News

Naoki Yoshida Awarded 13th JSPS Prize and Japan Academy Medal

Naoki Yoshida, Professor of the University of Tokyo School of Science and Kavli IPMU, was awarded the 13th JSPS (Japan Society for the Promotion of Science) Award and the 13th Japan Academy Medal in recognition of his "Large-Scale Numerical Simulations of Structure Formation in the Early Universe." The award ceremony was held at The Japan Academy on February 8, 2017.

Naoki Yoshida with his Japan Academy Medal. Photo: Courtesy of the Joint Institute for Computational Fundamental Science.

The JSPS Prize and Japan Academy Medal were both established in 2004. The JSPS Prize is meant to recognize young researchers with fresh ideas who have the potential to become world leaders in their fields. The purpose of the Japan Academy Medal is to honor outstanding young researchers, and up to six awardees (6 researchers this time) are selected every year from among the annual winners of the JSPS Prize (25 researchers this time).

Professor Yoshida has developed a computer simulation code called GADGET (GAlaxies with Dark matter and Gas intEracT) with collaborators. Using this code he has been studying structure formation and the evolution of the early universe, the formation of the first stars, and the origin of massive black holes.

Now, GADGET is a standard code in the field of large-scale computer simulation studies of the Universe. It also has a great influence on astronomical observations. Thus, Professor Yoshida's contribution to astronomy and future prospects of his research have been recognized.

Tomoyuki Abe Wins the 2017 MSJ Spring Prize

Kavli IPMU Associate Professor Tomoyuki Abe won the Mathematical Society of Japan (MSJ) Spring Prize for his contributions to the "Study of Arithmetic D-module Theory and Langlands Correspondence." An award ceremony was held on March 25 during the MSJ's Annual Meeting at Tokyo Metropolitan University.
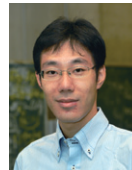
Tomoyuki Abe

The MSJ Spring Prize was inaugurated in 1988 as the successor to the Iyanaga Prize which had been established in 1973. It is awarded to MSJ members under the age of 40 to recognize outstanding mathematical achievement.

There are mainly two cohomology theories for varieties over fields of positive characteristic: one with a topological nature and the other with a more analytic nature. Deligne conjectured that these two cohomology theories have similar information. Professor Abe used a variant of "analytic cohomology theory," called theory of arithmetic D-modules, to establish Langlands type correspondence, and verified a part of Deligne's hope. His research is difficult to understand, but you may get some idea from his article in the Kavli IPMU News, No. 35, pp. 4-9.

Meeting of WPI Center Administrative Directors Held at Kavli IPMU

On March 8, 2017, a meeting of the WPI (World Premier International Research Center Initiative) center Administrative Directors was held at the Kavli IPMU. In addition to the Administrative Director and some administrative staff from each WPI center, WPI Program Director (PD) Toshio Kuroki, Deputy PD Akira Ukawa, Director Takuya Saito of the Office for the Promotion of Basic Research, the Basic Research Promotion Division, Research Promotion Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT), and some officers from MEXT and JSPS (Japan Society for the Promotion of Science) WPI Secretariat also attended the meeting.

To begin, meeting host and Kavli IPMU Administrative Director Haruyama reported on the necessity for the WPI program, 10 years after its launch, to deepen cooperation among the centers. Then, PD Kuroki, MEXT Director Saito, and others explained the present status toward establishing the "WPI Academy." According to these explanations, the WPI centers, which started in 2007 as first-generation centers, can maintain and develop their status of "World Premier International Research Center," attained through

their ten years of activities, in the new framework of the WPI Academy. As the Kavli IPMU is a WPI center with a five-year extension, it is expected to play its role in the WPI Academy as well as in the current WPI program. Further, there was a presentation of information by a fundraising specialist. He pointed out the necessity of an approach toward various kinds of fundraising, sufficient appeal power the WPI activities have, etc.

The participants toured the Kavli IPMU building which is known for its unique design, and attended daily tea time which is aimed at cross-disciplinary communication of researchers.

Finally, there was a discussion regarding problems that are common to each center. The participants recognized the importance of the Administrative Directors meeting like the one held this time, and agreed upon a policy of gathering periodically as often as possible for the purpose of building up WPI's bank of information that can be shared among the centers.

