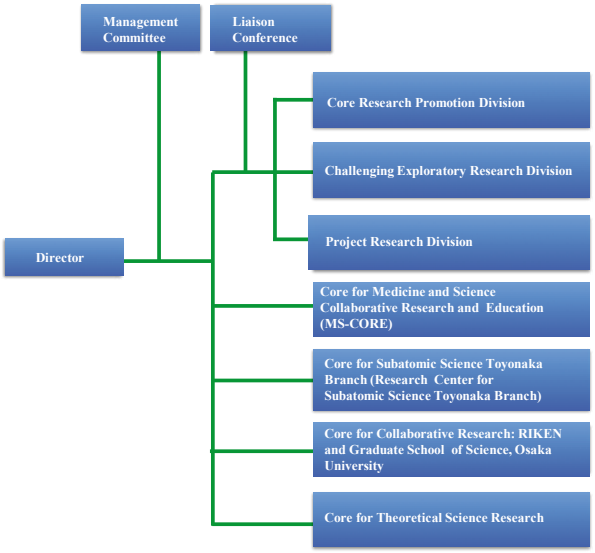
Project Research Center for Fundamental Sciences

Project Research Center for Fundamental Sciences

Overview

The Graduate School of Science at Osaka University is responsible for carrying out fundamental scientific research. In the spirit of the first president of Osaka University, Dr. Hantaro Nagaoka, whose motto was "Souhaku wo Namuru Nakare (Lack not in originality)" it is dedicated to the discovery of new insights and the development of new perspectives on matter. Our research programs also aim to foster young researchers, who will serve as the next generation of researchers in fundamental sciences and as internationally active leaders across many fields. The primary research style of the Graduate School of Science is thus to advance fundamental research with a long-term vision through the free thought and creativity of the individual. Research projects demonstrating major findings and showing great promise for future breakthroughs are awarded large-scale competitive funding. However, such large-scale research projects require short-term investments in people, facilities, and time as well as rapid implementation. Although this mode of research can certainly open a path to continuing the development of fundamental sciences, it is does not fit the traditional research style of the Graduate School of Science. Therefore, "The Project Research Center for Fundamental Sciences (PRC)" was established on October 1, 2011 to serve as a facility for large-scale research projects and other efforts, with open laboratories and specialized environments for working with radiation. Large-scale projects and interdisciplinary research in progress at this center have brought about remarkable advances in collaboration with ERATO, CREST, ImPACT, and medical research under projected budgetary allocations, as well as the establishment of an international therapeutic base for the treatment of advanced cancer.

The PRC was reorganized on July 1, 2015 to strengthen its engagement in highly challenging and creative research, education leading to germinal research, the creation of new research and development sectors through new collaborations, and strengthening of industrial-academic co-creation, as well as the advancement of large-scale research projects. With this re-organization, mid- and long-term projects will be carried out by the Graduate School of Science led "Core Research Promotion Division", while "Challenging Exploratory Research Division" was constructed and established as a new framework for engaging in challenging exploratory research. New centers of excellence were also established to facilitate the freedom of growth for research that extends across organizations and institutions. In this way, the PRC is enhancing its platform for advancing cutting-edge research and providing an environment for carrying out original and creative fundamental research at a level worthy of consideration for future Nobel prizes. The PRC will be reorganized again on April 1, 2022 to be a research center where talented and selected scholars can concentrate on their studies.



Faculty Members:

Director [Professor] Tetsuo OGAWA(Grad)
Vice Director [Professor] Masahiro UEDA(Fbs), Michisato TOYODA

Core Research Promotion Division

Division Head [Professor] Michisato TOYODA

Advanced Mass Spectrometry Research Group
[Professor] Michisato TOYODA, Masaaki ASHIDA(Es), Kunio AWAZU(Eng), Masahiro UEDA(Fbs), Yasuo KANEMATSU, Toshifumi TAKAO(Protein), Kentaro TERADA(Grad), Koichi FUKASE(Grad), Shinya MURAKAMI(Dent), Taku YAMANAKA(Grad)
[Associate Professor] Yoichi OTSUKA(Grad), Osamu HISATOMI(Grad), Hiroshi FURUTANI(Reno),Shoichiro YOKOTA(Grad)
[Specially Appointed Associate Professor] Kanako SEKIMOTO
[Assistant Professor] Jun AOKI, Yosuke KAWAI(Grad), Satomi MATSUOKA(Fbs)

