NATIONAL ACADEMY OF SCIENCES

2016 Japanese-American Kavli Frontiers of Science Symposium

December 2-4, 2016

Irvine, California, USA

Symposium Materials

The Kavli Frontiers of Science Symposium Series (www.nasonline.org/kfos)

Since 1989, the Academy has organized annual symposia on Frontiers of Science. These symposia bring together some the very best young scientists to discuss exciting advances and opportunities in their fields in a format that encourages informal collective as well as one-on-one discussions among participants. Speakers are urged to focus their talks on current cutting-edge research in their disciplines to colleagues outside their field and to address questions such as:

What are the major research problems and distinctive tools of your field?

What are the current limitations in advancing your field?

How might insight derived from other fields contribute to overcoming these limitations?

Formulating and answering such questions involves surmounting the barriers imposed by the specialized terminologies and techniques that characterize different branches of science. This poses formidable challenges that these symposia are addressing with success.

The first Frontiers symposium was held in Irvine, California, from March 2 to 4, 1989. The positive response to this meeting prompted the Academy to organize a second symposium in 1990 and annually thereafter.

At each symposium, approximately 25 young scientists report on current research within their disciplines to an academically trained and scientifically diverse audience. They highlight major research challenges, methodologies, and limitations to progress at the frontiers of their respective fields. All attendees participate actively in a general discussion period, during which they learn from and form collaborative relationships with other young scientists in different fields.

In 2005, the Oxnard, California-based Kavli Foundation, which supports scientific research, honors scientific achievement, and promotes public understanding of scientists and their work, provided a 10-year, $5 million gift. This gift provides a solid financial foundation for the program over the next decade, enabling broader dissemination of the content of each symposium, and strengthening opportunities for continued connections between participants over the years.

The success of the Frontiers symposium series has spawned similar programs, such as the series on Frontiers of Engineering by the National Academy of Engineering, and the German-American Frontiers of Science. In addition, Frontiers of Science symposia with Japan and China began in 1998, a bilateral symposium with India started in early 2005 and symposia with Indonesia (2011) Israel (2013) and S. Korea (2013). Thus, the Kavli Frontiers of Science symposia have become a major instrument in bringing together the best young researchers--the next generation of leaders--in the natural sciences and engineering fields, in the United States and around the world.

The U.S. National Academy of Sciences (www.nasonline.org)

The National Academy of Sciences (NAS) is an honorific society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare.

The NAS was established by an Act of Congress that was signed by President Abraham Lincoln on March 3, 1863, at the height of the Civil War, which calls upon the NAS to "investigate, examine, experiment, and report upon any subject of science or art" whenever called upon to do so by any department of the government. Scientific issues would become more complex in the years following the war, and to expand the expertise available to it in its advisory service to the government, the NAS created the National Research Council under its charter in 1916. To keep pace with the growing roles that science and technology would play in public life, the National Academy of Engineering was established under the NAS charter in 1964, and the Institute of Medicine followed in 1970.

Fifteenth Japanese-American Kavli Frontiers of Science Symposium

Japan Society for the Promotion of Science
U.S. National Academy of Sciences
Arnold and Mabel Beckman Center, Irvine, CA
December 2-4, 2016

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Fifteenth Japanese-American Kavli Frontiers of Science Symposium

Japan Society for the Promotion of Science - U.S. National Academy of Sciences
December 2-4, 2016 – Irvine, California

PROGRAM - sessions in alphabetical order

Advanced Manufacturing / 3-D Printing
Organizers: Lashanda Korley and Shinya Yoshioka

INTRODUCTORY SPEAKER:
3D Bioprinting of Tissues and Organs
Sean Murphy, Wake Forest University

SPEAKERS:
3D Printing Functional Materials & Devices
Michael McAlpine, University of Minnesota

Crystalline Gels for Light-induced Polymerized 3D Printing
Jin Gong, Yamagata University

Computational Cosmology: Observation and Theory
Organizers: Emilia Morosan and Kensuke Kobayashi

INTRODUCTORY SPEAKER:
The Origin of the Diversity Seen in the Present-Day Universe
Masayuki Akiyama, Tohoku University

SPEAKERS:
Supercomputer Simulations of Structure Formation in the Universe
Tomoaki Ishiyama, Chiba University

How did the Hot Big Bang Begin?
Mustafa Amin, Rice University

Decision-making: A Behavioral Economics and Neuroscience Perspective
Organizers: Marshall Burke and Hisaki Kono

INTRODUCTORY SPEAKER:
Your Brain Made You Do It
Sam McClure, Arizona State University

SPEAKERS:
Deconstructing Neural Mechanisms of Impulsive Choice
Michael Frank, Brown University

Social Preference: Measurement Issues, Interventions, and Its Origin
Katsunori Yamada, Kindai University

The Japanese-American Kavli Frontiers of Science symposia are sponsored by the U.S. National Academy of Sciences and the Japan Society for the Promotion of Science. Major support in the U.S. is provided by the Kavli Foundation with additional support from the National Academy of Sciences.

Deep Brain Stimulation and Neuromodulation of Neurodegenerative Disorders
Organizers: Shelly Flagel and Masaru Ishii

INTRODUCTORY SPEAKER:
Deep Brain Stimulation and Neuromodulation of Neurodegenerative Disorders
Masashi Hamada, The University of Tokyo

SPEAKERS:
Basal Ganglia Circuits in Health and Disease
Daniel Leventhal, University of Michigan

Restoring Lost Functions via Artificial Neural Connection
Yukio Nishimura, Kyoto University

Environmental Archaeology / Paleoclimate
Organizers: Jennifer Burney and Chika Minejima

INTRODUCTORY SPEAKER:
High Resolution Studies of Past Human-Environment Interactions
Hiroo Nasu, The Graduate University for Advanced Studies

SPEAKERS:
Footprints of the Sun Left in a Tropical Lake
Ikuko Kitaba, Ritsumeikan University

Fire, Climate, and Society in the Ancient Southwest:
Ancient Lessons for Sustainable Fire Management
Christopher Roos, Southern Methodist University

Good Sleep: Relief From Sleep Disorders
Organizers: Jacob Hooker and Miya Ishihara

INTRODUCTORY SPEAKER:
Mystery of Sleep
Akihiro Yamanaka, Nagoya University

SPEAKERS:
Why Do We Need Sleep?
Our Current Understanding of the Roles of REM and Non-REM Sleep
Yu Hayashi, University of Tsukuba

Sleep and Circadian Contributions to Health
Cathy Goldstein, University of Michigan Sleep Disorders Center

Manipulating the Genetic Code
Organizers: Arash Bashirullah and Kazuhiro Maeshima

INTRODUCTORY SPEAKER:
Manipulating the Genetic Code
Blake Wiedenheft, Montana State University

SPEAKERS:
CRISPR/Dcas9 for Reprogramming of the Human Genome
Stanley Qi, Stanford

Optical Control of the Genome
Moritoshi Sato, The University of Tokyo

New Directions in Mathematical Epidemiology
Organizers: Thomas Hull and Junichi Yamagishi

INTRODUCTORY SPEAKER
New Directions in Mathematical Epidemiology
Dylan Shepardson, Mt Holyoke College

SPEAKERS:
Analyses of National and Global Strategic Plans for Disease Prevention and Control
Chaitra Gopalappa University of Massachusetts Amherst

Real Time Research Response to Emerging Infectious Disease Epidemic
Hiroshi Nishiura, Hokkaido Univeristy

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AGENDA

Thursday, December 1, 2016

6:00 p.m. Session Coordination Meeting - *Hyatt Regency Newport Beach*

7:00 p.m. Welcome Reception at the Hyatt Regency Newport Beach

Friday, December 2, 2016

7:45 and 8:15 a.m. Bus pick-up from the Hyatt Regency Newport Beach to the Beckman Center

8:00 a.m. Breakfast at Beckman Center

9:00 a.m. **Opening Ceremony -** *Welcome*

9:30 a.m. **Session I**

11:30 a.m. Luncheon
2018 Planning Group Meeting lunch - *Executive Dining Room*

12:30 p.m. **Session II**

2:30 p.m. Break

3:00 p.m. **Session III**

5:00 p.m. Reception/ Dinner –*Beckman Center*

7:00 p.m. Flash Poster Talks - *Auditorium*

7:30 p.m. Poster Session I - *Huntington Room*

9:00 p.m. Buses depart Beckman Center for the Hyatt Regency Newport Beach

Saturday, December 3, 2016

7:15 and 7:45 a.m. Bus pick-up from the Hyatt Regency Newport Beach to the Beckman Center

7:30 a.m. Breakfast at Beckman Center

8:30 a.m. **Session IV**

10:30 a.m. Coffee Break

11:00 a.m. **Session V**

Saturday, December 3, 2016

1:00 p.m. Luncheon
2018 Planning Group Meeting - *Balboa Room*

2:30 p.m. Buses depart Beckman Center for San Juan Capistrano - *Cultural Tour*

3:00 p.m. Tour of Mission San Juan Capistrano and Historic District

5:30 p.m. Buses depart San Juan Capistrano for BLK Restaurant - *Huntington Beach*

6:30 p.m. Dinner - *BLK Restaurant in Huntington Beach*

8:00 p.m. Buses depart BLK Restaurant for the Hyatt Regency Newport Beach

Sunday, December 4, 2016

7:15 and 7:45 a.m. Bus pick-up from the Hyatt Regency Newport Beach to the Beckman Center

7:30 a.m. Breakfast at Beckman Center

8:30 a.m. **Session VI**

10:30 a.m. Flash Poster talks - *Auditorium*

11:00 a.m. Poster Session II **-** *Huntington Room*

12:30 p.m. Luncheon

1:30 p.m. **Session VII**

3:30 p.m. Coffee Break

4:00 p.m. **Session VIII**

6:00 p.m. Buses depart Beckman Center for the Hyatt Regency Newport Beach

6:30 p.m. Optional Dinner - *Hyatt Regency Newport Beach*

《Advanced Manufacturing / 3D printing》Glossary

Additive Manufacturing (AM) :【付加製造】also known as 3D printing, is an appropriate name to describe the technologies that build 3D objects by adding layer-upon-layer of material. 積層を繰り返して材料を付加していく造形方法，あるいはそれによる加工のことを指す

Light Polymerized 3D Printer:【光重合硬化 3D プリンタ】uses photopolymers as consumables. This method involves photo-reactive monomer having the property of curing with light of a sufficient energy to drive the reaction from liquid to solid. In the family of light polymerized 3D printer, Sterolithography (SLA), Digital Light Processing (DLP), Liquid Crystal Display (LCD) etc. are related technology subtypes. タンク内の液化したフォトポリマーを，光活性化重合によって選択的硬化させる手法を用いて造形を行う。関連積層造形技術はステレオリソグラフィー（SLA），デジタル光処理技術（DLP），液晶ディスプレイ（LCD）等がある

Phase Change Material (PCM):【相変化材料】is a substance with a high heat of fusion. It can store and release large amount of energy during the process of melting & freezing (changing from one phase to another). 物質の相変化時の潜熱を利用した蓄熱性能を持った材料である

Photopolymer:【光硬化性高分子】is polymer which changes its properties when exposed to light with a fixed wavelength. The most common form of light used is UltraViolet (UV) Laser. 紫外線をはじめとする特定の波長の光に反応して硬化する性質を持った高分子の総称である

NOTES

3D Bioprinting of Tissues and Organs

Sean Murphy, Wake Forest Baptist Medical Center

Additive manufacturing, otherwise known as three-dimensional (3D) printing, is driving major innovations in many areas, such as engineering, manufacturing, art, education and medicine. Recent advances have enabled 3D printing of biocompatible materials, cells and supporting components into complex 3D functional living tissues. 3D bioprinting is being applied to regenerative medicine to address the need for tissues and organs suitable for transplantation. Compared with non-biological printing, 3D bioprinting involves additional complexities, such as the choice of materials, cell types, growth and differentiation factors, and technical challenges related to the sensitivities of living cells and the construction of tissues. Addressing these complexities requires the integration of technologies from the fields of engineering, biomaterials science, cell biology, physics and medicine. 3D bioprinting has already been used for the generation and transplantation of several tissues, including multilayered skin, bone, vascular grafts, tracheal splints, heart tissue and cartilaginous structures. Other applications include developing high-throughput 3D-bioprinted tissue models for research, drug discovery and toxicology.

Background Review Article:

Murphy, Sean V., and Anthony Atala. "3D bioprinting of tissues and organs." Nature biotechnology 32.8 (2014): 773-785.

[article available on electronic agenda book]

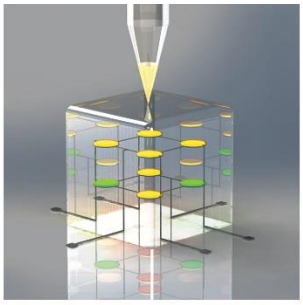
NOTES

3D Printing Functional Materials & Devices

Michael C. McAlpine, University of Minnesota

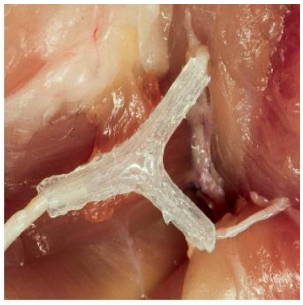
The development of methods for interfacing high performance functional devices with biology could impact regenerative medicine, smart prosthetics, and human-machine interfaces. Indeed, the ability to three-dimensionally interweave biological and functional materials could enable the creation of devices possessing unique geometries, properties, and functionalities. Yet, most high quality functional materials are two dimensional, hard and brittle, and require high crystallization temperatures for maximal performance. These properties render the corresponding devices incompatible with biology, which is three-dimensional, soft, stretchable, and temperature sensitive. We overcome these dichotomies by: 1) using 3D printing and scanning for customized, interwoven, anatomically accurate device architectures; 2) employing nanotechnology as an enabling route for overcoming mechanical discrepancies while retaining high performance; and 3) 3D printing a range of soft and nanoscale materials to enable the integration of a diverse palette of high quality functional nanomaterials with biology. 3D printing is a multi-scale platform, allowing for the incorporation of functional nanoscale inks, the printing of microscale features, and ultimately the creation of macroscale devices. This three-dimensional blending of functional materials and 'living' platforms may enable next-generation 3D printed devices.

Cells & Tissue



3D Electronics

Dynamic Control



Biomedical Devices

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Background Review Article:

Kong, Yong Lin, et al. "3D printed bionic nanodevices." Nano Today (2016).

[article available on electronic agenda book]

NOTES

Crystalline Gels for Light-induced Polymerized 3D Printing

Jin Gong, Yamagata University

3D printing, also known as Additive Manufacturing (AM), was first commercialized in 1986, and has been growing at breakneck speed since 2009 when Stratasys' key patent expired. Currently the 3D printing machines coming on the market can be broadly classified into three categories from the material state point of view: plastic filament printers, powder (or pellet) printers, film printers and liquid photopolymer printers.

Much of the work in my laboratory revolves around the crystalline gels. We have succeeded in developing them with high toughness, high flexibility, particularly with many functions as shape memory, energy storage, freshness-retaining, water-absorbing, etc. These crystalline gels are synthesized by light-reduced radical polymerization that involves photo-reactive monomer having the property of curing with light of a sufficient energy to drive the reaction from liquid to solid. Note that the light polymerized 3D printing uses the same principle. To open up possibilities for broader applications of our crystalline functional gels, we began to be interested in making them available for 3D printing.

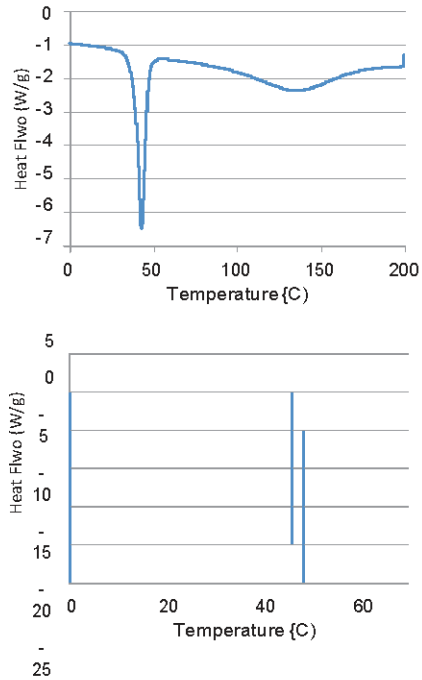

Figure 1. DSC curves of shape memory gel (upper) and energy storage gel (lower).

In this paper, I share with you our latest research on the 3D printing crystalline gels, mainly on special two functional gels of shape memory gel [1, 2] and energy storage gel. Their crystalline properties were evaluated on a Differential Scanning Calorimetry (DSC) and the results are shown in Figure 1. Results that both shape memory gel and energy storage gel show sharp peaks verified both of them have high crystallization.

(1) Shape Memory Gels

The crystalline shape memory gels were synthesized by radical bulk polymerization from vinyl monomers with acrylamide, alkyl or other functional side chains. The vinyl double bonds of monomers are reactive by facilitating macromolecular chain growth that yields linear main chains of gels. The side chains of monomers are mainly unreactive during the radical polymerization process while they have critical influence on properties of gels. The shape memory gel has two "amazing" properties: its superelasticity and the ability to change shapes. You can pull it to more than seven times and it will come back into its original shape quickly (Figure 2). Shape memory gels can be offered with different levels of hardness, elongation,

tear resistance and tensile strength by using in a variety of monomers with different side chains. Carp models were created using shape memory gels different in strength and flexibility on a light polymerized 3D printer (LumiForge, Lumi industries, Italy) as also shown in Figure 2.

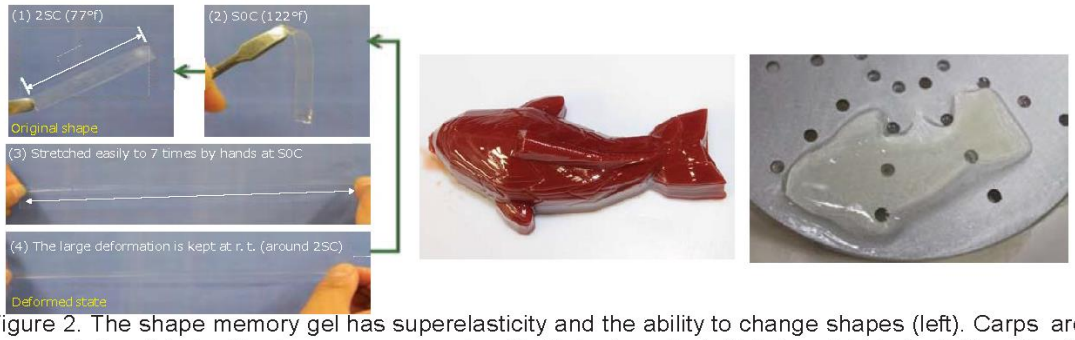

Figure 2. The shape memory gel has superelasticity and the ability to change shapes (left). Carps are successfully printed with shape memory gels with high strength (middle) and high flexibility (right), respectively.

(2) Energy Storage Gels

Latent heat storage systems are highly efficient and environmentally friendly way to use residual heat and store renewable energy [3]. Crystalline gels can provide an energy storage capacity by using the phase change property of their side chains. New phase change microcapsules having multivinyl groups on the surface were designed and synthesized by suspension polymerization first. The obtained microcapsules have the major diameter ranging between 10 μm and 30 μm (Figure 3). Then using the radical photo-reactive microcapsules as crosslinker, the energy storage gels were developed.

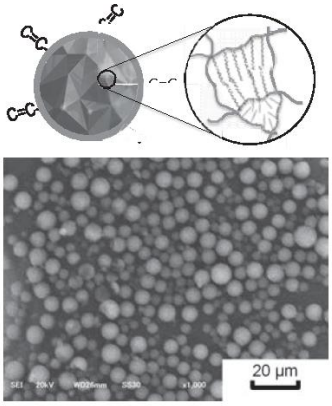

Figure 3. Diagram and SEM photograph of photo-reactive microcapsules.

Gel gears (Figure 4) were built up using also a light polymerized 3D printer iBox Nano (iBox printers, USA). The 3D printing can be addressed, but the optimization of gel liquid components, curing time, cure thickness, resolution from the printer etc. should be performed further to increase the manufacturing accuracy to grow objects with smoother surface and higher structural strength.

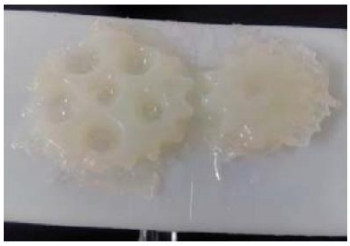

Figure 4. Gears 3D printed with energy storage gel.

References

1. J. Gong, H. Furukawa, *Expected Materials for the Future*, 13(1), 5-8(2013) (in Japanese).
2. J. Gong, S. Igarashi, K. Sawamura, H. Furukawa, *Adv. Mater. Res.*, 746, 325-329(2013).
3. Y. Shibasaki, K. Fukuda, *J. Polym. Sci. Polym. Chem. Ed.*, 17, 2947-2959(1979).

NOTES

《Computational Cosmology: Observation and Theory》Glossary

Acoustic wave 【音波】is a density fluctuation traveling with adiabatic compression and expansion. 物質の断熱的な圧縮と膨張により伝わる密度の揺らぎ。

Chemical enrichment 【化学進化】 is the increase of the fraction of the metals in a gas system. In astronomy, atoms other than hydrogen and helium are called “metals”. ガス中の金属の割合が増えること。天文学においては水素、ヘリウム以外は「金属」と呼ばれる。

Cosmic microwave background (CMB) 【宇宙マイクロ波背景放射】is relic radiation left over from the early Universe. In every direction, nearly uniform intensity is observed. The spectrum matches well to a blackbody with 2.725K. 初期宇宙の痕跡を残す背景放射。ほぼ等方的で、そのスペクトルは 2.725K の黒体輻射でよく近似される。

Dark matter structure 【ダークマター構造】consists of only dark matter and is gravitationally self-bounded. Another name is dark matter halo. ダークマターのみから構成され、自己重力で束縛されたシステム。ダークマターハローとも呼ばれる。

Gravitational lens 【重力レンズ】is the deflection of light by a gravitational source. 重力源によって、天体からの光が曲げられる現象。

Nucleosynthesis 【元素合成】is the creation of atoms from the protons, neutrons, and electrons in the early universe. 宇宙初期の陽子、中性子、電子から原子が構成されること。

Spectroscopic survey 【分光探査】is to obtain spectra of many astronomical objects with a spectrograph. We can estimate the distance and nature of a galaxy with the spectroscopic information. 多数の天体について分光観測を行い、スペクトルを取得すること。スペクトルから銀河までの距離や性質が特定できる。

NOTES

The Origin of the Diversity Seen In the Present-Day Universe

Masayuki Akiyama, Tohoku University

Astronomical observation is a “time travel”: we can look back the history of the universe thanks to the finite speed of light. We know that the present-day universe is filled with various astronomical objects from planets in the small scale to clusters of galaxies in the largest scale. On the other hand, it is also known that the physical conditions, i.e. temperature, density and chemical composition, in the early universe were highly uniform. With astronomical observations, we are tracing the history of the universe starting from the “uniformity”, and trying to understand the physical mechanisms which create the “diversity” seen in the present-day universe.

In the small scale, we are tracing the chemical “enrichment” history of the universe. The first atomic composition is determined in the nucleosynthesis during the Big Bang. In the early universe, the gas is dominated by hydrogen and helium, and the first stars and galaxies are formed from the fresh gas. Once the first stars finish their lives, various kinds of atoms are spread into the interstellar space, and the next generation stars are formed from the “enriched” gas. Repeating the star formation cycle, the gas in the galaxies is more and more enriched. Finally small particles are formed in the metal enriched gas, and the particles grow into planets.

In the large scale, we are tracing the formation and evolution of galaxies, and establishment history of the largest scale structure in the universe. The spatial distribution of the galaxies in the present universe follows filamentary large scale structure including clusters of galaxies and voids. The large scale structure is originated from weak fluctuations imprinted in the distribution of the matter in the early universe. Growth of the structure is driven by the gravity dominated by the dark matter, and the expansion history of the universe, which depends on the nature of the dark energy.
The formations of the diversities in the small and large scales depend on each other. The chemical enrichment, which results in the small scale diversity, is caused by the cycles of star formations in galaxies, whose formation and evolution are driven by the dark matter and dark energy in the large scale. In other words, existence of “life” is strongly connected to the frame-work of the universe.

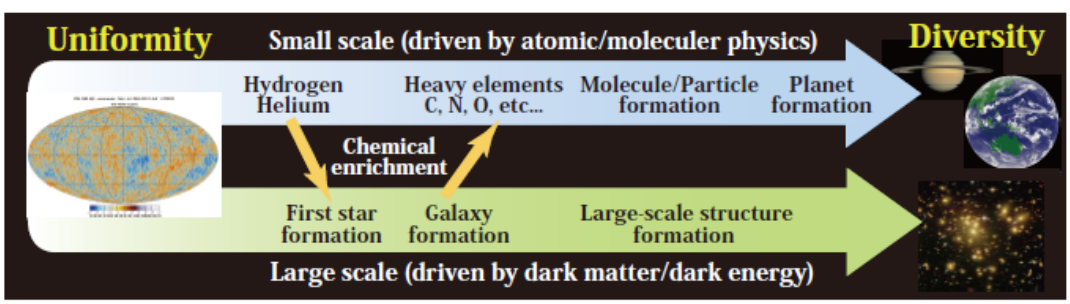

Fig: Overview of the cosmic history in both of the small and large scales.

A large spectroscopic survey of galaxies is one way to really trace back the cosmic history in both of the small and large scales. Currently such large survey is limited to the nearby universe, but next generation instruments on large telescopes can extend the surveys toward early universe, and we will witness the history of the “diversity” established from the “uniformity”.

NOTES

Supercomputer Simulations of Structure Formation in the Universe

Tomoaki Ishiyama, Chiba University

Over the last few decades, our understanding of the Universe has advanced significantly. According to the recent observation of the cosmic microwave background, dark matter exists five times as much as baryonic matter including atoms. It is the only matter which we can see through our eyes. Dark matter is something which interacts other matter through only the gravity and we cannot see through our eyes. This fact means that most of our Universe is made of something that we don't know yet and even cannot see by our eyes.

Interestingly, although particle nature of dark matter is still unknown, we can recognize indirectly its existence through the gravitational interaction. For example, we can identify it from the velocity dispersions of galaxies, the rotational velocities of galaxies, and gravitational lenses.

