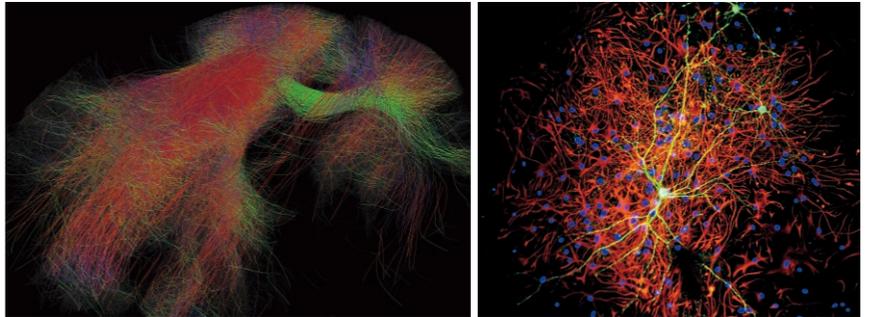
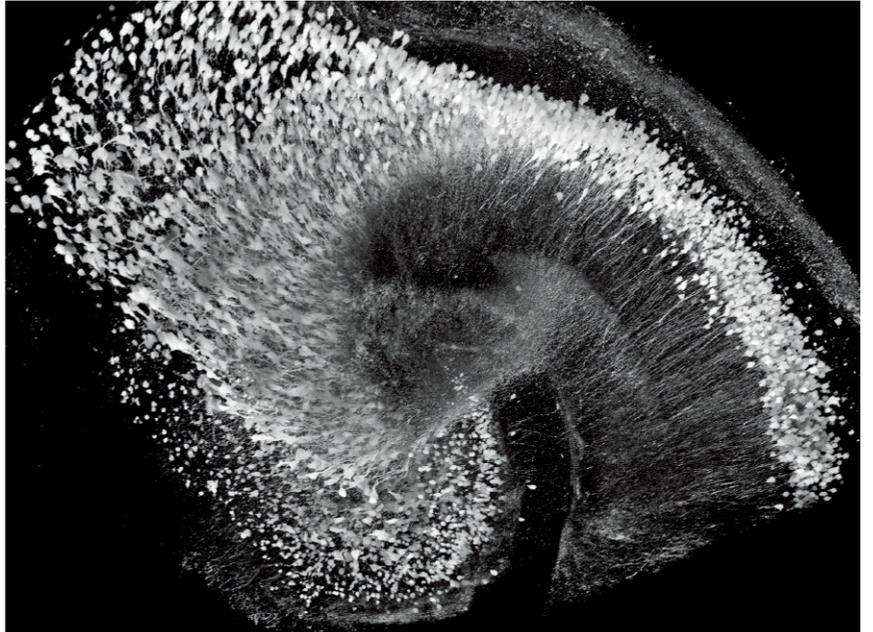


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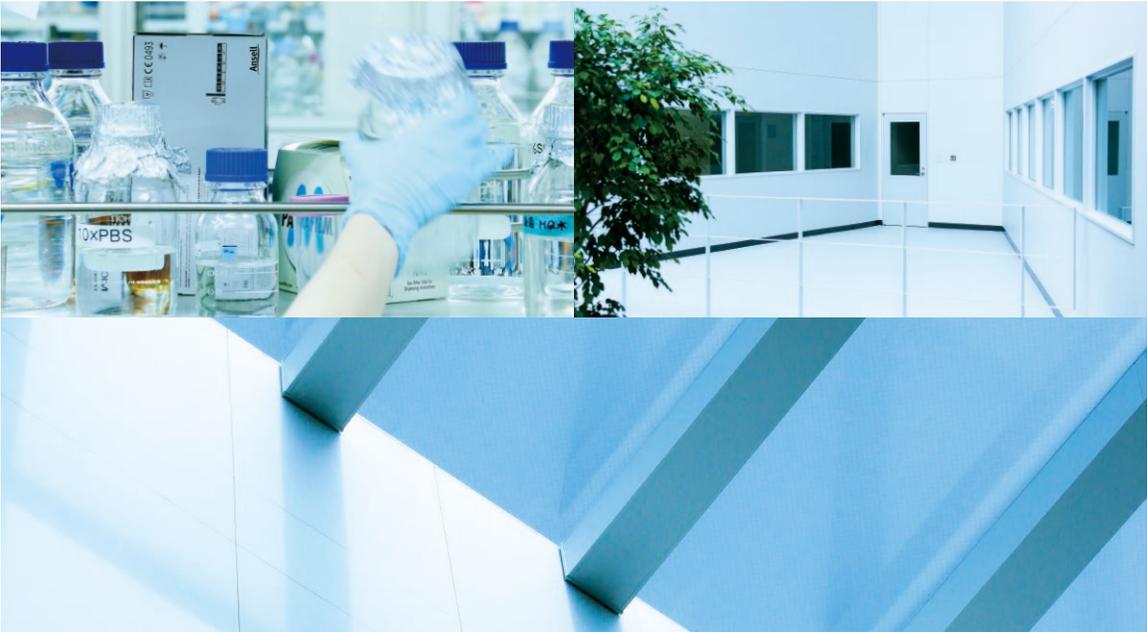
RIKEN CBS

RIKEN Center for Brain Science



RIKEN CBS

RIKEN Center for Brain Science





RIKEN Center for Brain Science (CBS) is a core research center that investigates the human brain as the foundation of the human mind.

