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INSTITUTE FOR ADVANCED RESEARCH
LETTER
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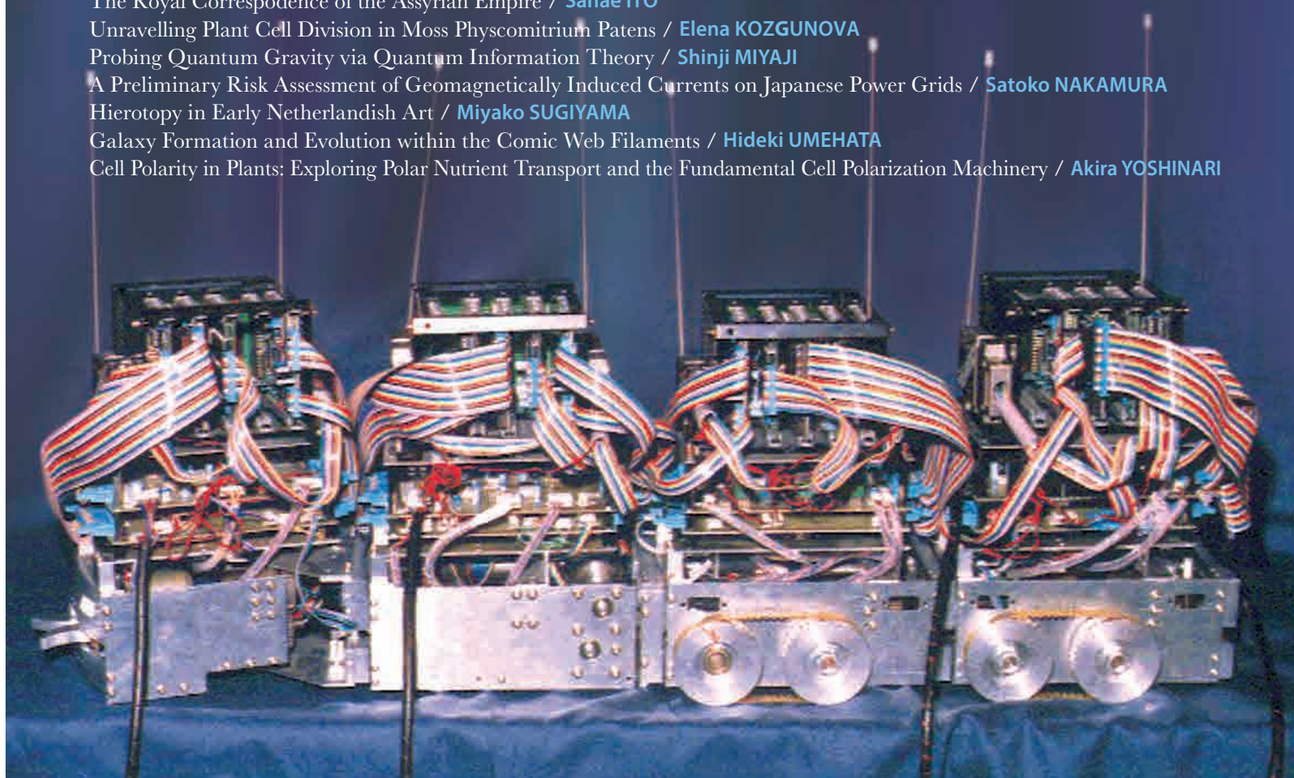
Special Interview

Research Highlights



Showcase for Advanced Research and Development of Talented Researchers Voyage for New Standards of Academia

The Institute for Advanced Research (IAR), Nagoya University, was established in 2002 to promote top-level global research and to contribute widely to society through its outstanding research outcomes. The IAR is among the first of such organizations established in Japanese universities by the first director Prof. Ryoji Noyori. The IAR has since been promoting Nagoya University' s research especially in pure research from a broad perspective that transcends conventional disciplinary boundaries. Today, the mission has expanded to include the promotion of academics at Nagoya University, support for excellence in research, developing the research and researchers leading next generation, and conducting international research exchanges. The IAR aims to promote the exploration of new and significant research fields as worthy of one of the global leading research universities. We have been hosting IAR lectures and seminars, including the Nagoya University Lectures, delivered by eminent researchers, who have been awarded special lectureship by the president of Nagoya University. The IAR has been also serving as a steering committee member of the University-Based Institutes for Advanced Study (UBIAS), which is the international network of other such institutions around the world. Furthermore, the IAR has been encouraging early-career researchers to be next-generation leaders through the Young Leaders Cultivation (YLC) program and Young Researcher Unit. As Nagoya University aims to become one of the global leading research universities under the framework of the Tokai National Higher Education and Research System, the IAR aims to further expand its function as a hub for research information and human resources, as well as its role in showcasing research, research activities, and the development of research personnel. I keenly look forward to your continued support, guidance, and encouragement for the IAR.

Kunio AWAGA
Director of Institute for Advanced Research

Director
Kunio AWAGA

21
March 2023

INSTITUTE FOR ADVANCED RESEARCH

LETTER

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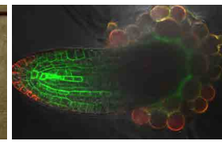


Cover Picture :
Dr.Toshio Fukuda's Representative Invenstion CEBOT mark IV (1992)

After a challenging last year with the coronavirus pandemic, this year, Nagoya University's Institute for Advanced Research (IAR) was able to organize several hybrid online and on-site events and invite several hundred people to an on-site symposium celebrating Honorary Director Noyori's receipt of the Historical Chemistry Paper Award.

Symposium to Celebrate the "Citations for Chemical Breakthrough Awards 2021 Awardees"

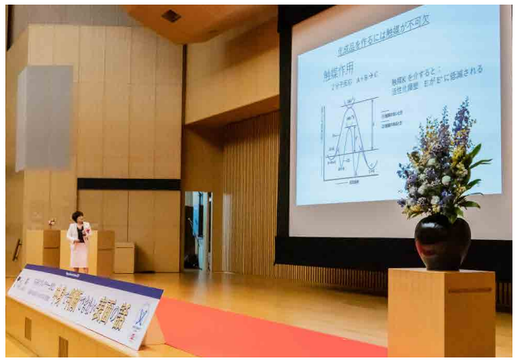
On July 2, 2022, the International Research Center for Materials Science and the MIRAI Global Science Campus (MIRAI GSC) of Nagoya University jointly hosted the "Symposium Celebrating the Historical Chemistry Paper Award." Citations for Chemical Breakthrough Awards are given by the American Chemical Society. In 2021, the first author, Ryoji Noyori, a distinguished Professor at Nagoya University and an Honorary Director at IAR (2001 Nobel laureate in chemistry), was awarded the first author's paper. The prize was awarded to the Department of Chemistry, Faculty of Science, Nagoya University, where Dr. Noyori conducted his research. The symposium featured the unveiling of a commemorative statue, a panel discussion between Dr. Ryoji Noyori and selected high school students from Nagoya University's MIRAI GSC, and lectures on the future of science and society by the prize winners and Nagoya University's leading chemistry researchers.

Nagoya University Lecture 2021

The Nagoya University lecture was held on January 9, 2022, in the Toyota Auditorium at Nagoya University. Dr. Takao Kondo, a distinguished Professor at Nagoya University and former Director of IAR, was honored with the title of Nagoya University lecturer. At the commemorative symposium, Prof. Takashi Yoshimura of Nagoya University gave a lecture on the connections and impressions between Dr. Kondo's research and his own. Afterward, Dr. Kondo gave a lecture titled "50 years of research on circadian clocks," in which he reviewed his own research life and gave a very passionate talk about his current and future research on clock proteins in cyanobacteria, which measure 24 h. An archive of his lecture is available on the IAR website (http://www.iar.nagoya-u.ac.jp/performance/1607/).

Nagoya University Lecture 2022

On October 30, 2022, the 2022 Nagoya University lecture series celebrated Dr. Maki Kawai, Director of the National Institutes of Natural Sciences, with guests invited on site at the Toyota Auditorium. Dr. Kawai was presented with a ceremonial plaque, and Dr. Takayuki Uchihashi, Professor at the Graduate School of Science of Nagoya University, gave a wonderful lecture on the impact of Dr. Maki Kawai's research on society at a commemorative symposium. Dr. Kawai then gave a lecture titled "The world of 'surface' that cannot be judged by its contents – A variety of functions created by breaks in continuity –." In her lecture, she gave a very passionate talk about the results of her research on catalytic reactions and her groundbreaking work in visualizing metal surface morphology and the image of molecules adsorbed on them. An archive of her lecture is available on the IAR website (http://www.iar.nagoya-u.ac.jp/performance/2076/).



The Ninth IAR Symposium

February 16, 2022

The IAR symposium aims to communicate Nagoya University's established, novel, and cutting-edge research to the wider university community and beyond. The seventh symposium, held last year, had a slightly different overall theme of "Significance and Contribution of Academia" but was well received. This year's symposium was the second such symposium, introducing social contribution and relations with society through research, and discussing its importance, difficulties, and problems. At the symposium, Dr. Yoshitaka Hibi from the Graduate School of Humanities and Letters spoke about the contribution of researchers to society, Dr. Miyuki Watanabe from the Graduate School of Law about civil dispute resolution procedures and social contribution, and Dr. Seiji Kadowaki from the Graduate School of Environmental Studies about research dissemination activities at the Nagoya University Museum.

The Third NU Initiative Webinar

June 23, 2022

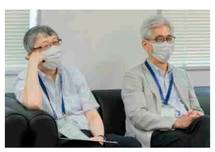
Since the time of COVID-19 in 2020, IAR and the Institutes of Innovation for Future Society have co-organized online webinars to achieve better communication between basic and applied sciences on campus. This year, four speakers from both institutes presented on the theme "Secrets of Academic Research Integration." Dr. Hisashi Hayakawa and Dr. Shinnosuke Ishizuka spoke on "Past Intense Solar Storms Explored in Historical Literature" and "The 'Microscopic' Chemistry of Earth and Space Dust," respectively. Two people from the Institutes of Innovation for Future Society gave presentations. Dr. Hiroshi Yukawa and Dr. Takayoshi Suganami presented on "Advanced imaging measurement and medical/pharmaceutical applications based on quantum nano-optics," and "Development of innovative diabetes treatment strategies using a 'stick-on' artificial pancreas device," respectively. This symposium had fruitful panel discussions, not only between the two institutes but also between the audiences at Nagoya University.

University-Based Institutes for Advanced Study (UBIAS) ICA Mini Workshop

August 31–September 2

UBIAS ICA Mini Workshop Day1

IAR and the co-organizer, the Moonshot Research and Development Program (Goal 3) of the Japan Science and Technology Agency, invited UBIAS ICA fellows to take part in the Mini Workshop of the Intercontinental Academia, “Robot and Artificial Intelligence” in Nagoya. This Mini Workshop “Robot and AI” was conceived during session 1 of ICA 4.0 by Dr. Olivier Bouin, Director at the RFIEA, and Dr. Toshio Fukuda, a mentor of ICA 4 and Professor Emeritus at Nagoya University, as a way to accelerate international relationship between ICA fellows to Japan to learn from each other during 3 days of lectures and discussions. Dr. Yasutomo Kawanishi from RIKEN Guardian Robot Project spoke on “Understanding and Remembering Daily 3D Environments by an Autonomous Robot.” Dr. André Fujita presented on “Network Statistics, Heart Informatics, and Robots.” Dr. Laura Candiotto from the Centre for Ethics at the University of Pardubice presented on “Can we have cultural robotics without emotions?” as an online speech. Dr. Alex Cayco Gajic from the Département d’Etudes Cognitives at École Normale Supérieure in Paris spoke on “Linking high-dimensional neural representations to complex behaviours.” Through this international workshop, all the participants were able to deepen their friendships with the researchers from other Institutes for Advanced Study around the world.



UBIAS ICA Mini Workshop Day2

UBIAS ICA 4

The fourth UBIAS Intercontinental Academia has been held with the title of “Intelligence and Artificial Intelligence.” Prof. Toshio Fukuda of Meijo University, a former IEEE president and IAR faculty, attended the workshop as a mentor, and Dr. Yasutomo Kawanishi (RIKEN), a former faculty at Nagoya University, was awarded as a participant in the workshop. The workshop in Belo Horizonte was held from November 7 to 12, 2022, in person and online.

UBIAS Directors’ Conference 2022

UBIAS’s online conference was held on May 23–24, 2022, and participated by directors worldwide. Prof. Olivier Bouin from the French Network of Institutes for Advanced Study (Paris, France) virtually hosted the directors’ conference. IAR has long played a central role as a steering committee of UBIAS. Prof. Awaga, Director of Nagoya IAR, has been elected as cochair of the steering committee, the so-called Triumvirate (coordination team), with the directors of the Merian Institute for Advanced Study in Africa (Accra, Ghana) and the French Network of Institutes for Advanced Study.