Challenging Exploratory Research Division

Division Head [Professor] Michisato TOYODA

[Professor] Masahiro UEDA(Fbs), Yasuo KANEMATSU, Michisato TOYODA, Nohiro MATSUMURA(Eco)
[Guest Professor] Kazuyoshi ITO, Tetsuro KOBAYASHI, Hiroyasu NAKATA, Masaaki YOKOYAMA

RoboLabo Project
[Professor] Yasuo KANEMATSU, Masahiro UEDA(Fbs), Michisato TOYODA
[Guest Professor] Ryohei SATO, Yasuhiro TACHIBANA
[Specially Appointed Researcher] Wakana MATSUDA

Project for Construction and Function of Innovative Supramolecular Materials
[Professor] Yoshinori TAKASHIMA(Accs)

Project Research Center for Fundamental Sciences

Project Research Center for Fundamental Sciences

Project Research Division

Division Head [Professor] Michio MURATA(Grad)

Research Project for Bioactive Molecules
[Professor] Michio MURATA(Grad),Yasuhiro KAJIHARA(Grad)
[Associate Professor] Kazuya KABAYAMA(Grad)
[Assistant Professor] Yuichi UMEGAWA(Grad), Yoshiyuki MANABE(Grad)
[Specially Appointed Assistant Professor] Tomokazu YASUDA(Grad)
[Guest Associate Professor] Sigeru MATSUOKA(Grad)

Advanced observation group in Astrophysics
[Professor] Hironori MATSUMOTO(Grad), Takahiro SUMI(Grad)
[Associate Professor] Kiyoshi HAYASHIDA(Grad)
[Assistant Professor] Daisuke SUZUKI (Grad), Hirofumi NODA(Grad), MASUDA Kento(Grad)

Detector R&D Projec
[Professor] Taku YAMANAKA(Grad), Michisato TOYODA, Hironori MATSUMOTO(Grad)
[Associate Professor] Hajime NANJO(Grad)
[Assistant Professor] Jun AOKI, Minoru HIROSE(Grad)

Project for Creation of Sustainable Suramolecular Materials
[Professor] Tadashi INOUE(Grad), Sadahito AOSHIMA(Grad), Katsumi IMADA(Grad), Kiyotaka ONITSUKA(Grad), Takahiro SATO(Grad), Yoshinori TAKASHIMA(Accs), Akihito HASHIDZUME(Grad), HiroyasuYAMAGUCHI(Grad)
[Specially Appointed Professor] Akira HARADA(Isir)
[Specially Appointed Associate Professor] Motofumi OSAKI
[Assistant Professor] Yuichiro KOBAYASHI(Grad)

JEOL YOKOGUSHI Research Alliance Laboratories Mass Spectrometry Open Innovation Project
[Professor] Michisato TOYODA, Masahiro UEDA(Fbs), Toshifumi TAKAO(Protein)
[Specially Appointed Researcher] Junichi OSUGA
[Guest Associate Professor] Yoshihisa UEDA
[Visiting Academic Staff] Takaya SATO

Immune Regulation Project: Collaborative Research between NIBIOHN and Graduate School of Science, Osaka University
[Professor] Koichi FUKASE(Grad), Yasuhiro KAJIHARA(Grad)
[Assistant Professor] Kazuya KABAYAMA(Grad),
[Assistant Professor] Atsushi SHIMOYAMA(Grad), Yoshiyuki MANABE(Grad)
[Guest Professor] Masahiro KAWAHARA, Jun KUNISAWA

Core for Medicine and Science Collaborative Research and Education (MS-CORE)

Division Head [Professor] Tetsuo OGAWA(Grad)

