Call for Joint Research Project Proposals FY 2021
National Institute for Physiological Sciences
National Institutes of Natural Sciences

1. Joint research projects to be proposed

(1) General collaborative project

(2) Planned collaborative project

Research themes:

(i) Physiological and neuroscientific analysis of genetically modified model animals

(ii) Analysis of metabolic physiology for mice and rats

(iii) Ultrastructure analysis of biological specimens by cutting-edge electron microscopy

(iv) Functional and morphological analyses of cells and tissues by multi-photon excitation microscopy

(v) Development and supply of viral vectors and gene-transfer to primates

(vi) Purification of supra molecular complexes and analyses of their constituents by mass spectrometry

(vii) Analyses of dynamic aspects of the function and structure of membrane proteins

(viii) Multi-dimensional fluorescence imaging analysis with a multi-point scanning microscope

(ix) Elucidation of the pathology of mental/neurological diseases by analysis of neural activity dynamics

(3) NIPS Research Meeting

(4) NIPS International Workshop

(5) Cooperative study by functional imaging

(For all types listed above, proposals must be made for the term from April 2021 to March 2022.)

*About the use of Animal Laboratories at the Center for Animal Resources and Collaborative Study

Refurbishment and extension of the building for the Center for Animal Resources and Collaborative Study has been completed. The specific-pathogen-free (SPF) breeding room and the SPF laboratory room, which are dedicated to mice and rats, will be available beginning in 2021. The SPF laboratory room is adjacent to the SPF breeding room, making it possible to perform animal experiments with SPF mice and rats that are bred on site. If you would like to use these facilities, please contact our faculty members in charge of general or planned collaborative projects.

2. Eligibility

A person who is a researcher at a research institution, such as a university or a national or public

research institute, or who is recognized by the Director-General of NIPS as having equivalent research capabilities.

3. How to apply

Proposals for joint research projects must be submitted to NIPS online using the Natural Science Collaborative Research Management System (NOUS). NOUS can be accessed from the login page (https://nous.nins.jp/user/signin).

Along with a research proposal submitted online, a document must be submitted by your institution certifying your supervisor's approval of the proposal. For more details, please refer to the NIPS website: https://www.nips.ac.jp/collabo/top.html.

Before submitting the proposal, anyone wishing to apply must consult with a NIPS professor or associate professor belonging to the Division most relevant to the intended research, regarding details such as the research theme, research plan, visit term, and required expenses, etc.

The names, persons in charge, research outlines, and contact information of Departments, Divisions, and Sections of NIPS are as shown in the Annex.

Please do not hesitate to contact the Section of Collaboration Promotion of NIPS for help (e.g., if you cannot find a NIPS laboratory that will accept your proposal).

<Support Desk for Collaboration Promotion>

Section of Collaboration Promotion of NIPS, NINS

TEL: +81-564-55-7722

e-mail: collabo@nips.ac.jp

URL: https://www.nips.ac.jp/collabo/researcher_poster.html

The NOUS is an online integrated project management system for joint research and joint use projects hosted by NINS. It covers all of procedures from submission, examination, and adoption of research proposals to reporting, publication, and analysis of project outcomes.

4. Deadline for proposals

17:00 Friday, December 4th, 2020

(Friday, December 11th, 2020 for the supervisor's approval document)

Some proposals not submitted by this deadline may be accepted at a later date. Please submit each proposal at least 1 month before the scheduled start of the proposed project.

As a general rule, if a proposal is not submitted by the deadline but is accepted at a later date, reimbursement of travel expenses and research expenses will not be provided.

Also, please be aware that in some cases it may not be possible to decide whether or not to accept or reject a proposal by the planned start date due to our review schedule.

5. Determination of proposal acceptance

The Director-General of NIPS will accept proposals based on reviews of proposed projects by the Advisory Committee for Research and Management of NIPS.

6. Date of decision regarding proposal acceptance

Around March 2021.

7. Travel expenses

Travel expenses will be reimbursed pursuant to the NINS Regulations for Travel Expenses within the budget.

When an undergraduate student who visits NIPS accompanied by or under the direction of a supervisor who is a researcher participating in a collaborative project with NIPS, the travel expenses for the student may also be reimbursed.

*In such cases, the undergraduate student is required to carry out the procedures prescribed in the NINS Guidelines for Undergraduate Students (or the Equivalent) Who Participate in Collaborative Projects at NINS Okazaki Three Institutions.

*Graduate and undergraduate students are required to have Personal Accident Insurance for Students Pursuing Education and Research (including Liability Insurance Coupled with PAS) provided by the Japan Educational Exchanges and Services, or insurance that is equivalent or more comprehensive.

*Due to budget constraints, daily allowances and/or accommodation expenses may be reduced or not paid.

8. Research expenses

Research expenses will be borne by NIPS as allowed by its budget. (Expenses must not be used outside of NIPS.)

9. Certificate application for individuals working with radiation

If a collaborative project or experiment involving radioisotopes at NIPS is accepted, the project will require registration procedures for individuals who will be working with radiation.