A scene from the WPI Administrative Directors meeting.

VLA and ALMA Team up to Give First Look at Birthplaces of Most Current Stars

An international team of astronomers, including Kavli IPMU postdoctral fellow Wiphu Rujopakarn (who is also affiliated with Chulalongkorn University in Bangkok) as the first author of the paper reporting this research, got their first look at the exact place where stars were born at a peak rate of star formation. To do so, they used the National Radio Astronomy Observatory's Karl G. Jansky Very Large Array (VLA) in New Mexico and the Atacama Large Millimeter/Submillimeter Array (ALMA) in Chile to look at eleven distant galaxies selected from the Hubble Ultra-Deep Field. They are seen as they were 8.9 – 11.5 billion years ago.

Most stars in the present Universe are thought to have been born then. However, galaxies forming stars prolifically are shrouded in a great deal of dust due to star formation activity. This makes it difficult to look at the birthplace of stars because intervening dust hides it from visible-light observations. However, radio waves, having longer wave lengths than visible light, can get through the dust. Therefore, the astronomers made the most sensitive image of such distant galaxies where star formation was occurring with the VLA, and observed the distribution of cold gas (which is the fuel for star formation) with the ALMA using radio waves in the millimeter wavelength region (called millimeter waves), as seen in the two figures shown on the right.
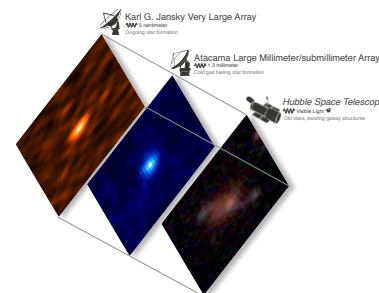
The new observations, using the VLA and ALMA, have shown that intense star formation in the galaxies they studied most frequently occurred throughout the galaxies, as opposed to much smaller regions in present-day galaxies with similar high star-formation rates. The star formation rate (the total mass of stars formed per year) in the galaxies they studied turned out to be 20 times as large as that in the present-day average galaxies.

By precisely observing and analyzing the images of more distant galaxies where star formation was occurring using both radio waves and millimeter waves in future research like the present one, it is expected that we can investigate what mechanisms were responsible for the bulk of star formation in those galaxies at that time, and how they are different from the star-formation mechanisms in present-day galaxies, and eventually, we can shed light on the history of galaxy evolution.

These results were published in the December 1 issue of the Astrophysical Journal.

Distant Star-Forming Galaxies
in the Hubble Ultra-Deep Field

11.2 billion light-years   9.0 billion light-years
9.4 billion light-years   10.9 billion light-years

Color composite: *Hubble Space Telescope* (visible wavelength)
Red overlay: Karl G. Jansky Very Large Array (radio wavelength)

Radio/Optical combination images of distant galaxies as seen with VLA and Hubble Space Telescope. Their distances from Earth are indicated in the images. Credit: K. Trisupatsilp, NRAO/AUI/NSF, NASA.

Karl G. Jansky Very Large Array
6 centimeter
Ongoing star formation

Atacama Large Millimeter/submillimeter Array
1.3 millimeter
Cold gas fueling star formation

Hubble Space Telescope
Visible Light
Old stars, existing galaxy structures

The combination of VLA, ALMA, and Hubble Space Telescope provides simultaneous insights into star formation, cold dust, and the existing stellar populations in distant galaxies in the Hubble Ultra Deep Field. Credit: Wiphu Rujopakarn/Kavli IPMU.

News

First Public Data Released by Hyper Suprime-Cam Subaru Strategic Program

The first public data set from the Hyper Suprime-Cam Subaru Strategic Program (HSC-SSP) was released on February 27, 2017 (local time in Hawaii). The HSC-SSP is a large survey being done using HSC, an optical imaging camera mounted at the prime focus of the Subaru Telescope. Since it is difficult to analyze such a huge dataset with standard tools, a dedicated database and interface for ease of access and use of the data has been developed.

