April 2010–March 2011

IPMU

ANNUAL REPORT 2010

World Premier International Research Center Initiative

THE UNIVERSITY OF TOKYO

Todai Institutes for Advanced Study

IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

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History (April 2010–March 2011)

April
- Workshop "Recent advances in mathematics at IPMU II"
- Press Release "Shape of dark matter distribution"
- Mini-Workshop "Cosmic Dust"

May
- Shaw Prize to David Spergel
- Press Release "Discovery of the most distant cluster of galaxies"
- Press Release "An unusual supernova may be a missing link in stellar evolution"

June
- CL J2010: From Massive Galaxy Formation to Dark Energy
- Press Conference "Study of type Ia supernovae strengthens the case for the dark energy"

July
- Institut d'Astrophysique de Paris Medal (France) to Ken'ichi Nomoto
- IPMU Day of Extra-galactic Astrophysics Seminars: Chemical Evolution

August
- Workshop "Galaxy and cosmology with Thirty Meter Telescope (TMT)"

September
- Subaru Future Instrumentation Workshop
- Horiba International Conference COSMO/CosPA

October
- The 3rd Anniversary of IPMU, All Hands Meeting and Reception
- Focus Week "String Cosmology"
- Nishinomiya-Yukawa Memorial Prize to Eiichiro Komatsu
- Workshop "Evolution of massive galaxies and their AGNs with the SDSS-III/BOSS survey"
- Open Campus Day: Public lecture, mini-lecture and exhibits

November
- Yukawa-Kimura Prize to Tadashi Takayanagi
- Domenico Orlando and Susanne Reffert Selected for Highlights of Classical Quantum Gravity Journal
- PSJ Young Scientist Award to Fuminobu Takahashi
- Mini-Workshop "Neutrinos"
- Workshop "Population III Gamma-Ray Burst"

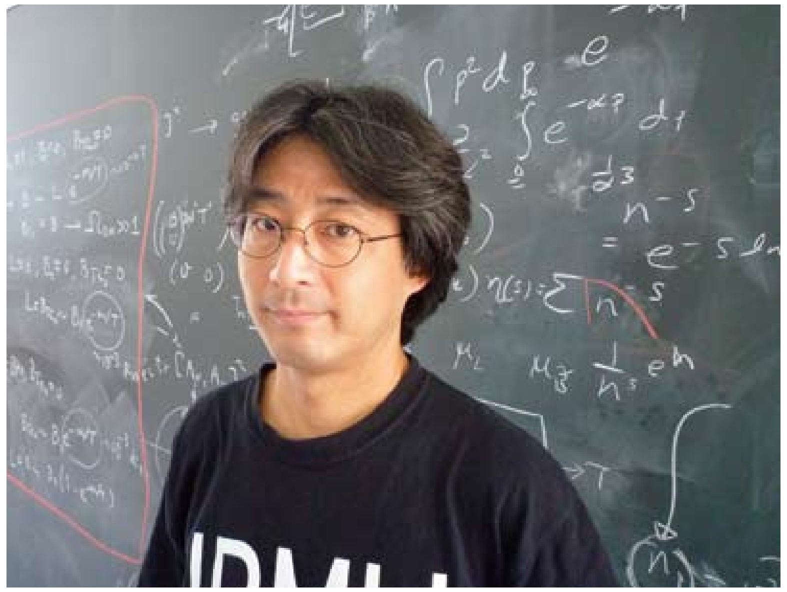
December
- Inoue Science Prize to Toshiyuki Kobayashi
- The 4th Meeting of Origin of Matter and Evolution of Galaxies Institute "Supernova Explosions and Nuclear-synthesis"
- Workshop "Science of Prime Focus Spectrograph (PFS)"

January
- Press Release "Sloan Digital Sky Survey III data release and IPMU contribution"
- IPMU as the first entity of Todai Institutes for Advanced Study (TODIAS)

February
- IPMU Workshop "Black Holes"
- Young Scientist Award in Theoretical Physics to Seong Chan Park
- Bruno Pontecorvo Prize to Yoichiro Suzuki and Serguey Petcov
- Workshop "Log Hodge Theory and Elliptic Flat Invariants"

March
- TODIAS Inauguration Lecture
- The 3.11 Earthquake. Interruptions and Comradeship

1 Mission



Hitoshi Murayama, IPMU Director

"Everything is made of atoms" had been the basic concept that had dominated our view of the universe for the past two centuries. The universe was made of atoms that obeyed quantum mechanics, and all gravity phenomena on earth and in the solar system were well-described by Einstein's general relativity.

