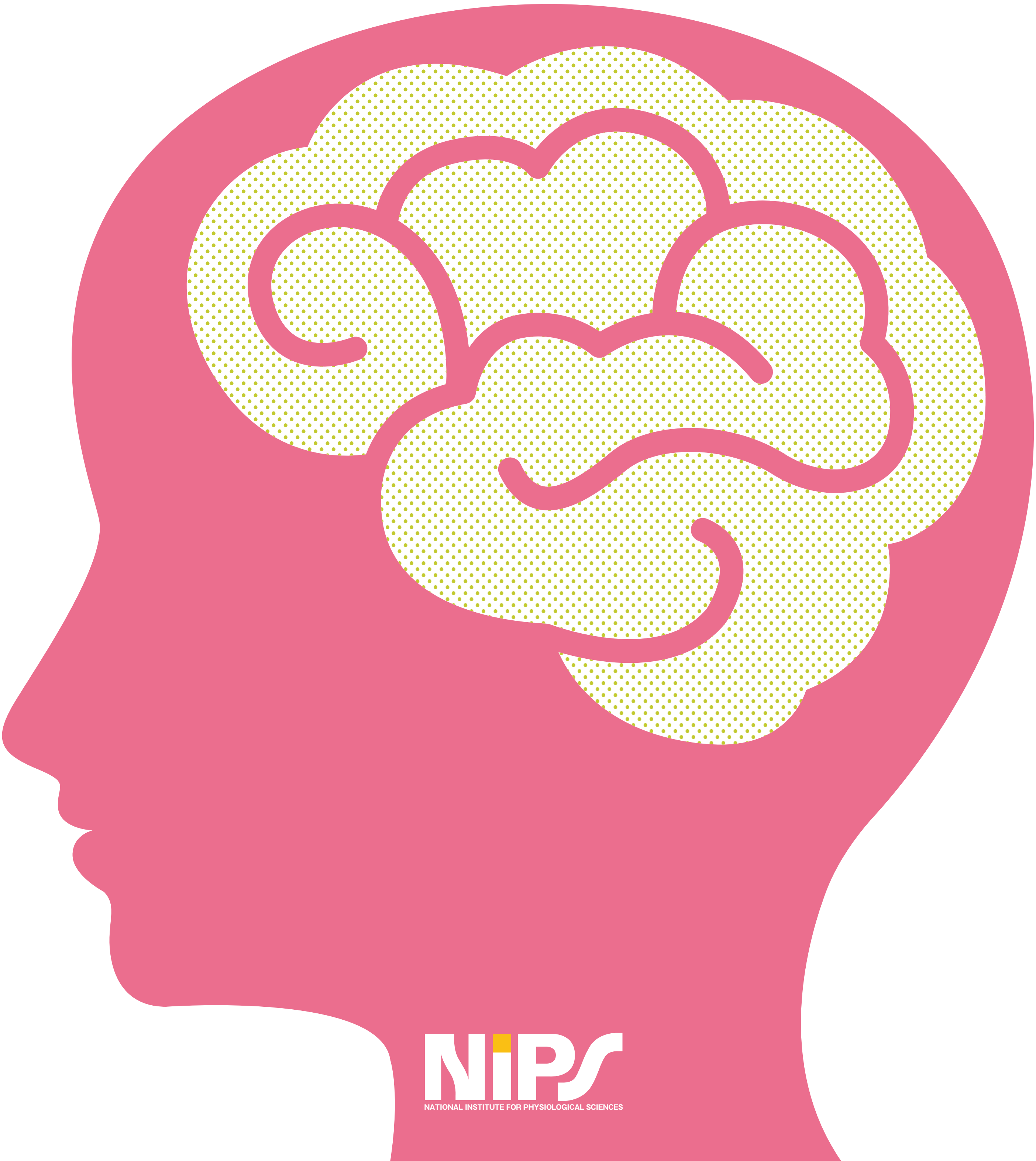
National Institute for Physiological Sciences

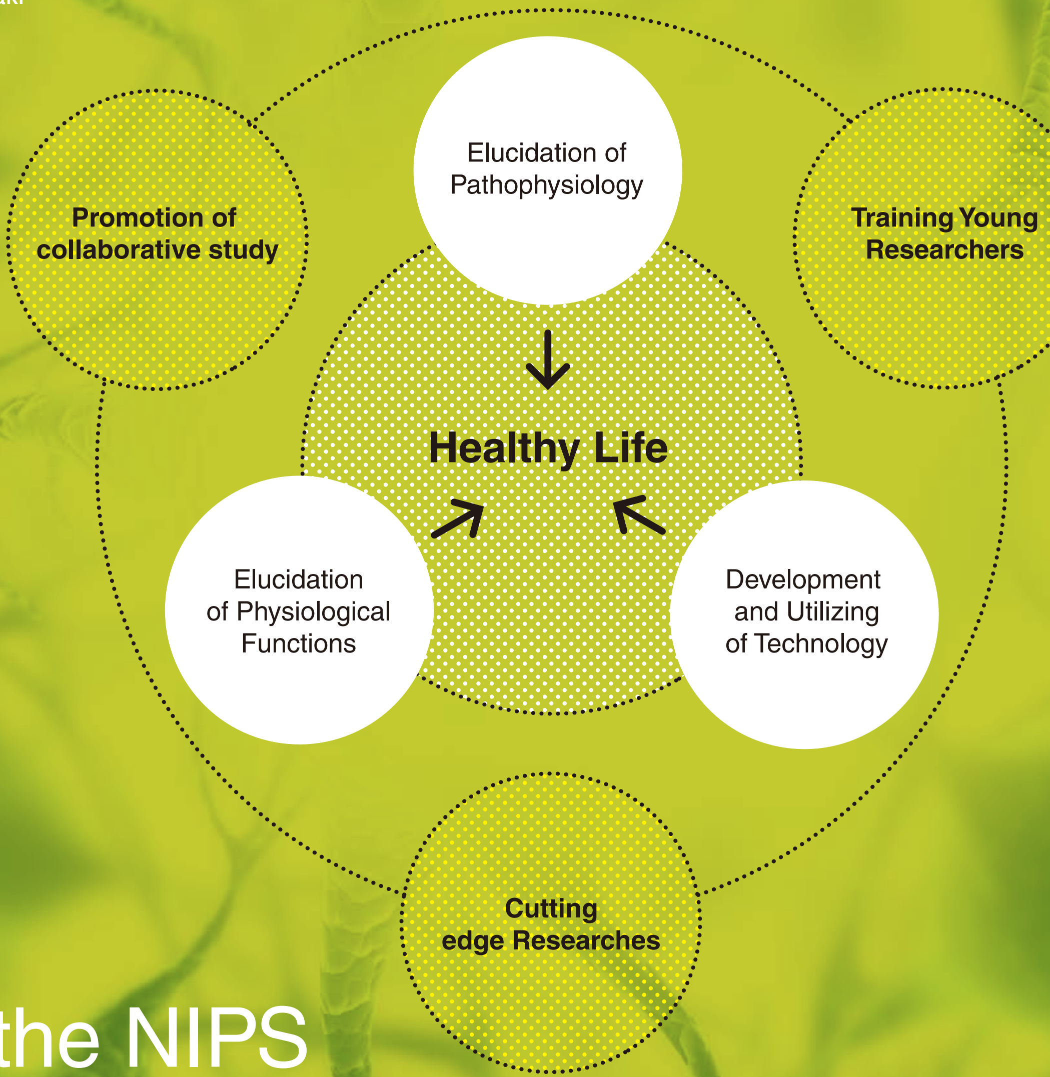
National Institutes of Natural Sciences



NIPS

NATIONAL INSTITUTE FOR PHYSIOLOGICAL SCIENCES

Contents



Goals for the NIPS

Physiology is the study of human beings and life.
The NIPS offers various types of the most advanced research devices and places for research using them to researchers belonging to universities and other research institutes on a nationwide basis, as the promotion of joint usage research with other research institutes, including national, public, and private universities throughout Japan, is one of its core duties.

In the NIPS, researchers with diverse backgrounds, belonging to it or universities or other research institutes, perform their research activities daily while desiring to promptly utilize the outcomes of their studies for social benefit and to elucidate the science of life.

Summary

Physiology

Physiology is the study of the functions and mechanisms of living organisms. "Living organisms" refer to all living matter, including the human body. "Functions" refer to the biological functions of an individual, as well as those of its components (molecules, cells, tissues, and organs) and those needed when multiple individuals lead social lives, including morphological and psychological events. In short, physiology aims to elucidate biological functions by clarifying mechanisms at the levels of molecules, cells, organs, and individuals, and integrate them as a system; therefore, physiology is also integrated biology. As one of the domains targeted for the Nobel Prizes is "physiology or medicine", it is an important academic discipline providing a basis for all life sciences, including medicine.

Roles of the National Institute for Physiological Sciences (NIPS)

1. Leading physiological research

The first duty of the National Institute for Physiological Sciences (NIPS) is to: continuously conduct high-quality studies on a global basis to examine living organisms at the levels of molecules, cells, tissues, organs, systems, and individuals; organically integrate the outcomes of such studies; and clarify biological functions and mechanisms.

2. Providing a basis for research on physiology

Its second duty is to: offer our most advanced research facilities, equipment, databases, techniques, and conference halls to domestic and international research institutes, including national, public, and private universities throughout Japan, as a joint usage research institute; and promote joint usage research by organizing diverse events, such as study seminars and symposiums, as a basis for domestic and international research communities.

3. Training researchers

The NIPS provides 5-year comprehensive doctoral programs for the Department of Physiological Sciences, School of Life Science at the Graduate University for Advanced Studies. It also contributes to the nurturing of physiologists who globally expand their activities through training courses, lectures on various topics, and symposiums for students and young researchers belonging to other research institutes. The development of human resources supporting research on physiology in- and outside Japan is the third duty of the NIPS.

