistry".



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UEDA Biological Timing Project

2020 ▸ 2025

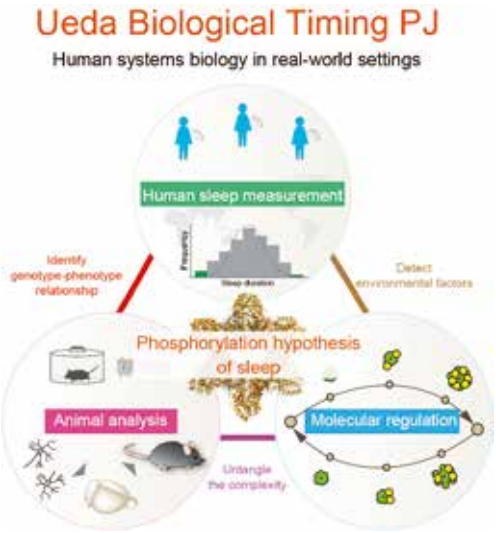
Hiroki R. UEDA

Professor, Graduate School of Medicine, The University of Tokyo /
Team leader, RIKEN Center for Biosystems Dynamics Research

Research Groups	Human sleep measurement / Animal analysis / Molecular regulation
WEBSITE	https://www.jst.go.jp/erato/uedah/

Based on the determination of the genome sequence, systems biology, which is the study of the function of biological systems based on the interactions among its components, has been developed. However, since mammals, especially humans have extremely complex biological systems including social and environmental factors in real-world settings, human systems biology not yet been fully established.

This project aims to elucidate the biological timing mechanisms underlying sleep-wake cycles by applying state-of-the-art technology in mouse genetics and human sleep measurement techniques. Centered on the phosphorylation hypothesis of sleep proposed by Ueda, this project explores relevant genes from human population data, identify genotype-phenotype causality relationships, and control gene product activities.



SUZUKI RNA Modification Project

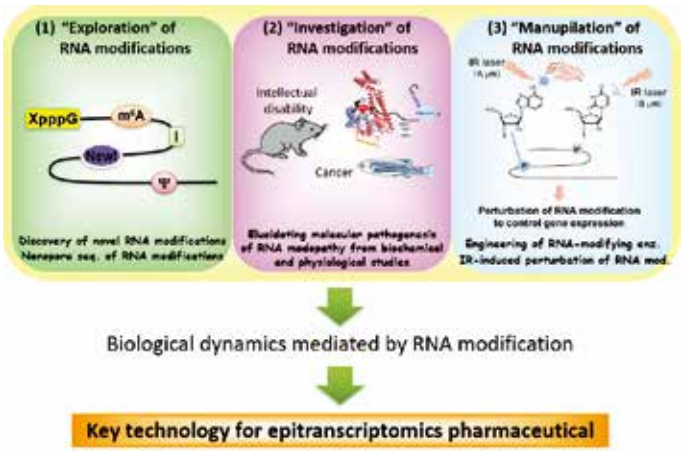
2020 ▸ 2025

Tsutomu SUZUKI

Professor, Graduate School of Engineering, The University of Tokyo

Research Groups	Biochemistry / Physiology / Bioinformatics / Single-Molecule Analysis
WEBSITE	https://www.jst.go.jp/erato/suzuki/english/index.html

This project aims to unveil physiological roles of RNA modifications associated with fundamental biological processes. We search for novel RNA modifications from human cells and other organisms, and determine their chemical structures by RNA mass spectrometry. We are also developing nanopore sequencing of RNA modifications assisted by neural networks and deep learning. In this project, we identify novel RNA-modifying enzymes and their genes, and study biogenesis and physiological function of the RNA modifications by generating knockout mice. We aim to elucidate molecular pathogenesis of “RNA modopathies”, human diseases caused by abnormal RNA modification. Furthermore, we attempt to control cellular processes by artificially manipulating RNA modifications, thereby establishing a technological basis for future drug discovery and therapeutic measures.



YAMAUCHI Materials Space-Tectonics Project

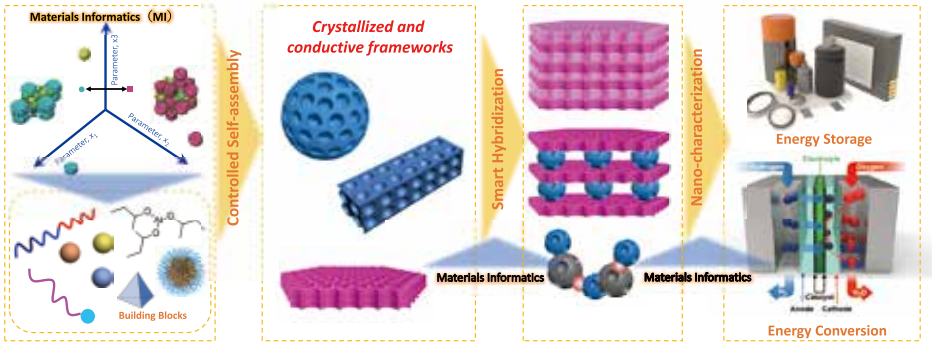
2020 ▸ 2025

Yusuke YAMAUCHI

Distinguished Professor, Department of Materials Science and Engineering, School of Engineering,
Nagoya University / Professor, The University of Queensland / MANA Principal Investigator, National Institute for Materials Science

Research Groups	Function Integration Tecton / MI Tecton / Nano-instrumentation Tecton / Interface Control Tecton / Nano-structural Control Tecton / New Materials Exploration
WEBSITE	https://www.jst.go.jp/erato/yamauchi/

In this ERATO, we will create novel “inorganic nanosolids” containing internal nanospaces, as unprecedented nanospace materials, and develop several methodologies for their effective integration with the aim of exploiting functions obtained based on the synergistic fusion of various supramolecular, photonic, and magnetic behaviors occurring in nanospace. We will cover a wide range of various porous systems such as metals, carbons, sulfides, phosphides, transition metal oxides, etc. We will efficiently combine ‘machine learning’ with our inorganic synthesis methods to accelerate the optimization of synthetic parameters for the design of target materials, and to select proper patterns of combination of each inorganic block for the integration of materials.



