

# News

## FY2018 WPI Site Visit

The FY2018 WPI site visit team visited Kavli IPMU's Kamioka Branch on July 11. The next day, they visited Kavli IPMU's research building on the University of Tokyo's Kashiwa campus, and on July 13, the site visit continued at the Crest Hotel Kashiwa near JR Kashiwa station (see photos on p. 3).

The site visit team to the Kamioka Branch consisted of ten members: WPI Program Director (PD) Akira Ukawa, WPI Academy Director (AD) Toshio Kuroki, Program Officer (PO) in charge of the Kavli IPMU Ichiro Sanda, members of the Working Group in charge of the Kavli IPMU (Tetsuji Miwa, Kaoru Ono, Matthias Staudacher, and Anthony Tyson), POs in charge of other WPI institutes (Shoken Miyama and Akihiko Nakano), and Director, Office for the Promotion of Basic Research, Basic Research Promotion Division, Research Promotion Bureau of MEXT (Ministry of Education, Culture, Sports, Science and Technology) Tadatoshi Kaneko. Director of Kavli IPMU Hitoshi Murayama, Director of the Kamioka Observatory, Institute for Cosmic Ray Research and Principal Investigator (PI) of Kavli IPMU Masayuki Nakahata, and other researchers reported research activities at the Kamioka

Branch and guided them to Super-Kamiokande and, in particular, the inside of its detector tank which was open for refurbishment work, the EGADS experiment (see pp. 10-13), and the XMASS experiment.

For the site visit to Kashiwa on July 12 and 13, five members joined (Deputy PD Minoru Yoshida, WPI Program Committee member Kiyoshi Kurokawa, JSPS (Japan Society for Promotion of Science) Executive Director Yasuhiro Iye, members of the Working Group in charge of the Kavli IPMU Akira Iso and Ian Shipsey), while PO Akihiko Nakano was absent, so the site visit team consisted of 14 members. They listened to Director Murayama's overview presentation and presentations by Kavli IPMU researchers on their research accomplishments. In the final session, the members of the site visit team gave their comments, and the site visit was concluded.



On July 12, the site visit team and Kavli IPMU researchers gathered for informal discussion at a poster session held in the Fujiwara Hall at the Kavli IPMU Building.

## UC Santa Cruz Chancellor Visits Kavli IPMU

On August 20, 2018, Chancellor George Blumenthal of the University of California at Santa Cruz (UCSC) visited the Kavli IPMU, accompanied by Associate Chancellor Ashish Sahnii and Assistant Vice Provost of Global Engagement Becky George (see photo on p. 3).

As UCSC is one of the premier institutions in the US in astronomy,

astrophysics, and physics, and Chancellor Blumenthal himself is an astrophysicist, they are interested in Director Murayama's presentation on research activities at the Kavli IPMU. There was also a discussion session between visitors and leading Kavli IPMU researchers, and agreement was reached on boosting exchanges of researchers at all levels, from undergraduate to faculty.

## Kavli IPMU Researchers and Administrative Staff Members Visited Super-Kamiokande

The water tank of the Super-Kamiokande (SK) detector was opened in June 2018 for the first time in twelve years, in order to refurbish the detector by adding gadolinium to the pure water in the detector to improve neutron detection efficiency as a result of successful R&D through the EGADS experiment. On this occasion, the Institute for Cosmic Ray Research, which operates SK, kindly arranged opportunities for Kavli IPMU researchers and administrative staff to visit and look at the inside of the beautiful SK detector on an elevating gondola for work on July 20 and August 7, in addition to the WPI site visit team on July 11 and the Kavli IPMU Steering Committee on August 1 (see photo on p. 3).

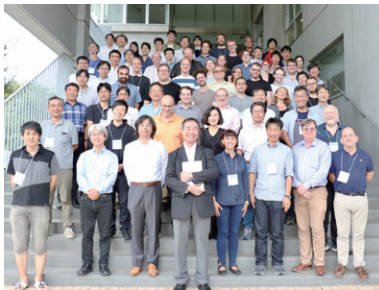
## An Encouraging Step Forward for the Hyper-Kamiokande Project

On September 9-13, 2018, the 7th Hyper-Kamiokande (HK) Proto-Collaboration Meeting was held at the Kavli IPMU.