Message from the Director-General

IMOTO, Keiji, M.D., Ph.D.,

The National Institute for Physiological Sciences (NIPS) is one of the constituting institutes of the National Institutes of Natural Sciences (NINS), and is dedicated to studying human body functions, such as those of the brain, through collaboration with researchers in domestic and foreign universities, and training young researchers in the fields of physiology and neuroscience. Basic research on human body functions and their mechanisms provides scientific bases of the guidelines for people to lead a healthy life and scientific clues for the clarification of mechanisms of diseases. The NIPS is a unique inter-university research institute for basic human physiology research and education in Japan. As Blaise Pascal wrote *"L'homme n'est qu'un roseau, le plus faible de la nature; mais c'est un roseau pensant"* (Pensées, 1670), the ability to think, thanks to our well-developed brain, is the most prominent feature of human being. The brain and nervous system also control and regulate other organs and tissues throughout the body while interacting with them. Therefore, we put the main focus of our research on the brain and neural control of the body.

The NIPS has 3 missions. The first one is to: conduct pioneering studies at the levels of molecules, cells, tissues, organs, systems, and individuals, as well as social activities; organically integrate the outcomes of such studies; and clarify biological functions and mechanisms. The NIPS has continuously conducted high-level studies on a global basis, with cooperation and support from research communities involved in physiology and related fields. We believe high-level science is the indispensable grounds for the second and third missions.

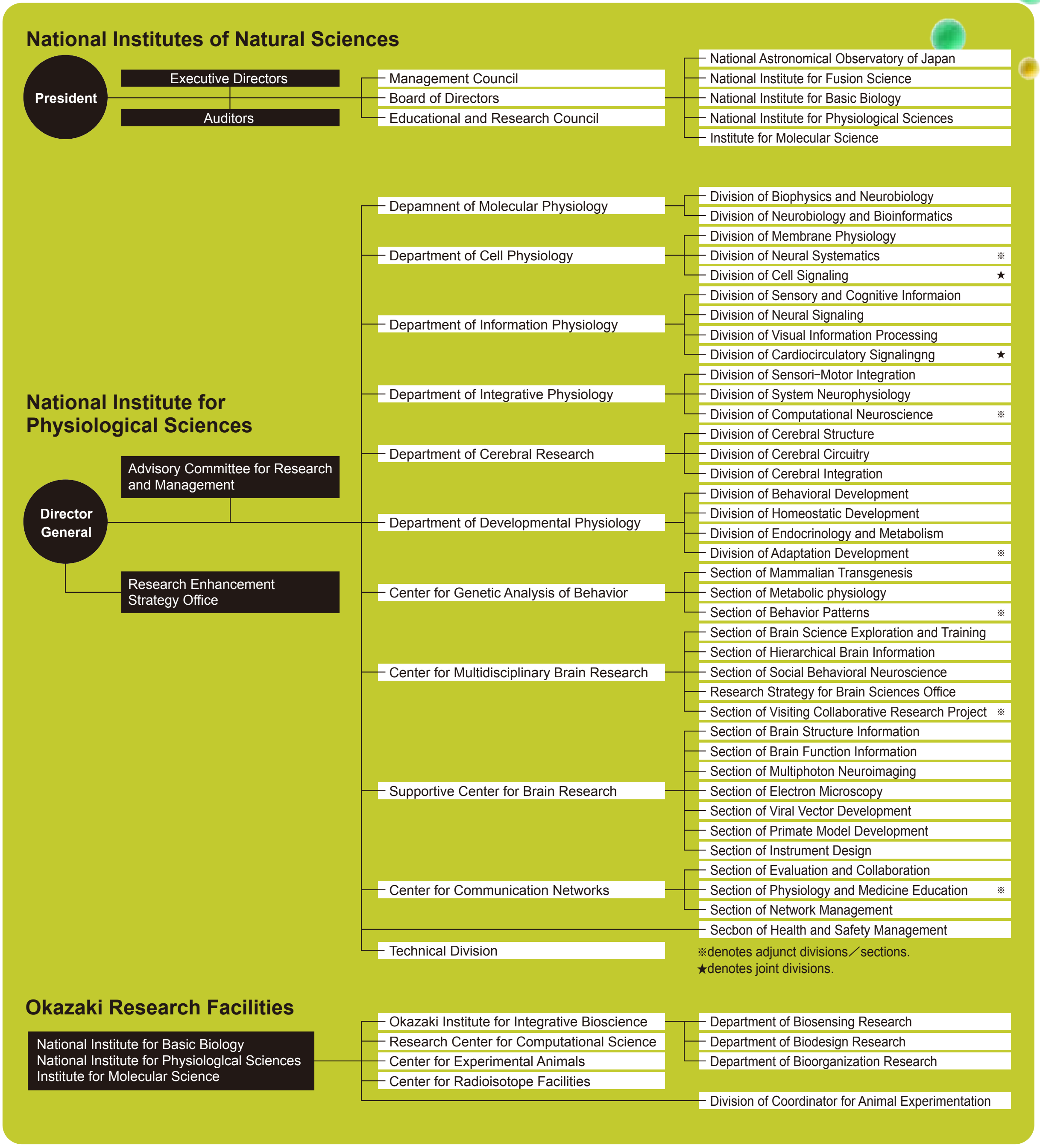
Our second mission is to: promote collaborative studies with researchers in domestic and foreign universities and institutes, while offering our advanced research facilities, equipment, databases, techniques, and conference halls. In line with this, the NIPS organises various and diverse collaborative studies, joint experiments, study seminars, and annual international symposiums, and invites a large number (total annual number: approximately 1,000) of researchers from in- and outside Japan. Recently, we have established a system to accept domestic scientists on sabbatical as visiting professors, associate or assistant professors to intensively conduct joint studies while staying in for 3 to 12 months.

Our third mission is to: train graduate students and young researchers; and provide human resources for universities and research institutes. At the Graduate University for Advanced Studies (SOKENDAI), we are training about fifty graduate students through 5-year educational programs for the Department of Physiological Sciences, School of Life Science. We are also providing training for graduate students who belong to other universities. Furthermore, we contribute to the training of students and young researchers by delivering training courses and lectures for them. We launched the SOKENDAI Brain Science Joint Program in 2010, aiming to provide brain science education for graduate students in other fields.

In addition to the accomplishment of these 3 missions, we realise the importance of distributing academic information and establishing mutually beneficial public relations. For example, we conduct partnership programs on human body functions and systems for elementary, junior, and senior high school education, public lectures, and open laboratory events. Also, the NIPS website (http://www.nips.ac.jp/) provides extensive information, such as on our latest research outcomes.

Toward the achievement of our goal of "comprehensively elucidating human body functions", specified in Article 1 of the "NIPS Charter" which was established when the institute was founded, we continue to move forward. Your support and guidance would be very much appreciated.

Organization of the Institute



Inter-University Research Institute Corporation National Institutes of Natural Sciences (NINS)

Inter-university research institute corporations are Japan's original and high-level research institutes managed by research communities. In such institutes, which have been organized as bases to offer places for joint usage and research to researchers throughout Japan, pioneering researchers are engaged in collaborative research activities, with the aim of developing new academic fields. The National Institutes of Natural Sciences (NINS) consist of 5 inter-university research institutes: the National Astronomical Observatory of Japan (NAOJ), National Institute for Fusion Science (NIFS), National Institute for Basic Biology (NIBB), National Institute for Physiological Sciences (NIPS), and Institute for Molecular Science (IMS).

National Institute for Physiological Sciences (NIPS)

The National Institute for Physiological Sciences (NIPS) is a research institute dedicated to studying human body functions, such as those of the brain, through collaboration with universities, and training young researchers as future physiologists. It is also a unique inter-university research institute corporation for basic human physiology research and education in Japan. Man is a "thinking reed", thanks to his well-developed brain. In the NIPS, diverse studies are currently being conducted to examine the brain as the central system of the human body.

Research Departments

01 Division of Biophysics and Neurobiology

Professor
KUBO, Yoshihiro

Structure-function relationship and regulation mechanisms of ion channels and receptors

The aim of our research is to elucidate the functioning mechanisms of ion channels and receptors. Toward the aim, we focus on the structure-function relationship, dynamic structural rearrangements and situation dependent regulation mechanisms of membrane proteins. We utilize *in vitro* expression systems such as Xenopus oocytes and HEK293 cells which enable solid and precise biophysical analyses by purely reconstituting the target molecules. We conduct research by combined techniques of (1) molecular biology to isolate cDNA and introduce mutations, (2) electrophysiology such as two electrode voltage-clamp, gating current analyses and patch-clamp, (3) optophysiology such as FRET analyses to detect structural rearrangements, voltage clamp fluorometry, and single molecule imaging for subunit counting. We also perform research using gene targeted mice to identify the distribution, molecular/cellular function and behavioral roles of orphan metabotropic receptors.

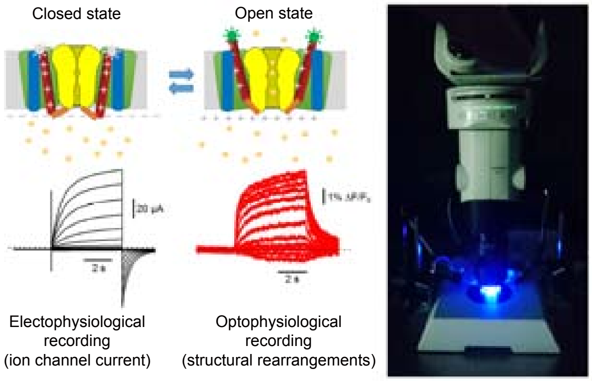


Figure legends
Simultaneous recordings of voltage-gated K^{+} channel current and its structural rearrangements by voltage-clamp fluorometry using Xenopus oocytes.

02 Division of Neurobiology and Bioinformatics

Professor
IKENAKA, Kazuhiro

1.Development and function of glial cells, and glial diseases

Central nervous system is composed of neurons and glial cells. Glial cells form a mutually interacting huge network, ‘glial assembly’. Glial assembly associates with neuronal circuit and modulates higher brain function.
We investigate on the following topics regarding glial assembly,
(1) Molecular mechanisms underlying glial development
(2) Mouse disease models caused by glial dysfunction
(3) Functional analysis of myelination and demyelination

2.Significance of glycans on glycoproteins in the nervous system

We have finely tuned the N-glycan analytical method and clarified the function of N-glycans. There are three projects going on in our laboratory; clarifying the function of sulfated N-glycans in the peripheral nervous system, exploring the function of a novel N-glycan whose expression level increases during brain development, and application of N-glycan profiling to the diagnosis of neuropsychiatric diseases.

