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INSTITUTE FOR ADVANCED RESEARCH

LETTER

March 2019 Vol. 17

Special Interview

Exploring the Frontiers of Research to Pursue the Mystery of How Living Organisms Measure Time of a Day ___ Takao Kondo

Research Highlights

The Institute for Advanced Research as a Flagship of Academic Activities at Nagoya University: Successfully Navigating Great Ocean of Knowledge

The Institute for Advanced Research (IAR), Nagoya University, was established in 2002 to further promote the world's top-level research, and to contribute to society through the university's excellent research outcomes. The foundation of the IAR is indebted to Honorary Director Prof. Ryoji Noyori's innovative idea, and the institute is among the first such organizations established in Japanese universities. The IAR has since maintained steady growth by strengthening Nagoya University's pure research from a broad perspective that transcends the conventional disciplinary boundaries. The initiatives of past presidents and the contributions of all the scholars and people involved in the activities of IAR are deeply valued and appreciated.

The primary mission of IAR since its establishment has been to identify the distinguished scholars of Nagoya University worthy of international recognition and to further encourage and support their research so that they will be able to show their academic excellence to the world and society at large. For this purpose, we have been hosting IAR lectures and seminars, most notably the Nagoya University Lectures, delivered by eminent researchers, to whom the president of Nagoya University awarded special lectureship. Furthermore, encouraging early-career researchers through interdisciplinary collaboration is becoming a key mission of our institute. This recognition is now widely shared with other institutions of this sort around the world, especially among the members of the University-Based Institutes for Advanced Study (UBIAS), in which IAR has been serving as a steering committee member. The IAR has led to the creation of the Young Leaders Cultivation (YLC) program, appointing about eight prominent early-career researchers of various fields every year as designated assistant professors for five years. It is our aim to support those junior fellows so that they will be able to contribute to the acceleration of breakthroughs, to encourage pioneering research into new research areas, as well as to further promote the research of our university.

Although Japanese universities are facing challenging times, the IAR envisions leading the way in innovative and wide-ranging projects, and strives to attain our goal of making Nagoya University a world-leading research university, as set out in NU MIRAI 2020. This, of course, requires the participation of all members of the university community who share the dream of advancing cutting-edge academic research, which is why I keenly look forward to your continued support for the IAR.

Yoshi SUTO
Director, Institute for Advanced Research

Director
SUTO, Yoshiyuki

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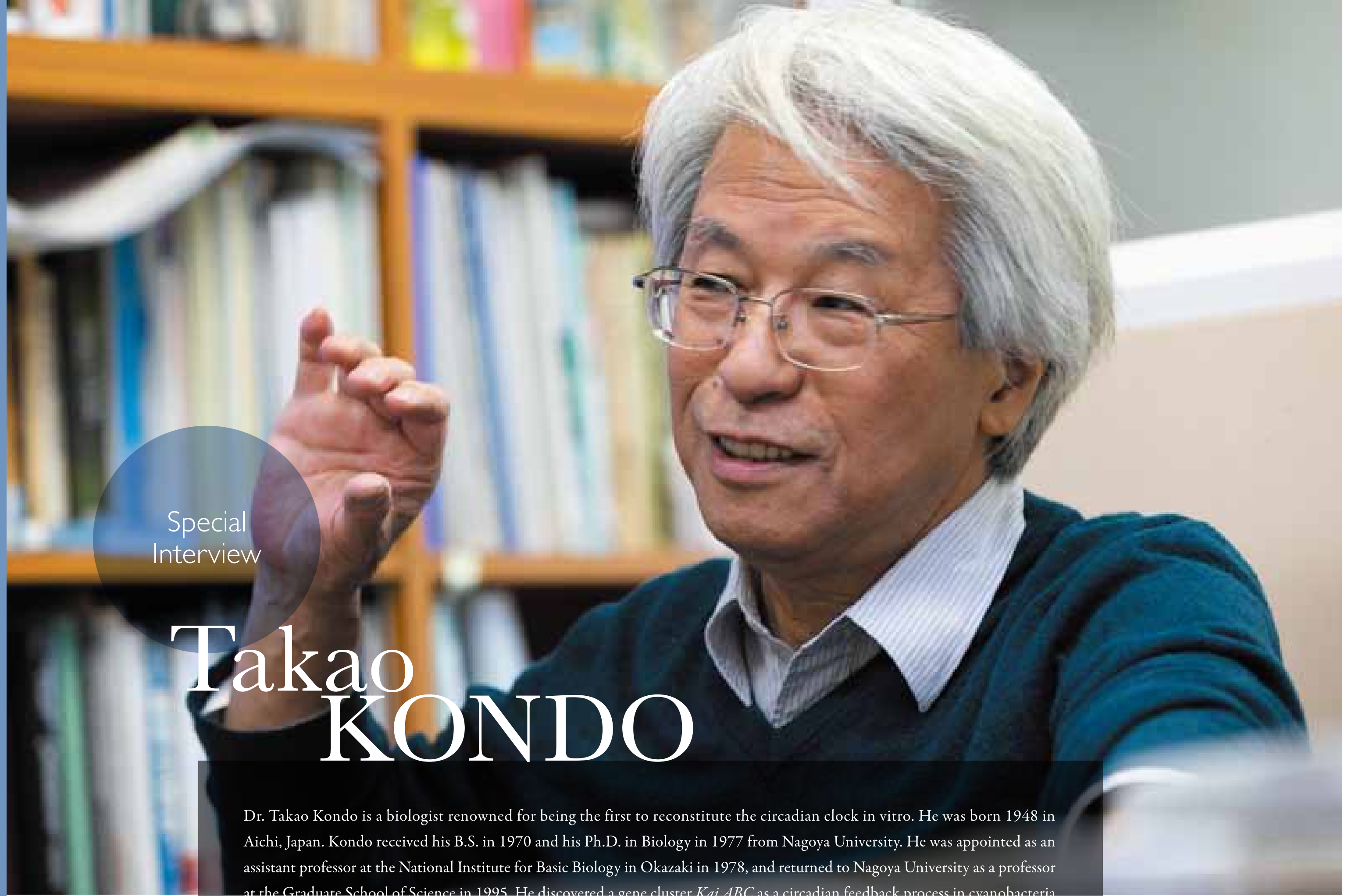
A view of the Bay of Naples from Castellammare di Stabia.
(Photograph by Yukiko Kawamoto, YLC assistant professor. See page 7.)



Special Interview

Takao KONDO

Dr. Takao Kondo is a biologist renowned for being the first to reconstitute the circadian clock in vitro. He was born 1948 in Aichi, Japan. Kondo received his B.S. in 1970 and his Ph.D. in Biology in 1977 from Nagoya University. He was appointed as an assistant professor at the National Institute for Basic Biology in Okazaki in 1978, and returned to Nagoya University as a professor at the Graduate School of Science in 1995. He discovered a gene cluster *Kai ABC* as a circadian feedback process in cyanobacteria in 1998, before he succeeded in reconstituting the circadian oscillation of cyanobacterial Kai C phosphorylation in vitro in 2005. He was the director of Nagoya-IAR from 2007 to 2013. Now he is a Professor Emeritus at Nagoya University. He has won numerous awards such as the Chunichi Prize (2005), the Asahi Prize (2007), the Japanse Society for the Promotion of Science Prize (2007), the Medal with Purple Ribbon (2011), the Japan Academy Prize (2014) and Gilbert Morgan Smith Medal (2015).

Exploring the Frontiers of Research to Pursue the Mystery of How Living Organisms Measure Time of a Day

What are biological clocks (internal clocks)?

KONDO: A day consists of 24 hours during the time the Earth rotates on its axis. The biological clock is like a wristwatch that keeps time in the body to accurately measure 24 hours a day. A biological clock is implemented in each cell of an organism as a gene, and the movement of its clock proteins is observed as a circadian rhythm.

Cicadas emerge from the ground during dark hours when there are few birds and other enemies. How do they know what time it is underground? This is applied to the case where plants bloom during the time when insects come to suck nectar. There is almost no doubt that all living organisms have biological clocks. I found that unicellular prokaryotes called "cyanobacteria" measure time using three Kai proteins.

How do cells affected by biological clocks function in the human body?

KONDO: Biological clocks tell us when and what we should do, including that we should get up when day breaks and that we should eat breakfast after getting up. Although they control various biological activities, they simply measure time without clock hands that show what time it is. Although biological clocks do not need to tell us what time it is, there is a core part of the entire clock somewhere that controls everything. Many data raise expectations that in the body exists such a core clock called a pacemaker and primary clock. Since a circadian rhythm often observed is created by a secondary clock under the control of the primary clock, any adjustment of the secondary clock does not affect the primary clock immediately. This relationship is always important in research on biological clocks.

For instance, some Western countries have introduced a summer time system that advances one hour ahead of standard time during the summer months to effectively provide extra hours of sunlight. You might think that only a one-hour advancement of the clock time does not have a major impact on the human body. However, the primary biological clock cannot be easily adjusted like a stem-winding wristwatch, even though time in the external world can be shifted immediately by force. Only a one-hour shift may greatly impact the human body for a long period of time. For instance, when going abroad, we suffer from jet lag, sometimes experiencing lack of sleep and appetite. Most of us adjust to the time difference after several days because our internal clocks are modified after a while even though they temporarily get off. Thus, biological clocks have a tuning function. For shift workers who keep unusual hours, biological clocks may sometimes severely influence their sleep and appetite even though the tuning function of the clocks can reduce the influence. The summer time system affects all the people equally in areas that follow it, with concerns that introduction of the system will cause problems with their biological clocks even though the time shift is small.

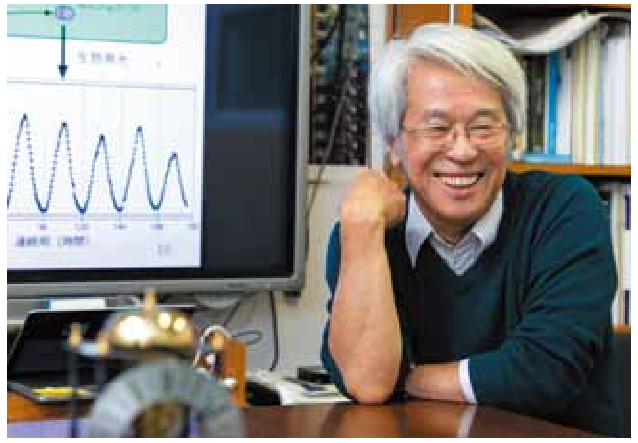
How did you begin research on biological clocks?

KONDO: Known from a long time ago, biological clocks were discovered 290 years ago by French astronomer Jean-Jacques d'Ortous de Mairan through his observation of the Mimosa plant. Plants have the property of unfolding their leaves during the day and folding them down at night. He confirmed that this rhythm did not change even in underground darkness. In his paper, he argued that this could be explained only by assuming that plants know the 24-hour time cycle or have biological clocks.

Modern research on biological clocks was established in 1960, when biological clocks were chosen as an important theme in biology at the symposium held at the Cold Spring Harbor Laboratory, a global research hub in the U.S. However, there were few researchers on biological clocks at that time. The cloning of clock genes (period gene) in *Drosophila* in 1984 triggered a rapid expansion of research on biological clocks. Three U.S. researchers who played a leading role in the research received the Nobel Prize in Physiology or Medicine in 2017.

What path did you follow until you chose biological clocks as research subjects?

KONDO: I was born in Kariya City, Aichi Prefecture. I was a quiet boy and when I was a high school student wanted to be an



entomologist. I collected many insect specimens, mainly moths. Although everyone around me disliked moths, I felt that they were beautiful if looked at carefully. I dreamed of discovering a new species to give it a scientific name.

Although I shifted my interest to DNA around the time I entered university, I became interested in biological clocks when reading the book Dobutsu no tainai dokei (Biological clocks in animals) by Dr. Masutaro Kuwabara (late Director-general of the National Institute for Basic Biology). After enrolling in the School of Science at Nagoya University, I listened to a lecture delivered by Dr. Yukito Oota (late Professor Emeritus at Nagoya University), one of the Japanese pioneers in research on biological clocks, and was motivated to study biological clocks because the lecture was very beatiful to me.

I had another reason to choose this topic, though. Since university student riots were happening frequently at that time, I doubted whether I should be involved only in research at the university campus. I then decided to become employed at a publishing company, wanting to engage in editing scientific journals. However, on the day when I was going to submit my application form, I heard that one of my climbing partners had tumbled down a mountainside and become injured. I raced to the mountain to care for him, and when returning to the university, I lost my drive to be employed. I reaffirmed my willingness to engage in research and went on to graduate school.

It was the dawn of research on biological clocks at that time.

KONDO: In around 1970, when I was in graduate school, no biological clock-related molecules had been detected yet. There were only research methods for observing circadian rhythms. I had no idea how to conduct research on biological clocks, and my fellow students were amazed at my quite unusual research topic. In my actual presentation at an academic conference, the given time of 15 minutes was already over when I was just finishing explaining the introduction. People around me seemed to think that I would continue working as an assistant professor throughout my life. I was then investigating floating aquatic plants, aiming to identify clock genes. Although I found their interesting properties, this did not lead to being able to identify any clock genes.

One day in 1984, one of assistant professor came to my laboratory to introduce a paper written by the U.S. researchers described before. Although I had known about the paper, I felt as if he were asking me if I was all right engaging in such research.

