

# Guidelines for Application 2020

## English-Based Master's Program

Mathematics

Physics

Chemistry

Biology

Planetology

Graduate School of Science, Kobe University

The Graduate School of Science, Kobe University, was established as a result of the reorganization of the Graduate School of Science and Technology in April 2007. The Graduate School of Science has five departments offering both Master's and Doctoral Programs: Mathematics, Physics, Chemistry, Biology, and Planetology.

A Master's Degree of Science will be granted upon completion of the Master's Program, and a Doctoral Degree, either a Dr. of Science or a PhD, will be granted upon completion of the Doctoral Program.

#### English-Based Degree Program

The Graduate School of Science, Kobe University is launching new courses in which students can obtain master's degree by taking classes conducted entirely in English.

<http://www.sci.kobe-u.ac.jp/english/admission.htm>

For inquiries, please contact:

Kyomu-gakusei-kakari (Section of Academic Affairs)

Graduate School of Science, Kobe University, 1-1, Rokkodai-cho, Nada-ku, Kobe 657-8501

TEL: 078-803-5767

e-mail: [sci-kyomu@office.kobe-u.ac.jp](mailto:sci-kyomu@office.kobe-u.ac.jp)

<http://www.sci.kobe-u.ac.jp/english>

(Web page of the Graduate School of Science, Kobe University)

<http://www.math.sci.kobe-u.ac.jp/index.html> (Department of Mathematics)

[http://www.phys.sci.kobe-u.ac.jp/index\\_e.html](http://www.phys.sci.kobe-u.ac.jp/index_e.html) (Department of Physics)

<http://www.chem.sci.kobe-u.ac.jp/en/> (Department of Chemistry)

[http://www.edu.kobe-u.ac.jp/fsci-biol/index\\_en.html](http://www.edu.kobe-u.ac.jp/fsci-biol/index_en.html) (Department of Biology)

[http://www.planet.sci.kobe-u.ac.jp/index\\_e.html](http://www.planet.sci.kobe-u.ac.jp/index_e.html)

(Department of Planetology)

### 1. Number of Students to Be Admitted

Department	Number of students to be admitted
Mathematics	A Few Persons
Physics	A Few Persons
Chemistry	A Few Persons
Biology	A Few Persons
Planetology	A Few Persons

### 2. Eligibility for Application

Applicant must satisfy all of the following requirements,

- (1) Applicants must satisfy at least one of the following requirements and receive adequate recommendation from the relevant university or organization
  - a) Those who are currently enrolled in or graduated from Kobe University.
  - b) Those who are currently enrolled in or graduated from universities with which the Graduate School of Science has Academic Exchange Agreements, or from universities which have previous exchange arrangements with Kobe University.
  - c) Those who have established close communication with faculty members of the Graduate School of Science and are recognized as eligible by the Graduate School of Science.
  - d) Those who have secured a foreign government or private scholarship for their research stay in Japan.
- (2) Those who have obtained consent from their intended supervisor of the Graduate School of Science who will supervise their studies upon enrollment.
- (3) Those who can acquire “student” residence status at time of enrollment.
- (4) Applicants must satisfy at least one of the following requirements.
  - a) Those who have completed 16 years of school education or will complete it by March 31, 2020, awarded in a foreign country.
  - b) Those who have completed 15 years of school education in a foreign country, and are recognized by the Graduate School of Science at Kobe University as having earned recognized credits with excellent grades.
  - c) Those who are recognized as having scholastic abilities equivalent or superior to graduates of university, as assessed through qualification screening by the Graduate School of Science, and who are 22 years of age or older at the day of March 31, 2020.

(Note 1) Applicants who intend to apply in accordance with qualifications (4)-b) or c) must refer to Page 9, “For Applicants Applying Under Condition (4)-b) or c)”

Applicants who satisfy (4)-c), are those who have graduated from a junior college, a specialized vocational higher college, a school of the miscellaneous category or other educational institutions.

(Note 2) For any questions concerning the application procedures, please contact the Student Affairs Office/Graduate School of Science. e-mail- [sci-kyomu@office.kobe-u.ac](mailto:sci-kyomu@office.kobe-u.ac)

### 3. Application Period

Department	Period of Application
Physics	From Tuesday, June 18 through Friday, June 21, 2019
Mathematics Chemistry Biology	From Tuesday, July 2 through Friday, July 5, 2019
Planetology	From Tuesday, July 23 through Friday, July 26, 2019

When submitting application documents in person, acceptance hours/office hours: 9:00-12:00, 13:00-17:00

#### 4. List of Application Documents to Submit

(1) Applicants must submit the following application documents.

\*mark –Please fill in using form prescribed by the Graduate School.

\*① Application Form

This should be completed in the format specified. Use the CV on the reverse side of application.

③ Photograph

Two photographs (4cm x 3cm) taken within the past three months, should be pasted on the application form and the ID for the examination.

④ Academic Transcript

This must be issued by the dean or the president of the applicant's graduate school.

Applicants applying from within Kobe University are not required to submit this certificate.

⑤ Graduate/Completion (expected) Certification

This must be issued by the dean or the president of the applicant's graduate university that the applicant attends or attended.