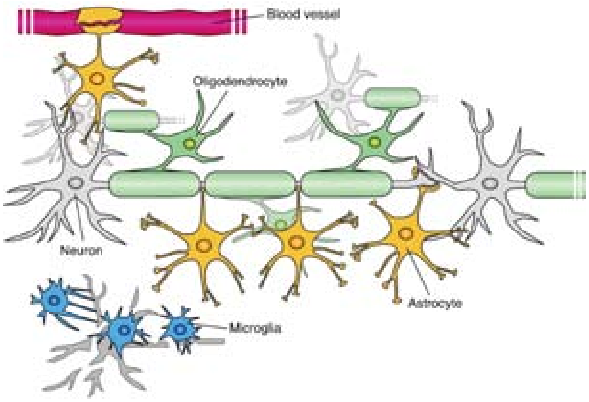


Figure legend
Glial cells in brain. Glial cells form glial circuits and communicate with neuronal circuits.

03 Division of Membrane Physiology

Professor
FUKATA, Masaki

Fundamental mechanisms for synaptic transmission and synaptic disorders

We will elucidate the core regulatory mechanisms for synaptic transmission and finally address the fundamental question, "How does our brain physiologically function and how is the system disrupted in brain diseases?". We have focused on the regulatory mechanisms for AMPA-type glutamate receptor (AMPAR) as AMPAR plays a central role in learning and memory formation. Based on our specific and quantitative biochemical methods, we discovered two types of AMPAR regulatory proteins: the DHHC palmitoylating enzymes and the epilepsy-related ligand/receptor, LGI1/ADAM22. So far, we have elucidated the physiological functions of these two AMPAR regulatory proteins and the implication in the pathogenesis of brain diseases such as epilepsy and limbic encephalitis, by developing new methods to screen the palmitoyl enzyme-substrate pairs and to specifically visualize the palmitoylated protein, and by integrating many methods such as super-resolution imaging, mouse genetics, and electrophysiology. We will elucidate the molecular basis in which these AMPAR regulatory proteins regulate synaptic plasticity and cognitive functions of mouse and human brains using the following our developed or cutting-edge approaches and resources.

1）Analyses of in vivo protein-protein interactions
2）Screening of palmitoylating enzyme library
3）Live cell imaging with palmitoylated protein-specific probes
4）Observation of synapses with super-resolution microscopy
5）Mouse models of human epilepsy with the LGI1 mutation

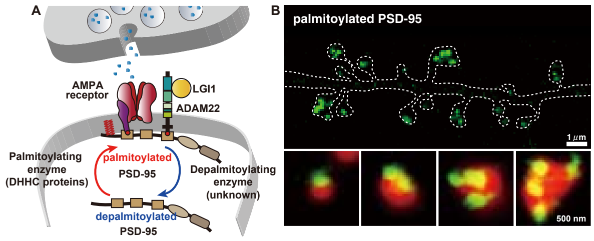


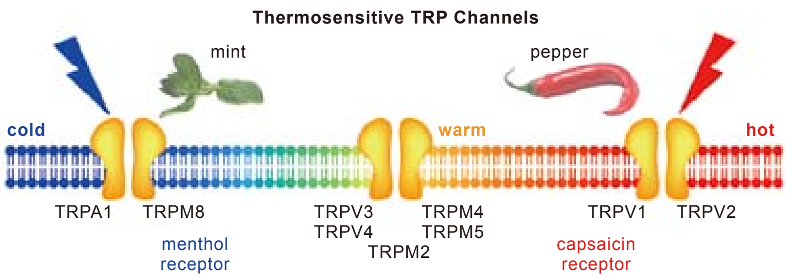
Figure (A) Two unique AMPA receptor regulatory proteins: DHHC palmitoylating enzymes and the epilepsy-related ligand/receptor, LGI1 and ADAM22. (B) Discovery of novel postsynaptic nanodomains by palmitoylated PSD-95-specific probe and super-resolution microscopy: a synaptic DHHC protein locally regulates the formation and reorganization of nanodomains.

04 Division of Cell Signaling

Professor
TOMINAGA, Makoto

Clarifying the Functions of Thermosensitive TRP Channels

It was little known until recently how temperature is detected although we survive by sensing a wide rage of ambient temperatures. Capsaicin receptor TRPV1 is the first molecule involved in temperature sensation, and now there are nine ion channels belonging to the TRP ion channel super family. These thermosensitive TRP channels not only sense noxious temperature and chemical stimuli in the sensory nerve endings but also are involved in the various physiological functions including ambient skin temperature detection, regulation of skin barrier function, detection of mechanical stimulation in bladder and intestine, regulation of taste sensation, insulin secretion from pancreas, regulation of immune cell function and regulation of neural excitability in the central nervous system under the body temperature conditions. Thus, most of the cells in our body which are not exposed to the dynamic temperature changes survive by detecting temperature around the cells.



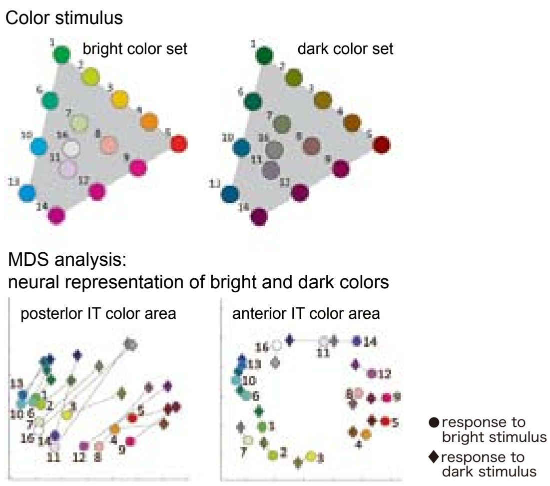
05

Division of Sensory and Cognitive Information

Professor
KOMATSU, Hidehiko

Neural mechanisms of visual perception and cognition

The main purpose of this division is to study the neural mechanisms of visual perception and cognition. We are mainly recording neuron activities from visual cortical areas of the macaque monkey to study the stimulus selectivity of neurons and their relationships with perception and behavior, as well as the representation of visual information in the brain. We are also conducting fMRI experiments using awake monkeys. In addition, we are conducting psychophysical and fMRI experiments using human subjects. We are mainly targeting higher visual areas, but we also target lower visual areas or even non-visual areas when necessary. Our research is currently focusing on the color information processing and neural representation of Shitsukan. Shitsukan is a Japanese word to indicate perception of materials and surface qualities of objects. With regard to color processing, we are studying functional architecture and the relationship between neuron activities and perception in the inferior temporal (IT) cortex, a higher ventral area critically involved in color vision. With regard to Shitsukan, we are analyzing neuron activities related to gloss perception, and we are also studying brain activities related to the representation of various materials.



06

Division of Neural Signaling

Associate Professor
FURUE, Hidemasa

Analysis of mechanisms underlying neural information processing

Using electrophysiological techniques (e.g. patch clamp recordings *in vivo* and brain/spinal cord slices *in vitro*), our laboratory focuses on the molecular and cellular mechanisms underlying the transduction and integration of neural information in a local network. We combine the use of genetically-modified animals with electrophysiological, biochemical and behavioral approaches to uncover the molecular basis of pathophysiological symptoms such as deficits of learning and memory. Recently, we have begun to use photo-release/optogenetic tools and computational methods. Ongoing projects include: 1) *In vivo* patch-clamp recording analysis of spinal synaptic responses elicited by optogenetic activation of locus coeruleus neurons (Fig. 1A). 2) Analyses of nociceptive synaptic transmission and autonomic control of the lower urinary tract. 3) Transmitter diffusion-dependent inter-synaptic crosstalk: Role of glia and transporters (Fig. 1B). 4) Computational simulation of neuronal network function. 5) Molecular basis of memory:Behavioral analysis of learning and memory using genetically modified mice (Fig. 1C). 6) Mechanisms underlying diseases of the nervous system.

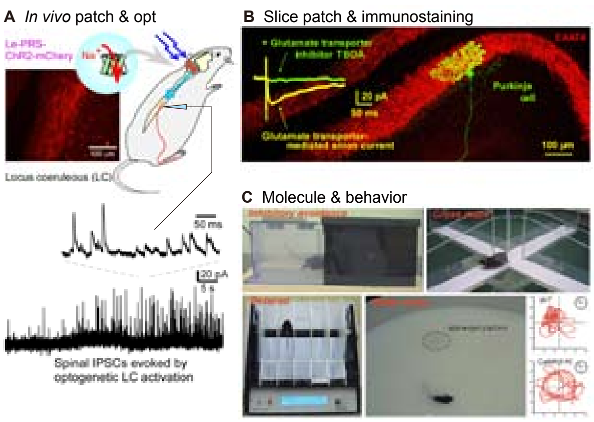


Fig. 1. Multilevel studies of the mechanisms underlying information processing in a neural network from the molecular level to whole animal physiology.

07

Division of Visual Information Processing

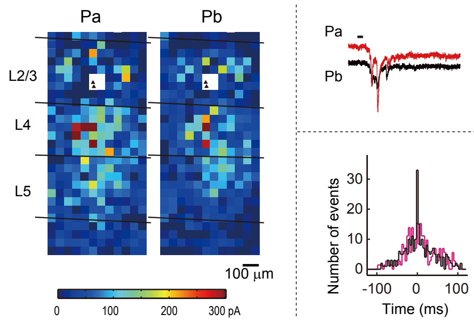
Professor
YOSHIMURA, Yumiko

The mechanisms of information processing in sensory cortex and the experience-dependent regulation of that processing.

In order to elucidate how specific neural circuits in the brain are established during development and how these circuits contribute to the sensory information processing, we are studying the following 3 issues using rodent sensory cortex.