The brain is the last frontier in natural science. The mission of CBS is to probe this frontier with thoughtful and diverse methods at the cellular, individual, and social levels, to produce results with societal impact.



Brain science — one of the ultimate frontiers in natural science — explores the mechanisms of brain and mind, spanning memories and emotions to decision-making and meta-cognition. Brain science is a multidisciplinary research endeavor that contributes to, and draws from, areas as diverse as information technology, artificial intelligence and neuropsychiatry. The Center for Brain Science (CBS) was established in April 2018 to explore and understand the brain and mind and to address many problems facing modern society. Under the leadership of the center's first director, Yasushi Miyashita, CBS recruited outstanding international researchers, established Collaboration Divisions to bridge the gap between diverse brain science fields such as clinical medicine and information technology, and initiated training programs for young researchers.

In 2020 and beyond, we will continue to delve deeper into the unexplored realms of brain science. Further, CBS will join efforts with both domestic and international research institutes, universities, and inter-university research institutes, foster connections with the industrial sector, promote Japan's Brain/MINDS project, and develop as a hub for an industry-academia-government network in the field of brain science. The public can look forward to even greater achievements from CBS in the future, as we are committed to returning the results of our research and contributing to the realization of a sustainable society.

Hiroyuki Kamiguchi

Acting Director, RIKEN Center for Brain Science



Four Keys to Unravelling the Brain



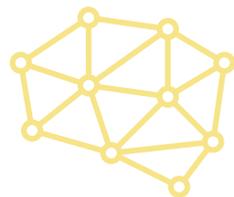
Understand what is unique about the human brain

The brain and mind remain shrouded in mystery. How do people understand themselves and others and how do they form relationships? We will elucidate the brain's highly-developed cognitive functions such as language and emotion.



Learn from the brains of other species

Looking at the brains of other species offers multiple comparative insights at the molecular, cellular or neural network levels. We will work out universal principles that link the brain and body across species.



Analyze the brain with big data

Information science and new technologies are crucial to advancing brain science. Analyzing already-collected data and examining the brain from new angles will allow researchers to reveal the internal computational principles, which can lead to a new generation of artificial intelligence.



Improve quality of life by studying the brain

People face an array of social problems and physical disorders. Many are caused by the deep involvement of the brain. Brain science can clarify the causes of mental and neurological disorders, leading to possible solutions for social problems.



Principal Investigators



Joshua Johansen
Laboratory for Neural Circuitry
of Learning and Memory

We study how aversive experiences trigger alterations in brain circuits and neural coding resulting in emotional memory formation.



Kumi Kuroda
Laboratory for Affiliative
Social Behavior

In support of parent-infant bonding, we study the brain mechanisms of mammalian parenting and attachment.



Lukas Ian Schmitt
Laboratory for Distributed
Cognitive Processing

We investigate how selective, short-term maintenance of information allows brain networks to produce continuous, connected perception based on noisy, disconnected inputs.



Kazuhisa Shibata
Laboratory for Human
Cognition and Learning

We clarify brain mechanisms of human cognition by psychophysics, neuroimaging, and machine learning.



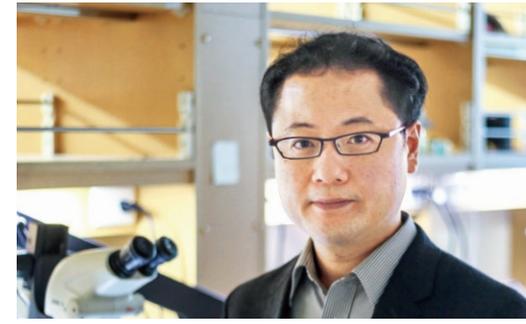
Reiko Mazuka
Laboratory for Language
Development

Understanding language acquisition through the window of infant speech perception.



Yasushi Miyashita
Laboratory for Cognition
Circuit Dynamics

Our goal is to delineate neural circuit dynamics where higher-level cognition emerges.