10. Gene recombination experiments

If a collaborative project or experiment involving gene recombination experiments at NIPS is accepted, approval will be required by the NIPS Recombinant DNA Experiments Safety Committee.

11. Animal experiments

If a collaborative project or experiment involving animal experiments at NIPS is accepted, approval by the President of NINS will be required after the project proposal is reviewed by the Institutional Animal

Care and Use Committee of National Institutes of Natural Sciences.

12. Any projects involving human subjects or specimens obtained from human bodies

In the case of a collaborative project or experiment involving physiological research with human subjects or specimens obtained from human bodies or related fields at NIPS, approval must be obtained from the ethics committee of your institution before the project proposal is submitted to NIPS.

If the project is approved, it will also require the approval of the Ethics Committee for Human Research of NIPS.

Furthermore, if the proposed project uses the 7-T Magnetic Resonance Apparatus for humans, the approval of both the NIPS Interactive Cooperative Project Promotion Committee and the Ethics Committee for Human Research of NIPS.

Finally, if a project is classified as "clinical research" by the Ethical Guidelines for Medical and Health Research Involving Human Subjects issued by the Ministry of Health, Labour, and Welfare of Japan, please consult with a NIPS researcher in advance.

13. Human genome or gene analysis research

In the case of collaborative projects or experiments involving human genome / gene analysis experiments at NIPS, approval by the Life Ethics Committee of the Three Okazaki Institutes will be required after approval.

14. Japan-U.S. Brain Research Cooperative Program

Projects that have been successfully adopted for the Japan–U.S. Science and Technology Cooperation Program, for which NIPS serves as a contact (http://www.nips.ac.jp/jusnou/), will be given priority upon claim.

15. Submission of research report

After the research project is finished, the principal investigator must submit a research report to the Director-General within 30 days of the completion date.

The report will be included and published in the NIPS Catalogue.

16. Clarification of supports by NIPS

If you publish any outcome of the proposed joint research in academic papers, please be sure to clearly **indicate in the Acknowledgments** that the work was performed as joint research hosted by NIPS.

Example: “This study was supported by the Joint Research Program (XX－YYY) of National Institute for Physiological Sciences.”

* Please replace "XX－YYY" with the project number, which will be provided when the project is adopted.

17. Handling of intellectual property rights

Intellectual property rights will be handled pursuant to the stipulations of the NINS Regulations on Inventions by Employees (NINS-Regulations No. 12 of 2004).

18. Accommodations

We have accommodations for use by researchers who participate in joint research.

19. Promotion of gender equality

NIPS actively promotes gender equality. Please consider this when planning and conducting any collaborative project with us.

20. Personal information

The personal information provided in proposals will be used only for the purpose of selecting successful projects and for administrative procedures involving NOUS.

Please be aware that the name and affiliation of the representative researcher, the project title, and other related information pertaining to each successful project will be published on the NIPS website and in the NIPS Handbook.

21. Childcare support

(1) On-site childcare facility

Depending on availability, researchers who participate in NIPS joint research projects can use our onsite childcare facility.

(2) Childcare support system

Researchers who participate in NIPS joint research projects can use our childcare support system, in which NIPS provides reimbursement for a portion of childcare expenses such as daycare, babysitting, and care for sick children.

(3) Support scheme for researchers who travel with their children

Researchers who participate in NIPS joint research projects can use our travel expenses support scheme whereby NIPS partially supports travel expenses when researchers are accompanied by any of their children during travel for the purpose of conducting the project.

For more details on (1) through (3), please refer to the NIPS website: https://www.nips.ac.jp/collabo/child_rearing_support.html.

22. Contact for inquiries and report submission

38 Nishigo-naka Myodaiji, Okazaki, Aichi, 444-8585, Japan

Joint Use Section of the International Research Cooperation Division, General Affairs Department,

Okazaki Administration Center, the National Institutes of Natural Sciences
TEL: 81(Japan)-564-55-7133; Fax: 81(Japan)-564-55－7119; E-mail: r7133@orion.ac.jp

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<<Access>>

From areas around Tokyo

Take JR Shinkansen to Toyohashi Station

Take Meitetsu Nagoya Honsen Line from Toyohashi Station to Higashi-Okazaki Station (about 20 min with a Limited Express train)

From areas around Osaka

Take JR Shinkansen or Kintetsu Line to Nagoya Station

Take Meitetsu Nagoya Honsen Line from Nagoya Station to Higashi-Okazaki Station (about 30 min with a Limited Express train)

7-minute walk from the south exit of Higashi-Okazaki Station (Meitetsu Line).

For more details, please refer to the NIPS website (https://www.nips.ac.jp/profile/access/).

Details of the Call for Proposals

I. General collaborative projects

1) Outline:

A general collaborative project is a project on a research theme proposed by a representative researcher and conducted by multiple researchers. The representative researcher must be a researcher (or the equivalent) who does not belong to NIPS, and at least one or more NIPS professors or associate professors must participate in each project.