KURUMIZAKA Chromatin Atlas Project

2019 ▸ 2024

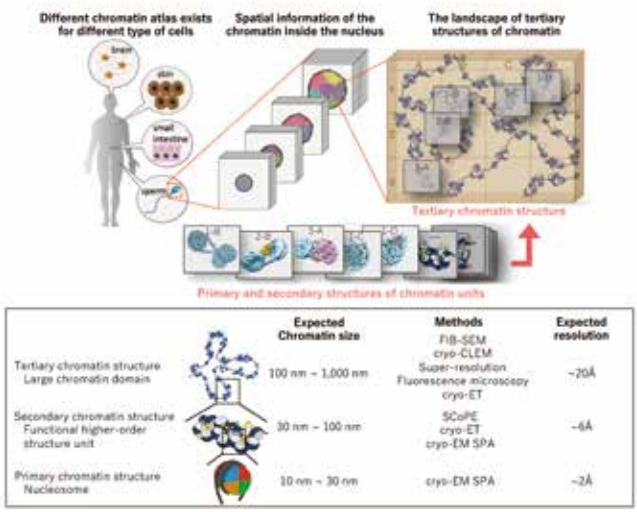
Hitoshi KURUMIZAKA

Professor, Institute for Quantitative Biosciences, The University of Tokyo

Research Groups	Chromatin structure research / Organic Synthesis chemistry research and development / Phenotype analysis research
WEBSITE	https://www.jst.go.jp/erato/kurumizaka/

In eukaryotes, genomic DNA is stored in the nucleus as nucleosomes, interacting with a set of proteins, forming a molecular complex called chromatin. The proper folding of the chromatin structure plays a crucial role in the regulation of genomic DNA functions, its disruption leading to various diseases. Therefore, understanding the chromatin structure-based mechanisms that regulate the use of the genetic information is crucial for designing new therapeutic strategies.

Based on advanced cryo-electron microscopy technology we try to determine the structures and functions of various chromatin units. Our project goal is to elucidate “chromatin atlas” representing the ensemble of these structures. Through these studies, we aim to create a new concept in regulatory mechanisms of genetic information.



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FUKATSU Evolving Symbiosis Project

2019 ▸ 2024

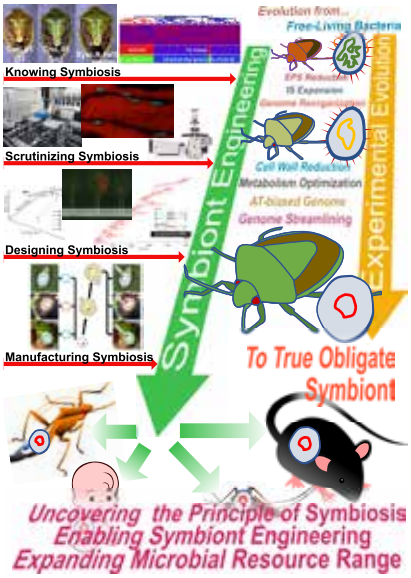
Takema FUKATSU

Prime Senior Researcher, Bioproduction Research Institute,
National Institute of Advanced Industrial Science and Technology (AIST)

Co-research director
Shinji FUKUDA — Project Professor, Institute for Advanced Biosciences, Keio University
Chikara FURUSAWA — Team Leader, Center for Biosystems Dynamics Research, RIKEN

Research Groups	Experimental Symbiotic Evolution/Genomics / Symbiotic Evolution Analysis/Evaluation/Control / Symbiont Genome Manipulation / Symbiotic Interactions/Communication / Symbiotic System Analysis/Reconstruction / Interspecific Symbiont Transfer/Experimental Evolution
WEBSITE	https://www.jst.go.jp/erato/fukatsu/english/

Symbiotic associations with microorganisms play pivotal roles in animals, plants and human. Now "symbiosis" and "microbiome" are important keywords in basic biology, agriculture and medical science. However, highly intimate symbiotic associations are difficult to investigate experimentally, because the symbiotic partners are usually non-model organisms that are integrated into an almost inseparable biological entity. Consequently, such microorganisms cannot survive outside the host and are mostly uncultivable. For a long time, these conditions have severely hindered our understanding of symbiosis. This project aims at bringing about breakthroughs to overcome these difficulties, on the basis of the establishment of novel insect-E. coli and mammal-E. coli experimental symbiotic systems and the development of recent genome engineering technologies, thereby drastically promoting our understanding of symbiosis.



MAEDA Artificial Intelligence in Chemical Reaction Design and Discovery Project

2019 ▸ 2024

Satoshi MAEDA

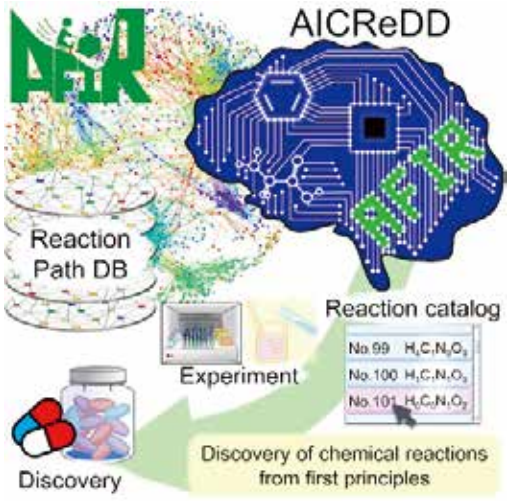
Director, WPI-ICReDD /
Professor, Faculty of Science, Hokkaido University

Co-research director
Satoru IWATA — Professor, Graduate School of Information Science and Technology, The University of Tokyo / Project Professor, WPI-ICReDD, Hokkaido University

Research Groups	Project Management / Quantum Chemistry / Materials Informatics / Organic Synthesis / Robot Synthesis / Optimization / Machine Learning
WEBSITE	https://www.jst.go.jp/erato/maeda/en/

This project aims to generate “Artificial Intelligence in Chemical Reaction Design Discovery” (AICReDD) that predicts “the whole picture of the behavior of atoms” in chemical reactions and suggests useful and unknown chemical reactions one after another. This will be done by integrating technologies in computational chemistry, information science, and materials informatics. Particularly, our highly versatile automated reaction path method called the Artificial Force Induced Reaction (AFIR) method and combinatorial optimization theory and algorithms are the bases of the AICReDD.

Specifically, we will use the AFIR method to calculate “reaction path network” for combinations of various reactants and catalysts and construct a system to quickly design and suggest chemical reactions appropriate for the synthesis of target substances from the obtained reaction path database. In this case, combinatorial optimization is applied to derive combinations of reactants that maximize the yield of the target product. We will further try to implement AICReDD in synthesis robots and aim to greatly accelerate the speed of discovering the most favorable chemical reaction producing the target substance.