[Professor] Tetsuo OGAWA(Grad), Hidenori INOHARA(Med), Masahiro UEDA(Fbs), Kazuhiko OGAWA(Med), Yasuhiro KAJIHARA(Grad), Yoshikatsu KANAI(Med), Yasufumi KANEDA(Med), Michisato TOYODA, Takashi NAKANO(RCNP, Koichi FUKASE(Grad), Mitsuhiro FUKUDA(RCNP), Michio MURATA(Grad), Hiroyasu YAMAGUCHI(Grad), Takashi YOSHIMURA(RI)
[Specially Appointed Professor] Atsushi SHINOHARA(Grad), Eku SHIMOSEGAWA(Med), Atsushi TOYOSHIMA(Irs), Masaharu NOMACHI(Irs), Jun HATAZAWA(RCNP)
[Associate Professor] Fumiaki ISOHASH(Med), Yoshitaka KASAMATSU(Grad), Hiroki KATOU(Med), Kazuya KABAYAMA(Grad), Mitsuaki TATSUMI(Med), Koichi FUJIMOTO(Grad)
[Specially Appointed Associate Professor] Kazuko KANEDA(Irs), Yoshifumi SHIRAKAMI(Irs)
[Lecturer] Hiroki KANDA (RCNP), Tetsuhiko YORITA(RCNP)
[Specially Appointed Lecturer] Toru TAKANO(Med), Takahiro TERAMOTO(Irs), Yukiko NAKATA(Med)
[Assistant Professor] Atsushi SHIMOYAMA(Grad), Tomokazu SUZUKI(RCNP),), Keisuke TAMARI(Med), Kojiro NAGATA(RI), Yoshiyuki MANABE(Grad), Tadashi WATABE(Med)
[Specially Appointed Assistant Professor] Kazuhiro OOE(Med), Yuichiro KADONAGA(Irs), Keiko MATSUNAGA(Med)
[Guest Professor] Jinichi INOKUCHI

Core for Subatomic Science Toyonaka Branch (Research Center for Subatomic Science Toyonaka Branch)

Division Head [Professor] Atsushi TAMII(Irs)

[Professor] Atsushi TAMII(Irs), Masaharu AOKI(Grad), Atsushi SAKAGUCHI(CHEGA)
[Specially Appointed Professor] Tadafumi KISHIMOTO(RCNP), Yoshitaka KUNO(RCNP), Masaharu NOMACHI(Irs)
[Associate Professor] Shuhei AJIMURA(RCNP), Tatsushi SHIMA（RCNP), Sei YOSHIDA(Grad)
[Specially Appointed Associate Professor] Saori UMEHARA(RCNP)
[Assistant Professor] Akira SATO(Grad), Yorihito SUGAYA(RCNP)
[Guest Professor] Keiji TAKAHISHA
[Specially Appointed Researcher] Kenji MATSUOKA(RCNP)

Core for Collaborative Research: RIKEN and Graduate School of Science, Osaka University

Division Head [Professor] Yasuhiro KAJIHARA(Grad)

[Professor] Yasuhiro KAJIHAR(Grad), Takashi KUBO(Grad), Koichi FUKASE(Grad), Michio MURATA(Grad), Hiroyasu YAMAGUCHI(Grad)
[Specially Appointed Professor] Yukishige ITOU
[Lecturer] Ryo OKAMOTO(Grad)
[Assistant Professor] Yuta MAKI(Grad)
[Guest Professor] Yukishige ITOU, Fumiaki HAYASHI(RIKEN)

Core for Theoretical Science Research

Division Head [Professor] Kentaro NAGAMINE(Grad)

[Professor] Kentaro NAGAMINE(Grad), Tetsuo OGAWA(Grad), Atsushi HOSAKA(RCNP)
[Associate Professor] Koichi FUJIMOTO(Grad)
[Guest Professor] Koji HASHIMOTO(Grad)

(Accs)…. Concurrent post belonging to Institute for Advanced Co-Creation Studies
(Dent)…. Concurrent post belonging to Graduate School of Dentistry
(Es) …… Concurrent post belonging to Graduate School of Engineering Science
(Eng)…… Concurrent post belonging to Graduate School of Engineering
(Eco) …. Concurrent post belonging to Graduate School of Economics
(Fbs) …… Concurrent post belonging to Graduate School of Frontier Biosciences
(Grad) …. Concurrent post belonging to Gradate School of Science
(Irs) …… Concurrent post belonging to Institute for Radiation Sciences
(Law) …. Concurrent post belonging to Graduate School of Law and Politics
(Med) …. Concurrent post belonging to Graduate School of Medicine
(Protein) .. Concurrent post belonging to the Insritute for Protein Research
(RCNP) .. Concurrent post belonging to the Research Center for Nuclear Physics
(Reno) …. Concurrent post belonging to the Center for Scientific Instrument Renovation and Manufacturing Support
(RI) …… Concurrent post belonging to the Radioisotope Research Center
(RIKEN) .. Concurrent post belonging to the Institute of Physical and Chemical Research
(Isir) …… Concurrent post belonging to the Institute of Scientific and Industrial Research
(CHEGA) .. Center for the Study of Higher Education and Global Admissions

Home Page
http://www.prc.sci.osaka-u.ac.jp/en/

Project Research Center for Fundamental Sciences

Advanced Mass Spectrometry Research Group

Research Themes

1.Development of the most advanced mass spectrometers
2.Interdisciplinary research using the developed mass spectrometers

The division aims at new interdisciplinary research beyond the framework of major disciplines, departments, or universities. The Graduate School of Science created Japan's first mass spectrometer apparatus in the latter half of the 1930s, and has continued since that time in developing a number of globally leading and original spectrometers. In particular, the multi-turn time-of-flight mass spectrometer (MULTUM) developed recently represents a compact apparatus that nonetheless is capable of an extremely high mass resolution. The MULTUM signifies an opportunity for on-site high-resolution mass spectrometry, previously an impossibility. Scientists across the globe look forward to tremendous advancements in this undeveloped domain.