The HK is an international project led by Japan to construct a huge water-Cherenkov detector with a fiducial mass 10 times larger than that of the highly successful Super-Kamiokande, aiming at further

developments in neutrino physics. At the University of Tokyo, the Institute for Cosmic Ray Research (ICRR), the Kavli IPMU and the School of Science partnered to launch the Next-Generation Neutrino Science Organization last year for the advancement of the HK project.

On September 12, the participants of the Meeting heard a very encouraging report from a guest speaker, Director-General of the Research Promotion Bureau of MEXT Keisuke Isogai, that MEXT allocated seed funding toward construction of the HK within its FY 2019 budget request to the Ministry of Finance. Subsequently, ICRR Director Takaaki Kajita introduced a statement from the President of the University of Tokyo, Makoto Gonokami, about the University of Tokyo's decision to start construction of the HK detector in April 2020. From past experience, it is expected that once the seed funding is approved, it will lead to approval of full funding the following year. Even before funding is confirmed, however, the statement indicates the University of Tokyo's firm determination.



Participants of the seventh Hyper-Kamiokande Proto-Collaboration Meeting.

### Beginning of HSC's Precision Cosmology Towards Elucidating Dark Components of Universe

Led by Kavli IPMU Assistant Professor Chiaki Hikage, a team of researchers from institutes including the University of Tokyo, the

National Astronomical Observatory of Japan, Nagoya University, Princeton University, and Academia Sinica Institute of Astronomy and Astrophysics (ASIAA) has successfully observed the distortion of images of about 10 million galaxies caused by the "weak" gravitational lensing effect from the distribution of dark matter in the Universe, based on about 90 nights of HSC data covering about 140 square degrees of sky (the area of about 3000 full moons). As the Subaru Telescope and a wide angle camera HSC is the world's best combination to conduct a wide imaging survey of galaxies in the distant and dark Universe, these results imply observation of the structures of the most distant (therefore, earliest) Universe in the weak gravitational lensing measurements conducted to date.

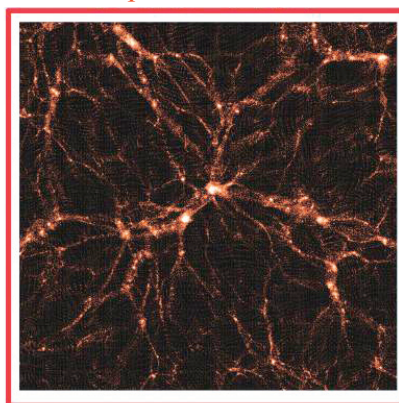
The researchers analyzed these results and deduced a physical parameter indicating the fluctuations or clumpiness of the matter distribution today. It is a key parameter that describes how the structures in the Universe grew after the Big Bang into the galaxies and

stars we see today. If the structure of the Universe is more evolved, there are more galaxies, for example. The results of the clumpiness of the matter distribution from HSC observations of the distant Universe using weak gravitational lensing are consistent with results from other similar observations (Dark Energy Survey (DES) and Kilo Degree Survey (KiDS)) of slightly nearby Universe.

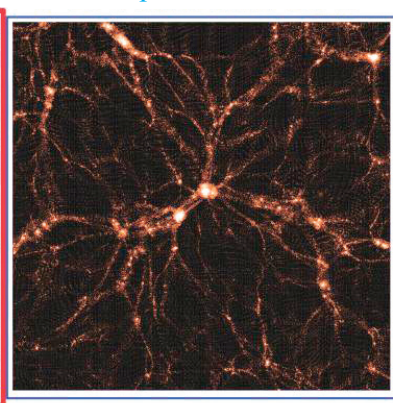
These results are also statistically consistent with the prediction from the observation of the cosmic microwave background in the very early Universe by the Planck satellite of the European Space Agency. Therefore, the HSC results are consistent with the simplest cosmological model, which is supported by the Planck observation, and predicts that the present Universe is dominated by dark matter and dark energy, and that dark energy behaves like Einstein's cosmological constant.

However, taken together the results from weak lensing surveys prefer a slightly smaller value of clumpiness of the matter distribution today than that predicted by the Planck satellite. The figure shows

HSC preferred universe



Planck preferred universe



The weak lensing surveys such as HSC prefer a slightly less clumpy Universe than that predicted by Planck. The pictures show the slight but noticeable difference as expected from large computer simulations. Is this difference a statistical fluctuation? Astronomers all around the world continue to collect more and more data to answer this question. (Image Credit: Kavli IPMU / Takahiro Nishimichi.)

simulation results of the formation of cosmological structures for two cosmological models. Although there are only slight differences, the Planck preferred universe seems clumpier than the HSC preferred universe.