2022 Young Leaders Cultivation Program

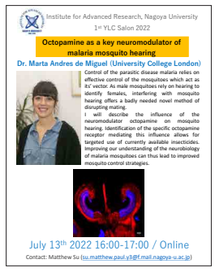
The YLC program is a strategic program of Nagoya IAR based on the premise that it is crucial to secure an appropriate quantity and quality of young researchers to sustain the development of outstanding education and research in the future. The Nagoya IAR recruits and trains young faculty members regularly and systematically. In the academic year 2022, Dr. Takuya Furuta (Graduate School of Law); Dr. Hirotaka Iijima (Graduate School of Medicine); Dr. Sanae Ito, and Dr. Miyako Sugiyama (Graduate School of Humanities); Dr. Elena Kozgunova, Dr. Masamichi Miyaji, and Dr. Hideki Umehata (Graduate School of Science); Dr. Satoko Nakamura (Institute for Space–Earth Environmental Research); and Dr. Akira Yoshinari (Institute of Transformative Bio-Molecules) were newly employed as designated assistant professors of the YLC program.

YLC Seminar

The YLC seminar is aimed at providing members with opportunities to understand each other's research interests to assist in interdisciplinary collaboration research. The 27th YLC seminar was organized online on March 22, 2022. Dr. Hanako Hagio (Graduate School of Bioagricultural Sciences) talked about "Evolution of the visual circuits, and mechanism of 'mogu-mogu' behavior in fish." and Dr. Yuichiro Tada (Graduate School of Science) talked about "Frontier of primordial black hole research – star first or black hole first?" The 28th YLC seminar was organized in person and online on June 28, 2022. Dr. Miyako Sugiyama (Graduate School of Humanities) talked about "Creating Sacred Space in the Late Medieval Bruges." and Dr. Qi-Dong Zhou (Kobayashi Maskawa Institute) talked about "Search for new physics by precise measurement of B meson decays." The 29th YLC seminar was organized in person and online on December 1, 2022. Dr. Takuya Furuta (Graduate School of Law) talked about "Theory and practice in reception history of political thought: Seeley in Japan 1880s–1940s," and Dr. Hirotaka Iijima (Graduate School of Medicine) talked about "Challenges towards an establishment of rehabilitation science-driven new interdisciplinary fields."

YLC Salon

The YLC salon was launched in 2019 with the aim of expanding YLC member's knowledge beyond their own area of expertise. One researcher was invited to this salon and gave a lecture on her latest research. The salon was held on July 13, 2022. Dr. Marta Andres de Miguel (University College London) gave a talk titled "Octopamine as a key neuromodulator of malaria mosquito hearing."



YLC Collaborative Research Grant

The YLC collaborative research grant was launched in 2018 to support the interdisciplinary collaboration between YLC faculties. YLC faculty voluntarily organized the grant contents, schedule, and selection process. In this year, YLC selected two research groups: one group was led by Dr. Hisashi Hayakawa (Institute for Space–Earth Environmental Research) with the title "Archaeoastronomical Analyses and Assessments of Ancient Eclipse Records," and the other group was represented by Dr. Miyako Sugiyama (Graduate School of Humanities) with the title "Comparative Study of Hierotopy in East–Western Churches and Buddhism.

IAR "Invitation to the Advanced Researches" Lecture Series

This lecture series includes lectures by the IAR academy and faculty members, IAR fellows, and Nagoya University researchers and targets Nagoya University students. This series was aimed at communicating the fun of academic research. In the academic year 2022, the following 15 lectures occurred online:

1."Science Started from Observation,"
Prof. **Sumio Iijima**
(Guest Professor at Nagoya University and Professor at Meijo University)

2."The Research History of Particle Physics,"
Prof. **Makoto Kobayashi**
(Director of the Kobayashi Maskawa Institute and 2008 Nobel laureate in physics)

3."The Dark Side of the Universe,"
Prof. **Naoshi Sugiyama** (President of Nagoya University)

4."Material Science—Fun and Useful,"
Prof. **Ichiro Terasaki** (Graduate School of Science)

5."The Present in Historical Studies:Excavate the Hellenism Civilization,"
Prof. **Yoshiyuki Suto** (Graduate School of Humanities and Eighth Director of IAR)

6."How to Use Contemporary Economics,"
Prof. **Jiro Nemoto** (Graduate School of Economics)

7."Visualize—Science About the Blessing of Nature,"
Prof. **Ryo Kohsaka** (University of Tokyo)

8."Analyze Democracy,"
Prof. **Hiroko Takeda** (Graduate School of Law and Deputy Director of Nagoya IAR)

9."Fascination with an Introduction to the History of Thought,"
Prof. **Takaho Ando** (Chukyo University and Sixth Director of Nagoya IAR)

10."Next-Generation Bio-imaging,"
Prof. **Shigehiro Yamaguchi**
(Graduate School of Science and Institute of Transformative Bio-Molecules)

11."Signaling Molecules Make Plant Life Resilient,"
Prof. **Hitoshi Sakakibara**
(Deputy Director of IAR and Graduate School of Bioagricultural Sciences)

12."Are Chemically Reacting Molecules 'Visible'?,"
Prof. **Akiyoshi Hishikawa** (Research Center for Material Science)

13."Chemistry of Anthocyanin —Make It Bloom the Blue Roses,"
Prof. **Kumi Yoshida** (Graduate School of Informatics)

14."How Is the Brain Formed? Research on Cell Development,"
Prof. **Takaki Miyata** (Graduate School of Medicine)

15."Concluding the Course of Invitation to the Advanced Researches"
Prof. **Yoshiyuki Suto** (Eighth Director of IAR)

Short-term Fellowship Program

To facilitate International Scientific cooperation, this program supports short research visits of overseas researchers (maximum of 4 weeks), including related activities such as holding a symposium. In the academic year 2022, Dr. Leigh Canham (Professor at the School of Physics and Astronomy, University of Birmingham) was selected for this fellowship.

Foreign Principal Investigator Fellowship Program

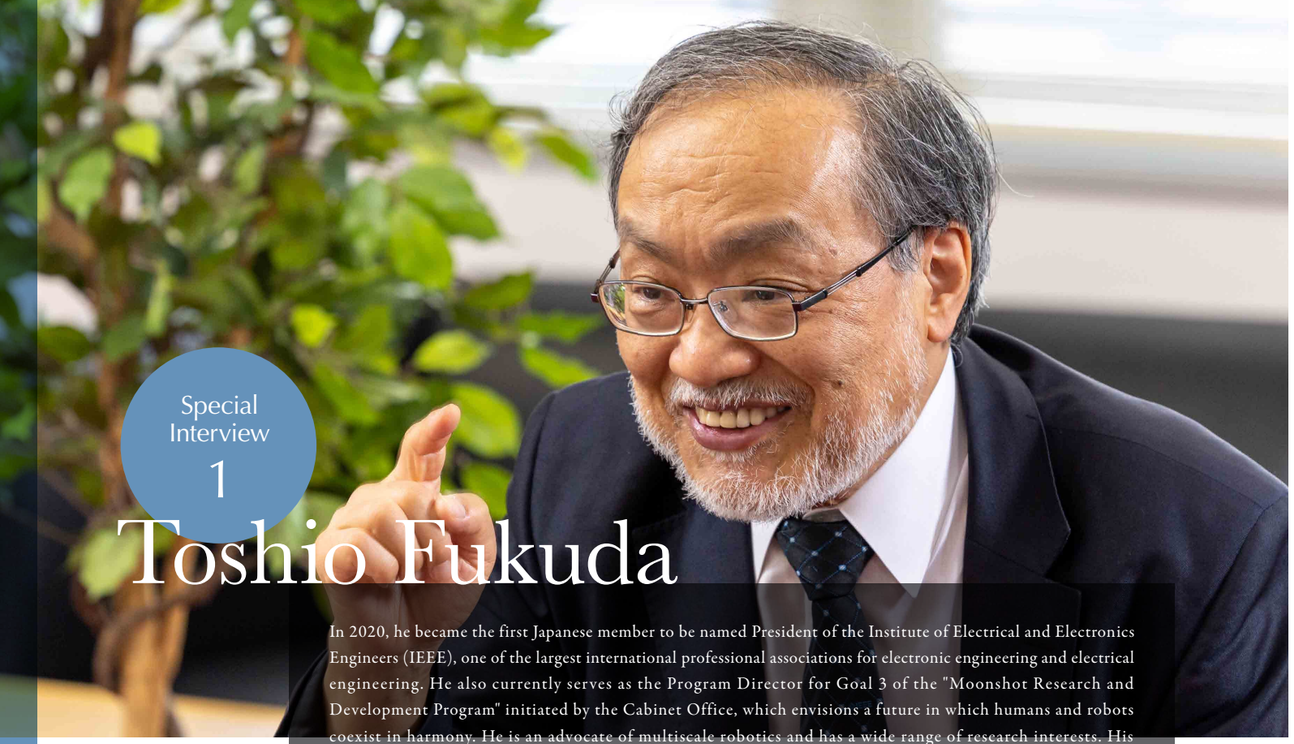
The Foreign Principal Investigator Fellowship Program invites excellent researchers from foreign countries with outstanding research achievements for 3–4 months' fellowship to promote the Universities' academic research. In the academic year 2022, Dr. Daniel F. Eberl (Professor at the Department of Biology, University of Iowa) was selected for this fellowship.

Awards

Dr. Hanako Hagio
(YLC/Graduate School of Bioagricultural Sciences) received the Inoue Award for Young Scientists (February 2022).

Dr. Satoko Nakamura
(YLC/Institute for Space–Earth Environmental Research) received the Obayashi Early Career Scientist Award (November 2022) and NF Foundation R&D Encouragement Award (November 2022).

Dr. Masamichi Miyaji
(YLC/Graduate School of Science) received the 2022 Young Scientist Award of the Physical Society of Japan. (He received this award while he was at the University of California, February 2022.)



Special Interview 1

Toshio Fukuda

In 2020, he became the first Japanese member to be named President of the Institute of Electrical and Electronics Engineers (IEEE), one of the largest international professional associations for electronic engineering and electrical engineering. He also currently serves as the Program Director for Goal 3 of the "Moonshot Research and Development Program" initiated by the Cabinet Office, which envisions a future in which humans and robots coexist in harmony. He is an advocate of multiscale robotics and has a wide range of research interests. His laboratory has produced 105 PhD candidates to date. He specializes in robotics.

Continuous Research and Development by Curiosity and Human Connection

−Aiming for the Development of Robots and Coexistence with People

—— Curiosity and the commonality of physical laws that enable the development of multiscale robotics

ゆく川のながれは絶えずして、
しかも、もとの水にあらず
淀みに浮ぶうたかたは、
かつ消えかつ結びて、
久しくとどまりたるためしなし

＊The above Japanese passage describes how "A river flows continuously, and not a single drop of water flowing through it remains the same. A bubble floating in stagnant water repeatedly disappears and is reborn."

It compares the concept of everything perpetually changing (impermanence) to the flow of a river.

This is a passage from the Hojoki, written by KamonChomei, famous historical essayist. It is one of Dr. Fukuda's favorite quotes and seems to aptly describe his continuous research and development. Dr. Fukuda says, "If you stay in the same study for even one year, it will be a thing of the past." He has worked on pipe-inspection robots, clustering self-organizing distributed robots "CEBOT," and brachiation robots that move like gibbons—a never-ending list. Based on the concept of multi-scale robotics, in which research and development are vertically conducted from the nanoscale to the macroscale, he has developed numerous technologies and robots.

What is the driving force behind his research and development? Part of its essence can be seen in the episode when he developed a micro-gripper, which was initiated in the 1980s. This delicate technology, which made it possible to grip micro-sized objects, attracted attention as a revolutionary idea at the time.

“It started out as a hobby. It's an interest in grasping a small object."

One day at lunchtime, Dr. Fukuda was rowing a boat in the moat of a park. Looking into the water, he unexpectedly saw many small creatures, including mosquito larvae. He scooped up a cup of water and brought it back to the lab, where he immediately looked at it under a microscope. He noticed that there were many organisms there, including vorticellae. Although he thought instantly, "I want to grab hold of them," of course neither his fingers nor tweezers would fit into the prepared specimen. It was at this time that he pondered whether there was any way to grab hold of them, and this was the beginning of a new development.

A power source to "move a thing only a little" is essential for gripping a small object. Using a motor did not work because it caused too much movement to grab a small object well. He heard about a power source called piezo (piezoelectric element); however, it was expensive and difficult to obtain at the time. In the midst of this situation, through his senior's connections, he learned that a prototype of a small actuator (a mechanism for converting energy into power) had been developed using another micro technology. He immediately visited the researcher who developed it. Fortunately, he was able to share about 20 of these devices. The displacement that this small actuator could move was only 4 micrometers. By making use of the principle of leverage, he made it possible to adjust the movement to 40 micrometers, and to 400 micrometers. Thus he was able to invent a micro-gripper, with the world’s best capability of grasping small objects at the time.

The research and development that originated from this is extensive. Attachment of a sensor to its tip made it possible to measure the width of the object displacement and the softness of the object, in addition to gripping it. It would also be possible to manipulate a single cell and precisely apply a physical stimulus to it. Eventually, offers for joint research began to come in, leading to the development of micro-grippers that could be used under vacuum conditions and to the application of microcatheters that could move inside blood vessels.

Dr. Fukuda speaks of these potential applications as follows.

“When improving the micro-gripper, for example, I considered a variety of actuators, including those made of shape memory alloys and polymer materials, those operated hydraulically and others that I had never dealt with before. All of these are in accordance with the fundamental physical phenomena. Even if they are dealt with by different research fields, they are all the same. It is often the case that what was not useful in other research fields is useful in my field.”