Dark matter is dominant as the source of gravity. Structure formation of the Universe proceeds hierarchically. Smaller-scale dark matter structures formed first from initial density fluctuations imprinted shortly after the Big Bang, and they then merge into larger-scale structures (Figure 1). At about 100 million years after the Big Bang, first stars and galaxies began to form in massive dark matter structures. Therefore, studying dark matter structures is important to understand not only what dark matter is, but also origins of the Milky Way, the solar system, the earth, and lives.

Numerical simulations are only tools to trace the evolution of individual structures, and thus have been playing a pivotal role to study them. Since dark matter structures exist in wide mass ranges larger than 20 orders of magnitude (earth mass to clusters of galaxies) and evolve over the long history of the Universe (14 billion years), huge simulations by supercomputers are demanded. Achieving large simulations efficiently on modern supercomputers (more than 10,000 CPUs) is challenging work, scientists have to develop innovative numerical algorithm and optimize their codes. At the same time, this situation has been facilitating cross disciplinary exchange about numerical simulations.

Our goal is to understand how structures in the Universe form and evolve by supercomputer simulations. This will help to improve the wisdom of humanity and develop new technologies. In this talk, I will review the current status of our work and to show the future perspective of our attempt.

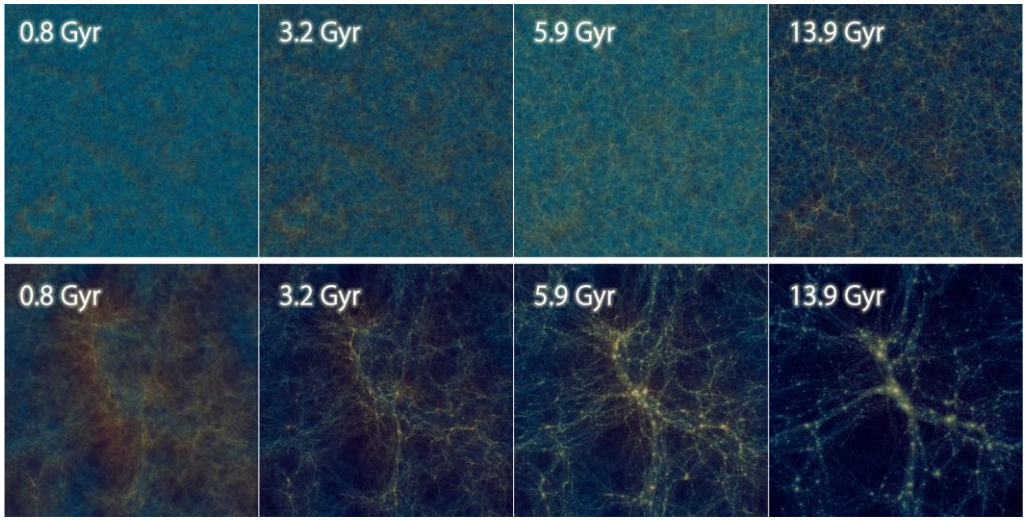

Fig 1. Evolution (left to right) of dark matter structures reproduced by two supercomputer simulations. The spatial sizes in the top (bottom) four panels are 5.4 and 0.33 comoving billion light years. Values in each of panels show the age of the Universe after the Big Bang. Brightness is corresponding to dark matter density.

NOTES

How did the Hot Big Bang Begin?

Mustafa Amin, Rice University

Quantum fluctuations in matter and spacetime are ever present. When combined with a rapid, accelerated expansion of space in our universe's infancy (inflation), these fluctuations can seed the formation of galaxies and ultimately, us. Such a picture is being exquisitely tested by measuring the patterns of light from the time of formation of the first atoms as well as the spatial distribution of galaxies in the cosmos.

Inflation, however, leaves the universe cold and empty. How did inflation end? How did the universe get populated with matter and radiation (reheating)? To recover the standard hot big bang, the stuff responsible for inflation must be converted into a hot thermal soup of matter, teeming with highly energetic particles. This conversion can be dynamically rich with explosive particle production (preheating), formation of solitons, generation of ripples in space and could even hold the secret to why there is more matter than antimatter. This era in the very early universe – between the end of inflation and before the first nuclei are born – presents a gap in the understanding of our cosmic history.

The typical energies during this early period are high compared to what can be probed in our most powerful accelerators – hence the physics is necessarily speculative. To reveal the secrets of this era we can take two approaches: (1) Calculate the dynamics of this period using analytic techniques and (often) detailed numerical simulations in the context of specific models and then compare to observations. (2) Take a "statistical" approach where we put on "foggy" glasses and only try to calculate coarse grained, but universal information which can be constrained by observations. In this talk, I will discuss my ideas and efforts within these approaches for probing our origins.

Further Reading:

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2. The LAMBDA website: https://lambda.gsfc.nasa.gov/
3. M. A. Amin et. al, "Nonperturbative dynamics of reheating after inflation", IJMP D24 (2014) [arXiv:1608.01213]
4. M. A. Amin et. al, "Oscillons after Inflation", Phys. Rev. Lett. 108, 241302 (2012) [arXiv:1106.3335]
5. M. A. Amin & D. Baumann, "From Wires to Cosmology", JCAP 1602, no. 02, 045 (2016) [arXiv:1512.02637]

NOTES

《Decision-Making: A Behavioral Economics and Neuroscience Perspective》 Glossary

Basal ganglia:【大脳基底核】 (or basal nuclei) comprise multiple subcortical nuclei, of varied origin, in the brains of vertebrates, which are situated at the base of the forebrain. The basal ganglia are associated with a variety of functions including: control of voluntary motor movements, procedural learning, routine behaviors or "habits" such as bruxism, eye movements, cognition and emotion.

Cerebral cortex:【大脳皮質】 is the cerebrum's (brain) outer layer of neural tissue in humans and other mammals. It plays a key role in memory, attention, perception, awareness, thought, language, and consciousness.

Discrete choice :【離散選択】 is the choices made by people among a finite set of alternatives, such as mode of transport (car, bus, rail), which car to purchase, which place to visit for holidays…

Economics of happiness :【幸福の経済学】studies happiness, life satisfaction and related concepts, typically combining economics with other fields such as psychology, health and sociology.

Easterlin paradox :【イースタリン・パラドックス】 is an empirical finding by Prof. R. Easterlin. Within a given country, individuals with higher incomes tend to report higher happiness scores. In cross-country comparison, however, higher national incomes are not significantly associated with reported happiness scores.

Executive functions :【実行機能】 , also known as cognitive control, are a set of cognitive processes – including attentional control, inhibitory control, working memory, reasoning, problem solving, planning – that are necessary for the cognitive control of behavior.

Functional magnetic resonance imaging (fMRI) :【機能的磁気共鳴画像法】is a functional neuroimaging procedure using MRI technology that measures brain activity by detecting changes associated with blood flow. When an area of the brain is in use, blood flow to that region also increases.

Moral licensing :【自己義認】 describes the subconscious phenomenon whereby increased confidence and security in one's self-image makes that individual worry less about the consequences of subsequent immoral behavior and, therefore, more likely to make immoral choices.

Pro-drop language：【代名詞主語省略言語】 is a language in which certain classes of pronouns may be omitted when they are in some sense pragmatically inferable.

Reinforcement learning：【強化学習】 is an area of machine learning, concerned with how agents ought to take actions in an environment so as to maximize some notion of cumulative reward.

Reward system：【報酬系】 is a group of neural structures responsible for incentive salience ("wanting" or desire), pleasure ("liking" or hedonic value), and positive reinforcement.

Social preferences：【社会的選好】are a type of preference associated with others' status including interpersonal altruism, fairness, reciprocity, and inequity aversion.

Striatums：【線条体】is a subcortical part of the forebrain and a critical component of the reward system. It receives glutamatergic and dopaminergic inputs from different sources and serves as the primary input to the basal ganglia system. The striatum coordinates multiple aspects of cognition, including motor and action planning, decision-making, motivation, reinforcement, and reward perception.

Thalamus：【視床】situated between the cerebral cortex and the midbrain. Some of its functions are the relaying of sensory and motor signals to the cerebral cortex, and the regulation of consciousness, sleep, and alertness.

Utility：【効用】 is a measure of preferences over some set of goods and services in economics.

NOTES

Your Brain Made You Do It

Samuel M. McClure, Arizona State University

In the mid-1990s, a model was developed that explained the function of midbrain dopamine neurons using reinforcement learning algorithms from computer science. In many ways, the talks in this session are direct descendants of this work. In short, this model described how people and animals learn the value of, and hence acquire preferences for, object in the world in terms of well-known brain systems. Spurred by this discover, tremendous advances have occurred in accounting for decision-making based on brain function – a field referred to as neuroeconomics. These advances have occurred all levels of description, from detailed accounts of changes at synapses to how characteristics of brain function explain larger-scale patterns of behavior and preferences. I will provide a brief summary of work done on brain reward systems to prepare the stage for Profs. Frank and Yamada.

NOTES

Deconstructing Neural Mechanisms of Impulsive Choice

Michael Frank, Brown University

Impulsivity is a substantial risk factor for aberrant behavior, especially in stressful environments. However, the construct of impulsivity is multi-faceted and can be decomposed into multiple component processes that are related to aberrations in distinct neural mechanisms of decision making. We build on theoretical and empirical work identifying two distinct forms of impulsivity linked to separate mechanisms within circuitry connecting the frontal cortex with the basal ganglia. The first involves a reward learning problem associated with elevations in dopamine, causing an asymmetry in learning from positive vs. negative decision outcomes and a bias to seek immediate rewards. The second involves a cognitive control problem associated with dysfunctional communication between prefrontal cortex and subthalamic nucleus, leading to a failure to adaptively pause or inhibit the decision process during difficult choices. I will present an overview of these mechanisms and relevant empirical studies designed to test them using an integrative approach, spanning computational models, human and animal research including measurements of neural activity and perturbations of these mechanisms using pharmacological and brain stimulation techniques.

Additional Resources:

http://ski.clps.brown.edu/ScienceNewsDBS.pdf

http://ski.clps.brown.edu/pubs-online.html

Background Review Article:

Maia, Tiago V., and Michael J. Frank. "From reinforcement learning models to psychiatric and neurological disorders." *Nature neuroscience* 14.2 (2011): 154-162.

[article available on electronic agenda book]

NOTES

Social Preference: Measurement Issues, Interventions, and Its Origin

Katsunori Yamada, Kindai University

Traditional economics theories assume that individuals make decisions to maximize their **utility** from absolute levels of own income/consumption, but behavioral evidence shows that social comparisons influence individuals' well-being. Since such **social preference** can be distortive forces on economic growth (Yamada, 2008), it is critically important to understand them in forming economic and social policies.

Despite well-stocked evidence from **economics of happiness**, debate still continues because conflicting results on **Easterlin paradox** has caused skepticism toward well-being data. By using **functional magnetic resonance imaging** (fMRI), we provided biological evidence showing limitations of happiness data (Tanaka, Yamada, et al. 2016): when people report happiness on a bounded scale of, i.e., 1 to 9, the re-scaling process from intrinsic utility to happiness scores causes activation of the **reward system**. It implies that happiness scores suffer from overstatement biases.

I then propose a new way of measuring social preferences via **discrete choice** questions, whereby we collect choice data instead of subjective evaluation data such as happiness. We have applied the method to Japan (Yamada and Sato, 2013), and the US and the UK (Shigeoka and Yamada 2016). Evidence from Japan holds that social preference dampens about 54 percent of increase in utility, as compared to when there are no comparison effects. Seeking a way to mitigate such losses of welfare due to comparisons, we randomly manipulated respondents from the US and UK with simple information to change comparison attitudes. However, our treatment lead UK respondents to make more comparisons, probably due to **moral license** effects. US respondents were not affected by the intervention. Since this is a new challenge for behavioral economists, we call for more efforts to establish an effective intervention scheme to change preferences.

Finally, I will introduce my recent experiment on the origins of preferences which focus on the use of specific languages. While traditional economics assumes that preferences are given by nature, linguists regard them to be nurtured. For the first time, we have established that there is a causal effect between the use of **pro-drop** sentences and social preference.

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NOTES

《Deep Brain Stimulation and Neuromodulation of Neurodegenerative Disorders》
Glossary

Brain–computer interface (BCI) :【脳-コンピューターインターフェース】Direct communication pathway between the brain and an external device. It is also called brain-machine interface (BMI). 脳信号の読み取とり脳とコンピュータ-との直接的な情報伝達を仲介するプログラムや機器の総称である。接続先がロボットや車いすなどの機械である場合にはブレイン・マシン・インタフェースとも呼ばれる。

Cerebral cortex :【大脳皮質】 The neural tissue that is outermost to the mammalian brain. It plays a key role in perception, cognition, language, decision making, and motor behavior. It is divided into a number of functional subareas including the visual cortex, the auditory and the motor cortex. 大脳の表面に広がる、神経細胞の灰白質の薄い層。知覚、認知、言語、意思決定、随意運動など、脳の高次機能を司る。大脳皮質はし視覚野、聴覚野、運動野など多くの領域に区分けされている。

Deep brain stimulation :【脳深部刺激】 is a highly effective surgical procedure to treat several disabling symptoms in patient with Parkinson's disease. Through implanted electrodes to specific target regions, such as subthalamic nucleus, and globus pallidus, high frequency electrical impulses are delivered via an implantable pulse generator. パーキンソン病の治療として非常に有用性が高い脳深部刺激は、刺激電極を通して脳深部組織である大脳基底核（視床下核、淡蒼球）を高頻度電気刺激する方法である。

Parkinson's disease :【パーキンソン病】is typically characterized by motor symptoms, such as shaking (tremor), increase in muscle tone (rigidity), inability to initiate movement (akinesia), slowness of movement (bradykinesia), postural instability. It results from degeneration of dopamine neurons in substatia nigra, a region in the midbrain. パーキンソン病は中脳の黒質にあるドーパミンニューロンの変性により、主に運動症状としてふるえ、筋強剛、無動、姿勢反射障害を呈する疾患である。

Spinal cord :【脊髄】A long, thin, tubular bundle of nervous tissue and support cells that extends from the brain through the spine. It mediates the transmission of neural signal from the brain to skeletal muscles, from sensory receptors to the brain. 脳から始まり背骨を通る神経組織と結合組織からなる細く長い束。脊髄は脳から筋肉、感覚器から脳へ信号伝達する仲介する。

Supra-spinal system: 【脊髄上神経システム】Nervous system innervates spinal cord. Those include cerebral cortex, basal ganglia, brain stem and cerebellum. 脊髄を支配している神経システムで、大脳皮質、大脳基底核、脳幹や小脳などがそれに当たる。

Transcranial magnetic stimulation :【経頭蓋磁気刺激】employs the principle of electromagnetic induction, first discovered by Michael Faraday, in which a changing magnetic field gives rise to a companion electric field which induces electrical currents in nearby conductive structures. In the case of TMS, a large pulse of current in the external stimulating coil generates a rapidly changing magnetic field that rises to, and falls from, 1 Tesla or more within 1 ms. This field can penetrate the scalp and skull with little impedance and the electrical field it induces causes currents to flow in the brain. 経頭蓋磁気刺激は急激な磁場変化によってファラデーの電磁誘導の法則により弱い誘導電流を組織内に誘起させることで脳内の神経細胞を刺激し活動電位を発生させる方法である。

NOTES

Deep Brain Stimulation and Neuromodulation of Neurodegenerative Disorders

Masashi Hamada, The University of Tokyo

Brain stimulation techniques have proven their potential to modulate brain activity. Therefore the techniques are rapidly transforming research into how the brain works and are developing into new ways to treat disease. The most successful brain stimulation treatment is deep brain stimulation (DBS) for patients with Parkinson's disease. DBS sends high frequency electrical impulses, through implanted electrodes, to specific brain regions, resulting in improvement of parkinsonian symptoms. The other method is transcranial magnetic stimulation (TMS), a safe and non-invasive method of stimulating neurons in intact humans. TMS uses electromagnetic induction to induce weak electric currents in the brain. There is good evidence that repetitive application of TMS (repetitive TMS, rTMS) can produce after-effects, offering potential for clinical application in variety of neurological and psychiatric diseases. Although the mechanisms of this after-effect are not fully understood, it is generally assumed that rTMS induced effects may closely relate to synaptic plasticity, such as long-term potentiation (LTP) or depression (LTD). Given that recovery from any brain disease depends on "relearning" new patterns of activity (presumably using synaptic plasticity) to maximize the use of remaining brain, plasticity induced by rTMS may be an effective therapeutic option to improve recovery. In many ways, the field of brain stimulation is a new paradigm shift, as it opens up new possibilities not only to gain neurophysiological insight into how the brain works but also to develop effective ways of neuromodulation.

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NOTES

Basal Ganglia Circuits in Health and Disease

Daniel Leventhal, University of Michigan

The basal ganglia are deep brain structures conserved from invertebrates to man, with clear importance to normal human behavior and common neuropsychiatric syndromes. Precisely what the basal ganglia do, and how they do it, however, remain poorly understood. Early clues to their function came from “natural lesion” studies, in which the function of neural systems is inferred from abilities lost when they are damaged. A common and disabling example of basal ganglia dysfunction is Parkinson Disease (PD). Clinically, it is characterized by tremor, slowness of movement (bradykinesia), rigidity, and gait disturbances. Its most prominent pathologic feature is degeneration of a basal ganglia nucleus whose primary function is to deliver dopamine to other basal ganglia nuclei. In the late 1960s, clever methods were developed to restore brain dopamine levels and ameliorate PD motor symptoms. Nonetheless, PD remains a source of significant disability.

The next significant therapeutic advance came in the 1990s with the advent of deep brain stimulation (DBS), in which implanted electrodes pass current into specific basal ganglia regions. Suddenly, deep brain recordings were available in humans, as well as the ability to compare distinct circuit manipulations. Observations during DBS surgery caused leading models of basal ganglia function to be modified, emphasizing neuronal activity patterns over simple firing rates. However, the causal chain from dopamine loss to the physiologic changes observed during DBS to clinical symptoms remains poorly understood.

I will discuss progress towards understanding how the basal ganglia in general, and dopamine specifically, contribute to motor control in health and disease. I will emphasize lessons learned during DBS surgeries, and how they have been translated back and forth between humans and animal models. Importantly, while PD and DBS provide a window into basal ganglia function in a specific pathologic condition, these findings are providing important insights into a range of neuropsychiatric syndromes associated with basal ganglia abnormalities.

Background Review Article:

Shen, Helen. "Neuroscience: Tuning the brain." Nature 507.7492 (2014): 290.

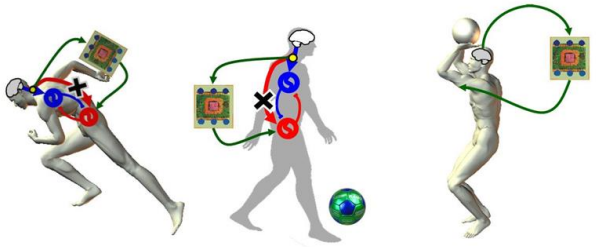
[article available on electronic agenda book]

NOTES

Restoring Lost Functions via Artificial Neural Connection

Yukio Nishimura, Kyoto University

Functional loss of limb control in individuals with spinal cord injury or stroke can be caused by transection of descending and ascending pathways those connects cortical to spinal network, although neural circuits locate above and below the impaired site remains their function. An artificial neural connection that bridges the lost pathway has potential to restore the functional loss. I will show an artificial neuronal connection that bridges supra-spinal system and spinal network beyond the lesion site restore lost function. The artificial connection was produced by a brain-computer interface that can detect the neural activity and converted in real-time to activity-contingent electrical stimuli delivered to nervous system. A promising application is to bridge impaired biological connections, as demonstrated for cortically controlled electrical stimulation to paretic muscles. Our results document that monkey utilized artificial connection to restore hand function, instead of physiological connections. A second application of the artificial connection is the volitional walking in patients in spinal cord injury (SCI) could be restored by muscle-controlled non-invasive magnetic stimulation to lumbar spinal cord in human. Patients with severe SCI could regain volitional control of walking which are initiate, stop walking and change the step cycles volitionally through artificial connection. A third application involves delivery of activity-dependent deep brain stimulation at subcortical reward sites, which can operantly reinforce the cortical or muscle activity that generates the stimulation. These paradigms have numerous potential applications, depending on the input signals, the computed transform and the output targets.



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NOTES

《Environmental Archaeology/ Paleoclimate》Glossary

Ancestral Pueblo: 【古代プエブロ人】The archaeological term for American Indian village farmers who lived in masonry dwellings, often in contiguous roomblocks, and made decorated pottery.

Crown fire: 【樹冠火】A wildfire that burns in the canopy of the forest, usually with very high mortality rates.

Dendrochronology: 【年輪年代学】 The science of tree-ring dating, including the climate, fire, and ecological information recorded in the tree rings.

Discontinuous ephemeral streams:【間欠河川】small stream drainages that only carry surface water infrequently.

Fire scar: 【焦げ跡】 Distinctive damage to tree ring cross section caused by a surface fire.

Fire regime: 【山火事の発生様式】The regular patterns by which wildfires occur in a particular landscape. This usually includes the regular frequency, size, seasonality, behavior, and ecological consequences thereof.

Geoarchaeology:【地考古学】The application of earth science methods and techniques to archaeological problems.

Intertropical Convergence Zone (ITCZ)：【熱帯収束帯】is the area where the trade winds in the northern and southern hemispheres come together. The convergent air convects upward and develops thick rainy clouds (i.e. cumulonimbus). In general, the ITCZ moves north in the northern hemisphere summer and south in the southern hemisphere summer. It affects the rainfall in tropical regions. 南北両半球の貿易風が合流し、大気が収束する帯状の境界。収束した空気は上昇し、積乱雲を発達させる。一般に、北半球が夏の時には北半球に、冬の時には南半球に移動し、熱帯域の降水に影響を与える。

Maya civilization：【マヤ文明】is a civilization which uniquely developed in central America from 1,000 BC to the 16th century. Mayan people developed a sophisticated writing system, as well as sophisticated calendars and advanced astronomy. 中米で紀元前 1000 年頃から 16 世紀にかけて独自に発展した文明。文字や暦、天文学を高度に発達させた。

Mega-fires: 【大規模森林火災】Unusually large and damaging fires that are not part of the historical fire regime for a particular landscape.

Sediment：【堆積物】consists of fine particles, usually minerals, microfossils and/or volcanic ash. They are transported by water, wind or glacier and settle in the ocean or lake bed, or on land. The deposits from minerals dissolved in water are also called sediment. 鉱物や岩石の破片、生物遺骸、火山噴出物などが、水や風、氷河によって運ばれて、海や湖、陸に積もったもの。水中に溶け込んだ物質が沈殿したものも堆積物に含まれる。

Social-Ecological Resilience: 【社会・生態システムの回復力】The ability of a coupled human-natural system to respond to shocks or disturbances and still maintain the same structure, function, and identity.

Solar activity：【太陽活動】is an approximately 11 year cycle where the sun's surface activity increases and decreases. 太陽表面で見られるさまざまな変化を総称したもの。太陽活動は、約 11 年の周期で活発になったり穏やかになったりする。

Surface fire: 【地表火】A wildfire that burns in grassy fuels, downed needles, and downed branches. These fires often kill seedlings but leave mature trees unharmed.

Varve：【年縞】is an annual layer of sediment deposited in response to seasonal variations. 1 年間の季節変化に対応して、供給される物質が変化することで、1 年に 1 枚形成される縞模様の堆積物。

Western Apaches: 【西アパッチ族】 An American Indian tribe composed of small bands who were seasonally mobile, part-time gardeners and part-time hunter-gatherers.

X-ray fluorescence (XRF) analysis：【蛍光 X 線分析】is one of the elemental analytical methods using X-rays. The type and concentration of constituent elements are obtained by measuring the energy distribution and intensity of X-ray fluorescence when the sample is irradiated by X-rays. X 線を用いて、試料を構成する元素の分析を行う方法。X 線を照射した時に発生する蛍光 X 線のエネルギー分布や強度から、物質を構成する元素の種類や濃度が得られる。

NOTES

High Resolution Studies of Past Human-Environment Interactions

Hiroo Nasu, SOKENDAI: The Graduate University for Advanced Studies

Environmental reconstruction in the past several thousand years becomes more significant issue to understand the mechanism of environmental change. Recent unexpected huge natural disasters taught us that observation data of centennial scale are not enough, but we need millennial scale environmental data, to better understand the interactions of environmental change and past human societies. It will provide us several clues to think how to survive in the changing environment near future.

Millennial scale past environment was well studied from the 1980's using several environmental archives such as lake and ocean sediments, however, the resolution of the dating was not sufficient. Although we need several thousand years long data set of environment archives, the each environmental proxy should be analyzed annual to several decadal resolution to correlate with the several events of the human history, such as land use change, population fluctuation, agricultural activity, war, rise and fall of civilization, etc.

Recently, we have developed our technique to use annual resolution of paleoenvironment archives, such as tree rings, verve sediments, coral, and speleothem. And also, we have developed more accurate calibration curves for radiocarbon dating. In this session, I will present the high resolution verve sediment data of Lake Suigetsu in Japan, which is refining the radiocarbon dates can be converted to the calendar time more accurate. Dr. Roos will present recent developed model based high resolution tree ring studies of fire-climate-human interactions in the ponderosa pine forest in the southwestern US where large scale forest fire occurs frequently. In considering the beneficial and sustainable fire regimes, his research has been noted as having a big contemporary significance. Dr. Kitaba will present very new findings of annual verve sediment in the lowland Guatemala, where is the center of Maya Civilization. The special verve sediment has potential to understand solar-climate interactions.

Background Review Article:

Bronk Ramsey et al. (2012) A Complete Terrestrial Radiocarbon Record for 11.2 to 52.8 kyr B.P. *Science* 338(6105) 370-374.

[article available on electronic agenda book]

NOTES

Footprints of the Sun Left in a Tropical Lake

Ikuko Kitaba, Ritsumeikan University

Since the dawn of time, people have developed advanced civilizations by using natural rhythms. In Central America, where the Mayan civilization originated, the climate changes rhythmically during the year. A band of thick rainy clouds (Intertropical Convergence Zone: ITCZ) develops in this region and the band follows the sun's seasonal movement. That brings the dry and wet seasons every year.

The lake sediment in Lake Petexbatún, north Guatemala, is very special. The clear annual layers (varves), consisting of the dry and wet seasonal sub-layers, have been deposited over the last 600 years. In addition, these varves are 10 times thicker than most varves found elsewhere, which means they are the highest quality varves in the world.