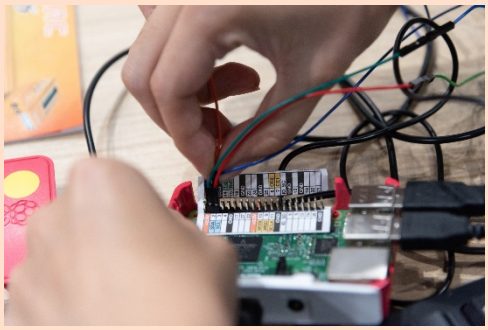
The Division of Interdisciplinary Science develops compact, lightweight, original mass spectrometers and associated technologies for purposes of greenhouse gas monitoring, detection of hazardous or illegal substances, medical diagnostics, deployment to planetary probes, etc.; leads interdisciplinary research across different fields of research through collaborative efforts among division members, faculty members belonging to the Graduate School of Science, researchers at other departments or other universities, and industry; and aims to promote new scientific inquiry.

Project Research Center for Fundamental Sciences

RoboLabo Project

This was launched in fiscal year 2018 as a pilot project to strengthen the appeal and fascination of basic science. This project heightens equipment development skill through collective prototyping of leading-edge equipment, instruments, and systems, and forms the basis for research rising to high challenges.

Interpersonal succession within the laboratory was formerly practicable for electronic circuit technology, high- and low-temperature technology, vacuum technology, machine engineering and construction, program development, and other fields of technology but has now become difficult. The objective is therefore to revive the transfer through incorporation of modern manufacturing methods.



This project fabricates the RoboLabo prototypes such as development of on-site environment analysis robots, planetary probes, mobile labs, remote labs, and other systems. Undergraduate and graduate students develop independence, perform discussion, form a specific image of actual machines, and gather information on required technologies. Learning of technologies in theory and practice grows not only through written characters and diagrams in books and on the Internet but also through interaction with experts including faculty, company researchers, and engineers.

Discipline and vying to meet goals are learned while overcoming failures and discovering the enjoyment of actual machine construction. Enthusiasm brings growth and leads to formation of the base for independent learning.

Project Research Center for Fundamental Sciences

Project for Construction and Functionalization of Innovative Supramolecular Materials

Realizing Supramolecular Materials with High Toughness and Self-Healing Properties
Creation of New Functional Materials

Soft materials such as synthetic polymers, biopolymers, liquid crystals, and molecular assemblies have been widely used in our daily life. Development of new functional soft materials are still desired for constructing mechanical equipment and electric devices with keeping our environment.

In this project, we develop a new type of tough polymer by introducing "*molecular recognition crosslinking*" to polymer networks. These junctions work as a reversible bonding points for self-healing and avoiding the stress concentration. Tough polymers are the prerequisite and promised material for light-weight, reliable, safe, and sustainable industrial products including next-generation vehicles. Moreover, functionalization of these tough materials, such as responsiveness for external stimuli, also enhances field where the polymeric material play an active part.

Project Research Center for Fundamental Sciences

Research Project for Bioactive Molecules

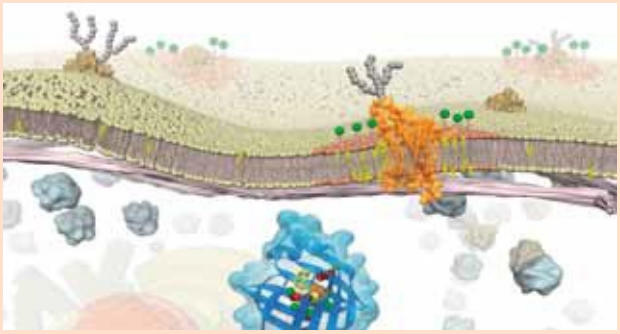
Research Area

1) Elucidation on membrane lipid structure which affects the structure and function of membrane proteins
2) Analysis of structure and dynamics on biomolecular complexes in a lipid bilayer
3) Construction for molecular basis of mutual interaction of lipid ligands and soluble proteins

Research Activities

Lipids are a main component of the biomembranes. The membrane lipids have been recently shown to play key roles in cell physiology through interactions with membrane proteins. On the other hand, structural biology, which has greatly accelerated the advance of biosciences, mainly focuses on proteins but little on lipids and lipid ligands. Because, lipids are highly flexible molecules, therefore the elucidation of the 3D structures binding to membrane proteins receptor is extremely difficult even with X-ray crystallography.