Through a genuine curiosity to grip something small, and as a result of nurturing this curiosity without giving up, a new field of microtechnology has blossomed. The commonality of physical laws serves as a hub for applications in other fields. This sequence of events is probably one of the driving forces behind his ideas, which are connected without stagnation.

—— A new world of research created by human connections

Of course, his ideas do not only come from his inner curiosity. He said that the impetus for his research and development had often came from connections with people. One example is the development of carbon nanotube processing technology. He learned about carbon nanotubes by talking to Dr. Yahachi Saito and Dr. Hisanori Shinohara, a leading nanocarbon researcher at Nagoya University.

"Carbon nanotube researchers focused their attention on unraveling the true nature of carbon nanotubes, including their physical properties. However, my interest was in how to manipulate and process them."

For Dr. Fukuda, the electron microscope was not an observation tool, but an experimental tool. In the late 1990s, he began to embark on research and development. He continued his research to develop a nano-robotic manipulator that works well in the confined space of an electron microscope, to improve the electron microscope itself and to develop a processing method using oxygen gas, which eventually enabled the measurement, processing and assembly of materials at the nanoscale.
Furthermore, since there was no forum for the presentation of such groundbreaking results at that time, Dr. Fukuda took the initiative to establish a new forum for presentation and discussion called the Nanotechnology Council within the IEEE in 2002. He pioneered the field of nanotechnology research that is done from the standpoint of robotics research.

of nanotechnology research that is done from the standpoint of robotics research.

"The new field was gaining worldwide recognition, and at one point so many students and researchers gathered at my lab that they could not enter. Every day our research received positive feedback. It was a really good time."

—— Creating a relationship where people and robots can learn from each other in order to coexist in harmony

How will robots and their technologies evolve in the future? And how will they integrate into our human society?
Goal 3 of the Moonshot Research and Development Program, for which Dr. Fukuda currently serves as the Program Director, is aimed at developing new, never-seen-before AI robots by 2050. For example, a robot that can autonomously learn, make decisions and adapt to its environment even in places it has never been before. It will be useful on the moon, at disaster sites and in other places where people cannot directly enter. Other examples include a robot that can understand human emotions and ethics and grow together with people. The keywords in development are "co-evolution" and "self-organization." The key to development is the "technology in which AI technology and robot technology work together to autonomously improve their performance" and the "AI and robot technologies that self-modify their own knowledge and functions."

Before they can be developed and applied to society, of course, many challenges must be overcome. For example, the introduction of AI robots also raises ethical issues. As a starting point for thinking about this issue, I would like to quote the "Three Laws of Robotics" that appear at the beginning of Isaac Asimov's science fiction novel "I, Robot."(1)

First Law: A robot may not injure a human being or, through inaction, allow a human being to come to harm.
Second Law: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
Third Law: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

The Three Laws of Robotics are summarized as necessary for autonomous robots to coexist with humans. Then, how should they be written to the robot and executed by the robot?
First, the current state of the art is not capable of writing the Three Laws of Robotics into the foundation of all controls and protecting them from tampering. Also, will robots be able to correctly identify "harm" to humans? In the first place, have people themselves been able to define what "harm" is? Thus, in addition to the technical aspects, there are also issues that we as humans will not be able to solve unless we are deeply engaged in protecting our own lives and livelihoods.

"For the coexistence of humans and robots, it is important that there is a balance between the two. Of the various perspectives, including hardware and software, even some should be symmetrical between humans and robots. Humans make robots smarter. Humans also learn from robots. I believe that we need to create a cross-learning relationship."

Research and development of AI robots and our society will continue to change like the flow of a river. Dr. Fukuda's facial expressions and every word he said powerfully emphasized that an interesting future will come after overcoming challenges one by one from a starting point of fully accepting these changes.

(1) "I, Robot—the Definitive Edition" Isaac Asimov (Author) / Fusa Obi (Translator) / Hayakawa Publishing Corporation / Publication date: August 6, 2004

Special Interview 2

Yuko Iida

Professor, Japanese Culture Studies, Graduate School of Humanities, Nagoya University / Director, Center for Transregional Culture and Society, Graduate School of Humanities, Nagoya University
She has published many works, including 彼女たちの文学：語りにくさと読まれること (single-authored)；女性と闘争：雑誌「女人芸術」と一九三〇年前後の文化生産 (authored and compiled)；and ケアを描く：育児と介護の現代小説 (co-authored). Her new work, プロレタリア文学とジェンダー：階級・ナラティブ・インターセクショナリティ (authored and compiled), was published on October 24, 2022. She presently works in a wide variety of fields, as indicated by her serving as the Director of the Center for Transregional Culture and Society and organizing the international symposium The Ethics of Care and the Humanities on January 28 and 29, 2023. She specializes in modern and contemporary Japanese literature and gender studies.

Recognizing Social Norms through Literature Fields
– To Select Better Norms in an Ever-Changing Era

—— What Is the Silent Power That Controls Us? The Pursuit of Research to Find the Answer

We live with various social labels attached.

- Students of the natural sciences are good at thinking logically. Students of the humanities have high-level communication skills.
- Stable jobs with lifetime employment are popular. Starting a business and working freely is also good as a modern style.

Although we are not sure if they are true or not, we often hear many other similar examples. These labels affect us as norms for living even before we realize it. Prof. Iida describes it in the following way:

"We all live in ignorance of norms. I feel that it is important to visualize and be conscious of norms. If they are correct, we should maintain them, and if they are incorrect, we can disregard them."

However, how should we perceive norms, which can be described as "implicit dynamics"? One of the approaches is analysis from the perspective of literature research.

In the late 1980s, a cultural research approach began to be incorporated into Japanese literature research. For example, a novel by a writer is read by many people, such as the editor, critics, and general readers, while influencing society and undergoing evaluation, which in turn influences the writer. Novels are therefore creations not only based on the writer's own views, but also based on the influence of society as a whole. Called the "literature field," this entire process is acknowledged as an element that forms culture. A close

analysis of the literature field enables a complex entanglement of the norms in society to be unraveled and visualized.

—— What is the "Literature Field," Which Reflects and Forms Society?

Let's take a look at proletarian literature, which is one of Prof. Iida's research areas and a major trend in modern literature.

The Meiji, Taisho, and Showa periods saw dramatic progress in the modernization of Japan. Textiles, mining, shipbuilding, and many other industries supported the development of Japan in those days, but at the time, they required a large amount of cheap labor. Consequently, the structure of economic disparities became conspicuous, as expressed by the terms "bourgeoisie of the capitalist class" and "proletariat of the wage-earning class." Under these circumstances, proletarian literature emerged with the theme of the harsh working environment of the proletariat and invited empathy from many people. This literature gained momentum especially in the 1920s and the 1930s, including the renowned work 蟹工船 (The Crab Cannery Ship) by Takiji Kobayashi.

Proletarian literature has been a popular research theme. Prof. Iida, who has incorporated the perspective of gender into the research, says:

"For gender research, it is important to look not only at gender, but also at connections with other elements."

Gender refers to the socially and culturally formed sex, rather than the biological sex. A gender perspective has been woven into each of education, work, public service, etc. The structure and true problems of gender will remain obscure if the relevant elements are simply identified and categorized. They will become explicit only after holistic consideration is given to their backgrounds and surroundings. Prof. Iida has given such consideration in プロレタリア文学とジェンダー　階級・ナラティブ・インターセクショナリティ,[1] authored and compiled by her and other literature researchers.

プロレタリア文学とジェンダー, authored and compiled by Prof. Iida

Those who challenged capitalism and fought for socialism and communism in those days were subject to imprisonment as "thought" criminals. Among them were some proletarian writers, including Takiji Kobayashi. Some citizens tried to provide relief to such imprisoned fighters by, for example, providing them with relief items, visiting them in prison, and offering support for their families.

For these relief efforts, women played the main role in a practical sense. However, public documents only record that men took the lead in the relevant relief organizations, almost without reference to the women's efforts. In this regard, literature research first highlights the reality hidden in the male gender norms of the time. For example, proletarian writers Shigeharu Nakano and Rintaro Takeda, who authored 病気なほる and 暴力, respectively, depict women engaged in relief efforts in their novels. In one of her works, Prof. Iida says:

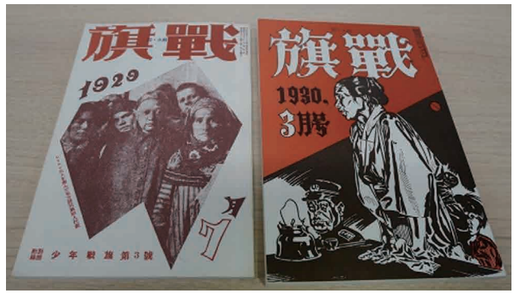
> "Based on the gap between the public record and reality, I would like to indicate that unlike the public record, the relief narrative represented by proletarian literature features women as the main players in the relief efforts. [...] Women, who do not appear in the public record, are portrayed in literature." [2]

In the structure of reality, there were gender norms of the "fight" as the central part played by men and of the "relief" as the peripheral part played by women. This theory is supported by the description of Tefu Watanabe, the "mother" of the relief efforts, as the symbol of the efforts. She is described in 残された前衛の家族はどうしてゐるか? by Misao Hata, published in the issue of March 1930 of the literature magazine 戦旗, along the following lines:

> "She always smiles as if she had completely forgotten about the sadness of her son having been XX. She is working as hard as the young, big Seki-san. She is exactly like the mother of Pavel in Mother by Gorky. She is the mother of the proletariat. [...] If any of you are about to feel depressed or intimidated even slightly, you should go there quickly and have a bowl of ramen noodles."[3]

Tefu Watanabe, who worked hard and made every effort to support the imprisoned fighters and their families, was often featured in proletarian literature magazines. Meanwhile, interestingly, she was at first described as a victim who had lost a family member in the midst of the fighting, namely a person to be relieved. A message to her was published in 同志×野からお母さんへ in the July 1929 issue of 戦旗:

> "Ms. Watanabe, please don't cry when you come to see me. [...] There are a lot of things to be done, including those that you can do. I hope that you will visit everyone and console them. Please do not think only about yourself but about everyone."[4]



Magazine 戦旗 Each sentence in the magazine presents differences in the historical background between then and now.

Tefu Watanabe, a mother in deep sorrow due to the loss of a family member, was gradually becoming transformed from a person to be relieved to the key player in the relief efforts. In one of her works, Prof. Iida discusses this transformation along the following lines:

> "Due to these dual features, the family grief and predicament served as rhetoric that mobilized citizens to be engaged in the relief efforts. Tefu Watanabe played a symbolic role in this process. [5]

To add momentum to the gender norm of the "fight" as the central part played by men, women placed in the peripheral were depicted differently depending on the purpose. To emphasize the necessity of relief, women were sometimes described with the focus on their family members who should be relieved and the women's predicament. At other times, women were depicted to encourage others to become committed as backup supporters. Prof. Iida says:

"Literature, especially novels, are based on a framework of thought which includes views about the family and society. Literature reflects and also forms society. "

The views described here are only a small part of her work プロレタリア文学とジェンダー, which we strongly recommend to you.

(1) プロレタリア文学とジェンダー：階級・ナラティブ・インターセクショナリティ Yuko Iida (auth. and comp.), Izumi Nakatani (auth. and comp.), and Kayo Sasao (auth. and comp.), Seikyusha, released at bookstores on October 24, 2022　ISBN978-4-7872-3514-5
(2) Authored by the same persons as (1), p. 87 and p. 89
(3) Misao Hata, 残された前衛の家族はどうしてゐるか?, 戦旗, March 1930 issue Senkisha, p. 179 (Note: Primary citation from プロレタリア文学とジェンダー)
(4) 同志×野からお母さんへ, 戦旗, July 1929 issue, Senkisha, p. 127 and p. 129 (Note: Primary citation from プロレタリア文学とジェンダー)
(5) Authored by the same persons as (1), p. 85

—— How Should We Behave When Norms Are Continuing to Change?

From the modern era to the contemporary era, many literature works present the norms of each period. For such norms, Prof. Iida feels something through her research. She says:

"History shows that norms have always been changing, and I feel that they will surely continue to change."

Gender norms will also surely change in line with the times. Today, people have begun to search for their ideal selves as men and women, and even various identities that cannot be simply categorized as men or women. If there are old-fashioned systems and approaches that disregard this trend, they need to be changed. Prof. Iida says:

"I don't feel that the framework of gender will or should cease to exist. However, I believe that discrimination caused by the framework should be eliminated. It would be nice if we could just accept diverse people as they are. People have traditionally fallen into various categories, such as age, origin, class, ethnicity, and race. Among these, gender figures very strongly. I feel that it would be good if gender were diluted by many other attributes."

Her lab is full of books. Each of them has its own story. Prof. Iida unravels the messages and historical backgrounds woven into stories every day.

Special Interview 3

Hiroyoshi Nishikawa

Professor of the Department of Immunology, Nagoya University Graduate School of Medicine, and also Chief of the Division of Cancer Immunology, Research Institute/Exploratory Oncology Research & Clinical Trial Center (EPOC), National Cancer Center

In 2022, Dr. Nishikawa was honored as one of the Highly Cited Researchers 2022 by Clarivate Analytics for a third consecutive year, following his recognition in 2020 and 2021. He continues to be a leader in the field of cancer immunology.

Be Sincere and Persistent in the Fact of Mystery
– Challenge of Elucidating Sophistiated Immune Response against Cancer

—— Don't pretend to understand what you don't understand.