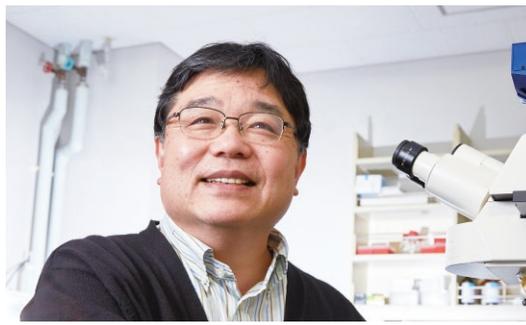
Shigeyoshi Fujisawa
Laboratory for Systems
Neurophysiology

Our goal is to elucidate the neuronal and network mechanisms underlying cognitive functions such as episodic memory and decision making.



Yukiko Goda
Laboratory for Synaptic
Plasticity and Connectivity

Determining the principles of synaptic circuit mechanisms that underlie animal behavior.



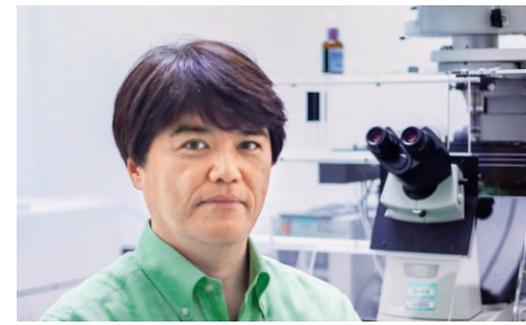
Hitoshi Okamoto
Laboratory for Neural Circuit
Dynamics of Decision Making

We study how the neural circuits for decision making under given circumstances work.



Keiji Tanaka
Laboratory for Cognitive
Brain Mapping

Clarifying the brain mechanisms underlying higher-order functions, such as visual recognition and goal-oriented behavior.



Hiroyuki Kamiguchi
Laboratory for Neural
Cell Dynamics

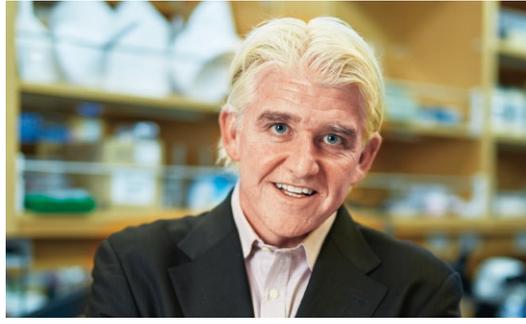
Understanding cellular mechanisms that control nervous system formation and repair.



Hokto Kazama
Laboratory for Circuit
Mechanisms of Sensory
Perception

Our goal is to understand the computations and neural circuit mechanisms underlying sensory-guided behavior.

Principal Investigators



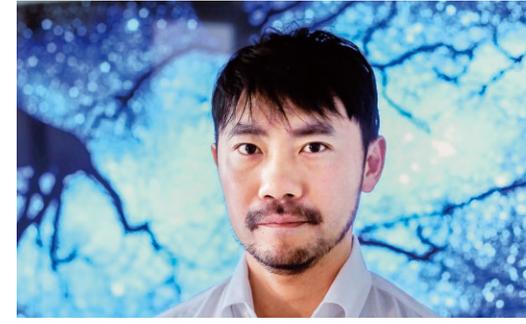
Thomas McHugh
Laboratory for Circuit and Behavioral Physiology

Our goal is to understand the neural circuits that allow the brain to encode, consolidate and recall memories.



Adrian Moore
Laboratory for Neurodiversity

Our lab asks: how does a neuron grow up to be different; how are differentiation pathways initiated and directed to create diversity in neuron form and function?



Masanori Murayama
Laboratory for Haptic Perception and Cognitive Physiology

We observe the living brain and clarify the relationship between perceptual behavior and neural activity at the single-cell and network level.



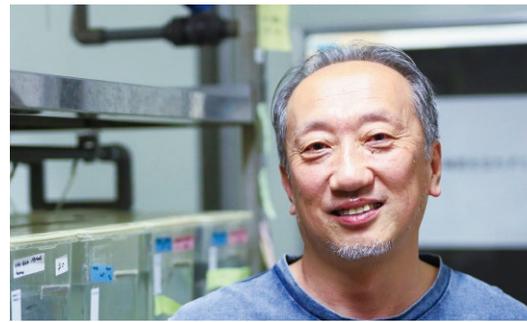
Hiroyuki Nakahara
Laboratory for Integrated Theoretical Neuroscience

Uncovering brain functions and computations for learning, decision making and social intelligence.