In this research, we analyzed the elements of the varves and made a 'natural rain gauge'. We reconstructed the rainfall variation in this region using this gauge. We found that the comprehensive wet-dry patterns synchronize with the temperature changes in the northern hemisphere. The reconstructed rainfall pattern shows a significant drying trend over the last 100 years, during which time the rainfall fluctuations became larger. It can also be seen from the peaks in rainfall that the wet-dry pattern has followed a ca. 9-11 year cycle. This result implies that the Mayan climate has been affected by solar activity over hundreds of years.

NOTES

Fire, Climate, and Society in the Ancient Southwest: Ancient Lessons for Sustainable Fire Management

Christopher Roos, Southern Methodist University

In 2015 alone, the US spent more than $2 billion suppressing wildfires. More than 100,000 people may have died from direct and indirect effects of Indonesian peat and forest fires that same year. Policymakers and land managers are aware that wildfires are creating new challenges. However, these fire problems have largely been considered ahistorically, as if humans learning to live in flammable environments is a new phenomenon. Archaeological records, however, indicate that human communities have been living in flammable landscapes for millennia. What lessons can be learned from the successes (and failures) of past societies in their relationship with wildfires? How might these lessons contribute to our understanding of contemporary wildfire problems?

In my research, I bridge archaeological records of past human occupation and land use, with paleoecological records of past fire activity, and paleoeclimate syntheses of climate-driven changes in fire activity. My research focuses on the fire-dependent, dry conifer forests of the Southwestern US, where novel fire behavior is threatening human lives, property, and infrastructure as well as transforming the ecosystems in unprecedented ways. These forests were home to American Indian farming and hunting communities since the start of the Common Era, during which fire use was an important livelihood tool, as well as an abundant natural phenomenon in the surrounding forests. Integrated histories of climate, people, and fire reveal the subtle but important long-term consequences of fire using human communities in a fire adapted and fire dependent forest.

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NOTES

《Good Sleep: Relief from Sleep Disorders》Glossary

Growth hormone:【成長ホルモン】is a peptide hormone that is not only important for growth but also for homeostasis and immune functions.成長だけでなく、恒常性維持や免疫機能において重要な機能を担うペプチドホルモン。

REM sleep:【レム睡眠】 (which stands for rapid eye movement sleep) is a phase of sleep first reported in 1953, as a state accompanied by rapid eye movement and dreams. REM sleep contributes to about 10~15% of total sleep. 急速眼球運動睡眠を表す。1953年に、急速眼球運動や夢を伴う睡眠のフェーズとして報告された。睡眠全体の 10-15%程度を占める。

Slow waves:【徐波】 are slow oscillatory brain activity observed from the surface of the brain during non-REM sleep. Slow waves are generated by the slow and synchronous oscillation of neurons in the neocortex. Slow waves are often used as a measure for sleep depth. Slow waves are known to be important for memory consolidation that occurs during non-REM sleep. ノンレム睡眠中に脳の表面から観測されるゆっくりとした振動性の電気活動。徐波は、大脳皮質の神経細胞が同調していっせいに興奮と抑制を繰り返すことで生じる。徐波はよく睡眠の深さの指標に用いられる。徐波はノンレム睡眠中に生じる記憶の定着に重要であることが知られる。

NOTES

Mystery of Sleep

Akihiro Yamanaka, Nagoya University

We spend almost one third of our life time just to sleep. Sleep is well conserved in wide range of species nevertheless sleep makes animal defenseless. Additionally sleep deprivation from animal resulted in death. These facts suggest that sleep has important physiological role and has benefits for survive. During sleep, we repetitive two different type of sleep, that is non-REM sleep and REM sleep (Figure 1). Initial sleep is non-REM sleep, you lose consciousness by dropping brain activity during non-REM sleep. Electroencephalogram (EEG) showed wider and low frequency wave called slow wave or delta wave. However, entering REM sleep, brain activity is relatively high in REM sleep. EEG showed narrow and high frequency wave called theta wave. Muscle is completely relaxed and you have vivid dream during REM sleep. These sleep/wakefulness state changes are a very intriguing physiological phenomenon. We fall asleep at least once per day. After sleeping for a while, we can wake up naturally. And we feel refreshed mind and vigorous when we woke up. The mechanism regulating sleep/wakefulness cycle and physiological role of sleep has not been completely understood so far.

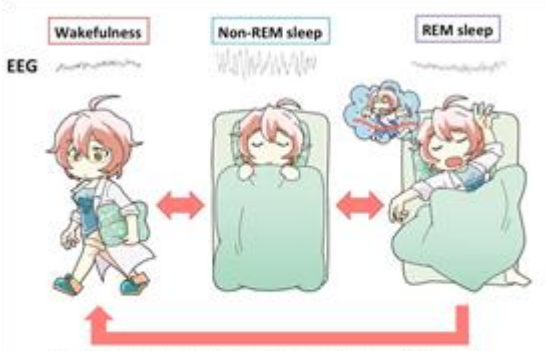

Figure 1 Sleep/wakefulness state changes and electroencephalogram (EEG)

Recently, new experimental techniques for neuroscience such as optogenetics or pharmacogenetics were developed (Boyden et al., 2005; Armbruster et al., 2007). These techniques allow us to control the activity of specific type of neurons using light or chemical substance using whole animal. Applying these techniques to sleep research, we can analyze causality between activity of specific type of neurons and sleep/wakefulness state changes. For example, the activity of orexin/hypocretin neurons in the hypothalamus was manipulated by using optogenetics or pharmacogenetics enabled control sleep/wakefulness state changes in mice (Adamantidis et al., 2007; Tsunematsu et al., 2011; Inutsuka et al., 2014). These results suggested that orexin/hypocretin neurons have an important role on the maintenance of wakefulness. In 2014, orexin receptors selective antagonist was placing on the market as a sleeping drug. This new drug induces sleep similar to natural sleep without affecting sleep architecture.

Taken together, recent progress in sleep research start to reveal the role and regulatory mechanism of sleep and to change our daily life.

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NOTES

Why Do We Need Sleep?
Our Current Understanding of the Roles of REM and Non-REM Sleep

Yu Hayashi, University of Tsukuba

1. Introduction

We spend nearly one-third of our life sleeping. Sleep is, just like eating or drinking is, essential for living. Almost everyone has experienced the feeling of falling to pieces after a night of poor sleep. Insufficient sleep not only causes distress but is also a risk factor for traffic accidents, metabolic syndromes, mood disorders, Alzheimer's disease, etc. Even the stem cells donated from subjects with insufficient sleep perform poorly after transplantation to the recipient. In one extreme case, human errors attributed to sleep loss and shiftwork were reported to have contributed to the tragic Space Shuttle Challenger accident. Thus improving people's sleep quality is beneficial for the whole society, and such concepts have led to activities such as the "Start School Later movement".

However, unlike eating or drinking, why sleep is so essential remains a mystery. In a radical experiment in which rats were not allowed to sleep at all, the sleep-deprived rats exhibited drastic symptoms such as excess body weight loss and severe skin lesions, and invariably died within a couple of weeks (Rechtschaffen and Bergmann, Sleep, 2002). The direct cause of such drastic symptoms remains unknown. Over the night, our sleep cycles between two distinct states, rapid eye movement (REM) sleep (which is the major source of vivid dreams) and non-REM sleep. Abnormal balance of the two sleep states is a common and early symptom in various psychiatric disorders, suggesting that both sleep states play important roles. These two sleep states are evident only in specific vertebrate species, and thus elucidating their functions might be a key to understanding our complex brain (Fig. 1).

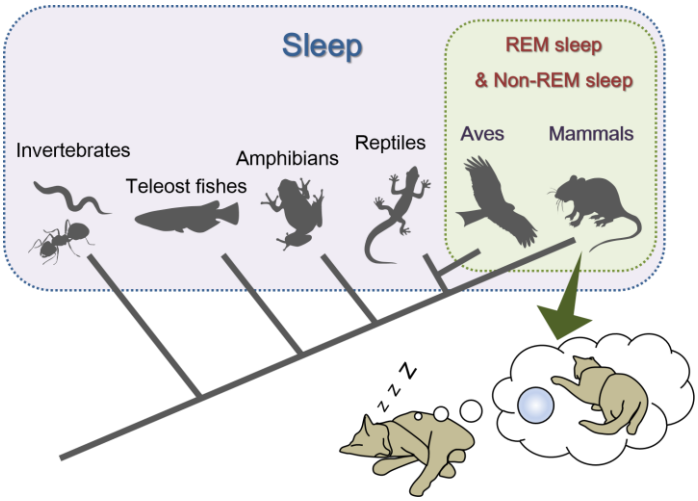

Fig. 1 -REM sleep and non-REM sleep are unique to certain vertebrate species.

2. Non-REM sleep and slow waves

Various physiologic changes occur during sleep, including increased growth hormone secretion (Takahashi et al, 1968) and enlargement of the brain interstitial space which might allow clearance of waste products from the brain (Xie et al, 2013). Even a short nap can drastically improve memory consolidation. Many of the currently clarified roles of sleep are mainly attributed to non-REM sleep, including the secretion of growth hormone and the consolidation of memories (Takahashi et al, 1996; Rasch et al, 2007). Interestingly, many of these effects of non-REM sleep are positively correlated with the intensity of slow waves, a kind of oscillatory brain activity that appears specifically during deep non-REM sleep (Gronfier et al, 1996; Marshall et al, 2006).

Thus, securing a good amount of deep non-REM sleep seems a key to getting “good sleep”.

3. REM sleep: a run-up to get “good non-REM sleep”?

By contrast, the function of REM sleep is far less understood and controversial. While many people have proposed that dreaming during REM sleep is a procedure to organize our memories, the roles of REM sleep in learning and memory is yet an ever-lasting controversy. However, if a person or animal is deprived of REM sleep, later, a huge rebound of REM sleep occurs, implying that, for some reason, we do need to get REM sleep. Our group previously identified a group of neurons in the brain that strongly suppress REM sleep. Genetic manipulation of these neurons allowed us to establish transgenic mice where REM sleep can be inhibited at any arbitrary timing (Fig. 2). Analyses of these mice suggested that one function of REM sleep is to enhance slow waves during subsequent non-REM sleep, and that the cyclic emergence of REM sleep might perhaps be to get “good non-REM sleep”, although the underlying mechanism is totally unknown (Hayashi et al, 2015).

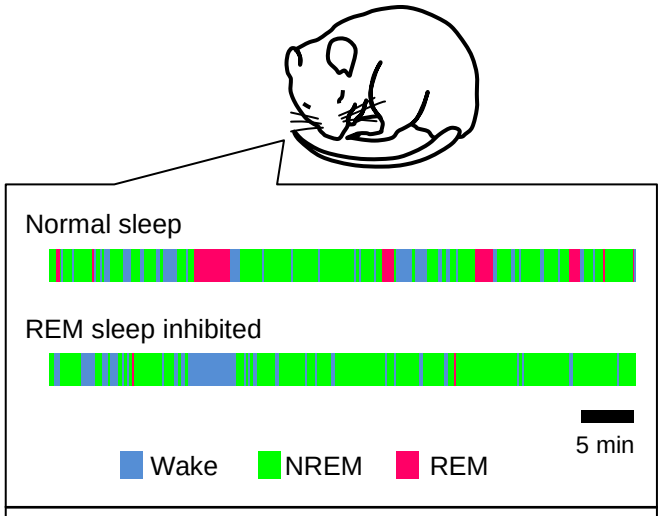

Fig. 2- We established transgenic mice in which REM sleep can be artificially inhibited.

4. Conclusion and future perspectives

Many transgenic mouse models which allow the manipulation of sleep are being developed by our group and other groups, and provide insights to the function of sleep. In the near future, we believe that there will also be a clear answer as to why we cannot live without sleep. In addition, although most of the currently adopted drugs for insomnia do increase total sleep amount, the resulting sleep has reduced deep non-REM sleep and REM sleep, thus quality. The identification of neurons that regulate sleep should also contribute to developing novel drugs for treating sleep problems.

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NOTES

Sleep and Circadian Contributions to Health

Cathy Goldstein, University of Michigan

Sleep is a critical part of the human experience; however, sleep is treated as an expendable commodity with nearly 30% of Americans sleeping six hours or less.[1] In addition to reduced sleep duration, approximately 20-30% of the workforce is engaged in non-conventional shiftwork which requires that sleep take place at atypical times.[2] The negative repercussions of poor sleep on alertness and performance have been experienced by nearly all of us first hand; but a growing body of evidence suggests that the impact of disturbed sleep may be more widespread.

Two-process model of sleep

Sleep is controlled by a two-process model, comprised of the homeostatic sleep drive and circadian rhythm.[3] The homeostatic sleep drive increases the longer one is awake and is dissipated by sleep. If sleep was controlled entirely by the homeostatic sleep drive, we would sleep in multiple bouts across the 24-hour day. Therefore, organisms possess an internal timing system or circadian rhythm. Circadian rhythms are the intrinsic, biological processes that allow an organism to adapt to the external, environmental changes resultant from the 24-hour rotation of the earth on its axis. The most obvious circadian rhythm in humans is the pattern of sleep and wake which aligns to the light-dark cycle. During the day the circadian alerting signal promotes wake, and during the night the neurons of the suprachiasmatic nucleus of the hypothalamus are quiescent such that there is a high propensity for sleep. The circadian rhythm results from the near 24-hour oscillation of core clock gene expression via a genetic transcriptional/translational feedback loop.[4]

Circadian control of physiological processes

Ten to twenty percent of the genome is expressed rhythmically[5,6] and virtually all organ systems demonstrate circadian timing as evident by the 24-hour variation in cardiovascular, immune, metabolic, endocrine, and other physiological function.[7,8] Further, the peripheral cells of most organs contain molecular clock machinery.[4]

Impact of sleep loss and circadian disruption on health

Ample evidence suggests that circadian disruption via aberration of the central clock or externally imposed abnormalities in light-dark cycle results in significant health consequences. Shift-work is the human model of circadian disruption given the overlap of the work period with the time of high sleep propensity while the time allotted for sleep aligns with the circadian promotion of wakefulness. Shift-work has been associated with cardiovascular[9], metabolic[9] ,neoplastic[10], reproductive[11], and gastrointestinal[12]

consequences. Apart from the circadian disruption that accompanies shift work, sleep that is short in duration may also result in similar risks[13].

Given the above, the importance of adequate, appropriately timed sleep transcends alertness and is a critical component of overall health and wellbeing.

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[article available on electronic agenda book]

NOTES

《Manipulating the genetic code》Glossary

CRISPR-Cas9 system【クリスパー キャスナイン システム】: This is a prokaryotic immune system that confers resistance to foreign genetic elements such as those present within phages.

Genome editing【ゲノム編集】: The CRISPR-Cas9 system is recently used for genome editing. By delivering the Cas9 nuclease and appropriate guide RNA into a cell, the genome of the cell can be cleaved at a desired location, allowing existing genes to be removed and/or new ones added.

Optogenetics【光遺伝学】: This is a biological technique, which involves the use of light to control cells in living tissue that have been genetically modified to express light-sensitive actuators. For example, neuronal control has been achieved using a light-sensitive ion channel, known as channelrhodopsin.

NOTES

Manipulating the Genetic Code

Blake Wiedenheft, Montana State University

Viruses that infect bacteria (i.e. phage) are the most diverse and abundant biological agents on the planet, causing roughly 10^{23} infections every second (Rodriguez-Valera *et al* Nat Rev Microbiol, 2009). The selective pressures imposed by viral predation have resulted in the evolution of numerous viral defense systems (Labrie *et al* Nat Rev Microbiol, 2010). Historically our appreciation for microbial immune systems had been restricted to innate defense mechanisms, but a sophisticated adaptive immune system has recently been discovered (Sorek *et al* Annu Rev Biochem, 2013). Bacteria acquire resistance to viral challengers by integrating short fragments of foreign nucleic acid into CRISPR (clustered regularly interspaced short palindromic repeat) loci in their own genome. CRISPRs serve as molecular vaccination cards by maintaining a genetic record of prior encounters with foreign transgressors. In this introduction, I will explain how CRISPRs were discovered and present a mechanistic model that provides a foundation for understanding how the emerging new properties of this defense system are now being routinely repurposed for genome engineering in a wide variety of cell types and multicellular organisms (Peter *et al* Cell, 2016 and Kawano *et al* Nature Chem. Biol. 2016). The creative application of these immune systems illustrates how basic research can lead to unexpected innovations with applications in environmental and medical sciences (van Erp *et al* 2014).

NOTES

CRISPR/Dcas9 for Reprogramming of the Human Genome

Stanley Qi, Stanford University

The mammalian cells use complex transcriptional and epigenetic programs to determine fate and function. The ability to reprogram the expression of multiple genes in the genome provides a powerful approach for understanding biology and modeling disease. Here I will present the CRISPRi method, which was repurposed from the bacterial CRISPR system, as a genetic toolkit for multiplexed, reversible, sequence-specific gene regulation. We have developed a general orthogonal dCas9-based platform to enable parallel transcriptome manipulation. The CRISPRi method enables high-order genetic interrogation, allowing large-scale screening of individual or combinatorial genes with important phenotypes. We further applied the technologies to address the needs for disease modeling using stem cells. We aim to apply the non-editing based genome engineering approaches for therapeutics.

Background Review Article:

Dominguez, Antonia A., Wendell A. Lim, and Lei S. Qi. "Beyond editing: repurposing CRISPR-Cas9 for precision genome regulation and interrogation." *Nature Reviews Molecular Cell Biology* (2015).

[article available on electronic agenda book]

NOTES

Optical Control of the Genome

Moritoshi Sato, The University of Tokyo

The genome consists of more than 20,000 genes and is essential for most of biological phenomena. To understand these biological phenomena, including diseases, and to utilize or modify them, approaches that enable the genome to be regulated at will are required.

For targeted genome regulation, a new class of technology, known as the CRISPR-Cas9 system, has offered powerful tools. Several studies have shown that the catalytically inactive mutant of Cas9 nuclease (dCas9) fused with the transcriptional activator domain enables targeted activation of user-defined endogenous genes. However, this technology is unable to offer precise spatiotemporal control of gene expression, despite the fact that many biological phenomena are regulated by highly dynamic patterns of gene expression.

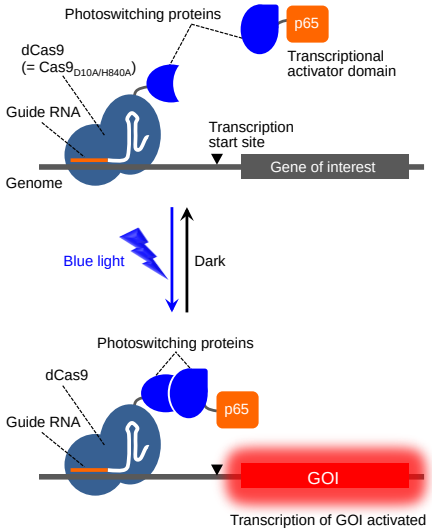

Fig.1. CRISPR-Cas9-based photoactivatable transcription system.

We developed a light-inducible, RNA-guided programmable system for endogenous gene activation based on the CRISPR-Cas9 system (Fig. 1) (Ref. 1). We demonstrated that this optogenetic system allows rapid and reversible targeted gene activation by light. Using this system, we exemplified photoactivation of multiple user-defined genes in mammalian cells. The CRISPR-Cas9-based, photoactivatable transcription system offers a simple and versatile approach to precise gene activation.

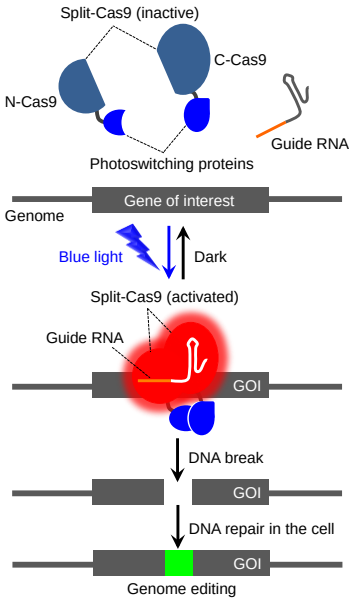

Fig.2. Photoactivatable Cas9 nuclease for light-induced genome editing.

Based on the CRISPR-Cas9 system, we also developed another optogenetic system, named photoactivatable Cas9 (paCas9) (Fig. 2) (Ref. 2). We divided the Cas9 nuclease into two fragments and connected photo-inducible dimerization proteins (Ref. 3) to the fragments, leading to the development of paCas9

of which nuclease activity is switchable with light. Different from the photoactivatable transcription system, paCas9 allows direct editing of DNA sequence of the genome by light stimulation.

We developed the CRISPR-Cas9-based optogenetic systems. Genome editing technology and optogenetics technology have emerged as different technologies from each other so far. The works described above merge these emerging research fields together.

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Background Review Article:

Knox, Margaret. "The Gene Genie." *Scientific American* 311.6 (2014): 42-46.

[article available on electronic agenda book]

NOTES

《New Directions in Mathematical Epidemiology》Glossary

Emerging infectious disease: 【新興感染症】is an infectious disease whose incidence has increased in the past 20 years and could increase in the near future. 最近 20 年くらいに新たに出現した或いは近い未来に急速な拡大が危惧される感染症.

Epidemic: 【流行】is the rapid spread of infectious disease to a large number of people in a given population within a short period of time, usually two weeks or less, in excess of our expectation. 普段からみられる以上に多くの感染者数が短期間に見られること.

MCMC (Markov Chain Monte Carlo): 【マルコフ連鎖モンテカルロ】 is an inferential method (or algorithm) by which a sampling of parameters is conducted from a probability distribution based on constructing a Markov chain that has the desired distribution as its equilibrium distribution. マルコフ連鎖を利用した確率分布からのランダムサンプリングを繰り返すことによるベイズ更新を活用したパラメータ推定方法のこと

MERS (Middle East respiratory disease): 【中東呼吸器症候群】is a viral respiratory infection caused by the MERS-coronavirus (MERS-CoV) which has originally been harbored by camel population. 元々ラクダが保有していた MERS 関連コロナウイルスによって引き起こされるウイルス性呼吸器感染症のこと.

MLE (maximum likelihood estimation): 【最尤推定法】is a method of estimating unknown parameters of a mathematical or statistical model given empirical data. 観察データが与えられたときに数理モデルあるいは統計モデルの未知のパラメータを推定する方法のこと.

Superspreader: 【スーパースプレッダー】is a host—an organism infected with a disease—that infects disproportionally more secondary contacts than other hosts also infected with the same disease. 感染者の中でも他の感染者と比較して異常に多くの 2 次感染者を生み出しており，多くの 2 次感染者の感染源となり得る者のこと.

Zika virus: 【ジカウイルス】is a member of the virus family Flaviviridae and the genus Flavivirus. It is spread by daytime-active Aedes mosquitoes, such as A. aegypti and A. albopictus. ジカ熱の原因となるウイルスでフラビウイルス科に属する. ネッタイシマカやヒトスジシマカなどのシマカによって媒介される.

NOTES

New Directions in Mathematical Epidemiology

Dylan Shepardson, Mount Holyoke College

Mathematical and statistical models play an increasingly important role in informing public health workers, clinicians, and policy makers. It is often not possible to test epidemiological hypotheses directly through experiment, and a reliable model gives us a way of assessing alternative scenarios and interventions. Increasing computational power and access to larger and more complex data sets have allowed the field to move beyond traditional compartmental models of disease transmission. At the same time, there has been a growing recognition of the ongoing challenge of responding rapidly and effectively to newly emerging and re-emerging diseases like SARS, MERS, Ebola, and Zika. Much of the current research in mathematical epidemiology is directed toward understanding the role of population heterogeneity, nonhomogeneous mixing, and epidemiological contact networks in the dynamics of disease transmission, and to finding ways to use data from a wide array of sources to develop models that can be deployed to respond to newly emerging and re-emerging diseases in real time.

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NOTES

Analyses of National and Global Strategic Plans for Disease Prevention and Control

Chaitra Gopalappa University of Massachusetts Amherst

The White House National HIV/AIDS Strategy calls for reduction in HIV incidence in the United States by 25% by 2020. The United Nations Sustainable Development Goals on Non-communicable Diseases (NCDs) calls for reduction in premature deaths from NCDs by one-third globally by 2030. While there exists these political commitments, there is a growing recognition that, under constrained resources, successfully achieving these goals requires a highly effective strategic plan for intervention implementation. While traditionally public health intervention guidelines are based on evidence of its impact measured independently though clinical trials or mathematical models, achieving national and global targets requires a paradigm shift in analyses of interventions. These arise from the fact that population-level disease prevention and control involves implementation of multiple intervention programs that dynamically interact with each other such that the overall impact is not a direct sum of the individual parts. Further, for communicable diseases, the trajectory of disease spread are defined by dynamical interactions between multiple parameters related to individual behavior, socio-economic conditions, population contact structures, and biological factors of the infectious agent. With the rise in computational feasibility and growing availability of data, mathematical models can play an increasingly important role through innovative techniques for simulating the above complicated dynamics, integrating disparate data sources to derive significant information that otherwise cannot be inferred through any of the data sources independently, analyzing multiple alternative combinations of interventions, and further informing data collection for more accurate design of models in the future. I will discuss our work in this area.

Background Review Article:

"Chaitra Gopalappa, Paul G. Farnham, Yao-Hsuan Chen, and Stephanie L. Sansom Progression and Transmission of HIV/AIDS (PATH 2.0): A New Agent-Based Model to Estimate HIV Transmissions in the United States, Medical Decision Making 0272989X16668509, first published on September 19, 2016 doi:10.1177/0272989X16668509"

[article available on electronic agenda book]

NOTES

Real Time Research Response to Emerging Infectious Disease Epidemic

Hiroshi Nishiura, Hokkaido University

When an emerging infectious disease appears in our society, the most prioritized task for mathematical epidemiologists is to respond to the epidemic, analyzing epidemiological and other empirical datasets, elucidating core components of epidemiological dynamics and clarifying the infectiousness, pathogenicity and virulence during the course of epidemic. Ideally, good feedback should be given to the government and also to the public in real time, helping to plan effective interventions against the growth of cases. Here outbreak studies of Middle East respiratory syndrome (MERS) and Zika virus are presented, highlighting how real-time studies have helped deciphering the transmission and natural history of these two infectious diseases. When MERS outbreak occurred in Korea, our research team was committed to identifying heterogeneous patterns of transmission and death. Devising a novel statistical model that addresses censoring issue during the course of an epidemic, risk factors of MERS death were identified. Genomic information of viruses was shown to help confidently reconstruct the transmission tree, thereby identifying superspreaders as arising from patients who visited multiple healthcare facilities. Similarly, real time studies of Zika virus successfully quantified country-specific risk of Zika virus importation and outbreak using airline transportation network data and also previous epidemic record of dengue and chikungunya viruses. Whereas those studies are certainly useful for public purpose, validity and reliability of those findings and common pitfalls have yet to be systematically explored, and moreover, talented experts to be engaged in real time studies have yet to be trained. These are likely to be the key for future risk assessment of infectious diseases in real time.

