Five Dialogues

for Future Research and Science with Early Career Researchers

Program for the Development of Next-generation Leading Scientists with Global Insight (L-INSIGHT)

Spin-off programme from HeKKSaGOn, 2021

Online Forum

Tuesday 23 November, 2021
17:30-JST | 9:30-CET

Five Dialogues *for* Future Research and Science *with* Early Career Researchers


UOK
TD

Most of the time, breakthroughs in issues that cannot be resolved individually are created by third parties asking questions that seem ridiculous.

KONO Yasuyuki

The awareness of differences in the historical and cultural backgrounds of researchers can serve as a driving force when resolving scientific questions.

Stefan Norra

Making our questions shareable and relevant to the target is important.

TANAKA Motomu

PART I
–
OUTLINE

Contents

L-INSIGHT

The Program for the Development of Next-generation Leading Scientists with Global Insight (L-INSIGHT) aims to develop, validate, and spread programs to train the next-generation of world-class researchers with global insight who can spearhead new paths to the future.
Program Director: Prof. Dr. YOSHIKAWA Minako Jen

HeKKSaGOn

The German-Japanese University Alliance (HeKKSaGOn) was founded in 2010 as an association of three German and three Japanese universities. HeKKSaGOn stands for the Heidelberg – Kyoto – Karlsruhe – Tohoku/Sendai – Göttingen – Osaka – alliance. The partner universities of HeKKSaGOn share the conviction that important global problems can be solved only through interdisciplinary and international cooperation and through the open exchange of knowledge. It places a strong value on high-quality teaching within an environment of internationally competitive research.

Introduction

On 23 November 2021, L-INSIGHT held the event “Five Dialogues for Future Research and Science with Early Career Researchers” that was organized in cooperation with Kyoto University, Heidelberg University, and the Karlsruhe Institute of Technology (KIT). This forum supports next generation of researchers in forming special international and inter-generational connections early in their careers in the hope of creating foundations for them to excel. This is a new initiative that was spun off the friendly relationship between German and Japanese universities fostered through the HeKKSaGOn (The German-Japanese University Alliance) framework, which is now in its eleventh year.

During this inaugural event of this new format, L-INSIGHT fellows and early career researchers mainly from the two German universities engaged in dialogues on trans-disciplinary topics proposed by the fellows in five parallel sessions. Futhermore, the group dialogues were chaired by 5 L-INSIGHT fellows of various fields. Up to four researchers from Heidelberg University and the KIT participated actively in each of these sessions and engaged in lively discussions, as did the audience comprised of individuals from a total of eighteen universities in Japan and overseas.

In the subsequent wrap-up session, the L-INSIGHT fellows who moderated the parallel dialogues shared their insights related to differences and similarities in perceptions between Germany and Japan and between different disciplines. They mentioned for example that due to the trans-disciplinary nature of the topics in the sessions, such opportunities for in-depth discussion are very much welcome. Also, they offered advice on trans-disciplinary research and approaches to discussions about such topics. Through the commentary offered by guests from all three universities, it was confirmed that differences in the historical and cultural backgrounds of researchers can serve as a driving force when resolving scientific questions. They additionally expressed their hope that this forum will continue to serve as an interdisciplinary discussion platform for early career researchers, and highlighted that it had, in fact, been an opportunity for fruitful discussions that transcended disciplines and generations.

The event shall be a starting point for subsequent visits of the L-INSIGHT fellows to Germany to deepen and expand the experiences and discussions sparked through the dialogues.

L-INSIGHT will continue to be creative to perpetuate this program for early career researchers as an open and international platform that transcends generations and disciplines.

On behalf of the organizers
–
Kyoto University
–
NAKANO Asa

Topics & Speakers

	Kyoto University	Heidelberg University	Karlsruhe Institute of Technology
| Opening |		| MC | Sabine Schenk [Heidelberg University Office, Kyoto (HUOK)]	
Opening remarks	Prof. Dr. TOKITOH Norihiro [Executive Vice President] Prof. YOKOYAMA Mika [Deputy Executive Vice-President, Director of Kyoto University European Center]	Prof. Dr. Matthias Weidemüller [Vice-Rector for Innovation and Transfer]	
| Parallel dialogues |			
Dialogue —— 1 **Quantification, control, and modeling of mechanical and dynamical alteration of cell and tissue towards detection and mechanistic understanding of disease**	Dr. YAMAMOTO Akihisa [Center for Integrative Medicine and Physics (CiMPhy), Institute for Advanced Study] Soft Matter Physics, Physics of Life	Dr. Falko Ziebert [Institute for Theroetical Physics] Research Group Physics of Complex Biosystems	
Dialogue —— 2 **What research do we need to do to reconcile the conflicts between biodiversity conservation and food security in developing countries?**	Dr. HONGO Shun [The Center for African Area Studies] Conservation Science, Wildlife Management, Primate Ecology	Dr. Katharina Brotzmann [Research group "Aquatic Ecology and Toxicology," EU-Project Horizon 2020 "EU-ToxRisk," Project "PharmaSea," Centre for Organismal Studies (COS)] Toxicology, Ecology, Zoology and Pharmaceuticals	Dr. Hjalmar Kühl [Max Planck Institute for Evolutionary Anthropology Department of Primatology] Ape Conservation Dr. Jochen Ait Müller [Department: Institute of Biological Boundary Surfaces] Molecular Biology
Dialogue —— 3 **What engineering research is expected from society in this "full-of-informatics" (e.g. AI, Drone, ICT) era? Any research field in the similar situations?**	Dr. TANAKA Tomohiro [Graduate School of Global Environmental Studies] Civil Engineering, Hydrology	Dr. Carolin Klonner [Institute of Geography] GIS	Tim Kerlin [Institute for Water and River Basin Management] Hydraulic Simulation (2D) of Urban Flash Floods—Flow Resistance Parametrization of Sheetflow Dr. Ralf Loritz [Department: Institute for Water and River Basin Management] Hydrology Dr. Andreas Schäfer [Geophysical Institute] Tsunami Risk and Hazard Dr. Hoang Thai Duong Vu [Institute for Water and Watercourse Development] Numerical Modeling
Dialogue —— 4 **Clarifying the most energetic particles in the universe**	Dr. FUJII Toshihiro [The Hakubi Center for Advanced Research/ Graduate School of Science] Astrophysics, Astroparticle Physics	Dr. Iryna Lypova [Genter for Astromony] Gamma Astronomy	Dr. Markus Roth [Group leader—Pierre Auger Observatory Institute for Astroparticle Physics (IAP)] Cosmic Rays
Dialogue —— 5 **How and where did life emerge? What did the first life look like? Is it possible to have other form of life?**	Dr. FUJII Yuri [The Graduate School of Human and Environmental Studies] Planetary Science, Astrophysics, Astronomy	Dr. Georg Lars Hildenbrand [Kirchhoff Institute for Physics (KIP)] Experimental Biophysics	
| General discussion |			
Comments from Guests	Prof. Dr. KONO Yasuyuki [Vice President, Director International Strategy Office]	Prof. Dr. TANAKA Motomu [Institute for Physical Chemistry] Physical Chemistry of Biosystems	Prof. Dr. Stefan Norra [Institute of Applied Geosciences]
Closing	Prof. Dr. YOSHIKAWA Minako Jen [Director, The Strategic Development Hub for Early Career Researchers, Center for Enhancing Next-Generation Research]		

I'm very pleased to host the spin-off program in my capacity as Director of the Kyoto University European Center that is also the HeKKSaGOn's Liaison Office. As many of you know, HeKKSaGOn is a university alliance founded in 2010 by six German and Japanese universities.

In its first phase, which ended in 2018, it organized nearly 50 symposia and workshops, exchanged more than 200 people, and co-authored 55 papers. Although the second phase of the Alliance is currently obstructed by the pandemic with little direct contact, we are able to organize events such as this one online, which is dedicated to the development of young researchers.

I would like to express my sincere gratitude to one of the key players, Professor Tanaka Motomu of Heidelberg University for agreeing to be a commentator here today. I would also like to express my sincere gratitude to Heidelberg University and Karlsruhe Institute of Technology who immediately understood the significance of our proposal and agreed to co-host this event.

Now, the environment of research is not all that bright. I can see some of this anxiety in the topics that the discussants today have chosen. However, I also hope that your curiosity will be broadened by the questions linked to these topics. I think it is important for ECRs to get in touch with other ECRs in the world to know each other.

I myself have now many good friends in European academia with whom I had had opportunity to work together when I was an ECR like you now. I sincerely hope that today's dialogue will stimulate your intellectual appetite and help you grow more and more. The Kyoto University European Center will continue to support you by promoting exchange between Japan and Europe and between Japan and Germany. Thank you.

Kyoto University
Deputy Executive Vice-President,
Director of Kyoto University European Center
–
Prof. YOKOYAMA Mika

Greeting 2

Also from my side, a warm welcome to all the participants. Great to see all these happy faces despite these, let's say complicated times. Of course, we would have loved to see each other in person. We all know this, but times are different. As was already mentioned by Dr. Yokoyama, this HeKKSaGOn collaboration is very dear to the heart of the university, having these strong links with Japanese Universities as well with our partners in Germany: the Karlsruhe Institute of Technology and the University of Göttingen. This is a wonderful network that is created, and I can also say personally, since I'm a quantum physicist by training, I have actually visited all of these places in Japan, also due to my scientific endeavors.