IKEGAYA Brain-AI Hybrid Project

2018 ▸ 2023

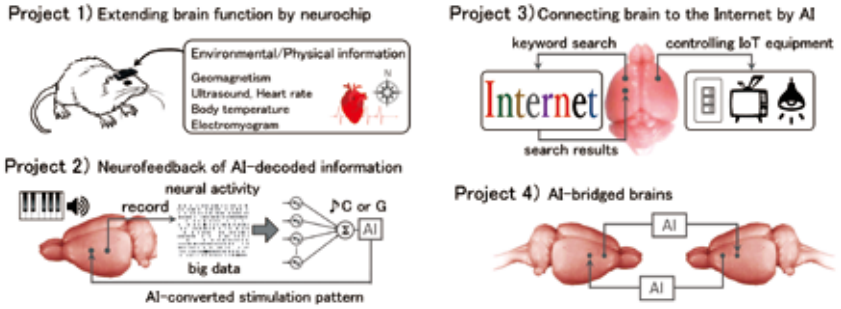
Yuji IKEGAYA

Professor, Graduate School of Pharmaceutical Sciences, The University of Tokyo

Research Groups	Fundamental Research / Computation / Analysis / Applied Research
WEBSITE	https://www.jst.go.jp/erato/ikegaya/english.html

The human brain has evolved by adapting to various tools that humans invented by themselves, including characters and telephones. This fact indicates that the brain also has potentials for adapting even to new yet-unknown environments in the future.

In this project, we aim to address how the brain is plastic enough to handle complex technologies and explore the new dimension of the latent ability of the brain using artificial intelligence (AI). To unveil the potentials of the brain, we will utilize and develop techniques and tools in neuroscience and machine learning for the brain signals. Specifically, with extreme care of bioethics, we will conduct electrophysiological and behavioral experiments in rodents and apply these outcomes to human research.



HAMACHI Innovative Molecular Technology for Neuroscience Project

2018 ▸ 2023

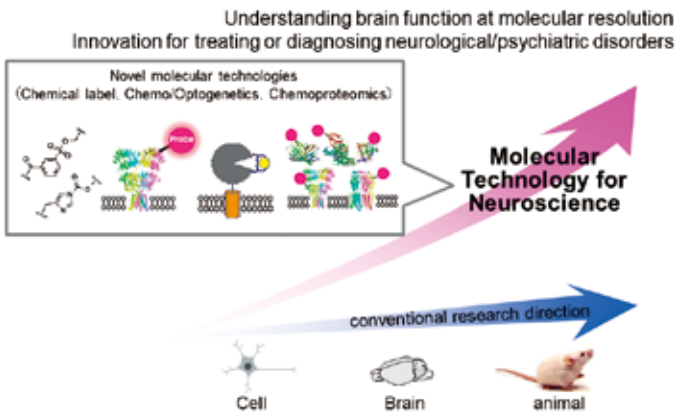
Itaru HAMACHI

Professor, Graduate School of Engineering, Kyoto University

Research Groups	Development of new live-cell organic chemistry / Development of methods for controlling protein activity / Strategies for imaging and regulation of neuron and brain tissue / Clarifying physiological roles in animals using molecular technologies
WEBSITE	https://www.jst.go.jp/erato/hamachi/en/index.html

Our research purpose is developing new molecular technology based on live-cell organic chemistry that can selectively label and modify target proteins under natural habitats. We also aim to develop unique chemical methods (chemical and photo-chemical genetics) for artificially controlling protein functions. These new methodologies are applied not only to model cells but also to complicated biological systems including cultured neurons, brain tissues and live animals. These allow for selective imaging of neurotransmitter receptors and clarification of neuronal networks at molecular resolution.

Based on these efforts, we would like to establish a new technology termed "Innovative molecular technology for neuroscience". We believe that this would contribute to understanding brain function at molecular level, and lead to the diagnosis and therapy for neurological and psychiatric disorders.



ERATO

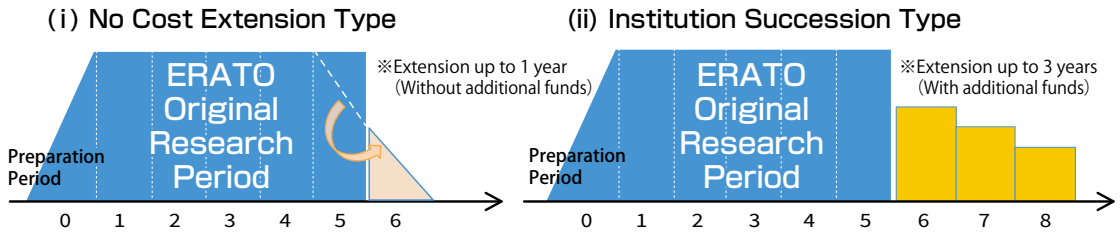
Additional Support Period

Depending on the project's development and the host research institution's commitment, an extension period, "Additional Support Period," can be granted continuously after the original five-year project period.

(i) Additional Support Period (No Cost Extension Type) may be granted if the extended period assures an adequate completion of the project and reinforces the research outcome, which leads to a next leap after ERATO. The extended period is up to one year. The budget for the extended period is provided with a reallocation from the final year's funds and is up to 50 million yen for direct cost plus 10 million yen for the Headquarters' cost.

(ii) Additional Support Period (Institution Succession Type) may be granted if the host institution specifically and strongly supports the project during the project's original period and plans a permanent framework to succeed the project on its own initiative, and further the framework will surely develop synergistically with a JST's supplementary support after the original project's period. The extended period is up to three years. The supplemental funds are up to 50 million yen for direct cost plus 20 million yen for the Headquarters' cost annually.

ERATO Additional Support Period



MIZUSHIMA Intracellular Degradation Project (No Cost Extention) 2017▸2023

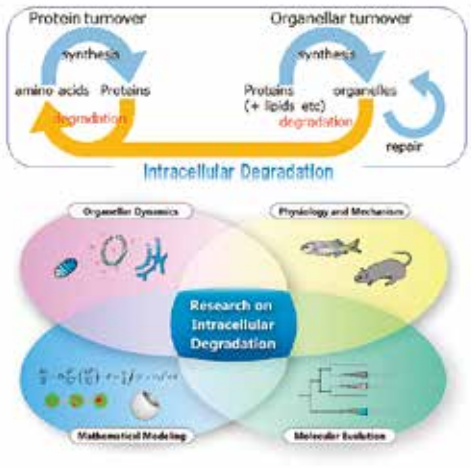
Noboru MIZUSHIMA

Professor, Graduate School of Medicine, The University of Tokyo

Research Groups	Organellar Dynamics Research / Physiology and Molecular Research / Mathematical Modeling / Molecular Evolution
WEBSITE	https://www.jst.go.jp/erato/mizushima/english/index.html

Intracellular constituents such as proteins and organelles are turned over by unremitting synthesis and degradation. This dynamic turnover is critical for homeostasis, development, and environmental adaptation. Autophagy, one of the major degradation systems, is conserved in most eukaryotes and can degrade not only proteins but also larger materials including organelles. Although autophagy is basically a non-selective process, it can act on specific substrates. However, our comprehensive and quantitative understanding of autophagic degradation remains relatively limited. Since autophagy is considered to be connected to aging and human diseases, a precise understanding of autophagy is now even more imperative.