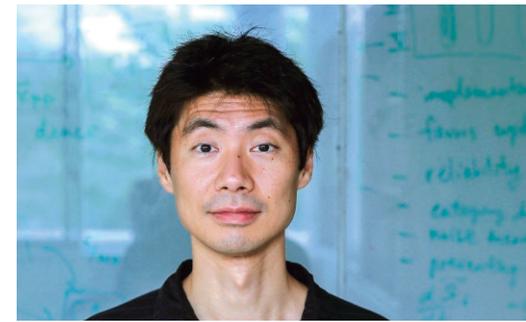
Tomomi Shimogori
Laboratory for Molecular Mechanisms of Brain Development

Revealing molecular mechanisms that control experience-dependent plasticity.



Yoshihiro Yoshihara
Laboratory for Systems Molecular Ethology

We aim to elucidate molecular, cellular and neural circuit mechanisms underlying various olfactory behaviors.



Taro Toyoizumi
Laboratory for Neural Computation and Adaptation

Exploring the principles behind learning in the brain by computational approaches.



Takuya Isomura
Brain Intelligence Theory Unit

We aim to mathematically express universal characterization of the brain intelligence.



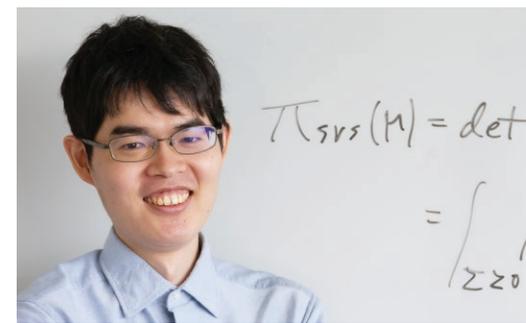
Andrea Benucci
Laboratory for Neural Circuits and Behavior

We study the neural basis of decision making from the viewpoint of visual perception.



Atsushi Miyawaki
Laboratory for Cell Function Dynamics

Our primary goal is to better understand how biological molecules behave in space and time.



Takeru Matsuda
Statistical Mathematics Unit

We develop statistical methods that extract more information from brain data.



Louis Kang
Neural Circuits and Computations Unit

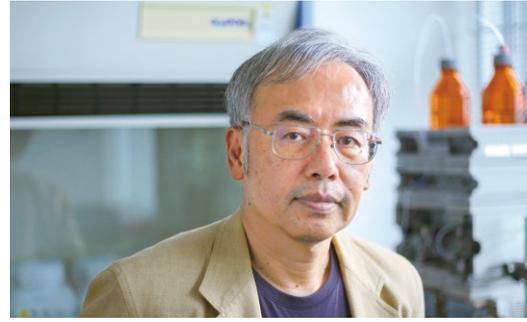
We study how computations in neural circuits produce memory and other mental capabilities.

Principal Investigators



Tadamfumi Kato
Laboratory for Molecular
Dynamics of Mental Disorders

Searching for the causes of bipolar disorder for the development of new treatments and diagnoses.



Takaomi Saïdo
Laboratory for Proteolytic
Neuroscience

We aim to elucidate and to regulate the mechanism of brain aging that leads to the onset of Alzheimer's Disease.



Jun Nagai
Laboratory for Glia-Neuron
Circuit Dynamics

Exploring contributions of glial cells to brain circuits and adaptive/maladaptive behavior.



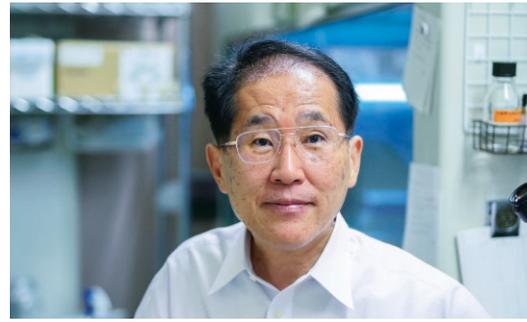
Asuka Takeishi
Neural Circuit of Multisensory
Integration RIKEN Hakubi
Research Team

Exploring the neural and molecular mechanisms of behavior choice in *C. elegans*.



Motomasa Tanaka
Laboratory for Protein
Conformation Diseases

Our goal is to elucidate molecular mechanisms of protein aggregation and its physiological consequences in neuropsychiatric diseases.



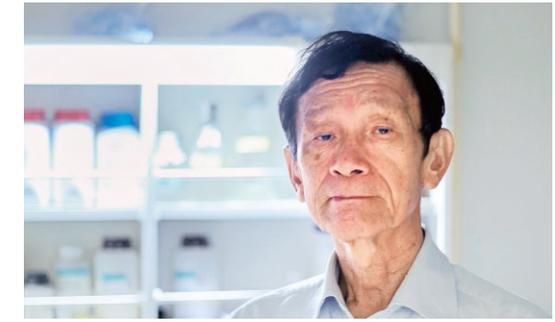
Takeo Yoshikawa
Laboratory for Molecular
Psychiatry

Deciphering the mechanisms for schizophrenia and autism spectrum disorder and developing early diagnostic measures.