Applicants applying from within Kobe University are not required to submit this certificate.

⑥ Application Fee -30,000 Yen

Please refer to (2) Payment for the examination fee. Application fee should be made with a payment form at a post office or by bank transfer.

Japanese Government Scholarship Students are exempt from this requirement.

⑦ Certificate of Monbukagakusho Scholarship Student

Applicants currently studying under a Japanese Government Scholarship must provide a certificate proving such status (issued by the university in which the student is currently enrolled).

⑧ Letter of Recommendation

Recommendation 1 – The letter must be issued by the dean of faculty.

Recommendation 2 – The letter must be issued by the academic professor of your attend or attended.

(1, 2 – Applicants applying within Kobe University are not required to submit this Letter of Recommendation.)

Recommendation 3 – If you are employed at a public agency or company at the time of application, submit a Letter of Recommendation from your immediate superior.

\*⑨ Address Label

Admission, including screening results will be sent to applicants by using these labels.

⑩ Residence certificate

International students who currently reside in Japan are requested to submit this certificate, issued by the local government office, which mentions your status of residence (issued within 30 days) or a photocopy of your Residence Card.

⑪ Statement of Purpose

If applying to the Physics and Biology Departments, submit the statement of purpose using a sheet of A4 size paper.

There is no set length or format for this note.

## ⑫ English Proficiency Test

### 1. Department of Chemistry

Submit a TOEIC Official Score Certificate, the test of which should be taken not more than two years before the examination. The Certificate will be returned to applicants after the examination. If the applicant is not able to submit a certificate at the time of application, submit it on the day of the writing examination. In this instance, please include a note on a sheet of A4 size paper explaining that you will submit your certificate at the examination, and submit this note with the application documents. There is no set length or format for this note. The TOEIC Official Score Certificate should be submitted to the person in charge of the examination at 10:20 before the examination. However, you may also re-submit scores on the day of the written examination even if you have already provided scores when you submitted your application. If applicants cannot submit the TOEIC Official Score due to a factor related to the education system of their countries or regions, they are required to take an English proficiency test in their specialized subject. Please submit a note on a sheet of A4 size paper explaining the reason why you are not able to submit this score and your intention to take an English proficiency test. There is no set length or format for the note.

### 2. Department of Biology

Submit a TOEIC Official Score Certificate or TOEFL Score Report, the test of which should be taken not more than two years before the examination. The Certificate or Report will be returned to the applicant after the examination. If the applicant is not able to submit a certificate at the time of application, submit it on the oral examination. In this instance, please include a note on a sheet of A4 size paper explaining that you will not submit your certificate at the examination, and submit it with the application documents. There is no set length or format for this note. The certificate or report should be submitted to the person in charge of the examination at the meeting time. If applicants cannot submit the certificate or report due to a factor related to the education system of their countries or regions, they are required to take an English proficiency test. Please submit a note on a sheet of A4 size paper, explaining the reason why you are not able to submit this score report and your intention to take an English proficiency test. There is no set length or format for this note. Details of the English proficiency examination will be sent to the applicant subsequently.

### 3. Department of Planetology

Submit a TOEIC Official Score Certificate or TOEFL Score Report, the test of which should be taken not more than two years before the examination. The Certificate or Report will be returned to the applicant. If the applicant is not able to submit a certificate at the time of application, submit it on the day of the oral examination. In this instance, please include a note on a sheet of A4 size paper explaining that you will submit your certificate at the examination, and submit it with the application documents. There is no set length or format for this note. The Official Score Report should be submitted before the oral examination at the meeting time. If applicants cannot submit the Official Score due to a factor related to the education system of their countries or regions, they are required to take an English proficiency test in their specialized subject. Please submit a note on a sheet of A4 size paper of the reason why you are not able to submit the score and your intention to take an English proficiency test. Details of the English proficiency examination will be sent to the applicant subsequently.

## (2) Application Fee

### (A) For applicants residing in Japan

Transfer from Japan Post Office

- Application fee payment of 30,000 yen (Japanese yen) can be transferred at post offices in Japan using a transfer application form provided by Kobe University.
- After making the payment, please submit part (A) of the form together with the application documents.  
(Make sure the transferred amount is correctly printed.)

### (B) For applicants residing outside Japan

Please make a payment of the 30,000 yen (Japanese yen) examination fee by transfer in accordance with the following instructions.

If remitting from abroad, the applicant should cover transfer fees charged by both the bank in the applicant's home country and the Bank of Sumitomo Mitsui. After the transaction is completed, overseas applicants should consult with their local bank to verify that the transferred amount to Kobe University's Bank of Sumitomo Mitsui account is 30,000 yen, and no less. Applicants must also submit a copy of the receipt of foreign remittance issued by the local remitting bank, or other evidence of the bank transfer, together with their application documents. Applicants should keep the original receipt for their own records.