Dr. Nishikawa said that his early work, conducted more than 20 years ago, still serves as the cornerstones of his current research.

"I was lucky to have experienced that work at the beginning. When something happens that I never expected, I can think that *there's only so much wisdom I can have, and there's still so much I have yet to learn,"* he said.

Our body's immune system plays a crucial role in not only fighting against bacteria and viruses but also eliminating cancer. Dr. Nishikawa started his research in the field of cancer immunology in the late 1990s, when the focus was mainly on the study of killer T cells, which directly attack cancer cells.

At that time, he thought that immunity was not so simple and decided to focus his research on helper T cells, which were recognized as coordinating the immune response. However, at the time, it was believed that helper T cells only assisted killer T cells in their fight against cancer, although much remained to be understood. He divided mice with cancer into several groups and treated them in different ways:

1. Activation of killer T cells only
2. Activation of helper T cells only
3. Activation of both killer and helper T cells
4. No treatment

He expected that mice with activated killer T cells and/or helper T cells would have better prognoses although to varying degrees; but unexpectedly, mice with only activated helper T cells showed cancer progression.

Why? Though he later noticed the fact during the days of research, CD4-positive T cells, to which helper T cells belong, can actually be further classified. In reality, in addition to helper T cells supporting killer T cells in fighting cancer, another subset of CD4-positive T cells called "regulatory T cells" also exist. They play a different role by putting the brakes on killer T cells' attacks. Immunity is such a powerful mechanism that once it gets out of control, it may cause excessive immune responses in the body. Regulatory T cells constantly monitor and control the immune system to prevent immune responses from getting out of hand.

Cancer can manipulate and exploit immune suppressive cells including regulatory T cells as a clever mechanism to evade attacks by the immune system. This mechanism may explain the results of his early research described above, in which treatment intended to activate helper T cells also activated regulatory T cells, unexpectedly leading to the protection of cancer cells. In fact, the two types of T cells work in balance with each other. CD4-positive T cells should not be lumped together as helper T cells only. The expected outcome would not be seen unless the two subsets of CD4-positive T cells are activated differently.

Dr. Shimon Sakaguchi, Specially-appointed Professor of Osaka University, discovered regulatory T cells in 1995. At the time, Dr. Nishikawa struggled with mysterious results, turned to Dr. Sakaguchi's research on regulatory T cells, thinking that it could be the key. Thus, he found the key to the solution and eventually paved the way for cancer immunology research.

He said, "Actually, immunology was my least favorite subject as a medical student. The theory at that time seemed like a patchwork of disconnected information that was being forced together. I couldn't understand it very well."

There are significant factors, such as one's position as a researcher and research trends at the time, that determine one's research theme. At the time, it must have taken courage for Dr. Nishikawa to focus on studying helper T cells.

"It is important for researchers to sincerely face the occurring phenomena. We should not pretend to understand what we don't understand," he said.

Dr. Nishikawa's research attitude is passed on to students through daily communication.

When you cannot explain well a phenomenon you are seeing or when you do not feel fully convinced, there is surely something wrong. An attitude of not running away from such dissatisfaction can lead to new findings.

—— A saying of his boss serves as his driving force: "If you see one phenomenon, continue to sit in front of it until you have written five papers on it."

The research of Dr. Tasuku Honjo, who is the Nobel Prize laureate in Physiology or Medicine 2018, has opened up a new field of cancer treatment known as "cancer immunotherapy," particularly, "PD-1 blockade therapy". One drug used in this therapy is nivolumab (Opdivo).

Killer T cells typically do not attack unless they can recognize and identify other cells as their attack targets. This is another mechanism that prevents excessive immune response, and cancer cells can also take advantage of this mechanism to suppress the attackers. Cancer cells provide a "certificate" that they are not the attack targets as another means of escape. Killer T cells are slowed down and cannot show their ability to attack in the presence of this certificate. PD-1 blockade therapy including Opdivo has the function of nullifying this certificate, allowing killer T cells to attack cancer cells.

Cancer immunotherapy is a relatively new field of medicine. Unfortunately, PD-1 blockade therapy is only effective in 20% to 30% of eligible cancer cases, for some reasons not entirely explained. Dr. Nishikawa has proven one of the reasons.

"The immune system works properly in a positive and negative balance. I realized the phenomenon I encountered 20 years ago commonly underlied the results of my current work," he said.

It has been shown that PD-1 blockade therapy activates not only killer T cells but also regulatory T cells surrounding cancer. Therefore, the key to the efficacy of the drug is the balance between the two types of T cells. If regulatory T cells in the periphery of cancer are strong, the killer T cells will eventually be outcompeted by them.

Dr. Nishikawa's research progressed further, and the next step was to demonstrate exactly what determines the balance between killer and regulatory T cells. He turned his attention to cancer metastases in the liver, which are particularly resistant to PD-1 blockade therapy.

The liver is a metabolically active organ that receives abundant nutrients supplied from the digestive system such as the large and small intestines. The liver consumes a large amount of glucose to generate energy for metabolism, which results in the release of lactic acid. Cancer cells also consume high amounts of glucose to grow and divide. Metastatic cancer tissues in the liver are richer in lactic acid than other tissues.

"What I keep in my mind during my research on cancer immunology is to have both the viewpoints of cancer and immunity. I've noticed that regulatory T cells can utilize lactic acid, which hasn't received attention in previous studies," said Dr. Nishikawa.

Killer T cells and most other types of immune cells use glucose as an energy source for their activities, but they cannot use lactic acid. In an area where a large number of immune cells are accumulating and actively working, glucose levels decrease while lactic acid levels increase. In such an environment, regulatory T cells, which can utilize lactic acid, would not have any trouble obtaining an energy source, allowing them to constantly monitor and control immune responses.

Furthermore, Dr. Nishikawa has demonstrated that high levels of lactic acid slow down the activity of killer T cells; this suggests that metastatic cancer in the liver may be a more favorable environment for regulatory T cells than for other immune cells.

This series of discoveries has provided new insights into the study of cancer immunology, and has significantly impacted clinical practice. It is a great advance to identify patients who are not expected to respond to PD-1 blockade therapy, considering their cost and potential side effects.

Dr. Nishikawa has accomplished many studies, and describes himself as "being persistent" when it comes to his research, while attributing much of his success to advances in science and technology and to superior researchers who have supported him. His research attitude can be traced back to the time when he was a researcher at the Memorial Sloan-Kettering Cancer Center in New York, U.S., from 2003 to 2006. His boss at the time, Dr. Lloyd J. Old, was a renowned leader in the field of cancer immunology.

"He told me that *when you see one phenomenon, continue to sit in front of it until you have written five papers on it.* It's pretty hard to write five papers, but I learned from him the attitude of doing as much as I can to solve a series of things," said Dr. Nishikawa.

A painting by Charles Demuth (left frame), a gift from Dr. Old to Dr. Nishikawa. The "No. 5" in the painting reminds Dr. Nishikawa of Dr. Old's saying.

—— The immune system is purposeful, interesting, and beautiful.

When and how does the immune system find and recognize cancer cells? Does the judgment of whether or not something is foreign depending on the situation? Can we create killer T cells that can utilize lactic acid?
Questions arise in his mind one after another. The immune system is very complex, and much of it is still a mystery. Therefore, efforts may not yield fruitful results. "It's daunting, and there's so much I don't understand yet, but that's what makes it exciting," Dr. Nishikawa stated. Each of his words sounds as if it conveys a spark of curiosity.

"While study immunology, I sometimes feel thrilled at such a complex but sophisticated mechanism present in our bodies, and the more I study, the more I am amazed and can only stand in awe of it. When I think something is wrong and research it again, I get exactly the results I was looking for. The immune system is so amazing that it makes me realize that human understanding is so far behind," he said.

A set of two advanced protein analyzers, one of only about five sets in Japan. Dr. Nishikawa's challenge of conducting innovative research continues.

Special Interviews were done by Science Communicator Tasuro Ayatsuka.

The Cambridge School and the Methodologies of History of Political Thought

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INTRODUCTION

The contemporary political philosopher David Miller has made renowned among students of political philosophy *The Allegory of Good and Bad Government,* a series of mural paintings of Ambrogio Lorenzetti. Figure 1 is a part of the painting, which illustrates good government. In this panel, a monarch representing the good government is surrounded by figures symbolizing values, such as justice and peace, while in another panel, the subjects enjoy a gratified and harmonious life under the good government. At the beginning of *Political Philosophy,* Miller says that looking at this painting is the best introduction to political philosophy. It tells us the perennial truth that politics affects human life, that there is good and bad politics, and that we are able to recognize the nature of the difference. Miller, in short, suggests that this painting provides us with the best way to consider the problem of values. He does not tell us, however, what the best "historical" approach is to the question of these values. This is the theme addressed by the Cambridge School, which is my research focus.

Figure 1. Ambrogio Lorenzetti's *Allegory of the Good Government* (Public Domain: Available on Wikipedia)

THE IDENTITY OF HISTORY OF POLITICAL IDEAS

The Cambridge School in intellectual history is a group of historians of political thought, represented by John Pocock, John Dunn, and Quentin Skinner. Although they have not conducted collaborative research, since the late 1950s, they have all published a series of methodological articles that share a common orientation. The Cambridge School criticized conventional research methods, significantly revising the traditional plot of the history of political ideas, mainly through the study of the distinguished philosophers, such as Thomas Hobbes and John Locke, and other prominent discourses in seventeenth-century England. Perhaps, it may be possible to elicit from classical works perennial messages still profitable today. But is conveying such messages to "us" really what Hobbes and Locke actually "did?" Here is room for historical inquires, distinct from philosophical investigations.

According to their view, "theory" or "thought," perceived as a set of propositions, does not itself constitute history. For example, the politico-philosophical proposition that "liberty signifies the absence of opposition" itself is a-historical. It is only when a person writes, speaks, or pronounces such a proposition that it appears in the history of human activities. Hence the history of ideas is the history of "action": writing and speaking. The two propositions, "Caesar crossed the Rubicon" and "liberty signifies the absence of opposition," are of entirely different status. But when the latter proposition was rewritten as "'Hobbes wrote' that liberty signifies the absence of opposition," it comes to be a description of an action, an event in the past, like Caesar's crossing the Rubicon. Historical inquiries of past ideas are to explore the meaning of the actions of writing a particular proposition, just as historians explore the meaning of Caesar's action.

Pursuing the history of ideas as history of actions, the Cambridge-style historians hoped to establish the identity of the history of political thought. Their common aspiration was to rebuild this history against the new academ ic background in the late twentieth century, in which natural scientific meth ods were being adopted in many areas of the humanities and social sciences. However, the model of natural scientific causal explanations, when applied to history of ideas without modification, leads to reductionism, which substitutes historical understanding of an idea with successive attempts to find the causes of the idea somewhere in, for examples, the social structure, economic structure, or personal biography. The Cambridge-style historians therefore oppose the direct application of such explanatory models, while seeking to defend the possibility, or autonomy, of the history of political thought as an independent discipline, which has distinctive methods. In doing so, they derived various supporting arguments not simply from the field of history of political ideas but also from a variety of related disciplines.

A FORGOTTEN LEGACY

However, it is this close connection between the Cambridge School and other disciplines that has often been overlooked, or simply forgotten. Their approach, often summarized as "contextualism," became widely accepted from the 1960s onwards. Ironically, the prevalence of their method itself has obscured their dialogue and tensions with the social and natural sciences. However, it is, I believe, in these forgotten aspects that we can learn some significant lessons today, when the relationship is being hotly debated between the natural sciences, social sciences, and the humanities. I am therefore conducting my research, focusing on these aspects; I am also convinced that this theme is perfectly suitable for research conducted at Nagoya University's Institute for Advanced Research, where young specialists from various field gather together.

Physical Exercise as a Means for Cellular Rejuvenation

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INTRODUCTION

All cells in the human body are subject to mechanical influences. This is particularly true in articular cartilage, given that its primary role is to transmit forces to the underlying bone. However, these functions are disrupted by cartilage deterioration over time. In most cases, cartilage damage eventually progresses to osteoarthritis (OA), which in 2019 represented the 15th leading cause of disability worldwide. Although we have known of the poor healing capacity of cartilage for over 250 years, effective treatment is currently lacking. This lack of treatment is attributed, at least partly, to a poor understanding of the molecular mechanisms underlying age-related OA.

AN AGE-RELATED INCREASE IN ECM STIFFNESS DRIVES EPIGENETIC REPRESSION OF α-KLOTHO

To address this gap, we performed a meta-analysis and bioinformatic analyses to elucidate the mechanisms of OA in the knee joint.[1] From this study, a pattern of common molecular and cellular denominators of knee OA emerged, including elevated inflammation, impaired autophagy, and cellular senescence—three hallmarks of aging. At the intersection of each of these hallmarks, we identified the longevity protein, α-Klotho, suggesting that α-Klotho may play a mechanistic role in the onset of knee OA. Indeed, using both murine and human samples, we found that aging drives a decrease in α-Klotho protein levels in chondrocytes.[2] However, supplementation of α-Klotho to aged mice restored a more youthful cartilage profile, suggesting that α-Klotho plays a critical role in the preservation of cartilage health.[2]

In search of factors that may drive declines in α-Klotho, we found that an age-related increase in extracellular matrix (ECM) stiffness initiates pathogenic mechanotransductive cascades that inhibit Klotho gene expression.[2] While matrix-provoked declines in tissue health are broadly recognized, the underlying mechanisms mediating these effects have been elusive. Our studies suggest that biophysical matrix characteristics epigenetically regulate Klotho gene expression. Specifically, we found that a stiff matrix engineered to mimic the biophysical properties of aged cartilage drove methylation of the Klotho promoter in young chondrocytes. Contrastingly, a soft (young-like) matrix restored a youthful phenotype to aged chondrocytes through Klotho promoter de-repression. These findings suggest that modulation of matrix mechanics or inhibition of downstream cellular response to the aged-like (stiff) matrix may be a therapeutically viable tool in the treatment of age-related knee OA.