I therefore resolved to change my research subjects to a new one – cyanobacteria. These enabled me to observe the daily rhythms of genes in living cells by monitoring gene expressions using a bioluminescence reporter gene. Although it was said then that a circadian rhythm was present in eukaryotes, but not in prokaryotes, such as cyanobacteria, it was reported to me that a circadian rhythm was indeed detected in cyanobacteria too. To monitor it on a 24-hour basis, I produced various devices, including a powerful device that used a cooled CCD camera to watch faint bioluminescence of cyanobacteria in petri dishes placed on a turntable with a diameter of around 70 cm that was rotated by a motor. Since I loved writing computer software, I programed a computer so that bioluminescence rhythms from colonies of 10,000 cyanobacteria colonies cultured on petri dishes could automatically be measured.

I first looked for mutants in which 24-hour bioluminescence rhythms were off, and inserted a normal gene fragment into each cell to look for cells that returned to a normal rhythm. Although there was only about one cell that met this requirement among tens of thousands of cells, I detected such cells and found three clock genes: *kaiA, kaiB,* and *kaiC.* Although these clock genes were different from those found in research using *Drosophila,* their gene expression pattern was the same as that of the latter, about which I published a paper in 1998.

—— You have further pursued your research since then.

KONDO: My research has significantly developed since 2005, driven by an experiment conducted by a graduate student who revealed that the KaiC protein has a phosphorylation cycle. A circadian rhythm of period genes, which was found by the U.S. researchers, was explained using a transcription-translation model of gene networks, which is a cycle for protein production from genes. Since gene expression in cyanobacteria does not occur in a dark environment, their biological clocks were supposed to stop under my experimental condition according to the theory of the transcription-translation model. In fact, however, their biological clocks continued to run even in a dark environment.

When examined closely, we found that phosphorylation and dephosphorylation occurred in the KaiC protein on a 24-hour cycle. This was an antithesis to the transcription-translation model for which the U.S. researchers received the Nobel Prize. Closer *in vitro* examination revealed that the 24-hour rhythm of phosphorylation in the KaiC protein was generated by ATP degradation caused by mixing three Kai proteins and ATP, a phosphate-binding molecule existing everywhere in the body. It was also found that in cyanobacteria, proteins served as pacemakers for biological clocks, creating an almost perfect circadian rhythm. I felt like the cyanobacteria were asking me, "Can you solve this mystery?"

The system of biological clocks comprises many layers, where a phosphorylation cycle of KaiC proteins is thought to exist in the further fundamental layers of the transcription-translation model. In my view, what is most fundamental in biological clocks is the pendulum-like function of the KaiC protein by using ATP degradation. On the other hand, human sleep, activities, and appetite are controlled in the terminal layer of the living system.

—— You were deemed as a candidate for the Nobel Prize as well. What did you think when you heard the news that the three U.S. researchers received the Nobel Prize?

KONDO: I was in Tokyo when the news was announced. I received many phone calls from the media because I knew the content of their research well. When reading the reasons why they received the Nobel Prize later, I found that our research achievements were also highly appreciated. Some people said that my research had more impact than that of the three U.S. researchers. However, I believe that they are pioneers who shaped the mechanism of biological clocks consisting of clock genes and provided me with the opportunity to launch research on cyanobacteria. Even though their transcription-translation model does not seem to be the most fundamental phenomenon, the explosive expansion of subsequent research on biological clocks was largely attributable to their achievements. I believe that it is natural that they were selected as Nobel Prize winners. When I met Dr. Michael Rosbash, one of the Prize winner, at an academic conference later, I said to him, "Congratulations!" and he was pleased so much to hear that.

—— What is the fascination of research on biological clocks for you?

KONDO: I was able to continue my research until my retirement, dealing with a topic that I had chosen when I entered graduate school, although I still do research after retirement. I think that I have been lucky with my selection.

Do you know the words of the Irish writer Oscar Wilde, who said that "Nature imitates Art"? In the pendulum clock invented by humans in the 17th century, a pendulum maintains a constant plane of oscillation with a high degree of accuracy, using the power of a spring, to measure correct time. Meanwhile, cyanobacteria measure time by maintaining a pendulum-like rhythm using ATP. Needless to say, although the protein clocks of cyanobacteria were developed further earlier than pendulum clocks, the mechanism of protein clocks was clarified more than 300 years after the mechanical clock was developed using the isochronism of a pendulum discovered by Galileo Galilei. When the mechanism of protein clocks of cyanobacteria appeared to me, I remembered these words of Oscar Wilde at the very beginning. Nature imitated clocks made by humans. Is it accidental or inevitable that biological clocks and mechanical clocks finally have the same design? I am quite sure that a harmonic oscillation that can measure time by use of a very small amount of energy is the origin of biological clocks, and I would like to clarify its mechanism somehow. Research is so interesting that I cannot stop doing it. I also would like to know how the mechanism of biological clocks is functioning in other organisms.

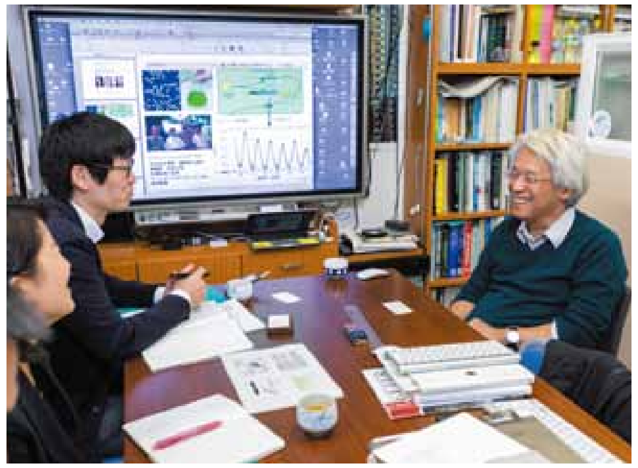
—— There is a tendency that basic research is treated lightly whereas applied research is treated importantly.

KONDO: Many people say that basic research is important. I completely agree with this. However, if we consider using basic research for future innovation, we might miss the most important aspects in basic research. One should not think like that. I encourage engaging in research with curiosity, intending to find something really interesting and feeling love for natural phenomena. It is important to pursue something interesting and beautiful even if it seems to be of no use. It is also crucial not to do the same thing as others. One of the reasons why I chose biological clocks as a research topic was that there were few researchers conducting research on them. Nevertheless, I intuitively knew that they might become a universal topic.

—— Could you give some advice to young researchers on the significance of pursuing research as an occupation?

KONDO: I would like them to work hard without forgetting that they should be true to their interests. When I entered Nagoya University, Dr. Shoichi Sakata, the Dean of the School of Science (late Professor Emeritus at Nagoya University) said to new students, "Never lose your initial enthusiasm." I then impudently thought how boring his words were.

However, I later realized that it was very difficult to follow one's initial enthusiasm. To pursue my interests, in some cases I had to disregard what a professor said and pay my own money to continue doing research in cases where research funding was used up. You have to find what really interests you so that you can continue your research at any cost. This is easy to say but hard to do. However, please believe that nature always gives you the answer.



Interview with Prof. Kondo was done by Nagoya-IAR faculties and S. Yasufuku (Chunichi Shimbun Co., Ltd). This interview article was written by S. Yasufuku and translated to English under the responsibility of Nagoya IAR.

Exploring Quantum Spacetime

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INTRODUCTION

Elementary physics mostly incorporates Einstein's theory of general relativity and quantum mechanics. The former associates gravity with the bending of space and time, collectively called *spacetime*, and the latter explains the characteristic properties of matter at short distances. According to general relativity, spacetime curves due to the existence of matter, and matter exhibits quantum characteristics at short distances. Therefore, spacetime and gravity are supposed to exhibit quantum mechanical effects and those effects become important around the Planck scale, which is a length of about 10^{-35} meters. My field of research is the search for a theory that describes the quantum effects of gravity, dubbed *quantum gravity*. The study of quantum gravity is important because it would allow us to understand how the Universe began: spacetime with all kinds of matter may be viewed as a "flip book" made out of the Universe at each instant of time, and the Universe is known to be expanding faster and faster. Going back in time, the size of the Universe at its "beginning" was about the Planck scale, and therefore the physical laws in this epoch can be explained by quantum gravity.

DIFFICULTIES

Combining general relativity and quantum mechanics based on "conventional" methods encounters notorious inconsistencies. According to the laws of quantum mechanics, investigating short scales requires large amounts of energy, and up to the present we are unable to create enough energy to investigate the Planck scale. The theoretical and experimental difficulties of doing this make the construction of quantum gravity complex.

STRATEGY

There exist various candidates for quantum gravity, but I am most interested in the approach based on statistical mechanics known as *Causal Dynamical Triangulation*, abbreviated to CDT [1]. In the CDT approach, spacetime is discretized by special simplices (see Fig. 1). Quantum mechanical effects of spacetime or gravity can be taken in by the statistical sum over "all possible shapes" of spacetime. Compared to the other candidates, the gee-whiz advantages of the CDT approach are that they allow us to explore the qualitative features of spacetime at the Planck scale and to reproduce the current expanding Universe by computer simulation. However, there are real limitations to machine power. To understand the laws that govern physics at the Planck scale, we need to do analytic computations, but we do not know how to do them at the moment. Constructing a method to deal with CDT analytically is of great significance as it will allow us to study the laws of Planck-scale physics quantitatively. When facing an abstruse problem, it is often helpful to simplify the problem to gain an insight into its true nature. I use *Dynamical Triangulation,* abbreviated to DT, in two spatial dimensions as a simplified model, although the dimensions of real observed spacetime are four—three spatial and one temporal. Since two-dimensional DT can be studied analytically, my strategy is to closely examine this two-dimensional model to find a technique for dealing with a realistic CDT approach in four dimensions.

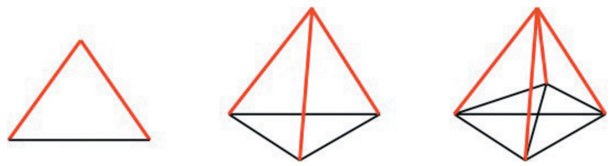

Figure: From the left, the figure depicts two-, three- and (one of) four-dimensional simplices. The red and blue lines indicate the temporal and spatial edges.

ZERO-TEMPERATURE CRITICALITY

We couple Ising spins as matter with two-dimensional DT and call this model the Kazakov model [2]. Since the Ising spin that mimics, for instance, the magnetic moment of an atom is a simple but non-trivial matter, we use the Kazakov model for this purpose. In the Kazakov model, reducing the critical temperature at which the Ising spin interaction becomes long range down to absolute zero temperature, we have tried to single out quantum effects, because at absolute zero only quantum fluctuations survive. Amazingly, the temporal direction "emerges" by cooling down the temperature and spacetime at the critical temperature of absolute zero "resembles" that obtained in the CDT approach [3]. A similar procedure was first discussed in [4, 5].

FUTURE DIRECTION

Dealing with DT in four spatial dimensions analytically seems far more tractable than the analytic study of CDT in four spacetime dimensions. In addition, according to our observations in the Kazakov model, the cool-down process may induce the temporal direction. Thus, once we construct a way to study four-dimensional DT analytically, we may have a chance to understand the properties of Planck-scale physics quantitatively by cooling the critical temperature down to absolute zero. Needless to say, this possibility is quite fascinating.

References

(1) J. Ambjorn, A. Goerlich, *et al.*, "Nonperturbative Quantum Gravity," Phys. Rept. 519, (2012) 127.
(2) V. A. Kazakov, "Ising model on a dynamical planar lattice: Exact solution," Phys. Lett. A 119, (1986) 140.
(3) Y. Sato and T. Tanaka, "Criticality at absolute zero from Ising model on two-dimensional dynamical triangulations," Phys. Rev. D 98, (2018) No. 2, 026026.
(4) J. Ambjorn, R. Loll, *et al.*, "A New continuum limit of matrix models," Phys. Lett. B 670, (2018) 224.
(5) J. Ambjorn, Y. Sato, *et al.*, "New multicritical matrix models and multicritical 2d CDT," Phys. Lett. B 712 (2012) 109.

Trilateral Relationships among Japan, Korea and China in 17th-19th Centuries

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INTRODUCTION

Joseon Korea, a kingdom caught between *Tokugawa* Japan and two consecutive dynasties of China, the *Ming* and the *Qing*, played a very important role in building diplomatic relations between the two in the first half of the seventeenth century. It contributed almost as much as it sabotaged. Throughout the early modern period, *Tokugawa* Japan and *Ming-Qing* China were connected by *Joseon* Korea, but the same country constantly tried to hamper progress.

RESEARCH BACKGROUND

Succeeding to country unified by his father, the second emperor *Hong Taiji* consolidated power within and declared a new dynasty—the *Qing*. The emperor ruled that establishing official diplomatic relations with Japan would be beneficial, but the consequences of the dynastic changes from *Ming* to *Qing* meant that efforts to that end yielded nothing concrete. The state of bilateral relations at that time has been called "silent diplomacy" (by *Iwai Shigeki*) or "non-diplomatic relations" (by *Sugeyama Kiyohiko*).

When we turn our sights on Japan, in the 1630s the *bakufu* imposed a prohibition on overseas voyages and limited foreign contact to the four ports of *Nagasaki, Tsushima, Satsuma,* and *Matsumae*. However, when we examine this situation from the perspective of the continent, we find that China was connected to Japan through the mediation of *Joseon* Korea and the *Ryukyu* Kingdom in the early-modern period. Research on the diplomatic situation in the *Ryukyu* Kingdom and cultural exchanges occurring via the *Ryukyu* Kingdom has been plentiful. However, the Sino-Japanese connection through *Joseon*, the most loyal vassal state of *Ming* China and later *Qing* China, has received far less attention.