The HSC-SSP is a "cosmic census" project expected to spend 300 nights over 5 to 6 years to conduct an imaging survey of various galaxies over a wide solid angle of the sky, corresponding to 6,000 times the area of the full moon, in sufficient depth to probe the distant Universe. The HSC-SSP is an international collaboration of astronomers from NAOJ, Kavli IPMU, and other institutes in Japan, the Academia Sinica Institute of Astronomy and Astrophysics (ASIAA) in Taiwan, and Princeton University in the United States. Kavli IPMU Professor Masahiro Takada serves as a leader of the HSC-SSP Science Working Group using the HSC-SSP data.

This release includes data from the first 1.7 years (61.5 nights of observations beginning in 2014) and the total amount of data comprises of 80 terabytes. Though this first public dataset represents only a sixth of that expected from the entire HSC-SSP survey, it already contains almost 100 million galaxies. In contrast, the US-based Sloan Digital Sky Survey (SDSS) —which is known for its wide area observation—took over 10 years to create equivalent data sets.

Why was it possible for the HSC-SSP survey to collect such a large amount of data within this short period? It is because the HSC-SSP is a large survey project which fully takes advantage of the performance of the Subaru telescope and the HSC. First, the Subaru telescope has a large 8.2 m diameter primary mirror, and, therefore, a high light-collecting power. Further, the HSC, a wide-field camera mounted at the prime focus of the Subaru telescope, has 104 CCDs (870 million pixels in total) for science exposures and a 1.77 square-degree field of view—about 1000 times as large as that of the Hubble Space Telescope.

In contrast to other surveys, the HSC-SSP can collect high-quality data including information on dim galaxies and distant galaxies. In future, it is expected to shed light on such topics as the origin of galaxies, and the nature of dark matter and dark energy, using these data.

Kavli IPMU / ELSI Joint Public Lecture "A Question of Origins"

On January 22, 2017, the 2nd public lecture—"A Question of Origins"—co-sponsored by Kavli IPMU and Tokyo Institute of Technology's Earth-Life Science Institute (ELSI) was held at the University of Tokyo's Ito Hall at Hongo campus.

The purpose of the Kavli IPMU is to pursue the "Origin of the Universe" and the purpose of the ELSI is to pursue the "Origin of the Earth and Life." These two WPI institutes planned this public lecture as an event to convey the latest findings of their research in an easy-to-understand way as well as to offer a diversity of perspectives, including the philosophical perspective to the audience, under the common theme

of "A Question of Origins," which is fundamental to mankind. The venue was filled to capacity with 350 people.

After an opening address by WPI Program Director Toshio Kuroki, Kavli IPMU Principal Investigator Hirosi Ooguri talked about "The Origin of the Universe from the Physics Point of View," ELSI Director Kei Hirose talked about "Learning the Past from the Present—Travelling through Time over 4.5 Billion Years—," and the University of Tokyo's Graduate School of the Humanities and Sociology Professor Noburu Notomi spoke about "Question of the Origin (arkhē) Posed by Ancient Greek Philosophy." After the lectures, the three speakers took part in a round table discussion entitled "What Does It Mean to Question Origins?" Finally, there was a discussion between the lecturers and the audience, and the event ended on a high note.

Round-table discussion. From right to left: Hirosi Ooguri, Kei Hirose, and Noburu Notomi.

AAAS 2017 Annual Meeting in Boston

The American Association for the Advancement of Science (AAAS) annual meeting was held in Boston from February 16 through 20, 2017. At this AAAS annual meeting, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Japan Society for the Promotion of Science (JSPS), and the nine WPI centers including the Kavli IPMU hosted the WPI booth for three days from February 17. Open

to all attendees, the booth showcased some of the latest research from WPI centers, as well as highlighted their efforts to create an open research environment that attracts scientists from around the world, with WPI Program Director Toshio Kuroki in attendance. During the three days, the WPI booth was visited by more than 300 people, including researchers, journalists, students, and families.

At this AAAS annual meeting, Nobel laureate Takaaki Kajita (Director of the University of Tokyo's Institute for Cosmic Ray Research and Kavli IPMU Principal Investigator) participated as a panelist at the panel discussion entitled, "Opening a New Era to the Universe with Gravitational Waves."

WPI booth at the AAAS annual meeting in Boston. Photo: Courtesy of the International Institute for Carbon-Neutral Energy Research (I²CNER), Kyushu University.