1. The mechanisms that establish fine-scale networks in visual cortex and the role of these networks in visual information processing
2. Cell-lineage dependent establishment of neural connections and visual responsiveness in visual cortex
3. Activity-dependent synaptic plasticity and the experience-dependent plasticity of visual responses

To this end, we are analyzing the visual responses of cortical neurons using multi-channel electrodes or calcium imaging with 2-photon microscopy, the properties of neural circuits with a combination of laser scanning photostimulation and whole-cell recording methods in brain slice preparations, and the neural connections morphologically using modern virus tracers.



The cross-correlation analysis of photostimulation-evoked EPSCs in synaptically connected pairs in visual cortical slices.

Research Departments

08

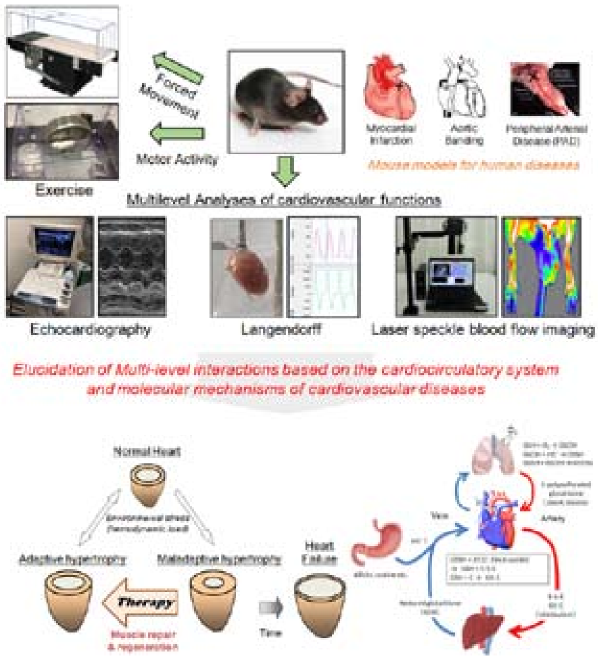
Division of Cardiocirculatory Signaling

Professor
NISHIDA, Motohiro

Elucidation of biological functions using multi-level techniques to evaluate cardiovascular functions and its clinical application

Our sanguiferous function is mainly regulated by muscular organs composed of striated muscles (heart and skeletal muscles) and smooth muscle (blood vessels). Our group aims to elucidate the molecular mechanisms underlying transition of the muscles from adaptation to maladaptation against environmental stress (mainly hemodynamic load) in vitro and in vivo using multi-level techniques to evaluate cardiovascular functions, and work toward practical application (e.g., drug discovery and fostering). We also investigate the mechanism of muscle repair and regeneration, and aim to develop a novel therapeutic strategy for refractory diseases. In addition, we address the inclusive research to elucidate the mechanism underlying maintenance and transfiguration of cardiocirculatory homeostasis via multi-organ interactions by combining non-invasive measuring methodologies of motor functions and cardiovascular functions.

Our laboratory has various techniques and equipments to drive the above researches.



09

Division of Sensori-Motor Integration

Professor
KAKIGI, Ryusuke

Non-invasive measurement of human brain functions

We investigate human brain functions non-invasively mainly using magnetoencephalography (MEG) and electroencephalography (EEG), but recently we have also used functional magnetic resonance imaging (fMRI), transcranial magnetic stimulation (TMS) and near-infrared spectroscopy (NIRS). Integrative studies using various methods are necessary to understand the advantages and disadvantages of each method.
Recent main topics are as follows.
(1) By recording brain responses to noxious stimuli using MEG and EEG, sensory processing in the nociceptive system is being investigated. For noxious stimulation, intra-epidermal electrical stimulation, which was developed in our department, is used.
(2) We newly developed an electrical stimulus method to cause itch sensation. It is very useful to investigate itch perception in humans, and we have reported many new findings using this method.
(3) Auditory system: we are investigating the neural mechanisms of auditory perception in normal and hearing impaired people by measuring the brain activity. We are conducting joint researches to establish a new treatment strategy against hearing disorders such as tinnitus and sudden hearing loss.

Magnetoencephalography device with 306 channels.

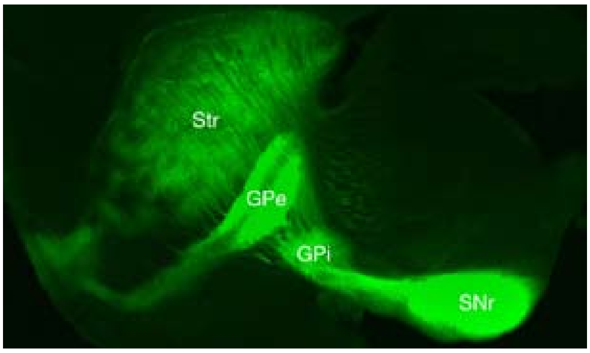
10

Division of System Neurophysiology

Professor
NAMBU, Atsushi

Mechanism of voluntary movements and pathophysiology of movement disorders

The cerebral cortex, basal ganglia and cerebellum work together to control voluntary movements. Malfunctions of these structures result in movement disorders, such as Parkinson's disease and dystonia. We are performing the following projects using rodents and subhuman primates to elucidate the mechanisms underlying higher motor functions and the pathophysiology of movement disorders, which will help to develop new therapeutic strategies.



1) Electrophysiological and anatomical studies to analyze information flows through the neuronal networks connecting the cerebral cortex, basal ganglia and cerebellum.
2) Electrophysiological recordings of neuronal activity from animals performing motor tasks, combined with local injection of neuronal blockers and optogenetics, to understand how the brain controls voluntary movements and higher brain functions.
3) Application of electrophysiological methods to animal models of movement disorders to study their pathophysiology and to normalize motor functions by suppressing abnormal neuronal firings.

A sagittal section of the mouse brain showing selective expression of channelrhodopsin-2 (ChR2, C128S) in striatal projection neurons as visualized by enhanced yellow fluorescent protein signals. Strong fluorescence was observed in the striatum (Str), as well as its targets, such as the external and internal segments of the globus pallidus (GPi and GPi) and the substantia nigra pars reticulata (SNr). Neurons expressing ChR2 can be selectively stimulated by applying blue lights.

11

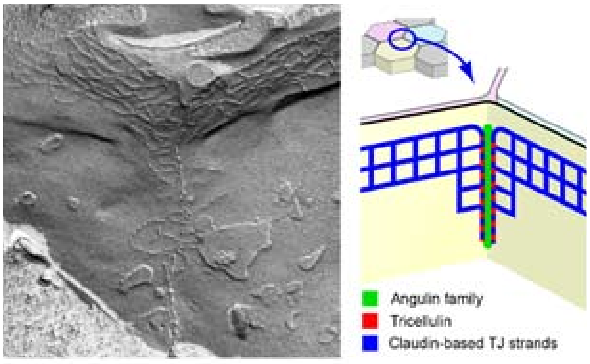
Division of Cerebral Structure

Professor
FURUSE, Mikio

Molecular basis of the regulation of epithelial barrier function and paracellular transport

The epithelium maintains the fluid environment of each body compartment not only by transporting various substances selectively but also by working as a diffusion barrier. To elucidate the mechanism underlying these roles of the epithelium, we have been clarifying the molecular basis of cell-cell junctions that directly contribute to the epithelial barrier function and passive transport of solutes through the paracellular pathway. By combinining molecular biological, morphological and physiological analyses, the following research projects are ongoing.

1) Analyses of the function and behavior of claudin family proteins, major structural components of tight junctions.
2) Molecular dissection of tricellular tight junctions.
3) Analyses of the regulatory mechanism of cell-cell junction formation by using Drosophila genetics.
4) Response of epithelial barrier function to environmental changes.



Freeze-fracture replica of tricellular tight junctions (left) and a model of the molecular organization of tricellular tight junctions (right).

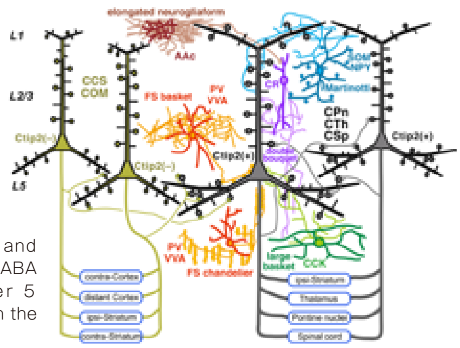
12

Division of Cerebral Circuitry

Professor
KAWAGUCHI, Yasuo

Analyses of neuronal organization and the micro-/macro-circuitry of the neocortex

Although early anatomical work revealed that cortical neurons are very diverse in their morphologies, a comprehensive understanding of neocortical structure has remained elusive. Cortical neurons are divided into excitatory glutamatergic pyramidal cells and inhibitory GABAergic cells. We first identified a subtype of GABAergic neuron called 'fast-spiking basket cells' based on their axonal morphology and selective expression of the calcium-binding protein 'parvalbumin'. Since then, we have identified many additional subtypes of cortical GABAergic cells by examination of their morphological, physiological, and chemical properties. We have followed this up by investigating their synaptic structures with pyramidal cells. Our findings have provided a framework for analysis of the structure and function of neocortical circuits under normal as well as pathological conditions. In addition to the GABAergic cells, we are now also investigating the organization and connectivity of cortical pyramidal cells projecting to diverse brain areas. To do this, we are using anatomical, molecular, and developmental techniques for identification of neocortical neuron groups, and electrophysiology and electron microscopy for circuit and synaptic transmission analysis. Our hope is that this new knowledge will provide insights into the function of the neocortex, as well as identify changes in cellular and circuit function that contribute to neurological and psychiatric disease.



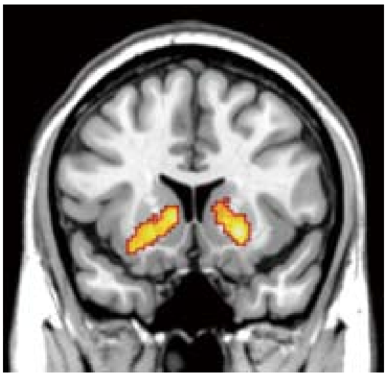
Basic subtypes and connections of GABA cells and layer 5 pyramidal cells in the frontal cortex.
Molecules expressed in GABA cells: AAc, alpha-actinin-2; CCK, cholecystokinin; CR, calretinin; NPY neuropeptide Y; PV, parvalbumin; SOM, somatostatin; VVA, binding with *Vicia villosa*. Pyramidal cell groups: CCS, crossed-corticostriatal cell; COM, commissural cell; CPn, corticopontine cell; CTh, corticothalamic cell; CSp, corticospinal cell.