Type of Transfer		Telegraphic transfer
Bank transfer charge		Borne by a remitter
Application Fee		30,000 yen
Deadline for Remittance	Mathematics, Chemistry, Biology	June 26, 2019
	Physics	June 12, 2019
	Planetology	July 17, 2019
Purpose of remittance		Application fee
Bank name		Sumitomo Mitsui Banking Corporation
Bank code		0009
Swift code		SMBCJPJT
Branch name		Rokko
Branch code		421
Account no.		4165080
Recipient name		Kobe University

\*1. Once the remittance is completed, please send an e-mail with the following information to the Student Affairs Section ([sci-kyomu@office.kobe-u.ac.jp](mailto:sci-kyomu@office.kobe-u.ac.jp)).

Applicant's name, contact address and phone number, remittance amount, and amount of foreign remittance fee.

\*2. If an overseas applicant's remittance is not completed by the deadline, the application will not be accepted. Once paid, the application fee will not be refunded for any reason.

(3) Application Procedure by mail

The applicants must be sent by registered mail to arrive no later than 17:00 on each department's deadline. At the same time, please send an e-mail indicating that your application documents have been sent by post. Upon receiving this e-mail, we will send you the "Examination Admission Card" and "Important Notice for Applicants" by e-mail.

(4) Contact for submission and inquiries

Kyomu-gakusei-kakari (Section of Student Affairs)  
Graduate School of Science, Kobe University  
1-1, Rokkodai-cho, Nada-ku, Kobe 657-8501  
TEL: 078-803-5767

## 5. Screening Method

(1) Mathematics, Physics, Chemistry

Screening will be made after comprehensively examining an academic transcript of the school the applicant graduated from and the results of written and oral examinations.

Details of the date and time and the written examination and oral examinations include specialty subjects as designated by each department. Please refer to Appendix - page 8.

(2) Biology

Screening will be made on the basis of the application documents and an oral examination using an internet phone service such as Skype. Details of the oral examination will be sent to the applicants individually by their intended professors. Oral examinations may be held at the examination room of the Graduate School of Science in person for those residing in Japan or who come to Japan.

Details of the oral examination and the examination room are specified in the Appendix page 8.

(3) Planetology

Screening will be made on the basis of the application documents and an oral examination. Details of the oral examination will be sent to each applicant separately by their intended professor.

Examinees who are not able to visit Japan for an unavoidable reason on the examination day can take the oral examination using an internet phone service such as Skype, if this is permitted by their department. Details of the date and time and examination room are specified in the Appendix page 8.

## 6. Notification of the Result

Biology results will be posted at the B-building, 2<sup>nd</sup> floor of the Graduate School of Science on August 8, 2019 at 10:00, and results for other departments will be posted at the Y- building, 1<sup>st</sup> floor of the Graduate School of Science on September 11, 2019 at 10:00. Applicants will also be notified of the result (pass or fail) by mail.

In addition, applicants can confirm their result through the official website of Kobe University.

Inquiry of the result by telephone is strictly prohibited.

## 7. Enrollment Procedure

(1) Admission Period • Enrollment Documents

Period of Enrollment Procedures : March, 2020.

Documents and forms required for university enrollment will be sent to every successful applicant together with an admission offer letter by the middle of March, 2020.

## (2) Admission Expenses

Payment Division		Amount	Details
Enrollment Fee		282,000 Yen	Must pay during the admission period.
Tuition	First Semester	267,900 Yen	For paying tuition for the first semester is withdrawn from the student's bank account on April 27, 2020. If the tuition fee is revised during enrollment, the new fee will apply.
	Annual total (at present)	535,800 Yen	

(Note) The Fees mentioned above is an example for 2019.

This is not required for applicants who are Japanese Government Scholarship Students.

## 8. Important Notice

- (1) Once you have submitted the documents, no changes to the contents are permitted, and the documents for your application will not be returned. The entrance examination fee is not refundable after application, except for the cases in which the application is not accepted.
- (2) The fees due prior to University entrance are not refundable.
- (3) For the "Name of the Department" and "Name of research field" you wish to enroll in, make an entry in the appropriate column of the application form with reference to the introduction to the Graduate School of Science and this notice. Your intended supervisor's name should also be entered in parentheses.
- (4) Applicants to the Department of Chemistry should contact the intended supervisor in advance of preparing an application.
- (5) Application documents which are incomplete, or contain errors and omissions will not be accepted. Please confirm that the application form has no omissions, or errors.
- (6) If any false statement is found in any of the application documents after admission, the admission may be cancelled. In cases in which an applicant does not fulfill entrance requirements, or has not graduated from university, earned a bachelor's degree, or completed school education, admission will be revoked.
- (7) Applicants who will take the examination in Japan, please pay attention to the points below:
  - ① Be sure to bring your Examination Admission Card with you on the day of examination.
  - ② Applicants are not allowed to bring watches with functions other than the normal time display function, such as a translation function or calculation function.
  - ③ Accommodation arrangements will not be made for the examination.
- (8) Applicants with special needs who require special support in undergoing the examination process should consult the Graduate School of Science at least two weeks before the examination.
- (9) Documents printed in languages other than English should be translated into English.
- (10) To obtain the necessary forms, please send your request by e-mail to [sci-kyomu@office.kobe-u.ac.jp](mailto:sci-kyomu@office.kobe-u.ac.jp).