It's always great to be in Japan. I can imagine, I'm already missing the great food there and exchanging views with you, but that's what the times are currently about. When I look at the program, as we said already, we're facing really challenging times, but at the same time, you might also say we are facing amazing opportunities because there are so many interesting problems, and I should say that for physicists, the word problem is positively annotated.

We are facing lots of interesting problems that we have to solve and the time is there, and the possibilities are there, and what I can see here from the program, there's also this wonderful crowd of people around that is capable and able to solve these problems. If I look at your program, these are wonderful topics that they have chosen for this program. They are all being very timely, all being very important, and I have to say, I wish I had more time today to also sneak into one or the other session in particular, of course, the ones on most energetic particles in the universe or the questions, how life actually emerges, so wonderful topics, and it's great to be able to form these connections, even despite the fact that this is still in this kind of like virtual rooms. I'm looking forward to this great meeting. I wish you great success, and of course I hope to see all of you either here in Heidelberg next time—in the virtual background you can see the building of my office and labs—or during one of my visits when coming to these great places in Japan next time when this is possible. Enjoy the meeting and have a great time.

Heidelberg University
Vice-Rector for Innovation and Transfer
–
Prof. Dr. Matthias Weidemüller

Greeting 3

On behalf of Kyoto University, I'd like to welcome all of you to the launch of the spin-off program from HeKKSaGOn 2021. This program is an initiative among Heidelberg University, Karlsruhe Institute of Technology and Kyoto University. L-INSIGHT, which I will explain shortly, is pleased to bring you the "Five Dialogues for Future Research and Science with Early Career Researchers".

As you know, the role of researchers has become much more diverse as the nature of society and the industrial structure have changed. Young researchers will be engaged in a changing society that mankind has yet to experience. The human perspectives will broaden and thus provide the basis for success in specialized spheres if young scientists take on more challenges of future-oriented activities by building special connections at a young age and traversing different research fields, generations and national borders.

I, therefore, would like to acknowledge the tremendous effort made by all parties involved in the HeKKSaGOn Alliance, which has fostered the strong relationship between German and Japanese universities for the past 11 years since its inception. It is worthy of note that the Alliance now provides a platform open to many young researchers.

At Kyoto University, a new dynamism has evolved, L-INSIGHT, that is Program for the Development of Next-generation Leading Scientists with Global Insight. The program is sponsored by the Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), and aims to assist young researchers in equipping abilities to span various boundaries with broad overviews, astute perceptions, and foresight.

L-INSIGHT Fellows selected five trans-disciplinary topics today that they believe important in discussing future research development, including research environment and ideas in other spheres of research. I hope that highly motivated young researchers from Japanese and German Universities will acquire valuable insights through active discussions. It is hoped that a program like today's initiative can activate individual exchanges so that researchers will be able to build multilateral relationships across various boundaries.

I'd like to express my sincere gratitude to Professor Motomu Tanaka from Heidelberg University, Professor Stefan Norra from KIT, and Professor Yasuyuki Kono from Kyoto University, who have kindly agreed to take part in the young researchers' discussions as commentators.

Let me conclude by encouraging all of you, including online participants, to engage yourselves actively in asking questions and/or sharing your comments.

Please enjoy today's forum. Thank you.

Kyoto University
Executive Vice-President
–
Prof. Dr. TOKITOH Norihiro

Programme

JST	CET		
17:30	09:30	Opening	Opening remarks
17:40	09:40	Parallel dialogues	Dialogue ——— 1 **Quantification, control, and modeling of mechanical and dynamical alteration of cell and tissue towards detection and mechanistic understanding of disease**
			Dialogue ——— 2 **What research do we need to do to reconcile the conflicts between biodiversity conservation and food security in developing countries?**
			Dialogue ——— 3 **What engineering research is expected from society in this “full-of-informatics” (e.g. AI, Drone, ICT) era? Any research field in the similar situations?**
			Dialogue ——— 4 **Clarifying the most energetic particles in the universe**
			Dialogue ——— 5 **How and where did life emerge? What did the first life look like? Is it possible to have other form of life?**
18:55	10:55	General discussion	Wrap-ups from each group (5min. × 5groups)
19:25	11:25		Comments from Guests
19:40	11:40		Closing

PART II
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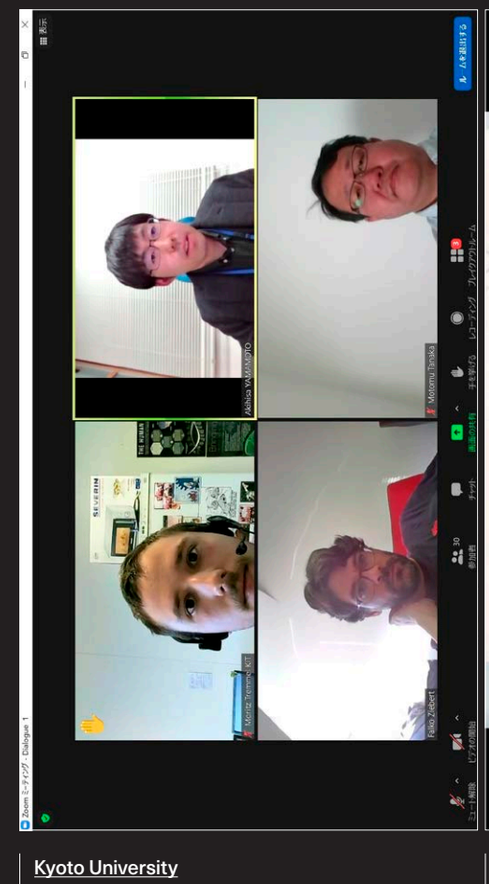
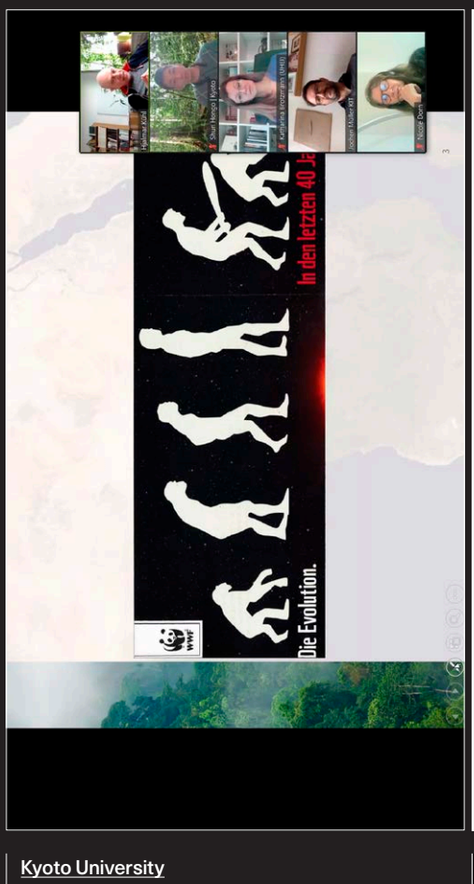
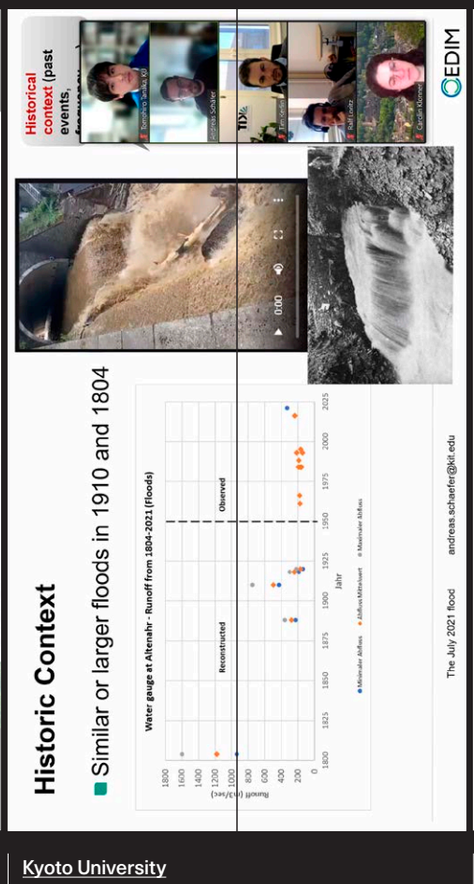
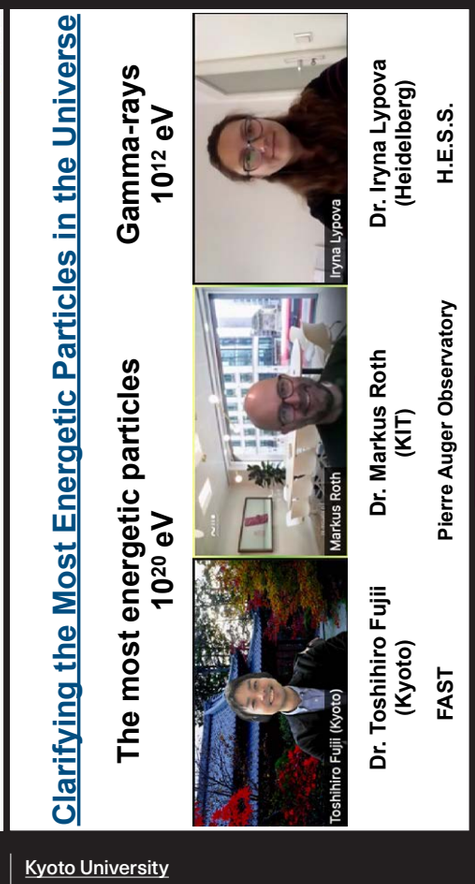
DIALOGUES