13 Division of Cerebral Integration

Professor
SADATO, Norihiro

Exploring neural substrates of human cognition by functional MRI

The goal of Division of Cerebral Integration is to understand the physiology of human voluntary movement and other mental processing including language using noninvasive functional neuroimaging technique, mainly fMRI. In particular, understanding of the mechanisms of plastic change in the human brain accompanied by learning, sensory deafferentation, and development of social cognition is the main focus of our research activities. Multimodality approach including EEG, MEG, TMS, and NIR are considered when appropriate. To explore the neural mechanism of real-time social interaction, hyper-scanning fMRI (3T) and 7TMRI will be applied.



Brain areas commonly activated by social and monetary rewards. Why are we nice to others? One answer provided by social psychologists is because it pays off. A social psychological theory stated that we do something nice to others for a good reputation or social approval just like we work for salary. Although this theory assumed that social reward of a good reputation has the same reward value as money, it was unknown whether it recruits the same reward circuitry as money in human brain. In this study, we found neural evidence that perceiving one' s good reputation formed by others activated the striatum, the brain' s reward system, in a similar manner to monetary reward. Considering a pivotal role played by a good reputation in social interactions, this study provides an important first step toward neural explanation for our everyday social behaviors.

14 Division of Homeostatic Development

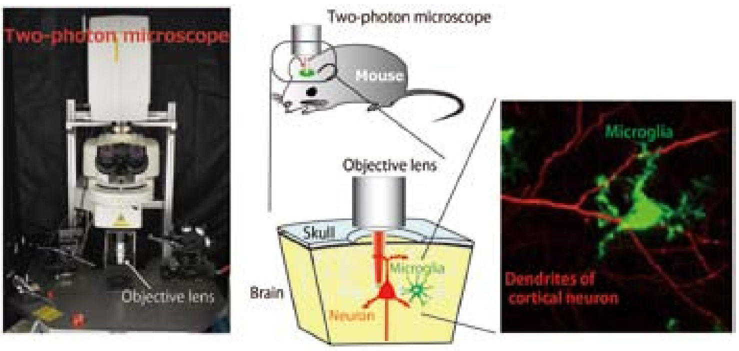
Professor
NABEKURA, Junichi

Functional regulation of the neural circuits remodeling in development and recovery. – Physiological role of the glial cells –

Our research is focused on studying the physiological function of glial cells. We use two photon microscopy to visualize the morphology and function of neurons and glial cells in living brain, and study how these cell types interact during development and during different behaviors.

We are focusing particularly on microglia cells and their contribution to regulating the number and activity of synapses. Our research has identified microglial phagocytosis of mature synapses, and conversely the promotion of immature spines. The regulation by microglia of the number and activity of synapses is essential for the proper development of the brain and for the maintenance of neural circuits in the mature brain.

Glial contribution for remodeling of neural circuits in vivo



Glia (microglia) could regulate the number of synapses by promoting their formation and eliminating them through glial phagocytic action in developing and mature brain.Thus glia (microglia) regulate the function of neural circuits.

15

Division of Endocrinology and Metabolism

Professor
MINOKOSHI,Yasuhiko

The central regulation of whole body energy metabolism

The animal body has an integrated-regulatory system for "homeostasis" that maintains a normal, constant internal state by responding to changes in both the external and internal environments. Within the central nervous system, the hypothalamus is a crucial center that regulates the homeostatic activities by integrating autonomic nervous system, endocrine system and immune function. This division is intensively investigating the role of hypothalamus in body energy balance in mammals. These studies are now important for better understanding the molecular mechanisms behind pathophysiology of obesity and diabetes mellitus.

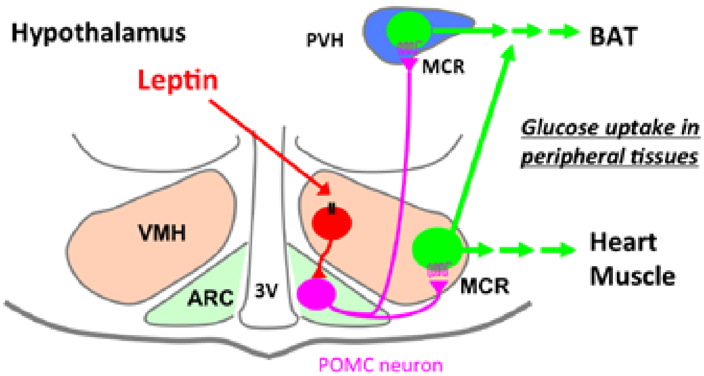


Fig. Regulatory role of the hypothalamic nuclei in glucose metabolism in peripheral tissues in response to leptin. Leptin activates POMC neurons in arcuate hypothalamus (ARC) via VMH neurons, thereby stimulating melanocortin receptor (MCR) in VMH and PVH neurons. Activation of MCR in VMH stimualtes gluocse uptake in BAT, heart and skeletal muscle, while MCR in PVH stimulates glucose uptake in BAT preferentially.

Ravshan Z. SABIROV

NIPS Foreign Researcher

Professor and Head
Laboratory of Molecular Physiology,
Institute of Bioorganic Chemistry, Academy of Sciences of Uzbekistan

①. What are you doing (researching) at NIPS?

My research is in the field of molecular and cellular physiology of ion channels in general and of volume-regulated anion channels in particular. I am currently trying to find the molecular basis of the maxi-anion channel and of the volume-sensitive outwardly rectifying (VSOR) anion channel of intermediate amplitude.

②. Why are you working at NIPS? (Why did you choose NIPS?)

The main reason I am working at NIPS is that my research interests are close to the field of studies of world-class scientists working at NIPS. I believe that NIPS is one of the best places to accomplish ambitious research projects in every field of Physiology, from molecules to the whole organisms.

③. What are the good points about NIPS?

There are many good points about NIPS. First of all, it is very well organized. Staff members, both scientific staff and technical departments, are very professional and are doing their best to support top-class research activities. The atmosphere in NIPS is quite nice and friendly. NIPS has very nice programs for collaboration, both domestic and international. Seminars as well as conferences and symposia inviting world-class Japanese and foreign scientists are held frequently to provide first-hand knowledge and a creative environment for researchers, particularly, for young people. Excellent state-of-the-art animal facilities established at NIPS are indispensable for high-level physiological studies.

Md. Rafiqul Islam

JSPS Postdoctoral Fellow

①. What are you doing (researching) at NIPS?

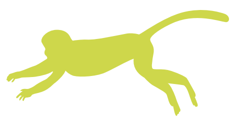
I have been trying to identify the molecular entity of a ubiquitously expressed anion channel (Maxi-anion/Maxi-Cl channel) which plays a vital role under normal physiological and patho-physiological condition. This channel-mediated released ATP and glutamate has been found to be associated with kidney tubuloglomerular feedback, cardiac ischemia/hypoxia, as well as brain ischemia/hypoxia and excitotoxic neurodegenaration. Using fibrosarcoma L929 cells, I could establish that Maxi-Cl channel works separately and distinctly as an ATP releasing channel unrelated to Pannexin 1 and plays an essential role in the cell volume regulation after osmotic swelling. Finally, we are now trying to pin-point the channel molecule by using electrophysiological, pharmacological, gene silencing and gene editing technology (CRISPR/Cas9).

②. Why are you working at NIPS? (Why did you choose NIPS?)

In order to contribute for the welfare of human beings it was my very strong desire and big dream to conduct a good research in biomedical field. After searching I found "National Institute for Physiological Sciences (NIPS)" located in Okazaki, Aichi, Japan as one of the world best research institute where remarkable and world-class cutting-edge research works in various fields (like molecular and cellular physiology, neurophysiology etc) are being performed. That's why I selected NIPS to do my research work. I felt me fortunate to get a renowned and highly cited researcher Prof. Yasunobu Okada as my mentor. My heartfelt thanks to him.

③. What are the good points about NIPS?

There are several good points of NIPS like-i) here labs are led by the world famous and highly talented & devoted Japanese professors/scientists, ii) all laboratories are enriched with modern sophisticated and *state-of-the-art* equipments & facilities and funding, iii) NIPS highly encourages international collaboration and always inviting foreign researchers thereby keeping a true international research environment and quality. It is also nicely fostering young Japanese and foreign researchers, iv) NIPS is located in a calm and quiet environment favorable to do research, v) NIPS provides very nice lodging facilities for the foreign researchers in a place adjacent to the campus.



01 Center for Genetic Analysis of Behavior

Director
Professor ***IKENAKA, Kazuhiro***

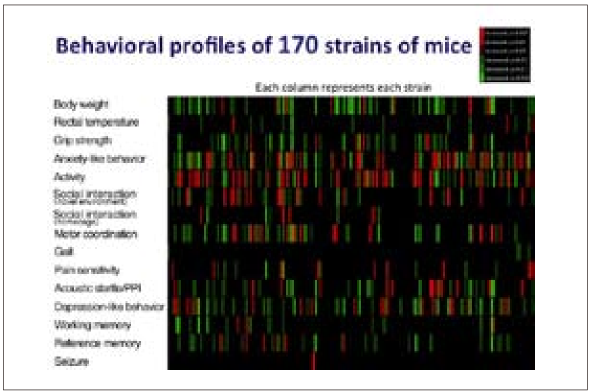
Section of Mammalian Transgenesis

Services offered by Laboratory for Transgenesis include generating transgenic rodents (mouse and rat) by pronuclear microinjection of foreign DNA and generating knockout (KO)/knock-in (KI) rodents by new genome-editing tools using zinc finger nucleases (ZFNs), TAL effector nucleases (TALENs) or the clustered regularly interspaced short palindromic repeat/Cas9 (CRISPR/Cas9). In addition, embryonic stem (ES) and induced pluripotent stem (iPS) cells established in rats can be utilized for researches in regenerative medicine. Production of cloned rats by somatic cell nuclear transplantation is a challenging subject.

