

News

Hiroshi Ooguri Awarded the 2018 Hamburg Prize for Theoretical Physics

On May 24, 2018, it was announced that Hiroshi Ooguri, Director of the California Institute of Technology's Walter Burke Institute for Theoretical Physics and Kavli IPMU Principal Investigator, has been awarded the 2018 Hamburg Prize for Theoretical Physics. This prize is awarded by the Joachim Herz Stiftung in partnership with the University of Hamburg and Deutsches Elektronen-Synchrotron (DESY). This is the first year the prize covers all areas of theoretical physics (previously it was given to theorists in quantum information, quantum optics, and quantum many-body systems). With a new endowment established for the prize, the prize money has been increased from 40,000 euros to 100,000 euros, making it one of the most valuable science prizes in Germany. The award ceremony will be held on November 7, 2018 at Planetarium Hamburg.



Hiroshi Ooguri

MEXT Deputy Minister Yoichi Ito Visits Kavli IPMU

On June 13, 2018, Deputy Minister of MEXT (Ministry of Education,

Culture, Sports, Science and Technology) Yoichi Ito visited the University of Tokyo's Kashiwa campus, accompanied by two MEXT officials. They arrived at the Kavli IPMU during its daily tea time break. There, they listened to Kavli IPMU Director Hitoshi Murayama as he introduced the institute, and talked to a number of researchers (see photo on p. 3).

Construction of Fourth Layer Ladders of the Belle II Silicon Vertex Detector Completed

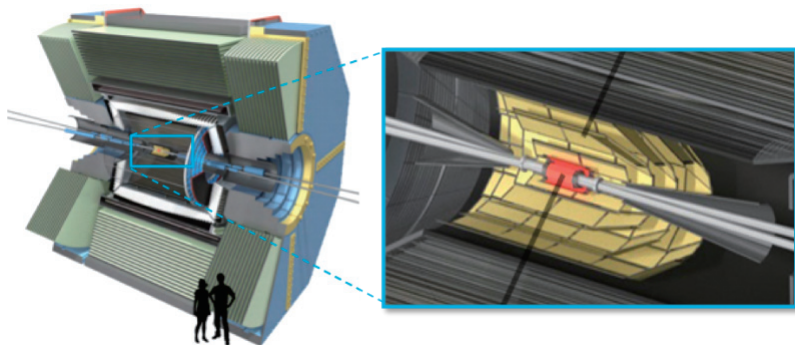
A group of researchers at the Kavli IPMU have been collaborating on the Belle II experiment to be conducted at the electron-positron collider SuperKEKB at KEK, and they have been constructing the fourth-layer "ladders" of the Silicon Vertex Detector (SVD). SVD is one of the seven different kinds of detectors that comprise the Belle II detector installed at the interaction point of SuperKEKB (see *Kavli IPMU News* No. 37, pp. 10 - 13).

SVD can measure the points where charged particles pass through its active silicon layers with high precision. In the Belle II detector located at the collision point of the SuperKEKB, SVD functions as a part of the Vertex Detector (VXD) which measures the decay vertices of short-lived particles such as B mesons, produced

in electron-positron interactions. If new physics beyond the Standard Model of elementary particles exists, SVD will play a very important role because decays of these short-lived particles may show different features from those of the predictions of the Standard Model.

Belle II collaborators at the Kavli IPMU started R&D for the construction of SVD fourth-layer ladders in 2011. They successfully constructed the memorable "final mockup ladder" in January 2016, and confirmed the completeness of all the ladder construction processes. In March 2016, they completed a prototype ladder with full electrical functions. In May 2016 they started construction of the ladders, and as of May 24, 2018, they successfully completed 16 ladders plus 3 spare ladders.

Starting in February 2016, the beam commissioning of SuperKEKB has been proceeding in three phases. The Belle II detector was "rolled-in" to the collision point of SuperKEKB in spring 2017, after Phase 1 commissioning without beam collisions. On March 19, 2018, Phase 2 commissioning started aiming at stable accumulation of the electron and positron beams, and the Belle II detector observed the first electron-positron collision event on April 26. The Phase 2 commissioning



The SVD will be placed at the center of the Belle II detector. At the very center, colored in red, is the pixelated silicon detector. The surrounding yellow components are the four layers making up the SVD. Kavli IPMU researchers built the fourth outermost layer. A part of the facilities at Kavli IPMU was also used by Indian researchers to build the second layer of the SVD. (Credit: Belle II Collaboration / Rey Hori.)

of SuperKEKB will be continued until July with Belle II detector taking data.