Kyoto University
Dr. YAMAMOTO Akihisa

Heidelberg University
Dr. Falko Ziebert

1

→ 12p

Kyoto University
Dr. HONGO Shun

Heidelberg University
Dr. Katharina Brotzmann

Karlsruhe Institute of Technology
Dr. Hjalmar Kühl
Dr. Jochen Ait Müller

2

→ 15p

Kyoto University
Dr. TANAKA Tomohiro

Heidelberg University
Dr. Carolin Klonner

Karlsruhe Institute of Technology
Mr. Tim Kerlin
Dr. Ralf Loritz
Dr. Andreas Schäfer
Dr. Hoang Thai Duong Vu

3

→ 19p

Kyoto University
Dr. FUJII Toshihiro

Heidelberg University
Dr. Iryna Lypova

Karlsruhe Institute of Technology
Dr. Markus Roth

4

→ 23p

Kyoto University
Dr. FUJII Yuri

Heidelberg University
Dr. Georg Lars Hildenbrand

5

→ 26p

Dialogue 1

Quantification, control, and modeling of mechanical and dynamical alteration of cell and tissue towards detection and mechanistic understanding of disease

Dr. YAMAMOTO Akihisa
Dr. Falko Ziebert

Soft Matter Physics, Physics of Life
Research Group Physics of Complex Biosystems

Background

The genetic and molecular properties of cells have been intensively studied, and changes in molecular signatures are utilized for detection of disease and deterioration of living organisms. On the other hand, the effect of such alterations on mechanical and dynamic properties of cells and tissues is still not well understood. In order to understand how the progression of diseases is associated with the change in physical properties of cells and tissues, orchestration of clear and minimally invasive observation of structure, fine control of external stimuli and environment, and theoretical modeling of mechanics and dynamics is essential. It is also critical to comprehensively understand how these changes arise from the alteration of molecular mechanisms and metabolism. Unraveling mechanical and dynamic properties of cells and tissues can be also a novel tool for disease detection, which can be complementary to conventional approaches.

Dr. YAMAMOTO Akihisa

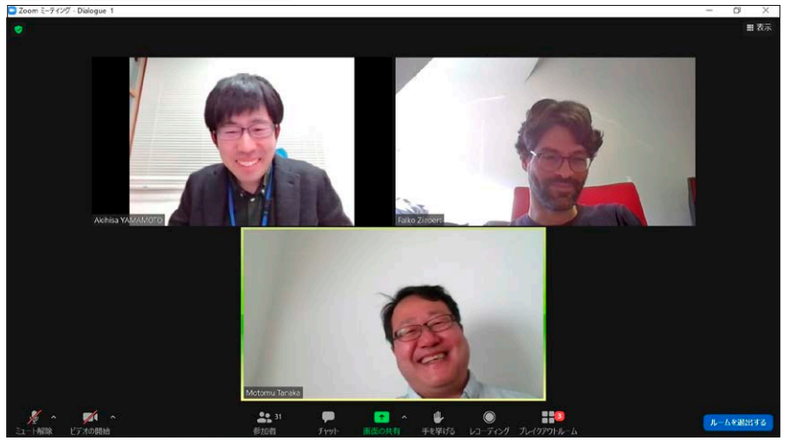
Summary

In Dialogue One, we discussed the quantification, control, and the modeling of cell and tissue for understanding the disease. In the beginning, I and the other speaker, Dr. Falko Ziebert, presented each research. From my side, I talked about how cancer cells move and deform in the experimental system, how the tissue changes its collective order of cells depending on the disease, and how we can use the quantitative tools to understand or discriminate the disease state in single cell and tissue scale. Afterwards, Dr. Ziebert gave a presentation about how we can understand the migration and deformation of the cells by developing the theoretical models with the equations, which is applicable not only for just single cells, but also for the collective cells. He also talked about how one can describe the movement of cells depending on the surrounding environment of cells.

In the discussion part, we talked about how we can understand the molecular mechanisms which determines the cell movement and deformation. It's always difficult to connect the physics to biological problems because the physics is trying to generalize the phenomena, and it is very important in biology to understand what each molecule and protein are doing in the system. We talked about how we can understand the physical properties of cells by utilizing the novel techniques such as optogenetics that can control cells with the light as external stimuli to change the expression level of the molecules.

We also had some questions from the audience about how we can understand that cancer metastasis from the perspective of the stiffness of the tissue, and if it is important to understand all the molecular mechanisms behind which determine the dynamics of the cells. There are still a lot to discuss, especially to make the physics and medical science get closer. We need more opportunities for scientists from the natural science and medical science to talk about the problems and potentials of what we can do together.

The important point is, in physics, there are still a lot to explore, to understand the living system. I believe there should be a lot of things that is unclear in the field of medical science that the physics can help understand. This was quite active and stimulating discussion at least for me, and I hope everyone shared the excitement. Thank you very much.



Slide

Dialogue 1

Quantification, control, and modeling
of mechanical and dynamical alteration of cell and tissue
towards detection and mechanistic understanding of disease

- Disease in living system is associated with the change in genetic and molecular properties of cells and tissues:
  Gene, protein, metabolism, …
- Informatics has been drawing wide attention:
  Big data, multiomics, machine/deep learning, …

- ✓ How does the change in genetic and molecular profile affect on the physical properties of cells and tissues, and vice versa?
- ✓ How much can we understand the progression of disease through mechanics and dynamics?

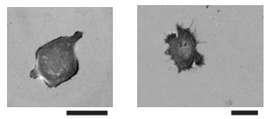
In this dialogue, we aim to share and exchange ideas about physics of living systems, and its future relationship to medical science.

Speaker

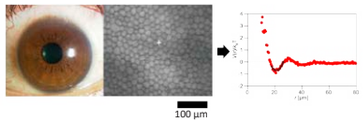
Dr. Aki Yamamoto
Center for Integrative Medicine and Physics, Kyoto University

Soft matter physics, Physics of life

- Dynamics of cancer cell morphology



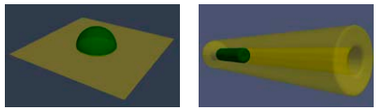
- Structural ordering of regenerated tissue



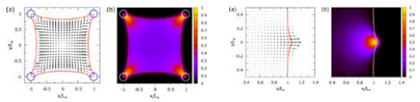
Dr. Falko Ziebert
Institute for Theoretical Physics, Heidelberg University

Physics of complex biosystems

- 3D cell migration model



- Elastic phase field model of cell monolayer



Dialogue topics

- ✓ How much have we understood the living system?
- ✓ What are our next challenges/targets towards the detection and mechanistic understanding of disease?
- ✓ How can we get *the generalization* in physics and *the specificity* in biology/medical science closer?
- ✓ How can we better understand the progression of disease and its relation to mechanics and dynamics? What kind of breakthrough are desired in the theory and technology?

Dialogue — 2

What research do we need to do to reconcile the conflicts between biodiversity conservation and food security in developing countries?

Dr. HONGO Shun	Conservation Science, Wildlife Management, Primate Ecology
Dr. Katharina Brotzmann	Toxicology, Ecology, Zoology and Pharmaceuticals
Dr. Hjalmar Kühl	Ape Conservation
Dr. Jochen Ait Müller	Molecular Biology

Background

My research perspective is local: I aim to develop a wildlife management system in rural areas of African rainforests to mitigate conflicts between local people and conservation officials. However, even if rural people can manage wildmeat production by themselves, urban needs of wildmeat may remain high, and the population in developing countries continues to grow. How can we resolve the conflicts at different scales between food security and biodiversity conservation? I would like to hear the views of researchers in different disciplines with a national, regional or international perspective on this issue. My interest is mainly in meateating, but the scope of discussion could be extended to cereal production.

Dr. HONGO Shun

Summary

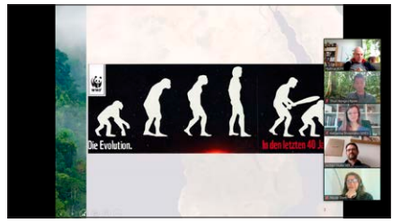
We had four speakers from Heidelberg University, KIT, Max Planck Institute, and Kyoto University. We discussed the research required to reconcile conflicts between biodiversity conservation and food security, especially on wild meat and hunting in Africa. We also focused on the communication between researchers and other stakeholders on different scales.

We first talked about the local level—collaborations with the local people, such as indigenous hunter-gatherers. Of course, we had different ideas, but I think we need mutual communication to manage the biodiversity and wildlife population with them.