This could just be a statistical fluctuation due to the limited amount of data available, or might be a signature of the breakdown of the standard model of the Universe, based on General Relativity and the cosmological constant. The HSC survey is ongoing, and these HSC results come from a mere one-tenth of the final survey. Upon completion, the survey will put considerably tighter constraints on cosmological parameters, deepening our understanding and further testing our understanding of both dark matter and dark energy.

The report of this research appeared in a preprint server on September 26 (<https://arxiv.org/abs/1809.09148>), and was submitted to *Publications of the Astronomical Society of Japan*. Also, the results of this research were released at a press conference held on September 20.

#### Science Café in English: Universe 2018

Every year, Kavli IPMU and the Tamarokuto Science Center co-host “Science Café Universe” at the Tamarokuto Science Center in Nishi-Tokyo City, and Science Café 2018 is the 10th of this series. Following Science Café Universe 2017, this year two Kavli IPMU postdoctoral fellows again delivered a lecture in English with no Japanese interpretation. Each time, there were about 30 attendees including junior high school and high school students.

On July 8, Matthias Weissenbacher gave the first lecture entitled

“Quantum Strings and the Vacuum Structure of the Universe.” He explained the development of superstring theory, starting from its prehistory up to the present. Further, he introduced some experiments at the CERN LHC in which searches have been made to find effects related to superstring theory.



Matthias Weissenbacher, giving a lecture.

The second lecture entitled “Supernova: The cradle of chemical elements in the universe” was given by Shing Chi Leung on September 29. After talking about how many of the elements that form our body have been produced in supernova explosions, he carefully explained different kinds of supernova explosions and their mechanisms, with demonstrations using a balloon and a tennis ball.



Shing Chi Leung, giving a lecture.

#### Booth at the 2018 Super Science High School Student Fair

On August 8 and 9, the 2018 Super Science High School Student Fair was held at the Kobe International Exhibition Hall in Kobe, Hyogo Prefecture. The Kavli IPMU and other

10 WPI centers jointly ran a booth exhibiting their research activities.

#### Kavli IPMU Seminars

1. “miniTimbeCube: Building The World’s Smallest Neutrino Detector”  
Speaker: Viacheslav Li (Hawaii U)  
Date: Apr 20, 2018
2. “A logarithmic McKay correspondence and derived invariance for parabolic sheaves”  
Speaker: Mattia Talpo (Simon Fraser U)  
Date: Apr 24, 2018
3. “Noether inequality for algebraic threefolds”  
Speaker: Chen Jiang (Kavli IPMU)  
Date: Apr 26, 2018
4. “Yang-Baxter equations and symmetric groups”  
Speaker: Simon Wood (Cardiff U)  
Date: May 01, 2018
5. “Cohomological field theories from matrix factorizations”  
Speaker: Arkady Vaintrob (U Oregon)  
Date: May 08, 2018
6. “Maximally Supersymmetric AdS Solutions and their Moduli Spaces”  
Speaker: Severin Lust (Ecole Polytechnique)  
Date: May 08, 2018
7. “The impact of EDGES 21-cm data on dark matter interactions”  
Speaker: Yue-Lin Sming Tsai (Academia Sinica)  
Date: May 09, 2018
8. “Understanding the chemical enrichment pattern in the hot haloes of massive ellipticals, groups, and clusters of galaxies”  
Speaker: Francois Mernier (Eötvös-Loránd U)  
Date: May 11, 2018
9. “Introduction to Deep Learning for Basic Science”  
Speaker: Masato Taki (RIKEN)  
Date: May 16, 2018