Hideyuki Okano
Laboratory for Marmoset
Neural Architecture

Our laboratory aims to understand higher brain functions and pathophysiology of human psychiatric and neurological diseases, by mapping the marmoset brain precisely.



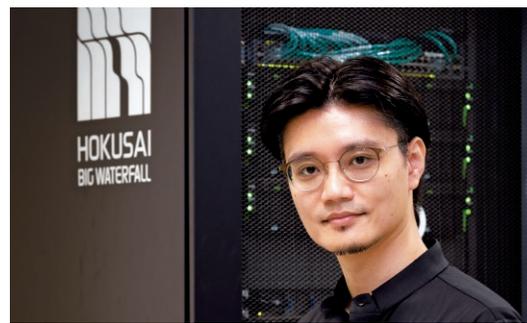
Tetsuo Yamamori
Laboratory for Molecular
Analysis of Higher Brain
Function

We are working to understand the features of primate-specific neural circuits and their functions by studying a large-scale structural brain mapping of marmoset as a model system.



Akiko Hayashi-Takagi
Laboratory for Multi-scale
Biological Psychiatry

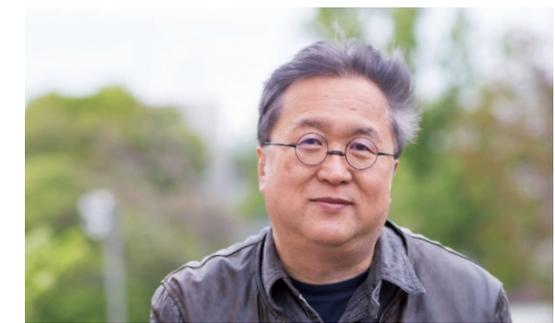
We aim to causally identify the contributory factors for psychiatric disorders, which could provide the knowledge necessary to establish circuit-centric therapeutics as well as molecular-based drug designs.



Atsushi Takata
Laboratory for Molecular
Pathology of Psychiatric
Disorders

Deciphering the biological basis of psychiatric disorders in order to transform clinical psychiatry.

Joint Research Laboratory



Kazuo Okanoya
Cognition and Behavior
Joint Research Laboratory

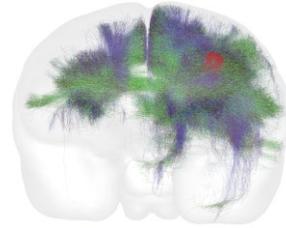
Collaborations with Universities and Research Institutes

CBS has established two collaborative divisions promoting inter-organizational communication with universities and research institutes.



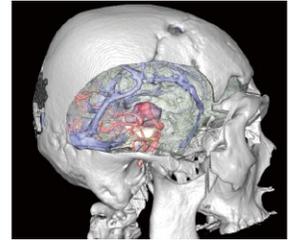
Integrative Computational Brain Science Collaboration Division

The Integrative Computational Brain Science Collaboration Division develops technologies to analyze big data and works together with the Graduate School of Information Science and Technology at the University of Tokyo. A unit specializing in data science promotes data-driven explorations of the field.



Brain Medical Science Collaboration Division

The Brain Medical Science Collaboration Division promotes academic exchange with university medical schools and research institutes. Joint laboratory facilities are shared with the Graduate School of Medicine at the University of Tokyo.



Keiji Tanaka
Integrative Computational Brain Science Collaboration Division
Neuroinformatics Unit
Data-driven Brain Science Collaboration Unit



Fumiyasu Komaki
Mathematical Informatics Collaboration Unit



Shigeo Okabe
Brain Medical Science Collaboration Division



Alexander Woodward
Connectome Analysis Unit
Brain Mapping by Integrated Neurotechnologies for Disease Studies (Brain/MINDS)



Henrik Skibbe
Brain Image Analysis Unit
Brain Mapping by Integrated Neurotechnologies for Disease Studies (Brain/MINDS)



Hirofumi Nakatomi
Biomedical Neural Dynamics Collaboration Laboratory
Analyzing the genomics from brain tissue, and investigating the pathophysiology of cerebrovascular diseases and epilepsy.



Masanori Matsuzaki
Brain Functional Dynamics Collaboration Laboratory
The goal of our laboratory is to elucidate the prefrontal neural dynamics relevant to cognition and behavior by studying the common marmoset.

Industrial Collaborations

CBS has established three industrial collaboration centers with the aim of ensuring our research outcomes have social benefit.