2) Research report:

After the project is finished, the principal investigator must submit a research report to the Director-General within 30 days of the completion date.

3) Other:

No project can be conducted for over 5 years on the same research theme.

II. Planned collaborative projects

1) Outline:

Planned collaborative projects are conducted on research themes designated by NIPS and are listed below. To participate in such projects, a representative researcher must submit a proposal to NIPS for conducting a project on any of the themes. Approved projects will be conducted at NIPS facilities.

Research themes

(i) Physiological and neuroscientific analysis of genetically modified model animals.

We produce genetically modified rats and mice and develop model animals that are useful for physiological and neuroscience experiments. Please note that as a general rule, the animals produced by these collaborative projects must be preserved as public bioresources and details regarding the animals must be available to the public. Please therefore deposit produced animals in the National BioResource Project (rats: Institute of Laboratory Animals, Graduate School of Medicine, Kyoto University; mice: RIKEN BioResource Research Center) within 3 years from the completion of the project.

(ii) Analysis of metabolic physiology for mice and rats

We measure the physiological functions and metabolic parameters of mice and rats over time. In FY 2020, we will advancing our studies with a focus on analyses of mice.

The items to be analyzed and the Divisions and persons in charge of the items are as follows:

a) Single-unit recording from motor-related brain regions in the awake state

(Division of System Neurophysiology, Prof. NAMBU)

b) Energy intake and expenditure in free-moving animals

(Division of Endocrinology and Metabolism, Prof. MINOKOSHI)

c) Body temperature, heart rate, and blood pressure in free-moving animals

(Division of Cell Signaling, Prof. TOMINAGA)

d) Measurement of cardiac functions and circulatory blood flow using isolated perfused hearts or anesthetized mice

(Division of Cardiocirculatory Signaling, Prof. NISHIDA)

(iii) Ultrastructure analysis of biological specimens by cutting-edge electron microscopy

Using the most advanced electron microscopy techniques such as those involving the phase-contrast method, we perform single-particle analysis of proteins and functional and morphological analysis of cells. We also use microtome-integrated scanning electron microscopy to reconstruct the three-dimensional ultrastructure model of specimens at a resolution of dozens of nanometers.

(iv) Functional and morphological analyses of cells and tissues by multi-photon excitation microscopy

We perform intracellular signal transduction and functional analysis of cell morphology in vivo and in vitro using fluorescence microscopy with two-photon excitation or fluorescence resonance energy transfer (FRET).

(v) Development and supply of viral vectors and gene transfer to primates

In recent years, the performance of viral vectors has improved as a gene transfer technique in the central nervous systems of mice, rats, primates and the like. The Section of Viral Vector Development of the Supportive Center for Genetic Analysis of Behavior promotes the collaboration by providing retrograde gene transfer viral vectors enabling the functional manipulation of specific neural pathways and conventional viral vectors. In addition, we work on the co-development of novel viral vector systems.

Furthermore, in order to clarify higher brain function, we will use viral vectors to introduce genes into primates such as macaques and marmosets to perform morphological, physiological, and behavioral analysis.

(vi) Purification of supra-molecular complexes and analyses of their constituents by mass spectrometry

To understand the functions of proteins in living organisms, it is essential to precisely identify the constituents of supra-molecular complexes. We thus purify protein complexes from tissues and cells with an emphasis on their specificity, and then identify constituents of the complexes with mass spectrometry.

Target antigens for autoantibodies in autoimmune diseases are also identified.

(vii) Analyses of dynamic aspects of the function and structure of membrane proteins

Functional membrane proteins such as ion channels and receptors are precisely designed molecules that show dynamic changes in structure and function depending on the situation. We analyze these dynamic aspects using electrophysiological and optophysiological experiments

involving in vitro expression systems.

(viii) Multi-dimensional fluorescence imaging analysis with a multi-point scanning microscope

We conduct joint research with our original multi-point scanning confocal/two-photon microscope. In particular, we quantitatively visualize and analyze various cell physiological functions, including circadian rhythms, with high-speed 3D, ultra-long-term, multicolor, and super-resolution observations.

(ix) Elucidation of the pathology of psychiatric/neurological diseases by analysis of neural activity dynamics

We study the relationship between human and animal neural activity dynamics and the pathology of various psychiatric and neurological diseases by combining unit recording, local field potentials (LFPs), electrocorticography (ECoG), scalp electroencephalography (scalp EEG), functional magnetic resonance imaging (fMRI), and magnetoencephalography (MEG) in a multi-layered manner. In particular, we analyze neural activity dynamics such as oscillation, synchronization, and fluctuations from the perspective of nonlinear dynamics and computational theory.

2) Contact person: Before submitting any proposal, please consult with one of the NIPS members listed below according to your interest.