PHYSICAL EXERCISE AS A MEANS TO COUNTERACT THE STIFF ECM-DRIVEN CELLULAR AGING

The above findings indicate that age-related alterations in ECM biophysical properties initiate mechanotransductive cascades that disrupt chondrocyte health via epigenetic repression of Klotho. As a next step, we aim to identify methods to counteract the pathogenic mechanotransductive cascades accompanying the aging process. A growing body of evidence has demonstrated the beneficial effects of young blood on the health and function of aged tissues. This is also true in cartilage, as evidenced by the fact that rejuvenation of the systemic microenvironment through exposure of aged mice to a young circulatory system restores cartilage integrity. With this in mind, numerous studies have sought to identify circulating "anti-geronic" factors that may transpose a youthful phenotype onto aged cells and tissues.

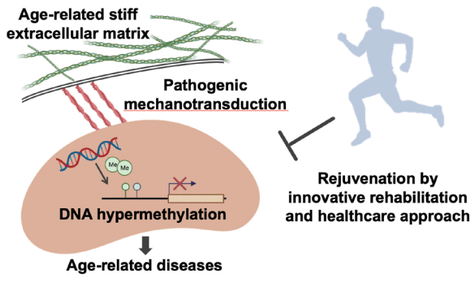

Figure. Exercise counteracts age-related pathogenic mechanotransduction

While the bulk of efforts to date have focused on free circulating proteins as potential mediators of the beneficial effect of young blood, we recently turned my attention to circulating extracellular vesicles (EVs). EVs are membrane-bound nanoparticles that transfer biomolecules targeting cells to regulate the physiological functions of recipient target cells. Blood contains a heterogeneous mixture of EVs of different origins, and these EVs are currently being tested for therapeutic and diagnostic purposes. In particular, the effects of EVs are now the subject of growing interest in the context of aging and cartilage disease, and recent in vitro studies have attempted to evaluate the chondrogenic potential of EVs from blood-derived products. In support of this premise, my preliminary results showed that treatment of aged chondrocytes with EVs isolated from young blood displayed a more youthful phenotype. Most notably, we found that the chondrogenic potential of EV was significantly improved by exercise.[3] These data suggest that physical exercise influences circulating EV cargoes that modulate mechanotransductive signals, and therefore, may be a promising tool to modulate the health and function of target chondrocytes (see Figure).

Building upon these previous works, I propose a new interdisciplinary research field, "Rejuvenative Rehabilitation," an interdisciplinary field that integrates approaches from rehabilitation medicine with rejuvenative medicine, with the ultimate goal of developing innovative anti-aging therapeutics that maximize physical function. I believe that the establishment of "Rejuvenative Rehabilitation" will accelerate our resolution of the challenges of human aging.

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The Royal Correspondence of the Assyrian Empire

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ASSYRIOLOGY

Assyriology covers various academic disciplines related to the research on ancient West Asia (modern Iraq, Iran, Syria, Lebanon, Jordan, Israel, Palestine, and Turkey) from the fourth millennium BCE to the first century CE. Assyriology, in its narrower sense, also means the philology dealing with cuneiform texts written in Akkadian—i.e., Assyrian and Babylonian, Sumerian, Eblaite, Hittite, Luwian, Elamite, Hurrian, Urartian, Ugaritic, and Old Persian. As most of the cuneiform texts were inscribed on clay tablets that hardly perish, about half a million texts have been discovered so far since the end of the 19th century CE and stored in museums worldwide (Fig. 1). However, it takes many years of focused effort to acquire the ability to decipher cuneiform documents; hence, the number of Assyriologists—researchers in Assyriology—in the world is roughly 200, spanning several generations. Systematical cuneiform text editing projects started from the middle of 1980s in North America and Europe and annotated editions of the various corpus, such as Assyrian and Babylonian royal inscriptions, state archival texts, scholarly writings, have been released. Having benefitted from these editions, Assyriologists are recently focusing on not only deciphering newly excavated cuneiform texts but also examining history, languages, art history, religion, science, literature, economy, societies, legal systems and material culture of the ancient West Asia.

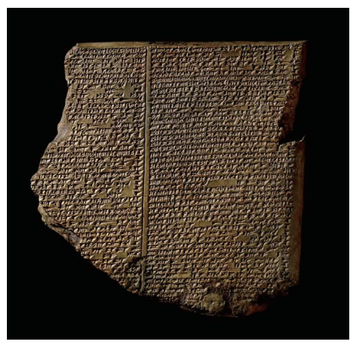

Figure 1. The flood tablet of the Gilgamesh Epic. © The Trustees of the British Museum.

THE ASSYRIAN EMPIRE

The Assyrian kingdom emerged as a city-state in the middle of the Euphrates from the 21st century BCE, became a territorial state in the second millennium BCE, and eventually turned into an empire in the first half of the first millennium BCE. The Assyrian Empire was the first world empire in history. At its height, it united a vast territory stretching from present-day Iran to Egypt. I am interested in the Assyrian Empire and understanding how the first world empire was constructed, managed, and inherited.

THE ROYAL CORRESPONDENCE

When I stayed at the University of Helsinki, where the research project on publishing the archival texts of the Assyrian Empire had been conducted, I took the opportunity to study the royal correspondence of Assurbanipal, the Assyrian king (668-c. 630 BCE) who expanded the territory to its biggest (Fig. 2). I conducted a philological and historical research on his letter as my Ph.D. work (1).

Figure 2. Relief of Assurbanipal hunting on horseback. © The Trustees of the British Museum.

Based on this research, I wrote an introduction when the text edition of half of his correspondence was published from the project (2). I also examined the complicated process of composing the Assyrian royal correspondence (3). Currently, I am at the Institute for Advanced Research in Nagoya University doing research on the Assyrian imperial communication system to reveal how the thousands of Assyrian state correspondence had been delivered. This system was the important instrument that enabled the empire to implement state policies and achieve its political aims for the cohesion of the vastly expanded empire. Additionally, Designated Assistant Professor H. Hayakawa and I do collaborative research on the solar eclipses mentioned in the Assyrian royal correspondence and the Babylonian astronomical diaries.

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Unravelling Plant Cell Division in Moss Physcomitrium Patens

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INTRODUCTION

The development of multicellular organisms depends on the ability of cells to make accurate copies of themselves; this is the core function of mitotic cell divisions. Our understanding of mitotic mechanisms is largely derived from studies conducted in animals. Although plant cell division follows the main stages of eukaryotic mitosis, some studies suggest that even conserved mitotic proteins have acquired novel functions in plants (1). Limited progress has been made in elucidating plant-specific mechanisms of mitosis, in part due to the slow speed of functional gene analysis in most common model plant species, which are diploid or polyploid with relatively long life cycles. However, these limitations do not apply to the moss *Physcomitrium patens* (*see* Fig.1a), which is also called "green yeast" by plant molecular biologists. *P. patens* is haploid for most of its life cycle and is distinguishable by its remarkable regeneration abilities, with any single somatic cell capable of regenerating into a whole plant. All genetic modifications can be easily obtained in the first generation within one to two months, and cutting-edge technology, such as a microfluidic device for high-resolution live-cell imaging, has been developed (2, 3). These advantages make *P. patens* an ideal model plant for genome-wide screens that can rapidly progress identification and functional characterization of new genes on a large scale.

POLYPLOIDY AND CELL DIVISION

Polyploidy, or genome multiplication, has greatly influenced plant evolution and speciation. Our current understanding of this process attributes errors in sexual reproduction to polyploidy—e.g., unreduced gamete fusion or polyspermy. However, a comprehensive screen of all major kinetochore components in *P. patens* led to an unexpected discovery: defects in chromosome segregation, namely lagging chromosomes that completely blocked cytokinesis in a spatio-temporal manner (4). The resulting cells had a duplicated genome and eventually developed into polyploid plants. This suggests that *P. patens* possesses a failsafe mechanism that ensures chromosome segregation post-metaphase and can terminate cytokinesis to prevent aneuploidy.

SPINDLE POSITION AND ORGAN DEVELOPMENT

In animals, mitotic spindle positioning determines the division site during asymmetric cell division. On the other hand, it was believed that in plants, the cell division site was determined before mitosis, and no evidence of active spindle positioning in plant cells was discovered until now. In the recent work, we characterized the function of the microtubule-associated protein targeting protein for Xklp2 (TPX2) during mitosis in *P. patens* and isolated a hypomorphic mutant of TPX2 that showed drastic spindle motility leading to a reversed cell ratio in asymmetric cell division and impaired organ development (5) (*see* Fig.1c).

FUTURE PERSPECTIVE

In the last decades, simple model organisms (e.g. *Saccharomyces cerevisiae*) have pioneered in the functional characterization of novel genes and path ways, knowledge that has been later transferred to other animal systems and the medical field. However, this promising approach of exploiting a simple, fast-growing organism for gene discovery remains rarely used in the plant field. In the future, using CRISPR/Cas9 gene editing and *P. patens,* I plan to pursue an ambitious genome-wide screen to identify novel factors involved in plant development and stress tolerance.

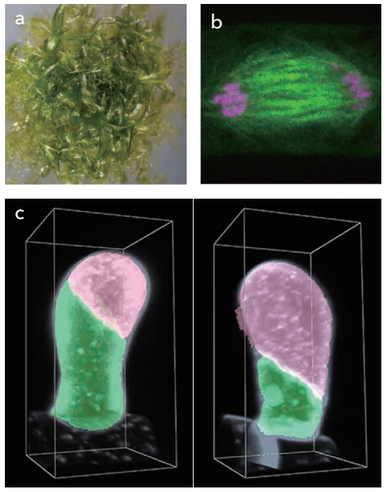

Figure 1. Cell division in the moss *Physcomitrium patens.*
(a) A photo of *P. patens* colony (b) One of the stages in cell division in *P. patens,* showing microtubules (green) and chromosomes (magenta) (*adapted from* (4)). (c) 3D cell reconstitution after first gametophore division (*adapted from* (5))

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Probing Quantum Gravity via Quantum Information Theory

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INTRODUCTION

Quantum mechanics and general relativity are two foundations of modern theoretical physics. Quantum mechanics is a theory of microscopic matter, such as elementary particles. General relativity is a theory of gravity, describing macroscopic objects such as stars. However, it is hard to construct a theory of gravity in terms of quantum mechanics, called quantum gravity, in such a way that general relativity appears when we neglect quantum effects. This means we are still unable to understand the physics of the black hole and the beginning of our universe.

This situation was substantially improved by the discovery of holography (Fig.1) [1, 2, 3]. Holography tells us that the quantum gravity of spacetime is equivalent to quantum mechanics on the spacetime boundary. The important point is that quantum mechanics does not contain gravity; therefore, once we know about quantum mechanics, which is a doable task, we can understand the corresponding physics of quantum gravity. The next question then is, which aspects of quantum mechanics correspond to the physics of quantum gravity of interest? One direction that has proved fruitful is focusing on the quantum information of the boundary quantum mechanics.

QUANTUM INFORMATION AND GRAVITY

Quantum mechanics has unique structures, as compared to classical mechanics. Such structures are formalized in quantum information theory. The fundamental fact is that information in quantum mechanics is stored in qubits, which have a far richer structure and unique applications compared to classical bits. One important example of an important structure studied in quantum information theory is quantum entanglement. Quantum entanglement is a non-local quantum correlation between two quantum systems. It plays an important role as a resource for quantum teleportation as well as a tool to study quantum mechanical systems.

One measure to quantify quantum entanglement is entanglement entropy, which can count the number of entangled pairs of particles in the system. Therefore, it can be used to study non-local correlations present in the system. Such non-local correlation is important since it can be used to classify the long-range order of the system of interest as an order parameter.

The profound connection between quantum information and quantum gravity in holography was first discovered as equality between entanglement entropy of the boundary quantum mechanics and the area of the Ryu-Takayanagi surface in the bulk spacetime (Fig.1) [4]. This relation is called the Ryu-Takayanagi formula and is the first connection between the quantity of the boundary quantum mechanics and fundamental degrees of freedom in gravity. The Ryu-Takayanagi formula has uncovered various important new directions in studying holography and quantum gravity. One significant implication is the resolution of Hawking's black hole information paradox [5, 6], which is one of the most notorious paradoxes in quantum gravity.

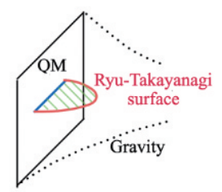

Figure 1: Quantum mechanics (QM) at the spacetime boundary and Ryu-Takayanagi surface.