RIKEN CBS – Olympus Collaboration Center (BOCC)

Established in June 2007

Linking the 20 years of brain science expertise of CBS with the optical know-how of Olympus, this center develops and harnesses fundamental bio-imaging technologies and instruments. The center also disseminates bio-imaging technology and knowledge through the technical support of researchers. Operational logs of microscopes at BOCC are used to improve bio-imaging products.

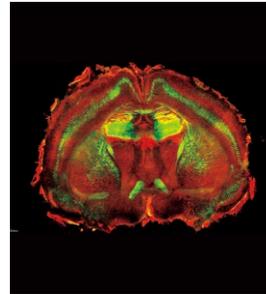


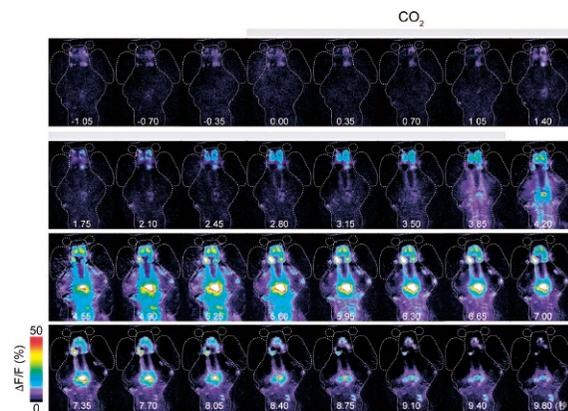
Image taken with FV3000 microscope Confocal Laser Microscope FV3000



RIKEN CBS – KAO Collaboration Center (BKCC)

Established in April 2016

This center fuses cutting-edge neuroscience with the technologies owned by KAO Corp. to explore the brain science of *kansei*, or perceptual sensibility. KAO is experienced in chemical and molecular biology, biochemistry and cell biology. It places importance not only on functional values but also on behavioral characteristics and emotional judgement by use of the five senses, like the tactile, form, color and smell. Research in this collaboration contributes to brain science outcomes that can apply to daily life, such as neuro-marketing, and expands the definition of brain science to include concepts like “sensitivity perception” and “emotional sensitivity”.



An example of research supported by KAO:
Tetsuya Koide, Yoichi Yabuki, Yoshihiro Yoshihara, "Terminal Nerve GnRH3 Neurons Mediate Slow Avoidance of Carbon Dioxide in Larval Zebrafish", *Cell Reports* (2018)



RIKEN CBS – Toyota Collaboration Center (BTCC)

Established in November 2007

This research organization was set up under a comprehensive agreement with Toyota Motor Corporation to serve as a base for socially-relevant innovation and exploration of the potential by merging brain science and technology. The center promotes research on social systems to boost the capabilities of individuals and support group creativity. There are

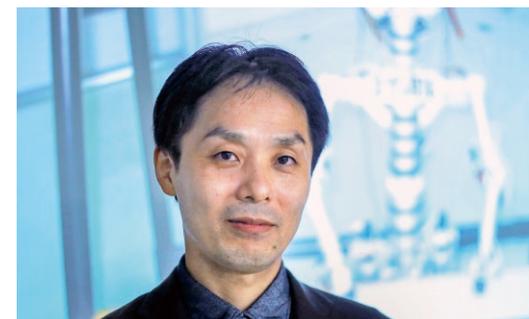
separate units focused on Intelligent Behavior Control, Rhythm-based Brain Information Processing and Social Value Decision Making. The center aims to understand the mechanisms of the human body, the human brain, and the human social network, to advance greater well-being in society.



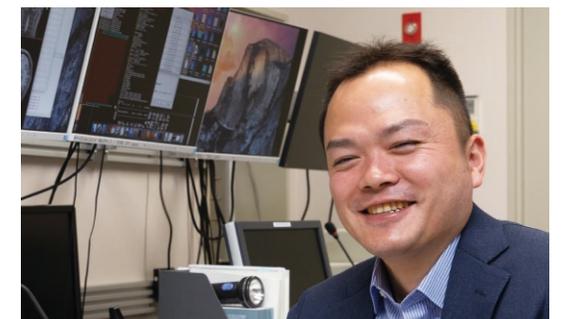
Yasuo Kuniyoshi
RIKEN CBS-Toyota Collaboration Center
Strategic Collaboration Unit



Keiichi Kitajo
Rhythm-Based Brain Information Processing Unit



Shingo Shimoda
Intelligent Behavior Control Unit



Rei Akaishi
Social Value Decision Making Collaboration Unit

Research Resources Division (RRD)

Research resources and research technologies are crucial for conducting brain science. Our Research Resources Division provides technological support, such as bio-material analysis, and maintains shared research equipment facilities for animal experimentation and human MRI, for example. RRD also provides support for researchers to use these resources. The division has specialized technical staff who offer guidance on experimental technologies to research teams.