10. "The power of high resolution X-ray spectroscopy: legacy from the Hitomi observatory"  
Speaker: Aurora Simionescu (JAXA)  
Date: May 16, 2018
11. "The Cosmic Microwave Background"  
Speaker: Mark Devlin (U Penn)  
Date: May 17, 2018
12. "Hodge-Tate conditions for Landau-Ginzburg models"  
Speaker: Yota Shamoto (Kavli IPMU)  
Date: May 17, 2018
13. "Systoles, Special Lagrangians, and Bridgeland stability conditions"  
Speaker: Yu-Wei Fan (Harvard U)  
Date: May 22, 2018
14. "Current status of MSSM Higgs bosons and future"  
Speaker: Biplob Bhattacharjee (Indian Inst of Science)  
Date: May 23, 2018
15. "The Planck Legacy Archive"  
Speaker: Marcos Lopez-Caniego (ESA)  
Date: May 23, 2018
16. "938 MeV dark matter, neutron decay, and neutron stars"  
Speaker: David McKeen (TRIUMF)  
Date: May 28, 2018
17. "A study of the stability manifold on an abelian threefold"  
Speaker: Dulip Piyaratne (U Arizona)  
Date: May 29, 2018
18. "What do we know about HI Cosmic Reionization? New Constraints from the High-z Lyman-Forest"  
Speaker: Jose Onorbe (U Edinburgh)  
Date: May 31, 2018
19. "E-infinity geometry and symmetric spectra"  
Speaker: Andrew Macpherson (Kavli IPMU)  
Date: May 31, 2018
20. "Fast Radio Bursts"  
Speaker: Vikram Ravi (Caltech)  
Date: Jun 05, 2018
21. "Telling the Story of Life in the Universe: The LUVOIR Mission Concept"  
Speaker: John O'Meara (St. Michael's College)  
Date: Jun 07, 2018
22. "Theories of Class F and Their Anomalies"  
Speaker: Craig Lawrie (U Heidelberg)  
Date: Jun 12, 2018
23. "Gamma-Ray Imaging Instrumentation in Oncology: Current Status, Challenges and Opportunities"  
Speaker: Lars Furenlid (U Arizona)  
Date: Jun 12, 2018
24. "Li Abundances in Extremely Metal-Poor Stars"  
Speaker: Tadafumi Matsuno (NAOJ)  
Date: Jun 15, 2018
25. "From Phase Space to Integrable Representations and Level-Rank Duality"  
Speaker: Arghya Chattopadhyay (IISER Bhopal)  
Date: Jun 19, 2018
26. "New multiplets in four dimensional  $N=2$  conformal supergravity"  
Speaker: Subramanya Hegde (IISER Thiruvananthapuram)  
Date: Jun 20, 2018
27. "M/N and 1/N Anomalous Dimensions in Chern-Simons theory"  
Speaker: V. Guru Charan (Dayalbagh Educational Inst, Agra)  
Date: Jun 21, 2018
28. "Brain PET imaging in awake mice and its application to human disease models"  
Speaker: Hiroshi Mizuma (RIKEN-BDR)  
Date: Jun 21, 2018
29. "A Flexible Halo Model for the Intrinsic Alignment of Galaxies"  
Speaker: Duncan Campbell (Carnegie Melon U)  
Date: Jun 21, 2018
30. "Structure of higher genus Gromov-Witten invariants of the quintic 3-fold"  
Speaker: Yongbin Ruan (U Michigan)  
Date: Jun 21, 2018
31. "Verlinde/Grassmanian Correspondence"  
Speaker: Yongbin Ruan (U Michigan)  
Date: Jun 22, 2018
32. "Tests of modified gravity using galaxy clusters and gravitational wave observations using GW170817"  
Speaker: Shantanu Desai (IIT Hyderabad)  
Date: Jun 26, 2018
33. "On generalized cohomology theories of regular nilpotent Hessenberg varieties of type A"  
Speaker: Anatol Kirillov (RIMS)  
Date: Jun 26, 2018
34. "Creating matter-antimatter asymmetry from dark matter annihilations in scotogenic scenarios"  
Speaker: Debasish Borah (IIT Guwahati)  
Date: Jun 28, 2018
35. "New applications of gravitational lensing to probe dark matter substructure"  
Speaker: Liang Dai (IAS, Princeton)  
Date: Jun 28, 2018
36. "Modularity, resurgence, and the 3d-3d correspondence"  
Speaker: Sarah Harrison (McGill U)  
Date: Jul 02, 2018
37. "Galaxies and Dark Matter Seen Through a Gravitational Lens"  
Speaker: Mike Hudson (U Waterloo)  
Date: Jul 03, 2018
38. "Computation of flat structures with irrelevant (negatively