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NOTES

Fifteenth Japanese-American Kavli Frontiers of Science Symposium

Japan Society for the Promotion of Science – U.S. National Academy of Sciences
Arnold and Mabel Beckman Center - Irvine, California
December 2-4, 2016

List of Poster Presenters[1]

Biology / Life Science

1 - A screen for systemic growth regulators reveals hobbit, a novel and conserved regulator of insulin secretion
Arash Bashirullah, University of Wisconsin, Madison

2 - Dissecting molecular mechanism of circadian clock by using chemical tools
Tsuyoshi Hirota, Nagoya University

3 - Solving the traffic jam of cellulases for better utilization of cellulosic biomass
Kiyohiko Igarashi, University of Tokyo

4 -Photoacoustic imaging technology: from in vivo bio-imaging to medical imaging
Miya Ishihara, National Defense Medical College

5 - Finding of group 2 innate lymphoid cells
Kazuyo Moro, RIKEN IMS

6 - In vivo molecular imaging for biomedical analyses and targeted therapies
Mikako Ogawa, Hokkaido University

7 - Using light to map and manipulate mechanical pathways in living systems
Khalid Salaita, Emory University

8 - Finding minor but important cells in immunological system by high throughput DNA sequencing
Katsuyuki Shiroguchi, RIKEN

9 - Genome Stability in Pluripotent Stem Cells
Tomomi Tsubouchi, National Institute for Basic Biology

10 - Development of techniques for single-cell genetic analysis of circulating tumor cells
Tomoko Yoshino, Tokyo University of Agriculture & Technology

Chemistry / Biochemistry

11 - Metal-Catalyzed Generation of Sulfonyl Fluorides using Solid SO2 Reagents
Nicholas Ball, Pomona College

12 - Effect of electrostatic interaction on sliding friction of hydrogel
Takayuki Kurokawa, Hokkaido University

[1] Odd numbered posters will present on Friday, December 2 from 7:00-9:00 p.m.; even numbered posters will present on Sunday, December 4 from 10:30 a.m.-12:30 p.m.

Chemistry / Biochemistry

13 - A Better Understanding of Cannabis Chemistry to Aid in Vapor Phase Detection of Intoxication
Tara Lovestead, National Institute of Standards and Technology

14 - A decadal estimate of global carbon dioxide flux distribution by the inverse modeling using a global Eulerian-Lagrangian coupled atmospheric model
Tomoko Shirai, National Institute for Environmental Studies

Earth Science / Environment

15 - Where is HONO from?
Chika Minejima, International Christian University

Materials Science / Biomaterials

16 - Anti-inflammatory Protein Display on Engineered Biofilm Matrix Proteins from Probiotic Bacteria
Neel Joshi, Harvard University

17 - Utilizing concepts of mechanics, transport, and assembly in Nature – towards responsive materials
LaShanda Korley, Case Western Reserve University

18 - Study of Ferroelectrics by Raman Spectroscopy
Shinya Tsukada, Shimane University

Mathematics / Applied Mathematics / Informatics

19 - Self-foldability of Rigid Origami
Thomas Hull, Western New England University

20 - Mining and Forecasting of Big Time-series Data
Yasuko Matsubara, Kumamoto University

21 - Mechanistic modelling of rubella epidemic in Japan
Masaya Saito, The Institute of Statistical Mathematics

22 - Fabrication of Soft Tissue Structure Utilizing Biofabrications and Investigation of its Bioelectric Potential
Shinjiro Umezu, Waseda University

Medical Science / Neuroscience

23 - Neural mechanisms of value, preference, and uncertainty
Alicia Izquierdo, University of California, Los Angeles

24 - The essential role of mTORC1 signaling pathway for oligodendrocyte differentiation and CNS myelination
Masato Koike, Juntendo University Graduate School of Medicine

Physics / Astrophysics / Astronomy

25 - Quantum electron transport in graphene and nanowire
Keiko Takase, NTT Basic Research Laboratories, NTT Corporation

Physics / Astrophysics / Astronomy
26 - All-optical switch actuated by a single photon
Haruka Tanji-Suzuki, The University of Electro-Communications

Social Sciences
27 - Archaeology of Environmental Injustice
Sarah Cowie, University of Nevada-Reno

28 - Does Marriage Work as a Savings Commitment Device? Experimental Evidence from Vietnam
Hisaki Kono, Kyoto University

29 - Economic Effects of Emergency Risk Communication: Evidence from the Fukushima Daiichi Nuclear Disaster
Hiroaki Matsuura, Shoin University

Poster Number – 1

A screen for systemic growth regulators reveals hobbit, a novel and conserved regulator of insulin secretion

Sarah D. Neuman, Jessica R. Smoko and Arash Bashirullah
University of Wisconsin-Madison, Madison, WI 53705

Insulin signaling plays a central role in the regulation of systemic growth in Drosophila, and therefore is critical in the determination of final body size. However, the mechanisms regulating insulin secretion remain poorly understood. In a forward genetic screen for mutants with reduced body size, we identified 5 alleles of a novel gene, which we named hobbit. Hobbit is highly conserved from yeast to humans, but no function has been assigned to the protein in any organism. Our results demonstrate that hobbit has a non-cell autonomous effect on growth, indicating that the small body size of the mutants is due to a systemic growth defect. We found that hobbit mutants exhibit dramatic defects in insulin secretion, and this defect is directly responsible for the small body size of the mutant animals. Importantly, these insulin secretion defects can be rescued by expressing Hobbit specifically in tissues required for insulin secretion. Furthermore, we demonstrate that expression of the human ortholog of hobbit is sufficient to rescue the fly mutant, suggesting that the function of hobbit in insulin secretion is conserved. We are currently focused on analyzing the mechanism by which hobbit regulates secretion of insulin, and our results indicate that hobbit is required for a novel step in the regulated exocytosis pathway. Overall, we have identified a novel regulator of exocytosis that is required for insulin secretion and the control of systemic growth during development.

Poster Number – 2

Dissecting molecular mechanism of circadian clock by using chemical tools

Tsuyoshi Hirota, Nagoya University

The circadian clock is an intrinsic time-keeping mechanism that controls the daily rhythms of numerous physiological processes, such as sleep/wake behavior, hormone secretion, and metabolism. Circadian rhythms are generated in a cell-autonomous manner through transcriptional regulatory networks of the clock genes. To search for novel modifiers of the circadian clock, we have conducted high-throughput phenotype-based screens in human cells. We applied chemical biology approaches that uses chemicals to investigate biological machinery. From hundreds of thousands of small molecules with diverse structure, we identified a number of compounds that potently change the function of the circadian clock. We developed affinity probe in collaboration with organic chemists and purified interacting proteins which were further identified with mass spectrometry analysis. By using these compounds as probes, we revealed important regulatory mechanisms of the circadian clock. Small molecules longdaysin and LH846 inhibit casein kinase I family proteins to lengthen the period of the clock, and KL001 directly interacts with the core clock protein CRY to inhibit its degradation for period lengthening. In this presentation, I will discuss recent progress of chemical biology approaches for the circadian clock research.

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Poster Number – 3

Solving the traffic jam of cellulases for better utilization of cellulosic biomass

Kiyohiko Igarashi, University of Tokyo

Cellulose and chitin are major components of plant cell wall and exoskeleton in animals, respectively. They are the most abundant biomass on earth, and efficient degradation of the biomass makes it possible to produce fuels and chemicals from the resources. However, biochemical conversion of the structural polysaccharides, cellulose and chitin, by cellulase and chitinase is a bottleneck of the process, mainly because they form recalcitrant crystalline region in these biomass. The enzymes degrading the crystalline polysaccharides share a common two-domain structure, carbohydrate-binding module and catalytic domain, and these domains cooperatively function for the effective hydrolysis of the substrates. Since the reaction is carried out at the surface of insoluble substrate, it is not straightforward to analyze the reaction at a solid/liquid interface.

We have recently reported the real-time visualization of crystalline polysaccharides degradation by individual cellulase or chitinase molecules using a high-speed atomic force microscopy, having sub-second time resolution and nanometer space resolution. From the comparison among fungal (*Trichoderma reesei*[1-3] and *Phanerochaete chrysosporium*[4]) cellobiohydrolases and *Serratia marcescens* chitinases[5], we discuss possible molecular mechanisms of these processive enzymes and the natural degradation of crystalline structural polysaccharides.

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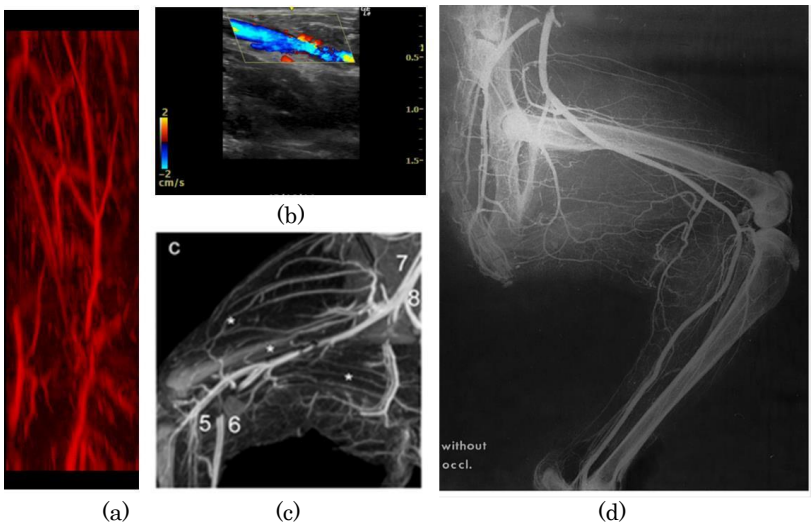
Poster Number – 4

Photoacoustic imaging technology: from in vivo bio-imaging to medical imaging

Miya Ishihara, National Defense Medical College

Photo-acoustics has been widely studied as new imaging modalities, which is based on optical absorption and ultrasonic detection. Photoacoustic imaging provides cross-sectional and/or three-dimensional images, noninvasively. Because acoustic waves scatter much less than optical waves in biological tissue, the photoacoustic imaging has the advantage of imaging that can penetrate deeply. Another advantage is spectroscopic-based specificity using endogenous and exogenous optical contrasts. This imaging technique is characterized by the scalability of its spatial resolution and depth penetration across both the optical and ultrasonic dimensions.

We developed a photoacoustic imaging system for clinical research trials, and also for animal experiments.



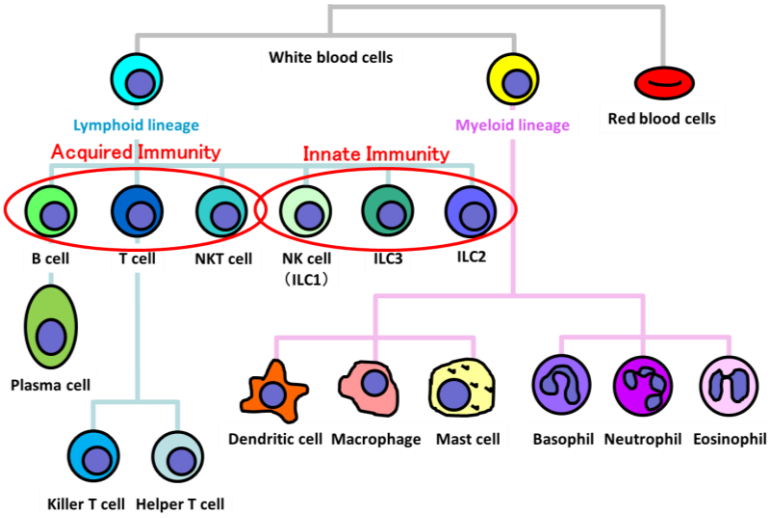
Comparison between photoacoustic and the well-established angiography: (a) in-vivo photoacoustic imaging of the microvasculature in a Japanese white rabbit groin, (b) the corresponding the color-Doppler ultrasonography, (c) MR angiography with a contrast medium cited from PLoS ONE (2011) and (d) X-ray catheter-angiography cited from Cardiovascular Research (2001).

(M. Ishihara, *SPIE BiOS,* 9323, 93232K, 2015)

Poster Number – 5

Finding of group 2 innate lymphoid cells

Kazuyo Moro, Laboratory for Innate Immune Systems, RIKEN-IMS, JAPAN



The immune system is pivotal for not only fighting against various infections but also regulating the homeostasis of numerous tissues and organs. Our research group focuses on the role of group 2 innate lymphoid cells (ILC2), a new innate lymphocyte that we recently identified, in the regulation of inflammation and tissue homeostasis. ILC2 express several cytokine receptors such as IL-2R, IL-7R, IL-25R and IL-33R. IL-25 and IL-33 are known to induce type 2 immune responses during helminth infection and allergic inflammation. ILC2 produce large amounts of IL-5 and IL-13 in response to a combination of IL-2 + IL-25 or IL-33 alone and induce eosinophilia and goblet cell hyperplasia that not only attacks the worm but also exacerbates allergic symptoms.

Progenitors and transcription factors which involved in ILC2 development are well reported. However, the microenvironment that regulates differentiation of ILC2 remains unclear. To identify the external factor that induces specific differentiation of lymphocytes, CLP were co-cultured with TSt4-DLL1 stromal cells under different concentrations of IL-7. We found that the concentration of IL-7 differentially regulates T cell and ILC2 differentiation. We also reveal that the strength and duration of Notch signals divided commitment to T cell, B cell and ILC2. Furthermore, to clarify the microenvironment that supports ILC2 development, we identified ILC progenitors and immature ILC2 in the fetal mesentery. We also showed by transplantation analysis that mesentery functions as a site that induces differentiation of mature ILC2. Our findings demonstrate that concentration of IL-7, and strength and duration of Notch signaling regulate lymphocyte lineage determination and the mesentery plays an important role in the differentiation and maturation of ILC2.

Poster Number – 6

In vivo molecular imaging for biomedical analyses and targeted therapies

Mikako Ogawa, Hokkaido University

In vivo molecular imaging has great possibility to monitor the molecular process in diagnostic or therapeutic applications noninvasively. Several kinds of imaging tools are used in clinical situations, such as positron emission tomography (PET), single photon emission computed tomography (SPECT), optical imaging, magnetic resonance imaging (MRI), computed tomography (CT), and ultrasound imaging (US). Among these, CT, MRI and ultrasound are categorized as morphological imaging technologies, although some molecular imaging trials are undertaken these days. PET, SPECT and optical imaging can be used for molecular imaging.

Furthermore, we have recently reported a new molecular-targeted cancer photo-therapy, photoimmunotherapy (PIT). Since this agent also emits a diagnostic fluorescence, it can be used to direct the application of light to minimize exposure to nonrelevant tissues and to noninvasively monitor any therapeutic effects of excitation light. Herein, we discuss advances and disadvantages of each imaging technique, and focus on the activatable optical imaging probe. Also, “Theragnostics (therapy + diagnosis)” by PIT would be discussed by showing practical examples.

Poster Number – 7

Using light to map and manipulate mechanical pathways in living systems

Khailid Salaita, Emory University

Brief Bio: Khalid obtained his Ph.D. under the guidance of Prof. Chad Mirkin at Northwestern University in 2006. During that time he studied the electrochemical properties of organic adsorbates patterned onto gold films and developed massively parallel dip-pen nanolithography approaches. From 2006-2009, Khalid was a postdoctoral scholar with Prof. Jay T. Groves at UC Berkeley. As a postdoc, he developed electrostatic-based approaches for DNA microarray readout, and also investigated the role of EphA2 receptor clustering in modulating cell signaling. In 2009, Khalid started his own lab at Emory University, where he currently investigates biophysical aspects of receptor-mediated cell signaling. To achieve this goal, his group has pioneered the development of molecular force probes and nano-mechanical actuators that are integrated with living cells. These materials are used to investigate the molecular mechanisms of a number of pathways where forces are thought to be important such as the Notch-Delta pathway, T cell activation and the integrin-based focal adhesion pathway. In recognition of his independent work, Khalid has received a number of awards, most notably: the Alfred P. Sloan Research Fellowship, the Camille-Dreyfus Teacher Scholar award, and the NSF Early CAREER award. Khalid's program is supported by NSF, NIH, and DARPA.

Abstract: A major challenge to understanding the role of forces in cell biology pertains to the lack of molecular tools that allow one to image and manipulate forces at the cell membrane. To address this issue, we have developed a set of fluorescent probes (mechanophores) and actuators to investigate the role of forces in biochemical signaling. In this poster, I will highlight our work developing molecular force probes and their application in the area of mechanotransduction. Force probes take advantage of FRET to determine the extension of a molecular "spring" to quantify tension. Tension probes are modular and the spring element can be engineered using PEG polymers, oligonucleotides, and proteins. The latest generation of tension probes employ fluorescence resonance energy transfer to a plasmonic nanoparticles, which provides significant improvement in sensitivity. I will also describe the application of these probes in the study of integrin receptor mechanotransduction and T cell receptor activation. Surprisingly, I will show recent results demonstrating that integrins experience ~100 pN of tension within mature focal adhesions – which is two orders of magnitude greater than was previously estimated. In the context of T cell mechanotransduction, I will describe the physical basis of TCR recognition. Finally, I will discuss the development and application of optically controlled nanoscale actuators to control receptor tension, thus demonstrating the first example of using light to physically control cell migration.

Poster Number – 8

Finding minor but important cells in immunological system by high throughput DNA sequencing

Katsuyuki Shiroguchi, RIKEN Quantitative Biology Center

In biological systems, different cells communicate each other and cell-cell network may generate functions of cell populations, tissues, and organisms. In order to understand this structure from cells to higher biological layers, one of the first question is: how many of what type of cells exist in a given cell population. Toward this direction, we have been developing a method to measure cell heterogeneity by identifying cell types and quantifying cell numbers based on target genomic sequences within a next generation sequencing workflow. For higher throughput measurements, we are developing a novel cell-barcoding method. I would like to introduce our method and discuss some results for immunological systems.

Poster Number – 9

Genome Stability in Pluripotent Stem Cells

Tomomi Tsubouchi, National Institute for Basic Biology

Pluripotent stem cells are capable of differentiating into all cell types that compose our bodies. In mammalian cells, these include embryonic stem cells (ES cells) that appear transiently during fetal development and induced pluripotent stem (iPS) cells that are created *ex vivo* using various cell types as starting material. Pluripotent stem cells have gained tremendous amount of attention over the years, with the expectation for their use in regenerative medicine. However, we are only beginning to uncover the nature of pluripotent stem cells *per se*.

Accumulating evidences suggest that pluripotent stem cells proliferate (divide) differently compared to other cell types. Most notably, ES cells appear to struggle during DNA replication stage, when cells duplicate their own genome to produce two daughter cells. As DNA is packaged differently in ES cells compared to other cell types, we hypothesize that such ES cell-specific features interfere with DNA replication.

Severe interference and blockage of DNA replication can lead to DNA damage. Indeed, DNA damage marks (e.g., □H2AX protein) appear at high levels in ES cells. We are currently investigating how such DNA damage is repaired and ES genome is protected from DNA damage.

Lastly, we are setting up a system to monitor the process of pluripotency-acquisition (i.e., reprogramming) through live-imaging. Some iPS cells are known to harbor DNA mutations that are likely caused by DNA replication errors.

Our goal is to understand how pluripotent stem cells self-renew while maintaining their genetic information and how ES-specific genome-maintenance mechanisms may be linked to pluripotency. Through our studies, we hope to uncover nature's different strategies to maintain their unique features without affecting their genetic information.

Poster Number – 10

Technology for single cell genetic analysis of circulating tumor cells

Tomoko Yoshino
Division of Biotechnology and Life Science, Institute of Engineering, Tokyo University of Agriculture and Technology

Abstract: Circulating tumor cells (CTCs) are defined as tumor cells circulating in the peripheral blood of patients with metastatic cancer (Fig.A). CTCs are well recognized as an accessible and valuable biomarker for cancer diagnosis and are a potential target for drug discovery. The presence of CTC had been indicted in mid-19th century, however the full-fledged researches were started in early-21 century. Because CTCs are extremely rare (one tumor cell in 5×10^9 blood cells), there had not been enough technology for the efficient recovery of CTCs from blood samples and further manipulation techniques. We have developed a metal micro-filters (microcavity array) for highly efficient enrichment of CTCs based on differences in the size and deformability between tumor and blood cells (Fig.B). Shapes and sizes of the cavity were optimized in order to trap tumor cells while letting blood cells flow through the cavity during whole blood filtration [1]. We conducted a clinical feasibility study in lung cancer patients, and the further techniques for the genetic analysis of a single CTC were developed [2]. These techniques for single cell analysis will pave the way for new findings in the field of cancer research and will act as novel tools for drug discovery. We believe that the proposed technology for single cell genetic analysis can also be widely utilized for other mammalian cells and microorganisms as well as for CTCs.

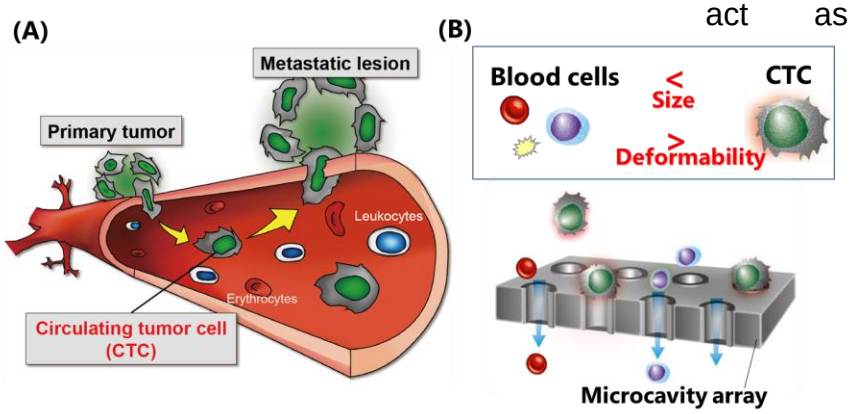


Fig. Circulating tumor cell(CTC) (A) and the principle of CTC recovery from blood sample using microcavity array (B).

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Poster Number – 11

Metal-Catalyzed Generation of Sulfonyl Fluorides using Solid SO2 Reagents

Nicholas Ball, Pomona College

Sulfonyl fluorides are of increasing interest as alternative precursors towards the synthesis of sulfonylated organic compounds and important chemical tools in biology. A current synthetic challenge to make aromatic sulfonyl fluorides is the need for sulfur-based organic starting materials. To address this challenge we have developed a Pd-catalyzed conversion of aryl iodides to aryl sulfonyl fluorides using a SO_2 surrogate and an electrophilic fluorine source. This methodology generated an array of electronically and sterically diverse sulfonyl fluorides in good to high yields. Current studies are focused on elucidating the mechanistic of SO_2 insertion and C–SO_2–heteroatom bond formation from model Pd and Ni complexes. Information gleaned from these studies will inform the development of metal-catalyzed sulfonylation reactions that use by-products of pollution to high-impact compounds

Effect of electrostatic interaction on sliding friction of hydrogel

Jamil Ahmed,[1] Takayuki Kurokawa,[1] Honglei Guo,[2] Tetsurou Yamamoto,[2] Masakazu Takahata,[3] Tasuku Nakajima,[1] and Jian Ping Gong[1]

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In this paper, we investigate the frictional behavior of PCDME hydrogels against glass substrates in varied ionic strength and pH medium. We used a homemade optical system to in situ monitor the friction interface, which gives information on the evolution of gel contact to the glass during sliding motion.

In order to discuss the molecular mechanism of friction, we need to avoid the macroscopic contact effect caused by water entrapment, and perform friction measurement with a full initial contact. For this purpose, we use a soft gel (E = 5.4 kPa) that can form complete contact by large deformation at the whole normal pressure range. As the hydrogel and glass substrate are flat enough, the friction of hydrogels at full contact comes from the elastic resistance, that is, a collective strength of deformation of adsorbed polymer chains.

We consider the pH dependence of electrostatic potential of glass surface. Lameiras et al. showed that lowering the pH of the solution pushes the ζ potential of glass toward zero (Figure 1a). The electrostatic interaction between gel and glass surface can be approximated as the product of their surface potential $\psi_{gel}\psi_{glass}$. Using the ζ potential of glass from literature as ψ_{glass} and the measured ψ_{gel} of PCDME hydrogel, Figure 1b shows the correlation between $\psi_{gel}\psi_{glass}$ and frictional stress as a function of pH. At low pH, the value of $\psi_{gel}\psi_{glass}$ is negative, which means there is an attraction between the sliding surfaces, and the friction is high. As the pH increases, $\psi_{gel}\psi_{glass}$ starts to increase and crosses zero at pH 8.5. Beyond this pH, the two surfaces are in repulsion and the friction starts to decrease. This result confirms again that the friction of zwitterionic PCDME gels on glass substrates has the electrostatic origin, as long as the surfaces remain microscopically smooth and are in complete contact.

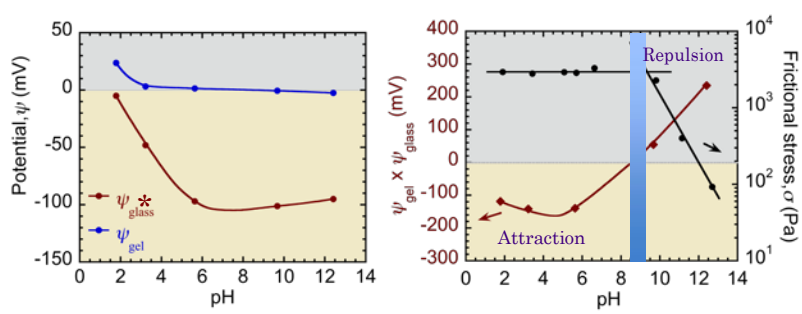

Figure 1. (a) Variation of potential of glass (ψ_{glass}) and PCDME hydrogel (ψ_{gel}) with different pH. (b) Product of potentials of these two surfaces and it is correlation with frictional stress over different pH. Frictional stress at low velocity limit (1.7×10^{-4} m/s) was adopted.