## 9.[Information for applicants who successfully passed the entrance exam]

### Control and Prevention of Infectious Diseases

Submission of a certificate demonstrating inoculation and an antibody test against measles and rubella:

Kobe University has implemented the *Measles and Rubella Registration Policy*, and all newly enrolled Kobe University students must submit one of the following three certificates (①, ②, or ③) to prevent a possible outbreak of measles and rubella on campus.

Please note that students admitted into the following schools should submit either ① or ③: School of Medicine (Faculty of Medicine and Faculty of Health Sciences), the Graduate School of Medicine, or the Graduate School of Health Sciences.

- ① A vaccination certificate to prove that you were inoculated against measles and rubella (twice each after one year of age).
  - ② A vaccination certificate to prove that you were inoculated with measles and rubella vaccines each within the last five years (since April 2015).
  - ③ An antibody certificate verifying that you have sufficient antibody titer in your blood (refer to the chart next page) to prevent the development of measles and rubella, based on the results of an antibody test performed within the last five years (since April 2015).
- \* For ① and ②, it can be a combined vaccine of measles and rubella vaccines (e.g., MR vaccine).
  - \* For ① and ②, the certificate must be issued by an accredited medical institution, and state the type of vaccine and the date of inoculation.
  - \* For ③, the certificate must specify the measuring method and the measured values of antibody titer in your blood (refer to the next page), and it must satisfy the judging standard listed in the chart. A blood test report sheet itself can be accepted for submission.
- If the antibody titer in your blood is insufficient, you must receive the necessary vaccination, and submit either ① or ②.
- \* You may submit a combination of ①, ②, and ③ (e.g., ① for measles, and ③ for rubella).
  - \* If the antibody titer level is below requirements, yet you cannot be inoculated with vaccines for some reason (e.g., illness or body composition), please submit an official document (for example, a certificate issued by the doctor) explaining why.

#### <Submission Period and Place of Submission>

Submit the certificate when you register at the Medical Center for Student Health (Rokkodai) during your routine medical check-up scheduled for early April.

#### Measuring Methods and Judging Standards for Protective Antibodies in Blood

	Measuring Method	Judging Standard	Remarks
Measles	IgG – EIA method	$8.0 \leq$ positive	Positive result by one of these three methods.
	PA method	$128x \leq$ positive	
	NT method	$4.0x \leq$ positive	
Rubella	HI method IgG – EIA method	$32x \leq$ positive	Positive result by one of these two methods. (HI method is recommended)

Make sure the above methods are followed when the antibody titer is measured in your blood.

The protective antibody value differs according to the measuring method used. Please note that **the judging standards are higher than the usual standards used at medical institutions.**

Before you visit a medical institution, please make an appointment and confirm that the antibody test and/or the vaccine you need are available at that institution.

When you visit a doctor at a medical institution, make sure you present this guidebook so your doctor can issue the necessary certificate(s). (Please make sure you confirm with your doctor the measuring methods and judging standards when measuring the antibody titer in your blood.)

\*Points to Consider when Submitting a Certificate:

- ① Please submit the original certificate and one set of copies (A4 size).
- ② If the certificate is written in a language other than Japanese or English, please attach a document that shows either a Japanese or English translation.

For further information, please refer to:

Medical Center for Student Health, Kobe University      Tel: 078-803-5245

Student Support Division, Student Affairs Department, Kobe University Tel: 078-803-5219

## 10. Others

### (1) Financial support

Kobe University offers an admission fee waiver and a tuition waiver program.

Details will be informed separately.

### (2) Privacy Statement

(1) With regard to personal data possessed by Kobe University, laws including the Law Concerning the Protection of Personal Information by Independent Administrative Institutions are observed, and every possible measure is taken to protect it based on the Personal Data Management Rules of Kobe University.

(2) Personal data provided to Kobe University for application are used for the selection of students, the announcement of accepted applicants, admission procedures, and research into selection methods of students.

(3) The personal data of accepted applicants provided to Kobe University for application is used after admission for student support (health management, scholarship application, etc.), educational purpose (student registration, academic guidance, etc.), and services related to tuition.

(4) With regard to the use of personal data for various services, some of the services may be entrusted by Kobe University to outside operators (hereinafter referred to as “entrusted operators”). In such cases, all or part of the personal data provided to Kobe University may be provided to the operators imposing the confidentiality of data, to the extent necessary to implement the entrusted services.

## Appendix (Table)

### 1. Schedule for written examinations and oral examinations

Major	Written examination		Date, Time	
	Subject	Language		
Mathematics	Mathematics	English	August 20, 2019	9:30 – 12:00 Mathematics I 13:00 – 14:30 Mathematics II 15:00 – 16:00 English
			August 21, 2019	9:30 - Interview
Physics	Physics	English	August 21, 2019	9:30 – 12:00 Physics I 12:50 – 13:50 English 14:30 – 17:00 Physics II
			August 22, 2019	9:30 - Interview
Chemistry	Chemistry	English	August 26, 2019	11:00 – 13:00 Chemistry
			Required arrival time 10:20	(14:00 – 15:00 English)
			August 27, 2019	13:00 - Interview
Biology			August 4, 2019	9:30 - Oral Examination
Planetology			August 29, 2019	9:00 - Oral Examination

(Note) (1) A dictionary may not be used at the English examination.