In this project, by focusing on autophagic degradation of proteins and organelles, we will develop innovative technologies for quantitative measurement of autophagic activity and organellar analysis and isolation, reveal the biological significance and mechanisms of intracellular degradation in vertebrates, incorporate mathematical and physical modeling approaches, and investigate molecular evolution of autophagy-related molecules. The findings and technologies developed in this project will contribute not only to various basic science fields such as cell biology and cell physiology but also to our understanding of pathogenesis and therapeutic strategy of intracellular turnover-related diseases.



HASUO Metamathematics for Systems Design Project (Institution Succession)

2016 ▸ 2024

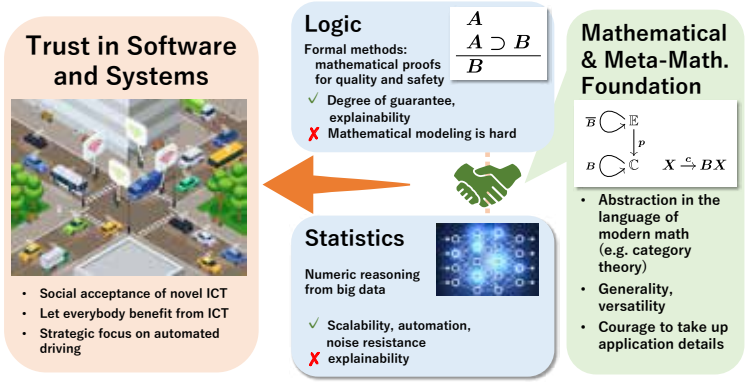
Ichiro HASUO

Professor, Information Systems Architecture Science Research Division,
National Institute of Informatics

Research Groups: Metamathematical Integration / Trust in Software and Systems
WEBSITE: https://www.jst.go.jp/erato/hasuo/en/

ICT is changing the landscape of manufacturing with pervasive automation and computer support in design and production processes. Our project aims to leverage techniques from software science—specifically the body of mathematical techniques called formal methods—in manufacturing, eventually leading to software tools that support various stages of design processes.

In doing so we face the challenge of modeling, that is, the difficulty of accommodating massive systems with black-box components and uncertainties in logically rigorous frameworks. Here we need the "top-down" use of formal logic that, unlike the conventional "bottom-up" use that stacks up verified facts only, decomposes quality/safety goals into smaller assumptions that are easier to assert, check, and enforce.



In the Additional Research Period, we will pursue this new use of logic, joining forces with statistical and empirical methodologies. Our characteristic emphasis on abstract (meta)theories will boost this interdisciplinary pursuit. Our project strives to be a hub for comprehensive software research, connecting academia and industry. Our strategic application domain is automated driving.

YAMAMOTO Atom Hybrid Project (Institution Succession)

2015 ▸ 2023

Kimihisa YAMAMOTO

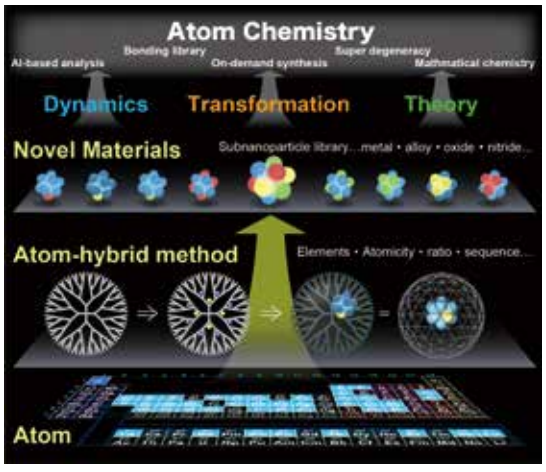
Professor, Laboratory for Chemistry and Life Science, Institute of Innovative Research,
Tokyo Institute of Technology

Research Groups: Subnano physical property / Subnano observation / Subnano reaction / Practical application
WEBSITE: https://www.jst.go.jp/erato/yamamoto/en/

Nanoparticles are employed extensively in the field of engineering as one of the most important nanotechnology materials, and there is fierce global competition in research and development. To date, however, the properties of sub-nanoparticles have not been fully characterized, which means progress in establishing methods of the synthesis has been hindered. Of special note is that there is as yet no universal method of assembling and blending the more than 90 metallic elements contained in the periodic table of elements with a predetermined number of dissimilar metallic atoms.

This project was established to create sub-nano metal particles in which the number of atoms is controllable, and sub-nano-hetero metal particles made from the precise blending of dissimilar elements at the atomic level with the goal of creating new next-generation functional materials.

We, during this special extension period, aim to create a new scientific category “atom chemistry” composed of three realms: the realm of Superatomic reaction, the realm of atomic dynamics, the realm of superatom theory. Furthermore, by positioning this project as a hub of “atom science” which deals with comprehensive science and technology of atom, we pursue continuous, constructive research development while collaborating with domestic and international research institutions and companies.



ERATO

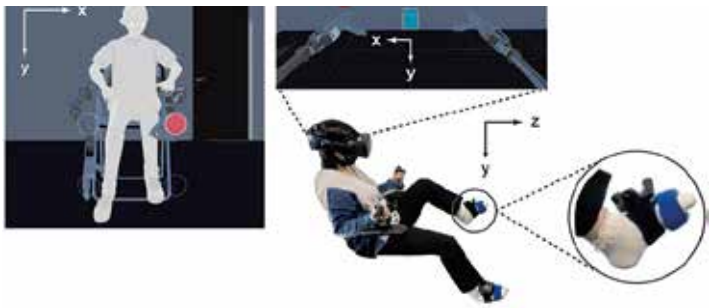
Highlighted Publications

(April 2022 - March 2023)