Fig.1.
A Rosa26-tdTomato KI rat offspring derived from the gene-modified rat ES cells.

Section of Behavior Patterns

Since 99% of mouse genes have homologous in humans, a large-scale project that is aimed to encompass knockouts of every gene in mice is in progress. Approximately 80% of all genes are expressed in brain and, to investigate their function in individual organisms, we should investigate their functions in the brain. We can identify the genes that have a significant impact on the brain functions efficiently by examining the final output level of gene function in the brain, that is, behavior. The influence of a given gene on a specific behavior can be determined by conducting the behavioral analysis of mutant mice lacking that gene. The test comprehensive behavioral battery covers sensori-motor functions, emotion, learning and memory, attention and so on. So far, we obtained behavioral data from 75 strains. In those mice strains, we found some models of psychiatric disorders.



Heat map showing behavioral phenotypes of genetically engineered mice. Each column represents the strain of genetically-engineered mice that has been analyzed. Each row represents a category of behavior assessed by comprehensive behavior test battery. Colors represent an increase (red) or decrease (green) in a comparison between the wild-type and mutant strains.

Section of Metabolic Physiology

This section analyzes the in vivo neuronal and metabolic activity in mice and rats which were modified their related genes and exposed with various environmental conditions. This section has been opened for the collaboratory use of researchers all over Japan since April, 2011. This section examines the following subjects:

1) Single unit recording from motor related brain regions in awake state.
2) Neurotransmitter release in local brain regions in free-moving animals.
3) Regional neural activity detected as intrinsic signals with taking the advantage of light fluorescent dynamics of flavin or hemoglobin.
4) Energy intake and expenditure in free-moving animals.
5) Body temperature, heart rate and blood pressure in free-moving animals.
6) Measurement of cardiac function using Langendorff-perfused hearts and non-invasive measurement of cardiac function and peripheral blood flow using anesthetized mice.

ARCO system: measurement of whole body energy metabolism by mass spectrometorical analysis of respiratory gas exchange

02 Center for Multidisciplinary Brain Research

Director
Professor ***ISA, Tadashi***

The brain adjusts and integrates the functions of individual organs in the human body. It is necessary to understand such brain function properly to understand the normal function and dysfunction of the human body, and to find the treatment of diseases. In addition, it might also be possible to make a computer or robots with novel operating principles by learning from the brain. Physiology and neuroscience has been developed to understand such brain function. However, nowadays, in addition to these classical fields of sciences, collaboration with a wide range of research fields such as engineering and psychology has become very active. We now have a strong belief that to understand the brain, integration of different knowledge is necessary. The Center for Multidisciplinary Brain Research offers the place and opportunities for the researchers from different fields, and from all over Japan, to create the human network, cooperation and joint researches by inviting researchers from various research fields as visiting professors. In particular, "Section of Brain Science Exploration and Training" is conducting model classes for creating a new educational program of multidisciplinary integration. It offers classes on the basic neuroanatomy to young researchers with engineering background. In addition, it organizes brainstorming for the young researchers from the various research fields so that they can exchange their ideas. Ot organized a public symposium based on the outcome of such brainstorming. "Section of Hierachical Brain Information" is promoting the cooperation with technologies for measurement and control of brain dynamics, and the material design technologies. "Section of Social Behavioral Neuroscience" is promoting the cooperation with the humanities and social sciences to study the brain function as the basis of human social interactions. "Research Strategy for Brain Sciences Office" carries out administration support of the mega-projects to create the domestic researchers network, and its public relations to introduce the research outcomes to the public for promotion of understanding the brain sciences among the citizens.

"Section of Visiting Collaborative Research Project" accepts sabbatical researchers from inside Japan and from abroad to facilitate the collaborative research. Especially, in 2014, an international collaboration laboratory was initiated, and a research unit led by a foreign PI started its research activity. The activities of such Center for Multidisciplinary Brain Research has been utilized by researchers who launches a new research project based on his/her original idea.

Histology practice in the Training and Lecture Course

Brainstorming meeting

03 Supportive Center for Brain Research

Director
Professor ***KUBO, Yoshihiro***

Supportive Center for Brain Research consists of six sections: Sections of Brain Structure Information, Brain Function Information, Multi-photon Neuroimaging, Electron Microscopy, Viral Vector Development, Primate Model Development and Instrument Design. Here the activities of three sections are introduced.

(1) In the Section of Brain Structure Information, we investigate the structures of bio-macromolecules and cell organelles at nanometer scales using the state-of-the-art electron microscopes (High-voltage TEM, Phase-contrast cryoEM, and Serial block-face SEM), and study the relationship with the function. The major research targets are large protein complexes, membrane proteins, viruses, bacteria, and synapses. We are also developing the new methodologies of bioimaging and image processing using electron microscopes through individual collaboration researches (Figure 1).

(2) Our state of the art two-photon fluorescence microscope and two-photon fluorescence lifetime imaging microscope allow us to image biochemical reactions in living cells and subcellular structures in deep tissue such as brain slice and brain of living mouse (Figure 2). By combining these techniques with optical manipulation techniques such as optogenetic approach, we are trying to understand the mechanism of memory system in brain.

We welcome any highly motivated student interested in our research area, and also accept collaborative research.

(3) A viral vector is a useful experimental tool for gene transfer to various mammals including a rodent and a non-human primate. Section of Viral Vector Development plays a role as Vector Core, and collaborates with other laboratories by providing adeno-associated viral vectors and lentiviral vectors. We have already provided viral vectors for many domestic and foreign laboratories, and various collaborations, mainly brain research projects, are now in progress. There are few domestic laboratories which possess technique to produce high quality viral vectors in a large scale. Therefore, we are going to promote the collaboration more actively by providing viral vectors in the future (Figure 3).

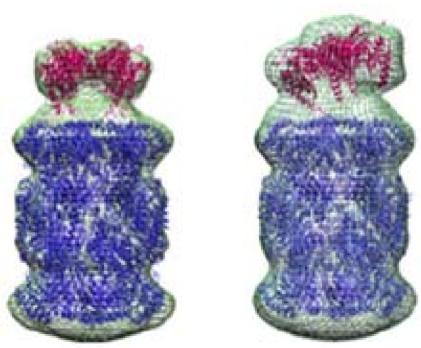


Figure 1.
Asymmetric binding architectures of the activation factors on 20S proteasome reveled by electron tomography and single particle analysis (Kumoi et al. PLOS ONE 8:e60294, 2013). Scale 10 nm.

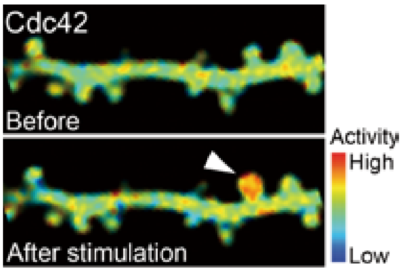


Figure 2.
Imaging biochemical reaction in a single synapse by 2-photon fluorescence lifetime imaging microscopy. The arrowhead indicates the activation of Cdc42 after glutamate uncaging stimulation.

Figure 3.
Expression of GFP gene in striatal neurons of mice using AAV vectors.

Research Centers

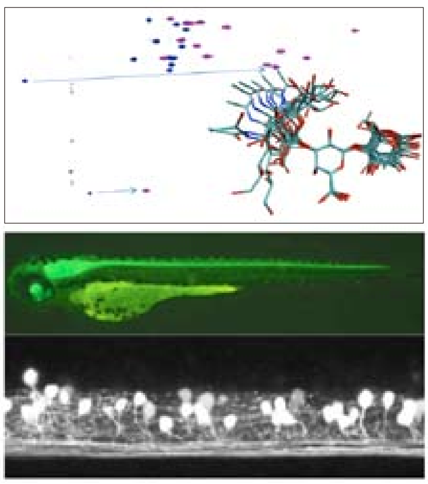
04 Okazaki Institute for Integrative Bioscience

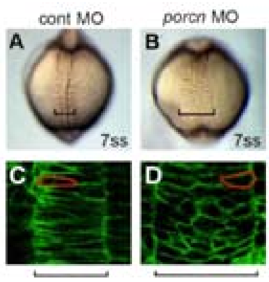
Okazaki Institute for Integrative Bioscience (OIIB) has been implementing research aiming at developing new research fields in biosciences since it was founded in 2000 as an Okazaki Research Facility. As life has the complicated hierarchy, it is required that we develop new research strategy with multiangle viewpoints and integrative approach to study it. In 2013 OIIB had reformed their organizational structure to meet these scientific requests and restructured existing three departments: Department of Biosensing Research, Department of Biodesign Research, and Department of Bioorganization Research. The following research has been performing in these departments.

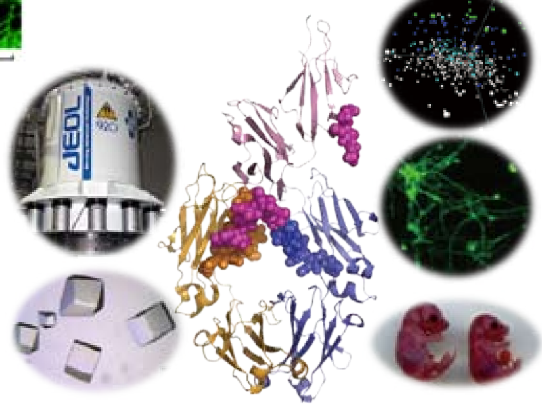
In Department of Biosensing Research, biosensing mechanisms responsible for sensing environmental signals are studied to elucidate dynamism of life system using various sensing systems from a molecular level to an organ level. There are different mechanisms for molecules, cells, and organs to sense environmental signals. The universality and specificity of biosensing system in different cells and species are clarified by elucidating the mechanism underlying integration of environmental signals by means of various approaches, including structural analyses of biosensors, modeling analyses, and evolutional analyses.

In Department of Biodesign Research, how time and space in life phenomenon are prescribed and regulated are elucidated. The research targets are biological phenomena with a broad time range; from shorter time range (such as molecular reaction) to a longer one (such as evolution), and mechanisms underlying prescription and regulation of size and location in a broad space scale, such as molecular assembly, organ and individual. Integrated research is performed by means of molecular genetics, omic analyses, imaging techniques using optical & electron microscopy, quantitative analyses including imaging analyses, and mathematical & information biology.