Nobuko Mataga Support Unit for Bio-Material Analysis

Support Unit for Bio-Material Analysis



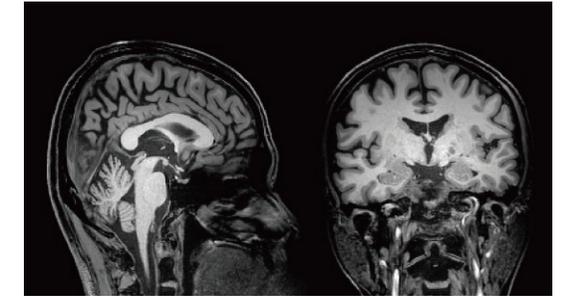
Researchers in bioscience including brain science require a variety of scientific technologies. This unit provides essential technical support and experimental environments to RIKEN members. The skillful staff carry out commissioned analyses on nucleic acids, proteins, amino acids, peptide synthesis, and more. The unit maintains research equipment in shared experimental areas and also gives technological advice. Educational seminars and exhibitions of research instruments are held as required.

Support Unit for Animal Resources Development



Brain science has accelerated through the use of laboratory animals. This unit maintains large-scale animal experimentation facilities, supplying high-quality laboratory animals. It provides relevant technological support, such as the production of mutant mice by genome editing and mouse embryo manipulation. It also offers administrative support, for example animal health certificates.

Support Unit for Functional Magnetic Resonance Imaging



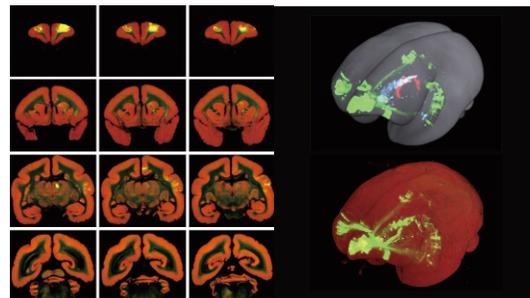
The ultimate goal of brain science is to understand the functioning of the human brain. This unit provides technological support for experimentation that uses non-invasive measurements of the structure and activities of the human brain, or the brains of other species, through magnetic resonance imaging (MRI). The unit is equipped with a 3 Tesla human MRI scanner, and a 7 Tesla human MRI scanner will be installed by mid-2021. Experiments with DTI, MRA, MRS and fMRI can be supported. The unit also develops its own technological imaging and analysis methods.

Technical Personnel Support Section (TPSS)



This section provides expert technicians to offer customized technical support. It assists researchers with close support, such as experiments that cannot be conducted at research labs and undertakes routine experiments on their behalf.

Large Experimentation Apparatus TissueCyte

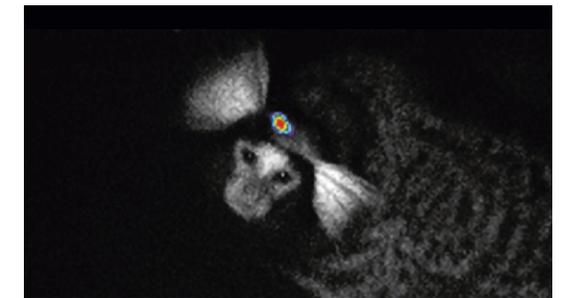


CBS has a shared-use equipment called TissueCyte, an integrated system of a high-level slicer and a two-photon confocal microscope. It is available to visualize a whole 3D brain, reconstructed from successive 2D images, without adjusting position during the process. This equipment is useful for studies across neuroscientific areas, from the investigation of neural circuits to the elucidation of abnormalities associated with mental and neurological disorders.

Brain Mapping by Integrated Neurotechnologies for Disease Studies (Brain/MINDS)



Brain/MINDS is a national project to fully understand the structure and networks of the brain. Similar projects are underway in the USA, EU and China, but Brain/MINDS is characterized by an emphasis on the study of the marmoset (a small, non-human primate). To understand our human brains, it is essential to learn from other primates. Marmoset brains can be genetically modified and comprehensively analyzed and have significant advantages as research targets, allowing



an understanding of the neural circuit mechanisms developed in primates. These studies can lead to overcoming mental and neurological diseases in humans. CBS is the core partner in the Brain/MINDS project and promotes research in collaboration with domestic and overseas universities and other scientific institutions.

Human Resource Development

Human Resource Development Program



CBS Summer Program

This program began in 1999 with the aim of training junior brain scientists, mainly those currently in graduate school. About 50 students from around the world are selected each year through a rigorous application. The program offers a two-month laboratory internship and a one-week intensive lecture course with domestic and overseas experts in cutting-edge research areas. The entire program, including exchange meetings, is delivered in English.