Poster Number – 13

A Better Understanding of Cannabis Chemistry to Aid in Vapor Phase Detection of Intoxication

Tara Lovestead, National Institute of Standards and Technology

Decreased criminalization of cannabis has led to a surge in both medical and recreational use. As a consequence, a rise in intoxicated drivers and workers may follow, making imperative the need to detect cannabis-induced intoxication for both law enforcement and workplace safety. Additionally, in spite of decriminalization on the state level, cannabis still remains a Schedule I, federally illegal drug. Alcohol intoxication can be detected by monitoring the concentration of ethanol in the blood or breath. In general, increasing the amount of alcohol consumption correlates to increased alcohol intoxication and diminished faculties. Interestingly, intoxication from cannabis consumption is a much more complex problem.

The cannabis plant is composed of over 400 compounds, including more than 100 plant cannabinoids. Different plant cannabinoids impart either therapeutic or psychoactive affects, e.g., cannabidiol (CBD) and Δ^9-tetrahydrocannabinol (Δ^9-THC), respectively. Most methods developed to test for cannabis use determine Δ^9-THC. There are many problems with detecting Δ^9-THC concentration. Δ^9-THC is rapidly metabolized in the body into non-psychoactive metabolites. Additionally, a small portion of this compound is taken up by fatty tissue and is slowly released over long time periods (hours, days, weeks). Δ^9-THC levels also depend on the mode of consumption (smoking versus eating). Thus, Δ^9-THC concentrations in the body are governed by many factors and no good correlation to intoxication has been established.

Devices that detect Δ^9-THC in the breath are currently being developed and have many advantages. Breath testing is non-invasive, can be stand-off and portable, and has been shown to indicate recent use, 0.5 hours to 2 hours.[1] However, impairment may last longer than that caused by recent use.[1]

Our approach is three-pronged. We are developing the measurement science necessary to obtain fundamental data to make intuitive material selection choices for “catch” and “release” of important compounds. This will also aid in our “breathalomics” efforts. In turn, breathalomics will inform us the compounds with which to make fundamental data measurements. Additionally, materials development will aid both our fundamental data measurements and our breathalomics efforts. This approach will ultimately aid industry to develop useful, in-the-field vapor phase detection devices to aid law enforcement personnel to determine recent illicit drug use and intoxication.

We began our work by characterizing vapor pressures and molecular interactions of CBD and Δ^9-THC. We utilized both an ultra-sensitive, quantitative, trace headspace analysis technique called porous layered open tubular-cryoadsorption (PLOT-cryo) [2] and nuclear magnetic resonance (NMR) spectroscopy. In the first experiment, PLOT-cryo was used to determine the mass collected in the vapor phase at a given temperature. Presentation of this data in the form of a van’t Hoff equation plot reveals the predictive capability of the methodology employed here.

NMR was used to examine minute structural changes of Δ^9-THC and CBD in the presence of different compounds, interactors, and solvents. By observing the changes in the proton signals of cannabinoids as a function of interactor concentration, we obtain insight into the presence of important intermolecular interactions. These thermochemical data will specifically inform material selection for adsorption and technique for desorption of the important compounds determined by use of breathalomics.

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Poster Number – 14

A decadal estimate of global carbon dioxide flux distribution by the inverse modeling using a global Eulerian-Lagrangian coupled atmospheric model

Tomoko Shirai, National Institute for Environmental Studies

Carbon dioxide (CO_2) is a major greenhouse gas and the most important contributor to anthropogenic climate change. Before the industrial revolution, the atmospheric CO_2 exchange with natural carbon reservoirs (land and ocean) was largely in balance. This balance has been disrupted by the addition of considerably large amounts of CO_2 to the atmosphere due to combustion of fossil fuels and other human activities since then. The 2014 Fifth Assessment Report of the Intergovernmental Panel on Climate Change concluded that observed warming of the climate system is unequivocal (e.g. the globally averaged surface temperature increased by 0.85°C between 1880 and 2012 (IPCC, 2013)). In addition to a general upward trend, land and ocean surface temperatures show substantial variability on annual to decadal time scales. To assess the potential impacts of ongoing global climate change, the processes driving the variability must be investigated. Since natural sink processes remove about half of the anthropogenic CO_2 in the atmosphere, it is urgent to understand the current status and trends of carbon cycle; CO_2 exchange between land, ocean, and atmosphere.

Inverse modeling is one approach to quantifying the spatiotemporal distribution of sources and sinks at the Earth's surface, starting from a set of atmospheric mixing ratio observations by using an atmospheric transport model and sophisticated statistical inversion schemes. This approach is often called "top-down approach" as opposed to "bottom-up approach" that investigates the processes controlling sources and sinks to be quantified locally by flux observations, process-based models, and so on. In the carbon cycle research community, the top-down and bottom-up approaches are cooperating with each other to better quantify the global/regional carbon budget.

Here I introduce an atmospheric inverse modeling system based on GELCA (Global Eulerian-Lagrangian Coupled Atmospheric model) and present a decadal estimate of global CO_2 flux distribution for the period of 2002-2011 as a result. The advantages and disadvantages of the method will be discussed along with an introduction to recent topics in the research field.

IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J.Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1–30, doi:10.1017/CBO9781107415324.004.

Poster Number – 15

Where is HONO from?

Chika Minejima, International Christian University

Another ongoing project is to find out sources and production mechanisms of gaseous nitrous acid (HONO) in the atmosphere by in situ measurements. HONO is a precursor of hydroxyl radical (OH). Through its reactions with organic compounds, OH initiates the production of O_3. Its high reactivity and low concentration, however, prohibit accurate measurements of OH concentrations. An alternate method of determining photochemical oxidant production is to quantify the sources and sinks of OH. The main OH source in the morning is often HONO photolysis. Unexpectedly high contributions have also been reported during the midday hours, though the daytime HONO source remains uncertain (Ren et al., 2006). Also HONO is important because it was pointed out that HONO is likely to be the causative agent of asthma attack (Ohyama et al., 2010). In spite of the importance, the whole picture of HONO sources is not yet revealed. And to explain the measured HONO concentrations in the atmosphere requires identifying other sources (Zhang et al., 2010).

HONO emission from soils is suspected to be a strong daytime HONO source. Nitrite ion (NO_2^-) in the soils is in the equilibrium with $HNO_2(\mathrm{aq})$ and volatilizes as HONO. HONO emissions from soils in laboratory experiments were just measured and were reported very recently and no field experiments are reported yet. Therefore, the objectives of this study are to quantitatively determine HONO fluxes from soils and to evaluate the contributions of them to the atmospheric HONO concentration. I focus on rice fields because it has high nitrogen load due to fertilization and rice paddies are unique because its water level is controlled. When water covers the soil, the soil is anaerobic, but during the mid-summer drainage and cultivation, the soil environment changes to the aerobic condition. The soil nitrate changes its form from ammonium (NH_4^+) to nitrite (NO_2^-) and to nitrate (NO_3^-) rapidly. I expect HONO is emitted during the drainage periods at once. Thus, I tried to measure HONO flux over rice paddies at Namekata, Ibaraki during drainage periods.

Also emission mechanism of HONO by nitrifying bacteria and denitrifying bacteria are investigated by the laboratory pot studies using activated sludge.

Poster Number – 16

Anti-inflammatory Protein Display on Engineered Biofilm Matrix Proteins from Probiotic Bacteria

Pichet Praveschotinunt[1,2], Anna Duraj-Thatte[1,2], Trevor Nash[3], Fred Ward[3], Noemie-Manuelle Dorval Courchesne[2] and Neel Joshi[1,2]

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[2] Wyss Institute for Biologically Inspired Engineering at Harvard University, Boston, MA, 0211[3]Harvard College, Harvard University, Cambridge, MA, 02138

The number of cases of inflammatory bowel diseases (IBD) such as Crohn's disease and ulcerative colitis has significantly increased in last few decades. The diseases are currently incurable and require patients to undergo lifelong treatments. The probiotic *E. coli* Nissle 1917 (EcN) has been shown to be effective in induction and maintaining remission in ulcerative colitis, yet can be improved upon in terms of gut residence time and therapeutic efficacy. We have engineered the biofilm matrix of EcN as a material capable of delivering biologically active peptides to the gastrointestinal tract for the treatment of IBD. Our approach involves alteration of curli protein to display trefoil factors (TFFs), a family of small peptides secreted from the GI tract, which play important roles in the protection and the repair of the gastrointestinal epithelial surfaces. This engineered biofilm matrix is not only able display TFFs extracellularly but also able to adhere to a human intestinal Caco-2 cell line better than that without displayed peptides. We have also shown *in vitro* that curli-TFFs are able to interact with mucin and regulate various biomarkers in Caco-2 cells which correlate with TFF activity. Moreover, EcN expressing curli-TFFs exhibited extended residence time and enhanced attachment in the mouse gut compared to the control EcN *in vivo*. Based on these results, the ability to control the residence time of EcN, the anti-inflammatory property of curli-TFFs in mouse models of colitis, and the delivery of a range of therapeutic peptides to the gastrointestinal tract will be further investigated.

Grant acknowledgement: *Wyss Institute, Blavatnik Accelerator Fund*

Poster Number – 17

Utilizing concepts of mechanics, transport, and assembly in Nature – towards responsive materials

LaShanda Korley, Case Western Reserve University

Taking clues from biological systems, we are motivated by Nature's materials design rule and apply these strategies to the development of mechanically-enhanced and functional materials.

One area of particular interest is the incorporation of responsive, supramolecular reinforcing elements in polymeric composites with the goal of combining superior mechanical behavior that can be tuned with additional functionality, such as sensing and bioactivity. In one approach, a cholesterol-derived diacetylene low molecular gelator has been designed to self-assemble into one-dimensional fibers within an elastomeric matrix.[1] Highlighted in this design strategy is the ability to induce inherent dispersion via molecular-level control of filler assembly and to manufacture these composites via a facile process. Bio-inspired composites were also derived from hierarchical electrospun nanofiber fillers that exhibited interfacially-controlled, mechanical switchability and tunable transport behavior.[2-4] New insights into the fabrication of hygromorphic materials have also been revealed.[5] These water-responsive systems have unique applications in therapeutic delivery and chemical/biological protection.

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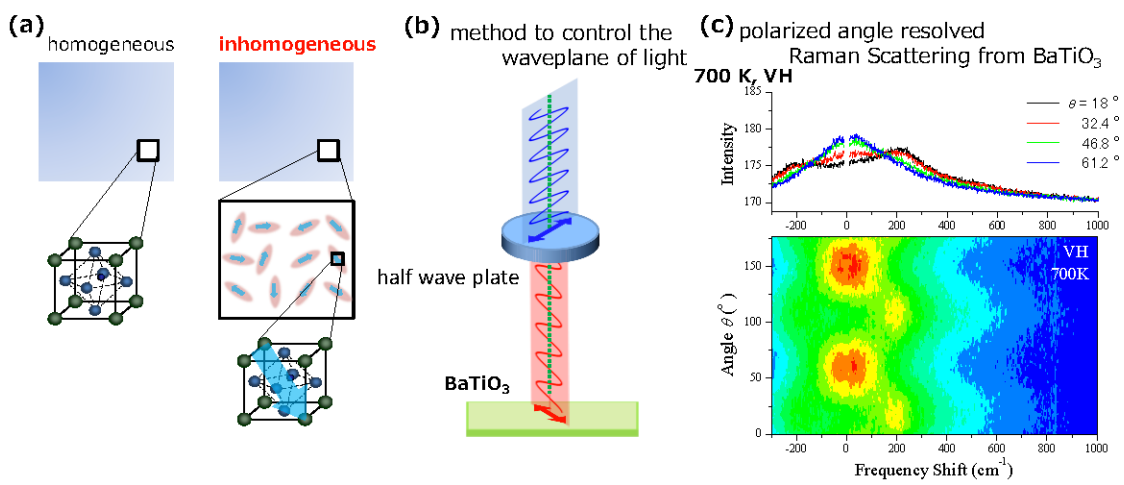
Poster Number – 18

Study of Ferroelectrics by Raman Spectroscopy

Shinya Tsukada, Faculty of Education, University of Shimane, Matsue, Shimane 690-8504

Ferroelectrics are defined as “a group of materials exhibiting spontaneous polarization that can be reversed by the application of a suitable electric field”. Because ferroelectrics show convenient properties for electric elements, we are surrounded by more than ten thousand ferroelectrics. One of the most typical and convenient ferroelectrics is BaTiO3. The useful properties of BaTiO3 are dependent on temperature and closely related with the phase transitions. However, micro- and mesoscopic pictures of phases and phase transitions are still uncertain. One important picture in history is the displacive model (homogeneous concept in FIG. a). Although various properties of BaTiO3 have been understood well on the basis of this simple model, inconsistencies of experimental results from the model have been apparent. In order to explain these experimental results inconsistent with the displacive model, temporal disorders due to the Ti-ion-hopping in eight-site have been considered as microscopic dipoles and ferroelectricity is induced by their interaction. In other words, Ti-ions are always located in one of eight minima along <111>-direction for all phases, and the average position of Ti-ions determines the macroscopic polarization (inhomogeneous concept in FIG. a).

To understand BaTiO3 more clearly and to evaluate the inhomogeneous structure, angle-resolved-polarized Raman scattering was measured from BaTiO3 crystals. By rotating the waveplane of the laser light (FIG. b), Raman scattering changes depending on the crystal direction (FIG. c). By analyzing the angle-resolved-Raman scattering, we have made clear the inhomogeneous structure and its dynamic fluctuations.



FIGs. (a) Homogeneous and inhomogeneous concepts to explain ferroelectrics. (b) Schematic diagram of waveplane rotation of polarize light. (c) Raman spectra of BaTiO3 at 700 K in the backscattering geometry on (001) plane crystal. The angle denotes polarization direction of incident light. [100]-direction corresponds to 0o, while [010]-direction corresponds to 90°.

Poster Number – 19

Self-foldability of Rigid Origami

Thomas C. Hull, Western New England University

When actuating a rigid origami mechanism by applying driving forces (moments) at the crease lines, we often confront the bifurcation problem where it is not possible to predict the way the model will fold when it is in a flat state. We develop a mathematical model of self-folding and propose the concept of self-foldability of rigid origami when a set of driving forces are given. In particular, we desire to design a driving force such that a given crease pattern can uniquely self-fold to a desired mode without getting caught in a bifurcation. We provide necessary conditions for self-foldability that serve as tools to analyze and design self-foldable crease patterns. Using these tools, we analyze the unique self-foldability of several fundamental patterns and demonstrate the usefulness of the proposed model for mechanical design.

This is joint work with Tomohiro Tachi of the University of Tokyo.

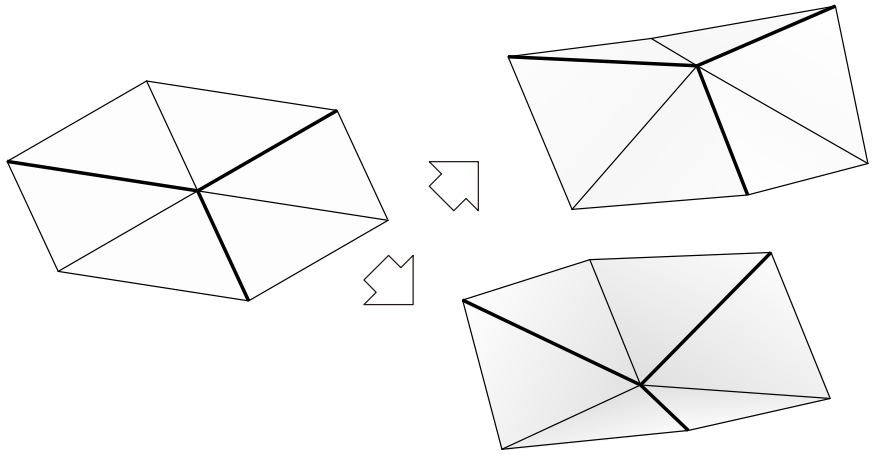
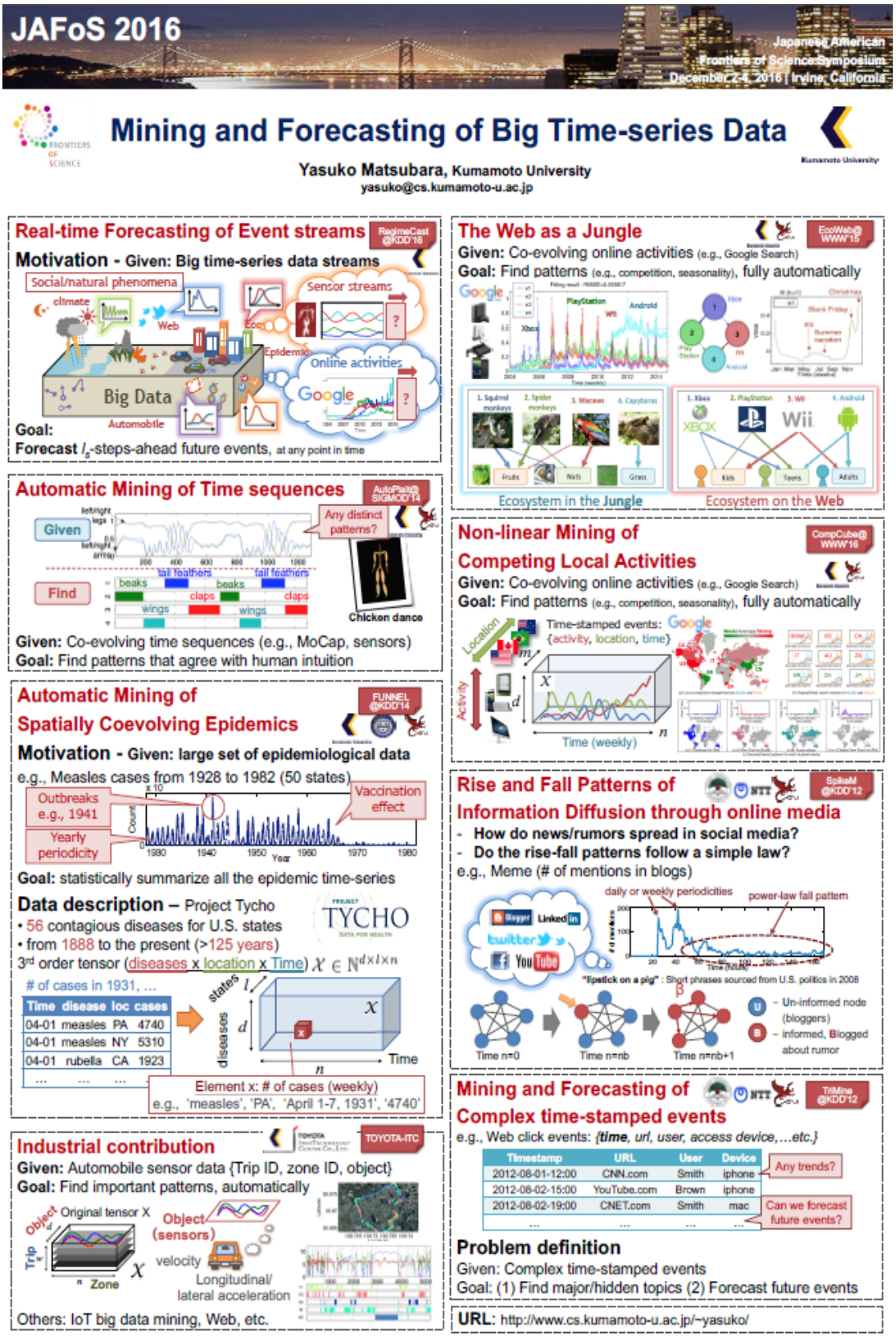


Fig. 1. A vertex with three mountains and three valleys. This can pop up or pop down even with the same MV assignment. Note that pop-up state has sharper mountains and pop-down state has shaper valleys.


JAFoS 2016
Japanese American Frontiers of Science Symposium
December 2-4, 2016 | Irvine, California
Mining and Forecasting of Big Time-series Data
Yasuko Matsubara, Kumamoto University
yasuko@cs.kumamoto-u.ac.jp
Real-time Forecasting of Event streams
RegimeCast @KDD'16
Motivation - Given: Big time-series data streams
Social/natural phenomena
climate
Web
Sensor streams
Epidemic
Online activities
Google
Big Data
Automobile
Goal:
Forecast l_s-steps-ahead future events, at any point in time
The Web as a Jungle
EcoWeb@ WWW'15
Given: Co-evolving online activities (e.g., Google Search)
Goal: Find patterns (e.g., competition, seasonality), fully automatically
Ecosystem in the Jungle
Ecosystem on the Web
Automatic Mining of Time sequences
AutoPlait@ SIGMOD'14
Given
Find
Any distinct patterns?
tail feathers
beaks
claps
wings
Chicken dance
Given: Co-evolving time sequences (e.g., MoCap, sensors)
Goal: Find patterns that agree with human intuition
Non-linear Mining of Competing Local Activities
CompCube@ WWW'16
Given: Co-evolving online activities (e.g., Google Search)
Goal: Find patterns (e.g., competition, seasonality), fully automatically
Time-stamped events: {activity, location, time}
Location
Activity
Time (weekly)
Automatic Mining of Spatially Coevolving Epidemics
FUNNEL @KDD'14
Motivation - Given: large set of epidemiological data
e.g., Measles cases from 1928 to 1982 (50 states)
Outbreaks e.g., 1941
Yearly periodicity
Vaccination effect
Goal: statistically summarize all the epidemic time-series
Data description – Project Tycho
• 56 contagious diseases for U.S. states
• from 1888 to the present (>125 years)
3rd order tensor (diseases x location x Time) $\mathcal{X} \in \mathbb{N}^{d \times l \times n}$
# of cases in 1931, ...
Time disease loc cases
04-01 measles PA 4740
04-01 measles NY 5310
04-01 rubella CA 1923
states
diseases
Time
Element x: # of cases (weekly)
e.g., 'measles', 'PA', 'April 1-7, 1931', '4740'
Rise and Fall Patterns of Information Diffusion through online media
SpikeM @KDD'12
- How do news/rumors spread in social media?
- Do the rise-fall patterns follow a simple law?
e.g., Meme (# of mentions in blogs)
daily or weekly periodicities
power-law fall pattern
"lipstick on a pig" : Short phrases sourced from U.S. politics in 2008
Time n=0
Time n=nb
Time n=nb+1
U – Un-informed node (bloggers)
B – informed, Blogged about rumor
Industrial contribution
TOYOTA-ITC
Given: Automobile sensor data {Trip ID, zone ID, object}
Goal: Find important patterns, automatically
Original tensor X
Object
Trip
Zone
Object (sensors)
velocity
Longitudinal/ lateral acceleration
Others: IoT big data mining, Web, etc.
Mining and Forecasting of Complex time-stamped events
TriMine @KDD'12
e.g., Web click events: {time, url, user, access device,...etc.}
Timestamp URL User Device
2012-08-01-12:00 CNN.com Smith iphone
2012-08-02-15:00 YouTube.com Brown iphone
2012-08-02-19:00 CNET.com Smith mac
Any trends?
Can we forecast future events?
Problem definition
Given: Complex time-stamped events
Goal: (1) Find major/hidden topics (2) Forecast future events
URL: http://www.cs.kumamoto-u.ac.jp/~yasuko/

Poster Number – 21

Mechanistic modelling of rubella epidemic in Japan

Masaya M. Saito, The Institute of Statistical Mechanics
Ryo Kinoshita, Graduate School of Medicine, Hokkaido University
Hiroshi Nishiura, Graduate School of Medicine, Hokkaido University

Background

The proportion of rubella susceptible people in Japan has been decreasing but there are still “susceptible-pockets” [1]. In actual, during 2012-13 a relatively large epidemic in recent years occurred in Japan. The occurrence of outbreak (exponential growth in the weekly reported cases) is recognized only in prefectures with a large city and the most of prefectures just experienced the number of cases a few times larger than usual. A serological study [2] also shows that the 2012/13 epidemic did not enhanced Japanese herd immunity very much (less than 5% in the most effective age/gender group). Hence, a mechanistic model that can reproduce the 2012/13 epidemic can be applied to assess the effectiveness of planed interventions.

Results

Colizer et al.’s metapopulation-type SIR model is employed to describe the 2012/13 epidemic. The model parameters are estimated so as to reproduce the weekly reported cases in 47 Japanese prefectures by combining a particle filter (PF) algorithm and Markov-Chain Monte-Carlo (MCMC). We have studied the reproducibility of the model under different assumption on the seasonality of the transmissibility parameter β. The first assumption is that β is common over the prefectures and take a constant value in five phases (before epidemic, 2012-increasing, 2012-decreasing, 2013-incresing, and 2013-decreasing). In the second assumption, prefectures is divided into two groups (groups I including Tokyo and group II including Osaka) and β is defined for each group as a piece-wise constant function for time. Our calculation shows that the observed epidemic is mostly reproducible under assumption (i) except an underestimation of Osaka and neighboring regions and this underestimation is solved under assumption (ii).

Acknowledgements

This research has been conducted as a part of CREST project "Detecting premonitory signs and real-time forecasting of pandemic using big biological data" under the support of CREST, JST.

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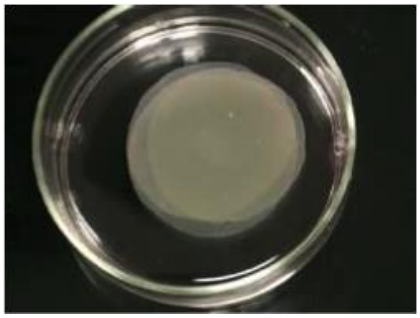
Poster Number – 22

Fabrication of Soft Tissue Structure Utilizing Biofabrications and Investigation of its Bioelectric Potential

Shinjiro Umezu, Waseda University

Biofabrication technologies are essential to create implantable artificial biostructure composed of living cells and biocompatible materials. We created soft tissue structures by means of biofabrication technologies such as cell sheet and micro 3D bio-printer. In addition, we measured the local bioelectric potential of the soft tissue structure.



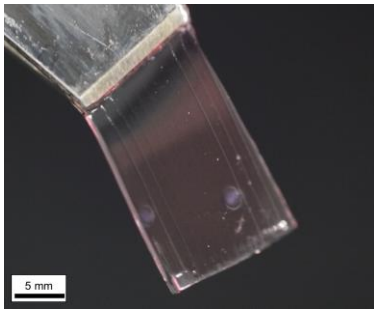


Fig. 1 Laminated cell sheet.
Fig. 2 Print sample of biomaterial on soft structure.