Some speakers said indigenous people have the knowledge: They are keenly aware of their nature and resources. But we also find poachers coming from outside the local community for hunting and selling wild meat in urban areas. Some participants pointed out the possibility of domestication of wildlife to address the issue.

Also, we will need to learn from behavioural change research: Methods that reduce the amount of alcohol and tobacco consumption could also be applied to reducing the demand for wild meat. This was interesting to me. And an audience pointed out the need to investigate the wastage of wild meat in urban areas.

Finally, researchers have to publish not only papers but also grey literature facilitating communication between people at different layers—international communities, national governments, urban people, and the local community.



Slide

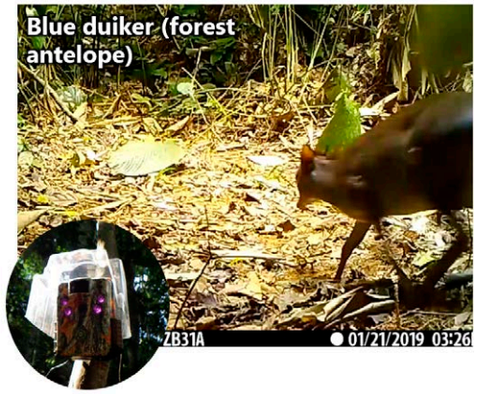
Dialogue 2 | Speakers

- **Katharina Brotzmann**
  - Heidelberg University
- **Jochen A. Müller**
  - Karlsruhe Institute of Technology
- **Hjalmar S. Kühl**
  - Max Planck Institute for Evolutionary Anthropology
- **Shun Hongo**
  - Kyoto University

Dialogue 2 | Theme

What research do we need to **reconcile conflicts between biodiversity conservation and food security** in developing countries?

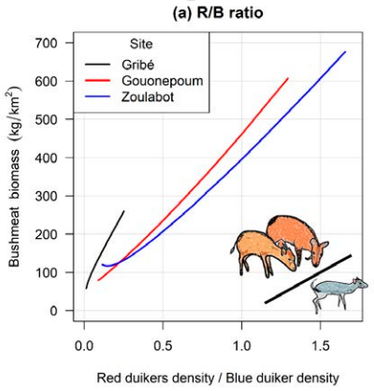
My Research | Wildlife management in the Congo Basin



- **Estimate population density** of mammals hunted for **bushmeat** using camera traps

Slide

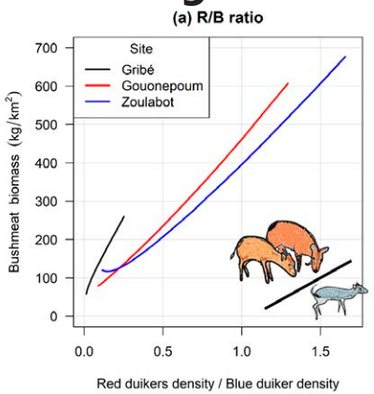
My Research | Wildlife management in the Congo Basin



(Hongo et al. in submission)

- **Estimate population density** of mammals hunted for **bushmeat** using camera traps
- **Find a simple indicator** that are useful for management

My Research | Wildlife management in the Congo Basin



(Hongo et al. in submission)

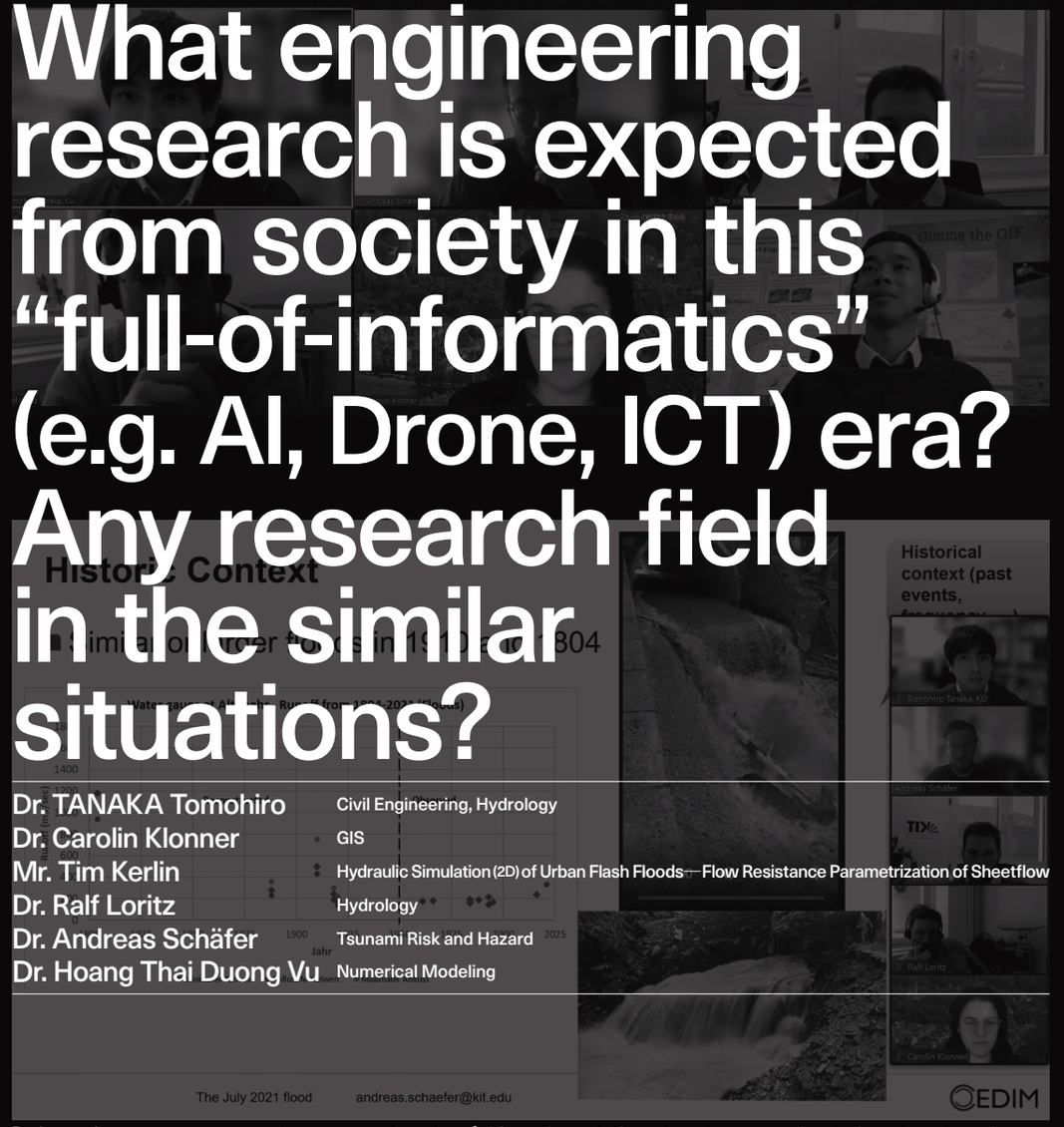
- **Estimate population density** of mammals hunted for **bushmeat** using camera traps
- **Find a simple indicator** that are useful for management
- **Establish a community-based wildlife management system** in rural areas

Issue

- **The community-based management** can curb overhunting and reduce conflicts between local people and conservation officials
- However, **problems on larger scales** continue to favour wild meat
  - **Urban needs** for wildmeat remain high
  - **Human population** in developing countries continues to grow
- How can we resolve the conflicts on different scales between **food security** and **biodiversity conservation**?
- **What roles** should researchers play for this and related

Dialogue — 3

What engineering research is expected from society in this “full-of-informatics” (e.g. AI, Drone, ICT) era? Any research field in the similar situations?



Background

In many engineering fields such as civil engineering or mechanical engineering, the fundamental advancements in fluid dynamics, structural dynamics, aerodynamics, mechanical dynamics have been seen at present. Hence, many early-career researchers in such research fields feel that the remaining issues are marginal deepening of the existing research directions would not yield drastic achievements done in the former era not only in academia but also in society. Applied science and technology such as AI or Drone are interesting topics, but not basic engineering research in a sense that people without any background in fluid dynamics can apply AI to predict river discharge, rainfall, wave, surge, landslide and so on. However, with the increasing capacity of informatics technology like AI, the mechanism-oriented theory/technology might be replaced with AI according to society’s needs. I would like to make discussion on possible ways for mechanism-oriented research in forthcoming AI (black-box learning) era in broader research fields.