In Department of Bioorganization Research, the mechanisms determining how soft and robust higher-order systems are constructed by dynamic meeting and parting of biological elements that are components of life system (cells and molecules composing individual and cell, respectively) are studied. The development of new techniques for physicochemical measurement by which scientific inquiry for relationships between micro and macro scales in bioorganization is promoted. Based on obtained data, research is performed with a broad and integrative approach by means of bioinformatics, quantitative biology, mathematical biology, supramolecular science and synthetic biology.







05 Center for Experimental Animals

Director
Professor ***MINOKOSHI, Yasuhiko***

Experimental animals are relevant to human health and contribute meaningfully to medical advances such as providing better support for the life science research and the development of medical technology. To perform a highly reproducible animal experiment, it is necessary to maintain high standards of experimental animals. In order to achieve this aim, the experimental animal facilities have to control the uniformly breeding environment all year round, provide basic husbandry to experimental animals in a clean state without pathogenic microbial contamination (specific pathogen-free: SPF).

The structure of Okazaki National Research Institutes changed following establishment of Center of Integrative Bioscience in 2000. Currently, the Center for Experimental Animals is intended for rearing management of animals and conducting experiments on animals required for the researches of Molecular Sciences, Basic Biology and Physiological Sciences. The animal facility is one of the top-class experimental animal centers in Japan. It consists of “Myodaiji” area and “Yamate” area, the total floor space is approximately 7,000 square meters. In the terrestrial animal section and the aquatic animal section, where about 30 species including SPF rat, SPF mouse, marmoset, monkey, zebrafish and Xenopus, are kept and supplied for experimentation.

The mission of the Center for Experimental Animals is not only to provide Okazaki National Research Institutes withoptimal animal resources, but also support for the domestic and international scientific collaboration in biomedical research in Japan. In addition, we concentrate our efforts on three main priorities: (1) appropriate breeding management of SPF rodents and other experimental animals, (2) embryo transfer and cryopreservation of genetically modified mouse lines, (3) providing information and techniques related to animal experimentation, education and awareness, based on ethical consideration and related regulations in experimental animals. For this purpose, it is necessary to provide air condition, care for animal health, and prevention of infectious diseases. In recent years, our facilities are equipped with modern cage washers, autoclaves, surgical rooms, experimental rooms, Individually Ventilated Cage (IVC) system and blood chemical examination outfit. Facilities exist for a variety of animal use purposes including: maintenance of genetically defined animal colonies and ABSL-2 projects. We have also equipped with advanced breeding equipment such as special cage system suitable for non-human primates, especially the breeding area for Japanese macaques.

The Center for Experimental Animals has modern animal breeding instruments and staffs have breeding management and technologies. We are capable of supplying high quality animal care and resources to researchers to reach the best research achievements in the world.

Individually ventilated cage system

Aquatic animal section

06 Research Center for Computational Science

Research Center for Computational Science, it was established the computer center of IMS in 1977, primarily provides an opportunity for large scale computation in molecular science which could not be carried out at regional university computer centers. Further, the Center is supporting experimental data collection and analysis, developed and maintained the program library and database in molecular science, basic biology and physiological sciences.

Computer Cluster
Fujitsu PRIMERGY RX300S7
Specificatons: 126.9TFlops, 5472cores, 342nodes, 43.7TB memory

Computer Cluster
Fujitsu PRIMERGY CX2550M1
Specificatons: 302.8TFlops, 7280cores, 260nodes, 33.2TB memory

07 Center for Radioisotpe Facilities

The Center for Radioisotope Facilities promotes research works using radioisotopes for three institutes in the Okazaki campus. The center educates researchers for their safe and efficient experiments and strictly controls the use of radioisotopes to ensure the safe handling.

Radioisotope laboratory
Radioisotope experiments in the controlled area for research using radioactive materials.

Monitoring system for the safe use of radioisotopes

Joint usage facilities

The National Institute for Physiological Sciences (NIPS) as an inter-university joint usage institute corporation is conducting diverse (general and planned) joint research projects and joint usage experiments using various types of large-scale equipment through collaboration with researchers belonging to universities throughout Japan and national or public research institutes.

Large facilities and equipments for cooperative studies

As a mission to be the inter-university research institute, NIPS conducts joint studies with researchers from domestic or foreign universities and other research institutes. NIPS provides specialized equipments, large-scale equipments and research facilities, and develops new equipments for morphological and functional 4D imagings of various organs such as brain.

High Voltage Electron Microscope (HVEM)

Hitachi H-1250M is the unique high voltage electron microscope specially designed for biological and medical sciences. The microscope usually operates at an accelerating voltage of 1,000 kV. The column pressure is kept at less than 7×10^{-6} Pa near the specimen position. The image acuisition is performed at the magnification ranges from 1k to 1,000 k. Projections of thick biological specimens up to 5 μm are collected at tilt angles between ±60° using the side entry specimen holder, which gives 3-dimentional ultra-structures of biological specimens at nanometer scales.

Phase Contrast Electron Cryomicroscope

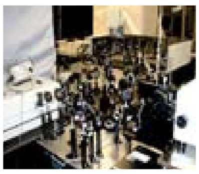
Phase contrast electron cryomicroscope is an electron microscope developed for observing close-to-life state biological samples with a combination of rapid freezing and ice embedding sample preparation methods. Biological specimens up to 200 nm thickness can be observed with a high-resolution and a high contrast. Structural analyses of protein molecules, viruses, bacteria, cultured cells and frozen tissue sections are performed with this novel microscopic system.

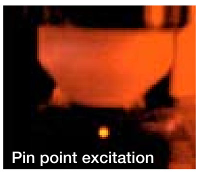
Serial Block-Face Scanning Electron Microscope (SBF-SEM)

Serial block-face scanning electron microscope (SBF-SEM) is an advanced 3-D imaging equippment. Two different types of SBF-SEM are available; high-resolution type and wide-area type. A resin-embedded biological specimen is trimed by a diamond knife attached inside the chamber, and the block-face images are acquired by scanning electron microscope (SEM) continuously. 3-D structure of the specimen is finally rebuilt from the serial block-face images. 3-D structures of large biological specimens like a brain tissue can be visualized by at dosens of nanometer resolution.

Mutiphoton excitation microscopy

Multi-photon excitation is a method to visualize living tissue by exciting the fluorescence molecules with the tightly focused near-infrared femtosecond pulse laser. Since the longer wavelength is used for multi-photon excitaton, it has a superior deeper tissue penetration and reduced phototoxicity than single-photon excitation. Current projects are the imaging of neurons, glial cells in deep tissues such as mouse brain. Our 2-photon microscopes have a top level specification for deep tissue imaging. As new projects, we recently started to image protein-protein interaction and the activation of signaling molecules by using a 2-photon fluorescence imaging microscope.





Pin point excitation

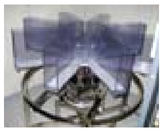
Analytical equipment for in vivo neuronal, metabolic and physiological parameters in mice and rats

We analyze the following physiological parameters in mice and rats: 1) Single unit record ingfrom motor related brain regions in awake state , 2) Neurotransmitter release in local brain regions in freemoving animals, 3) Regional neural activity detected as intrinsic signals with taking the advantage of light fluorescent dynamics of flavin or hemoglobin, 4) Energy intake and expenditure in free-moving animals, 5) Body temperature, heart rate and blood pressure in free-moving animals.

A comprehensive behavioral test battery

We conduct various kinds of behavioral tests for genetically engineered mice, including wire hang, grip strength, light/dark transition, open field, elevated plus maze, hot plate, social interaction, rotarod, prepulse inhibition/startle response, Porsolt forced swim, gait analysis, beam test, eight-arm radial maze, T maze, Morris water maze, Barnes maze, object recognition test, cued and contextual fear conditioning, passive avoidance, tail suspension, and 24 hour home cage monitoring.

The primary goal of our research group is to reveal functional significances of genes and their involvement in neuropsychiatric disorders by conducting a comprehensive behavioral test battery on genetically engineered mice.



eight-arm radial maze

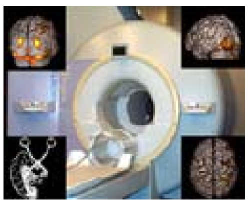
Morris water maze

Magnetoencephalography (MEG)

Magnetoencephalography (MEG) has a potential to measure brain activities with better temporal and spatial resolution in milliseconds and millimeter, respectively, compared with other methods such as functional magnetic resonance imaging. Event-related magnetic fields following various kinds of sensory stimulation are mainly analyzed. In addition, background brain activities (brain waves) in various conditions can be analyzed.

Magnetic Resonance Imaging System

MRI is an imaging technique that utilizes the nuclear magnetic resonance of the hydrogen atom. Not only to image the anatomical details of the brain, MRI also allows to explore the neural substrates of human cognitive function by the visualization of the task-related changes in regional cerebral blood flow (functional MRI). For over a decade, we have been working on 3T MRI to investigate higher brain function of human. To simultaneously measure the neural activities of two participants during their social interaction,we have recently installed dual functional MRI system with two 3T MRI. Furthermore, ultra-high field (7T) MRI system is now being installed. Thus NIPS is now equipped with three 3-Tesla MRIs and one 7-Tesla MRI (Allegra, Siemens in FY 2000, and Verio x 2, Siemens in FY 2009, Magnetom 7T, Siemens in FY 2014).



Research communities

The NIPS also functions as a base for research communities. It is currently developing systems to provide researchers throughout Japan and the general public with information more actively.

Japan-U.S Brain Research Cooperative Program

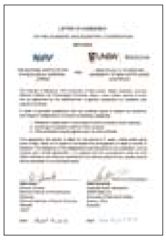
Japan-U.S. Science and Technology Cooperation Program has been implemented since 1979 under the treaty concluded between the governments of two countries, of which "Brain Research" Division was commenced in the year 2000. National Institute for Physiological Sciences from Japanese side and National Institute of Neurological Disorders and Stroke (NINDS), a sub-organ of NIH, from the U.S. support the cooperative projects of researchers of both countries as the responsible agency. The activities are classified into 1) Researchers dispatched to the US, 2) Group joint study project, and 3) Information exchange seminars. The recruitment is made by publicly announcing through the home page and academic journals.