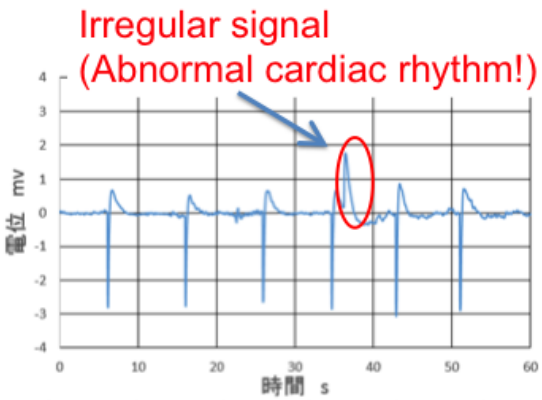


Fig. 3 Experimental set-up to measure bioelectric potential.
Fig. 4 Measured bioelectric potential.

Poster Number – 23

Neural coding of value, preference, and uncertainty

Alicia Izquierdo, University of California, Los Angeles

Organisms are frequently separated from rewards by their associated costs– such as delay, effort, and risk. Of particular importance in understanding value-based decision making is outlining how the brain calculates different facets of reward to then make a choice among different options. The seemingly simple behavior of selecting 'the best option' among others involves orchestration of rather complex functions, including: representation of the outcomes, computation of cost and benefit, and generation of expectations and/or confidence in the outcomes themselves. These functions are surprisingly conserved across mammalian species given that ancestral habitats were dynamic and required active foraging. Consequently, even rodents exhibit choice behavior according to behavioral economic principles that govern choice in primates. Harnessing this conserved circuitry, in my lab we study the neural mechanism of value-based choices in an animal model. The basolateral nucleus of the amygdala (BLA) now has a well-supported role in reward, not just fear, learning. Another brain region that contributes heavily to reward choices is a ventral subregion of the frontal cortex, the orbitofrontal cortex (OFC). Given their interconnectedness, their distinct roles in value, preference, and generating expectations are frequently difficult to dissociate. Using two behavioral paradigms, I will present converging data from molecular, pharmacological, and lesion experiments partnered with computational analyses of choice behavior to identify unique contributions of these brain regions in value, preference, and in adapting to uncertainty. Specifically, results from my laboratory show that BLA generates and updates value and preference of a qualitatively preferred option and OFC instead maintains the "status quo," anchoring choice to an objective mean rate of reward. I will conclude my presentation by discussing how environmental factors such as stress, inflammation, and drug experience may greatly influence these mechanisms, as well as how they might change in development.

Poster Number – 24

The essential role of mTORC1 signaling pathway for oligodendrocyte differentiation and CNS myelination

Masato Koike and Takehiko Sunabori
Department of Cell Biology and Neurosciences, Juntendo University Graduate School of Medicine, Tokyo, Japan.

mTOR (mammalian target of rapamycin) is a serine/threonine protein kinase which is a central regulator of cellular metabolism, growth and survival in response to extracellular environments. mTOR functions as part of two structurally and functionally distinct signaling complexes mTORC1 and mTORC2 (mTOR complex 1 and 2). However, little is known about the relationship between mTORC and cell differentiation.

In the present study we produced mice deficient for activating the mTORC1 signaling pathway in the central nervous system (CNS). Mutant mice showed weight loss, tremor and died at around postnatal day 14 (P14). Morphological and histochemical analyses revealed that CNS myelination was almost completely impaired and the mature oligodendrocytes were absent throughout the CNS. Although the number of Olig1/2-positive oligodendrocyte progenitors slightly decreased, they were still observed in the mutant mice at P14. Furthermore, no histological features of neurodegeneration such as gliosis and acceleration of cell death were observed throughout development. These results suggest the critical roles of mTORC1-mediated signaling pathway for the differentiation of oligodendrocyte lineage cells.

Poster Number – 25

Quantum electron transport in graphene and nanowire

Keiko Takase, NTT Basic Research Laboratories, NTT Corporation

I will present our recent results on quantum electrical transport measurements for epitaxial graphene and InAs nanowire devices.

For epitaxial graphene on silicon carbide, we demonstrate experimentally that graphene quantum capacitance C_q significantly have a strong impact on transport spectroscopy through the interplay with nearby charge reservoirs in the field-effect-gated device. The Fermi-level dependence of C_q is manifested as an unusual parabolic gate voltage (V_g) dependence of the carrier density, centered on the Dirac point. Consequently, in high magnetic fields B, the spectroscopy of longitudinal resistance (R_{xx}) vs. V_g represents the structure of the unequally spaced relativistic graphene Landau levels (LLs). R_{xx} mapping vs. V_g and B thus reveals the crucial role of the zero-energy LL on the development of the anomalously wide $\nu = 2$ quantum Hall state [1, 2].

For InAs nanowire device, we report a high-performance InAs nanowire MOSFET with a gate-all-around (GAA) structure, where we control the spin precession using the Rashba spin-orbit interaction. Our FET has a high on-off ratio (10^4 ~ 10^6) and a high field-effect mobility (1200 cm^2/Vs), which are as high as those of previously reported nanowire FETs. At the same time, GAA geometry using high-□□dielectric allows us to create a large and uniform coaxial electric field, so that the Rashba coupling parameter that we can control is ten times larger than ever obtained for conventional nanowire MOSFETs. Our demonstration of high FET performance and spin controllability paves a way for realizing low-power consumption nanoscale spin MOSFETs [3]. As a related project, we also present recent data obtained for quantum dots formed in InAs nanowire devices.

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Poster Number – 26

All-optical switch actuated by a single photon

Haruka Tanji-Suzuki, The University of Electro-Communications

Light has established itself as an ideal information carrier due to its large bandwidth and the ability to travel at a large velocity over long distances without too much attenuation. In the quest for faster and more energy-efficient communication, there has been growing interest in all-optical communication, where information processing circumvents large energy dissipation by avoiding the use of electrical signals, especially at very low light levels [1]. When making light weaker and weaker, it starts to exhibit the quantum, or the particle-like, nature, behaving as individual photons. One of the biggest challenges faced by low-light-level all-optical communication is in the processing of transmitted signals which requires weak light pulses, or photons in the ultimate case, to interact with one another. As photons do not interact with each other in vacuum, one may envision processing the signals using nonlinear optical effects in matter, where the first light pulse modifies the optical properties of the matter, and the matter in turn changes the behavior of the second light pulse. Such effects, however, are generally very small in conventional matter and become negligible at a few-photon level. In order for photons to interact with one another, there needs to be some form of very strong light- matter interaction. Here we explain how one may realize effective photon-photon interaction by means of very cold atomic gas (at few tens of microkelvin, very close to absolute zero) and ultra-high reflectivity mirrors (99.995% reflection). In particular, we show an example of all-optical switch and transistor operating at a few-photon level [2]. We then discuss the possibility of utilizing the so-called “vacuum field” (electromagnetic field containing no photons at all!) [3] in order to realize a high-throughput single-photon all-optical switch. Such a switch will be a crucial component of the potential all-optical quantum information network, where the ultimate security of communication is guaranteed by the principles of physics [4].

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Poster Number – 27

Archaeology of Environmental Injustice

Sarah Cowie, University of Nevada-Reno

The relationships between biopolitics and processes of capitalism and industrialization have come under increasing scrutiny by activists in the environmental justice movement. Modern and historic societies have demonstrated marked environmental discrimination that disproportionally affected the health and well-being of certain populations such as working-class communities and racialized groups. Discriminatory practices resulted in the disempowerment of marginalized populations, loss of land, forcible movement of communities, contamination of natural resources, and sickening of human populations. While environmental injustice has been explored by researchers throughout the social and environmental sciences, archaeological studies have just begun to address this type of discrimination. Archaeology can provide a unique perspective on historical-period environmental injustice, which is particularly important when the documentary record is incomplete or misleading; for example, this was often the case in historic industrial communities and widespread sites connected with the removal of Native Americans from their traditional homelands. Archaeological work on this topic is especially effective when drawing from numerous disciplines including geochemistry, plant and animal biology, public health, autonomous robotics, GIS and remote sensing, as well as linguistics, sociology and philosophy. This poster outlines a framework of theory and method for exploring environmental injustice through an archaeological lens, and offers suggestions for potential applications.

Poster Number – 28

Does Marriage Work as a Savings Commitment Device?: Experimental Evidence from Vietnam

Hisaki Kono Kyoto University &Tomomi Tanaka, World Bank

Marriage is a traditional institution. We investigate if marriage works as a saving commitment device to alleviate individual present bias problems. We conducted a time discounting experiment with married couples in Vietnam, and examined how time preference parameters affect intrahousehold financial management. Though we find that joint decision with their spouses makes people more patient than individual decision, present-biased individuals turn over less earnings to and receive more from their spouses irrespective of their joint decision time preferences. Present-biased individuals also more likely keep cash within households compared with time-consistent individuals. We do find that couples who are joint decision time consistent al- locate less allowance for present-biased spouses, but they conceal money to compensate it. We conclude that marriage not only fails in functioning as a savings commitment device, but also exacerbate the individual present bias problem. External savings commitment devices such as ROSCAs will play an important role to protect household budget from present-biased spouses.

Poster Number – 29

Economic Effects of Emergency Risk Communication: Evidence from the Fukushima Daiichi Nuclear Disaster

Hiroaki Matsuura, Shoin University

A tremendous amount of radioactive products were discharged as a result of the accident at the Fukushima nuclear power plant in March 2011, which resulted in radioactive contamination of the plant and surrounding areas. When describing the geographical distribution of radioactive contamination, the government, media, and other organizations largely used administrative boundaries (prefectures, municipalities etc.) or distance from the radiation source as a reference. I examine how this sometimes misleading information about risks, as opposed to the actual risks of radiation, significantly and negatively affected land prices in locations near the plant. I find that the prefecture border effects – but neither the distance effect from the nuclear power plant nor the effect of the actual risk of radiation – are significantly related to a reduction in land price after the accident. This is to say that, even with the absence of the actual risk of radiation, the land price in Fukushima and its three adjacent prefectures has declined more rapidly than that in other prefectures of Japan after the accident. Although health risk information based on prefecture has an obvious advantage of distilling large and complex risk information into a simple one, the government, media, and other organizations need to recognize and carefully examine the potential of misclassifying non-contaminated areas into contaminated prefectures. Doing so will avoid unintentional consequences to the region's economy.

Fifteenth Japanese-American
Kavli Frontiers of Science Symposium

Japan Society for the Promotion of Science - U.S. National Academy of Sciences

Arnold and Mabel Beckman Center - Irvine, California
December 2-4, 2016

List of Attendees

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Research: Observational Cosmology

He conducted researches to reveal the origin of the X-ray background emission by examining nature of X-ray sources with optical and infrared observations in his doctor course, and finished his Ph.D. at Department of Astronomy, Kyoto University in Mar. 2000. Since his second year of the doctor course, he stayed in the Subaru telescope, National Astronomical Observatory of Japan, in Hawaii to join the fiber multi-object spectrograph project, which enable large scale spectroscopic surveys in near-infrared. Since Apr. 2008, he has been associate professor at the astronomical institute of Tohoku university. He is currently conducting surveys of active galactic nuclei to unveil the cosmological co-evolution of galaxies and super-massive black holes, and also working on wide-field adaptive optics systems for the next generation large ground-based telescope, Thirty Meter Telescope project, as well as the Subaru telescope.

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Research: Theoretical Cosmology

I want to understand how the universe first got populated with particles during the Hot Big Bang. I also delve into astrophysical problems related to dark matter/dark energy, the Cosmic Microwave Background and gravitational waves. On the mathematical side, I am fascinated by solitons and their relevance to cosmology. I seek out interdisciplinary projects. Currently, I am exploring a fascinating connection between (the modeling of) current conduction in wires and particle production in cosmology.

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Research: Organometalllic Catalysis

We are interested in turning pollution into products, by using the power of transition-metal catalysis. Our focus is to develop methodologies that convert deleterious air, water, and ground pollutants into useful feedstocks for chemical synthesis. Particularly, the conversion of air pollutants (e.g. CO2, CO, SO2, NO2, etc.) into useful sources carbon, sulfur, and nitrogen. Our strategy is to achieve this goal by metal-catalyzed direct insertion of these small molecules into organic molecules using cross-coupling platforms

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Research: Genetics

Our research program uses insect metamorphosis as an experimental paradigm to uncover fundamental principles of biology. We are particularly interested in identifying genes that control the changes in shape and size that occur after birth, as animals progress towards adulthood.

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Research: Environmental Economics, Development Economics

I study how changes in environmental conditions shape a range of social and economic outcomes.

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Research: Environmental Science

Climate impacts and adaptation; role of air pollution in climate system.

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Research: Anthropology/Archaeology

Sarah Cowie is an anthropologist specializing in historical-period and indigenous archaeology. She directs projects that integrate geochemistry, remote sensing, public health, linguistics, and sociology among others. Her first book, The Plurality of Power: An Archaeology of Industrial Capitalism, addresses social power relationships in industrialized society. She is currently co-editing a second book called Governmentality and Collaborative Archaeology at the Stewart Indian School, which addresses epistemological debates about science and heritage in modern social-networks.

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Research: Behavioral Neuroscience

I am interested in the neural circuitry underlying individual variation in responses to environmental stimuli. Specifically, I am investigating the neurobiological mechanisms that regulate cue-motivated behaviors. Work in my lab currently focuses on the role of "top-down" cortical processes vs. "bottom-up" subcortical processes in mediating individual differences in stimulus-reward learning. This work will shed light on potential neurobiological targets for the treatment of disorders of impulse control, including addiction.

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Research: Computational Cognitive Neuroscience

My research combines multiple levels of computational modeling and experimental work to understand the neural mechanisms underlying reinforcement learning, decision making and cognitive control. We develop neural circuit and algorithmic models that simulate systems-level interactions between multiple brain areas (primarily prefrontal cortex and basal ganglia and their modulation by dopamine). We test theoretical predictions of the models using various neuropsychological, pharmacological, genetic, and imaging techniques.

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Research: Sleep Medicine

My broad research interest is the impact of short, disturbed, and mistimed sleep in health conditions including reproductive and gastrointestinal disorders. My current work uses actigraphy to assess sleep over the entirety of the in vitro fertilization (IVF) cycle to determine the association of sleep with infertility treatment outcomes. I also collaborate with the department of mathematics in digital tracking and estimation of sleep and circadian phase.

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Research: crysatalline gel, 3D printing

Jin Gong came to Japan for doing her PhD after graduating from Zhengzhou University with her bachelor and master degree in China. In 2008 she received her doctorate from Okayama University for research performed in the laboratory of professor Kunio Kimura on synthesis and morphology control of high-performance aromatic polymers. Thereafter, she moved to Yamagata University and started the research on polymer gels. Since April 2015 she is head of the Research Group for Crystalline Gels at Yamagata University. Her current research interest is centered around the synthesis and applications of high-performance crystalline gels, including the 3D printing of these gels.

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Research: Operations Research

Trajectory of infectious diseases are defined by dynamical interactions between multiple parameters related to individual behavior, socio-economic conditions, population contact structures, and biological factors of the infectious agent. My interests are in development of methodologies and computational models for simulating the above dynamic complexities for predicting disease spread and evaluating alternative population-level disease prevention and control strategies.

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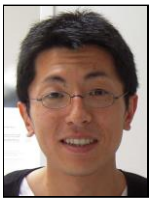

Research: Neurology

Masashi Hamada is an assistant professor of Neurology at the University of Tokyo Hospital in Japan. After medical school at Tohoku University, he completed his neurology training in Tokyo. He then completed a PhD at the University of Tokyo and became a fellow in Sobell Department of Motor Neuroscience and Movement Disorders at the UCL Institute of Neurology in London. Research interests include variability in response to non-invasive stimulation, and neuronal plasticity related to motor control, learning and neurological disorders.

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Research: Neuroscience

Yu Hayashi is an associate professor and principal investigator at the International Institute for Integrative Sleep Medicine (WPI-IIIS), University of Tsukuba. He received his PhD degree from the University of Tokyo in 2008 under the supervision of Dr. Takeo Kubo. Then he began his research on sleep at RIKEN Brain Science Institute as a postdoctoral fellow in the lab of Dr. Shigeyoshi Itohara from 2008 to 2013. Since 2013, he has been appointed the current position. He is also a Japan Science and Technology Agency (JST) PRESTO researcher. His current focus is on the function and evolution of sleep. He combines neuroscience techniques with genetic approaches in mice and nematodes.

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Research: Chronobiology

Dr. Hirota holds BS in Biochemistry and Molecular Biology from the University of Tokyo (Japan). He finished his PhD under the supervision of Dr. Fukada at the University of Tokyo in 2003 with support from JSPS fellowship (DC1). Thereafter, he worked as a Project Assistant Professor in the Fukada laboratory at the University of Tokyo, and then joined the Kay laboratory at TSRI/UCSD/USC (USA). Since May 2014 he is a Designated Associate Professor and co-PI of the Institute of Transformative Bio-Molecules at the Nagoya University (Japan). His present research is focused on chemical genetic dissection of mammalian circadian clock system.

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Research: chemistry / molecular imaging

Prof. Hooker's lab has the mission of accelerating the study of the living, human brain and nervous system through development of application of molecular imaging agents. The lab has developed and patented several imaging technologies for neuroscience including, a first-in-class radiotracer for neuroepigenetic imaging. Prof. Hooker and his team use molecular imaging to study the underlying pathophysiology of psychiatric, neurodevelopment and neurodegenerative diseases including schizophrenia, autism and Alzheimer's disease.

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Research: mathematics of origami

I study the mathematics of origami (paper folding). I am currently working on how folded states can be predicted and achieved by controlling the folding process. This uses elements of calculus, linear algebra, rigidity theory, and discrete mathematics.

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Research: Biomass utilization

Kiyohiko Igarashi is an Associate Professor of Forest Chemistry Laboratory, Department of Biomaterial Sciences, Graduate School of Agricultural and Life Sciences in the University of Tokyo. He received PhD degree in 1999 from Graduate School of Agricultural and Life Sciences in the University of Tokyo. Before receiving PhD, he focused on the kinetic analysis of cellobiose dehydrogenase, extracellular flavocytochrome produced by filamentous fungi, with the late Professor Karl-Erik L. Eriksson (University of Georgia) and Professor Masahiro Samejima (University of Tokyo). After receiving the degree, he stayed in Uppsala University (Sweden) as a PostDoc from 2000 to 2001, and returned to the same lab in the University of Tokyo as an Assistant Professor. Currently he is doing kinetics of cellulase and other CAZymes combined with their 3-dimentional structure. He is also focusing on the single molecular observations of cellulase and chitinase acting at the solid/liquid interface.

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Research: Biomedical Imaging

Biomedical and biological applications of photoacoustics, Wideband ultrasonic sensor development for photoacoutic imaging and measurement, Functional optical imaging using time-resolved spectroscopy, Optics in tissue engineering and regenerative medicine especially for orthopaedic application, Defense technology transfer for biomedical application,

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Research: Immunology

Masaru Ishii, M.D., Ph.D. was graduated from the Osaka University Medical School in 1998, and then worked as a rheumatologist. He studied in the National Institutes of Health as a research fellow supported by the Human Frontier Science Program (2006-2008), as a laboratory chief in Osaka University Immunology Frontier Research Center (Associate Professor; 2008-2011, Professor; 2011-2013), and then appointed as a professor and chairman of the Department of Immunology and Cell Biology, Graduate School of Medicine and Frontier Biosciences, Osaka University, since 2013. The bulk of his studies have so far elucidated the cellular dynamics in live bone tissues, with a special focus on bone-resorbing osteoclasts, by using intravital multiphoton imaging that he has originally developed. His study is not limited in the field of bone and immunology, but is currently covering diverse research topics where cells are dynamically moving, such as immune cell migration in inflammatory sites and cancer invasion.

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Research: Computational astrophysics

Ishiyama holds a Bachelor's degree from University of Tokyo. He finished his PhD under the supervision of Prof. Makino at Graduate Studies in Arts and Sciences, University of Tokyo in 2010. Thereafter, he worked as a JSPS Research Fellow in the theory group of National Astronomical Observatory of Japan. Since May 2011, he worked as a Research Fellow in the Center for Computational Sciences at Tsukuba University. Since March 2015, he is an associate professor in Institute of Management and Information Technologies, Chiba University. His present research is focused on studying the formation and evolution of structure formation in the Universe, including dark matter structures, galaxies, stars by means of supercomputer simulations.

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Research: Behavioral Neuroscience

I study the neural basis of reward choices. My research interests span basic questions about how the brain computes cost and benefit (value), to how this process can go awry in pathological conditions like addiction. My lab explores the impact of drug experience, development, diet, exercise, stress, and inflammation on choice using a combination of behavioral, molecular, pharmacological, and computational methods. More recently we have investigated the role of uncertainty and reinforcement history on choices.

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Research: Biologically Fabricated Materials

My group works at the interface of synthetic biology and materials science to repurpose bacterial biofilms as programmable functional materials for beneficial applications. We are specifically interested in the curli system of E. coli, which is a well-studied functional amyloid. We are pursuing applications in water purification, scalable manufacturing, and therapeutic delivery to the gastrointestinal tract.

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Research: Economics

I am awarded PhD in 2015 under the supervision of Martin Pesendorfer at the London School of Economics and Political Science. The title of the dissertation is "Essays in industrial economics: applications for marketing and management decisions". My research is to develop empirical strategy to study firm and consumer behaviors to help management and policy decisions.

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Research: Paleoclimatology, cosmoclimatology

Ikuko Kitaba graduated with a Doctorate of science in Earth and Planetary Sciences under the supervision of Prof. Masayuki Hyodo at Kobe University in 2011. Thereafter, she worked as a JSPS Research fellow and an assistant professor in Research Center for Inland Seas, Kobe University. She currently holds an associate professor position at Ritsumeikan University in the Research Centre for Paleoclimatology. Her primary interest is the geomagnetic and solar linkages to climate. Her present research is also focused on abrupt climate changes and its impact on ancient civilizations and early hominins. She is involved several lake drilling projects in the Mayan Lowland (Guatemala), Lake Suigetsu and Lake Ichi-no-megata (Japan).

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Research: Physics

Recent progress in nanotechnology enables us to directly address quantum transport of electrons in nano-devices made of metals or semiconductors. The advantage of this "nanophysics" field lies in the controllability and the versatile degrees of freedom in device design. We aim at controlling charge, spin, coherence and many-body effects of electrons in various novel quantum and nonequilibrium systems especially by focusing on the dynamical aspects of electron transport.

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Research: Cellular Neurobiology

Masato Koike studied medicine at Osaka University and obtained medical license in 1998. In 2002 he obtained his PhD from the Osaka University Graduate School of Medicine (Supervisor: Prof. Yasuo Uchiyama) on the morphological analyses of mice deficient in lysosomal cathepsin D. Thereafter, he worked as an assistant and associate professor at Osaka and Juntendo University, respectively. In 2014, he became full professor of the Department of Cell Biology and Neuroscience at Juntendo University. In 2014, he awarded sabbatical and stayed as a visiting professor of the Department of Cell Biology and Cell Microscopy Core at University Medical Center Utrecht. His present research is focused on studying molecular mechanisms of neurodegenerative diseases related to the dysfunction of autophagy, endo-lysosomes, secretory pathways and mitochondria.

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Research: Development Economics

Development Economics, Microeconometrics, Contract Theory, Experimental Economics, Poverty Reduction, Microfinance

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Research: Polymers

My research program focuses on the design of mechanically-enhanced, multi-functional materials inspired by nature, including the interplay between structural assembly and manufacturing, hierarchical architectures, and responsive phenomena. These lessons from nature have generated new polymeric materials with a focus on tunable mechanics. Four research themes are currently targeted: 1) hierarchical peptide polymer hybrids; 2) fiber-reinforced hydrogels; 3) hygromorphic materials; and 4) supramolecular elastomers.

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Research: Political Science

Keiichi Kubo holds a BA and MA degree in Political Science from Waseda University, Tokyo, Japan. He completed his PhD on the dynamics of ethnic rebellion and state response under the supervision of Paul Mitchell and Sumantra Bose at the London School of Economics and Political Science (UK) in 2007. He has been working as a faculty member (Associate Professor until March 2016, Professor since April 2016) at Waseda University since April 2008. His research interests include causes and dynamics of political regime change (democratization), civil war and post-conflict peacebuilding, as well as causes and consequences of transitional justice and reconciliation after atrocities, with special emphasis on the region of post-communist countries, especially former Yugoslav countries.

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Research: Polymer gel

Takayuki Kurokawa graduated in polymer science from Hokkaido University, Japan in 2000. He received his PhD for study on Effect of Polymer Dynamics on Friction of Gels from Hokkaido University under the supervision of prof. Gong in 2005. He joined RIKEN, Japan as a postdoctoral researcher, then Creative Research Institution at Hokkaido University as an assistant professor in 2009. He is an associate professor of Faculty of Advanced Life Science at Hokkaido University since 2013. He received Hokkaido University President's Award for Research Excellence for AY2014 in 2015 and AY2015 in 2016 as well. He focuses on functions of polymer gels, such as mechanical property, permeability, friction and application of the hydrogels as bio-tissues.

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Research: Neuroscience

Dr. Leventhal received his MD and PhD (Biomedical Engineering) from Case Western in 2004. He then pursued Neurology residency, a Movement Disorders fellowship, and post-doctoral training at the University of Michigan before joining the faculty there in 2012. He co-directs the Deep Brain Stimulation program at the VA Ann Arbor Health System, and runs a laboratory studying basal ganglia physiology in rodent models. Current focuses include understanding dopaminergic mechanisms of motor control and thalamic physiology.

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Research: Forensic Science

My current interests are in the thermophysical properties of cannabinoids. A device for detecting cannabis intoxication from breath is necessary and lacking, in part, because a reliable correlation between use and intoxication still does not exist. I aim to develop the measurement science necessary to obtain fundamental data to make intuitive material selection choices for "catch" and "release" of important compounds that indicate intoxication. These important compounds will be determined by collaborators using "breathalomics".

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Research: Structural Biology

My research interest lies in determining how a long string of genomic DNA is three-dimensionally organized in the cells, and how the organized genome functions during cellular proliferation, differentiation, and development. We are using a novel combination of molecular cell biology and biophysics to elucidate 3D-organization and dynamics of human genome DNA.

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Research: cognitive science and music

My research explores the relationship between musical materials and musical experience. I use behavioral methodologies, EEG, and neuroimaging to ask how people make sense of music—especially people without any formal training. Recent lines of inquiry have examined the perceptual changes that occur across repeated listenings to the same song, and across the transformation from language to music in the speech-to-song illusion, and the ways music perception does and does not rely on mediation by language.