Published Date	Project	Title
2022/4/4	NOMURA Microbial Community Control	Staphylococcus aureus utilizes environmental RNA as a building material in specific polysaccharide-dependent biofilms
2022/4/12	SUZUKI RNA Modification	Mechanistic insights into tRNA cleavage by a contact-dependent growth inhibitor protein and translation factors
2022/4/28	SUZUKI RNA Modification	Reversible RNA phosphorylation stabilizes tRNA for cellular thermotolerance
2022/5/10	FUKATSU Evolving Symbiosis	History-Dependent Physiological Adaptation to Lethal Genetic Modification under Antibiotic Exposure
2022/5/10	SUZUKI RNA Modification	Regulation of A-to-I RNA editing and stop codon recoding to control selenoprotein expression during skeletal myogenesis
2022/5/11	SAITOH Spin Quantum Rectification	Observation of spin-current striction in a magnet
2022/5/16	NUMATA Organellar Reaction Cluster	Polymer-coated carbon nanotube hybrids with functional peptides for gene delivery into plant mitochondria
2022/6/10	KURUMIZAKA Chromatin Atlas	Structural basis for binding diversity of acetyltransferase p300 to the nucleosome
2022/6/16	HAMACHI Innovative Molecular Technology for Neuroscience	Coordination chemogenetics for activation of GPCR-type glutamate receptors in brain tissue
2022/6/27	INAMI JIZAI Body	Embodiment of supernumerary robotic limbs in virtual reality
2022/7/7	HASUO Metamathematics for Systems Design	Goal-Aware RSS for Complex Scenarios via Program Logic
2022/8/5	FUKATSU Evolving Symbiosis	Single mutation makes Escherichia coli an insect mutualist
2022/8/9	MAEDA Artificial Intelligence in Chemical Reaction Design and Discovery	In silico reaction screening with difluorocarbene for N-difluoroalkylative dearomatization of pyridines
2022/9/6	YAMAUCHI Materials Space-Tectonics	MOF-derived nanoporous carbons with exotic nanoarchitectures
2022/9/29	KATAOKA Line X-ray and Gamma-ray Imaging	Compton camera imaging of a gamma-ray glow from a thunderstorm
2022/9/30	NUMATA Organellar Reaction Cluster	Organellar Glue: A Molecular Tool to Artificially Control Chloroplast-Chloroplast Interactions
2022/10/5	UEDA Biological Timing	Distinct phosphorylation states of mammalian CaMKII β control the induction and maintenance of sleep.
2022/11/9	KATAOKA Line X-ray and Gamma-ray Imaging	Activation imaging of drugs with hybrid Compton camera: A proof-of-concept study
2022/11/21	MAEDA Artificial Intelligence in Chemical Reaction Design and Discovery	A theory-driven synthesis of symmetric and unsymmetric 1,2-bis(diphenylphosphino)ethane analogues via radical difunctionalization of ethylene
2022/11/30	KURUMIZAKA Chromatin Atlas	Structural basis of RNA polymerase II transcription on the chromatosome containing linker histone H1
2022/12/1	MAEDA Artificial Intelligence in Chemical Reaction Design and Discovery	Prediction of High-Yielding Single-Step or Cascade Pericyclic Reactions for the Synthesis of Complex Synthetic Targets
2022/12/2	HAMACHI Innovative Molecular Technology for Neuroscience	Revisiting PFA-mediated tissue fixation chemistry: *FixEL* enables trapping of small molecules in the brain to visualize their distribution changes
2022/12/8	IKEGAYA Brain-AI Hybrid	A survey of researchers and the public on their attitude toward the BRAIN–AI convergence
2022/12/14	FUKATSU Evolving Symbiosis	Analysis of the evolution of resistance to multiple antibiotics enables prediction of the *Escherichia coli* phenotype-based fitness landscape
2022/12/19	ARITA Lipidome Atlas	Computational mass spectrometry accelerates C=C position-resolved untargeted lipidomics using oxygen attachment dissociation
2023/1/23	NOMURA Microbial Community Control	Instantaneous Clearing of Biofilm (iCBiofilm): an optical approach to revisit bacterial and fungal biofilm imaging
2023/1/26	FUKATSU Evolving Symbiosis	Bacteroides uniformis and its preferred substrate, α-cyclodextrin, enhance endurance exercise performance in mice and human males
2023/3/14	HAMACHI Innovative Molecular Technology for Neuroscience	Organelle-selective click labeling coupled with flow cytometry allows pooled CRISPR screening of genes involved in phosphatidylcholine metabolism
2023/3/17	SUZUKI RNA Modification	Restoration of mitochondrial function through activation of hypomodified tRNAs with pathogenic mutations associated with mitochondrial diseases
2023/3/21	SHIBATA Ultra-atomic Resolution Electron Microscopy	Real-space observation of a two-dimensional electron gas at semiconductor heterointerfaces

- Project name: INAMI JIZAI Body Project
- ResearchDirector: **Masahiko INAMI** Professor, Research Center for Advanced Science and Technology, The University of Tokyo
- Press Title: Supernumerary virtual robotic arms can feel like part of our body

Professor Masahiko INAMI and his group of the University of Tokyo's Research Center for Advanced Science and Technology, in collaboration with Keio University and Toyohashi University of Technology have developed a virtual robotic limb system which can be operated by users' feet in a virtual environment as extra, or supernumerary, limbs. After training, users reported feeling like the virtual robotic arms had become part of their own body. This study focused on the perceptual changes of the participants, understanding of which can contribute to designing real physical robotic supernumerary limb systems that people can use naturally and freely just like our own bodies.



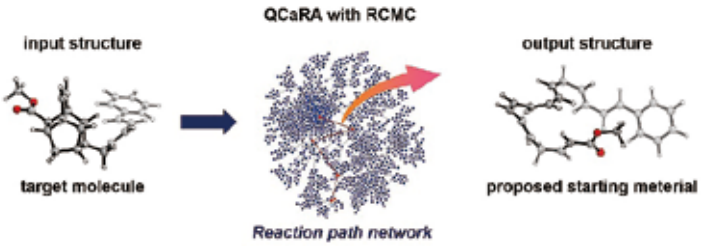
The supernumerary limb robot system that operates in a VR environment consists of a head-mounted display that presents visual information from a first-person perspective, a tracker that detects the movement of the wearer, and a tactile device that responds to feet of a participant.

Press Information Scientific Reports, 12, 9769(2022): 1–12

- Project name: MAEDA Artificial Intelligence in Chemical Reaction Design and Discovery Project
- ResearchDirector: **Satoshi MAEDA** Director, WPI-ICReDD / Professor, Faculty of Science, Hokkaido University
- Co-Research Director: **Satoru IWATA** Professor, Graduate School of Information Science and Technology, The University of Tokyo / Project Professor, WPI-ICReDD, Hokkaido University
- Press Title: Automated chemical reaction prediction: now in stereo

The discovery of new chemical reactions with industrial impact requires a large number of repeated experiments. The team developed Quantum Chemistry-aided Retrosynthetic Analysis (QCaRA), which finds a route from a target compound to available raw materials based solely on quantum chemical calculations, without using the knowledge and experience of organic chemists or a database based on experiments. This was achieved by combining their automated reaction path search and kinetic analysis methods.