Dr. TANAKA Tomohiro

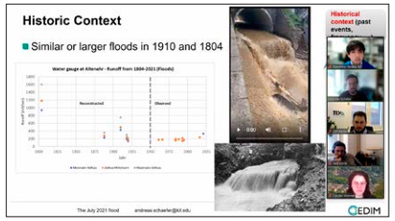
Summary

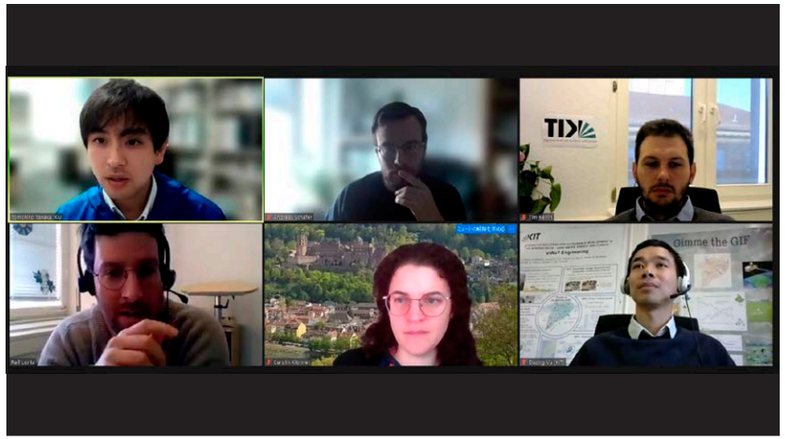
Group Three had six members in total. First, they introduced themselves with their research topics. We confirmed that they are coming from the variety of approaches around water-related disasters and future change projections for tsunami or river flooding: the risk communication, participatory tools and feedback to its prediction of natural disasters or urban flood modeling, machine learning approaches to these natural disasters, the remote sensing approach in hydrology and the climate change issues. What is the awareness we shared from this group was the paradigm shift of natural disaster research, especially the prediction or disaster reduction researches from the modeling or process-based understandings to the more application or implementation.

Also, as in the title of the group, the AI, emerging as a new technology, potentially replaces the conventionally focused research. Most of our group agreed with this awareness. We don't have much significant difference in the perceptions. Throughout the discussion, we found many common points, e.g. both in Germany and Japan, both for tsunami and river flooding, AI is a powerful tool sometimes replacing classical physical based modeling and other times combined, we need for more efficient prediction. Its integration is very important, and integration is not only limited to the AI. Before the workshop, I expected some conflicting relationship between the AI versus the physical modeling; it was not necessarily the case in this group.

One discussant majoring risk communication suggested another aspect: the human or society, in other term, the appropriate use of the prediction of disasters for the communication with local people or governments. Without this perspective, the natural science research outcome do not yield results in reduction of the risk, and previously that was of course pursued by many researchers, but not the main research topic in the field. Today, it is becoming one of important research issues and yielding paper works, so it's a kind of another paradigm shift.

At the same time, we have also a modeler in group members, who mentioned about the importance of understanding what the model prediction needs for both users and modelers, otherwise the miscommunication between the engineering model development with the direction of the understanding may happen. It may not result in proper contribution to risk reduction. This kind of communication between the disciplines should be necessary for the future direction, and as a next opportunity of this group, we can discuss more. Thank you very much.





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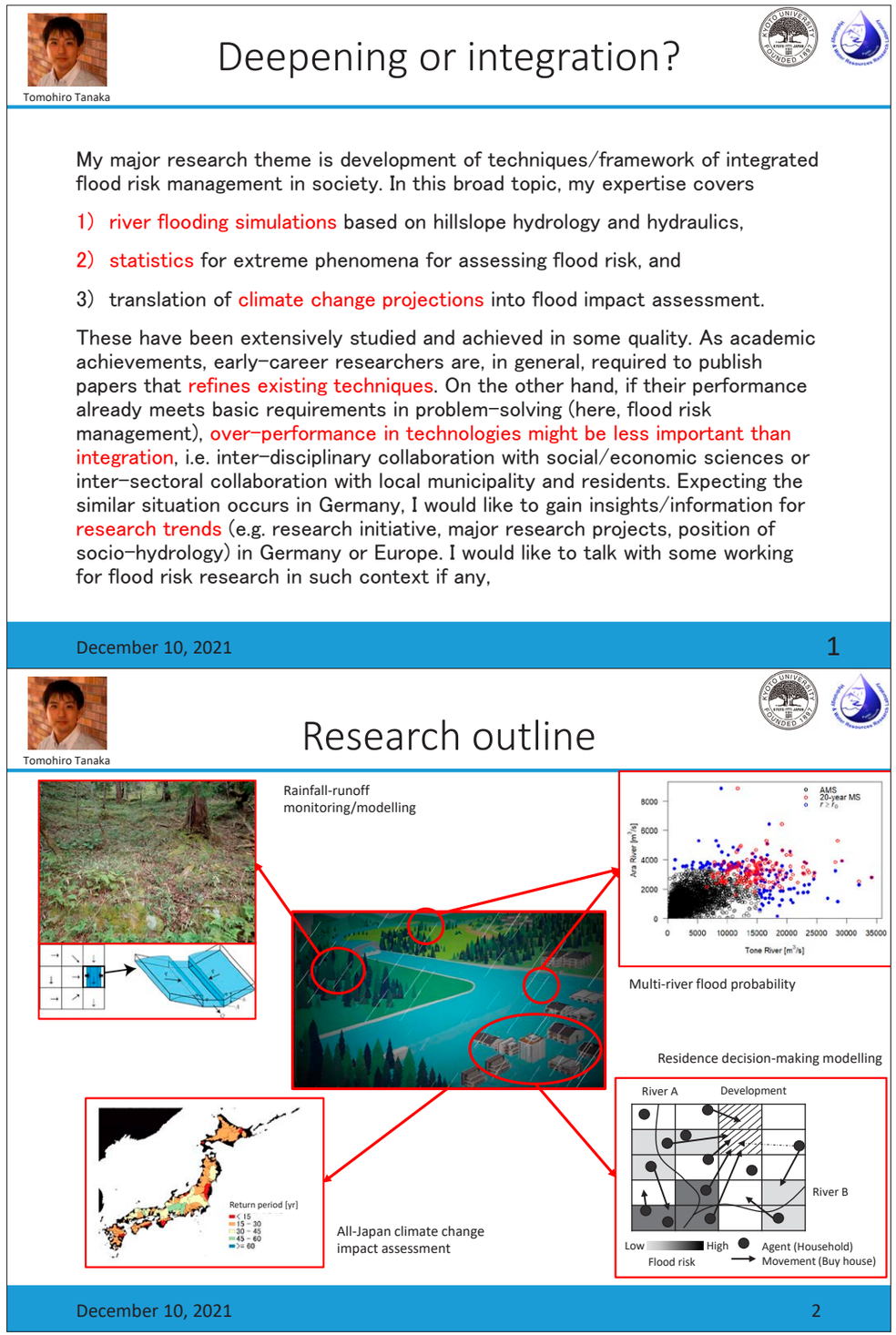

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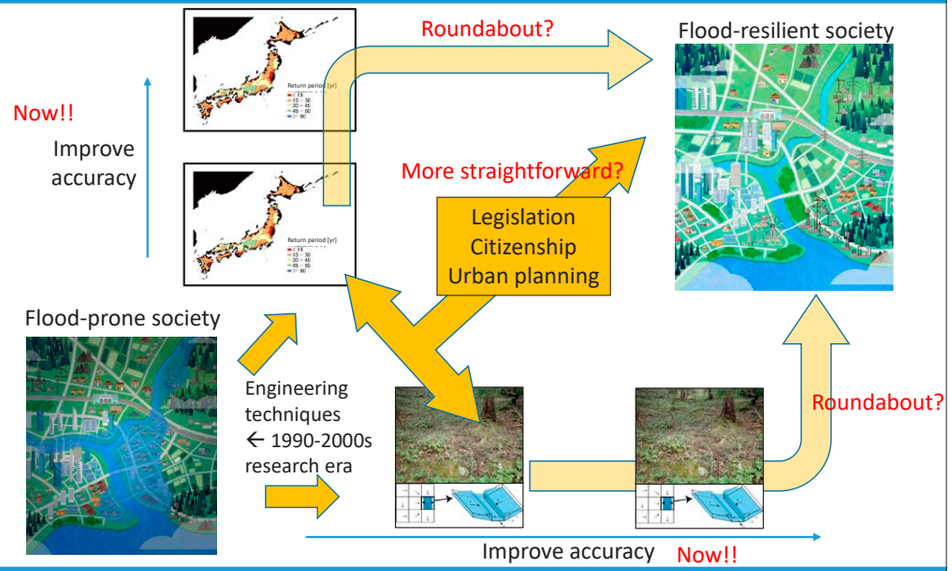
Tomohiro Tanaka

Example of the discussion theme



December 10, 2021 3

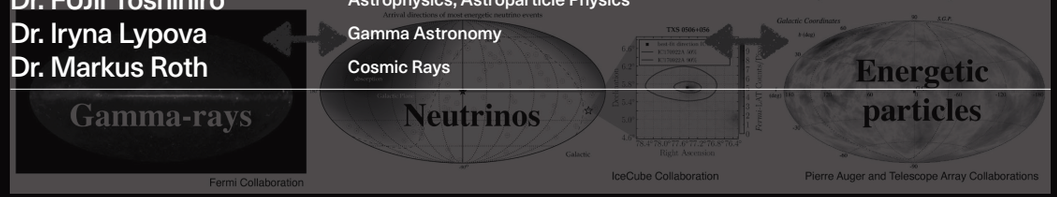
Dialogue 4

Clarifying the most energetic particles in the universe

Unraveling mysteries of extremely energetic phenomena by multi-messenger astronomies

Dr. FUJII Toshihiro
Dr. Iryna Lypova
Dr. Markus Roth

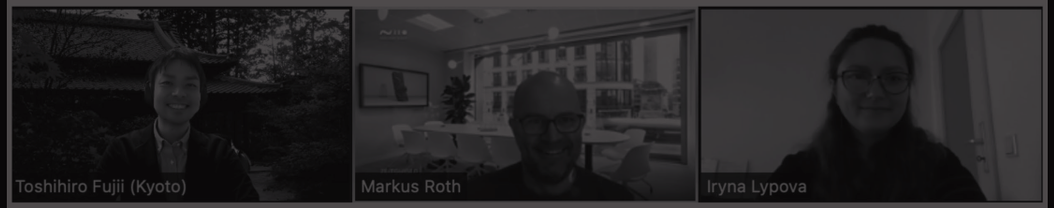
Astrophysics, Astroparticle Physics
Gamma Astronomy
Cosmic Rays



Clarifying the Most Energetic Particles in the Universe

The most energetic particles
10^{20} eV

Gamma-rays
10^{12} eV



Dr. Toshihiro Fujii (Kyoto)
FAST

Dr. Markus Roth (KIT)
Pierre Auger Observatory

Dr. Iryna Lypova (Heidelberg)
H.E.S.S.