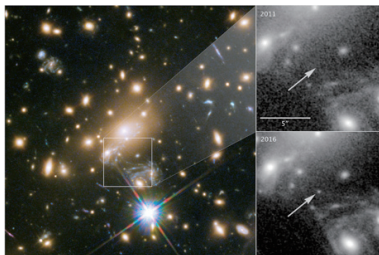
The fourth layer ladders of SVD which Kavli IPMU constructed are scheduled to be installed, together with ladders of the other layers, inside SuperKEKB in December this year after tuning and performance tests at KEK. The Phase 3 commissioning is expected to start in February 2019. In this phase, Belle II will take physics data with all kinds of detectors comprising the Belle II detector in operation, and real physics data analysis will begin.

Farthest Star Ever Seen in the Universe Detected

An international team of researchers, led by Patrick Kelly of the University of Minnesota, and including the University of Tokyo School of Science Assistant Professor and Kavli IPMU Associate Scientist Masamune Oguri, successfully observed the most distant individual star, 9 billion light years away from the Earth.

Except very near galaxies, it is usually impossible to spot individual stars in a galaxy because of the limitations in the sensitivities and resolutions of telescopes. However, since a gravitational lens can focus and magnify distant objects, in principle it would provide a means to overcome these limitations to observe a distant individual star.

While originally observing galaxy



Icarus capture by the Hubble Space Telescope. The left image shows galaxy cluster MACS J1149+2223 and the position of Icarus. The top right image shows how Icarus was not visible in 2011, and became visible in 2016. (Credit: NASA/ESA/P. Kelly)

cluster MACS J1149+2223, 5 billion light years away, using the Hubble Space Telescope, the researchers noticed a flickering light in a 9-billion-light-year distant galaxy in the background. Closer analysis revealed that the light was not from a star exploding at the end of its life, but a blue star with its brightness magnified by a gravitational lens. They have named it Icarus. These results were published in the April 3 issue of *Nature Astronomy*.

In addition to providing precious information regarding stars comprising distant galaxies, it also turned out that the discovery of Icarus is important for researchers studying dark matter, which constitutes most of the total mass in the Universe. Detailed theoretical analysis about it is reported by M. Oguri et al. in *Physical Review D* **97** (2018) 023518.

It is expected that many more magnified stars will be discovered when the upcoming James Webb Telescope becomes operational, and when they do so, they will be able to provide more insight into the stars comprising distant galaxies and the properties of dark matter.

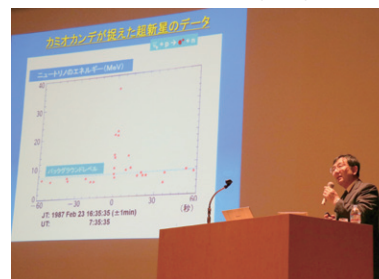
18th Kavli IPMU-ICRR Joint Public Lecture

On April 14, 2018, the Kavli IPMU and ICRR jointly held the 18th joint public lecture at Amuser Kashiwa in Kashiwa City, Chiba Prefecture with the catchphrase “Exploring Particles, Describing the Universe with Particles.” There was an audience of 333 people including junior high-school and high-school students.

After the opening address by ICRR Director and Kavli IPMU Principal Investigator Takaaki Kajita, the first lecture, entitled “Super-Kamiokande: The Forefront of Supernova Neutrino

Observations,” was given by ICRR’s Kamioka Observatory Director and Kavli IPMU Principal Investigator Masayuki Nakahata. He talked about the world’s first observation of supernova neutrinos by Kamiokande in 1987, when SN1987A appeared. He then explained that a countless number of supernova explosions have occurred throughout the history of the Universe, and spoke about experimental projects which attempt to observe diffuse supernova neutrinos originating from past supernova explosions.

The second lecture was given by Kavli IPMU Assistant Professor Satoshi Shirai. He talked about “Naturalness: Unnatural Nature Explored by the LHC Experiments.” First he explained what “phenomenology” is, and mentioned the Standard Model of elementary particles which is often referred to as a successful example. Then he talked about how the Standard Model failed to explain some phenomena such as neutrino mass. In particular, he stressed that the mass of the Higgs boson is quite unnatural and theoretical studies are ongoing,



Masayuki Nakahata, giving a talk.