National Bio-Resources Project “Nihonzaru”

National Bio-Resource Project “Nihonzaru” (NBR) aims at establishing a system to collect, maintain, and supply the Japanese macaque monkeys (*macaca fuscata*) as essential bioresource for life science researches on the national scale. Macaca fuscata has high cognitive abilities and is an essential animal model for higher brain function studies in Japan. NIPS promotes the NBR as its headquarter.

International research collaboration

The NIPS has reached agreements with 8 research institutes of the United States,Germany, Uzbekistan, Italy, and South Korea for academic exchange. It is also conducting joint research with those of other European countries, Asian countries, such as China and Thailand, and Australia. Furthermore, it receives graduate students from other countries, mainly Asia; the NIPS has also come to an academic agreement with the University of New South Wales (UNSW) Medicine, Australia.



Study seminars

The NIPS organizes more than 20 study seminars annually for researchers belonging to universities throughout Japan to participate in discussions on important topics. Up to the present, a total of approximately 1,400 researchers have participated in such events. Unlike academic meetings, these seminars enable researchers to thoroughly discuss important research topics in relatively small groups within sufficient time frames, consequently contributing to the development of new research areas and formation of new research groups. For example, specific research areas, such as “neuron-glia networks”, “the membrane transport complex”, and “cellular sensation”, have been developed in study seminars organized by the NIPS.

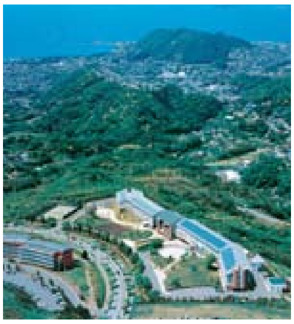
NIPS international symposium and NIPS international workshop

We organize NIPS international symposium and workshop every year inviting cutting-edge researchers from abroad. In 2014, two NIPS international workshops entitled “Conference on neural oscillation” and “A quarter century after the direct and indirect pathways model of the basal ganglia and beyond”, and one NIPS international symposium entitled “Cutting-edge approaches towards the functioning mechanisms of membrane proteins” were held. In the symposium, 26 oral presentations, including 10 by invited oversea speakers, and 36 poster presentations were given to stimulate fruitful discussion. Okazaki Conference Center and accommodation facilities support institutional activities.

Young Fostering

One of the missions of NIPS is fostering young researchers who could lead science of Japan in the future.

What is SOKENDAI?



SOKENDAI (The Graduate University of Advanced Studies) is a graduate school which educates students in the institutes belonging to the Inter-University Research Institute Corporation where students are exposed to the leading edge of science and become scientists having sophisticated expertise, a wide perspective and an ability to explore the novel scientific research. NIPS is in charge of Department of Physiological Sciences which forms School of Life Science with Departments of Basic Biology (National Institute of Basic Biology) and Genetics (National Institute of Genetics).

A lot of researchers are working on brain and neuroscience in NIPS and NIPS is one of a few strong education bases where students can learn a wide rage of brain science. Because brain science is really interdisciplinary, students entering Department of Physiological Sciences have various backgrounds not only of scientific research fields such as medicine, science, technology and agriculture but also of cultural sciences. In order to further enhance the interdisciplinary education of brain science, Department of Physiological Sciences is carrying out a Brain Science Joint Program with other Departments related to brain science research using a remote lecture system.

In addition, School of Life Science Retreat is held once a year with students and teachers belonging to the three Departments in School of Life Science and Department of Evolutionary Studies of Biosystems in which people improve mutual understanding through oral and poster presentations.

Collaborative Researcher

In addition to the SOKENDAI students, graduate students from universities of all over the country are working in NIPS.

Young Fostering & Career Paths

It is an important function for NIPS to foster prestigious researchers in the field of physiological sciences and to supply them to universities and research institutes all over the country, and indeed, a lot of excellent researchers from NIPS are successfully working inside and outside the country. Sixteen, 16 and 10 researchers from NIPS got full professor, associate professor and lecturer positions, respectively, in universities and research institutes last ten years. In addition, NIPS supports especially young researchers by providing original research grants.

Common Facilities in Okazaki

Okazaki Conference Center

Okazaki Conference Center was founded on February,1996 to promote international and domestic conferenceprogram of research and education.

- Conferece Room A (capacity of 200)
- Conferece Room B (capacity of 120)
- Conferece Room C (2 rooms, capacity of 50 each)

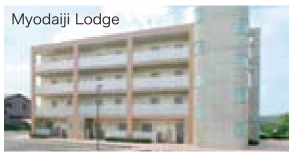
Conferece Room

Accommodation

The lodging houses (Mishima Lodge and Myodaiji Lodge) are provided for guests, both foreign and domestic, for the common use of the three Institutes (NIPS, NIBB and IMS).

The lodging capacities are as follows :

	Single Room	Twin Room	Family Room
Mishima Lodge	60	14	20
Myodaiji Lodge	17	–	3



Myodaiji Lodge

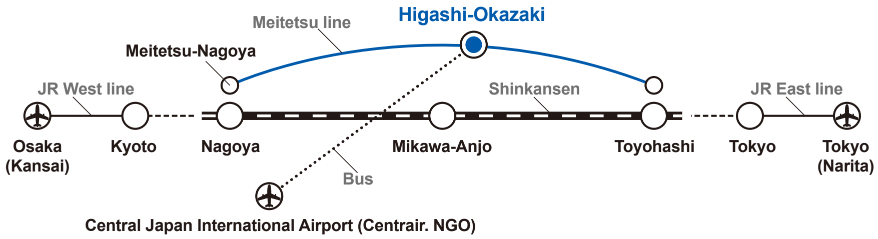
The Sakura Nursery School

The Sakura nursery school is the institutional child care facility established for supporting both research and child-rearing.
The school accept a child from the 57th day of after the birth, and is supporting a researcher's smooth return to research activity.

- Age: From the 57th day of after the birth to 3 years old
- Capacity: 18 persons
- Use candidate: The officers, reserchers, visiting researchers, graduate students at Okazaki three institutes
- Opening day: From Monday to Friday
- Opening time: From 8:00 to 19:00 (maximum extension 20:00)
- Childcare form: Regular childcare, temporary nursery care

Location of Institute

(http://www.nips.ac.jp/eng/profile/access.html)



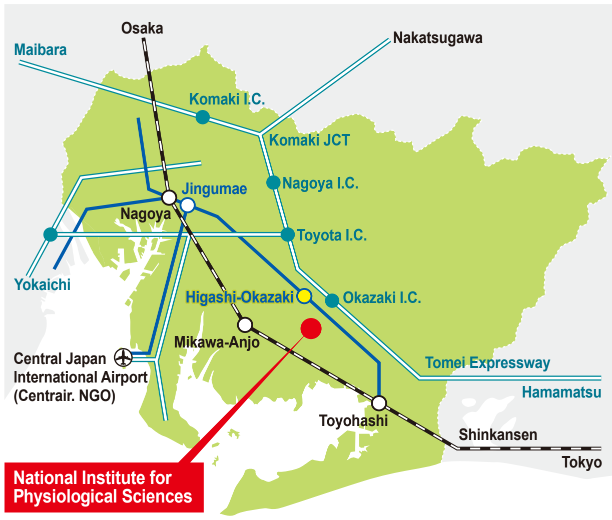
From Central Japan International Airport

A) By bus

Get on the Meitetsu Airport Bus bound for Okazaki Station and get off at Higashi Okazaki Station

B) By train

Take the Meitetsu train from Central Japan International Airport to Higashi Okazaki Station. NIPS is a 7-minute walk up the hill on the south side of the station.



From New Tokyo International Airport (Narita Airport)

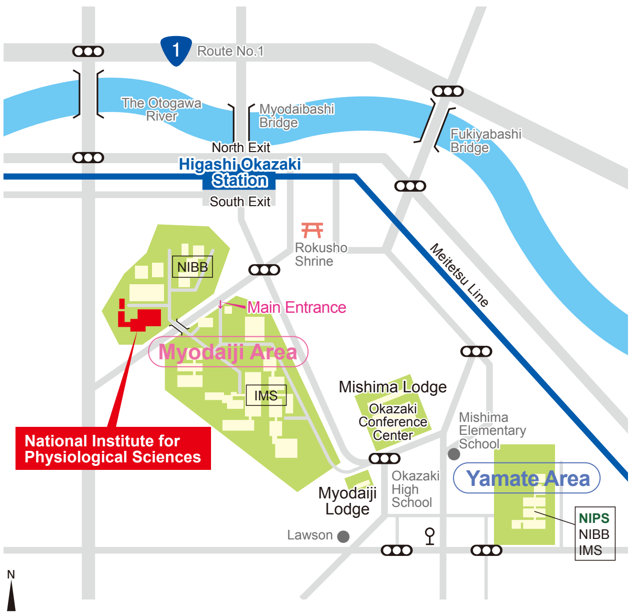
A) By plane (*Recommended)

Transfer to Central Japan International Airport

B) By train

Take the JR Narita Express airport shuttle train from Narita to Tokyo Station (approximately 60 minutes) and change trains to the Tokaido shinkansen* (bullet train).

At Toyohashi JR Station (approximately 2.5 hours from Tokyo), change trains to the Meitetsu Line's Limited Express train** bound for Gifu. Get off at Higashi Okazaki Station (approximately 20 minutes from Toyohashi). Turn left (south) at the ticket gate and exit the station. NIPS is a 7-minute walk up the hill.



Myodaiji Area

From the south exit of Higashi-Okazaki station.
About 7 min. on foot.

Yamate Area

From the south exit of Higashi-Okazaki station.

- By taxi : About 7 min.
- By bus : Take Tatsumigaoka-jyunkan, which departs from No11 bus station, and get off at Tatsumi-kita-1chome (about 6min), and walk to the east for about 3min..
- On foot : About 20 min.

NIPS
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