(i) Person in charge of the Section of Mammalian Transgenesis of the Center for Genetic Analysis of Behavior

(ii) Person in charge of each Section or Division

(iii) Assoc. Prof. MURATA (Section of Electron Microscopy), Prof. FURUSE (Division of Cell Structure), and Adjunct Prof. OHNO (Division of Ultrastructural Research)

(iv) Assoc. Prof. NARUSHIMA (Division of Homeostatic Development) or Assoc. Prof. MURAKOSHI (Section of Multiphoton Neuroimaging)

(v) Assoc. Prof. Kobayashi (Section of Viral Vector Development) for preparation and provision of viral vectors

Prof. Nambu (Division of System Neurophysiology) for gene transfer into primates

(vi) Prof. FUKATA (Division of Membrane Physiology)

(vii) Prof. KUBO (Division of Biophysics and Neurobiology)

(viii) Prof. NEMOTO (Division of Biophotonics)

(ix) Prof. KITAJO (Division of Neural Dynamics)

3) Research report: After the research project is finished, the principal investigator must submit a research report to the Director-General within 30 days of the completion date.

4) Others: No project can be conducted for over 5 years on the same research theme.

(Note) Please note that only a small number of proposals will be accepted as planned collaborative projects due to the limited capacity of each Division or Section.

III. NIPS Research Meeting

1) Purpose and Overview

The NIPS research meeting is a relatively small group meeting (about 100 people or fewer) for debating the creation of new academic fields and developing new technologies. At least one NIPS professors or associate professors must participate in each meeting. Travel expenses of participants will be partly borne by NIPS.

2) Duration

The duration of each research meeting cannot be longer than 3 days.

3) Venue

The meeting must be carried out in the Okazaki area of NINS.

Please note that you can hold a meeting in the Okazaki Conference Center of NINS. For details on reservation procedures, please contact the Joint Use Section of the International Research Cooperation Division (r7133@orion.ac.jp).

To contribute to the research communities surrounding NIPS and to Japanese universities, we plan to adopt one proposal (or more if possible) for holding a NIPS research meeting outside the NINS Okazaki area. Preferably the venue will be a university or other related institute. As a general rule, the research meeting cannot be held in conjunction with any other event, such as an academic conference or the like. Travel expenses for these research meetings will be handled in accordance with the rules for those held in the Okazaki area.

4) Research report

After the research meeting is finished, the principal investigator must submit a research report to the Director-General within 30 days of the completion date.

5) Others

If any research meeting is to be held on the same theme for more than 3 years, its significance must be reviewed. If you desire to continue the meetings for over 3 years, we expect a new development to be included in the proposal.

Please pay special consideration to gender equality when selecting participants in the proposed project.

IV. NIPS International Workshop

1) Purpose and Overview

To promote the internationalization and development of NIPS, we hold a NIPS International Workshop that invites several scientists from around the world. The Workshop is held in English. You can submit the same content as both a NIPS Research Meeting proposal and a NIPS

International Workshop proposal. If both of the proposals are approved, the project will be held as an International Workshop. We plan to adopt one to three proposals for the International Workshop every year.

At least one or more NIPS professors or associate professors must participate in each workshop. The expected number of participants in a Workshop is 50 to 100. The International Workshops are relatively small events compared to the NIPS International Symposium, which is held once or twice every year.

2) Budget

Depending on the size of the workshop, NIPS will support expenses of up to 750,000 yen.

3) Duration

The duration of an International Workshop cannot be longer than 3 days.

4) Venue

The meeting must be carried out in the Okazaki area of NINS.

Please note that you can hold a meeting in the Okazaki Conference Center of NINS. For details on applying for its use, please contact the Joint Use Section of the International Research Cooperation Division (tel: +81-564-55-7138).

5) Research report

After the workshop is finished, the principal investigator must submit a research report to the Director-General within 30 days of the completion date.

V. Cooperative studies by functional imaging

1. Magnetic resonance imaging (MRI) scanner

1) Research themes

For collaborative studies using our MRI scanner, we have defined the following two research themes. Under these themes, researchers inside and outside NIPS aim to comprehensively elucidate biological functions from the molecular level to the individual level.

i) Non-destructive, 3-dimensional observation of the inside of living organisms

ii) Continuous observation of morphological and energy states associated with biological activities (including brain activation tests)

Please note that our 7-T magnetic resonance device will be used for technical examination and development related to imaging and image processing for a while.

2) Overview of the MRI scanner installed at NIPS

Please refer to Annex 1.

3) Before submitting any proposal, please consult with one of the NIPS members listed below based on your interest.

Prof. ISODA (Division of Behavioral Development)

Prof. NAMBU (Division of System Neurophysiology)

Prof. KITAJO (Division of Neural Dynamics)

Prof. SADATO (Division of Cerebral Integration)

Assoc. Prof. FUKUNAGA (Division of Cerebral Integration)

Assoc. Prof. CHIKAZOE (Supportive Center for Brain Research)

2. Magnetoencephalography (MEG)

1) Research themes

Using non-invasive measurement methods such as magnetoencephalography and electroencephalography, researchers inside and outside NIPS collaborate to clarify the higher brain functions of humans. For FY 2020, we have defined the following two research themes as per past years and will adopt a few proposals.

i) Mechanisms of the manifestation of higher brain functions such as judgment, memory, and learning

ii) Mechanisms of the manifestation of cerebral magnetic fields related to sensory functions and voluntary motor functions

2) Overview of the magnetoencephalography device installed at NIPS

Please refer to Annex 2.