Why were diplomatic relations between Japan and China not restored and became dependent on the mediation of secondary countries? The primary cause was the Japanese invasion of Korea (1592–98), which disturbed the old international order in East Asia. Japan's restoration of diplomatic relations with *Ming* China, which formed part of post-war normalization, contributed to the establishment of diplomatic channels between Japan, China and Korea.

RESTORATION PROCESS

At the dawn of the Tokugawa *bakufu*, *Tokugawa Ieyasu* attempted to reconstruct diplomatic relations with *Ming* China through three channels: (1) *Ming* merchants visiting Nagasaki, (2) *Joseon* Korea, and (3) the *Ryukyu* Kingdom. However, (1) and (3) did not bring good results, with only attempt (2) bringing results. However, scholars have not investigated (2) to the same extent as the other two.

In this project, I have investigated the diplomatic process and real situation surrounding how *Tokugawa* Japan attempted to restore diplomatic relations with *Ming* and *Qing* China via *Joseon* Korea in the seventeenth century.

Since the *Tokugawa bakufu* had already given the *Tsushima* domain the right to manage *Joseon* affairs, in examining Japan's attempt to restore relations with China, the activities of the *Tokugawa bakufu* and *Tsushima* domain should be discussed separately. This process is divided into two periods: the period of coexistence of multiple intermediaries mentioned above (before 1615), and the period when Korea was the sole mediator (after 1615).

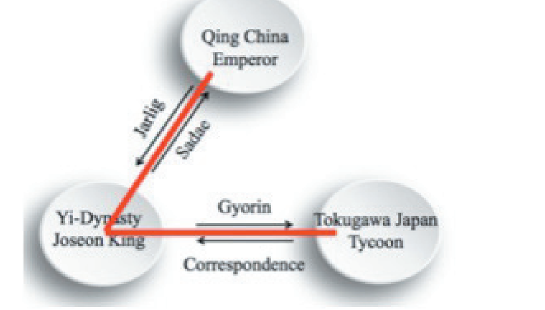

Figure: Relationships between Japan, Korean and China in the early modern period

JOSEON KOREA: THE SOLE MEDIATOR

After *Jurchen* Manchu's invasion of Korea in 1627, the only *bakufu*-sanctioned envoy sent to Seoul in the early-modern period was *Kihaku Genpo*, a diplomat-monk from the *Tsushima* domain, in 1629. Deciphering his manuscripts, including letters written by *Genpo* recorded in "*Zenrin Tsusho*," *Genpo's* diary "*Hochoro Jokyo nisshi*," and the reception record "*Eumbing haenggi*" which have been largely ignored by researchers up to the present, we have discovered that restoration of diplomatic relations was not ordered by the *bakufu* in the 1629 mission, but was used by *Tsushima* as an excuse to visit the capital of the *Joseon* Dynasty. Also, since *Qing* China was suspicious of *Joseon's* relationship with Japan, *Joseon* did not report to *Qing* China on *Tsushima's* expectations for the restoration of diplomatic relations.

OVERVIEW

From my empirical analysis, I demonstrate that placing *Joseon* Korea as a mediator between *Tokugawa* Japan and *Ming-Qing* China, who had not established formal diplomatic relation in the 17th–19th centuries, allowed China and Japan to have mediated political connections. To truly understand the trilateral relationship is not to build up bilateral relations between any of the two, even in a detail-oriented way. By sleight of hand, *Joseon* Korea benefited from being the mediating state, manipulating diplomatic relations between Japan and *Qing* China to its own ends.

References

(1) Ura Renichi, "*Meimatsushinshyo no senman kankei jyo ni okeru nihon no chii,*" 2 明末清初の鮮満関係上における日本の地位 (二), Shirin 史林 19(3), 1934, pp. 122-146

The Origin of European Formal Gardens

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INTRODUCTION

It is believed that European formal gardens, especially those adorned with clipped trees (topiary) and plants arranged in geometrical patterns, have their origins in Roman gardens. This understanding is based on the evidence of 'opus topiarium' and trimmed plants in Latin texts, although it is known that the 'topiarius' is not what 'topiary' means in a modern sense. Wall paintings, textual evidence, and excavated Pompeian gardens suggest that the Romans had densely planted gardens resembling natural groves, challenging our previous conception of Roman gardens. My research explores how the Romans perceived and described their gardens, and whether Roman gardens can be the origin of European formal gardens.

GARDENS IN POMPEII

When Wilhelmina F. Jashemski, an American classicist who had green fingers, decided to study Roman gardens in the early-1950s, it was not a topic which received scholarly attention. Pierre Grimal, a French classicist who wrote a book on Roman gardens in 1943, is an exception but he did not feature examples of uncovered gardens in Pompeii, which had already been reported by Italian and German excavators since the end of the nineteenth century. Jashemski first envisaged writing a monograph covering all the known textual and archaeological examples of Roman gardens, but she soon realised the scale of this challenge. Instead, she started excavating gardens in Pompeii and neighbouring sites, and collaborated with archaeologists, archaeobotanists, ornithologists, natural scientists, and others. Based on the outcomes of her excavations, she edited volumes on Pompeian gardens which became sources of information for later scholars.

The excavations in Pompeii made Jashemski realise that many Roman gardens were not formal gardens, because plant root cavities discovered in gardens suggest that the plants did not form geometric patterns. (cf. organic substance such as roots decayed gradually following the eruption of Mt. Vesuvius in 79 CE and made cavities inside volcanic deposits. It is well known that a famous Pompeianist Giuseppe Fiorelli poured plaster into cavities and made plaster casts of victims.) Her observation was followed by Annamaria Ciarallo, a Pompeianist, whose analyses suggested that Pompeian gardens were often reconstructed in the styles popular at the time of excavation. In the case of Casa degli Amorini Dorati (Figure), archaeologists referred to sculptural finds but there is no mention of the garden patterns in the excavation reports *Notizie degli Scavi* (cf. the wreaths and oscillae hanging in the colonnade are based on depictions on wall paintings). Nevertheless, the garden was reconstructed as if it had been a formal garden.

TEXTS, WALL PAINTINGS, AND EXCAVATION

Following in Jashemski and Ciarallo's footsteps, excavators in the 21st century recognised that the appearance of Roman gardens envisaged by scholars in previous centuries should be revised. Kathryn Gleason, for example, has affirmed this view in her excavation at the Villa Arianna in Stabiae. I also analysed garden wall paintings and classical literary sources and argued that Roman gardens had a more naturalistic appearance.

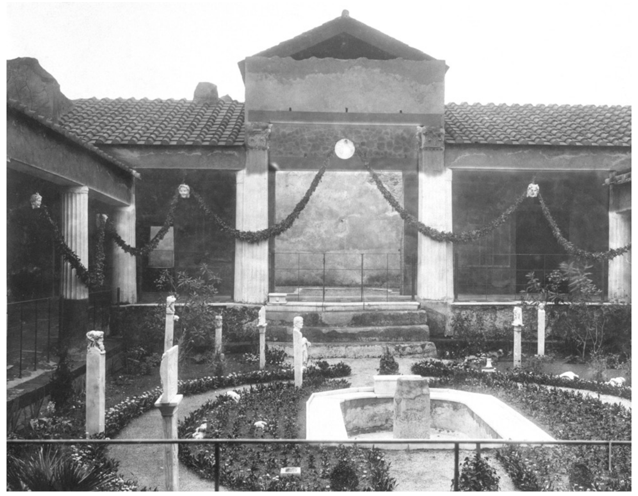

Figure: Casa degli Amorini Dorati, Pompeii. After the reconstruction. (Credit: P.Grunwald, Neg. D-DAI-Z-83.2037. Deutsches Archäologisches Institut Rom)

However, the question remains: 'Why did we start thinking that Roman gardens are the origin of European formal gardens?' By using archaeological and textual evidence, I am trying to answer this question during my fellowship at the Institute for Advanced Research, Nagoya University.

TAKING A STEP FURTHER

My project 'European Gardens: Origins, Reception, and Reconstruction' is generously supported by the Program for Fostering Researchers for the Next Generation (Japan Science and Technology Agency). In this project, I shall collaborate with historians and natural scientists based at Hokkaido, Tohoku, and Nagoya Universities. Through this project, I aim to study how scientific analyses of archaeological finds are conducted and how one should interpret the results provided by natural scientists.

References

(1) Grimal, P. (1943) *Les jardins romains a la fin de la republique et aux deux premiers siecles de l'empire. Essai sur le naturalisme romain* (Paris).
(2) Jashemski, W. F. (1979, 1993) *The Gardens of Pompeii: Herculaneum and the Villas Destroyed by Vesuvius,* 2 vols. (New Rochelle).
(3) Jashemski, W. F. and Meyer, F. (eds.) (2002) *The Natural History of Pompeii* (Cambridge).
(4) Jashemski, W. F., Gleason, K., Hartswick, K. J., and Malek, A.-A. (eds.) (2017) *Gardens of the Roman Empire* (Cambridge).

A Delicate Molecular Orchestration to Create Functional Stomata

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INTRODUCTION

Stomata are tiny pores on the leaf surface in almost all land plants, which enable a plant to take in carbon dioxide to make food through photosynthesis and release oxygen that we breathe. Stomata also function as a water passage; open to evaporate water and close under the dry condition to prevent water loss. In order for stomata to open and close in response to the environment, an intact structure in which a pair of guard cells surrounding the pore is essential. Proper gas and water exchange through stomata greatly impacts the crop yield and water cycle in the atmosphere, which eventually influence the sustainability of humanity. The functional stomata are generated by a single symmetric division of a stomatal precursor known as guard mother cells or (GMCs), however, it was not known how this event is coordinated. Our research published in the American scientific journal Developmental Cell in May 2018[1] elucidated the mechanism by which only one symmetric cell division occurs for functional stomata through the genetics, molecular biology, bioinformatics and mathematical modelling.

MASTER REGULATORS OF STOMATAL DEVELOPMENT

Stomata emerge from uniformed cells on the leaf surface. The subset of cells is committed to the stomatal lineages and undergoes a series of controlled cell division and differentiation to form mature guard cells. In *Arabidopsis* plants, each step of the stomatal lineages is mediated by the sequential action of transcription factors; SPCH, MUTE and FAMA, and SCREAMS[2]. Transcription factors behave like a switch that can control the "on" or "off" state of other plant genes in order to make sure gene expression happens in the right place, time and amount for the accurate developmental decision upon signal sensing. Among these three transcription factors, when MUTE is forcibly expressed, the plant surface is sorely composed of stomata (Fig. 1B), while no stomata are formed when plants lose MUTE gene activity (Fig. 1C). Therefore, we hypothesized that MUTE instruct the gene expression program to create stomata and wanted to comprehensively identify the genes controlled by MUTE.

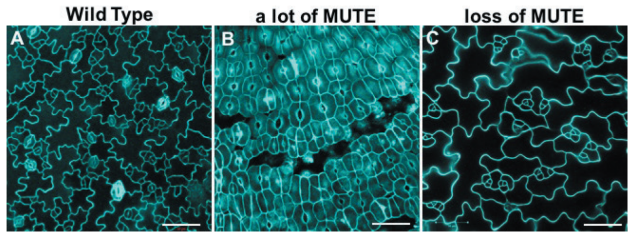

Figure 1: Close-up images of the leaf surface of *Arabidopsis* plants, taken using a microscope. (A) A typical arrangement of stomata across the surface. (B) *Arabidopsis* strain that artificially produces a lot of the MUTE protein, and has many abnormal stomata as a result. (C) *Arabidopsis* strain that lacks MUTE gene activity. Scale bars are 50 micrometers.

MUTE INDUCES BOTH CELL CYCLE GENES AND THEIR REPRESSORS

Thanks to the Next Generation Sequencing technology and bioinformatics, we could easily identify which genes the MUTE protein turned on or off by employing a strain of *Arabidopsis* (Fig. 1B) in which we can manipulate to produce a lot of MUTE protein. It turned out that MUTE is the potent inducer of the cell cycle factor needed for the symmetrical division of GMCs. Among them, Cyclin D5 (CYCD5) was identified as a direct target of MUTE. Unexpectedly, we found that MUTE directly induces expression of sister transcription factor FAMA and another type of transcription factor FOUR LIPS (FLP). Both FAMA and FLP are known to have an inhibitory action on symmetric cell division. These findings show that MUTE induces both activators and repressor of GMC division. Why would MUTE do this?

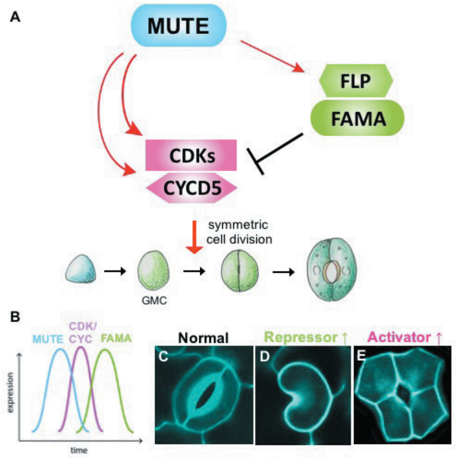

Figure 2: (A, B) Regulatory network orchestrated by MUTE drives the single symmetric cell division to create functional stomata and (C) Typical stomata: paired guard cell (D, E) abnormal stomata produced by genetic perturbation of the network.