In this project, we will elucidate the active structure of lipids in and around proteins by means of solid-state NMR techniques combined with X-ray crystallography, organic synthesis and protein engineering. Function of lipids will be more profoundly understood in terms of their 3D structures. This breakthrough will advance our knowledge in biological and biomedical sciences over the next decade, thus eventually stimulating research and development in medical and pharmaceutical areas.

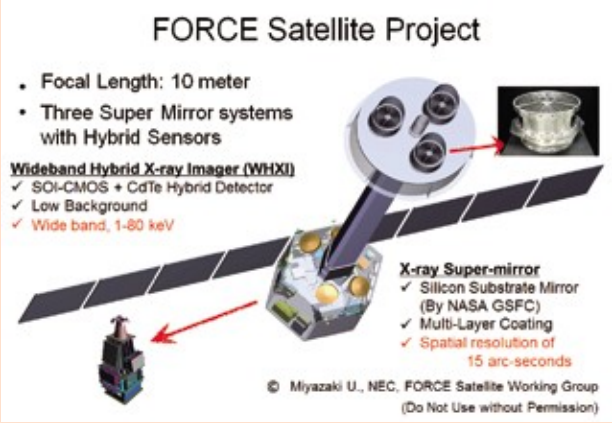


Project Research Center for Fundamental Sciences

Advanced Observation Group in Astrophysics

We are aiming to develop observational instruments by using state-of-the-art technologies and to operate them for actual observations by ourselves. For cosmic X-ray observation, we are developing a new X-ray CCD camera for the next X-ray satellite XRISM. We are also developing a new type of high-angular resolution X-ray imaging instrument which utilizes the Talbot effect. We participate in the FORCE project and the XL-Calibur project. Both of them are international projects and we are developing X-ray telescopes for them. Main targets of FORCE and XL-Calibur are black holes and neutron stars, and the the growth mechanism of massive black holes and physics in ultra-strong magnetic fields of neutron stars are expected to be clarified.

In the field of infrared astronomy, we are leading the Japanese contribution to the Nancy Grace Roman Space Telescope project of NASA. This project will pursue to investigate the structure of the universe including the dark energy and dark matter, formation histories of galaxies, stars, and exoplanets. Furthermore, we are studying with our own small ground-base telescopes. The MOA project is a collaboration between Japan, USA and New Zealand. We are conducting the exoplanet search via gravitational

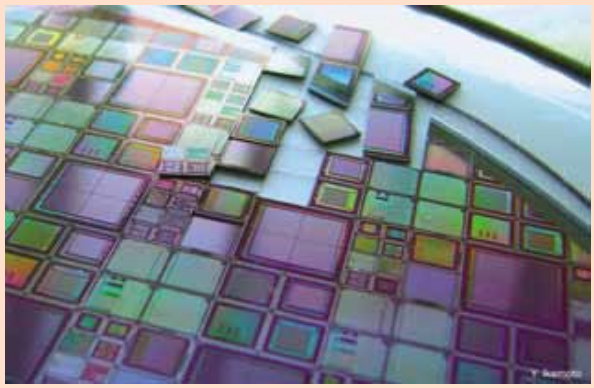


Project Research Center for Fundamental Sciences

Detector R&D Project

The detector technologies are crucial in modern physics experiments. In particle physics, radiation-hard semi-conductor detectors with very fine position resolution, and photon detectors with extremely low inefficiency are often required. In astrophysics, detectors and electronics on satellites are required to have light weight, low energy consumption, and radiation hardness. The detector used in infrared astronomy needs an ASIC that can be operated in ultra low temperature. In mass spectroscopy, semi-conductor detectors are being considered.

We plan to study and develop common basic technologies, and then apply them to cutting-edge detectors for each application in various fields, such as experimental particle physics, astrophysics, mass spectroscopy, and imaging in chemistry and biology.