(2) A desk calculator will be lent to all the examinees in the examination for Chemistry.

In the Chemistry, Biology and Planetology departments, the English examination is only available for applicants who have registered their intention to take an English proficiency test and cannot submit the TOEIC Official Score Certificate or the TOEFL Score Report due to a factor related to the education system of their country or region. Please refer to ⑫ of page 2-3 for details.

(3) In the Biology and Planetology departments, the set criteria for judging English performance gives a weighting of 1:3 for listening:reading when looking at the results of the TOEIC Official Score or the TOEFL Score Reprt.

(4) In the Chemistry department, set criteria for judging English performance gives a weighting of 1:2 for listening:reading when looking at the results of the TOEIC Score.

(5) In case of emergency, please check our website (<http://www.sci.kobe-u.ac.jp/english/>) or our Twitter(@kobeU\_PR).

### 2. The place of writing and oral examinations

① Graduate School of Science, Kobe University

(1-1, Rokkodai-cho, Nada-ku, Kobe 657-8501)

\*Access to Rokkodai Campus (Graduate School of Science)

From the nearest stations to Rokkodai Campus

Hanshin "Mikage" station, JR "Rokkomichi" station or Hankyu "Rokko" station

Take Kobe City Bus No.36 to "Shindai Bun/Ri/Nou Gakubu Mae" bus stop then walk for about three minutes south(downhill).

- ② Writing examination room and Oral examination room will be posted at the Y-building, 1-st floor of the Graduate School of Science on the day of examination.

**\*Preliminary examination of eligibility 2.(4)-b) or(4)-c)**

1. Application Qualifications

Applicants must be recognized as having scholastic abilities equivalent or superior to a university graduate, as assessed through qualification screening of the Graduate School of Science, and must be 22 years of age or older at the day of March 31, 2020. (Applicants include those who have graduated from a junior college, as specialized vocational higher college, a school of the miscellaneous category or other educational institutions.)

2. Application Procedure

Applicants who intend to apply in accordance with above qualifications 2-(4)-a) or (4)-d), in Section 2 are required to apply in advance for the preliminary examination.

Please submit the following documents accordingly by Monday, June 17, 2019.

(Physics – by June 4, 2019 (Tue.), Planetology – by July 1, 2019 (Mon.) - by 17:00)

If you send your documents by mail, make sure that you write either “Application for Preliminary examination for English-Based on Master’s Program” with your major in red on the envelope and send it by registered mail to the Academic Affairs Section, Graduate School of Science, Kobe University.

Announcement of the result of the preliminary examination- Applicants will be informed of the result of the evaluation by June 26 (Wed.), 2019.

(Physics – by June 11, 2019 (Tue.), Planetology – by July 9, 2019 (Tue.))

Please inform us that you have posted your application documents by sending a message to the following e-mail address: e-mail- sci-kyomu@office.kobe.u.ac.jp

(1) Documents to be submitted for preliminary examination

- Approval Request Form for Application(prescribed form)
- Application eligibility certification record(prescribed form)
- Research plan (Prescribed form)
- Letter of Recommendation (Prescribed form)
- Graduation/Completion Certificate/Academic Transcript for the university which you attend or attended

(2) Approval Request Form

Please ask the Academic Affairs Section of the Graduate School of Science via e-mail “sci-kyomu@office.kobe-u.ac.jp”

3. Application Procedures

The applicants who receive notification of being eligible through preliminary examination should submit the documents stipulated in the application guidelines

# Graduate School of Science, Kobe University

## Department of Mathematics

### I. Division of Analysis

This subject is aimed at the mathematical structures of changes occurring in phenomena. Included are the fields of functional equations, functional analysis, complex analysis, harmonic analysis, algebraic analysis and differential equations.

#### (1) Functional Equations

Analytic methods for solving systems, both linear and nonlinear, defined by differential or difference equations; fundamental theory of special functions and their applications.

(M. Noumi\*)

#### (2) Functional Analysis

Fourier analysis; Functional analytic methods for partial differential equations.

(K. Fukuyama, H. Takaoka)

#### (3) Complex Analysis

Complex analytic functions and special functions, such as elliptic functions and solutions of differential equations; Riemann surfaces; use of analytic and algebraic and geometric methods.

(Y. Yamada)

### II. Division of Algebra and Geometry

This subject is aimed at elucidating the essential properties behind the continuity and symmetry in structures related to equations and spaces. Included are the fields of number theory, automorphic forms, algebraic geometry, differential geometry and topology.

#### (1) Algebra

Structure and theory of algebraic manifolds, period integrals, moduli theory, automorphic forms, automorphic representations, number theory, integrable systems in geometry and mirror symmetry. (M.-H. Saito, K. Yoshioka, T. Taniguchi, K. Morimoto, K. Mitsui, T. Sano)

#### (2) Geometry

Differential geometry and topology; differentiable manifolds; theory of knots and links; minimal and constant mean curvature surfaces; singularities on Riemannian manifolds; hyperbolic space and low dimensional topology. (Y. Nakanishi\*\*, W. Rossman, S. Satoh, K. Saji)

### III. Division of Applied Mathematics

This subject is aimed at the fields of probability, combinatorics, automorphic forms, number theory, computational mathematics, information science and mathematical physics, with applications to such things as science, engineering, computer science and economics in mind.