Satoshi Shirai, giving a talk.

assuming new physics which would resolve this unnaturalness. He also mentioned that experimental results from the LHC at CERN are greatly anticipated as powerful tools for probing new physics.

After the lectures, a discussion was held between the lecturers. The audience was then invited to the foyer of the hall to chat with the lecturers, and many of them eagerly asked questions.

Kavli IPMU Public Lecture “Universe × World”

On June 10, 2018, the Kavli IPMU hosted a public lecture “Universe × World” at the Miraikan Hall of the National Museum of Emerging Science and Innovation (Miraikan) in Odaiba, Tokyo, where 215 people attended the lectures delivered by Yasunori Nomura, Professor of Physics at the University of California, Berkeley and Principal Investigator at the Kavli IPMU, and Markus Gabriel, Professor of Philosophy at the University of Bonn.

First, Professor Nomura gave a lecture entitled “Beyond the Universe.” He pointed out the fact that our Universe is too good for our existence because there is a huge difference between the vacuum energy of our Universe and its theoretical expectation. Then, he talked about how string theory and the inflationary theory of cosmology suggest that the “multiverse” cosmology, which predicts the existence of many universes other than our Universe, is a promising hypothesis. He went on to talk about a quantum many-worlds interpretation of the multiverse: many worlds exist quantum mechanically in probability space. He concluded that our presence is insignificant, but we can understand Nature.

The next lecture, entitled “Universe, World, and Reality” was given by Professor Gabriel, who is known as the author of *Why the World Does Not Exist* (Polity Press, Cambridge, UK, 2015, translated by Gregory Moss). He began with the comment that it is no coincidence that Nomura’s depiction of the “multiverse” and his idea of the philosophical logical space have a similar form. Gabriel’s talk presented his negative proposal that the world does not exist by rejecting three conceptions of the world. He then went on to present his positive proposal that reality is a meshwork of locally overlapping fields of sense without a global context of all contexts.

Afterward, the lecturers exchanged opinions about reductionism and determinism from the viewpoints of physics and philosophy, respectively. The event ended with conversations between the lectures and the audience, and the lecturers were surrounded with many inquiries.



Yasunori Nomura (left) and Markus Gabriel (right).

Public Lecture “Gravitational Waves and Universe’s Dark Components: Forefront of Observational Cosmology”

On June 17, 2018, the Kavli IPMU and Grant-in-Aid for Scientific Research on Innovative Areas “Why does the Universe accelerate? – Exhaustive study and challenge for the future–” (Kavli IPMU Director Hitoshi Murayama acting as Principal Investigator) cohosted a public lecture

“Gravitational Waves and Universe’s Dark Components: Forefront of Observational Cosmology” at Koshiba Hall on the University of Tokyo’s Hongo campus. The venue was filled to capacity with 196 audience members including junior high-school and high-school students.

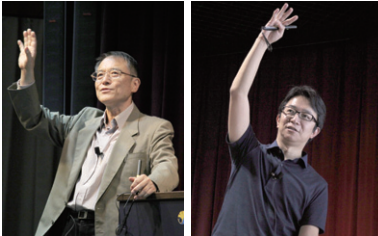
The first lecture was given by Kavli IPMU Deputy Director Misao Sasaki. He spoke on “The dawn of gravitational wave astronomy.” He started from the results of the gravitational wave signal detections from a binary black hole merger and colliding neutron stars, both observed by the group of scientists at the Laser Interferometer Gravitational-Wave Observatory (LIGO) in the United States. He then talked about the impacts which these results have had on astronomy and cosmology. He also mentioned the LiteBIRD project, which, led by Kavli IPMU, aims at detecting primordial gravitational waves imprinted in a primordial B-mode component of the cosmic microwave background through multiple frequency measurements. He concluded his talk by presenting the future of gravitational wave observations.

Kavli IPMU Principal Investigator Masahiro Takada then spoke on “Dark Components of the Universe Probed by Subaru.” He started his talk by talking about how our Universe is filled with dark matter and dark energy which together are called “dark components,” and introduced Hyper Suprime-Cam (HSC) to be mounted on the Subaru Telescope in Hawaii. He told that it is expected to be a powerful tool to investigate these mysterious dark components.

He further talked about how gravitational lensing is a particularly effective means to investigate dark

matter, and, as a recent achievement obtained by using gravitational lens effects and HSC, that the observed results greatly constrained a theory which proposes the possibility of dark matter being composed of primordial black holes.