Project Research Center for Fundamental Sciences

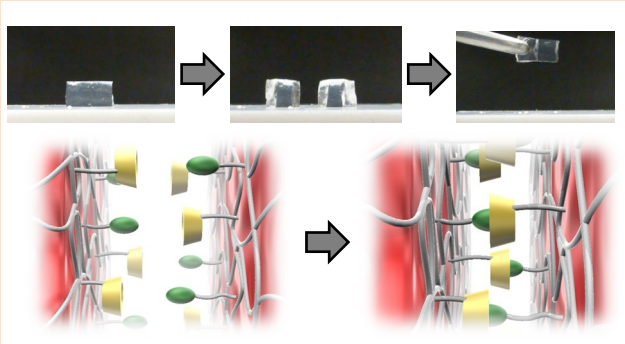
Project for Creation of Sustainable Supramolecular Materials

Realizing High Toughness and Self-Healing of Polymers by Supramolecular Assembly
Creation of New Joining Technology Based on Chemical Bonding

Soft materials such as synthetic polymers, biopolymers, liquid crystals, and molecular assemblies have been widely used in our daily life, and modification of these soft materials and development of new functional soft materials are still desired. New types of gels have been developed, for example, stimulation-responsive gels, self-healing gels and so on.

In this project, we develop a new type of tough polymer by introducing "*molecular recognition crosslinking*" or "*molecular mechanical crosslinking*" in polymer networks. These junctions can work as a well-controlled self-healing point and a pulley effective for avoiding the stress concentration, respectively. Tough polymers are the prerequisite and promised material for light-weight, reliable, safe, and sustainable industrial products including next-generation vehicles.

Adhesives have been widely used to glueing components of product. However, the adhesives have some weak points in toughness and durability for organic solvents. We develop a new material joining technique by introducing covalent bonds between dissimilar materials without using adhesives. We are also studying new adhesive techniques based on molecular recognition, which make it possible to adhere the components with distinguishing their materials.



Project Research Center for Fundamental Sciences

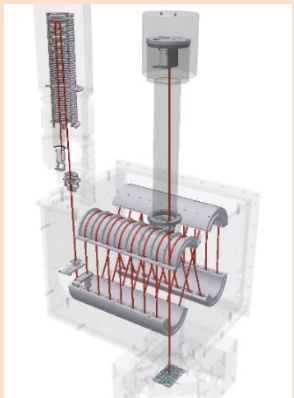
JEOL YOKOGUSHI Research Alliance Laboratories

Mass Spectrometry Open Innovation Project

A research laboratory has been established in April 2018 by JEOL Ltd. and Osaka University, which in the Graduate School of Frontier Biosciences as a JEOL YOKOGUSHI Alliance Research laboratory that is rearranged previous 3 laboratories in Osaka University. This project succeed the Mass Spectrometry Open Innovation Joint Research Chair first launched in April 2017. The project restarted as Mass Spectrometry Open Innovation Project of the Project Research Center for Fundamental Science in Graduate School of Science. In addition to mass spectrometric research, its mission includes the development of new fields of application in conjunction with electron microscopy, nuclear magnetic resonance, and other JEOL core technologies. The project will advance the development of technologies and applications relating to mass spectrometry as the core of this industry–university collaboration effort, which will bring together researchers and companies from multiple fields. The project will engage in themes ranging from medical, dental, and pharmaceutical science to the environmental and other sectors. The project will form a wing of the JEOL YOKOGUSHI Research Alliance Laboratories and advance cross-sectoral research.

One of research and development theme in this project is the development of an onsite periodontal disease diagnosis method and system. Concurrently with the development of a method that enables rapid analysis, the project is engaged in the development of metabolite analysis technology to facilitate understanding the basal pathology.

The project is also developing new technology for nano-structure and light-enhanced ionization and cell detection and identification. In parallel with its research and development, the laboratory is engaged in promoting in human resource development, cultivation and basic technology succession, related to instrumental analysis.

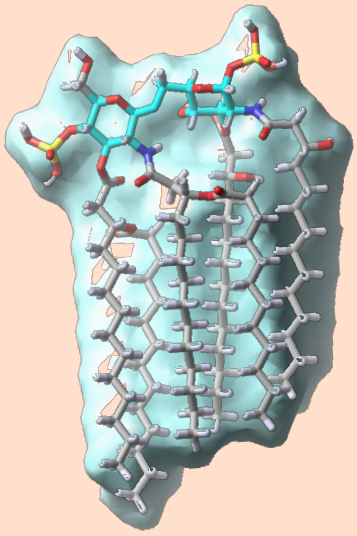


A diagram of Ion trajectory of JMS-S3000, which applies the ion optics of the MULTUM developed at Osaka University.