3) Before submitting any proposal, please have a meeting with one of the NIPS members listed below based on your interest.

Prof. KITAJO (Division of Neural Dynamics)

Prof. SADATO (Division of Cerebral Integration)

Adjunct Prof. INUI (Supportive Center for Brain Research)

3. Report:

After the research project is finished, the principal investigator must submit a research report to the Director-General within 30 days of the completion date.

[Note] Due to the nature of the apparatuses, only a small number of proposals will be accepted.

Please plan your project so that it will be finished within 3 years.

List of host researchers

(2021/4/1)

Department	Division	Professor	Associate Professor	TEL
Department of Molecular and Cellular Physiology	Division of Biophysics and Neurobiology	KUBO, Yoshihiro	TATEYAMA, Michihiro	<0564>55-7831 <0564>55-7832
	Division of Membrane Physiology	FUKATA, Masaki	FUKATA, Yuko	<0564>59-5873
	Division of Neural Development & Regeneration (Adjunct Division)	(Adjunct Prof.) SAWAMOTO, Kazunobu		
Department of Homeostatic Regulation	Division of Cell Structure	FURUSE, Mikio	IZUMI, Yasushi	<0564>59-5277 <0564>59-5279
	Division of Cell Signaling (Concurrent division)	TOMINAGA, Makoto	SOKABE, Takaaki	<0564>59-5286 <0564>59-5287
	Division of Cardiocirculatory Signaling (Concurrent division)	NISHIDA, Motohiro		<0564>59-5560
	Division of Endocrinology and Metabolism	MINOKOSHI, Yasuhiko	NAKAJIMA Ken-ichiro	<0564>55-7742
	Division of Ultrastructural Research (Adjunct Division)	(Adjunct Prof.) OHNO, Nobuhiko		
Department of Fundamental Neuroscience	Division of Cerebral Circuitry		KUBOTA, Yoshiyuki	<0564>59-5282
	Division of Homeostatic Development		NARUSHIMA, Madoka (Project) AGETSUMA, Masakazu	<0564>55-7851 <0564>55-7854
	Division of Visual Information Processing	YOSHIMURA, Yumiko		<0564>55-7731
	Division of Biophotonics	NEMOTO, Tomomi	ENOKI, Ryosuke	<0564>59-5255 <0564>59-5258
Department of System Neuroscience	Division of Behavioral Development	ISODA, Masaki	(Project) TOMATSU, Saeka (Project) GO, Yasuhiro	<0564>55-7761 <0564>55-7764 <0564>55-7824
	Division of System Neurophysiology	NAMBU, Atsushi		<0564>55-7771
	Division of Neural Dynamics	KITAJO, Keiichi		<0564>55-7751
	Division of Cerebral Integration	SADATO, Norihiro	FUKUNAGA, Masaki	<0564>55-7841 <0564>55-7844
Supportive Center for Brain Research	Section of Brain Structure Information		MURATA, Kazuyoshi	<0564>55-7872 <0564>59-5290
	Section of Multiphoton Neuroimaging		MURAKOSHI, Hideji	<0564>55-7857
	Section of Electron Microscopy	(Concurrent) FURUSE, Mikio	(Concurrent) MURATA, Kazuyoshi (Concurrent) KUBOTA, Yoshiyuki	<0564>59-5277
	Section of Brain Function Information	(Concurrent) SADATO, Norihiro (Adjunct Prof) INUI, Koji	CHIKAZOE, Junichi	<0564>55-7845
Center for Genetic Analysis of Behavior	Section of Viral Vector Development	(Concurrent) NAMBU, Atsushi	KOBAYASHI, Kenta	<0564>55-7827
	Section of Mammalian Transgenesis		HIRABAYASHI, Masumi	<0564>59-5265
	Section of Metabolic Physiology	(Concurrent) MINOKOSHI, Yasuhiko		<0564>55-7741

Department of Molecular and Cellular Physiology

The Division of Biophysics and Neurobiology (Prof. KUBO, Yoshihiro) uses an in vivo expression system to study dynamic structure–function relationships, with a focus on the mechanisms of ion channels, receptors, and G proteins, which are key elements of the nervous system. The Division also uses genetically modified mice in order to clarify the functional significance of each element in the cranial nervous system.

The Division of Membrane Physiology (Prof. FUKATA Masaki) uses a unique biochemical method to identify synaptic protein complexes in brain tissue, and then uses the complexes in conjunction with a hippocampal neural cell primary culture system, genetically modified mice, etc., to clarify the mechanism that controls synaptic transmission efficiency. In addition, focusing on palmitoylation, the Division identifies specific palmitoylating enzymes and analyzes the localization and kinetics of synaptic proteins mediated by these enzymes.