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Research: Computer science, Data mining, Time-series, Databases

Yasuko Matsubara is an Assistant Professor at Kumamoto University, Japan. She obtained her BS and MS degrees from Ochanomizu University in 2007 and 2009 respectively, and her PhD from Kyoto University in 2012. She was a visiting researcher at Carnegie Mellon University during 2011-2012 and 2013-2014. Her research focuses on time-series data mining and non-linear dynamic systems. Her current research interests include (a) automatic mining of co-evolving time sequences, (b) non-linear modeling of large online social activities, © tensor analysis and multi-aspect non-linear time-series modeling, and (d) real-time monitoring and forecasting of big time-series data streams.

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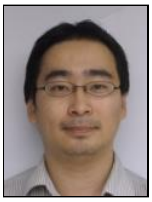

Research: Health Economics, Economic Demography

Hiroaki Matsuura is Provost and Vice President of Shoin University and Associate Professor at the Faculty of Business Management and Corporate Culture. He is also a (non-resident) visiting fellow at the Center for Global Development. Before assuming the current position, he was Departmental Lecturer in the Economy of Japan at the School of Interdisciplinary Area Studies at the University of Oxford. Hiroaki received his B.A. in Economics from Keio University, M.A. in Social Science from the University of Chicago, M.S. in Project Management from Northwestern University's McCormick School of Engineering and Applied Science, and Sc.D. in Global Health and Population (Economics track) from Harvard University. He has also served as a consultant for UNDP, UNFPA, and UNU-WIDER. His main interests are health economics and demography, with a special interest in the relation between human rights and population health.

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Research: 3D Printing Functional Materials & Devices

The McAlpine Research Group is focused on expanding the capabilities of 3D printing to include functional electronic and biological materials, and the interweaving of these materials in three dimensions. 3D printing is a multi-scale platform, allowing for the incorporation of functional nanoscale inks, the printing of microscale features, and ultimately the creation of macroscale devices. This three-dimensional blending of functional materials and 'living' platforms may enable next-generation 3D printed devices.

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Research: Cognitive Neuroscience

My research investigates reward processing and executive control in human decision-making using human neuroimaging (fMRI and EEG), behavioral studies, and computational modeling. In particular, I study the function of the human dopamine system in learning and decision-making. Additionally, I investigate the interaction between brain reward systems and regions of neocortex implicated in executive control. This latter work has elucidated neural interactions that underlie self-control processes as well as mechanisms underlying competitive behavior in social interactions.

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Research: Atmospheric Science

My research focuses on understanding (1) dynamics of atmospheric pollutants, especially nitrogen oxides. I use field measurements to find sources, chemical reactions and removal processes of nitrogen oxides, and (2) the source-receptor relationship between atmospheric pollutants and greenhouse gases using computer simulation with atmospheric transport models.

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Research: Environmental Economics

I am currently working on the impacts of solar geoengineering on the distribution of climate impacts, and the implications on international climate negotiations and national climate policy. I am also studying the mechanisms that drove past energy transitions to inform policy regarding a future transition to a clean energy system. Regional variation in the structure of the energy industry, and its contribution to the economy, seem to play a fundamental role in understanding this transition.

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Research: Immunology

Kazuyo Moro, D.D.S., PhD graduated from Nihon University School of Dentistry in 2003, and finished her doctorate in the Department of Microbiology and Immunology, Keio University School of Medicine in 2007. She continued to work at Keio as a postdoctoral fellow for 5 years and transferred to RIKEN RCAI/IMS in 2012. For the first 2 years she worked in the Laboratory for Immune Cell Systems as a senior researcher, and last year, she became team leader for the Laboratory for Innate Immune Systems. She specializes in innate lymphocytes, particularly in group 2 ILC which she discovered in 2010. Her work has focused on the cytokine regulation and development of ILC2 and elucidating the role of ILC2 in helminth infection, allergic inflammation and metabolism.

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Research: Physics

Our group is focused on the design and synthesis of novel compounds with unconventional ground states, showing exceptional physics and potential for applications. We are particularly interested in superconductivity, local and itinerant electron magnetism, quantum phase transitions and more. We employ conventional methods of solid state synthesis, vapor transport and flux crystal growth. The characterization of our compounds includes xray and neutron diffraction, magnetization, electrical and thermal transport, and specific heat measurements, complemented by band structure calculations.

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Research: Regenerative Medicine

1. Perinatal stem cell therapy for lung disease, 2. 3D bioprinting a tissue engineered airway, 3. Lung organoid and microfluidic technology for disease modeling and drug discovery, 4. Reversing established lung fibrosis with small molecules, 5. Perinatal tissue-derived biomaterials for wound healing applications

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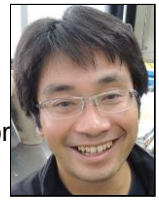

Research: Environmental Archaeology

Hiroo Nasu holds a diploma degree in Agriculture from the Chiba University in Chiba, Japan. He finished his PhD under the supervision of Prof. Yoshinori Yasuda at the Department of Japanese Studies of SOKENDAI: The Graduate University for Advanced Studies in Kyoto, Japan in 2004. Thereafter, he worked as a Research Fellow in the Center for the Promotion of Integrated Sciences of SOKENDAI in Hayama, Japan. Since April 2012 he is working as assistant professor in the Department of Evolutionary Studies of Biosystems, School of Advanced Sciences, SOKENDAI, Hayama, Japan. His present research is focused on studying the origin of agriculture, and the relationship between environment and civilization.

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Research: Neurophysiology

Yukio Nishimura received his B.S. in Sports Science from Nihon University in 1995, and his M.S. in Education from Yokohama National University. He finished his PhD under supervision Prof. Yoshio Nakajima at Chiba University in 1993. Thereafter he worked in National Institute for Physiological Science from 2003 and then the University of Washington for postdoctoral work from 2007 in Neuroscience. He came to National Institute for Physiological Science in 2011, as Associate Professor. From April in 2016, he is currently Associate Professor in the department of neuroscience, graduate school of medicine, Kyoto University. His overall research has concerned the neural control of limb movement in human and non-human primates. His present research is focused on neural mechanisms of functional recovery after spinal cord injury and restoring lost function via brain computer interface.

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Research: Mathematical Epidemiology

Dr. Nishiura is a Professor at Graduate School of Medicine, Hokkaido University. His research interests span the areas of statistical epidemiology of infectious diseases, epidemiological modeling and biomathematical formulation of the transmission dynamics of infectious diseases. He aims to answer policy-relevant questions by integrating various mathematical models with empirically observed data. A common thread in his research is an understanding of the epidemiological dynamics underlying empirically observed data. Having a background in medicine and being a licensed physician in Japan, he became infectious disease epidemiologist because he strongly believes that population science is the most important and useful subject for elucidating the most effective strategy for infectious disease control.

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Research: In vivo imaging

Mikako Ogawa received PhD degree in 2007 from Graduate School of Pharmaceutical Sciences, Kyoto University (Japan), under the supervision of Prof. Hideo Saji. Thereafter, she worked at National Institute for Longevity Sciences, National Cardio Vascular Center, and Hamamatsu University School of Medicine in Japan. From 2007 to 2009, she worked as a visiting fellow at NCI/NIH, USA. Since 2015, she is a professor of Hokkaido University. She is a molecular imaging chemist, and her research interest is developing new imaging agents, especially for in vivo application. Recently, using the knowledge of in vivo molecular imaging, she is also developing molecular targeted therapeutic agents.

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Research: Neuromodulation

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Research: Genome engineering

1. Precision reprogramming of immune cells for treating cancers, 2. Genomic reprogramming for regenerative medicine, 3. Novel and safer CRISPR technology for gene therapy

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Research: Environmental Archaeology

My recently completed multi-year NSF funded projects in Fiji and New Mexico have built upon my prior work on the impact of human fire-use on the ecological resilience of fire-adapted forests. I am currently exploring how these impacts change with scale, notably how the different feedback mechanisms through fuelwood consumption and through ignitions alter the landscape fire dynamics with increasing American Indian population densities approaching modern "Wildland-Urban Interface" conditions.

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Research: Data Assimilation, Non-linear systems

Masaya Saito have been awarded Ph.D. degree in science by the graduate university "SOKENDAI" in 2005 for research on the rectilinear three-body problem. Since the graduation to present he has studied hierarchical triple systems aiming at application to planetary systems. Since 2010 he has participated in the study of mathematical modelling of infectious disease modelling. A major work on this field is to simulate how a new influenza spread over a hypothetical city and to evaluate a degree of herd immunity enhancement by different ways of vaccine distribution (Saito et al., 2013). Currently, a rubella spread model over Japan has been developed at the aim of finding an effective vaccination strategy in order to establish a complete herd immunity against rubella in Japan.

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Research: Biophysics & Chemical Biology

My goal is to revolutionize mechanobiology by developing new methods to map and manipulate molecular forces in living cells. To achieve this goal we develop fluorescent probes to map molecular forces at the cell surface. We have also developed a new class of opto-mechanical actuators that can deliver piconewton forces to cells using near-infrared illumination. By combining chemical biology with materials chemistry we have unraveled mechanisms of integrin, Notch, and T cell receptor activation.

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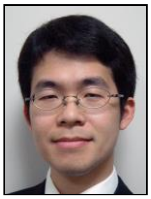

Research: Chemical Biology

Moritoshi Sato received his B.S., M.S., and Ph.D. degrees in chemistry from the University of Tokyo in 1996, 1998, and 2001, respectively (Mentor: Prof. Yoshio Umezawa). He was appointed as Assistant Professor at the University of Tokyo in 2000, and promoted to Lecturer in 2005. In 2007, he was promoted to Associate Professor at The University of Tokyo. His research interests include building molecular probes to visualize or manipulate molecular processes in living cells and individuals.

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Research: Mathematical Epidemiology, Optimization

I study the mathematics of infectious disease transmission and applications of optimization theory, including linear and integer programming, to problems in social and biological sciences. Ongoing projects include work to develop an evolving network models for newly emerging and re-emerging diseases, studying the relationship between problems in voting theory and the facet geometry of the linear ordering polytope, and using differential equation-based models to study the evolution of genetically mediated altruistic behavior.

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Research: Atmospheric Chemistry

Tomoko Shirai holds a diploma degree in Chemistry from the University of Tokyo. She finished her PhD under the supervision of Prof. Yoshihiro Makide at the University of Tokyo in 1999. Thereafter, she worked as an engineer in the group of Dr. Toshihiro Ogawa at the Earth Observation Research Center of National Space Development Agency of Japan (currently JAXA). Since February 2002 she joined the Roland/Blake laboratory of the chemistry department at UCI as an associate research specialist and participated aircraft measurement of atmospheric trace gases. She joined National Institute for Environmental Studies in 2004 and her present research is focused on studying the behavior of atmospheric trace gases, especially greenhouse gases (CO2, CH4, halocarbons) and nonmethane hydrocarbons (NMHCs).

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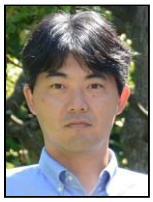

Research: Biophysics

Dr. Katsuyuki Shiroguchi is a Unit Leader in RIKEN Quantitative Biology Center, Japan. He started his research career in biophysics, and he received "Early Research in Biophysics Award" from The Biophysical Society of Japan in 2005, and 1st Place Poster Award from Gordon Research Conference: Single Molecule Approaches to Biology in 2006 on understanding working mechanism of a molecular motor studied by single molecule dynamics observation under a microscope. Later, he shifted to genomics research, and is currently working on multidisciplinary research based on experience from the both research fields, biophysics and omics. He is mainly working on methodological development: he developed digital RNA sequencing, and working on high throughput single cell analysis using next generation sequencer.

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Research: Physics, graphene, nanowire

Keiko Takase received the B.Sc., M.Sc., and Ph.D. degrees in physics from the University of Tokyo. At graduate school, she studied transport measurements on quantum Hall effect in GaAs/AlGaAs heterostructures and semiconductor surface physics using scanning tunneling microscopy. After receiving a Ph.D. degree, she joined NTT Basic Research Laboratory as a permanent researcher. Since then, she has been engaged in research on the quantum Hall states in GaAs and in graphene, and has recently started transport measurements on nanowires with strong spin-orbit interaction. She also worked as a diversity council member for diversity issues of NTT staffs for around 2 years. She is a member of the Physical Society of Japan, the Japan Society of Applied Physics and the Surface Science Society of Japan.

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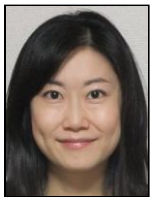

Research: Physics

Haruka Tanji-Suzuki holds a Bachelor's and a Master's degree from the University of Tokyo as well as AM from Harvard University. She received her Ph.D. from Harvard University in 2011 under the supervision of Vladan Vuletic at Massachusetts Institute of Technology. After working at NTT Basic Research Laboratories as a postdoc, she joined the group of Masato Koashi at the Photon Science Center of the University of Tokyo as a project research associate in April 2012, where she was promoted to a research associate in March 2013. She is an associate professor at the Institute for Laser Science at the University of Electro-Communications since August 2015. Her research interest includes quantum control of atoms and photons in optical cavities and quantum measurements using cold atoms.

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Research: nanomaterials, materials chemistry, plasmonics

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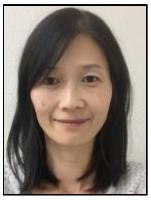

Research: Cell Biology

Tomomi Tsubouchi holds a diploma degree and MS from Osaka University, where she studied DNA damage repair using yeast as a model. She then entered PhD program at Yale University (USA), where she studied how DNA recombination is regulated during gamete formation under the supervision of Prof. G. Shirleen Roeder. She joined Prof. Amanda Fisher's group as a post-doctoral fellow, to learn embryonic stem cell culture and cell-fusion system for nuclear reprogramming. Before starting her own group at National Institute for Basic Biology in Aichi, Japan, she was also affiliated with Genome Damage and Stability Centre (University of Sussex, UK), focusing her research on DNA repair in stem cells. Her team investigates genome maintenance mechanisms in embryonic stem cells and reprogramming cells.

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Research: Geological Sciences

Tatsuki Tsujimori is a professor of geological sciences who specializes in metamorphic petrology and regional tectonics, with a particular research focus on the petrogenesis and geochemistry of high-pressure/ low-temperature metamorphic rocks such as blueschists and eclogites. He graduated from Shimane University in 1994, and received a master's degree from Kanazawa University in 1996, then a Ph.D. from Kanazawa University in 1999. After his postdoctoral experiences at Okayama University of Science (2000–2004) and Stanford University (2002–2006), he worked as an assistant professor (2006–2009) and an associate professor (2010–2015) at the Institute for Study of the Earth's Interior at Okayama University. In September 2015, he began as a full-professor at the Center for Northeast Asian Studies at Tohoku University.

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Research: Materials Science

Shinya TSUKADA is a Lecturer of Physics and Physics Education at Shimane University. He received his B. in "Engineering" in 2005, and his Ph. D. in "Engineering" in 2009 from University of Tsukuba. He got a research fellow ship from Japan Society for the Promotion of Science during his Ph. D. course. He was an assistant professor in the dielectric materials group at Shimane University before starting his own laboratory on Ferroelectrics and Spectroscopy. Many of his current research interests revolve around ferroelectric phase transitions in oxides and the interplay between the two: a) thermodynamics and statistical physics, b) Raman and Brillouin spectroscopy, and c) crystal growth and ceramics fabrication. In recent years, by a combination of his experiences, he has become actively involved in the materials design on the basis of Raman tensor.

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Research: Mathematics / Applied Mathematics / Informatics

Shinjiro Umezu was a Research Associate at Waseda University since September 2003. He finished his PhD under the supervision of Prof. Kawamoto at Waseda University in 2006. He moved to RIKEN as a Special Postdoctroral Researcher in 2007. Thereafter, he worked as an Assistant Professor and an Jr. Associate Professor at Tokai University. From 2014, he was an Associate Professor at Waseda University. His present research is focused on studying the micro fabrication, and its application for bioengineering, greentechnology, biomimetics, and so on.

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Research: CRISPRs

My career has been dedicated to understanding the mechanisms that viruses use to manipulate their hosts and the defense systems that microbes employ to defend themselves from infection. As a graduate student my work involved molecular analysis of viruses that infect microorganisms isolated from boiling-acid environments in Yellowstone National Park. Today my research program focuses on understanding the molecular mechanisms of adaptive immune systems in bacteria and viral proteins that subvert the adaptive immune response.

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Research: Economics

Katsunori Yamada finished his PhD at Kyoto University (Economics) in 2006 under the supervision of Prof. Akihisa Shibata. Thereafter, he worked as a JSPS Research Fellow (PD) and GCOE fellow at Osaka University for 5 years. He was promoted to assistant professor of economics at ISER, Osaka University in 2011. Since 2014, he has been at the Faculty of Economics at Kindai University as an associate professor. Yamada's primary research topic is social preferences, whereby people take others' reward/status into their own utility. He started as a theoretical macro-economist, working on economic growth under the influence of social preferences. His disciplines then have expanded to include behavioral/experimental economics, and computational neurosciences for the purpose of obtaining comprehensive understandings of social preferences.

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Research: speech information processing, machine learning

Speech information processing, Speech synthesis, Speech recognition, Machine learning, Statistics, Pattern recognition, Assistive technology

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Web: www.riem.nagoya-u.ac.jp/4/drof1/nr/index.html

Research: Neuroscience

Although the regulatory mechanisms underlying the neural control of sleep/wakefulness are incompletely understood, identification of the orexin/hypocretin neuropeptide system has enabled important progress to be made. In addition, the recently developed optogenetic or pharmacogenetic methods are a powerful tool to study the function of neural networks. Therefore, I immediately incorporated these techniques into my research and succeeded in controlling the activity of orexin/hypocretin neurons in vivo. And I revealed physiological role of these neurons in the regulation of sleep/wakefulness.

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Research: Biotechnology

Tomoko Yoshino is Associate Professor of Tokyo University of Agriculture and Technology. She received her Doctor of Engineering degree in Biotechnology from Tokyo University of Agriculture and Technology in 2005. After studying as a Research Associate in Waseda University, she was adopted for Associate Professor of tenure-track system at Tokyo University of Agriculture and Technology. She was promoted to Associate Professor with tenure in 2011, served as Team Director of Woman's Future Development Organization, from 2013. Her present research is focused on studying development of novel techniques for single cell analysis. She is currently a reader of CREST promotion program in the research area "Innovative Technology Platforms for Integrated Single Cell Analysis". In addition, she also focused on the production of functional materials using genetically engineered microorganism.

Shinya Yoshioka
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Japan
Tel: +81-4-7122-9343
E-mail: syoshi@rs.tus.ac.jp

Research: Optical Physics

Structural color of natural systems and its application(biomimetics) pattern, formation under non-equilibrium conditions

Guests, Media and Staff

Hiroki Arimura
Hokkaido University
Professor
Graduate School of Information Science and Technology
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Fax: +81-(0)11-706-7680
E-mail: arim@ist.hokudai.ac.jp
Web: www-ikn.ist.hokudai.ac.jp/~arim/arim_en.html
Research: Informatics / Computational Learning Theory, Data mining, and Information Retrieval
I am interested in Data Mining and Computational Learning Theory, which are branches of Informatics and Artificial Intelligence. Data Mining is a study on efficient methods for discovering patterns and rules from large data collections, while Computational Learning Theory studies the possibilities and the limitation of automatic learning process by computers from experiments. In particular, my scientific interests are on Text and Web Mining, Data Mining from Large Semi-structured Data, Design and Analysis of Machine Learning Algorithms, Information Retrieval Algorithms.

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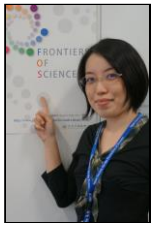

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Yoshihiro Kubo
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E-mail: ykubo@nips.ac.jp
Web: www.nips.ac.jp/eng/research/group/post/
Research: Biophysics/ Physiology/ Neuroscience
My research interest is the functioning mechanisms of ion channels and receptors. Our lab is working on the structure-function relationship, dynamic aspects of the function and structure, situation dependent regulations of ion channels and receptors. We utilize heterologous expression systems such as Xenopus oocytes as well as HEK293T cells, and approach by various techniques including electrophysiology and optical physiology.

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SUMMARY OF JSPS AND FOLLOW-UP PROGRAM

Frontiers of Science (FoS) Symposium
Follow-Up Program (JSPS)

Japan Society for the Promotion of Science (JSPS) organizes Frontiers of Science (FoS) Symposia, in which promising young researchers from Japan and overseas, from various disciplines, gather together for three days and concentrate on discussion on the frontiers of science. The objectives of these symposia are to broaden the academic visions of young researchers and offer a setting where the future leaders in academia can create networks among themselves.

The Frontiers of Science (FoS) Symposium Follow-Up Program is held in line with the aims of the FoS Symposia, to support continuous exchanges between participants in years following the symposia. JSPS covers part of the expenses for Japanese researchers to invite counterpart overseas researchers who have participated in the same FoS Symposium.

Though application for FY2016 has already been closed, the next call for proposals in a similar format will be announced to the FoS participants around December, 2016.

1. Duration and time of visit to Japan
Period for arrival in Japan and departure from Japan: April 1, 2017 and March 31, 2018
Duration of visit: 7 to 14 days
Shorter visit than 7 days may be approved if the necessity is acknowledged.
*Visiting researchers may extend their stay in Japan at their own expenses.

2. Expenses covered by JSPS
JSPS covers the following expenses for visiting researchers:
Round- trip International airfare (economy class)
Maintenance allowance of 14,000 yen a day
Overseas travel insurance during the stay
In addition, host researchers can request up to 50,000 yen for supplementary allowance.

3. Submission of invitation plan
After the invitation plan is fixed, the host researcher in Japan is to submit the plan to JSPS by e-mail. Prior to that, please inform JSPS of the wish to come to Japan via Japanese host researcher by the end of February, 2017.
Submit to: fos@jsps.go.jp
When to submit: 3 months prior to the planned arrival of the visiting researcher

4. Contact information
Japan Society for the Promotion of Science (JSPS)
Research Cooperation Division, Frontiers of Science (FoS) Symposium Team
5-3-1 Kojimachi Chiyoda-ku Tokyo 102-0083 JAPAN
Phone: +81-3-3263-1944, 1844
E-mail: fos@jsps.go.jp

SUMMARY OF JSPS AND FOLLOW-UP PROGRAM

Japan Society for the Promotion of Science (JSPS)

Japan Society for the Promotion of Science (JSPS) was established in 1932 with an endowment from the Emperor Showa for the promotion of science. After undergoing changes of its legal status, it is currently the sole research funding agency in Japan which supports scientific research of all fields established under the national law.

At present, JSPS's program rests on four pillars: (1) Creating Diverse World Level Knowledge; (2) Building robust international cooperative networks; (3) Fostering the Next Generation while Enhancing the Education and Research Functions of Universities; and (4) Building Evidence-Based Science-Promotion Systems and Strengthening Linkage with Society.

The various programs of JSPS are operated on a budget issued from Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) and are implemented by fair and impartial peer review by top researchers. To be selected for JSPS programs is considered achieving high status among researchers.

Main programs of JSPS

<Grants-in-Aid for Scientific Research (KAKENHI) >
These grants support research based on the free ideas of researchers. Every year, there are approximately 104,000 applications, and through impartial selection, approximately 80,000 projects are implemented each year, including continuing ones. It is the most important grant which supports the research activities of researchers of Japanese universities.

<International Collaboration Programs>
JSPS implements programs for international research activities based on cooperative relationships with 90 institutions in 50 countries/regions. These include programs supporting the formation of international research hubs, fellowship programs for foreign researchers to conduct research activities in Japan, and symposiums where internationally active young researchers discuss and create networks. Under these programs, every year about 4,000 foreign researchers are invited to Japan and about 5,500 researchers are sent overseas from Japan.

<Research Fellowships for Young Researchers>
These are the core fellowship programs which foster top-class researchers in Japan, who are about to obtain or have just obtained their doctoral degree. Recently, this fellowship has been granted every year to about 6,000 researchers who have been selected through highly competitive selection, allowing young researchers to conduct research in a self-directed way. For students in Japan aspiring to become researchers, acquiring this fellowship is considered a gateway to success.

SUMMARY OF JSPS AND FOLLOW-UP PROGRAM

<JSPS Prize>
JSPS awards the JSPS Prize to about 25 young Japanese researchers who play an active part in the world's top-level research arena and encourages them to advance their research.

<JSPS Overseas Offices>
JSPS Overseas Offices in 10 cities in 9 countries, such as the JSPS Bonn Office, cooperate with science promotion organizations in each country. They also support the international activities of Japanese universities.

In addition to the above, JSPS provides various programs for researchers both in Japan and overseas to advance scientific research. For details, visit the following site:
http://www.jsps.go.jp/english/

Crowing Rooster, Emblem of JSPS

From days of old in Japan, it has been the belief that the vigorous cry of the rooster in the gray of the morning augurs the coming of a new and bright day. As the crowing rooster can therefore be thought of as a harbinger of the kind of new knowledge that promises a brilliant future for humankind, it was chosen as the emblem of the Japan Society for the Promotion of Science.

Logo of the Frontiers of Science Symposium

JSPS has created a logo for the Frontiers of Science Symposium program. The various colors in the logo signify young researchers of diverse backgrounds and the diversity of research disciplines; the spatially wide design portrays the vast realm of science in which research fields can be transcendent through FoS participation and the limitless possibilities in stock for young researchers.

2016 Japanese-American Kavli Frontiers of Science

This section includes everything you'll need to know about the conference meeting site, hotel accommodations, symposium contact, transportation, conference center layout, wireless access and emergency procedures at the Beckman Center.

Meeting Site

Arnold and Mabel Beckman Center of the National Academies of Sciences and Engineering
100 Academy
Irvine, CA 92617
(p) 949.721.2200
(f) 949.721.2288
http://www.thebeckmancenter.org

Hotel Accommodations

Hyatt Regency Newport Beach Hotel
1107 Jamboree Road
Newport Beach, CA 92660
USA
Tel: 949-729-1234
Fax: 949-644-1552
Web: www.newportbeach.hyatt.com

U.S. National Academy of Sciences
Kavli Frontiers of Science

Edward Patte	Danielle Crosser
100 Academy 2nd Floor	100 Academy 2Nd Floor
Irvine, CA 92617	Irvine, CA 92617
Tel: 949-721-2268	Tel: 949-721-2269
Fax: 949-721-2216	Cell: 714-719-2896

Transportation to/from the John Wayne (Orange County) Airport and Hotel

If you fly into John Wayne (Orange County) Airport, there is complimentary hourly shuttle service to the Hyatt Regency Newport Beach hotel. If you miss the hourly shuttle, there is a courtesy phone at the hotel kiosk near the baggage claim area, which can be used to call the hotel to arrange for pick up.