Background

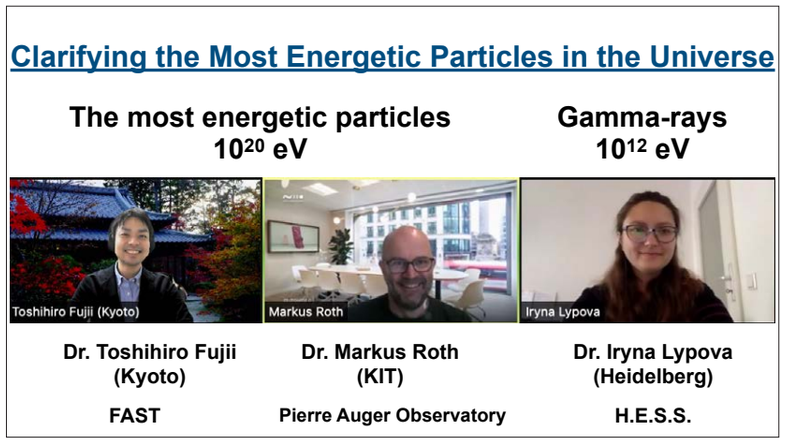
The origin and nature of the most energetic particles in the universe, called ultra-high-energy cosmic rays (UHECRs), remain an open question in astroparticle physics. Motivated by the need for an unprecedented sensitivity for further advancements, we propose the Fluorescence detector Array of Single-pixel Telescopes (FAST) as a next-generation ground-based UHECR observatory that aims to cover a huge area by deploying a large array of low-cost fluorescence detectors. We will install a micro array of the FAST prototype at the Pierre Auger Observatory in Mendoza, Argentina, commencing a remote stand-alone observation of UHECRs.

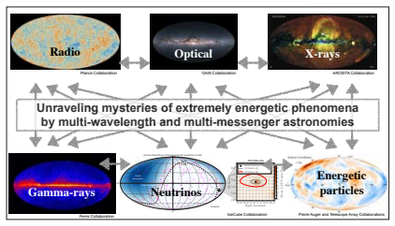
Dr. FUJII Toshihiro

Summary

We have addressed the clarifying the most energetic particles from the universe. We have three very active members, myself and the Dr. Markus Roth from Karlsruhe Institute of Technology and Dr. Iryna Lypova from the Heidelberg University. We discussed some connections of our research, and we, myself and Markus, are doing the most energetic particle. The energy is 10 to the power of 20 electron Volt and Iryna doing the gamma ray up to 10 to the power of 12 electron Volt. We discussed the possible synergy and some future collaborations. Firstly, we addressed what's our targeted physics in the current decade. Of course, we need to continue the operation of the current ongoing observatory, and also to build the future generation of observatory for gamma rays and the most energetic particles. To achieve it, what we needed to accomplish is to continue the data analysis of the current ongoing observatory, and also, we need to think the autonomous detector and precise resolution required. Also, we need to develop a new detector like radio, optical, and those mixture, and one key point that we needed to build really cheaper and low-price detectors are essential to cover the large area with more cost effectively. This is a common understanding among us. As a possible synergy and the collaboration, one of the key messages is the multi-messenger and multi-wavelength connection, meaning among the most energetic particle and the gamma ray, and the other messengers.

If we see the sky with different wavelengths and also different messengers, these figures are the radio and the optical, you can see the Milky Way here, and if we go to the slightly higher energies, X-ray, you can see the Milky Way and some spherical structure, and also going further higher energy, this is the gamma rays, and also recently, scientists discovered the high energy neutrinos. This is distributed almost uniformly, and also what we are doing collaborating, Markus and myself, is the most energy particle. We have recently seen some clustering of the signal, but definitely need to collaborate to understand and unravel the mystery of the extremely energetic phenomena by multi-wavelengths and also multi-messenger astronomies. This is the key message of our group. Thanks a lot.





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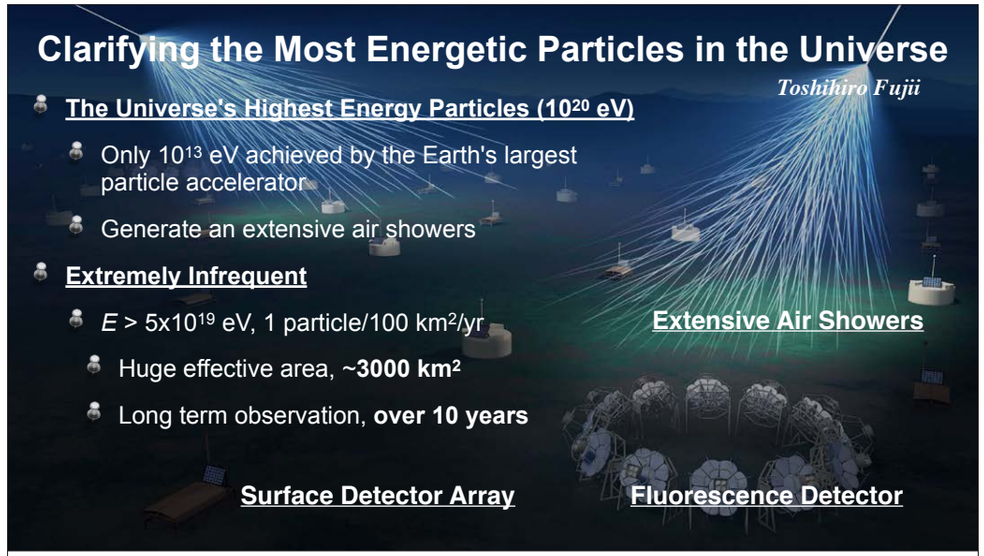
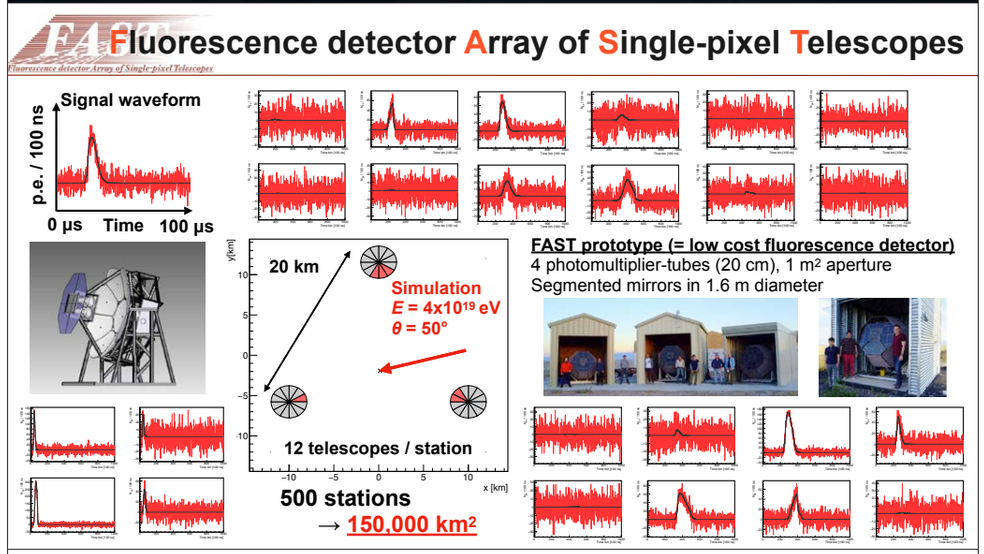
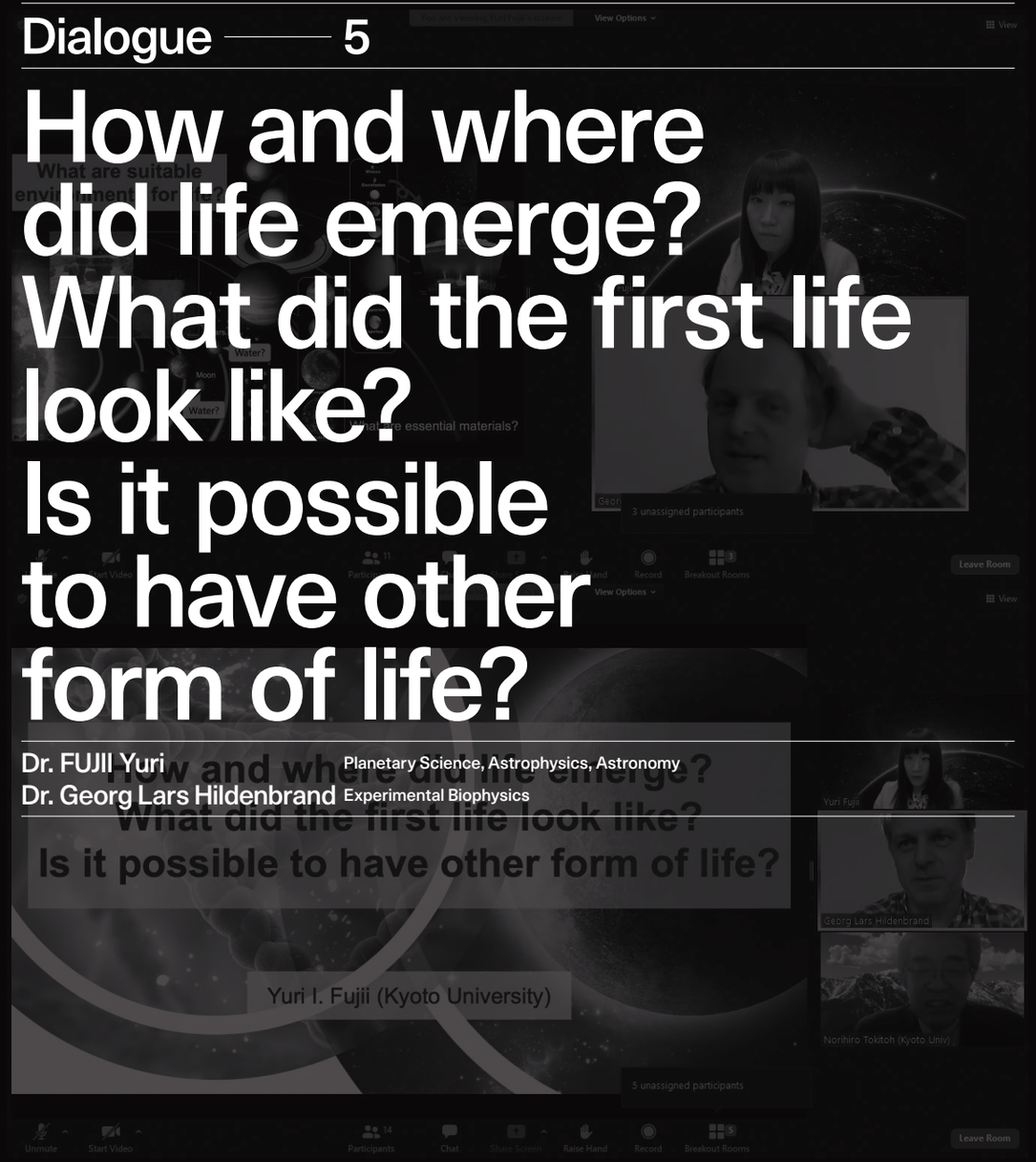