The Division of Neural Development & Regeneration (Adjunct Division, Adjunct Prof. SAWAMOTO, Kazunobu) studies the mechanism whereby neurons and glial cells are generated during brain development and regeneration after brain injury. The Division also tries to stimulate these regeneration processes.

Department of Homeostatic Regulation

The Division of Cell Structure (Prof. FURUSE, Mikio) focuses on the molecular basis of cell-cell junctions involved in epithelial barrier function and passive transfer via paracellular pathways. In addition to basic analysis using cultured epithelial cells, the Division is proceeding with individual-level analysis using genetically modified mice and Drosophila in conjunction with techniques in the fields of cell biology and physiology.

The Division of Cell Signaling (Thermal Biology Group, Exploratory Research Center on Life and Living Systems (ExCELLS)) (Prof. TOMINAGA, Makoto and Assoc. Prof. SOKABE, Takaaki) aims to clarify the molecular mechanisms of thermosensitivity and pain sensitivity centering on TRP channels, which serve as biomolecular sensors necessary for cells survival. In addition to analyses using electrophysiological, molecular cell biological, and biochemical techniques, the Division conducts studies at an individual level using genetically modified mice. Behavioral analysis of temperature, taste, and mechanical stimulus reception using *Drosophila*, and analysis of effects of pesticides and repellents are also performed. In addition, the Division analyzes the evolution of temperature-sensitive TRP channels because it is considered that organisms evolutionarily adapted to changes in environmental temperature by dynamically changing their temperature sensitivities.

The Division of Cardiocirculatory Signaling (Cardiocirculatory Dynamism Research Group of the ExCELLS) (Prof. NISHIDA, Motohiro) aims to clarify the mechanism that controls the cardiovascular adaptation or maladaptation to hemodynamic load. Specifically, it strives to

elucidate the molecular mechanism of cardiovascular homeostasis from the viewpoint of signal transduction by using a wide range of techniques, including creation of model mice for human cardiovascular disease, measurement of cardiovascular functions using isolated organs, signal transduction analysis using primary cultured cardiomyocytes, and in situ imaging of post-translational protein modification based on chemical principles.

The Division of Endocrinology and Metabolism (Prof. MINOKOSHI, Yasuhiko and Assoc. Prof. NAKAJIMA Ken-ichiro) studies the control mechanisms, mainly involving the hypothalamus, that underlie the regulation of whole-body energy metabolism. Specifically, the Division aims to elucidate the mechanism of eating and food preference and the means by which taste sensitivity is controlled by the hypothalamus, as well as the mechanism whereby metabolic homeostasis is maintained by the autonomic nervous system at the molecular, tissue, and individual levels. The Division also studies the relationship between disordered homoeostasis and obesity, diabetes, and lifestyle-related diseases.

The Division of Ultrastructural Research (Adjunct Division) (Adjunct Prof. OHNO, Nobuhiko) aims to clarify the molecular backgrounds of structural and functional changes in the nervous system in myelin diseases. To this end, the Division uses imaging techniques such as 3-dimensional microstructure analysis involving microtome-integrated serial block-face scanning electron microscopy (SBF-SEM). In addition, by combining such imaging techniques with cultured models and genetically modified animals, the Division is elucidating the mechanisms of dynamic changes in organelles (e.g., mitochondria) in the nervous system and developing technologies to control these changes.

Department of Fundamental Neuroscience

The Division of Cerebral Circuitry (Assoc. Prof. KUBOTA, Yoshiyuki) aims to elucidate the structural basis of cortical microcircuits as well as the principles of their involvement in learning. This is done by combining in vivo brain observation / virus tracing using a two-photon microscope with synaptic connection analysis using 3-dimensional reconstruction of electron microscopic serial sections.

The Division of Homeostatic Development (Assoc. Prof. NARUSHIMA, Madoka and Project Assoc. Prof. AGETSUMA, Masakazu) focuses on the remodeling of neuronal circuits during the developmental and injury recovery periods. In particular, they are involved in the following: 1) electrophysiological analysis of synaptic transmission and receptor functions; (2) analysis of plastic changes in the functions of the inhibitory neurotransmitters GABA and glycine, especially from the viewpoint of the intracellular regulation mechanism for chloride ion concentration; and (3) use of in vivo multiphoton laser microscopy to determine the morphological and behavioral changes in neuronal circuits during the developmental period and in various disease states, and the contribution of glial cells to these changes.

The Division of Visual Information Processing (Prof. YOSHIMURA, Yumiko) characterizes the neural circuits of the visual cortex and elucidates the mechanisms underlying the experience-dependent development of the cortex. To this end, cortical slices and anesthetized and conscious mice are analyzed with the combined use of local laser light stimulation and electrophysiological and Ca^{2+} imaging techniques.