BLACK HOLE INTERIOR FROM QUANTUM INFORMATION

Black holes are heavy objects which distort the spacetime around them and are believed to be ubiquitous in our universe. A black hole has an event horizon from which nothing can escape after falling behind it. Inside the event horizon, there is a singularity where general relativity is no longer true, and quantum gravity is necessary. Therefore, to understand the properties of the black hole interior, singularity, and quantum gravity, it is necessary to construct physical quantity at the boundary quantum mechanics, which corresponds to geometric quantities behind the horizon.

QUANTUM FISHER INFORMATION

Quantum Fisher information is a quantum information theoretic measure that quantifies the distinguishability of quantum states in terms of parameters. In other words, quantum Fisher information tells how difficult it is to estimate the parameters of the given quantum state. Miyaji et al. found that the quantum Fisher information corresponds to a volume of the maximal volume time slice (Fig.2). There are several remarkable points in this finding. First, this correspondence is another example connecting geometry and quantum information theoretic quantity. Second, the maximal volume slice can penetrate beyond the event horizon of the black hole, enabling us to study the black hole interior in terms of the boundary quantum mechanics. It is an exciting future program to extend this correspondence in order to investigate geometry behind the horizon out of the maximal volume slice. Ultimately, the goal in this direction is to capture physics near the black hole singularity using some quantum information theoretic quantity by extending the quantum Fisher information.

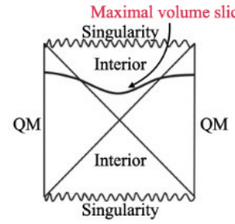

Figure 2 : Maximal volume slice penetrating the black hole interior.

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A Preliminary Risk Assessment of Geomagnetically Induced Currents on Japanese Power Grids.

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INTRODUCTION

Geomagnetically induced current (GIC) is hazardous to social infrastructures having long-length conductors, such as power lines, pipelines, and communication cables as shown in Figure 1. Our research team has developed a new numerical model for calculating GIC flowing in the Extra High Voltage (EHV) power transmission lines in Japan to estimate a potential risk of GIC in Japan. A risk of (GIC) is expected to be high for large magnetic storms caused by solar eruptions. One of the most famous consequences was the collapse of the Hydro-Québec power grid on March 13, 1989, associated with a severe geomagnetic storm. Previously, it had been believed that the occurrence of strong GICs is limited in the high latitude regions. Japan is located at low- and mid-latitudes, and the influence from GIC on the transformer situated in the Japanese power grid is small. It has recently been suggested that the Japanese grid system may not always be safe as previously thought.

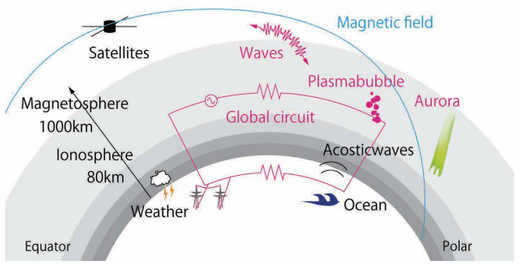

Figure 1. A concept map of the space weather chain.

RISK ESTIMATION

Our group investigated the problem of realistic modeling of GICs in Japan. The islands of Japan are located in a highly heterogeneous geologic region and are also surrounded by a conductive ocean. High-resolution 3D electrical conductivity modeling is presented for physics-based time-domain modeling of the geoelectric fields and the GICs in Japan. This is a timely topic, and the methodology developed to address the problem is novel, sophisticated, and reflects the best practices in this area of research. The analysis is scientifically valid and is a great addition to the modern literature on the topic. Using a subsurface electrical conductivity model, GIEs generated by external geomagnetic disturbances can be calculated. When the GIE distribution is provided, the magnitude of the GIC can be determined by the topology and electrical parameters of the power grid, such as the resistance values of the ground and the transmission line. Lehtinen and Pirjola (1985) suggested a scheme to calculate the GIC flowing in an entire grid for a given GIE and parameters of the power grid. Figure 2 inducates that large-amplitude GICs tend to flow at substations near the coast. In addition, particularly large GICs are found in the inland areas where the gradient of the conductivity is high.

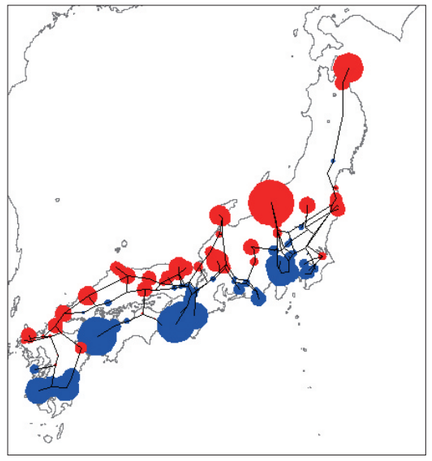

Figure 2. The distribution of the estimated risk against GICs for a 500-kV transmission. network in Japan. The magnitude of the GIC flowing at a substation is indicated by the radius of the circle

This is a notable example showing that the inhomogeneity of the conductivity and topology of the power grid are significant in the generation of a GIC. As described above, the mechanism of GICs has been clarified to some extent by studies in the last ten years; however, there are still some problems to be solved for the reproduction of actual GICs and estimation of possible GICs in the future. Further studies are required to improve the accuracy of GIC reproduction and prediction capability of GICs against extremely large geomagnetic storms. Another issue that has not been discussed well thus far is the effect of the complex magnetospheric ionospheric current system that emerges during an extremely large geomagnetic storm. Moreover, the interaction between the ground and transmission lines (i.e., electromagnetic coupling between ground and transmission lines) has not been fully discussed. Field and numerical experiments will help understand the coupling and evaluate the generation of GICs more precisely.

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Hierotopy in Early Netherlandish Art

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CONCEPT

Hierotopy is a concept suggested by Alexei Lidov in 2001 and published in 2006 (1). The term combines two Greek roots: *hieros* (sacred) and *topos* (place, space, notion), and this concept focuses on the procedure and system of making a sacred space. The combination of the architecture, religious imagery, liturgical performance, incenses, and lighting all contribute to creating a sense of sacredness in the space. This sense is a core necessity for human beings to communicate with the celestial world.

SACRED SPACE AND IMAGE

The main focus of hierotopic research so far has been Eastern Christianity (Byzantine and Medieval Russia), and little study has been done on western churches and other religions (2). For the first time, this research project introduces the hierotopic methodology to the study of art and culture in the late medieval Low Countries, the territories in which early Netherlandish art flourished in the fifteenth and early sixteenth centuries. The project especially focuses on the system of creating new sacred spaces in local cities through copies of sacred images. According to medieval theology, an image was believed to reflect its divine prototype. For instance, Saint Basil the Great (ca. 330–79) said that "the honor paid to the image passes on to the prototype" (3). This opinion established a standard idea of an image as a window through which beholders could communicate with a sacred presence.

PROTOTYPE AND COPY

A copy of a sacred image contributed to creating a new space for devotion. For instance, there are a number of copies of the *Cambrai Madonna* (Fig.1), the famous miraculous icon—a devotional painting of a holy figure. A copy in Kansas City (Fig. 2) is not an exact copy of the original, but rather a modern interpretation of the older icon (4). It was modified to fit the aesthetic taste in the fifteenth-century Netherlands. This type of "modern icon" stimulates the audience to see the image, and by providing an adequate setting as a shrine, to perform various devotional acts in front of it. In the late medieval Netherlands, not only the sacred images but also the sacred places, such as Jerusalem and Rome, were copied. A particular example is the Adornes family chapel, or Jeruzalemkapel (5). The Adornes family in Bruges had a long history of devotion to the Holy City, where several family members went on pilgrimage. Between 1470 and 1471, Anselm Adornes and his oldest son Jan Adornes traveled together to Jerusalem, among other cities. After returning from their travel, they renovated their family chapel (Fig. 3) to commemorate their journey and experience in the Holy Sepulcher. The chapel was originally founded in 1427. In previous literature, the chapel has generally been mentioned as a kind of copy of Jerusalem, "conceptual Jerusalem in miniature," or "a domestication of the Jerusalem pilgrimage experience" to do virtual pilgrimage to the Holy City (6). However, it is worth pointing out that the chapel itself is not an exact copy of the Holy Sepulcher, but rather an interpretation or a completely new creation of Calvary to attract local citizens with its unique design and concept. What is copied in both the aforementioned "modern icon" and the Adornes family chapel is, as will be demonstrated in this research, a core concept. New elements and environment were then provided to adapt to the new context. Copying the sacredness is, paradoxically, a creative activity to make a new place for devotion in the secular world.

Figure 1

Figure 2

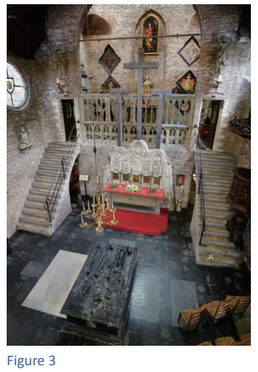

Figure 3

Figure 1. Italo-Byzantine, *The Cambrai Madonna,* mid-14th century, tempera on panel, 35.7 x 25.7 cm, Cambrai Cathedral
Figure 2. Hayne de Bruxelles, *Virgin and Child,* ca. 1454–55, oil on panel, 62.2 x 36 cm, Nelson-Atkins Museum of Art, Kansas City
Figure 3. Adornes family chapel (Jeruzalemkapel), 1470s–80s, Bruges

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Galaxy Formation and Evolution within the Cosmic Web Filaments

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INTRODUCTION

It is becoming clear that galaxy formation activity and growth of super-massive black holes (SMBHs) change across cosmic time. After the Big Bang, structure formation was initiated and matters were assembled, dragged by gravity. The first galaxies were born in hundreds of million years. The formation activity gradually increased and the universe underwent the most active phase, in which violent star-forming activity and rapid growth of SMBHs occurred, about 10–12 billion years ago. As time passed, however, more and more metals and dust were produced, which hid such intrinsically intensive activity and prevent us from accurately understanding the cosmic history. Such activity then gradually declined toward the present. Charting galaxy formation and evolution in the actively forming era, which is often obscured by dust, is thus essential.

KEYWORD: COSMIC WEB

For this purpose, one avenue is observations of galaxies and SMBHs. Another is the exploration of surrounding matter. Galaxies possess only less than 1% of the total mass of matter in the Universe and only around 20% of ordinary matter. Models of cosmological structure formation in a cold dark matter universe predict that the bulk of ordinary matter assembles in a cosmic web of sheets and filaments as a consequence of gravitational collapse. The cosmic web is the main reservoir of baryons and play a critical role in shaping galaxy evolution. Thus, we need to comprehensively understand the cosmic web, galaxies, and SMBHs, which have a wide variety of scales and densities. Unfortunately, although most baryons are in these filaments, their low density, low temperatures, and low metal abundance make them notoriously hard to observe. Indeed, the cosmic web is predicted to emit HI Lyα 1216 arising from fluorescence induced by the UV background (UVB). However, due to the intrinsic low surface brightness, detection of the emission from the intergalactic filaments has remained elusive so far.

NEW FINDINGS

To obviate to this limitation, one can turn to regions where the local radiation field boosts the Lyα emission, compared to regions that are only illuminated by UVB. The boosted emission from the cosmic web is expected to have detectable Lyα surface brightness in the presence of a high density of ionizing photons. Galaxy overdensity in the early Universe, a proto-cluster, can provide an ideal laboratory, owing to high density of matter and a number of ionizing sources. The local radiation field can boost the Lyα emission, compared to regions that are only illuminated by UVB. Furthermore, Lyα surface brightness can also be boosted in the node as a result of complex phenomena, including ionization, cooling radiation, and scattering. Following such a new prescription developed by us, we successfully reported the detection of rest-frame ultraviolet Lyman-alpha radiation from multiple filaments at z=3 (z is redshift; it corresponds to 11.5 billion years ago). The network of filaments was found to connect individual galaxies across a large volume, allowing it to power dust-obscured activity, intense star formation, and black-hole growth

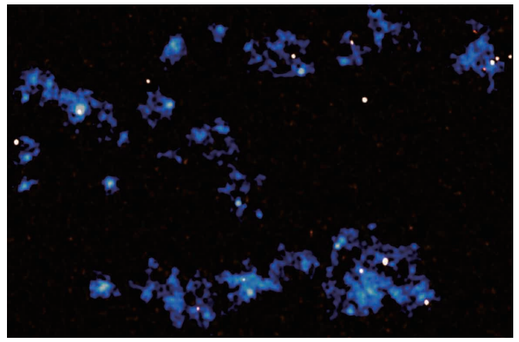

Figure legend. Cosmic web filaments found in this work. Extended Lya emission are shown across the panel (0.9x1.3Mpc at z=3.1 in size). Background image is the 1.1mm map taken with ALMA. Dusty starburst galaxies ubiquitously distribute along the filaments, which suggests that cosmic web fuels such active galaxy growth.

(Figure, Ref. (1)). The groundbreaking results tell us the arrival of a new era in which we can directly observe and investigate the cosmic web in the early universe.