Transportation to/from the Los Angeles Airport and Hotel/Beckman Center

If you fly into Los Angeles, door-to-door airport shuttle service is available, for which reservations must be made in advance. To reserve a Super Shuttle from LAX in advance, call (310) 782-6600 or book on-line (www.supershuttle.com). Shuttle service operates 7 days a week, 24 hours a day. Upon arrival at LAX, collect your baggage, then call the above number or use the phone on the Ground Transportation Board. Pick-up is at the Van Stop area on the airport lower level.

Directions to the Hyatt Regency Newport Beach from San Diego (South)
Take the 5 freeway North to the 405 freeway North. Exit Jamboree Rd. Turn left. Travel 5 miles south. Hotel is on the right.

Directions to the Hyatt Regency Newport Beach Hotel from Los Angeles (North)
Take the 405 freeway South (or 5 South to 55 South) to the 73 South. Exit Jamboree Rd. and turn right. Travel 3 miles south. Hotel is on the right.

Directions to the Hyatt Regency Newport Beach Hotel from Orange County / John Wayne Airport (5 miles)
From Orange County/John Wayne Airport (5 miles):
Exit airport to MacArthur Blvd., turn right. Continue 1 mile. Turn right on Jamboree Rd. Travel 3 miles south. Hotel is on right.

Directions to the Beckman Center from San Diego (South)
Take Interstate 5 north to Interstate 405 north. Exit Jeffrey Road; turn left. Jeffrey Road becomes University Drive. Continue for approximately three miles to California Avenue and turn left. Take the first right onto Academy Drive. The Beckman Center will be on your right-hand side.

Directions to the Beckman Center from Los Angeles (North)
Follow Interstate 405 south to 73 south. Exit at University Drive; turn left. Continue to California; turn right. Take the first right onto Academy Drive. The Beckman Center will be on your right-hand side.

Hyatt Regency Newport Beach

ADDRESS 1107 Jamboree Road, Newport Beach, CA 92660, USA
PHONE 949-729-1234 SALES FAX 949-759-3253
WEB www.newportbeach.hyatt.com

ACCOMMODATION

- 403 guestrooms, including nine suites, 181 kings / queens, 201 double / doubles, 28 Hyatt Business Plan®, 285 Hyatt Gold Passport®, 163 rooms with balconies / patios, and 375 non-smoking rooms;

All accommodations offer:

- Wireless high-speed Internet access in guestroom
- Television with remote control, cable movie channels, in-room pay movies
- Video messages, account review, checkout
- Voice mail, telephone with message light, data port
- Individual climate control
- Full bath amenities
- Turndown available upon request
- Iron / ironing board
- AM / FM alarm clock radio
- In-room safety-deposit box
- Hair dryer
- Coffeemaker and complimentary coffee
- Daily newspaper delivery

SERVICES & FACILITIES

- 1-800-CHECK-IN®
- In-room dining
- Concierge
- Hyatt Meeting Concierge™
- 24 hour self-automated business center
- Multilingual staff
- Complimentary transportation to and from Orange County / John Wayne Airport, Fashion Island and Balboa Island
- Car rental on site
- Valet service
- Currency exchange
- Safe-deposit boxes at front desk
- Laundry / dry cleaning
- Valet parking and self parking
- Gift shop

RESTAURANTS & BARS

- Sol—Our menu reflects the bounty of Southern California with simply prepared meats and seafood, the finest in fresh produce, and the best of California wines
- Sandbar Lounge—Newport Beach's newest haunt, this festive hot spot boasts an outdoor fire pit, Adirondack-style furniture, and live entertainment on featured nights
- The Buzz Stop—Freshly brewed Starbucks® coffee, espresso drinks, pastries or fresh fruit to go

CONFERENCES & BANQUETS

- A total of 26,000 square feet of function space, plus acres of beautifully landscaped outdoor event space
- A total of 19 breakout rooms, including the elegant Plaza Ballroom and Terrace Room
- Select meeting accommodations offer tropical garden settings and charming French windows
- 26 acres of beautifully landscaped grounds, complemented by three pools and whirlpools, nine-hole Executive Par 3 Golf Course, and tennis courts
- All meeting accommodations offer high-speed Internet access, individual or master controls for heat / AC, sound, music, telephones, multiple electrical/microphone outlets, and special lighting effects

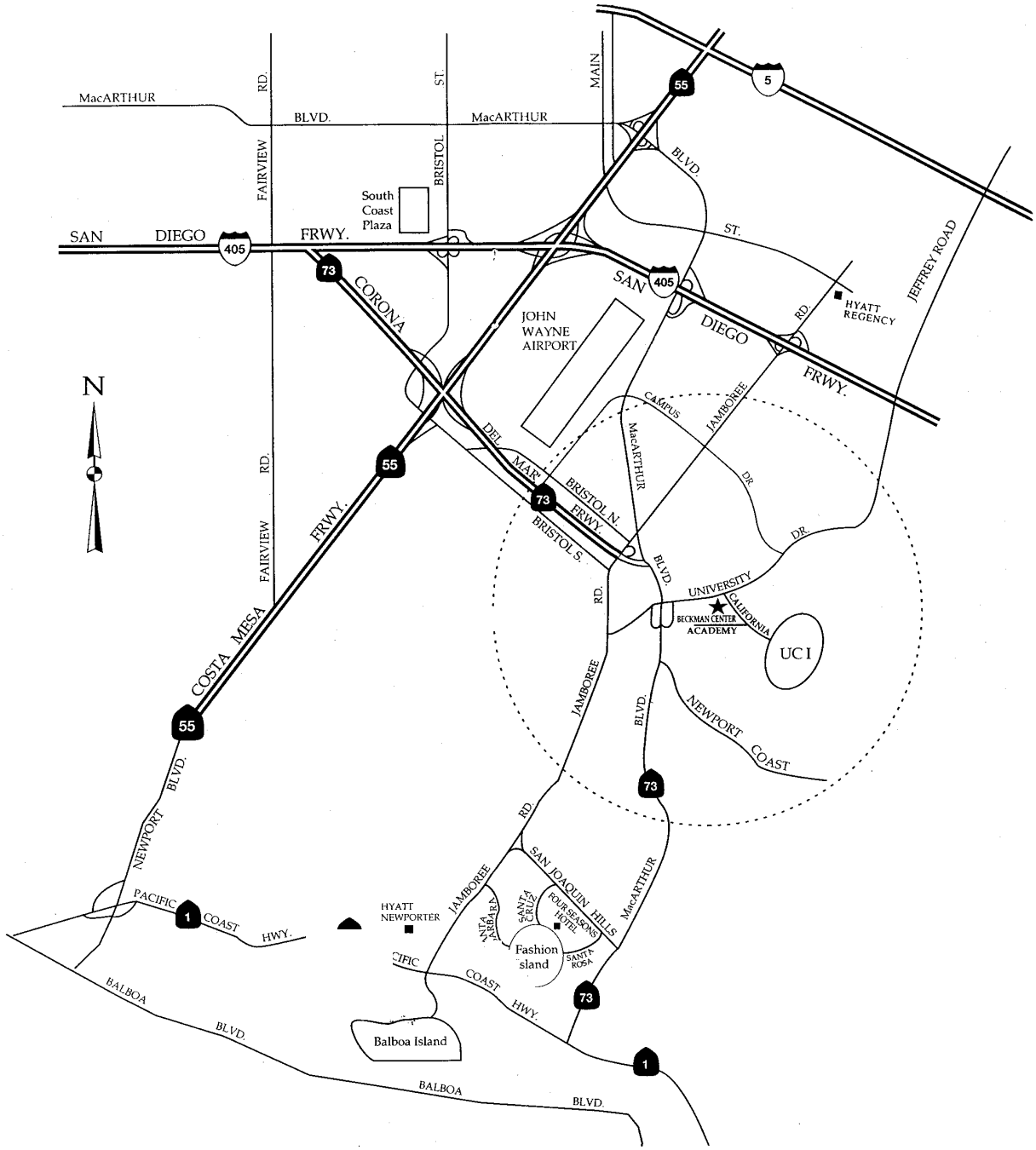
RECREATIONAL FACILITIES

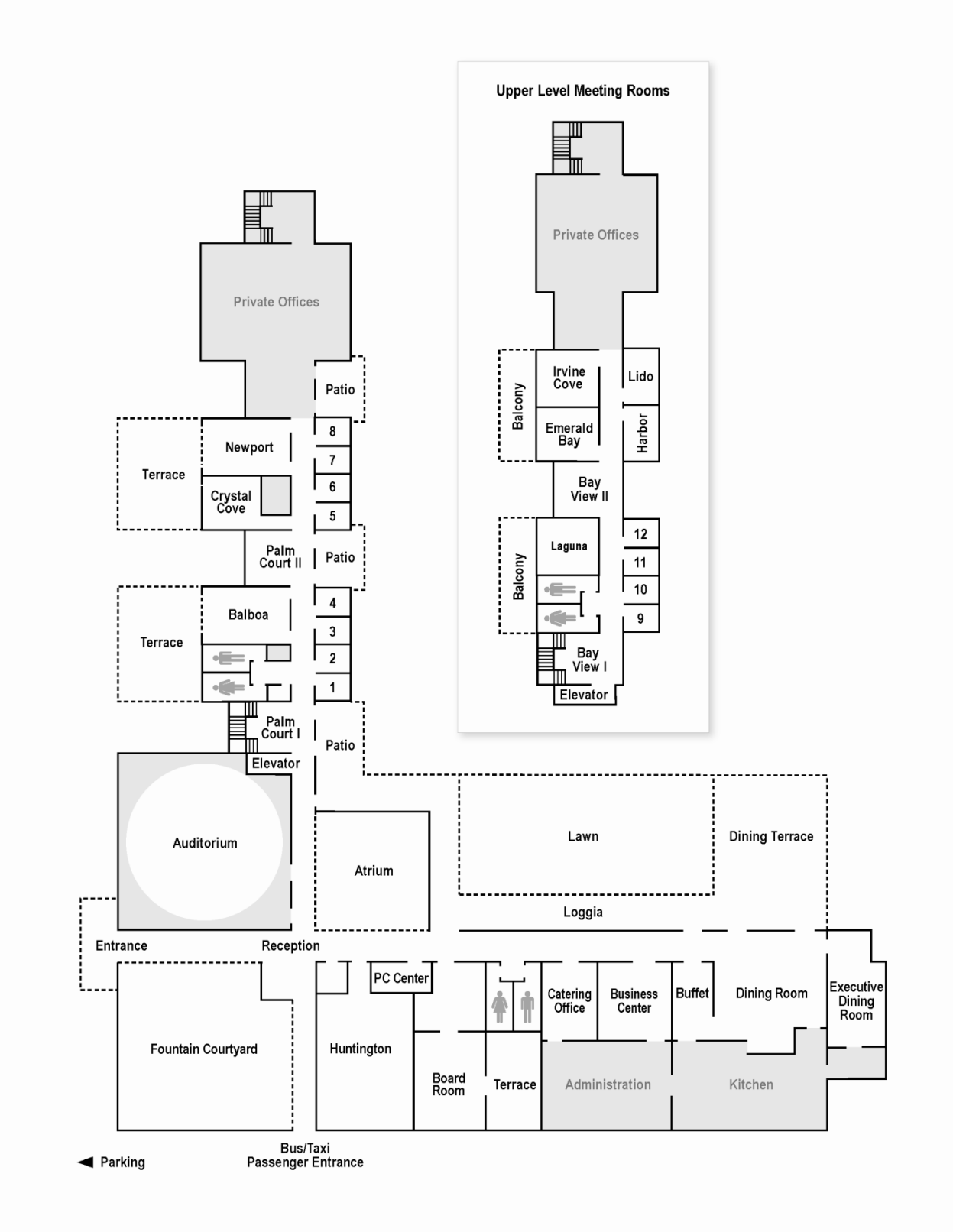
- Three outdoor swimming pools and whirlpools reflect the hotel's tropical setting—all of which are situated throughout the property
- Fully equipped Cardio Room, complete with free weight
- Gaylee Signature Spa
- Bicycle rentals, biking and jogging trails, shuffleboard, table tennis, and volleyball
- On-property golf at the nine-hole, par-3 Back Bay Golf Course
- 16 lighted tennis courts at the Palisakes Tennis Club, on-property

POINTS OF INTEREST

- Laguna Beach
- Newport Beach
- Balboa Island / Balboa Peninsula
- Disneyland® Resort
- Knott's Berry Farm
- South Coast Repertory
- Orange County Performing Arts Center
- Fashion Island shopping and dining
- Edison Internationall Field (Angels)
- Arrowhead Pond of Anaheim (Mighty Ducks)
- South Coast Plaza
- Catalina Island
- Richard Nixon Library
- Laguna Beach Art Festival / Pageant of the Masters
- University of California Irvine
- Orange County Museum of Arts

Irvine, California




Upper Level Meeting Rooms
Private Offices
Irvine Cove
Lido
Balcony
Emerald Bay
Harbor
Bay View II
Laguna
12
11
10
9
Balcony
Bay View I
Elevator
Private Offices
Patio
Newport
8
7
Terrace
Crystal Cove
6
5
Palm Court II
Patio
Balboa
4
3
Terrace
2
1
Palm Court I
Patio
Elevator
Auditorium
Atrium
Lawn
Dining Terrace
Loggia
Entrance
Reception
PC Center
Catering Office
Business Center
Buffet
Dining Room
Executive Dining Room
Fountain Courtyard
Huntington
Board Room
Terrace
Administration
Kitchen
Parking
Bus/Taxi Passenger Entrance

Visitor Based Wireless Network (VBWN):
The National Academies building at the Beckman Center has a visitor's based wireless network (VBWN) that allows visitors to connect their laptops to the Internet. This service is available in all the meeting rooms including the dining room area.

- A wireless network card is required in order to access the wireless network with your laptop. (802.11b,g compliant) ***Make sure your wireless card is turned on.***
- Your laptop must be setup for dynamic addressing (DHCP)
- Our SSID = visitor

Other important facts about the Visitor Based Wireless Network:

- No encryption is used. (WEP)
- Date rate is auto-sensing, supporting 1MBS, 2MBS, 5.5MBS, 11MBS, 54MBS
- **Users must use their own SMTP work server address or ISP, as the VBWN does not provide SMTP mail server service.**
- VPN sessions have been tested and work appropriately.
- This connection is not to be used for copying or sharing any copyrighted material on the Internet.
- This connection should not be used to undertake any illegal activity, including, but not limited to scanning, monitoring, probing or attacking other computers.

SSID Setup for Windows XP & Windows 7:

1. Right click on "My Network Places" and click on "Properties"
2. Right click on your Wireless connection and click on "Properties"
3. On the "Wireless Networks" tab, click "Add…"
4. Type "visitor" in the SSID highlighted, click on the Properties button and make sure that the "Data encryption (WEP enabled)" and "Network Authentication (Shared mode)" boxes are unchecked. Click on "OK" or "Cancel" depending on if you had to change anything.
5. Click on "OK" and close the network properties windows.
6. Next, open your web browser to and splash screen should appear.
7. Click Access the Internet button to begin your wireless session.

SSID Setup for Windows 2000:

1. Right click on "My Network Places" and click on "Properties"
2. Right click on your Wireless connection and click on "Properties"
3. On the Wireless Properties, click "Configure…"
4. On the Advanced Tab, under properties, select SSID.
5. Under value, type "visitor"
6. Click on "OK", and close the network properties windows.
7. Next, open your web browser to and splash screen should appear.
8. Click Access the Internet button to begin your wireless session.

SSID Setup for MAC OS X:

1. Open System Preferences
2. Double Click Network
3. Select your Location
4. Under “Show” select “Airport” *** (Make sure that “Airport us turned on”) ***
5. Under the Airport tab, type “visitor” for the Preferred Network and click “Apply Now”
6. Quit System Preferences
7. Next, open your web browser to and splash screen should appear.
8. Click Access the Internet button to begin your wireless session.
9. If the wireless connection is not working, close out your web browser and then re-start it.

SSID Setup for MAC OS 9:

1. Go to Apple Menu> Airport *** (Make sure that “Airport us turned on”) ***
2. Check “Allow selection of closed networks” box (May need to expand “Settings” option)
3. Under “Choose network” select “Other…”
4. Type “visitor” for the Network Name, leave password field blank
5. Click “OK”
6. Quit Airport
7. Next, open your web browser to and splash screen should appear.
8. Click Access the Internet button to begin your wireless session.
9. If the wireless connection is not working, close out your web browser and then re-start it.

Note: If you still cannot connect, please see a Beckman Center Tech Staff member for assistance.

EMERGENCY EVACUATION

Whenever emergency evacuation of the Beckman Center is necessary because of a fire or other emergency, the fire alarm evacuation system will be activated accompanied by horns and flashing strobe lights. The fire alarm system is activated whenever a fire alarm pull station in the building has been activated or sensors located throughout the building detect evidence of a fire.

The following procedures should be followed in the event the building has to be evacuated:

1. **When the fire alarm sounds, leave the building immediately by way of the nearest emergency exit.**

   WALK; do not run. DO NOT USE AN ELEVATOR to evacuate, unless directed to do so by building security or public safety personnel.

   All the emergency exit stairways are designed to provide protection from a fire in the building for at least two hours.

   There are numerous emergency exits in this building. Please locate the two nearest to your work location.

   Once you have exited, move away from the building for your own safety and to make room for those exiting behind you and gathering in the lower area of the side parking lot or as directed by public safety personnel and wait for further instructions.

2. Close windows and doors, but do not lock all doors as you leave.

3. Before exiting through any closed door, check for heat and the presence of fire behind the door by feeling the door with the back of your hand. If the door feels very warm or hot to the touch, advise everyone to proceed to another exit. Do **not** open the door.

4. Follow the instructions and public safety personnel responding to the emergency.

5. The cessation of the alarm or departure of the fire department does not indicate an "all clear" to re-enter the building as corrective measures may still be in progress. Stay clear of the building until public safety personnel have advised you to re-enter the building.

6. Assist visitors during alarm/emergency situations. Visitors are not familiar with exits or our emergency evacuation procedures. Employees should calmly inform visitors of the proper actions to be taken and assist them with the evacuation.

7. In the event you are unable to exit the building:
   a. Remain calm; do not panic.

b. If there is smoke in your area and you need to move around, remain low; crawl if necessary.
c. Place a cloth, wet if possible, over your mouth to serve as a filter.
d. If you have a portable phone, keep it with you and call 911 to let them know where you are.
e. If there is no fire in your area, close all fire doors and stay put.
f. Go to a room with an outside window and telephone, closing all doors between you and the fire, stuff cracks around the door and any vent openings with cloth to keep out smoke.
g. Signal for help from a window. Use a towel, clothing, sign, flashlight, etc.

8. Plan ahead and be prepared.
   a. Learn at least two routes for exiting the building.
   b. Count the doors between your location and the nearest emergency exits. You may have to escape a fire in the dark.
   c. Take note of the locations of the building's fire alarm pull stations in your area.
   d. Take a moment to identify routes for exiting the building at the beginning of a meeting in a conference room.

EMERGENCY SHELTER FROM BIOLOGICAL, CHEMICAL, RADIOLOGICAL OR OTHER HAZARD

Whenever it is necessary for occupants of the Beckman Center to seek temporary shelter within the building because of a biological, chemical, radiological or other hazard in the vicinity of the building, the following procedures should be followed:

1. Proceed to Auditorium on the first floor, which is the designated shelter area for all occupants of the Beckman Center.

2. Close windows and turn off unnecessary equipment, including any room heating/cooling unit. Close but do not lock doors as you leave your location and head for the shelter area.

3. Take any medications you are using with you to the shelter area.

4. If one of the portable radios or flashlights positioned throughout the building is in your location, take it with you to the shelter area. If you have a personal portable radio, cell phone or flashlight, bring it to the shelter area to supplement the pre-positioned equipment.

5. Assist others in responding to the emergency.

6. **DO NOT USE THE ELEVATORS**. Use of an elevator increases the risk that any hazardous agent in the building will spread to additional floors.

7. Once you are in the designated shelter area, remain there until you are told it is safe to leave. Keep doors leading to and from the shelter area closed as much as possible.

Limit your physical activity as much as possible. You will be given information and instructions concerning the emergency. Information may also be available over the portable radios in the shelter area.

8. There is sufficient food and water in the Beckman Center to support its occupants for at least three days. Should the shelter emergency last long enough to require use of these provisions, you will be given information regarding distribution of food and water.

9. Follow the instructions of public safety personnel responding to the emergency.

10. Plan ahead and be prepared.
    a. Memorize the location of the designated shelter area for your location and other parts of the building you visit and learn the best routes for getting there.
    b. Keep medication and other things you want to take to the shelter area together in a place where you can reach them quickly.

INDIVIDUALS REQUIRING SPECIAL ASSISTANCE

Some individuals require special assistance in exiting the building during an **emergency evacuation**. For these individuals there is an emergency evacuation chair specifically designed to safely transport them down a stairwell and out of the building during an emergency evacuation. This chair is in a clearly marked container on the 2nd floor near the elevator.

If you need special assistance in exiting the building during an emergency evacuation you should go to one of the stairs located throughout the building. Once you have reached the stairs you may either:

1. Go down the stairs and exit the building using an emergency evacuation chair with the help of a trained volunteer.
   OR
2. Wait until fire department or other public safety personnel arrive to take you down the stairs and out of the building.

If you need assistance in moving to a shelter area during a **shelter emergency**, please indicate this to a nearby individual or the emergency coordinator when he or she reaches the area in which you are located. You may, if you wish, identify yourself to the Director of Administration as someone who needs special assistance in exiting the building during an emergency evacuation or in moving to a designated shelter area during a shelter emergency. The Director of Administration will then work with you to identify and train specific individuals to assist you in the event of an emergency.

The Japan Society for the Promotion of Science (www.jsps.go.jp/english/)

Japan Society for the Promotion of Science (JSPS) was established in 1932 with an endowment from the Emperor Showa for the promotion of science. After undergoing changes of its legal status, it is currently the sole research funding agency in Japan which supports scientific research of all fields established under the national law.

At present, JSPS's program rests on four pillars: (1) Creating Diverse World Level Knowledge; (2) Building robust international cooperative networks; (3) Fostering the Next Generation while Enhancing the Education and Research Functions of Universities; and (4) Building Evidence-Based Science-Promotion Systems and Strengthening Linkage with Society.

The various programs of JSPS are operated on a budget issued from Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) and are implemented by fair and impartial peer review by top researchers. To be selected for JSPS programs is considered achieving high status among researchers.

The Kavli Foundation (www.kavlifoundation.org**)**

The Kavli Foundation, based in Oxnard, California, is dedicated to the goals of advancing science for the benefit of humanity and promoting increased public understanding and support for scientists and their work.

The Foundation's mission is implemented through an international program of research institutes, professorships, and symposia in the fields of astrophysics, nanoscience, neuroscience, and theoretical physics as well as prizes in the fields of astrophysics, nanoscience, and neuroscience.

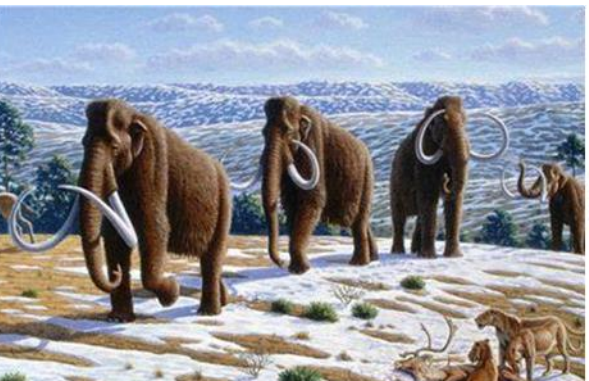
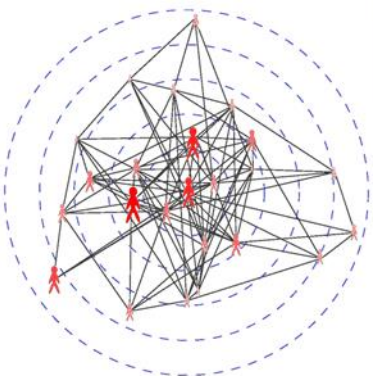
The Kavli Foundation was established in December 2000 by its founder and benefactor, Fred Kavli, a prominent California business leader and noted philanthropist whose foundation is currently actively involved in establishing major research institutes at leading universities and institutions in the United States, Europe and Asia.

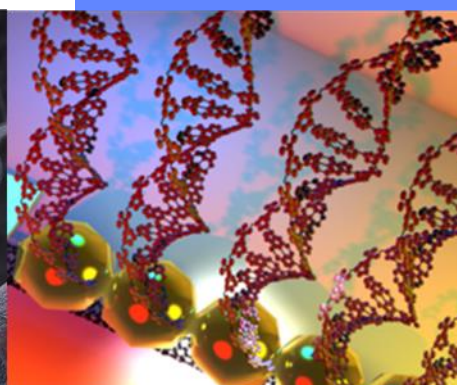
To date, The Kavli Foundation has established Kavli Institutes on the campuses of the University of California Santa Barbara, Stanford University, the University of Chicago, the Massachusetts Institute of Technology, the California Institute of Technology, Cornell University, Delft University of Technology in the Netherlands, Yale University, Columbia University, the University of California San Diego, Harvard University, Peking University, the Chinese Academy of Sciences, the University of Cambridge, the Norwegian University of Science and Technology, the University of Tokyo, and the University of California, Berkeley.

In addition to the Kavli Institutes, seven Kavli professorships have been established: two at the University of California Santa Barbara, one at University of California Los Angeles, one at the University of California Irvine, one at Columbia University, one at the California Institute of Technology and one at Harvard.

Fred Kavli, a Norwegian-born American, was a physicist, entrepreneur, business leader, innovator and philanthropist. The founder, former chairman and chief executive officer of Kavlico Corporation, he divested his interest in the company and in 2000 established The Kavli Foundation. At the time the company was sold, Kavlico was one of the world's largest suppliers of sensors for aeronautics, automotive and industrial applications.

The Kavli Foundation is a private foundation qualified under IRS Section 501 (c) (3).



A special thank you to the members of the 2014-2016 Planning Group

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- Thomas Hull
  Western New England University
- Miya Ishihara
  National Defense Medical College
- Masaru Ishii
  Osaka University
- Kensuke Kobayashi
  Osaka University
- Hisaki Kono
  Kyoto University
- Lashanda Korley
  Case Western Reserve University
- Kazuhiro Maeshima
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- Chika Minejima
  International Christian University
- Emilia Morosan
  Rice University
- Junichi Yamagishi
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