The Division of Biophotonics (Biophotonics Research Group of the ExCELLS) (Prof. NEMOTO, Tomomi and Assoc. Prof. ENOKI, Ryosuke) advances the development and application of cutting-edge imaging devices, including in vivo two-photon microscopes, multi-beam scanning-type two-photon microscopes, and two-photon super-resolution microscopes. The Division also conducts research in the field of chronobiology, for instance utilizing imaging techniques to examine the neuroscientific basis of circadian rhythms.

Department of System Neuroscience

The Division of Behavioral Development (Prof. ISODA, Masaki) aims to clarify the neural basis of social cognitive functions via studies of system neuroscience using primates. To this end, the Division conducts integrated analyses combining behavioral, electrophysiological, and neuropharmacological techniques, and also utilizes neuroanatomical methods and selectively manipulates neural circuits using viral vectors.

The Division of System Neurophysiology (Prof. NAMBU, Atsushi) strives to clarify the brain mechanisms underlying voluntary movements, and to understand the pathophysiology of movement disorders due to malfunctions of these mechanisms. To this end, the Division records nerve activity in the basal ganglia, cerebellum, and cerebrum in primates, rodents, and other disease model animals, and manipulates this activity with neuropharmacological, photochemical, chemogenetic, and other techniques.

The Division of Neural Dynamics (Prof. KITAJO, Keiichi) aims to unveil the functional roles of diverse neural dynamics in brain information processing. In particular, experiments involving the non-invasive measurement of human electroencephalogram and brain stimulation are used in conjunction with data analysis (nonlinear dynamics, network analysis, statistical machine learning methods, etc.) to model the information-processing mechanisms of the human brain and thereby clarify pathological conditions and individual characteristics.

The Division of Cerebral Integration (Prof. SADATO, Norihiro) advances experimental studies on higher cerebral cortex activities related to cognition, memory, emotion, judgment, intention, behavior, and social ability using neuroimaging techniques. The Division aims to understand higher brain function dynamically and globally by utilizing non-invasive brain function imaging

techniques to assess local circulatory changes and alterations in energy metabolism associated with cranial nerve activity.

Supportive Center for Brain Research

The Section of Brain Structure Information (Assoc. Prof. MURATA, Kazuyoshi) aims to elucidate the complex biological functions of the brain based on its structure. A 200-kV cryo-electron microscope is used for structural analysis of biomolecular samples. Some samples may be analyzed with an energy filter, a phase plate, a sample stage with larger tilt, etc., in combination with the cryo-electron microscope.

The Section of Multiphoton Neuroimaging (Assoc. Prof. MURAKOSHI, Hideji) explores cell functions by imaging cell morphology, signal transduction, and molecular interactions using unique two-photon microscopy techniques and two-photon fluorescence resonance energy transfer (FRET) microscopy. In addition to state-of-the-art optical technology, the Section develops novel fluorescent proteins and photoresponsive protein molecules. By combining these technologies with the patch clamp method, the Section aims to elucidate the functions of nerve cells and cultured cells.

The Section of Electron Microscopy (Prof. FURUSE, Mikio, Assoc. Prof. MURATA, Kazuyoshi, and Assoc. Prof. KUBOTA, Yoshiyuki) has introduced a new microtome-integrated scanning electron microscope for conducting connectomics studies. With this device, the Section automatically captures several hundred to a thousand sequential electron microscope images a day and reconstructs them into 3D models.

The Section of Brain Function Information (Prof. SADATO, Norihiro, Assoc. Prof. CHIKAZOE, Junichi, and Adjunct Prof. INUI, Koji) supports collaborative studies on brain function measurement in humans and monkeys using high-field magnetic resonance imaging (3T and 7T) and magnetoencephalography (MEG) devices equipped at NIPS. The Section also promotes research on functional–anatomical mapping of the primate brain. A 7-T magnetic resonance imaging device for evaluating humans was installed in 2014. It was confirmed that the device can be operated in a stable manner so it will be generally available for collaborative research projects. In addition, the Section promotes collaborative projects specializing in basic brain science that evaluate humans using whole-head magnetoencephalography.

Center for Genetic Analysis of Behavior

The Section of Viral Vector Development (Prof. NAMBU, Atsushi and Assoc. Prof. KOBAYASHI, Kenta) develops high-quality and high-performance virus vectors that can be applied to: i) analysis of the neural basis of higher brain functions using model animals such as primates and rodents, and ii) pathological analysis of mental and neurological diseases. In addition, it serves as a central hub for providing viral vectors in response to requests from other

laboratories. Through such efforts, the Section actively promotes joint research.

The Section of Mammalian Transgenesis (Assoc. Prof. HIRABAYASHI, Masumi) produces and provides genetically modified animals (transgenic and gene-targeted rats and mice), making full use of molecular biology and developmental engineering techniques. To make further advances at the technological level, the Section also performs reproduction engineering research such as gamete preservation of genetically modified animals, microinsemination, and establishment of rat embryonic stem cells and induced pluripotent stem cells.