The results of applying QCaRA to natural organic compounds have indeed proven that the starting materials can be efficiently searched by QCaRA. In the future, QCaRA is expected to make a significant contribution to the development of the field of organic synthetic chemistry.



Press Information J. Am. Chem. Soc. 2022, 144, 50, 22985–23000

Visit our website for the latest information

News

The latest information about research achievements and public events is available.

About The Program

Funding scheme and features of the ERATO are summarized with its historical views.

Research Area/Projects

Each of the on-going and completed ERATO projects are introduced including research overview and achievement.

Call for nominations

JST calls for recommendation of excellent researchers suitable to become an ERATO Research Director through out the year.

https://www.jst.go.jp/erato/en/ ERATO

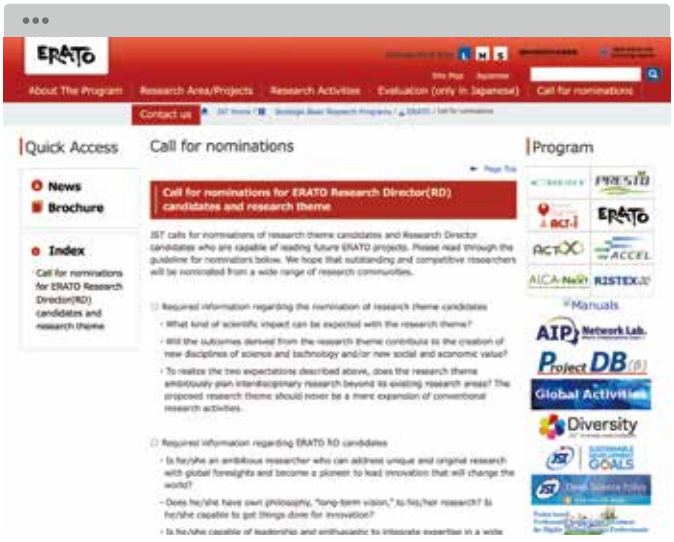
Recruitment of ERATO theme candidate and research director candidate

Overview

This recruitment aims to receive a wide range of information about research trends and researchers as a part of the preliminary selection steps for ERATO research projects and research directors. (This is not a call for proposals for research grants).

Purpose

Based on ERATO's philosophy of "enhancing unique and talented researchers who can change the world and betting on them to create scientific and technological impact", JST conducts surveys throughout the year to determine opportunities to conduct top research with the leading researchers. In order to achieve the ERATO's objectives and make the most of ERATO's features, we would like to ask for information on both "persons" with extremely original ideas and research philosophies, and on unique "themes" to create a new research stream in the future..



See the ERATO website "Call for nominations" for how to apply.

https://www.jst.go.jp/erato/en/call_for_nominations/

ERATO nomination

Completed Projects

ERATO Research Area

Affiliation and position of the Research Directors are as of the time of completion of the research period.

2017 - 2022

INAMI JIZAI Body

Research Director
Masahiko INAMI
Professor,
The University of Tokyo

2016 - 2022

NUMATA Organellar Reaction Cluster

Research Director
Keiji NUMATA
Professor,
Kyoto University /
Team Leader,
RIKEN

2016 - 2021

NAKAMURA Macroscopic Quantum Machines

Research Director
Yasunobu NAKAMURA
Professor,
The University of Tokyo /
Director, RIKEN

2015 - 2021

KAWAHARA Universal Information Network

Research Director
Yoshihiro KAWAHARA
Professor,
The University of Tokyo

NOMURA Microbial Community Control

Research Director
Nobuhiko NOMURA
Professor,
University of Tsukuba

2014 - 2019

ISHIGURO Symbiotic Human-Robot Interaction

Research Director
Hiroshi ISHIGURO
Professor,
Osaka University /
Director (visiting),
Advanced Telecommunications
Research Institute International

SAITOH Spin Quantum Rectification

Research Director
Eiji SAITOH
Professor,
The University of Tokyo

MOMOSE Quantum Beam Phase Imaging

Research Director
Atsushi MOMOSE
Professor,
Tohoku University

2013 - 2018

ADACHI Molecular Exciton Engineering

Research Director
Chihaya ADACHI
Professor,
Kyushu University

ISOBE Degenerate π-Integration

Research Director
Hiroyuki ISOBE
Professor,
The University of Tokyo

2013 - 2018

ITAMI Molecular Nanocarbon

Research Director
Kenichiro ITAMI
Professor,
Nagoya University

SATO Live Bio-Forecasting

Research Director
Thomas N. SATO
Director,
Advanced Telecommunications
Research Institute International

MINOSHIMA Intelligent Optical Synthesizer

Research Director
Kaoru MINOSHIMA
Professor,
The University of
Electro-Communications

2012 - 2017

KAWARABAYASHI Large Graph

Research Director
Kenichi KAWARABAYASHI
Professor,
National Institute of
Informatics