Brain Science Training Program

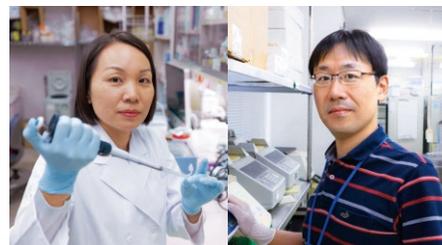
BSTP is a one-year program for fostering young researchers, directed mainly at first-year Master's students. Systematic exposure is given to acquire comprehensive as well as specialized knowledge of brain science. Instruction is in English. Many alumni have gone on to become successful researchers at overseas institutions.

CBS Young Talent Training Program



Young Investigators' Seminar

This event allows young researchers to present their work to the CBS community. Participants are given feedback from team leaders and the audience. Seminars provide an opportunity to initiate future joint research and social gatherings are held to allow informal discussion and exchange.



Career Development Program

This program fosters career-building opportunities for researchers of proven ability and experience. Selected candidates are nominated to the position of CDP Young Chief Investigator and awarded an annual research budget to manage independent laboratory activities. The program is targeted for researchers to transition to principal investigators at universities or institutions beyond RIKEN.



CBS – MIT Interaction Opportunity for Young Scientists

A biennial program sends junior researchers from CBS to the Picower Institute for Learning and Memory at MIT, where they participate in the institute's retreat, make poster presentations and give talks. Lab visits and discussions with MIT researchers are organized to develop research and networking.

CBS Internal Members' Exchange Program



Retreat

The annual off-site retreat is an opportunity for exchange of ideas among researchers in different branches of brain science. Free discussion is encouraged across specialized fields. The retreat program has lectures, workshops, poster presentations and roundtables for researchers who might not normally interact to meet and exchange ideas. A lecturer from UCSF is invited every year.



PDFA (Postdoctoral Fellow Association)

PDFA is a self-governing organization within CBS. It was formed by young researchers who organize workshops and forums for career development, scientific discussion and advancement of diversity. Members volunteer at the CBS Summer Program to interact with and assist invited junior researchers from across the globe.



Collaboration with Domestic and Overseas Universities

Collaborations have been established to promote developments in the field of brain science. CBS team leaders may be appointed as visiting professors, while Ph.D. students from collaborating universities are able to visit and undertake research.

Public Relations and Outreach

CBS places great importance on outreach activities. We use social media to deliver press releases and research news to wide audiences. CBS welcomes some 1,000 visitors every year and holds an annual RIKEN Open Day with lectures and demonstrations for adults and children.

As part of World Brain Awareness Week (an international awareness campaign for brain science), CBS holds a popular summer science class for high school students that is known for its clear lectures and hands-on research experience opportunities.



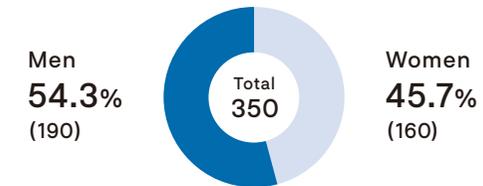


Staff

CBS welcomes diverse personnel and promotes gender equality and internationalization.

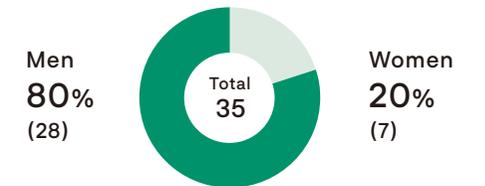
Researchers

Excluding administration and part-timers

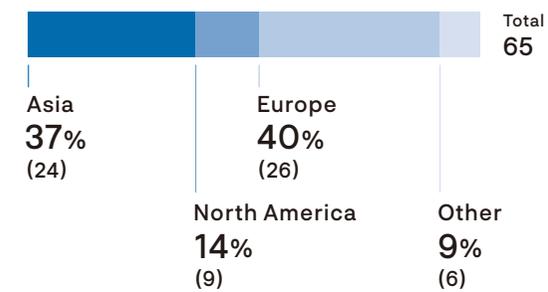


Team Leaders

Excluding collaboration research teams



Foreign Researchers by Region



As of October 1, 2019

Bio-resources

635 model mice with Alzheimer's disease, developed by Laboratory for Proteolytic Neuroscience and 183 DNA clones from the Laboratory for Cell Function Dynamics have been supplied to domestic and overseas research institutions (2018). Other CBS research teams accept inquiries concerning bio-resources from all over the world. Genetically modified zebrafish, for example, have been provided by CBS.



RIKEN Center for Brain Science

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cbs.riken.jp/en



RIKEN CBS



Cover Images provided by:

- 1 Laboratory for Cell Function Dynamics
- 2 Brain Image Analysis Unit
- 3 Laboratory for Synaptic Plasticity and Connectivity