Finally, there was a discussion between the lecturers and the audience, and the event ended as a great success.



Misao Sasaki (left) and Masahiro Takada (right) .

Kavli IPMU Seminars

1. "What is strong lensing good for? — two aspects of this question"
Speaker: Xuheng Ding (Beijing National U)
Date: Jan 30, 2018
2. "Majorana neutrino in seesaw mechanism and Bogoliubov quasiparticle"
Speaker: Kazuo Fujikawa (Riken)
Date: Jan 31, 2018
3. "The Astrophysics of BH-BH/NS-NS Mergers with LIGO/Virgo"
Speaker: Chris Belczynski (Warsaw U)
Date: Feb 06, 2018
4. "6d SCFTs and AdS₃×S³×B holography"
Speaker: Hee Cheol Kim (POSTECH)
Date: Feb 06, 2018
5. "The Three Pillars of Supersymmetry"
Speaker: Jason Evans (KIAS)
Date: Feb 07, 2018
6. "Simulating structure formation in different environments and the application"
Speaker: Chi-Ting Chiang (Stony Brook U)
Date: Feb 07, 2018
7. "The Square Kilometre Array: understanding the history of the Universe"
Speaker: Phil Diamond (SKA Director-General)
Date: Feb 08, 2018
8. "Resummed Photon Spectra for WIMP Annihilation"
Speaker: Ian Mould (UC Berkeley)
Date: Feb 09, 2018
9. "HKR theorems in analytic geometry"
Speaker: Mauro Porta (U Strasbourg)
Date: Feb 13, 2018
10. "Implications of the mixed B – L anomaly"
Speaker: Archil Kobakhidze (U Sydney)
Date: Feb 21, 2018
11. "Using sheaf techniques to construct structures on categories"
Speaker: Alex Takeda (UC Berkeley)
Date: Feb 22, 2018
12. "The Vertex Algebra Vertex"
Speaker: Miroslav Rapcak (Perimeter)
Date: Feb 27, 2018
13. "The Frobenius structure conjecture in dimension two"
Speaker: Tony Yue-Yu (Laboratoire de Mathematiques d'Orsay, Universite Paris-Sud)
Date: Feb 27, 2018
14. "The CALorimetric Electron Telescope (CALET) on the International Space Station: Results from the First Two Years of Operation"
Speaker: Shoji Torii (Waseda U)
Date: Feb 28, 2018
15. "Measuring BAOs with cosmic voids"
Speaker: Francisco-Shu Kitaura (U La Laguna)
Date: Mar 01, 2018
16. "Little Conformal Symmetry and Neutral Naturalness"
Speaker: Rachel Houtz
Date: Mar 05, 2018
17. "On double covers and their degenerations"
Speaker: Patricio Gallardo (U Washington)
Date: Mar 06, 2018
18. "G-Hilb and crepant resolutions of certain abelian orbifolds in dimension 4"
Speaker: Sara Muhvic (Warwick U)
Date: Mar 06, 2018
19. "Brane bricks and mirror symmetry for hypersurfaces"
Speaker: Benjamin Gammage (UC Berkeley)
Date: Mar 07, 2018
20. "Interpretation of electromagnetic counterpart to a neutron star merger GW170817"
Speaker: Kenta Hotokezaka (Princeton U)
Date: Mar 07, 2018
21. "Crepant resolution and the McKay correspondence"
Speaker: Yukari Ito (Kavli IPMU / Nagoya U)
Date: Mar 08, 2018
22. "The muon $g_{\mu} - 2$ in the Earth's gravity"
Speaker: Takahiro Morishima (Nagoya U)
Date: Mar 09, 2018
23. "Neutron-Antineutron Oscillations and Discrete Symmetries"
Speaker: Arkady Vainshtein (U Minnesota)
Date: Mar 14, 2018
24. "Observational properties of stripped-envelope supernovae and constraints on their progenitors"
Speaker: Danfeng Xiang (Tsinghua U)
Date: Mar 15, 2018
25. "Insensitivity of bulk properties to the twisted boundary condition"
Speaker: Haruki Watanabe (U Tokyo)
Date: Mar 16, 2018