Dialogue 5

How and where did life emerge? What did the first life look like? Is it possible to have other form of life?

Dr. FUJII Yuri Planetary Science, Astrophysics, Astronomy
Dr. Georg Lars Hildenbrand Experimental Biophysics



Background

We know only one kind of life, which is life on the Earth. We have large variety of organisms on the Earth, but they are all based on RNA/DNA. They all need organic compounds. I am not an expert on the origin of life, but am very interested in this topic. I would like to take this opportunity to have interdisciplinary discussion on the possibility of other form of life, such as non-carbon based one, on the requirement for the emergence of life, on the formation and delivery of building blocks of life and its environment, on the origin of life on the Earth, and so on. I believe this kind of discussion is useful for searching for extraterrestrial life and/or studying the environment that is suitable for life.

Dr. FUJII Yuri

Summary

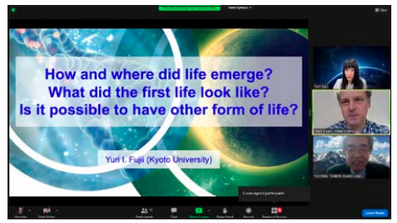
The topics for Dialogue Five are these questions:
How and where did life emerge?
What did the first life look like?
Is it possible to have other form of life?

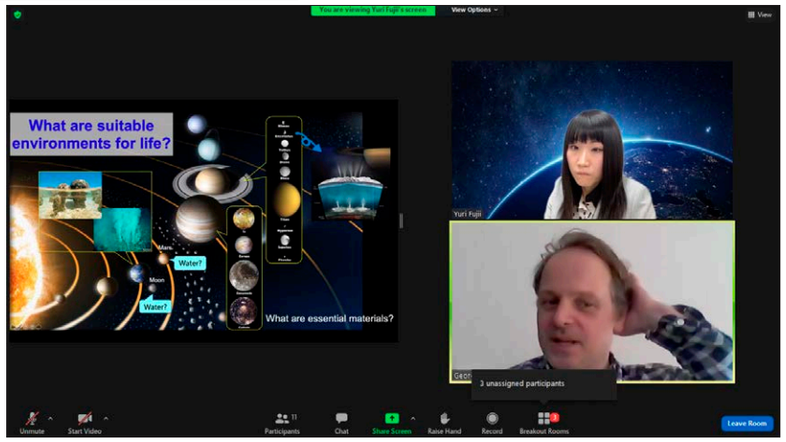
For the first question, of course, this 1.5 hour time period is not enough to make a conclusion, but we shared some ideas. For your reference, there are some researchers who think that life has emerged in interstellar space, but we both agreed that we need presumably relatively large body, planetary-sized body, with atmosphere. This is mainly for protection against impacts and/or radiations. We also think air/water pressure is needed to develop stable structures of organisms.

We didn't talk much about the second question, instead, we talked more about the third one. We discussed approaches regarding the chemical perspective of the environment on the bodies of our solar system. When people think about astrobiology, they mainly focus on liquid water. But, we talked about other possibilities, such as a form of life based on non-water solvent. We also considered the possibility of non-carbon-based organisms, such as the usage of silane and/or crystals, and also the perspective of silicon-chip-based life, i.e. AI as life form.

For the future collaborations, we talked about the effects of heat sources on the impact for biogenesis. For example, we are interested in the distribution of radionuclides, such as aluminum 26 and/or geothermal effects of bodies in the early solar system and other system on the main sequence. We came up with some ideas for potential collaborations, but, we still need more time to get ready and actually start.

We were asked if we had any issues due to different cultural or research backgrounds. As we mainly talked about things outside of the earth, we don't think we were affected by the cultural differences. We are from different fields, but the discussion topics were interdisciplinary, and we share the interests. So, we didn't feel differences in the perspectives. We had a very nice discussion. Thank you very much for this opportunity.





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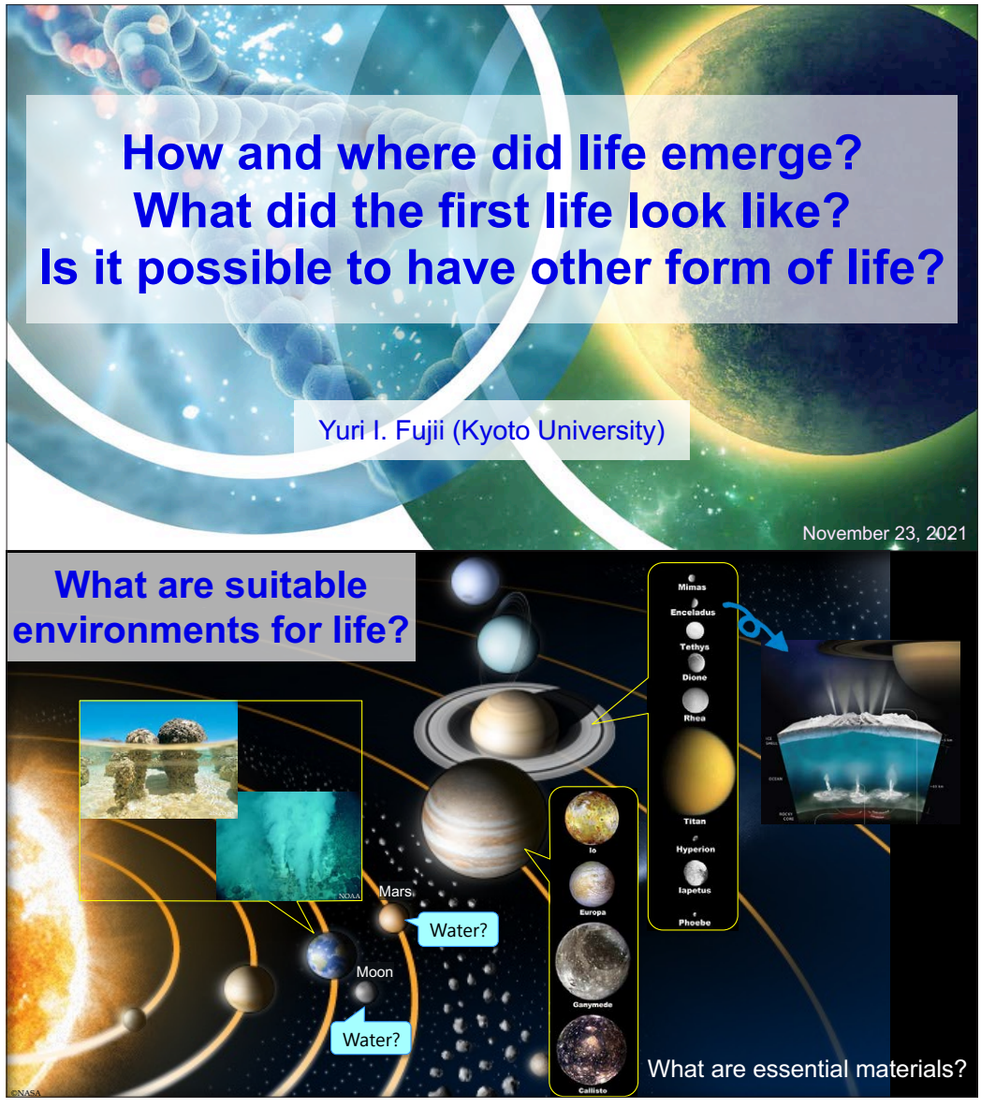