RESEARCH OBJECTIVES

We are in the initial phase: a small part of the cosmic web has been (finally) captured. We are further developing the work in several ways. The first theme is to obtain a whole picture of the gaseous network and association of galaxies. The Subaru telescope in Hawaii provides a strong tool, utilizing its capability to observe a wide sky area. Our ongoing 100 hours intensive survey will uncover the cosmic web on a cosmological scale, together with deeper spectroscopy in 3D taken with other telescopes. The second theme is to unveil the interplay between the cosmic web and galaxies. How do galaxies obtain mass, metals, and angular momentum? How much gas is actually funneled onto galaxies or expelled out from galaxies during the forming phase? On the basis of intensive observational campaigns of cosmic web and galaxies, we will uncover how cosmic web actually regulate galaxy formation in the early Universe. The third theme is to uncover the co-evolution of galaxies and SMBHs. One of the big challenges in this theme is the mass measurement of heavily obscured SMBHs. We believe our method can achieve it, using the James Webb Space Telescope and ALMA. With these multi-epoch/scales/phases strategy, the following overarching questions will be answered.

- How did the Universe assemble matter in the cosmic history?
- How did the Universe shape galaxies and SMBHs through the cosmic web?

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Cell Polarity in Plants: Exploring Polar Nutrient Transport and the Fundamental Cell Polarization Machinery

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INTRODUCTION

Plants have developed sophisticated tissues and organs, which are complex and highly functionalized to adapt to terrestrial environments. Cell polarity plays a key role in the coordinated developmental processes in plants and is also required for the efficient transport of nutrients from the roots to the shoots for homeostasis and growth. However, the molecular framework that regulates cell polarity has not been elucidated in plants. I have been studying cell polarity in plants by focusing on unique proteins that polarly localize in the cell membrane.

POLARITY MAINTENANCE BY ENDOCYTOSIS

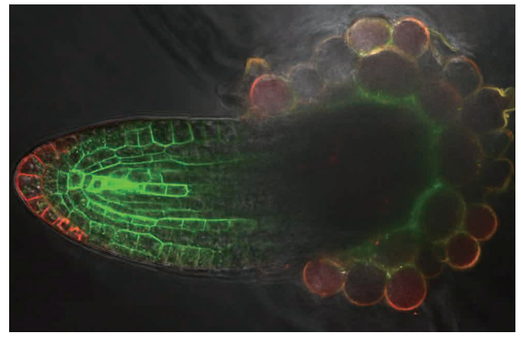
Boron is an essential nutrient for plants. In the roots of the model plant *Arabidopsis thaliana,* boron is mainly taken up from the soil by the boric acid channel NIP5;1 and transported to the vasculature by the borate transporter BOR1 when the environmental boron concentration is limited.[1] Interestingly, these proteins are localized in the plasma membrane, with distinct polarities;[1] NIP5;1 and BOR1 are localized in the outer (soil-side) and the inner (stele-side) domains of the plasma membrane, respectively (Figure). The polar localization of these proteins is crucial for the efficient directional transport of boron in plants under low-boron conditions. We investigated how the polar localization and intracellular trafficking of these proteins are controlled in plant cells.

Plant root cells, except endodermal cells, do not have a diffusion barrier such as the tight junction that restricts the diffusion of membrane proteins and maintains the polar domains in animal epithelial cells. However, polar localization of NIP5;1 and BOR1 is kept in various cells. This phenomenon can be explained by constitutive transcytosis—cycling of the protein transport to the polar domain and removal from the opposite domains. Through reverse genetic analyses, we found that the clathrin adaptor protein complex-2 (AP-2) is required for the constitutive endocytosis and polar localization of both NIP5;1 and BOR1, indicating that endocytic removal of the proteins from the opposite domains is essential for the maintenance of the polarity.[2, 3, 4]

When the boric acid concentration in the rhizosphere is elevated, Arabidopsis plants need to remove the BOR1 protein from the plasma membrane by endocytosis and subsequently transport it into the vacuole. This vacuolar degradation of BOR1 is important to avoid excessive accumulation of boric acid.[1] We found that the endocytic degradation of BOR1 normally takes place in mutants lacking the AP-2 subunits, suggesting that Arabidopsis utilizes the AP-2-dependent and -independent machinery of clathrin-mediated endocytosis for BOR1 trafficking.[4]

FUTURE FOCUS

My research focus has been shifting to a more fundamental mechanism underlying cell polarization since I moved to Nagoya University. Recently, I found a unique membrane-residing protein that is localized in the soil-side domain of the plasma membrane in the epidermal and cortical



A lateral root of *Arabidopsis thaliana*. The boric acid channel NIP5;1 (red) and the borate transporter BOR1 (green) are localized in the outer (soil-side) and inner (stele-side) domains of the plasma membrane, respectively, for directional transport of boron toward the vasculature.

cell layers, whereas the polarity domain has switched to the stele-side domain in the endodermal cell layer. I named this phenomenon "polarity switch," and it is possibly regulated by a small change in the combination of post-translational modifications in the protein or by a membrane trafficking factor expressed in a cell layer-specific manner. I expect that studying the polarity switch will uncover a minimal determinant for the polar localization of proteins in plants.

I am also undertaking chemical genetics to identify the cell polarization factors. Many small compounds, which inhibit the polar localization of BOR1, have been isolated, thanks to a great collaboration with the ITbM Chemical Library Center. These compounds likely interfere with specific proteins required for cell polarization, endocytosis, or endomembrane trafficking. Identification of the proteins targeted by the compounds will provide fundamental insights into cell polarity in plants.

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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.

Kunio AWAGA
Director

Affiliation : Director of Nagoya IAR / Professor of the Graduate school of Science
Research Field : Solid-State Chemistry

Research Interests

Prof. Kunio Awaga is pursuing novel electronic and electrochemical functions by creating characteristic structural topologies using molecular materials. His research group aims for win-win results in both fundamentals and applications by consistently carrying out synthesis of topological molecular materials, exploration of fundamental physical properties, and device development for organic electronics and energy storages.

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

Research Interests

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.

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Deputy Director

Affiliation : Deputy Director of Nagoya IAR / Professor of the Graduate School of Law
Research Field : Political Sociology, Politics

Research Interests

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.

Yoshitaka ITOW
Deputy Director

Affiliation : Deputy Director of Nagoya IAR / Professor of Institute for Space-Environmental Research
Research Field : Cosmic ray physics, Neutrino and dark matter

Research Interests

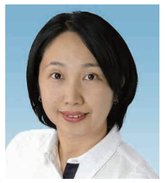
My main research interest is cosmic ray physics, where particle physics and astrophysics cross over. I have been working for neutrino physics at Super-Kamiokande for many years, and now promoting Hyper-Kamiokande, a future large water Cherenkov detector. I am also searching for dark matter, considered unknown neutral particles, by a liquid xenon detector in the XENONnT experiment in Italy. I also conduct LHCf and RHICf experiments dedicated to measuring very forward photons and neutrons at LHC and RHIC for a precise understanding of air showers of high energy cosmic-rays.

Yukinori KAWAE
Full-Time Faculty

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

Research Interests

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.



Satomi KANNO
Full-Time Faculty

Affiliation : Associate Professor at Nagoya IAR
Research Field : Plant Physiology, Plant nutrients

Research Interests

My research interest is understanding plant growth adaptation mechanisms according to environmental nutrients conditions. Plant senses internal and external ion level and controls the ion transport system to optimize their growth. I am working on these mechanisms focusing on phosphate, one of the macronutrients for plant growth, by using molecular biology technics and imaging technologies to trace ions in the living plants.

Tsutomu FUKUDA
Full-Time Faculty

Affiliation : Designated Lecturer at Nagoya IAR
Research Field : Particle Physics, Astrophysics

Research Interests

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.

IAR Steering Committee

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

Kenji KADOMATSU
Steering Committee

Affiliation : Vice President of Nagoya University / Professor of the Graduate School of Medicine
Research Field : Biochemistry

Research Interests

My research interest lies at the intersection of glycans and nerves. We have found that glycans regulate neuroaxonal regeneration and synapse formation. On the other hand, I am currently working to establish an all-Japan system for acquiring comprehensive human glycan structural information to develop the foundation for life science.

Kumiko KATO
Steering Committee

Affiliation : Professor of the Graduate School of Humanities
Research Field : Southeast Asian History, Tai History

Research Interests

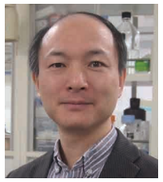
My main research interest is in the early modern history of mainland Southeast Asia and southwestern China. These areas had many Tai (Dai) premodern states; I have been especially interested in one such state, Sipsongpanna, which became the Xishungbannna Dai Autonomous Prefecture in the late 1950s. Recently, my research has focused on Qing China's views of Sipsongpanna and other Tai states in the eastern Shan States of Myanmar and northern Thailand.

Shin NAYATANI
Steering Committee

Affiliation : Professor of the Graduate School of Mathematics
Research Field : Differential Geometry

Research Interests

I have worked on various subjects and problems in differential geometry as well as its applications to other fields in mathematics. For a long period I was devoted to the study of rigidity of actions of discrete groups on spaces by geometric method. Recently I'm most interested in the eigenvalue maximization problem. Here the eigenvalue means the eigenvalue of the Laplacian of a curved space, and the problem is to maximize this quantity over all possible shapes of the space. Though this is primarily an analytic problem, it is closely related to a geometric problem to find the best realization of a given space in a Euclidean space.



Kazuhiro NAKAMURA
Steering Committee

Affiliation : Professor of the Graduate School of Medicine
Research Field : Autonomic Neuroscience, Physiology

Research Interests

My research focuses on the brain neural circuit mechanisms of homeostatic physiological functions in mammals, such as body temperature regulation, fever, and stress responses. These functions are essential for sustaining life. The circuit mechanisms also function for the defense from various environmental stresses, such as infection, enemies, heat, cold, and starvation. By combining state-of-the-art molecular biological techniques with in vivo physiological and neuroanatomical experiments, I am pursuing to unify the circuits into a central neural network fundamental for homeostasis.

Akihiko YANASE
Steering Committee

Affiliation : Professor of the Graduate School of Economics
Research Field : International economics, Economic theory

Research Interests

I have worked on theoretical studies in international economics, public economics, environmental economics, and industrial organization. My current research topic is mainly on the interactions among international trade, market competition, and government policies. For government policies, public investment in infrastructure development is of particular interest. I develop static or dynamic game models that capture the interactions between governments and/or economic agents, analyze the properties of equilibrium outcomes of the games, and apply the theoretical results to practical policy issues.

Yoshinobu
BABA
Steering Committee

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

Research Interests

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.

Shigeki
KIYONAKA
Steering Committee

Affiliation : Professor of the Graduate School of Engineering
Research Field : Chemical Biology

Research Interests

My research focus is understanding the molecular basis of the complex biological system using "chemistry". One of the research directions is to develop new chemical tools for visualizing or controlling neurotransmitter receptors in neurons, to understand the physiological roles of proteins in the brain. Another is manipulating target cells of interest in organs or live animals by combining chemical approaches with genetic engineering, to clarify the roles of the cells in living animals.

IAR
Visiting Professor & Designated Professor

Takaho
ANDO
Visiting Professor

Affiliation : Visiting Professor at Nagoya IAR / Professor at Chubu University
Research Field : History of Social Thoughts

Research Interests

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

Yasuro
ABE
Visiting Professor

Affiliation : Visiting Professor at Nagoya IAR
Research Field : Medieval Japanese Culture and Texts

Research Interests

My research focuses on the religious texts of medieval Japan, emphasizing their context as objects of religious cultural heritage. I have strived to demonstrate how religious texts, images, and other objects have been used, transmitted, and understood from the Middle Ages through the present day. Through the analysis of concrete examples—such as the cult of Prince Shōtoku, and various conceptions of the "sacred" in medieval Japan—I have demonstrated that these texts mutually interact not only with each other, but also with external works of literature, performative arts, and iconography.

Dapeng
CAI
Visiting Professor

Affiliation : Visiting Professor at Nagoya IAR / Professor at Nanzan University
Research Field : International Economics

Research Interests

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.

Atsushi
J. NISHIZAWA
Visiting Associate
Professor

Affiliation : Visiting Associate Professor at Nagoya University /Associate Professor at
Gifu Shotoku Gakuen University
Research Field : Observational Cosmology, Astronomy

Research Interests

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.

YLC
Program Faculty

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

Teppei
KITAHARA
Young Leaders
Cultivation Program
Faculty
(YLC)

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

Research Interests

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.

Hiroki
FUJINO
Young Leaders
Cultivation Program
Faculty
(YLC)

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

Research Interests

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.

Yumi
BAMBA
Young Leaders
Cultivation Program
Faculty
(YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Division for Integrated Studies,
Institute for Space-Earth Environmental Research
Research Field : Solar Physics, Space Weather

Research Interests

Solar eruptions, such as "solar flares" and "coronal mass ejections (CMEs)" are sometimes impact to space environment around the Earth. However, onset mechanisms and propagation processes of those phenomena are not yet revealed. Therefore, our ability of "space weather forecast", which predict disturbances of space environment near the Earth, does not satisfy requirements from modern society, which rapidly promote space development. I aim to understand the onset and propagation processes of solar eruptions by comparison of various observational data and numerical modelings.

Yoko
MIZUTA
Young Leaders
Cultivation Program
Faculty
(YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Institute of Transformative
Bio-Molecules (ITbM), Nagoya University
Research Field : Molecular biology, Plant reproduction

Research Interests

In the flowering plants, sexual reproduction occurs in a flower. In the flower, pollen lands on the female tissue, and pollen germinates pollen tube and deliver the sperm to the egg cell. After that, fertilization occurs. During this process, it is necessary to fertilize without waste both males (pollen tubes) and females (ovules) to produce more seeds in nature, but the whole picture of such precise plant fertilization mechanism is unclear. To understand this mechanism, two-photon imaging, expression and phylogenic analyses will be performed. I developed deep-and live-imaging technics using two-photon microscopy. The pollen tube mediated gene modification technology is also developed.