Workshop –Searching for the Lost Study–Art×Science×Philosophy

On March 25, 2017, a workshop Called "Searching for the Lost Study–Art×Science×Philosophy" was held at Tamarokuto Science Center in Nishi-Tokyo City.

This workshop was aimed at considering similarities and differences between science, art, and philosophy. The following specialists were invited to present their view on this theme: Masahito Yamazaki (Kavli IPMU Assistant Professor; Physics), Yoshihiro Maruyama (Kyoto University's Hakubi Project/Graduate School of Letters

Assistant Professor; Mathematical Philosophy), Masafumi Oizumi (ARAYA's Manager; Cognitive Science), Syunsuke Kuwahara (The University of Tokyo's Department of Aesthetics Assistant Professor; Aesthetics), and Nozomu Ogawa (Art Center Ongoing Director; Contemporary Art). There were about 40 participants. More than half of them were women.

The workshop lasted the whole day, with a Science session, Art session, and General session, and it was organized in such a way that there were frequent discussion times among the participants. In each group sitting around a table, a very active discussion was made to deepen the understanding of the presentation given by lecturers.

Presentation of Kavli IPMU's physicist Masahito Yamazaki.

A scene of the workshop.

Japanese Class Completion Ceremony

At the Kavli IPMU, its own Japanese classes are open to researchers and their families. To date, many people have completed their 40 hours of Introductory Japanese Course taught by Kavli IPMU's Japanese Language teacher Masami Nishikawa.

On March 13, 2017, six students celebrated finishing their Japanese classes. They presented speeches in Japanese and received their certificates. They are Kavli IPMU Postdoctoral Fellows Jiaxin Han, Ting-Wen Lan, Juliana Kwan, Fabian Koehlinger, Po-yen Tseng, and his wife Chia-I Chen.
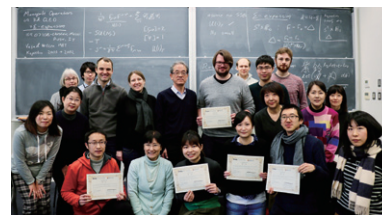
It looks that there are only five people holding their certificates, but there is another one who is not showing his certificate clearly.

Kavli IPMU Seminars

1. "Towards understanding the Large-Scale Structure in the Universe using perturbation theory"
   Speaker: Zvonimir Vlah (KIPAC)
   Date: Nov 09, 2016
2. "Supernovae and their progenitor systems"
   Speaker: Samuel Jones (HITS, Heidelberg)
   Date: Nov 10, 2016
3. "Gauge Theory and Calibrated Geometry for Calabi-Yau 4-folds: Part III"
   Speaker: Yalong Cao (Kavli IPMU)
   Date: Nov 11, 2016
4. "Primitive forms for Gepner singularities"
   Speaker: Andrei Ionov (HSE)
   Date: Nov 14, 2016
5. "Decoding the perfect Universe"
   Speaker: Charles Kirkham Rhodes (U of Illinois, Chicago)
   Date: Nov 15, 2016
6. "4d N=1 from 6d (1,0)"
   Speaker: Gabi Zafrir (Kavli IPMU)
   Date: Nov 15, 2016
7. "The search for the oldest stars in our Galaxy"

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Speaker: Patrick Francois (Observatoire de Paris-Meudon)
Date: Nov 16, 2016

8. "Hydrodynamics of Rotating Stars"
Speaker: Philipp Edelmann (HITS, Heidelberg)
Date: Nov 17, 2016

9. "Homological mirror symmetry via constructible sheaves"
Speaker: Tatsuki Kuwagaki (U Tokyo)
Date: Nov 18, 2016

10. "Geometric Satake correspondence"
Speaker: Mikhail Kapranov (Kavli IPMU)
Date: Nov 21, 2016

11. "The ϵ-expansion of the codimension two twist defect from conformal field theory"
Speaker: Satoshi Yamaguchi (Osaka U)
Date: Nov 22, 2016

12. "Tyurin conjecture and SYZ mirror symmetry"
Speaker: Atsushi Kanazawa (Kyoto U)
Date: Nov 28, 2016

13. "Planar zeros in gauge theories and gravity"
Speaker: Miguel A. Vazquez-Mozo (Universidad de Salamanca)
Date: Nov 29, 2016