TOUHARA Chemosensory Signal

Research Director
Kazushige TOUHARA
Professor,
The University of Tokyo

2011 - 2016

AKIYOSHI Bio-Nanotransporter

Research Director
Kazunari AKIYOSHI

Professor,
Kyoto University

ASANO Active Enzyme Molecule

Research Director
Yasuhisa ASANO

Professor,
Toyama Prefectural University

KANAI Life Science Catalysis

Research Director
Motomu KANAI

Professor,
The University of Tokyo

SAITOU Totipotent Epigenome

Research Director
Mitinori SAITOU

Professor,
Kyoto University

SOMEYA Bio-Harmonized Electronics

Research Director
Takao SOMEYA

Professor,
The University of Tokyo

2010 - 2015

IYODA Supra-integrated Material

Research Director
Tomokazu IYODA

Professor,
Tokyo Institute of Technology

KATORI Innovative Space-Time

Research Director
Hidetoshi KATORI

Professor,
The University of Tokyo /
Chief Scientist, RIKEN

TAKEUCHI Biohybrid Innovation

Research Director
Shoji TAKEUCHI

Professor,
The University of Tokyo

HIGASHIYAMA Live-Holonics

Research Director
Tetsuya HIGASHIYAMA

Professor,
Nagoya University

MURATA Lipid Active Structure

Research Director
Michio MURATA

Professor,
Osaka University

2009 - 2014

SUEMATSU Gas Biology

Research Director
Makoto SUEMATSU

Professor,
Keio University

Counterpart
Gregg L. SEMENZA

Professor,
Johns Hopkins University

ITO Glycotrilogy

Research Director
Yukishige ITO

Chief Scientist,
RIKEN

TAKAYANAGI Osteonetwork

Research Director
Hiroshi TAKAYANAGI

Professor,
The University of Tokyo

YOMO Dynamical Micro-scale Reaction Environment

Research Director
Tetsuya YOMO

Professor,
Osaka University

MINATO Discrete Structure Manipulation System

Research Director
Shin-ichi MINATO

Professor,
Hokkaido University

2009 - 2014

NAKAJIMA Designer Nanocluster Assembly

Research Director
Atsushi NAKAJIMA
Professor,
Keio University

2008- 2013

SODEOKA Live Cell Chemistry

Research Director
Mikiko SODEOKA
Chief Scientist,
RIKEN

KAWAOKA Infection-induced Host Responses

Research Director
Yoshihiro KAWAOKA
Professor,
The University of Tokyo

TAKAHARA Soft Interface

Research Director
Atsushi TAKAHARA
Professor,
Kyushu University

OKANOYA Emotional Information

Research Director
Kazuo OKANOYA
Professor,
The University of Tokyo

2007 - 2012

HIRAYAMA Nuclear Spin Electronics

Research Director
Yoshiro HIRAYAMA
Professor,
Tohoku University

IGARASHI Design Interface

Research Director
Takeo IGARASHI
Professor,
The University of Tokyo

MAENAKA Human-Sensing Fusion

Research Director
Kazusuke MAENAKA
Professor,
University of Hyogo

KITAGAWA Integrated Pores

Research Director
Susumu KITAGAWA
Professor,
Kyoto University

Counterpart
Omar M. YAGHI
Professor,
University of California,
Los Angeles

NAKAUCHI Stem Cell and Organ Regeneration

Research Director
Hiromitsu NAKAUCHI
Professor,
The University of Tokyo

2006 - 2011

SHIMODA Nano-Liquid Process

Research Director
Tatsuya SHIMODA
Professor,
Japan Advanced
Institute of Science and
Technology

TOKURA Multiferroics

Research Director
Yoshinori TOKURA
Professor,
The University of Tokyo

MIYAWAKI Life Function Dynamics

Research Director
Atsushi MIYAWAKI
Group Director,
RIKEN

HASHIMOTO Light Energy Conversion

Research Director
Kazuhito HASHIMOTO
Professor,
The University of Tokyo

2005- 2010

ASADA Synergistic Intelligence

Research Director
Minoru ASADA
Professor,
Osaka University

2005- 2010

UEDA Macroscopic Quantum Control

Research Director
Masahito UEDA

Professor,
The University of Tokyo

IWATA Human Receptor Crystallography

Research Director
So IWATA

Professor,
Imperial College London

HASEBE Reprogramming Evolution

Research Director
Mitsuyasu HASEBE

Professor,
National Institute for
Basic Biology

2004- 2009

KANEKO Complex Systems Biology

Research Director
Kunihiko KANEKO

Professor,
The University of Tokyo

NAKAMURA Functional Carbon Cluster

Research Director
Eiichi NAKAMURA

Professor,
The University of Tokyo

2004- 2009

SHIMOJO Implicit Brain Function

Research Director
Shinsuke SHIMOJO

Professor,
California Institute of
Technology

KATO Nuclear Complex

Research Director
Shigeaki KATO

Professor,
The University of Tokyo

2003- 2008

AIHARA Complexity Modelling

Research Director
Kazuyuki AIHARA

Professor,
The University of Tokyo

KOSHIHARA Non-Equilibrium Dynamics

Research Director
Shinya KOSHIHARA

Professor,
Tokyo Institute of
Technology

KOBAYASHI Highly Functionalized Reaction Environments

Research Director
Shu KOBAYASHI

Professor,
The University of Tokyo

2003- 2008

MAEDA Actin-Filament Dynamics

Research Director
Yuichiro MAEDA

Professor,
Nagoya University

2002- 2007

OHNO Semiconductor Spintronics

Research Director
Hideo OHNO

Professor,
Tohoku University

YASHIMA Super-structured Helix

Research Director
Eiji YASHIMA

Professor,
Nagoya University

AKIRA Innate Immunity

Research Director
Shizuo AKIRA

Professor,
Osaka University

YAMAMOTO Environmental Response

Research Director
Masayuki YAMAMOTO

Professor,
Tohoku University

2001- 2006

TOKURA Spin Superstructure

Research Director
Yoshinori TOKURA

Professor,
The University of Tokyo

NAKAMURA Inhomogeneous Crystal

Research Director
Shuji NAKAMURA

Professor,
University of California
Santa Barbara

YOSHIDA ATP System

Research Director
Masasuke YOSHIDA

Professor,
Tokyo Institute of
Technology

YANAGISAWA Orphan Receptor

Research Director
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Professor,
The University of Texas
Southwestern Medical
Center

2000- 2005

IMAI Quantum Computation and Information

Research Director
Hiroshi IMAI

Professor,
The University of Tokyo

2000- 2005

AIDA Nanospace

Research Director
Takuzo AIDA

Professor,
The University of Tokyo

KOIKE Photonics Polymer

Research Director
Yasuhiro KOIKE

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Keio University

SEKIGUCHI Biomatrix Signaling

Research Director
Kiyotoshi SEKIGUCHI

Professor,
Osaka University

1999- 2004

TARUCHA Mesoscopic Correlation

Research Director
Seigo TARUCHA

Professor,
The University of Tokyo

1999- 2004

YOKOYAMA Nanostructured Liquid Crystal

Research Director
Hiroshi YOKOYAMA

Director,
National Institute of
Advanced Industrial
Science and Technology

1999- 2004

HOSONO Transparent ElectroActive Materials

Research Director
Hideo HOSONO

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Tokyo Institute of
Technology

KURODA Chiromorphology

Research Director
Reiko KURODA

Professor,
The University of Tokyo

1998- 2003

OHTSU Localized Photon

Research Director
Motoichi OHTSU

Professor,
Tokyo Institute of
Technology

KITANO Symbiotic Systems

Research Director
Hiroaki KITANO

Senior Researcher,
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Laboratories Inc.