MODE OF CONTROL BY MUTE

Through precise experiments, we obtained data on the timing MUTE activation of these activators and repressors of cell division; premature expression of the repressor (FAMA or FLP) produces a single guard cell (Fig. 2D) and prolonged or precautious expression of the activator (CYCD5) yields extra cell division (Fig. 2E). We also incorporated this information into a mathematical model and simulated how MUTE acts to both activate and repress cell division in the GMC. MUTE first turns on the cell cycle activator including CYCD5, which triggers one round of cell division. Then, FAMA and FOUR LIPS induced by MUTE act to prevent further cell division, yielding one functional stomata consisting of two guard cells (Fig. 2A). The result shows that MUTE drives a tightly orchestrated sequences of activation and repression (Fig. 2B) that ensures one and only one single cell division to create functional stomata. This mode of control by MUTE is known as a feedforward circuit, which is widely seen in rapid gene expression control of animals, yeast and bacteria to generate sharp output in developmental processes[3]. Therefore, this research is close to the fundamental principle of making shapes regardless of organisms, and it is expected to contribute to crop improvement through the control of stomata development.

Figure 3: MUTE is a conductor of the delicate molecular symphony of stomatal development in *Arabidopsis*. Keiko Torii and her daughter Erika.

References

(1) Han, S.K., Qi, X., Sugihara, K., Dang, J.H., Endo, T.A., Miller, K.L., Kim, E.D., Miura, T., Torii, K.U. MUTE Directly Orchestrates Cell-State Switch and the Single Symmetric Division to Create Stomata. Dev Cell. 45, 303-315 (2018)
(2) Han, S.K., and Torii, K.U. Lineage-specific stem cells, signals and asymmetries during stomatal development. Development 143, 1259–1270, (2016)
(3) Basu, S., Mehreja, R., Thiberge, S., Chen, M.T., and Weiss, R. (2004). Spatiotemporal control of gene expression with pulse-generating networks. Proc. Natl. Acad. Sci. USA 101, 6355–6360, (2004)

SRPP, a Cell Wall Protein is Involved in Development and Protection of Seeds and Root Hairs.

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IDENTIFICATION OF SRPP

Root hairs are involved in major root functions such as the absorption of water, acquisition of nutrients, and secretion of organic acids and enzymes (Ref. [1]). Enhancement of root hair development in response to a phosphate (Pi) deficit has been reported extensively. Our studies revealed that the expression of plasma membrane phosphate transporters and the secretion amounts of acid phosphatase and organic acids markedly increased in long root hairs under Pi-deficient conditions. These emergently elongating root hairs may provide good material for understanding the maintenance mechanism of the structure and function of root hairs. We performed a proteomic analysis using a root hair-less line to identify new types of proteins that keep the structure and function of root hairs, and identified a protein (Seed and Root Hair Protective Protein, SRPP) that was induced in root hairs under Pi-deficient conditions.

PHYSIOLOGICAL FUNCTION OF SRPP

Promoter assay and mRNA quantification revealed that SRPP was expressed not only in root hairs but also in seeds. Considering the tissue-specific expression, we focused our attention on the physiological role of SRPP and investigated the phenotypic properties of root hairs and seeds of a transposon-tagged knockout mutant, *srpp-1*, which consistently displayed defects in root hairs and seeds. Root hairs in *srpp-1* were short and most of them were dead under Pi-deficient conditions. In addition to root hairs, most *srpp-1* seeds were withered and their embryos were dead (right side of figure). SRPP tagged with green fluorescent protein was detected in the cell wall. Electron microscopy showed abnormal morphology of the cell wall of *srpp-1* (left side of figure). Wild-type phenotypes were restored when the *SRPP* gene was expressed in *srpp-1*. These results strongly suggest that SRPP contributes to the construction of robust cell walls, whereby it plays a key role in the development of root hairs and seeds (Ref. [2]).

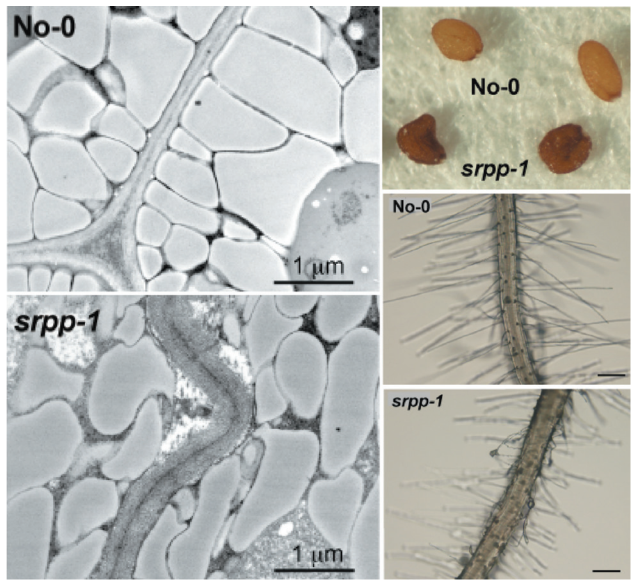

Figure legend. The cell wall protein SRPP is essential for the construction of robust cell walls. The knockout mutant *srpp-1* shows defects in root hairs and seeds.

ENHANCEMENT OF SRPP EXPRESSION DURING EMERGENT ROOT HAIR DEVELOPMENT

We analyzed the expression profile of *SRPP* during cell elongation of root hairs under Pi-deficient conditions and compared the transcript levels in several mutants with short root hairs. The mRNA level decreased in mutants with short root hairs. Induction of *SRPP* expression by Pi starvation occurred one or two days later than the induction of Pi-deficient sensitive genes such as *PHT1* and *PHF1* (Ref. [3]). These results indicate that the expression of *SRPP* is coordinated with root hair elongation. We concluded that SRPP is essential for the structural robustness of the cell walls of root hairs.

OVEREXPRESSION OF SRPP IN SEED MATURATION

The ratio of severe phenotypic *srpp-1* seeds was dependent on the growth conditions. When the *srpp-1* plants were cultivated at low humidity, the defect ratio was 73%, which was higher than the 60% at normal humidity. Therefore, we estimated that SRPP enhances the stress tolerance of seeds and tries to make overexpressors of *SRPP* using the *35S* promoter. Overexpression of *SRPP* enhanced the thermotolerance. In the heat treatment of seeds at 50° C for 2 h, the germination rate of the seeds from the overexpressor was increased to twice that of the wild-type seeds (Ref. [4]). Under the same conditions, no *srpp-1* seed was germinated. The results indicate that SRPP is essential in siliques for producing normal viable seeds under stress conditions. SRPP, a basic protein, may interact with acidic components such as pectin and be involved in construction of a robust cell wall. Seed integrity can potentially be improved through modification of the *SRPP* gene.

References

(1) Tanaka N., Kato M., Tomioka R. *et al.*, Characteristics of root-hair less line of Arabidopsis thaliana under physiological stresses. *J. Exp. Bot.* 65, 1497-1512 (2014).
(2) Tanaka N., Uno H., Okuda S. *et al.*, SRPP, a cell wall protein is involved in development and protection of seeds and root hairs in Arabidopsis thaliana. *Plant Cell Physiol.* 58, 760-769 (2017).
(3) Uno H.,* Tanaka-Takada N.* (*co-first authorship), Sato R. *et al.*, Enhancement of cell wall protein SRPP expression during emergent root hair development in *Arabidopsis*. *Plant Signaling & Behavior*. 12, 10, e1368940 (2017).
(4) Uno H.,* Tanaka-Takada N.* (*co-first authorship), Hattori M. *et al.*, Physiological role of a cell-wall protein SRPP in *Arabidopsis* seed maturation. *J. Plant Research*, 132: 145-154. (2019).

Degenerations in Infinite Dimensional Teichmüller Spaces

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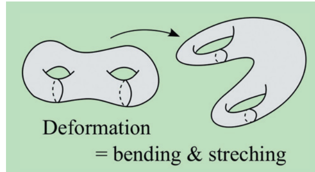
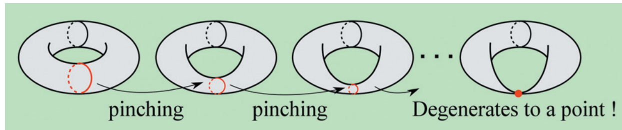
INTRODUCTION

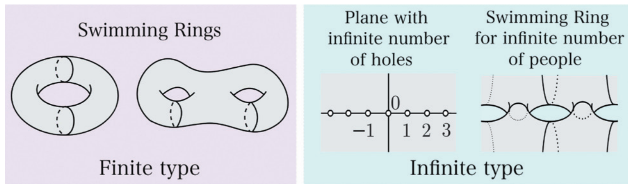
I am Hiroki FUJINO, YLC designated assistant professor for this academic year. My research is in the field of mathematics, including function theory, complex analysis, metric geometry and similar fields. I am currently particularly interested in the degeneration of surfaces (more precisely, Riemann surfaces) in so-called Teichmüller spaces. Inside Teichmüller spaces, surfaces can be stretched and bent. Thus, surfaces generally degenerate into "surface-like objects" near the boundaries of the Teichmüller spaces, as shown in the following diagram. When we consider infinite dimensional Teichmüller spaces, we can easily find many kinds of (strange) degenerations besides the above. I am studying these kinds of degeneration so that we will be able to deal with them logically and quantitatively.





RIEMANN SURFACES

A *Riemann surface* can roughly be described as a two-dimensional space where the concept of an "angle" exists. For example, a sphere (like the surface of the earth) is a Riemann surface. In mathematics, Riemann surfaces are defined as connected one-dimensional complex manifolds. This definition first appeared in H. Weyl's textbook in 1913. Since then (or from earlier, according to another definition), Riemann surfaces have been studied as an important concept in several fields of mathematics. Riemann surfaces are divided into two classes: finite-type and infinite-type. Although I will not explain how to classify Riemann surfaces here, as an example, a sphere is classified as a *finite-type* (see the figure below for further examples).



QUASICONFORMAL DEFORMATIONS

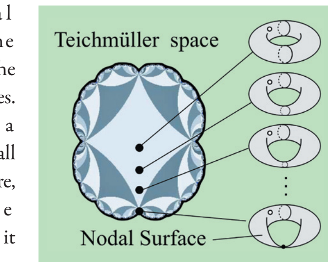
Next, let us consider deformations of Riemann surfaces. Easy ways to deform a Riemann surface are by stretching and bending. Among such deformations, *quasiconformal deformations* are important. Quasiconformal deformations are kinds of stretching and bending that do not change the angles too much. Because of this characteristic, they have the convenient properties of differentiability almost everywhere, absolute continuity and no overly-large changes in their conformal invariants. However, this feature makes it difficult to determine intuitively whether a given deformation is quasiconformal or not.

TEICHMÜLLER SPACES

In the theory of Riemann surfaces, one of the most significant problems is the *Riemann moduli problem*. This problem asks us, "How many Riemann surfaces can be obtained by deforming a given Riemann surface?" This problem has already been solved in several ways, but it was the Teichmüller theory that answered the problem rigorously and brilliantly. For a given Riemann surface, its *Teichmüller space* is defined as the space containing all quasiconformal deformations. For a swim ring in which g people can fit, the (complex) dimension of its Teichmüller space is 3g-3.

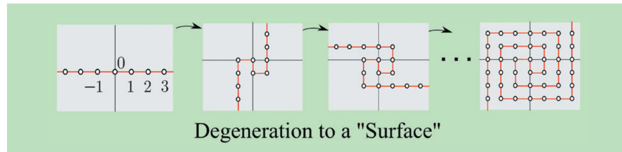
DEGENERATIONS

When quasiconformal deformations come closer to the boundary of the Teichmüller space, the Riemann surface gradually degenerates. C. McMullen proved that, for a finite-type Riemann surface, almost all degenerations are nodal surfaces. (Here, "almost all" is NOT in the mathematical sense. Mathematically, it is correct to say that nodal surfaces are "dense" at the boundary.) A nodal surface is a kind of surface-like object, and is certainly not a Riemann surface by definition (see the figure on the right).



Conversely, for some infinite-type Riemann surfaces, we can observe strange degenerations. For example, the following figure shows a degeneration that cannot occur in the case of a finite-type surface. The feature of this degeneration is that the degeneration surface is exactly a Riemann surface! You might think, "Should we call this a degeneration?" However, we can certainly prove that there is no quasiconformal deformation from the initial surface to the degeneration surface (Ref. [1]). Of course, many strange degeneration phenomena can be found besides this if we look at other infinite-type Riemann surfaces (Ref. [2]).

Understanding degeneration phenomena is one of the most important problems in the deformation theory of Riemann surfaces. From the above observations, the problem appears to be very complicated, but also interesting.



References

(1) H. Fujino, "The existence of quasiconformal homeomorphism between planes with countable marked points," *Kodai Math. J.* 38. 732-746 (2015).
(2) H. Fujino, "Quasisymmetric embedding of the integer set and its quasiconformal extension," *Ann. Acad. Sci. Finn. Math.* 42, 575-584 (2017).