#### (1) Probability

Applications of probability theory to random motions, fluctuations and random phenomena of mathematical objects. (N. Kajino)

#### (2) Combinatorics

Combinatorics and counting techniques, and their applications to discrete systems and mathematical physics; integrable systems and cellular automata. (Y. Ohta)

### (3) Computational Mathematics

Computational methods in the mathematical sciences; efficient implementation on computers and development of computer algebra systems; applications to algebra, algebraic analysis and mathematical physics. (N. Takayama, S. Aoki)

Those staff members indicated by \* are scheduled to retire at the end of March 2020.

Those staff members indicated by \*\* are scheduled to retire at the end of March 2021.

## Department of Physics

### I. Division of Theoretical Physics

The aim of this division is to study theoretically on elementary particles, the most fundamental constituents of the universe, and various physical properties of condensed matter systems.

#### (1) Elementary Particle Theory

The properties of elementary particles and physics beyond the standard model are studied theoretically. The main interests of our research include higher dimensional theories, functional renormalization group, and supersymmetric theories. (M. Sakamoto, H. Sonoda)

#### (2) Cosmology

The origin of the spacetime and matter in the universe is investigated. The evolution of the large scale structure of the universe is also studied. (J. Soda, T. Noumi)

#### (3) Condensed Matter Theory

Mechanisms of superconductivity and magnetism in various systems are studied using analytical and numerical methods with emphasis on the view point of spontaneous symmetry breaking and quantum information. (K. Kuboki, T. Nishino)

#### (4) Quantum Solid State Physics

Electronic properties of solid states are theoretically investigated to understand the macroscopic quantum phenomena in strongly correlated electron systems such as heavy electron systems. (H. Harima)

### II. Division of Particle Physics

The aim of this division is to experimentally study the properties of elementary particles and the interactions between them, and to answer questions about the early universe.

#### (1) Particle Physics

We work on experiments, using the most advanced experimental facilities, such as high-energy hadron collider experiment (LHC), neutrino experiments (T2K, Super-Kamiokande) and dark-matter searches (XMASS, NEWAGE). (H. Kurashige, Y. Takeuchi, Y. Yamazaki, A. Ochi, K. Miuchi, J. Maeda, A. Suzuki.)

### III. Division of Condensed Matter Physics

The aim of this division is to experimentally study on the magnetic, electric, and thermal properties of condensed matter systems such as magnetic material, superconductor, and semiconductor.

#### (1) Extreme Condition Condensed Matter Physics

Quantum phenomena are studied by electron spin resonance and nano-scale magnetometry under extreme conditions, such as low temperature, high magnetic field, and high pressure. (H. Ohta, E. Ohmichi, S. Okubo)

#### (2) Low Temperature Condensed Matter Physics

Quantum phenomena, such as superconductivity, magnetism, and multipole order, are studied by nuclear magnetic resonance and macroscopic measurements under complex conditions such as low-temperature, high-magnetic field and high pressure. (H. Tou, H. Kotegawa)

### (3) Quantum Dynamics

Spectroscopic studies on the dynamical and microscopic responses of electrons, atoms and molecules in condensed matter by means of ultrashort laser pulses, and highly charged ions. (T. Kohmoto, M. Sakurai\*\*)

### (4) Correlated Electron Physics

Our study is focused on the crystal growth and low temperature measurements in highly correlated electron systems to explore new quantum phenomena, such as unconventional superconductivity and magnetism. (H. Sugawara, E. Matsuoka)

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## Department of Chemistry

### I. Division of Physical Chemistry

Research and education are directed toward understanding structures and dynamics of molecules, clusters, and solid surfaces using various laser spectroscopic and quantum chemical methods. The structures are investigated by high-resolution spectroscopy, resonant enhanced multi-photon spectroscopy, and scanning micro probe. The excited states and reaction dynamics are studied by time-resolved nonlinear spectroscopy, scanning micro probe, and pulse shaping method. Physicochemical understanding of chemical reaction mechanism is learned through the experimental studies.

#### (1) Molecular Structure and Dynamics

Research and education are aimed to understand molecular structure and control dynamics and chemical reaction on the basis of laser spectroscopy and quantum theory.

(A. Wada, S. Kasahara)

#### (2) Material Physical Chemistry

Chemistry at buried interfaces is studied with advanced scanning probe microscopy and optical spectroscopy. Brand-new methods for characterizing nanometer-sized materials are being developed. New solid compounds are synthesized. (H. Onishi, K. Kimura, K. Eda)

#### (3) Chemical Reaction Dynamics

Research and education focus on structure and electronic interaction of intermediate species in photoactive proteins and in solar cells by using time resolved electron paramagnetic resonance spectroscopy. Our main scope is elucidations of molecular function for novel light-energy conversion processes. (Y. Kobori, T. Tachikawa)

### II. Division of Inorganic Chemistry

Research and education focus on coordination chemistry, inorganic materials chemistry, analytical chemistry, electrochemistry, and reaction chemistry: development of functional materials including organometallic compounds, metal oxides, and polyoxometalate compounds, and analysis of electrochemical reactions, electron transfer reactions, and chemical dynamics in condensed matter.