- weighted) directions”  
 Speaker: Konstantin Aleshkin (SISSA)  
 Date: Jul 03, 2018
39. “Duality Interfaces and the 4-simplex”  
 Speaker: Natalie Paquette (Caltech)  
 Date: Jul 03, 2018
40. “Alternative production mechanism of sterile neutrino dark matter”  
 Speaker: Takashi Toma (TUM)  
 Date: Jul 04, 2018
41. “Supersymmetric Bolt solutions and their free energy via susy localization”  
 Speaker: Chiara Toldo (KITP, UCSB)  
 Date: Jul 05, 2018
42. “Heavy (dynamical) axions”  
 Speaker: Pablo Quílez (UAM)  
 Date: Jul 06, 2018
43. “Integrability, correlation functions, and stringy WZW models”  
 Speaker: Alessandro Sfondrini (ITP, ETH Zurich)  
 Date: Jul 09, 2018
44. “Spontaneous CP breaking in QCD and the axion potential”  
 Speaker: Gabriele Veneziano (CERN/Collège de France)  
 Date: Jul 09, 2018
45. “First star formation with streaming velocities and Lyman-Werner radiation”  
 Speaker: Anna Schauer (U Heidelberg)  
 Date: Jul 10, 2018
46. “Cheshire Cat Resurgence in QM and QFT”  
 Speaker: Daniele Dorigoni (Durham U)  
 Date: Jul 10, 2018
47. “Bosonization and other exact dualities in 2+1 dimensions”  
 Speaker: Djordje Radicevic (Perimeter Inst)  
 Date: Jul 10, 2018

48. “Hunt for low mass diphoton resonance at LHC and Kaon factory”  
 Speaker: Kohsaku Tobioka (Stony Brook U)  
 Date: Jul 11, 2018
49. “Parametric approach for Dark Energy”  
 Speaker: Mariana Jaber (UNAM)  
 Date: Jul 11, 2018

## Personnel Changes

### Appointment of a New PI

Kavli IPMU Professor Hiraku Nakajima was appointed to a Kavli IPMU Principal Investigator on August 1, 2018.

### Promotion

Mark Hartz, who was Kavli IPMU Assistant Professor, became Kavli IPMU Associate Professor on August 1, 2018.



Mark Hartz

### 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 Associate Professor Surhud More [September 1, 2012 – February 28, 2014 as an IPMU postdoctoral fellow, then – February 28, 2018 as a Kavli IPMU Assistant Professor, and then – July 15, 2018 as a Kavli IPMU Associate Professor] moved to Inter-University Center for Astronomy and Astrophysics in India as an Associate Professor.

Kavli IPMU postdoctoral fellow Jiaxin Han [July 1, 2016 – August 31, 2018] moved to Shanghai Jiao Tong University as an Assistant Professor.

Kavli IPMU postdoctoral fellow Juliana Kwan [October 1, 2016 –

September 30, 2018] moved to Liverpool John Moores University as a postdoctoral fellow.

Kavli IPMU postdoctoral fellow Evangelos Routis [August 1, 2015 – September 30, 2018] moved to the Max Planck Institute for Mathematics as a postdoctoral fellow.

Kavli IPMU postdoctoral fellow Alessandro Sonnenfeld [September 1, 2015 – August 31, 2018] moved to the Leiden Observatory in The Netherlands as a postdoctoral fellow.

Kavli IPMU postdoctoral fellow Alexey Tolstov [April 1, 2014 – September 30, 2018] moved to The Open University of Japan as a researcher.

Kavli IPMU postdoctoral fellow Benda Xu [April 1, 2015 – August 19, 2018] moved to Tsinghua University as an Assistant Professor.

Kavli IPMU postdoctoral fellow Itamar Yaakov [September 1, 2015 – August 31, 2018] moved to the University of Parma as a postdoctoral fellow.

Kavli IPMU postdoctoral fellow Louis Yang [October 1, 2017 – September 5, 2018] moved to Tubular Labs, Inc. as a Data Scientist II.

JSPS overseas postdoctoral researcher Mathew Murdoch [November 8, 2016 – July 26, 2018] moved to the University of Liverpool as a Royal Society of Edinburgh Enterprise Fellow.

### Erratum to *Kavli IPMU News* No. 39 (September 2017)

On page 12 of *Kavli IPMU News* No. 39, Hillary Child's title “Postdoc” should read “JSPS Overseas Researcher.” Her “Moving Out” information [*Kavli IPMU News* No. 41 (March 2018), page 29, right column] refers to her correct title.