Direct Dark Matter Search With XENON

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INDIRECT EVIDENCE FOR DARK MATTER

Everything we can observe on the Earth consists of ordinary matter. However, astronomical and cosmological observations at various scales strongly indicate that there must exist another kind of matter in the Universe. It is not composed of particles that we know of so far and does not emit any radiation. Therefore, we cannot directly observe it, and it has thus been named "dark matter." Nevertheless, dark matter particles have a finite mass and form large structures in the Universe. We can observe the gravitational effects of dark matter in the dynamics of galaxies and galaxy clusters, as well as in gravitational lensing measurements. Observation of the cosmic microwave background suggests that there should be about five times more dark matter than ordinary matter. Despite the huge amount of dark matter, we still do not know what it is made of. One of the most promising theories, supersymmetry (SUSY), suggests that dark matter consists of weakly interacting massive particles (WIMPs), which have masses comparable to atomic nuclei. Such particles could have a non-zero interaction cross-section with ordinary matter. Since dark matter is believed to exist everywhere throughout our galaxy and constantly pass through the Earth, we can observe such interactions in detectors specifically designed to identify the nature of dark matter.

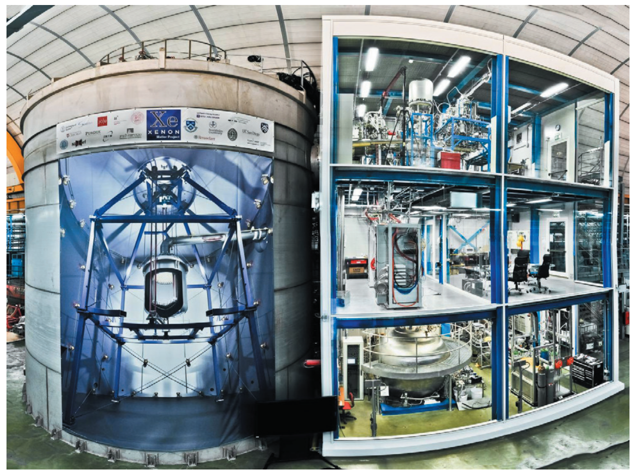

Figure 1: XENON1T facility in the underground hall of Laboratori Nazionali del Gran Sasso (LNGS). The building on the right houses various auxiliary systems. The cryostat containing the liquid xenon is located inside the large water tank on the left, next to the building. (Credit: Roberto Corrieri and Patrick De Perio)

SEARCH FOR DARK MATTER WITH LIQUID XENON

The XENON experiment is a program for the direct detection of dark matter that uses liquid xenon as a detector medium. XENON collaboration involves nearly 170 researchers from the Japan, the US, Germany, Italy, Switzerland, Portugal, France, the Netherlands, Israel, Sweden and the United Arab Emirates. The XENON experiment aims at detecting the tiny amount of charge and light that is emitted after the interaction of a dark matter particle with a xenon nucleus. The goal of the experiment is to achieve a sensitivity to very small cross sections predicted by the cosmological observations and theories beyond the Standard Model of particle physics such as SUSY. The current detector, XENON1T [1], has been installed underground at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy (see Figure 1). XENON1T, with its 3.6 tons of xenon, of which two tons are in the active part of the detector, allowed the sensitivity to be lowered to levels never explored so far (see Figure 2), becoming the most sensitive detector in the world for dark matter hunting [2, 3]. This success has been made possible thanks to the significant care put into efficiently reducing most of the sources of background noise that could mimic a dark matter signal, including those that may be produced by the detector itself.

FUTURE PROSPECTS FOR DARK MATTER SEARCH

The next phase of the XENON project, called XENONnT, foresees an upgrade of the current detector with the aim of extending the sensitivity of the experiment by a factor of 10. Such a performance can be realized by increasing the size of the target medium (to around 8.4 tons of xenon) and a stronger reduction of the background. The main contribution of our group consists of the construction of a purification system for liquid xenon, veto systems for the neutron background and analysis of the acquired data. These systems will play important roles in achieving the designed sensitivity (see Figure 2), and the construction of these systems is now underway to start operation in 2019.

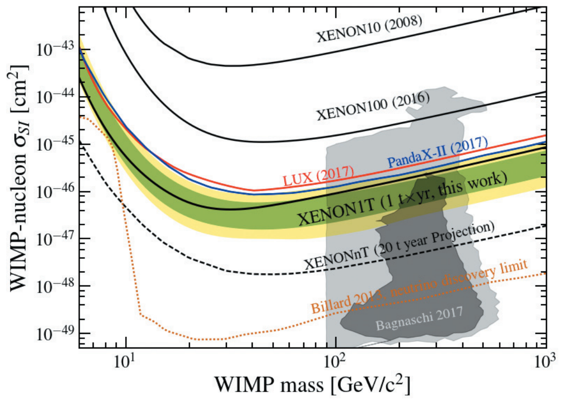

Figure 2: Constraint on the interaction cross-section between dark matter particles and nuclei from the XENON1T experiment. Expected sensitivity of the XENONnT experiment is also shown.

References

(1) E. Aprile *et al.*, The XENON1T Dark Matter Experiment, *Eur. Phys. J. C* (2017) 77: 881, 2017.
(2) E. Aprile *et al.*, First Dark Matter Search Results from the XENON1T Experiment, *Phys. Rev. Lett.* 119, 181301, 2017.
(3) E. Aprile *et al.*, Dark Matter Search Results from a One Ton-Year Exposure of XENON1T, *Phys. Rev. Lett.* 121, 111302, 2018.

Searching for New Physics through Precision Flavor Physics

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CP VIOLATION

Have you ever heard of "*CP* violation"? Some readers may have heard this phrase ten years ago. Makoto Kobayashi and Toshihide Maskawa were awarded the Nobel Prize in Physics in 2008 for establishing the Kobayashi-Maskawa theory: They discovered the origin of a violation of *CP* symmetry (*CP* violation) and predicted the 3rd generation of quarks. This theory has been confirmed in many different Hadron-Collider experiments and B-factory experiments. Eventually, this theory became one of the most important pieces of the Standard Model in particle physics.

The figure shows *CP* symmetry in particle physics as a combination of two different types of symmetry; charge conjugation (*C*) symmetry and parity (*P*) symmetry. *CP* symmetry roughly corresponds to matter-antimatter symmetry. A violation of *CP* symmetry, therefore, produces matter-antimatter asymmetry. *CP* violation plays an important role in our world; for instance, unlike matter, anti-matter is very rare.

BEYOND THE STANDARD MODEL

The Standard Model of particle physics is known to be incomplete in the light of cosmological observations: deficits of dark matter component and in matter-antimatter asymmetry. An extension of the Standard Model is therefore essential.

One main strategy for probing physics beyond the Standard Model is precision measurements of the properties of Standard Model particles, which can reveal new physics contributions through radiative corrections. These measurements often have the potential to explore new physics beyond the reach of the Large Hadron Collider.

FLAVOR PHYSICS

In particle physics, the term "flavor" is used to describe species of quarks and leptons. The Standard Model contains six flavors of quarks: up (u), down (d), strange (s), charm (c), bottom (b) and top (t) quarks. Precision measurement of the flavor-changing processes is called flavor physics. Flavor physics, especially utilizing *CP* violation and/or flavor-changing neutral currents, is remarkably useful in the search for new physics. The former involves precisely comparing the decay contents of antimatter to those of matter. The latter represents flavor-changing processes that keep their electromagnetic charges, like $b \to s$, $t \to c$, and $s \to d$. *CP*-violating processes and flavor-changing neutral currents are strongly suppressed in the Standard Model, but they are not suppressed in new physics scenarios in general. Therefore, their precision measurements are particularly promising in the search for new physics.

KAON PHYSICS

A quark and an antiquark bound together form what is called a meson. A s quark and a light quark (u or d) bound together are called a kaon (or K meson). The kaon possesses an interesting feature: the neutral kaon and the anti-neutral kaon oscillate between each other, and their linear combinations produce two different physical states (a long-lived kaon K_L and a short-lived kaon K_S). Applying this feature, the first *CP* violation was discovered in $K_L \to \pi\pi$ decay in 1964. Even today, this measurement gives one of the best sensitivity to new physics at high-energy scales.

A direct *CP* violation in the $K_L \to \pi\pi$ decay, represented by ε', which is different observable from discovered one in 1964, has attracted attention after the first lattice QCD calculation was conducted in 2015. High theoretical precision in the Standard Model is crucial for probing the footprints of new physics. In Ref. [1], we improved the Standard Model prediction of ε' and concluded that the prediction is 2.8σ below the experimental data. We also found that this discrepancy can be explained naturally in the minimal supersymmetric model that is one of the promising new physics scenarios.

Other interesting channels in kaon rare decays are $K_S \to \mu^+\mu^-$ and $K_L \to \pi^0 \nu\bar{\nu}$. In Ref. [2], we discovered that a new *CP* violation could be observed in $K_S \to \mu^+\mu^-$ decay. $K_L \to \pi^0 \nu\bar{\nu}$ emerges from a pure *CP*-violating contribution. Once these channels are observed, their measurements help to search for new physics in the future [3].

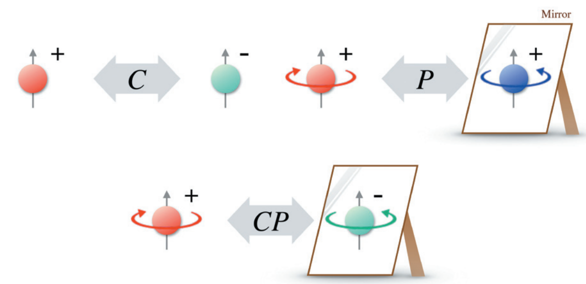


Figure: Image of the *CP* transformation. The charge conjugation transformation reverses the particle' s charge. The parity transformation corresponds to a mirror reflection. The *CP* transformation is their combination.

B PHYSICS

Precision measurements of *B*-meson decays are also very important for probing new physics. Many physicists are continuing their great efforts. We improved one of the Standard Model predictions for *B*-meson semileptonic decays [4]. It is expected that the Belle II experiment at KEK, which is designed to achieve a world-record collider luminosity, will bring enormous and remarkable achievements in the near future.

References

(1) Kitahara T., Nierste U., Tremper P., Supersymmetric explanation of CP violation in $K \to \pi\pi$ decays. *Phys. Rev. Lett.* 117, no. 9, 091802 (2016); Singularity-free next-to-leading order ΔS=1 RGE and ε'/ε in the Standard Model and beyond. *JHEP*. 1612, 078 (2016).
(2) D'Ambrosio G., Kitahara T., Direct *CP* violation in $K \to \mu^+\mu^-$ *Phys. Rev. Lett.* 119, no. 20, 201802 (2017).
(3) Endo M., Goto T., Kitahara T., Mishima S., Ueda D., Yamamoto K., Gluino-mediated electroweak penguin with flavor-violating trilinear couplings. *JHEP*. 1804, 019 (2018).
(4) de Boer S., Kitahara T., Nisandzic I., Soft-photon corrections to $B \to D\tau\bar{\nu}$ relative to $B \to D\mu\bar{\nu}$. *Phys. Rev. Lett.* 120, no. 26, 261804 (2018).

IAR Core Faculty Committee

The IAR Core Faculty Committee is composed of the Institute Director, Deputy Directors, Full-Time Faculty Members, and member of the clerical staff, who promote the Institute's activities, and make proposals to the IAR Committee.

Yoshiyuki SUTO
Director

Affiliation : Director of Nagoya IAR/ Professor of the Graduate School of Humanities
Research Interests : Ancient Greek History

Research Project

My research interests include Aegean Archaeology, Ancient Greek History, and especially the study of contact and interaction between Greek and Egyptian culture in the Hellenistic period. As a member of Akoris Archaeological Project I have been working in Middle Egypt for the purpose of elucidating the history of local society under the Ptolemaic rule.

Hitoshi SAKAKIBARA
Deputy Director

Affiliation : Deputy Director of Nagoya IAR/ Professor of the Graduate School of Bioagricultural Sciences
Research Interests : Molecular Plant Physiology, Phytohormone

Research Project

My research interest is to understand how plants manage their growth and development under abiotic stress conditions, such as nitrogen limitation. Plant orchestrates a number of cues including phytohormone actions and metabolic responses to coordinate its development and metabolism at a whole-body level. I am studying molecular basis of this topic with focusing on nitrogen-dependent regulation of phytohormone biosynthesis and signaling.

Ichiro TERASAKI
Deputy Director

Affiliation : Deputy Director of Nagoya IAR/ Professor of the Graduate School of Science
Research Interests : condensed matter physics (experiment)

Research Project

Ichiro Terasaki synthesizes new materials, investigates their transport and magnetic properties, and develops functions hidden there. His major research activity has been devoted to the thermoelectric properties of transition-metal oxides including the layered cobalt oxides, and recently extended to giant nonlinear conduction in strongly correlated systems such as conducting organic salts and layered ruthenates. His recent interest extends to exotic magnetic materials such as room-temperature ferromagnetic semiconductors and spin-liquid candidates.

Hiroko TAKEDA
Deputy Director

Affiliation : Deputy Director of Nagoya IAR/ Professor of the Centre for Asian Legal Exchange
Research Interests : Political Sociology, Politics

Research Project

My research can be mapped out in an intersection of the following three major elements; political sociology, gender and Japan/UK. Political Sociology is my disciplinary background. In particular, I developed a keen interest in the studies on governmentality. As for gender, I have long been interested in gender issues and the core of academic questions that I have continuously explored in my extant work--the ways in which the world of the everyday life is linked with the state system --was formulated as an outcome of my effort to examine gender issues with reference to governmentality. Finally, Japan has been my primary source of case studies and recently, I also started to explore the British cases.