#### (1) Solid State Chemistry

Research and education focus on synthesis and characterization of functional inorganic materials including coordination compounds and metal oxides in crystalline or non-crystalline forms. (T. Mochida, T. Uchino, K. Takahashi)

#### (2) Solution Chemistry

Research and education focus on the charge (ion and electron) transfer reactions at electrode/solution and oil/water interfaces and their application to the electrochemical analysis of biologically relevant compounds. (T. Osakai)

#### (3) Physical Inorganic Chemistry

Chemical dynamics is studied in condensed matter such as liquids and proteins including their interaction, reaction, and relaxation. (K. Tominaga, S. Akimoto)

### III. Division Organic Chemistry

Fundamental researches on organic chemistry and biochemistry, in particular, investigations of new synthetic methodologies and molecular design based on supramolecular chemistry and protein science are executed.

(1) Organic Reaction Chemistry

Research and education are conducted on development of new methodologies for selective organic synthesis, investigation of general and highly efficient catalytic routes yielding useful compounds for life science and material science. (M. Hayashi, R. Matsubara)

(2) Organic Molecular Structure and Function

Research and education focus on molecular structure and functions based on organic chemistry and material science; design, synthesis, and structural analysis of supramolecular architectures composed of p-conjugated macrocycles and cage compounds.

(A. Tsuda)

(3) Biomolecular Science

Research and education focusing on folding and structural formation of proteins and enzymes, their dynamical functions in solutions and in biomembranes, and conversion of their functions by biotechnological methods. (M. Tsubaki\*, A. Tamura, E. Chatani, T. Kimura)

**IV. Visiting Academic Staff for Cooperative Division** (Japan Synchrotron Radiation Research Institute)

(1) Materials Structure Science

Research and education are conducted with a focus on the structural analysis of crystalline materials with synchrotron radiation, dynamic structural analysis, and the use of diffraction techniques and biological macromolecules using X-ray scattering techniques and fluid structure analysis. (H. Iwamoto\*\*, K.Sugimoto)

**V. Visiting Academic Staff for Cooperative Division** (Institute of Physical and Chemical Research)

(1) Theoretical Biochemistry

By computer simulations based on statistical mechanics and quantum chemistry, we aim to understand structural and functional relationships in biomolecules. (T. Nakajima)

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## Department of Biology

### I. Division of Biomolecular Organization

This division conducts education and research on the cell structure and functions in levels of molecules, cells, tissues, and individuals.

#### (1) Molecular Physiology

We educate and research on the molecular mechanisms of stimulus reception in sensory cells, and of cell motility of unicellular organisms. The molecular mechanisms functioning in inter-cellular and inter-individual relationships are also studied. (M. Ozaki\*, T. Suzuki\*\*, M. Sakura)

#### (2) Cell Function

Plants do not have to move from where they live by conducting photosynthesis. Instead, they have abilities to change their cell function, organ growth, and developmental program in response to environmental changes. We educate and research on the mechanisms and their evolution of various plant physiological/morphological responses to environment based on the molecular and cell biology. (T. Mimura\*, H. Fukaki, K. Ishizaki)

#### (3) Bioinformation

Aiming to explore information processing in biological systems, our education and research focus on signal transductions underlying "brain function" and "membrane traffic and cellular morphology in model organisms". (M. Miyamoto, M. Morita, J. Kashiwazaki)

### II. Division of Biosignal Transduction

This division conducts education and research on the mechanisms of gene expression and the regulation of biological responses through the intracellular signal transduction.

#### (1) Gene Expression

We educate and research on the mechanisms of gene expression and the related developmental processes; germ cell determination and differentiation in the nematode *C. elegans* and zebrafish, microRNA function, and regulation of RNA splicing in vertebrates and *C. elegans*, as well as gene regulatory mechanism of cell fate specification in cardiac neural crest. (H. Sakamoto, K. Inoue, S. Matsuhana)

#### (2) Genetic Information

We educate and research on the molecular mechanisms underlying maintenance and diversification of genetic information, and also on the intracellular signal transduction pathways by the post-translational modifications of proteins that regulate biological responses to genotoxic stresses caused by various endogenous as well as environmental agents. (K. Sugawara, M. Yokoi, W. Sakai)

#### (3) Gene Function

We educate and research on the functions of genes involved in the regulation of cellular transformation, apoptosis, and senescence, and also in the processes of morphogenesis. Studies are focused on the molecular mechanisms of cell fate decision between apoptosis and senescence induced by cellular stresses, and the functions of long noncoding RNA and small peptide genes in *Drosophila* development. (S. Kamada, Y. Kageyama, T. Iwasaki)

### III. Division of Biodiversity

This division conducts research and educational program on ecology and systematic biology for elucidating origin and sustenance mechanism of biodiversity of various biota inhabiting both terrestrial and marine environments.