The Section of Metabolic Physiology (Prof. MINOKOSHI, Yasuhiko) is equipped with and conducts joint research using apparatuses for chronological and automatic measurement of physiological functions and metabolic parameters of mice and rats. The apparatuses can measure the following: 1) single-unit recordings from motor related brain regions in an awake state; 2) energy intake and expenditure in free-moving animals; 3) body temperature, heart rate, and blood pressure in free-moving animals; 4) non-invasive echographic imaging of tissue structure-function relationships (liver, kidney, and blood vessels), 4-dimensional changes in cardiac functions, and capillary blood flow (brain and umbilical cord) in anesthetized mice; and 5) mouse temperature preference assays with a thermal gradient ring.

ANNEX 1

Overview of magnetic resonance imaging (MRI) scanners installed at NIPS

Performance and features of the MRI scanner installed at the NIPS Supportive Center for Brain Research (two 3-T Verio scanners, 2009, Siemens Co.; one 7-T scanner, 2014, Siemens Co., Ltd.)

Verio

1. Superconducting magnet
   1) Magnetic field strength: 3 Tesla, magnet inner diameter 70 cm
   2) Magnetic field uniformity: 0.03 ppm or less (spherical range with a diameter of 20 cm, volume residual mean squared method)
   3) Shimming: Active + passive shimming, automatic shimming for each subject
   4) Liquid helium evaporation: 0.01 L/year or less

2. Imaging functions
   1) Nuclei: ^{1}H
   2) Pulse sequence: echo planar imaging, turbo spin echo imaging, etc.
   3) Slice direction: axial, sagittal, coronal, oblique
   4) Min. slice thickness: 1 mm (2-dimensional imaging), 0.3 mm (3-dimensional imaging)
   5) Gradient magnetic field: 45 mTesla/m, rise time 0.225 ms
   6) Probe: 32-channel head coil, circular polarized body coil, etc.
   7) Data processing device: Automatically saves obtained images in DICOM format via Windows network
   8) Other functions: T1, T2, T2*, proton density-weighted images, MR angiography, diffusion-weighted image, image statistical processing software, communication mediation relay system for simultaneously measuring neural activity during interaction between two individuals

7-T MRI

1. Superconducting magnet
   1) Magnetic field strength: 7 Tesla, magnet inner diameter 60 cm
   2) Magnetic field uniformity : 1 ppm or less (spherical range with a diameter of 25 cm, volume residual mean squared method)
   3) Shimming: Active + passive shimming, automatic shimming for each subject
   4) Liquid helium evaporation: 0.01 L/year or less

2. Imaging functions
   1) Nuclei: ^{1}H, ^{13}C, ^{17}O, ^{19}F, ^{23}Na, ^{31}P

2) Pulse sequence: echo planar imaging, turbo spin echo imaging etc.

3) Slice dimensions: axial, sagittal, coronal, oblique

4) Min. slice thickness: 0.5 mm (2-dimensional imaging), 0.05 mm (3-dimensional imaging)

5) Gradient magnetic field: 70 mTesla/m, rise time 0.350 ms

6) Probe: 32-channel receive-only head coil (^{1}H), circular polarized transmit/receive head coil (^{1}H, ^{23}Na, ^{31}P), transmit/receive surface coil (^{13}C, ^{17}O, ^{19}F), etc.

7) Data processing device: Automatically saves obtained images in DICOM format via Windows network

8) Other functions: T1, T2, T2*, proton density-weighted images, MR angiography, diffusion-weighted image, image statistical processing software

ANNEX 2

Overview of the whole-head type magnetoencephalography (MEG) device installed at NIPS

Overview of the Vectorview whole-head type MEG device installed at NIPS (2002, Neuromag)

1. Sensor
   (1) Number of channels: 306 channels
   (2) Induction coil: flat-bottomed gradiometer, 204 channels
   magnetometer, 102 channels
   (3) System noise: 5 fTesla /√Hz or less
   (4) Sensor arrangement: 102 sensor units evenly distributed over 1220 cm^2
   Each sensor unit incorporates two orthogonal gradiometers and magnetometers
   (5) Measurement position: sitting position or supine position

2. Shielded room
   (1) Inner dimension: width 3 m x depth 4 m x height 2.4 m
   (2) Outer dimension: width 3.6 m x depth 4.6 m x height 3 m
   (3) Shielding ratio 0.1 Hz, 42 dB or more
   1.0 Hz, 60 dB or more
   10 Hz, 80 dB or more

3. Active shielding system
   An active shielding system is adopted to reduce the influence of the environmental magnetic field at low-frequency bands. The change in the environmental magnetic field at 1 Hz or less is decreased.

4. Analysis control device (UNIX Workstation HPUX J6700)
   (1) Control device: Connected to sensor system via Ethernet
   Analogue inputs: MEG: 306 channels
   EEG input: 128 channels
   A/D conversion: 24-bit/Save 32-bit
   Sampling (up to 8 kHz)
   (2) Key processing functions: Signal source estimation: Single/multi-dipole estimation (Sphere model/Real shape model)
   MCE
   Signal processing: Digital filter, FFT, etc.
   (3) Data storage device: 5-inch magneto-optical disk 9.1 GB/disk