Project Research Center for Fundamental Sciences

Immune Regulation Project: Collaborative Research between NIBIOHN and Graduate School of Science, Osaka University

In recent years, the field of chemical biology, which aims to elucidate biological phenomena at the molecular level using chemical methods, has become more and more important as the molecular basis of various biological phenomena has been unveiled. The National Institute of Biomedical Innovation, Health and Nutrition (NIBIOHN) and Graduate School of Science will promote the research on immune regulation based on chemical biology. The development of vaccines and adjuvants is becoming increasingly important. NIBIOHN has investigated to develop innovative pharmaceuticals including vaccines and adjuvants and to improve the health of the Japanese. Therefore, this collaborative project will promote joint research on drug development and improvement of public health, focusing on immune regulation research.



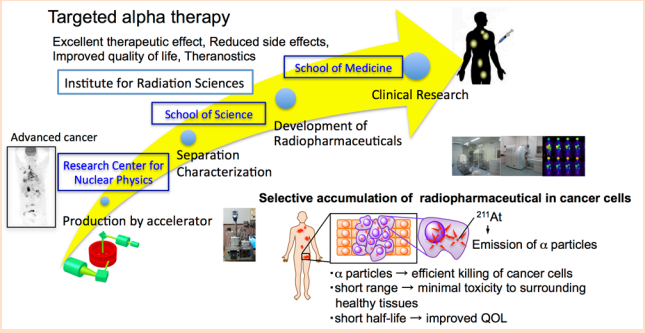
To achieve immune functional regulation at the molecular level, we will conduct the basic scientific research; chemical synthesis and immune functional analysis of bacterial glycoconjugates, functional analysis of host immunoreceptor proteins, development of novel immunomodulation technology using host-derived glycans. Furthermore, based on the molecular basis of immunoregulation, we will develop innovative non-toxic vaccine adjuvants, which will be applied to the development of vaccines for diseases with high social needs. Furthermore, this project is expected to contribute to society in areas related to health and disease, such as drug development.

Project Research Center for Fundamental Sciences

Core for Medicine and Science Collaborative Research and Education (MS-CORE)

Project Overview

Joint research on production and medical applications of radionuclides using the accelerator is conducted with the cooperation of Graduate School of Science, Research Center for Nuclear Physics, and Graduate School of Medicine. Since Osaka University established the Institute for Radiation Sciences (IRS) on April 1, 2018 to promote research and education in radiation sciences, MS-core has collaborated with IRS to promote the interdisciplinary researches between nuclear physics, nuclear chemistry, biomolecular chemistry, nuclear medicine, and radiology. The development of new cancer treatments has been desired, since one-third of cancer patients are diagnosed as progressive cancers such as adjacent organ invasion and distant metastasis at the time of initial diagnosis, and therefore the 5-year relative survival rate are less than 15%. In this project, we will develop a new internal radiotherapy for advanced cancer, i.e., "targeted α-particle radiotherapy" where cancer patients are treated by irradiating the α ray to cancer by administrating cancer-targeting agents tagged with α-emitting radionuclides. This therapy will achieve the high cancer cell-killing ability as well as the less invasiveness to peripheral organs and the reduction of side effects at the same time, owing to the high-energy and the short flight of α ray and the short-lives of α-emitting radionuclides. In order to develop this therapy, we are working on the development of skeleton cyclotron that can produce the high beam intensity with power-saving property as well as the development of the large quantity production α-emitting radionuclides and the automatic separation of the radionuclides. Further, we are studying the synthesis of the radionuclide-carrying targeting agents as the radiation drug candidates, verifying the therapeutic effects and side effects of the agents, and investigating the clinical trials of the



Project Research Center for Fundamental Sciences

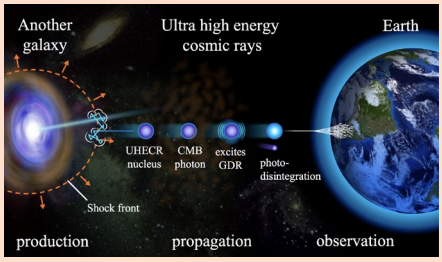
Core for Subatomic Science Toyonaka Branch
(Research Center for Subatomic Science)

Subatomic Science is a subject to study the universe from its beginning to the era of being radiation transparent and the later evolutions.