(1) Ecology and speciation

This course covers studies on ecological aspects of biodiversity and its conservation, with particular interests in revealing mechanisms of species interactions, evolutionary change, speciation and diversity of aquatic plants and animals. (T. Sato, K. Suetsugu)

(2) Evolution and phylogeny

We focus on the researches and education of the evolutionary aspects of biodiversity, systematics, metabolic physiology, cell structures and ecology of diverse algae, and apply the results for the conservation and improvement of the aquatic ecosystems. (H. Kawai\*, S. Uwai, A. Murakami\*\*, H. Sakayama, T. Hanyuda)

#### **IV. Division of Developmental Biology**

Our educational program provides fundamental concepts and basic knowledge in developmental biology. We also conduct advanced research in developmental genetics, cell biology, and evolutionary biology.

(1) Developmental Biology\*\*\*

Research and education in this division cover fundamental developmental processes, including epithelial morphogenesis in *Drosophila*, respiratory system development in mouse, evolutionary morphology in vertebrates, and genome evolution. (S. Hayashi, S. Kuratani, M. Morimoto, S. Kuraku)

#### **V. Division of Bioregulatory Science**

This division reviews the discovery research for bioactive compounds and the study of their mode of action, translocation and metabolism in organisms such as insects, fungi and plants.

(1) Bioregulatory Science\*\*\*

Research and education in this division are conducted to clarify the interaction between the organisms and bioactive compounds integrating a variety of technologies. (S. Kawamura, S. Yamato)

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For retirement schedule of the staffs in the research field indicated by \*\*\*, please contact each faculty member.

## **Department of Planetology**

Why is this planet to be the Earth? In order to answer this fundamental question, we are aiming at comprehensive understanding of the evolution of the earth, planetary and solar systems by analyzing various processes occurring at spaces from the center of the Earth to the edge of the solar system with multidisciplinary approaches.

### **I. Division of Fundamental Planetology**

This division aims at cultivating discerning persons leading society and /or academic communities by logical analyses and considerations of variable phenomena in planetary and Earth systems.

#### **(1) Geology**

We examine surficial materials and natural histories of the Earth, aiming to elucidate various kinds of phenomena universal in the solar system as well as those peculiar to the Earth. The main objects of our study include the Earth's environments and life evolution, paleomagnetism, volcanology, and tectonics. (M. Hyodo\*, K. Suzuki-Kamata\*, K. Kaneko, K. Yamasaki, K. Kiyosugi)

#### **(2) Petrology and Mineralogy**

We examine various kinds of Earth and planetary materials to elucidate their origin and evolution by using various methods such as electron microscopy, chemical analyses, synchrotron radiation, experimental reproductions, field works, and so on. (Y. Tatsumi\*, Y. Seto)

#### **(3) Solid Geophysics**

We study source processes of large earthquakes and slow earthquakes, seismic wave propagation, tsunami generation and propagation processes, and dynamics associated with subduction of oceanic plates such as slab deformation, temperature and flow fields. (S. Yoshioka, Y. Kakei)

#### **(4) Fluid Geophysics**

We investigate, by the use of theoretical and numerical methods, the structures and the evolutions of fluid spheres, mainly the atmospheres, of the planets in our solar and exosolar systems in general, and we are trying to argue the problem by understanding Earth's fluid sphere as one of the realization of those general features. (Y. Hayashi, Y. Takahashi)

#### **(5) Planetary Astrophysics**

The major goal of our group is to advance our understanding of the origin and evolution of ring-satellite systems, small solar system bodies, and planetary systems including those outside our solar system, mainly by theoretical research and analysis of data obtained by telescopes and spacecraft observations. (K. Ohtsuki, A. M. Nakamura, N. Hirata)

### **II. Division of Frontier Planetology**

This division aims at cultivating aspirational persons pioneering frontier researches in planetology in collaboration with national institutes of planetary and earth sciences.

#### **(1) Experimental Planetary Science**

We study the origin and evolution of planetary bodies by means of laboratory experiments and planetary explorations. Our research interests are the effects of planetary collisions on the variety of solar system bodies and the tectonics of icy satellites and cometary nuclei. (M. Arakawa, M. Yasui)

#### **(2) Marine Geodynamics**

We conduct researches on the structure and evolution of the solid Earth using marine

geophysical methods. (N. Seama, H. Hirose, H. Sugioka, T. Matsuno)

### (3) Computational Planetology

We mainly study the formation and evolution of astronomical objects from the large scale structure of the universe for planets by means of theoretical and computational approaches. We also works on the research and development of numerical algorithms, software, and hardware (J. Makino, T. Saitoh).

## **III. Cooperative Division**

### (1) Evolutionary History of the Planets and the Earth

We study the origin and evolution of solar system, and exoplanetary systems by astronomical observations (NAOJ), and the history of the Japanese Islands related to global evolution of the Earth (JAMSTEC).(D. Suetsugu, N. Ohashi, T. Nozaki)

### (2) Applied Planetology

Japan has experienced natural disaster conditions brought by torrential rain, typhoons, and so on. The global warming is also an urgent issue. Thus, meteorology is an increasingly important branch of the planetary science. By making use of various facilities of the Meteorological Research Institute, we study the atmosphere close to the earth's surface and the data assimilation and predictions of local heavy rainfalls (H. Mouri, T. Kawabata).

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