PART III
–
COMMENTARY

Commentary 1

Most of the time, breakthroughs in issues that cannot be resolved individually are created by third parties asking questions that seem ridiculous.

First of all, let me express my sincere thanks to all the participants. I actually visited all five rooms, of course briefly, and found that in each room, you were having very active discussions. It seems that you all enjoyed it very much. It's very difficult to comment on all five topics because they are diverse, and each team had a different discussion style. I, myself, have some experience in interdisciplinary research. I'm working for the Center of Southeast Asian Studies. My background is agriculture, but my topics are sometimes about society, economics, or culture. Based on such experiences, allow me to offer some comments.

I would like to discuss three points. First, what shall we pursue through interdisciplinary research? Usually, we first agree on a goal. Say that we decide to develop an artificial satellite. Then, scientists in mechanical engineering, astronomy, energy, and health might join. You work together to develop the satellite. In interdisciplinary research, such goal-sharing is a common style. However, recently, there has been another type of interdisciplinary research in which questions instead of goals are shared.

Of course, various people gather and discuss the questions. Each member is thinking through the questions, but at the same time, they are thinking about their own topic, going back and forth between the two. This kind of interdisciplinary dialogue is quite stimulating for, and ends up being reflected in, their own research work. Members don't share the net outcome, but this style of interdisciplinary dialogue is also important. This is the first point. I found today things similar to this type of interdisciplinary dialogue (for example, Dialogue Five).

The second point is, what should we communicate in interdisciplinary dialogues? We should, of course, communicate what we found and our research progress. But after some time, it is important to communicate what is unknown in each of our research fields. This is not written anywhere and therefore is quite difficult to know from other disciplines. By sharing this kind of information, we can raise new questions. That is the second point.

The third point is as follows. What kind of interdisciplinary dialogues has power to create breakthrough regarding issues in research? In most cases, questions that appear ridiculous create such breakthroughs. We shouldn't hesitate to raise any questions in interdisciplinary dialogues. Such questions might appear quite strange from other disciplines' perspectives, but we should dare to raise them to others.

One more point I want to raise is not really for the participants but mainly the organizers. Interdisciplinary discussion is quite difficult, but today, all the dialogue groups had to summarize their discussions. They were provided with questions, such as, "What are the specific issues that need to be approached?", but this kind of question is quite difficult to answer. Organizers should also be patient when fostering interdisciplinary dialogues. Thank you very much.

Prof. Dr. KONO Yasuyuki
–
Kyoto University
Center for Southeast Asian Studies

Commentary 2

The awareness of differences in the historical and cultural backgrounds of researchers can serve as a driving force when resolving scientific questions.

I like this forum of communication very much. It's the first time for me to participate here in a HeKKSaGOn workshop. I liked very much that not just research was presented, but also lively discussions about scientific topics took place. These five dialogues could each have been half-day standalone workshops because all are fundamental questions that have been quite internationally discussed between Japan and Germany. I congratulate you on this format, and I think this should be done even more often in the future. It was quite interesting for me to accompany these different discussions. Unfortunately, because of the limited time, I could not attend all five, only four. However, they were on quite broad subjects, from biodiversity conservation and the origin of life to the universe's most energetic particles. As I said, they addressed fundamental questions, as well as related methods and scientific challenges.

I think one comment was quite important. It was in Dialogue Three about informatics. We have models, but we are missing data. We have the nicest models we can imagine, but what do we need models for if you do not have the data? This is also something we perhaps need to communicate to funding organizations. In other words, that we should not just focus on sitting in our offices to create and program models, but we also need much more to go out into the field to sample, analyze, and collect information.

I liked this event very much also because I was not so much involved in the discussions themselves. This gave me a view from the outside, and it came to my mind that we have some scientific questions to solve in both Japan and Germany, but sitting between these questions and us are colored spectacles. These spectacles are our historical and cultural backgrounds. Discussions like those today also help us go beyond these spectacles. It was quite clear that finding and identifying the most energetic particles is physics. This is something we can agree on very easily. It's much more difficult to agree on how to conserve biodiversity and what we should investigate in the field of biodiversity.

What is important here? Not the tools of physics. Here, we suddenly have to agree, and also our subjective, individual thoughts and feelings come into the game. This is something which we really can learn here and work on. This brings to mind an old guy from Russia named Vladimir Vernadsky.

He is the one who introduced the word biosphere, for example, and I think in everything we have discussed today, the biosphere and ultimately the xenosphere of Vernadsky is quite important. When we are coming here together, doing these discussions, it's much more than just presenting what we create. We start to reign over, interfere with, and govern the earth and all flows with our thoughts and brain.

This leads me to my last question to the physicists: what kind of physics do we ultimately need? This was also a question posed by Vernadsky for describing how our thoughts can really change the world, because normally, we think in terms of physics and mechanistic understandings. For example, a stone falls, and here we have some gravitation and all the physical understandings. We can really change the world with our thoughts. But what about the mass flows, and the emergence of the world? These things are also within our thoughts. This is perhaps the ultimate question, especially for Dialogue Five: how and where did life emerge? Because until now we only have experiments saying life comes from life.

I liked this very much, and I think it is a very good platform to discuss fundamental questions we are all interested in. Perhaps they can help us also to govern the earth in the future in a better way.

Prof. Dr. Stefan Norra
–
Karlsruhe Institute of Technology
Institute of Applied Geosciences

Commentary 3

Making our questions shareable and relevant to the target is important.

It was first of all a great pleasure to join this event. I enjoyed listening to the talks and discussions a lot. I'm one of the oldest members of the HeKKSaGOn Alliance, not in terms of age, but I have been serving as one of the discussion leaders since the first meeting held in Heidelberg in 2010. It was a great pleasure to see in this audience Professor Junichi Mori, who was a big helper and supporter at the beginning of this HeKKSaGOn Network.

Also, I was very much honored to be mentioned by Professor Yokoyama and Professor Tokitoh at the beginning as one contributor to this network. I must say that today's meeting was for me the easiest meeting we've held within the framework of HeKKSaGOn because I didn't do anything. I just had to enjoy the talks and listen to the discussions. It was a nice job. I was sticking to Dialogue One because of my preference. I was also delighted to see more than 30 people participating in this session, including Japanese scientists who studied in Heidelberg, and Karlsruhe and Heidelberg students and alumni who studied in Kyoto.

It was a really nice, organized meeting for me to just say hello to these people. Dr. Ziebert and Dr. Yamamoto gave great presentations. Also, I was happy to see that many of the Ph.D. students and junior researchers were actively asking questions and raising some provocative statements. This was really nice. I think the length of time was, as we all know, too short to discuss many questions in depth, but I had the feeling that this kind of event is an ideal platform for generating questions and sharing questions like Professor Kono mentioned in the beginning.

However, I have to say to the participants and the junior researchers that making our questions shareable and relevant to the target is important. We often pose questions that are maybe interesting from a physics viewpoint. But when, for instance, dealing with diseases or medical problems, if the questions we generated are not relevant, it's pointless.

With that said, I think for this kind of event, we should not overly generalize our discussions or attempt to make them understandable to anyone and everyone but instead think about making our approaches really fun. I think this will be strengthened when we in the future hold this kind of event in person—having poster sessions with students, having beer or wine together—and exchange thoughts in a more relaxed way. But anyway, I think it was a great event and success, and I thank all the organizers and the administrative staff for everything. Thank you very much.

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Heidelberg University
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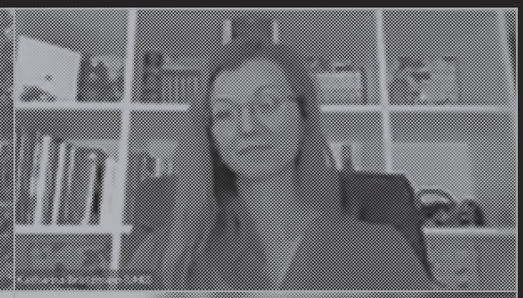







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