Yukinori KAWAE
Full-Time Faculty

Affiliation : Associate Professor at Nagoya IAR
Research Interests : Egyptian Archaeology, Pyramid, 3D Survey

Research Project

My research interests lie in the field of Egyptian archaeology, particularly in 3D surveys of ancient megalithic structures and excavations of ancient settlements. My academic career started the excavation of the Lost City of the Pyramids at Giza. Soon after the introduction of 3D technology in Egyptian archaeology, I began conducting an interdisciplinary research project to complete 3D surveys of pyramids. Recently, I expanded the collaborative research to include a television production company as Open Innovation Project. My use of 3D data challenges the unprecedented empirical analysis approach to understanding the mystery of the pyramids' construction.

Miki KAWACHI
Full-Time Faculty

Affiliation : Associate Professor at Nagoya IAR
Research Interests : Plant Physiology, Zinc Biology

Research Project

My research mainly concerns the transport of micro-nutrients in living organisms. All organisms need elements like zinc or manganese in very minute amounts, however, even a small excesses can be harmful. Specialized transport proteins are the principal means of nutrient movement within and between cells. I am interested in the structure of those proteins and how structural differences might affect their function. I am working with diverse model organisms ranging from microbes to all the way to fruit trees.

Atsushi J. NISHIZAWA
Full-Time Faculty

Affiliation : Designated Lecturer at Nagoya IAR
Research Interests : Observational Cosmology, Astronomy

Research Project

My research interest ranges from theoretical aspects of cosmological model that explains accelerating expansion of the Universe, to the theory of galaxy formation. To reveal such problems in the Universe, large astronomical data obtained by telescope is used. Recently I am working on the photometric redshift that determines the distance to galaxies. The redshift of galaxies are of particular importance for doing both cosmology and astronomy. I am also interested in the methods of data analysis including machine learning.

IAR PEOPLE | IAR Core Faculty Committee

IAR Visiting Professor & Designated Professor

Takaho ANDO
Visiting Professor

Affiliation : Visiting Professor at Nagoya IAR/ Professor at Chubu University
Research Interests : Hiistory of Social Thoughts

Research Project

Research on History of Social Thoughts, especially on French Enlightenment and Liberalism.

Dapeng CAI
Visiting Associate Professor

Affiliation : Visiting Associate Professor at Nagoya IAR/ Associate Prodessor at Nanzan University
Research Interests : International Economics

Research Project

An increasing number of challenges facing humanity today, such as the reduction of the emission of the greenhouse gases, or the protection of global commons, all require intensive cooperation by many countries. My research aims at analyzing the international negotiation processes that are underlying the formation of the needed international cooperation. Besides the issue of emission reductions, I also examine other issues that require international negotiations - in particular, those between the North and the South - such as the protection of intellectual property rights, as well as the setting of investment rules or production standards.

Takaki HAYASHI
Designated Professor

Affiliation : Designated Professor at Nagoya IAR / Nagoya University Global Science Campus Cordinator

YLC Program Faculty

YLC Faculty members are promising young researchers recruited under the Nagoya University Young Leaders Cultivation Program (YLC Program).

Chuan XIAO
Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Information Science
Research Interests : Databases

Research Project

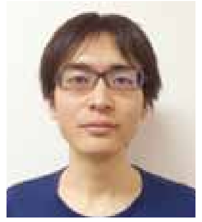
Chuan Xiao's research interests center around query processing and optimization in database systems and novel data management applications, including data cleaning, data integration, textual databases, graph databases, and spatial databases.

Itaru KUSHIMA
Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Medicine
Research Interests : Psychiatric genetics

Research Project

My research interest is to identify rare genetic variants associated with risk for mental disorders (schizophrenia, autism spectrum disorder, and bipolar disorder) and to develop biomarkers and novel therapeutics for these conditions.



Kunihiro MORISHIMA
Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Ecotopia Science Institute/ PRESTO Researcher, JST
Research Interests : Particle and Astrophysical Science

Research Project

I'm developing nuclear emulsion technologies which can detect fundamental particles with sub-micro metric accuracy in three dimension from the point of fundamental and applied physics. Especially, current main theme is the development of cosmic-ray muon tomography with nuclear emulsions and its applications. Until now, I applied the technology to take image of inner structure of melted core at Fukushima Daiichi Nuclear Power Plant No.2. In 2017, I applied them to investigate the Great Pyramid at Cairo and discovered the unknown big void near the center and entrance.

Takuya MATSUMOTO
Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Mathematics
Research Interests : Mathematical Physics

Research Project

I am interested in the mathematical understanding of the physical models. Recently, I am working for the two-dimensional conformal field theories, which is relating to the various notions of the modern mathematics such as the quantum groups with the deformation parameters at the root of unity and the symmetric polynomials, so called the Jack polynomials. The representation theoretical point of view, this is a non-semisimple generalization of the celebrated BPZ minimal models.

IAR Steering Committee

The IAR Steering Committee plan, discuss, and decide on the Institute's academic activities.

Masahide TAKAHASHI
Steering Committee

Affiliation : Trustee and Vice President of Nagoya University/ Professor of the Graduate School of Medicine
Research Interests : Experimental Pathology, Tumor Biology

Research Project

Our group has been studying the molecular mechanisms of cancer development and invasion. In particular, We are focusing on the roles of Ret oncogene and Girdin family genes in cancer cells. We are also studying the roles of these genes in organogenesis including the development of the nervous system.

Mitsuru SUGIMOTO
Steering Committee

Affiliation : Professor of the Graduate School of Mathematics
Research Interests : Partial differential equations

Research Project

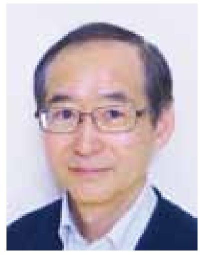
Various phenomena of nature can be treated mathematically by describing them in the language of partial differential equations (PDE). Through the analysis, I aim to extract new principles which comprehend concrete phenomena. As a methodology of PDE, many properties of the solutions to PDE can be deduced from their characteristics, and I employ this idea to investigate quantitative properties of solutions like size, regularity, and so on. Simultaneously I proceed with the study of Fourier analysis as an important tool for such analysis.

Testuya OKAJIMA
Steering Committee

Affiliation : Professor of the Graduate School of Medicine
Research Interests : Biochemistry, Glycobiology

Research Project

My research has focused on biochemical and biological analyses of O-glycan modification on glycoproteins. Previous studies revealed that unique glycans such as O-fucose and O-GlcNAc regulate Notch signaling and Notch-dependent biological processes. Currently, I am investigating how O-glycan modification is coordinated to fine-tune Notch signal strength essential for developmental control and homeostasis. Given that Notch signaling pathway is associated with many human diseases, elucidation of molecular mechanisms how O-glycans control Notch activity will be of great pharmaceutical interest.



Takahiro SEKI
Steering Committee

Affiliation : Professor of the Graduate School of Engineering/Director of Center for the Studies of Higher Education
Research Interests : Photoresponsive polymer thin films

Research Project

Photoresponsive organic and polymeric materials are attracting much attention due to great potential in next-generation photonics technologies. My major research interest is to study photoresponsive (mostly photochromic) thin films of polymeric liquid crystals. The alignment control of liquid crystal that is essential in liquid crystal photonics can be achieved by irradiation with linearly polarized light to the surface photoresponisive layer on a substrate or a free surface. Based on this phenomenon, we are extending the possibilities of photoalignment process for orientation control of various functional materials.

Yoshinobu BABA
Steering Committee

Affiliation : Professor of the Graduate School of Engineering/ Director of Institute of Nano-Life-Systems
Research Interests : nanobioscience, biomedical engineering

Research Project

The research efforts in my laboratory have been focused on the development of nanobiodevices for biomedical applications and healthcare, including single cancer cell diagnosis for cancer metastasis, circulating tumor cell (CTC) detection by microfluidic devices, nanopillar devices for ultrafast analysis of genomic DNA and microRNA, nanopore devices for single DNA and microRNA sequencing, nanowire devices for exosome analysis, single-molecular epigenetic analysis, AI-powered nano-IoT sensors, quantum switching *intra vital* imaging of iPS cells and stem cells, and quantum technology-based cancer theranostics.

Sayaka OKI
Steering Committee

Affiliation : Professor of the Graduate School of Economics
Research Interests : History of Science and Technology

Research Project

History of Science in the 17-18th century of France, especially on the relationship between the government and academic institutions of science; Concept of "Economy" and its relationship with natural sciences in the latter half of the 18th century

IAR PEOPLE | IAR Steering Committee

Akira ICHIKAWA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Letters
Research Interests : Mesoamerican archaeology

Research Project

Ichikawa Akira is an archaeologist. His research centers on the interactions in Prehispanic Southeastern Mesoamerica, from a long-term perspective, the correlation between natural disasters (especially volcanic eruption) and human society, and community-based archaeological practices. He is currently director of the San Andrés and Cara Sucia archaeological projects. This project examines the social process of Southeastern Mesoamerica (actually El Salvador) in different environmental settings from the Preclassic to the Postclassic period (ca. 600 B.C. - A.D. 1200) and clarifies the dating of the gigantic eruption of Ilopango and its impact on the ancient society.

Sachiko KUROYANAGI

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Interests : Cosmology with gravitational waves

Research Project

Einstein's general relativity predicts propagation of space-time distortion, which is called "Gravitational waves". The detection was finally made by Advanced-LIGO on September 14, 2015, 100 years after the general relativity was published. One of the important benefits of analyzing GWs is that they carry "clean" information, since they interact with matter very weakly. This property allows us to directly observe the very early Universe. I make theoretical predictions to extract information on the origin and history of the Universe using future gravitational wave experiments. I am also extending my research to include development of data analysis technique for upcoming experiments.

Hidetoshi SANO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Interests : Radio Astronomy, High-Energy Astrophysics

Research Project

To understand high-mass stars from birth to death is essential in exploring the origin of galaxies and human beings. Strong UV radiation from high-mass stars promotes the galaxy evolution. A supernova explosion that signals the death of high-mass star ejects various elements into the interstellar space, which is a process to produce elements consisting our bodies. Moreover, shock waves from the explosion generate high-energy particles filling the interstellar space, so-called cosmic-rays. My research themes are to explore the formation mechanism of high-mass stars and the origin of cosmic-rays by analyzing the astronomical data taken at multi-wavelengths.

Mana KANO-NAKATA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Bioagricultural Sciences
Research Interests : Crop Production Science

Research Project

About one third of the world's rice production areas is rainfed lowland rice ecosystem, which is fully dependent on rains. Rice production in rainfed lowland areas is constrained by water stresses such as drought and soil moisture fluctuations. Therefore, development of better adapted cultivars to water stress is an urgent subject.The aim of this study is to identify the key traits and their quantitative trait loci (QTLs) related to water stress adaptation with special emphases on root development and functions, and to evaluate the genotype x environment (GxE) interactions in rice.

Takahiro HORIBE

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Engineering
Research Interests : Organic Chemistry, Development of Catalyst

Research Project

Dr. Takahiro Horibe specializes in organic chemistry, and organometallic chemistry. He is particularly interested in the development of novel catalyses for increasing process efficiency, controlling reaction selectivity, and reducing byproducts in organic reaction. Merging metal catalysts and charge transfer interaction, he is developing novel catalysts for novel reaction and anomalous selectivity.

Chun LI

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Interests : Molecular biology

Research Project

Study of axon regeneration is crucial for developing methods to restore the severed axons caused by accidents or surgeries. Caenorhabditis elegans has recently emerged as a tractable model for studying regenerative responses in neurons. Recent studies using C. elegans have revealed that JNK and p38 MAP kinase (MAPK) pathways are important for axon regeneration. I have been demonstrated that the C. elegans SVH-1 growth factor and its receptor, SVH-2 tyrosine kinase, regulate axon regeneration via the JNK MAPK pathway. Now I aimed to investigate the upstream and downstream factors of these pathways to understand how these pathways are activated and how they regulate axon regeneration.

Tomohiro ABE

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Kobayashi Maskawa Institute (KMI)
Research Interests : elementary particle physics

Research Project

My interest lies in physics beyond the standard model of elementary particles. One of my research topics is the muon anomalous magnetic moment that shows a discrepancy between the standard model prediction and the observed value. This discrepancy implies the existence of new particles coupling to muon. I have completed analyzing a model with new leptophilic particles as a solution of this anomaly. I also have been working on models for dark matter and the origin of the Higgs potential with focusing on various ongoing and planned experiments in future.

Shingo KOBAYASHI

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Engineering
Research Interests : Condensed matter physics (theory)

Research Project

Several interesting physical phenomena emerge in solids due to many-body effects of electrons. During recent years, I have studied the physical properties of electrons with a non-trivial topological number in solids, which lead to new physical phenomena beyond the conventional condensed matter physics. Here, the concept of topological invariants is introduced from topology in mathematics. In three decades ago, the integer quantum Hall effect was discovered as an example that the topology of electrons plays an important role. Triggered by the discovery of topological insulators in 2000s, topology has become a new guiding principle in condensed matter physics.

Masaru TAKEUCHI

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Engineering
Research Interests : Micro-nano manipulation

Research Project

My research interests are micro-nano manipulation, microfluidics and optoelectronic devices for biological applications. Especially, developments of small devices for three dimensional assembly of cell structures using self-assembly process has been conducted. Micromanipulation devices using solid-liquid phase change were also developed to handle single cells, or actuate small amount of liquid. The assembled 3D cell structures by the developed devices will be used as in vitro models of our organs.