Why there are three kinds of quarks and lepton existing in nature and why are they transformed from one to another ? It is one of the mysteries, which should be answered by elementary particle physics. In order to answer this question, physics phenomena which cannot be explained by the Standard Model of particle physics are sought for with using muons. At the MuSIC facility, we produce 10^9 muons/sec at a 400 W proton beam that is one of the strongest muon beam in the world.

Our universe is made of matter without anti-matter. In order to explain it, particle number and CP symmetry need to be violated. The CP violation results in a little difference between the matter and anti-matter worlds. We wish to demonstrate the particle number violation by observing neutrino-less double beta decay of ^{48}Ca by the CANDLES detector for explaining our matter universe.

We study new nuclear phenomena by measuring the properties of the nuclear matter consisting of protons and neutrons for solving problems in the beginning of the universe and its evolution. In particular, we focus on the photo-nuclear reactions for extracting the electric dipole polarizability of nuclei, new excitation modes, the equation of state of a neutron star, Big Bang nucleosynthesis and photo-disintegration of ultra-high-energy cosmic-rays during the extragalactic propagation.



Project Research Center for Fundamental Sciences

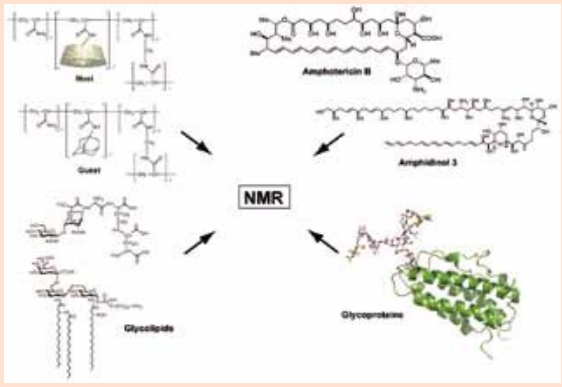
Core for Collaboration Research : Riken and Graduate School of Science, Osaka University Group

Research Topics

1.Studies of host-guest interaction by means of nuclear magnetic resonance (NMR)

2.Studies of structural analyses as well as molecular dynamics of lipids, glycolipids, and glycoproteins by means of NMR

This project examines frontier scientific researches by combining both techniques accumulated in Riken and graduate school of science, Osaka University. Riken has developed a huge frontier NMR facility in Yokohama and elucidated many protein structures. These results have been applied not only to the elucidation of protein functions but also to basic researches and the development of pharmaceutical drugs. Researchers in graduate school of science, Osaka University have demonstrated isolation, chemical syntheses and structural analyses of valuable natural molecules and novel functional derivatives, e.g. specific binding experiments between novel macromolecular gels modified with unique host and guest molecules, syntheses of glycolipids concerned with our immune system, antibiotics interacting with cell lipid bilayer and glycoproteins. The collaboration of Riken's NMR techniques and chemical approaches by graduate school of science, Osaka University will open up a new avenue to elucidate the functions and molecular dynamics of natural and new functional compounds in detail.



Project Research Center for Fundamental Sciences

Core for Theoretical Science Research

Research Themes
1. Academic exchange of researchers in theoretical sciences.
2. Integration of theoretical research and development of applications.

Theoretical science has a mathematical structure as its foundation, and is essentially the common foundation for all theoretical science fields. However, due to the rampant performance-based approach, the scientific society has become increasingly fragmented, and even among laboratories, communication to nurture the seeds of new science has become impaired.

Therefore, this project aims to bring together theoretical researchers who are interested in common mathematics and observables, to create new seeds of research by inserting skewers into theoretical research, and to make a breakthrough by examining the problems of each research subject from various angles.

The basis of theoretical research is academic exchange among researchers. By organizing a colloquium on basic science, we will greatly promote research exchange and scientific exchange within the Graduate School of Science, including graduate and undergraduate students. After the launch of this project, we will hold monthly or bimonthly "Nambu Colloquium" to promote exchanges between researchers and students in the School of Science, focusing on theory and physics. In addition, we will hold seminars and social events in collaboration with RIKEN. In 2013, the first Nambu Colloquium was held with participation of the renowned Dr. Jona-Lasinio, who was a collaborator of Distinguished Professor Yoichiro Nambu when he was awarded the Nobel Prize and delivered the Nobel Prize Lecture. The Nambu Colloquium aims to create a place for researchers in the Graduate School of Science to interact with each other.

The colloquium will be held as needed to accelerate research exchange. In particular, if there is a possibility that the colloquia and exchange meetings will nurture the seeds of joint research, we will focus on that topic and host a collaborative research meeting in a related field to promote its development.