26. "Search for Axion Like Particles using Laue-case Conversion in a Single Crystal"
Speaker: Tomohiro Yamaji (U Tokyo)
Date: Mar 16, 2018
27. "Introduction to derived algebraic geometry"
Speaker: Gabriele Vezzosi (U Firenze)
Date: Mar 20, 2018
28. "Magnetar Models for Superluminous Supernovae"
Speaker: Andrey Zhiglo (Kharkov Inst of Physics and Technology, Ukraine)
Date: Mar 20, 2018
29. "Symplectic and Poisson structures in derived algebraic geometry"
Speaker: Bertrand Toen (U Toulouse)
Date: Mar 20, 2018
30. "Co-evolution of galaxies and the multi-scale cosmic web: from predictions to observations"
Speaker: Clotilde Laigle (U Oxford)
Date: Mar 22, 2018
31. "The geometry of the cyclotomic trace"
Speaker: Aaron Mazel-Gee (U Southern California)
Date: Mar 22, 2018
32. "Clustering Distortions from Lyman-alpha Radiative Transfer"
Speaker: Chris Byrohl (MPA)
Date: Mar 23, 2018
33. "Quantum groups and monodromy"
Speaker: Andrea Appel (U Edinburgh)
Date: Mar 27, 2018
34. "Asymptotic geometry of monopole moduli space and the Sen Conjecture"
Speaker: Michael Singer (U College London)
Date: Mar 27, 2018
35. "Neutrino Mixing and CP Violation from Discrete Flavour Symmetries"
Speaker: Arsenii Titov (Durham U)
Date: Mar 28, 2018
36. "A geometric realization of the quantum enveloping algebra associated with the circle"
Speaker: Francesco Sala (Kavli IPMU)
Date: Mar 29, 2018
37. "Predicting neutrino CP violation in the minimal seesaw"
Speaker: Morimitsu Tanimoto (Niigata U)
Date: Mar 30, 2018
38. "Search for Dark Neutrino via Vacuum Magnetic Birefringence Experiment"
Speaker: Kimiko Yamashita (National Tsing Hua U)
Date: Apr 04, 2018
39. "What is Nature Astronomy and how do I get published in it?"
Speaker: Marios Karouzos (Nature Astronomy)
Date: Apr 04, 2018
40. "Planet Nine from Outer Space"
Speaker: Konstantin Batygin (Caltech)
Date: Apr 10, 2018
41. "Witten, Cardy, and the Holonomy Saddle"
Speaker: Piljin Yi (KIAS)
Date: Apr 10, 2018
42. "The quest for the origin of neutrino masses"
Speaker: Josu Hernandez (SISSA)
Date: Apr 11, 2018
43. "The Search for Planet Nine"
Speaker: Mike Brown (Caltech)
Date: Apr 11, 2018
44. "Letting the Data Speak for Themselves: What Observations Tell Us About Galaxy Formation"
Speaker: Neal Katz (U Massachusetts)
Date: Apr 12, 2018
45. "Energy-momentum tensor from the Yang-Mills gradient flow"
Speaker: Hiroshi Suzuki (Kyusyu U)
Date: Apr 12, 2018
46. "Topologically twisted index on Riemann surface and Bethe ansatz of q-boson"
Speaker: Yutaka Yoshida (Kavli IPMU)
Date: Apr 12, 2018

47. "Galaxy clustering: an effective field theory approach"
Speaker: Fabian Schmidt (MPA)
Date: Apr 13, 2018
48. "Making Galaxy Formation Great Again"
Speaker: Neal Katz (U Massachusetts)
Date: Apr 17, 2018
49. "Quantum Spectral Curve (QSC) for bi-scalar fishnet theory"
Speaker: David Grabner (King's College London)
Date: Apr 17, 2018

Personnel Changes

Changes of Deputy Directors

Misao Sasaki was appointed to Kavli IPMU Deputy Director on April 1, 2018.

Kavli IPMU Professor Yoichiro Suzuki stepped down as Kavli IPMU Deputy Director on March 31, 2018.

Appointment of a New PI

Kavli IPMU Professor Tadayuki Takahashi was appointed to a Kavli IPMU Principal Investigator on April 1, 2018.

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 William Donovan [November 1, 2014 – May 31, 2018] moved to Yau Mathematical Sciences Center, Tsinghua University in China as a tenure-track Assistant Professor.

Kavli IPMU Postdoctoral Fellow Anupreeta More [September 1, 2012 – June 30, 2018] moved to Inter-University Center for Astronomy and Astrophysics in India as a Data Scientist.