Mio HORIE

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Letters
Research Interests : Anthropology, Area Studies

Research Project

Since the Open-Door Policy, China's economic growth has brought new domestic population flow. The developed coastal area has attracted many people from rural area because of widening regional economic gap, both labor migration and women's chain-marriage migration from the peripheral area to the developed area is remarkable. The current population flow is one of the cross points of several issues which is important to understand modern China society. I focus on such changing mobility from one of the ethnic group named Lahu who lives in southwestern China border and discuss how such population flow has changed the local way of life.

Kazuhide SATO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Medicine
Research Interests : Respiratory Medicine, Oncology

Research Project

Lung cancer is the most common cause of cancer-related deaths, and the cure rate of lung cancer is still under 20%, therefore, there is urgent need for new treatments. I aim to develop new innovative cancer therapy with a concept "less toxic, more anti-tumor effect". Along with different approaches from conventional cancer therapies, I have been studying about photo-activated cancer therapy in order to destroy only cancer cells inside body. I would like to develop new technologies that could cause effects only on the cancers with a multidisciplined approach.

Tsutomu FUKUDA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Interests : Particle Physics, Astrophysics

Research Project

A fundamental particle "neutrino" is a key for revealing the origin of the matter dominated universe. I have carried out accelerator based neutrino experiments with nuclear emulsion detector. So far we provided the final evidence of nu_mu -> nu_tau neutrino oscillation with tau neutrino appearance in a muon neutrino beam from CERN in the OPERA experiment. Then I have established and am promoting a new experimental project (NINJA Experiment) to measure neutrino interactions precisely at J-PARC as the PI. Precise measurement of neutrino-nucleus interactions is essential for observing the neutrino-CP violation which is an important hint for matter-antimatter asymmetry in our universe.

Yuri FUJII

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Interests : Astropysics, Planetary Science

Research Project

Planets are thought to form in disks around young stars. Recent observation results show wide variety of the disks, and we need to study their dynamical evolution to understand the variety. Magnetic field is thought to play an important role in the disk evolution. We need to solve chemical reactions in a disk to determine the ionization degree because it governs the interaction between the disk gas and the magnetic field. I perform magnetohydrodynamical (MHD) simulations with ionization chemistry. Satellites are thought to form in a gaseous disk appears around a newly-born planet. In order to understand the origin of satellites, I also work on the formation and evolution of circumplanetary disks.

Hidenori TAKEUCHI

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Institute of Transformative Bio-Molecules (ITbM)
Research Interests : Molecular biology in plant reproduction

Research Project

Fertilization between male and female gametes of the same species is fundamental for seed production and species maintenance in higher plants. My research interests are in species-specific male-female recognition mechanisms, including prezygotic pollen tube guidance and postzygotic chromosome maintenance. I will especially try to identify key factors involved in these processes. I finally aim to understand the species-specific mechanisms in plant reproduction, which could lead to technologies for generating useful hybrid plants.

Henrik BACHMANN

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Mathematics
Research Interests : Number theory

Research Project

I am interested in various subjects related to the theory of multiple zeta values and modular forms. In particular I am studying multiple Eisenstein series, which can be seen as a mixture between classical Eisenstein series and multiple zeta values. These objects also have a connection to q-analogues of multiple zeta values and I am interested in their algebraic structure and connection to other areas in mathematics such as enumerative geometry and combinatorics.

Hironao MITATAKE

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Interests : Cosmology, Weak Gravitational Lensing

Research Project

My research interests lie in observational cosmology. Cosmic acceleration discovered in the late 1990s is one of the most mysterious phenomena in physics and astronomy, which indicates the existence of dark energy or the modification to general relativity. I have been working on exploiting weak lensing observables, the subtle distortion in the shapes of distant galaxies due to massive foreground structures, to extract the nature of cosmic acceleration from big imaging data taken by Hyper Suprime-Cam (HSC) at the Subaru Telescope. I am also involved in upcoming international galaxy surveys such as Large Synoptic Survey Telescope (LSST) and NASA's Wide Field Infrared Survey Telescope (WFIRST).

IAR PEOPLE | YLC Program Faculty

Shingo KAZAMA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Kobayashi-Maskawa Institute (KMI)
Research Interests : Particle Physics, Astroparticle Physics

Research Project

Despite the overwhelming evidence for dark matter from astronomical and cosmological indications at various scales, a clear evidence of a particle which explains these observations remains absent. I'm involved in the XENON project to search for the low-energy interactions of galactic dark matter with nuclei. The XENON collaboration has built the XENON1T detector, the most sensitive detector ever built, but no clear evidences of dark matter have been found. We are currently upgrading the XENON1T detector by enlarging the target xenon mass from 2 to 6 tonnes. The new experiment will start its operation in 2019, and this will allows us to explore promising parameter spaces towards a first discovery.

Yukiko KAWAMOTO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Humanities
Research Interests : Ancient History, Classics

Research Project

My research has focused on Roman architectural, cultural, and social history, using textual and archaeological evidence. My research project explores the designs of Roman gardens and how they influenced later European gardens. It is believed that Roman gardens are the origin of formal gardens adorned with clipped trees (topiary) and plants arranged in geometrical patterns (e.g. Versailles). However, both archaeological and textual evidence show that Roman gardens seem to have aimed at a natural appearance. This project examines various types of evidence and explores how the Roman gardens looked, and why people have started to consider Roman gardens to be the origin of formal gardens.

Teppei KITAHARA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Kobayashi-Maskawa Institute (KMI)
Research Interests : High energy physics, Flavor physics

Research Project

I am interested in searching for physics beyond the standard model through precision measurements of the properties of standard model particles, and especially my main focus is on flavor physics. I am going to improve the standard model predictions of B-meson decays and also investigate CP violation in rare kaon decays. I am broadly interested in testable physics of various experiments, and I hope to stimulate interactions between theory and experiment.

Yuki SATO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Interests : Quantum gravity

Research Project

Modern physics incorporates Einstein's general relativity and quantum mechanics. The former associates gravity with the bending of spacetime, and the latter explains characteristic properties of matters at short distances. According to general relativity, the spacetime curves due to the existence of matters, and matters indicate quantum characteristics at short distances. Therefore, gravity is supposed to show quantum mechanical effects, and those effects would become important around the Planck scale. The theory that describes quantum effects of gravity, quantum gravity, is my field of research. I mainly study discrete approaches to quantum gravity.

IAR PEOPLE | YLC Program Faculty

Natsuki TAKADA-TANAKA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Bioagricultural Sciences
Research Interests : Plant Molecular Physiology, Biochemistry

Research Project

Plants live in a frequently changing environment from which they cannot escape and have signaling mechanisms to adapt to new conditions. Calcium, lipid and protein are involved in the signaling pathways. However, limited information on signal transduction between different signaling systems is available. I focus on a new type signal transducer PCaP1 which can convert Ca^{2+} signal to phospholipid signal on plasma membrane. Thus I investigate PCaP1-related physiological processes, such as stomata closure and root hydrotropism, to reveal a novel mechanism to adapt a new environmental conditions.

Yongchao CHENG

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Humanities
Research Interests : International Relations of East Asia

Research Project

By putting Joseon Korea as a mediator between Tokugawa Japan and Ming - Qing China, which have not established formal diplomatic relation in 17th- 19th centuries, I demonstrate and empirically analyze, that China and Japan had mediated political connections, aiming to rebuild the history of East Asia by using the approach of global history. Instead of just adding up of several bilateral relations, such as Japan- Korea and Korea- China, I am putting the historical pieces scattered in Chinese, Japanese, Korean documents together and confronting simultaneously the trilateral relation of countries, to illuminate the entanglements and interactions among early-modern East Asian countries.

Hiroki FUJINO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Mathematics
Research Interests : complex analysis, function theory

Research Project

My research topic is on the global properties of the infinite dimensional Teichmuller spaces. In particular, I am mainly interested in degeneration phenomena of Riemann surfaces on the boundaries of the Teichmuller spaces. The Teichmuller space is a space which parametrizes all quasiconformal deformations of a given surface. If the given surface is of finite type, the degenerations to nodal surfaces appear as a dense subset of the boundary. However, in the case of infinite type surfaces, various degeneration phenomena are obtained besides the degenerations to nodal surfaces.

Soon-Ki Han

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Institute of Transformative Bio-Molecules (ITbM)
Research Interests : Plant stomata development

Research Project

Plant stomata are cellular valves surrounded by a pair of guard cells that impact plant growth, sustenance, and atmospheric environment. Stomatal stem cells are produced and transiently amplified on the leaf surface, and their stem cell activity is terminated before differentiation. I aim to understand the direct roles of transcription factors in a dynamic alteration of gene expression that is responsible for stomatal differentiation especially in maintenance and termination of stomatal lineage stem cells.

"From Study to Research - What is the career of a researcher?" [3rd] and "Academic fields without gender barriers - are there any academic fields relevant for boys or for girls?" [4th]. A report compiled by the participants can be read on the IAR website.

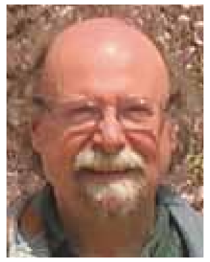
Dr. Noyori with participants

Foreign PI Fellowship Program

The Foreign Principal Investigator (PI) Fellowship Program is a program inviting excellent researchers from foreign countries with outstanding research achievements for a three to four months' fellowship, to promote the University's academic research. In academic year 2018, Dr. Jinmyon Lee (Director at Industry and Trade Analysis Division, Korea Institute for Industrial Economics & Trade. (KIET)), Dr. Shaker Meguid (Professor at University of Toronto) and Dr. Stephen Michael Playfer (Professor at The University of Edinburgh) were selected for this fellowship. While they were visiting Nagoya University, they discussed collaborative research with PIs in Nagoya University. Also, they contributed to the education of young researchers by giving advice and lectures. Dr. Lee gave a lecture "Recent Trends of Environmental Goods Agreement (EGA) and Korean Situation", Dr. Meguid gave a seminar "Multiscale Modeling of Multifunctional Nanocomposites: Opportunities and Challenges" and Dr. Playfer gave lectures "Matter antimatter asymmetries", "Evidence of Sterile Neutrino" and "Status and prospect for lepton universality violation at LHCb".

Dr. Lee

Dr. Meguid

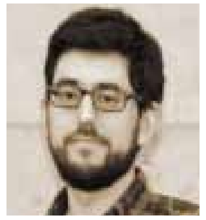


Dr. Playfer

Nagoya IAR, Short-term Fellowship Program

In order to facilitate international scientific cooperation, this program supports short research visits of overseas researchers (max. four weeks) including related activities such as holding a symposium. In academic year 2018, two proposals were selected for this program. One was from Dr. Hiroko Ito (Designated Associate Professor of Grad. Sch. of Law). She invited Dr. Shnaz Huda (Professor of School of Law, Dhaka University) and organized Dr Huda's lectures titled "Legal System and Protection of Women and Children in Bangladesh" and "Women's protection at home". The other proposal came from Dr. Bisei Ookawara (Associate Professor of Grad. Sch. of Medicine). She invited Dr. Sergio P. Acebrón (Independent group leader at Heidelberg University) for seminars titled "Post-translational roles of Wnt signaling" and "Career Talks for Young Researchers".

Dr. Shanaz Huda



Dr. Acebrón

2018 Young Leaders Cultivation Program

The Young Leaders Cultivation (YLC) Program, through which Nagoya University regularly and systematically recruits and trains young faculty members, is a strategic program based on the premise that it is important to secure an appropriate quantity and quality of young faculty members, in order to sustain the development of outstanding education and research in the future. In academic year 2018, Dr. Shingo Kazama (KMI), Dr. Yukiko Kawamoto (Grad. Sch. of Humanities), Dr. Yuki Sato (Grad. Sch. of Science), Dr. Natsuki Takada-Tanaka (Grad. Sch. of Bioagricultural Science), Dr. Yongchao Cheng (Grad. Sch. of Humanities), Dr. Hiroki Fujino (Grad. Sch. of Mathematics 2018), Dr. Soon-Ki HAN (Institute of Transformative Bio-Molecules) and Dr. Teppei Kitahara (Kobayashi-Maskawa Institute) were newly employed as designated assistant professors of the YLC program.

YLC Seminar

The 16th YLC seminar was held on May 29, 2018. Dr. Yukiko Kawamoto (YLC Assistant Professor of Nagoya IAR/ Grad. Sch. of Humanities) talked about "Roman Gardens and their Reception" and Dr. Shoichi Sato (Professor Emeritus of Nagoya University/ Academy member of Nagoya IAR) talked about "History of Civilization and World-Systems Theory". The 17th YLC seminar was held on December 25, 2018. Dr. Henrik Bachmann (YLC Assistant Professor of Nagoya IAR/ Dep. of Mathematics) talked about "Numbers, Infinite sums and multiple zeta values" and Dr. Tohohiro Abe (YLC Assistant Professor of Nagoya IAR/ KMI) talked about "Physics beyond the standard model of particle physics". The 18th YLC seminar was held on February 28. Former YLC faculty Dr. Mikio Kurita (Associate Professor of Grad. Sch. of Science, Kyoto University) and Dr. Sayuri Yoshida (Associate Professor of Dep. of Global Liberal Studies, Nanzan University) talked about how they worked when they were YLC assistant professors at Nagoya IAR.