Aaron
CHAN
Young Leaders
Cultivation Program
Faculty
(YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Mathematics
Research Field : Representation theory, category theory

Research Interests

I research in the representation theory of algebras and related structures, which originates from the approximating (i.e. ' representing') abstract mathematical objects using linear algebra. I am particularly interested in tilting theory. This studies different methods in modifying a category of representations in a way that preserves homological properties. I am also involved in a similar theory-cluster-tilting theory-which is a theory in the algebraic analogue of resolution of singularities.

Angela
MENESES-
GUTIERREZ
Young Leaders
Cultivation Program
Faculty
(YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Disaster Mitigation Research Center
Research Field : Crustal deformation

Research Interests

I study crustal deformation through geodetic observations (Global Navigation Satellite Systems (GNSS), Interferometric Synthetic Aperture Radar (InSAR), etc.), focusing on the analysis of earthquake-related processes. I am interested in distinguishing strain accumulation due to elastic processes in the Earth, released in the form of large earthquakes, from inelastic processes which are irreversible and cause strain to accumulate over geological time.

Daichi KASHINO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Science
Research Field : Astrophysics

Research Interests

The present-day Universe contains a variety of elements and is a rich world in which stars, galaxies, and life exist. I aim to understand the material evolution in the Universe. We are especially paying attention to a phenomenon called cosmic reionization that completed until about 1 billion years after the Big Bang. Cosmic reionization is a phenomenon in which the Universe, which was initially filled with electrically neutral hydrogen gas, was ionized by the ultraviolet rays emitted by stars and galaxies born in the early Universe, and is the first step in material evolution. We are carrying out various observations using large telescopes to understand the physical process of reionization.

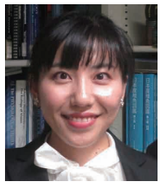
Tomoya NAKAYAMA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Bioagricultural Sciences
Research Field : Animal physiology, Molecular biology

Research Interests

In temperate zones of the earth, dynamic environmental fluctuations occur at the annual seasonal cycle. To cope with these seasonal changes, many animals adapt their physiology and behavior. Although some of these seasonal activities, such as reproduction, growth and hibernation are known to be controlled by endogenous annual rhythmicity, which is called circannual rhythm, in some animals, the molecular mechanism is still unknown. We use medaka fish as a model to understand this mechanism.



Hanako HAGIO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Bioagricultural Sciences
Research Field : Fish Neuroscience

Research Interests

Two ascending visual pathways to the telencephalon are present in mammals. However, some species of fish possess two visual pathways, while others one pathway. Our studies in several fish species suggest that the common ancestor of actinopterygians possessed two pathways, and later one pathway was lost in the common ancestor of acanthopterygians, which include many fishes for fisheries. We try to elucidate functions of visual pathways using genome editing and microscopic live imaging analyses on visually-evoked neural activities. We would like to find visual stimuli attractive for fishes and utilize its characteristics in fishing gear to contribute to the academic field and fisheries industry.

Hisashi HAYAKAWA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Institute for Space-Earth Environmental Research
Research Field : Space Weather, History, Solar Activity

Research Interests

Hisashi Hayakawa is working on historical space weather events and long-term solar activity based on the contemporary analog records. He consults analog records for sunspots, solar flares, geomagnetic measurements, and auroral sightings to reconstruct chronology and intensity of the space weather events, namely sequence of solar flares, interplanetary coronal mass ejections, geomagnetic storms, and auroral displays. He also analyses historical sunspot records to quantitatively reconstruct and improve long-term solar variability. Thus he chronologically extends the time series of the existing scientific databases for centuries and quantitatively contextualises the modern data into longer time series.

Manabu BESSHO-UEHARA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Science
Research Field : Biology, Evolution, Bioluminescence

Research Interests

Bioluminescence, light production by living organisms, is one of the most common traits of the animals on the Earth (75-90% of macroscopic individuals in the ocean can emit light). Bioluminescence evolved among diverse taxa independently, which is the best model to study evolution. The molecular mechanisms involved in the light emission are poorly understood except for a few well-studied animals. In addition, I recently discovered kleptoprotein, stealing protein from the prey, for bioluminescence. I study the molecular mechanisms involved in the luminescent reaction, luciferin and luciferase, to understand extreme convergent evolution of bioluminescence.

Qidong ZHOU

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Science
Research Field : Particle physics and astrophysics

Research Interests

Dark matter, matter dominance universe, there are phenomena still could not be explained by the current framework of theory in particle physics, the standard model (SM). To explore the new physics beyond standard model, it is a useful approach to precisely measure the decay reactions under the environment just like the beginning of our universe which is created by colliding-beam accelerator. Belle II is an experiment dedicated to explore new physics beyond SM based on this approach. It has already started collecting data since April 2018. I am preforming the detector upgrade and data analysis in parallel. In coming years, these data will help us to understand the origins of matter and the universe.

Shinnosuke ISHIZUKA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Institute for Space-Earth Environmental Research
Research Field : Laboratory Atmospheric and Astrochemistry

Research Interests

Nano to sub micrometer sized particles is ubiquitous in the nature and play central roles in chemical evolution. Cosmic dust diffused into interstellar space act as catalyst providing complexed molecules and are building blocks of the solar system. Aerosols in Earth's atmosphere impact the climate system by light absorption and scattering and by promoting cloud formation. However, little attention has been paid for specific-chemistry of the fine particles. We experimentally reveal how the tiny characters affect their lives.

Sotaro SUGISHITA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Science
Research Field : Quantum Gravity, Quantum Field Theory

Research Interests

My research field is theoretical physics, with a particular interest in quantum gravity, a quantum theory of spacetime. Quantum gravity provides a theoretical explanation for the mystery of how our universe begins. The theory describing our universe is still under construction. Holography is the hypothesis that a quantum spacetime emerges like a hologram from a low-dimensional spacetime. We have not understood well the mechanism of this hypothesis and to what extent we can use it. I am working on the holography from various points of view to construct the theory of quantum gravity.

Yuichiro TADA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Science
Research Field : Early Universe

Research Interests

My main interest is physics of the early stage of our universe. In particular, I have so far focused on inflation, the accelerated expansion preceding the hot Big-Bang universe. I have proposed a novel analysis approach to inflation with use of mathematics of random noise called stochastic calculus. Primordial black hole is also my research topic as a direct consequence of particular dynamics of the early universe. I'm also working on several production mechanism of gravitational waves

Ryo HIGUCHI

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Humanities
Research Field : History of Architecture

Research Interests

While the framework of Orthodox Christianity and wall painting was standardised during the middle Byzantine period (9th–12th centuries), the forms of the architecture followed various types while the churches themselves had different roles. The purpose of my study is to investigate why middle Byzantine architecture took various architectural forms and to understand the role of the churches in Byzantine society, through a detailed and comprehensive analysis of surviving architecture.

Asuka HIGO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Center for Gene Research
Research Field : Plant development, Sexual reproduction

Research Interests

Annual plants need to orchestrate the growth and death cycle of whole body to end the sexual reproduction before dying. The signals and receptors for this important regulation is totally unknown. I want to identify the integrator secreted from the stem cell tissue and its receptor and also understand the evolution of plant life cycle variation : annual vs perennial plants.

Minoru HIROSE

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Mathematics
Research Field : Number Theory

Research Interests

I am working on multiple zeta values and its surroundings. Multiple zeta values are concrete numbers defined by simple infinite series, but their algebraic structure is deep and interesting. Also, multiple zeta values are related to various areas such as mixed motif theory, Lie algebras, absolute Galois groups, knot theory, fundamental groups of moduli spaces, modular forms, calculations of amplitudes in string theory, and so on.

Jie HUANG

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Humanities
Research Field : Cultural anthropology

Research Interests

My research interest lies primarily in the cultural anthropology studies on the dynamics or contemporary development of folk beliefs in Southeast Asia countries. My research mostly focusing on the syncretism of indigenous beliefs, with foreign religions in the substratum of Mainland Southeast Asian societies from the 20th century to the present. Through case studies of the syncretism of the city pillar shrine and other folk beliefs in urban Thailand, my research tries extending new theories of folk beliefs in Southeast Asian studies.

Matthew Paul SU

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant professor at Nagoya IAR and Graduate School of Science
Research Field : Mosquito neuroscience and behavior

Research Interests

Male mosquitoes rely on hearing to locate females for mating. Novel control tools which interfere with mosquito hearing are thus highly promising, as they could prevent copulation from occurring. However, our understanding of the underlying bases of mosquito audition remains poor. My research focuses on the elucidating the molecular and neuronal bases of mosquito hearing behaviors in order to improve this understanding. In particular, I am interested in the connections between mosquito mating, hearing and their circadian clocks, as these clocks influence the time at which mating can occur.

Takuya FURUTA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Law
Research Field : History of Political Thought

Research Interests

I am an historian of Western political ideas, interested in how and when various political concepts that we are using today have been formed and re-formed. My current research focuses on exploring the 'identity' of the history of political thought—its purpose, methodology, and contemporary relevance. In particular, I am engaged in contextualizing the ideas of the "Cambridge school" in intellectual history.

Hirotaka IIJIMA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Medicine
Research Field : Rehabilitation medicine, Mechanobiology, Aging, Systems biology

Research Interests

Aging is a progressive degenerative process that results in an increased risk of chronic diseases. I am proposing a new interdisciplinary research field, "Rejuvenative Rehabilitation", the interdisciplinary field that integrates approaches from rehabilitation medicine together with rejuvenative medicine with the ultimate goal of the development of innovative anti-aging therapeutics which maximize physical function.

Sanae ITO

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Humanities
Research Field : Assyriology

Research Interests

Assyriology is the philology dealing with cuneiform texts. My main research interest is in the political and intellectual history of the Assyrian Empire (747-c. 612 BCE) in relation to the Assyrian royal correspondence. My current research focuses on the Assyrian imperial communication system. This system enabled the empire to implement state policies for the cohesion of the vastly expanded state.

Elena KOZGUNOVA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Field : Plant cell division

Research Interests

The development of multicellular organisms depends on the ability of cells to make accurate copies of themselves; this is the core function of mitotic cell divisions in both animals and plants. However, limited progress has been made in elucidating plant-specific mechanisms of mitosis, in part due to slow speed of functional gene analysis in the common model plant species, which are diploid or polyploid with long life cycles. These limitations do not apply to the moss *Physcomitrium patens,* also known as "green yeast" of plant molecular biology. Using CRISPR/Cas9 gene editing and *P. patens* I plan to pursue genome-wide screen to identify novel factors involved in plant development and stress tolerance.

Shinji MIYAJI

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Field : Theoretical Physics

Research Interests

My primary research fields are quantum gravity, quantum field theory, and quantum information theory. I am particularly interested in understanding the non-perturbative physics of quantum gravity, such as the black hole interior and the initial singularity of our universe, by using quantum information theoretic quantities. I am also interested in applying these quantities to condensed matter physics using inspirations from gravity theory.

Satoko NAKAMURA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Institute for Space-Earth Environmental Research
Research Field : Space Weather

Research Interests

The modern society, which is supported by advanced information systems and space technology, is at an increasing risk from severe space weather disasters. This research develops the model for the risk assessment associated Geomagnetically Induced Currents on Japanese Power Grid. We refine our previous physics-based model under this wide range of domestic and international cooperation, including researchers on the space physics, the engineering, and power companies.

Miyako SUGIYAMA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Humanities
Research Field : Art history, Cultural anthropology

Research Interests

Miyako Sugiyama is an art historian specializing in early Netherlandish art. She received her Ph.D. in art history from Ghent University in 2017. Her research focuses on the functions of images and the diverse relationships between art and devotional practices in the late medieval Netherlands. She published various books and articles on the topic, including *Images and Indulgences in Early Netherlandish Painting.* Currently she is a designated assistant professor at Nagoya University.

Hideki UMEHATA

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Graduate School of Science
Research Field : Astronomy, Astrophysics

Research Interests

The Universe is thought to generates interconnecting filaments of baryons and dark matters called the cosmic web, within which galaxies form and evolve. To test this paradigm observationally and chart the history of matter assembly, I will develop and lead the new research field, observational study of cosmic web and galaxy formation, using ALMA, Subaru, and other cutting-edge facilities.

Akira YOSHINARI

Young Leaders Cultivation Program Faculty (YLC)

Affiliation : Designated Assistant Professor at Nagoya IAR and Institute of Transformative Bio-Molecules Sciences
Research Field : Plant Biology

Research Interests

Cell polarity plays a key role in the coordinated developmental processes in plants. However, the molecular framework to regulate cell polarity is still unclear. I will uncover the mechanism underlying cell polarization and polarized distribution of membrane proteins in plants by novel approaches relying on chemical genetics and proteomics.

Science Communicator

Tatsuro AYATUSKA

Science Communicator

Affiliation : Science Communicator
Research Field : Science Communication

Research Interests

Science communication that coordinates the context between various stakeholders is important for gaining a positive understanding of research and moving society forward. In my career, I have been involved in various science communication activities ranging from fan science to risk communication. While analyzing the state of public communication, I will enhance the showcase function of the Institute for Advanced Research by using various methods as tools, including article writing, movie distribution, and event planning.