14. "Combining Cosmological Probes in the Dark Energy Survey, and Beyond"
Speaker: Elisabeth Krause (U Stanford)
Date: Dec 06, 2016

15. "Cheshire Cat Resurgence and Quasi-Exact Solvability"
Speaker: Yuya Tanizaki (RIKEN BNL Research Center)
Date: Dec 06, 2016

16. "The Assembly of Today's Most Massive Galaxies Over the Last 12.8 Gyr"
Speaker: Danilo Marchesini (Tufts U)
Date: Dec 07, 2016

17. "HETDEX: the Hobby-Eberly Telescope, VIRUS, and the evolution of dark energy"
Speaker: Gary Hill (U Texas)
Date: Dec 08, 2016

18. "Canonical relative tilting generator"
Speaker: Alexey Bondal (Kavli IPMU)
Date: Dec 08, 2016

19. "Bulk reconstruction in the Hartle-Hawking formalism"
Speaker: Daniel Jafferis (Harvard U)
Date: Dec 09, 2016

20. "Constructing expansion parameters for QCD-type theories"
Speaker: Aleksey Cherman (U Washington)
Date: Dec 13, 2016

21. "Pre-supernova Convection in Massive Stars"
Speaker: Manos Chatzopoulos (Louisiana State U)
Date: Dec 13, 2016

22. "On Perturbative/Non-perturbative Relations"
Speaker: Gerald Dunne (U Connecticut)
Date: Dec 14, 2016

23. "The Connection between Galaxy Growth and Dark Matter Halo Assembly from z=0-10"
Speaker: Peter Behroozi (UC Berkeley)
Date: Dec 15, 2016

24. "3D Observations of Molecular Gas in Galaxies: From Global Dynamics to Supermassive Black Holes"
Speaker: Martin Bureau (U Oxford)
Date: Dec 22, 2016

25. "Random Tensor Models and Melonic Large N Limits"
Speaker: Igor Klebanov (Princeton U)
Date: Jan 05, 2017

26. "Searching for ultralight dark matter with atomic spectroscopy and magnetic resonance"
Speaker: Dmitry Budker (Johannes Gutenberg University)
Date: Jan 06, 2017

27. "The Lightcone Bootstrap and the Spectrum of the 3d Ising CFT"
Speaker: David Simmons-Duffin (IAS)
Date: Jan 10, 2017

28. "Entanglement Entropy in Smooth Quenches"
Speaker: Masahiro Nozaki (U Chicago)
Date: Jan 10, 2017

29. "Modeling baryonic physics in galaxy clusters"
Speaker: Erwin Lau (Yale U)
Date: Jan 11, 2017

30. "Observable properties of accretion disks in Kerr spacetimes"
Speaker: Frederico Garcia (Institute of Radioastronomy, Argentina)
Date: Jan 12, 2017

31. "K-HA/CoHA of the stack of Higgs sheaves on a curve"
Speaker: Francesco Sala (Kavli IPMU)
Date: Jan 12, 2017

32. "Peculiar Type Ia Supernovae - An Observational Perspective"
Speaker: Devendra Sahu (IIAP)
Date: Jan 13, 2017

33. "Collapsar Model of Gamma Ray Bursts with MHD"
Speaker: Gary Lowe (Montana State U)
Date: Jan 16, 2017

34. "Global properties of gauge theories via M-Theory"
Speaker: Susanne Reffert (U Bern)
Date: Jan 17, 2017

35. "Compensating strong coupling with large charge"
Speaker: Domenico Orlando (U Bern)
Date: Jan 17, 2017

36. "Spherical symmetry of the bounce solution"
Speaker: Ryosuke Sato (Weizmann Institute)
Date: Jan 18, 2017

37. "Life and Death of the First Stars"
    Speaker: Alexander Heger (Monash U)
    Date: Jan 18, 2017
38. "A Tale of Three Lenses: From Galaxy Structure to Cosmology"
    Speaker: Kenneth Wong (NAOJ)
    Date: Jan 19, 2017
39. "Double Bruhat cells, clusters and maximal green sequences"
    Speaker: Milen Yakimov (Louisiana State U)
    Date: Jan 25, 2017
40. "Painlevé equations and AGT correspondence"
    Speaker: Antonio Sciarappa (KIAS)
    Date: Jan 27, 2017
41. "1. Production of high stellar-mass primordial black holes in trapped inflation / 2. Axion Dark Matter Induced Cosmic Microwave Background B-modes"
    Speaker: Kin-Wang Ng (Academia Sinica)
    Date: Jan 27, 2017
42. "(0,2) hybrid models"
    Speaker: Marco Bertolini (Kavli IPMU)
    Date: Jan 31, 2017