The 19th YLC seminar was held on March 26, 2019. Dr. Chuan Xiao (YLC Assistant Professor of Nagoya IAR/ Grad. Sch. of Information Science) talked about "Data science, machine learning, and databases" and Dr. Takuya Matsumoto (YLC Assistant Professor of Nagoya IAR/ Grad. Sch. of Mathematics) talked about "Role of symmetries in mathematical physics".

The 17th YLC seminar

IAR Freshmen Lecture Series

Targeting freshmen of the University, this lecture series includes lectures delivered by members of the Academy, IAR Faculty members, IAR Fellows, and researchers of Nagoya University. It is aimed at communicating the fun of academic research. In academic year 2018, the following 14 lectures were given:

1. "Creating enzymes: The boundary of chemistry and biology"
Prof. Yoshito Watanabe (Grad. Sch. of Science/Vice President)

2. "The dark universe"
Prof. Naoshi Sugiyama (Grad. Sch. of Science/Deputy Director of Nagoya IAR)

3. "The laws of science and development"
Prof. Toshihide Maskawa
(Director of the Kobayashi Maskawa Institute, 2008 Nobel Laureate in Physics)

4. "Are chemically reacting molecules 'visible'?"
Prof. Akiyoshi Hishikawa (Research Center for Material Science)

5. "What is social justice?"
Prof. Hajime Wada (Grad. Sch. of Law, Deputy Director of Nagoya IAR)

6. "How to use contemporary economics"
Prof. Jiro Nemoto (Grad. Sch. of Economics)

7. "Fascination with an introduction to the history of thought"
Prof. Takaho Ando (Chuo University / Sixth Director of Nagoya IAR)

8. "Children in Islam: Different cultures seen from education"
Prof. Mina Hattori (Grad. Sch. of Education and Human Development)

9. "Present of Historical studies: from Object to Relations"
Prof. Yoshiyuki Suto (Grad. Sch. of Letter)

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INFORMATION | Activity & News

The Nagoya University Lecture 2018

The Nagoya University Lecture 2018, titled “2015 Nobel Prize in Physics Memorial Lecture” was held at the university’s Toyoda Auditorium on Friday, November 23, 2018, co-organized by Nagoya University and the Chunichi Shimbun. This lecture series is one of the most important lecture events organized by the university. It is designed, as a public lecture, to provide citizens with opportunities to learn state-of-the-art scientific knowledge from outstanding researchers in their respective academic disciplines. Lecturers are awarded the title “Nagoya University Lecturer”, the university’s most prestigious title, with a recognition plaque. This year, the lectureship was awarded to Dr. Takaaki Kajita, a director of the Institute for Cosmic Ray Research (ICRR), University of Tokyo, who won the Nobel prize in Physics 2015 for the discovery of neutrino oscillations, which proved that neutrinos have mass.

The 2018 Nagoya University Lecture began with an opening address by Nagoya University President Seiichi Matsuo. In the first half of the lecture session, Dr. Naoshi Sugiyama (Professor of Grad. Sch. of Science, Nagoya University) delivered a lecture titled “A mysterious particle neutrino” and introduced Dr. Takaaki Kajita’s work. In the second half of the lecture session, Dr. Kajita gave a lecture titled “Look back on neutrino research in Kamioka”. He spoke about the hard and long road to his discovery of neutrino oscillations and the importance of basic science. More than 900 people participated in the event.

Prof. Dr. Kajita (right) at the Lectureship award ceremony

UBIAS The 2018 Topic of the Year Workshop “Aging”-Life, Culture, Civilization

On December 19-20, 2018, Nagoya IAR held a two day-long international workshop jointly with the Waseda Institute for Advanced Study (WIAS) and the Institute for Advanced Studies in Humanities and Social Sciences, Nanjing University (IAS) at the Center for Asian Legal Exchange (CALE), Nagoya University. Eleven speakers from various research fields such as literature, physics and biology gave talks related to the UBIAS 2018 Topic of the Year “Aging” and exchanged interdisciplinary ideas.

Group photo of the Workshop

Program of the Workshop

The 10th IAR Lecture

The 10th IAR Lecture

The 10th IAR Lecture on “Khufu’s Pyramid and particle physics” was held on April 18, 2018 at the Sakata Hirata Hall, Nagoya University. Dr. Kunihiro Morishima (YLC Assistant Professor of Nagoya IAR) gave a lecture titled “Detection of new void in the Pyramid of Khufu using cosmic ray imaging” and Dr. Yukinori Kawae (Researcher of School of Humanities, Nagoya University) gave a lecture titled “Three-dimensional investigation of pyramids by Open Innovation”. More than 200 people listened intensely to the young and energetic speakers.

The 11th IAR Lecture

Commemorative photo with lecturers

The 11th IAR lecture on “Buddhist ruins in Afghanistan—Investigation of the Bamiyan cultural heritage” was held on December 23, 2018 at the Sakata Hirata Hall, Nagoya University. The 11th IAR lecture was opened by remarks from Dr. Yoshiyuki Suto, director of Nagoya IAR followed by five talks, “Otani expedition and Ryukoku University’s Afghanistan survey” by Dr. Takashi Irisawa (President of Ryukoku University), “Nagoya University’s Bamiyan Survey and Conservation Activities after the Destruction of the Buddhas” Dr. Kosaku Maeda (Visiting Professor at Tokyo University of the Arts), “Radiocarbon dating of the two giant Buddhas in Bamiyan and the Mural Paintings of the Bamiyan Buddhist Caves” by Dr. Toshio Nakamura (Professor Emeritus at Nagoya University), “The Two Giant Buddhas in Bamiyan and its ceiling mural” by Dr. Akira Miyaji (Professor Emeritus at Nagoya University, Professor Emeritus at Ryukoku University) and “Linking Silk Road -Bamiyan, Kutscha and Dunhuang-” by Dr. Shunpei Iwai (Associate professor of Ryukoku Museum). More than 160 people listened attentively to the valuable talks.

Celebratory Lecture in honor of Dr. Shoichi Sato

On December 2018, Dr. Shoichi Sato (Professor Emeritus at Nagoya University, Academy member of Nagoya IAR) was awarded the Order of the Sacred Treasure, Gold and Silver Star from the Japanese government. To celebrate his winning of the award, a celebratory lecture in honor of Dr. Sato was held on March 2, 2019 at the Noyori Conference Hall. After Dr. Osamu Kano (Professor of Grad. Sch. of Humanities, Nagoya University) introduced Dr. Sato’s achievements, Dr. Sato gave a lecture titled “New phase of the Western Middle Ages research development in Japan”. About 60 people attended.

Dr. Sato at the lecture

Academy Salon, Live till night: real-time discussion with Prof. Noyori

The “Live till night: real-time discussion with Prof. Noyori”, starting from 2017, is a salon in which one can freely discuss various topics with Dr. Ryoji Noyori, who is one of the Nobel Laureates in Chemistry 2001. In academic year 2018, the third and fourth sessions of the Academic Salon were held. The topics were

"From Study to Research - What is the career of a researcher?" [3rd] and "Academic fields without gender barriers - are there any academic fields relevant for boys or for girls?" [4th]. A report compiled by the participants can be read on the IAR website.

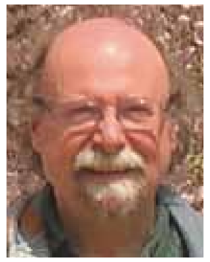
Dr. Noyori with participants

Foreign PI Fellowship Program

The Foreign Principal Investigator (PI) Fellowship Program is a program inviting excellent researchers from foreign countries with outstanding research achievements for a three to four months' fellowship, to promote the University's academic research. In academic year 2018, Dr. Jinmyon Lee (Director at Industry and Trade Analysis Division, Korea Institute for Industrial Economics & Trade. (KIET)), Dr. Shaker Meguid (Professor at University of Toronto) and Dr. Stephen Michael Playfer (Professor at The University of Edinburgh) were selected for this fellowship. While they were visiting Nagoya University, they discussed collaborative research with PIs in Nagoya University. Also, they contributed to the education of young researchers by giving advice and lectures. Dr. Lee gave a lecture "Recent Trends of Environmental Goods Agreement (EGA) and Korean Situation", Dr. Meguid gave a seminar "Multiscale Modeling of Multifunctional Nanocomposites: Opportunities and Challenges" and Dr. Playfer gave lectures "Matter antimatter asymmetries", "Evidence of Sterile Neutrino" and "Status and prospect for lepton universality violation at LHCb".

Dr. Lee

Dr. Meguid

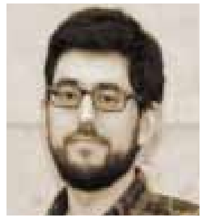


Dr. Playfer

Nagoya IAR, Short-term Fellowship Program

In order to facilitate international scientific cooperation, this program supports short research visits of overseas researchers (max. four weeks) including related activities such as holding a symposium. In academic year 2018, two proposals were selected for this program. One was from Dr. Hiroko Ito (Designated Associate Professor of Grad. Sch. of Law). She invited Dr. Shnaz Huda (Professor of School of Law, Dhaka University) and organized Dr Huda's lectures titled "Legal System and Protection of Women and Children in Bangladesh" and "Women's protection at home". The other proposal came from Dr. Bisei Ookawara (Associate Professor of Grad. Sch. of Medicine). She invited Dr. Sergio P. Acebrón (Independent group leader at Heidelberg University) for seminars titled "Post-translational roles of Wnt signaling" and "Career Talks for Young Researchers".

Dr. Shanaz Huda



Dr. Acebrón

2018 Young Leaders Cultivation Program

The Young Leaders Cultivation (YLC) Program, through which Nagoya University regularly and systematically recruits and trains young faculty members, is a strategic program based on the premise that it is important to secure an appropriate quantity and quality of young faculty members, in order to sustain the development of outstanding education and research in the future. In academic year 2018, Dr. Shingo Kazama (KMI), Dr. Yukiko Kawamoto (Grad. Sch. of Humanities), Dr. Yuki Sato (Grad. Sch. of Science), Dr. Natsuki Takada-Tanaka (Grad. Sch. of Bioagricultural Science), Dr. Yongchao Cheng (Grad. Sch. of Humanities), Dr. Hiroki Fujino (Grad. Sch. of Mathematics 2018), Dr. Soon-Ki HAN (Institute of Transformative Bio-Molecules) and Dr. Teppei Kitahara (Kobayashi-Maskawa Institute) were newly employed as designated assistant professors of the YLC program.

YLC Seminar

The 16th YLC seminar was held on May 29, 2018. Dr. Yukiko Kawamoto (YLC Assistant Professor of Nagoya IAR/ Grad. Sch. of Humanities) talked about "Roman Gardens and their Reception" and Dr. Shoichi Sato (Professor Emeritus of Nagoya University/ Academy member of Nagoya IAR) talked about "History of Civilization and World-Systems Theory". The 17th YLC seminar was held on December 25, 2018. Dr. Henrik Bachmann (YLC Assistant Professor of Nagoya IAR/ Dep. of Mathematics) talked about "Numbers, Infinite sums and multiple zeta values" and Dr. Tohohiro Abe (YLC Assistant Professor of Nagoya IAR/ KMI) talked about "Physics beyond the standard model of particle physics". The 18th YLC seminar was held on February 28. Former YLC faculty Dr. Mikio Kurita (Associate Professor of Grad. Sch. of Science, Kyoto University) and Dr. Sayuri Yoshida (Associate Professor of Dep. of Global Liberal Studies, Nanzan University) talked about how they worked when they were YLC assistant professors at Nagoya IAR.

The 19th YLC seminar was held on March 26, 2019. Dr. Chuan Xiao (YLC Assistant Professor of Nagoya IAR/ Grad. Sch. of Information Science) talked about "Data science, machine learning, and databases" and Dr. Takuya Matsumoto (YLC Assistant Professor of Nagoya IAR/ Grad. Sch. of Mathematics) talked about "Role of symmetries in mathematical physics".

The 17th YLC seminar

IAR Freshmen Lecture Series

Targeting freshmen of the University, this lecture series includes lectures delivered by members of the Academy, IAR Faculty members, IAR Fellows, and researchers of Nagoya University. It is aimed at communicating the fun of academic research. In academic year 2018, the following 14 lectures were given:

1.**"Creating enzymes: The boundary of chemistry and biology"**
Prof. Yoshito Watanabe (Grad. Sch. of Science/Vice President)

2.**"The dark universe"**
Prof. Naoshi Sugiyama (Grad. Sch. of Science/Deputy Director of Nagoya IAR)

3.**"The laws of science and development"**
Prof. Toshihide Maskawa
(Director of the Kobayashi Maskawa Institute, 2008 Nobel Laureate in Physics)

4.**"Are chemically reacting molecules 'visible'?"**
Prof. Akiyoshi Hishikawa (Research Center for Material Science)

5.**"What is social justice?"**
Prof. Hajime Wada (Grad. Sch. of Law, Deputy Director of Nagoya IAR)

6.**"How to use contemporary economics"**
Prof. Jiro Nemoto (Grad. Sch. of Economics)

7.**"Fascination with an introduction to the history of thought"**
Prof. Takaho Ando (Chuo University / Sixth Director of Nagoya IAR)

8.**"Children in Islam: Different cultures seen from education"**
Prof. Mina Hattori (Grad. Sch. of Education and Human Development)

9.**"Present of Historical studies: from Object to Relations"**
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