KUSUMI Membrane Organizer

Research Director
Akihiro KUSUMI

Professor,
Nagoya University

1998- 2003

KONDOH Differentiation Signaling

Research Director
Hisato KONDOH

Professor,
Osaka University

1997- 2002

GONOKAMI Cooperative Excitation

Research Director
Makoto GONOKAMI

Professor,
The University of Tokyo

INOUE Superliquid Glass

Research Director
Akihisa INOUE

Director,
Tohoku University

NAMBA Protonic Nanomachine

Research Director
Keiichi NAMBA

Professor,
Osaka University

HORIKOSHI Gene Selector

Research Director
Masami HORIKOSHI

Associate Professor,
The University of Tokyo

1996- 2001

KAWATO Dynamic Brain

Research Director
Mitsuo KAWATO

Project Leader,
Advanced Telecommunications
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INOUE Photochirogenesis

Research Director
Yoshihisa INOUE

Professor,
Osaka University

YOKOYAMA CytoLogic

Research Director
Shigeyuki YOKOYAMA

Professor,
The University of Tokyo /
Project Director, RIKEN

TSUKITA Cell Axis

Research Director
Shoichiro TSUKITA

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Kyoto University

1995- 2000

MASUMOTO Single Quantum Dot

Research Director
Yasuaki MASUMOTO

Professor,
University of Tsukuba

1995- 2000

KATO Cytoprotein Network

Research Director
Seishi KATO

Chief Researcher,
Sagami Chemical
Research Center

DOI Bioasymmetry

Research Director
Hirofumi DOI

President & CEO,
Celestar Lexico-Sciences,
Inc.

MIKOSHIBA Calciosignal Net

Research Director
Katsuhiko MIKOSHIBA

Professor,
The University of Tokyo /
Group Director, RIKEN

1994- 1999

TAKAYANAGI Particle Surface

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Kunio TAKAYANAGI

Professor,
Tokyo Institute of
Technology

HIRAO Active Glass

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Kazuyuki HIRAO

Professor,
Kyoto University

1994- 1999

YAMAMOTO Behavior Genes

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Professor,
Waseda University

TAKAI Biotimer

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Yoshimi TAKAI

Professor,
Osaka University

1993- 1998

YAMAMOTO Quantum Fluctuation

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Yoshihisa YAMAMOTO

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Executive Research Scientist,
NTT Basic Research
Laboratories

TANAKA Solid Junction

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Shun-ichiro TANAKA

Chief Research Scientist,
Toshiba Corporation

HASHIMOTO Polymer Phasing

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Professor,
Kyoto University

1993- 1998

HIROHASHI Cell-Configuration

Research Director
Setsuo HIROHASHI

Deputy Director,
National Cancer Center
Research Institute

1992- 1997

KAWACHI Millibioflight

Research Director
Keiji KAWACHI

Professor,
The University of Tokyo

ITAYA Electro-chemiscopy

Research Director
Kingo ITAYA

Professor,
Tohoku University

YANAGIDA Biomotron

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Toshio YANAGIDA

Professor,
Osaka University

YOSHIZATO MorphoMatrix

Research Director
Katsutoshi YOSHIZATO

Professor,
Hiroshima University

1991- 1996

YOSHIMURA π- Electron Materials

Research Director
Susumu YOSHIMURA

Senior Managing
Director,
Matsushita Research
Institute Tokyo, Inc.

NOYORI Molecular Catalysis

Research Director
Ryoji NOYORI

Professor,
Nagoya University

FUSETANI Biofouling

Research Director
Nobuhiro FUSETANI

Professor,
The University of Tokyo

OKAYAMA Cell Switching

Research Director
Hiroto OKAYAMA

Professor,
The University of Tokyo

1990 - 1995

KIMURA Metamelt

Research Director
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Supervising Researcher,
National Institute for
Research in Inorganic
Materials

1990 - 1995

NAGAYAMA Protein Array

Research Director
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Professor,
The University of Tokyo

TORII Nutrient-Stasis

Research Director
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Chief Researcher,
Ajinomoto Co., Inc.

SHINKAI Chemirecognics

Research Director
Seiji SHINKAI

Professor,
Kyushu University

1989 - 1994

TONOMURA Electron Wavefront

Research Director
Akira TONOMURA

Senior Chief Research Scientist,
Hitachi Ltd.

AONO Atomcraft

Research Director
Masakazu AONO

Chief Scientist,
RIKEN

1989 - 1994

IKEDA Genosphere

Research Director
Joh-E. IKEDA

Professor,
Tokai University

1988 - 1993

SAKAKI Quantum Wave

Research Director
Hiroyuki SAKAKI

Professor,
The University of Tokyo

MASUHARA Microphotoconversion

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Professor,
Osaka University

MIZUTANI Plant Ecochemicals

Research Director
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Professor,
Hokkaido University

1987 - 1992

NISHIZAWA Terahertz

Research Director
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President ,
Tohoku University

1987 - 1992

FURUSAWA MorphoGenes

Research Director
Mitsuru FURUSAWA

Board Director,
Daiichi Pharmaceutical Co., Ltd.

KUNITAKE Molecular Architecture

Research Director
Toyoki KUNITAKE

Professor,
Kyushu University

1986 - 1991

GOTO Quantum Magneto Flux Logic

Research Director
Eiichi GOTO

Professor,
Kanagawa University

HOTANI Molecular Dynamic Assembly

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Hirokazu HOTANI

Professor,
Teikyo University

INABA Biophoton

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Humio INABA

Professor,
Tohoku University

1985 - 1990

YOSHIDA Nano-Mechanism

Research Director
Shoichiro YOSHIDA

Managing Director,
NIKON Corporation

KURODA Solid Surface

Research Director
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Professor,
The University of Tokyo

1984 - 1989

HORIKOSHI Superbugs

Research Director
Koki HORIKOSHI

Professor,
Tokyo Institute of Technology /
Chief Scientist, RIKEN

1983 - 1988

HAYAISHI Bioinformation Transfer

Research Director
Osamu HAYAISHI

Director,
Osaka Bioscience Institute

1982 - 1987

MIZUNO Bioholonics

Research Director
Den'ichi MIZUNO

Professor,
Teikyo University

1981 - 1986

HAYASHI Ultra-Fine Particle

Research Director
Chikara HAYASHI

Chairman,
ULVAC Corporation

MASUMOTO Amorphous & Intercalation Compounds

Research Director
Tsuyoshi MASUMOTO

Professor,
Tohoku University

OGATA Fine Polymer

Research Director
Naoya OGATA

Professor,
Sophia University

NISHIZAWA Perfect Crystal

Research Director
Jun-ichi NISHIZAWA

Professor,
Tohoku University

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＊ Co-Research Director
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	NAGAYAMA Kuniaki	Protein Array	'90 ▶ '95	27
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	YOSHIZATO Katsutoshi	MorphoMatrix	'92 ▶ '97	26

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