Changes to Principal Investigators

The Kavli IPMU was launched as a WPI center, the Institute for the Physics and Mathematics of the Universe (IPMU), on October 1, 2007, and renamed as the Kavli IPMU following an endowment from the Kavli Foundation in 2012. At the end of March, 2017 (end of fiscal 2016 in Japan), the initial 10 years (effectively, 9.5 years) of funding under the WPI Program expires, and a 5-year extension of funding for the Kavli IPMU will starts from the beginning of FY 2017. On this occasion, some of the Kavli IPMU's Principal Investigators (PIs) step down, and the number of PIs, including many younger researchrs, will increase from 19 to 26.

PIs who step down at the end of March, 2017
(Their position at the Kavli IPMU after April 1 is shown in parentheses.)
Ken'ichi Nomoto (Senior Scientist)
Kyoji Saito (Senior Scientist)
Henry Sobel
Yoichiro Suzuki (Deputy Director, Project Professor)
Tsutomu Yanagida (Project Professor)

New PIs from the beginning of April, 2017
(Their position is shown in parentheses.)
Kentaro Hori (Professor)
Mikhail Kapranov（Professor）
Young-Kee Kim (Chicago University Professor)
Eiichiro Komatsu (Max Planck Institute for Astrophysics Director)
Kai Martens（Associate Professor）
Shigeki Matsumoto (Associate Professor）
Shigetaka Moriyama (University of Tokyo's Institute for Cosmic Ray Research Associate Professor)
Yasunori Nomura (University of California, Berkeley Professor)
Masahiro Takada (Professor)
Yukinobu Toda (Associate Professor）
Mark Vagins（Professor）
Naoki Yoshida (University of Tokyo's School of Science/Kavli IPMU Professor)

List of PIs who continue to serve
Hiroaki Aihara, Alexey Bondal, Kunio Inoue, Takaaki Kajita, Stavros Katsanevas, Masahiro Kawasaki, Toshiyuki Kobayashi, Toshitake Kohno, Hitoshi Murayama, Masayuki Nakahata, Mihoko Nojiri, Hirosi Ooguri, David Spergel, and Naoshi Sugiyama.

Personnel Changes

Moving Out

The following people left the Kavli IPMU to work at other institutes. Their time at the Kavli IPMU is shown in square brackets.

Kavli IPMU Postdoctoral Fellow Yalong Cao [August 1, 2016 – March 31, 2017] moved to the University of Oxford as a Newton International Fellow.

Kavli IPMU Postdoctoral Fellow Dongmin Gang [October 1, 2014 – March 31, 2017] moved to Seoul National University as a Postdoctoral Fellow.

Kavli IPMU Postdoctoral Fellow Song Huang [August 1, 2014 – February 14, 2017] moved to the University of California, Santa Cruz as a Postdoctoral Fellow.

Kavli IPMU Postdoctoral Fellow Ilya Karzhemanov [November 1, 2013 – January 31, 2017] moved to Moscow Institute of Physics and Technology as an Associate Professor.

Kavli IPMU Postdoctoral Fellow Yoshiki Oshima [April 1, 2013 – August 31, 2013 and September 1, 2014 – March 31, 2017] moved to the Graduate School of Information Science and Technology, Osaka University as an Associate Professor.

JSPS Postdoctoral Fellow Koji Ichikawa [April 1, 2016 – March 31, 2017] moved to NEC Corporation as a Researcher.

JSPS Postdoctoral Fellow Maresuke Shiraishi [April 1, 2015 – March 31, 2017] moved to National Institute of Technology, Kagawa College (Kagawa KOSEN) as an Assistant Professor.

Also, Kavli IPMU Postdoctoral Fellow Tirasan Khandhawit resigned the Kavli IPMU at the expiration of his term, from September 1, 2013 to August 31, 2016, and September 16, 2016 to January 15, 2017.