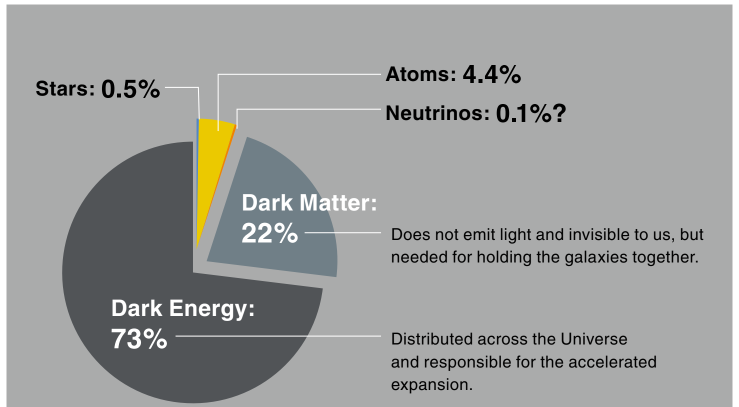
But the 1998 discovery that "the universe is expanding with an accelerated speed" has changed our entire understanding. Many researchers now believe that mysterious dark energy must be distributed across the universe and the cause of this acceleration.

It has been known for some time that the galaxies must contain large amount of invisible dark matter in order to hold their spiral shapes. But we do not know what they are.

An attempt to describe the early and still tiny universe faces other type of serious difficulty because quantum fluctuation becomes so enormous that theories of general relativity and quantum mechanics break down. Therefore, a necessity to combine quantum mechanics and general relativity, which has been a subject for fundamental understanding of elementary particles, also appears as we try to understand the beginning of the universe. Many researchers believe that superstring theory can solve this problem. But its whereabouts is still not known.

Our strategy to face these challenges is to bring the world top-level scientists in mathematics, physics and astronomy into one place. A close collaboration among those traditionally different research fields should induce a synergistic effect and develop into new ideas and new concepts.

It is essential to include mathematics in this approach. History teaches us that breakthrough in search for fundamental laws of nature was always built on the invention of new mathematics. Galileo, who lived at the dawn of cosmology in the 16 to 17th century, wrote that "The Universe is written in the language of mathematics." More than ever before, we need a close collaboration of mathematicians with astronomers and physicists in order to answer big questions of the universe we face today.



Composition of the universe

Composition of the universe
We knew only 5% of the universe!

We develop ultra-high resolution optical instruments, HyperSuprime Cam for collecting images and PrimeFocus Spectrograph for studying spectroscopy both with a large field of view, and attach to the Subaru telescope. Using "Gravitational Lensing Effect" we perform three-dimensional mapping of dark matter. Furthermore we explore the properties of dark energy by examining how the matter distribution varies with time.

We use three underground detectors: Super-Kamiokande to search for "supernova relic neutrinos" (neutrinos that are produced by ancient supernova explosions and wander through the present universe); XMASS to directly search for dark matter that must be present in our Milky Way Galaxy; KamLAND to look for an important but yet to be discovered neutrino-less double beta decay.

We study phenomenology in particle physics to explore physics beyond the Standard Model. Data from collider experiments and astrophysical observations are closely examined for any clue of dark matter candidates, extra dimensions, and other exotic phenomena.

Investigation of dark matter and dark energy requires further development of theory and mathematics. Superstring theory, which attempts to unify gNGK-barubu.c.inddeneral relativity and quantum theory and is considered as a candidate for the ultimate unified theory of elementary particles, requires further investigation of geometrical properties of the theory. At IPMU, mathematicians and physicists work closely on this problem. String theory, if indeed the ultimate theory, should give consistent answers to a wide subject in physics. String theorists at IPMU initiate active collaboration with condensed matter physicists of other institutions in the area such as superconductivity. Systematic investigation to apply superstring theory to particle physics phenomena such as low energy baryon physics is also pursued at IPMU.

Teatime is held everyday at 3 o'clock at the Piazza Fujiwara, where lively discussion takes place among researchers of different disciplines. This large open space that occupies the center of the IPMU building from the 3rd floor and up was designed to attract scientists and have free and informal interactions. The word of Galileo "The Universe is written in the language of mathematics" is inscribed on the obelisk at the center of the space.

Contents

2 Introduction

The biggest news for us in JFY 2010 came in January 2011. On 11th of January, the University of Tokyo established the Todai Institutes for Advanced Study (TODIAS), and approved IPMU as its first member-institute in this new and permanent organization.

The IPMU Director Hitoshi Murayama said, "I deeply thank President Hamada for his bold vision, Director Okamura for his involvement in kick-starting IPMU, and everybody in the Todai community for making the TODIAS possible. This is a critical step for IPMU to become a permanent member of the Todai community. Indeed this provides IPMU a "citizenship" within Todai, and a wonderful opportunity to continue its research on the fundamental questions about the Universe. The IPMU members and I will do our best to fulfill the expectations in TODIAS, and ask for your continued support."

IPMU was founded on October 1, 2007 by the World Premier International Research Center Initiative (WPI). The WPI funding has a term of 10 years, and mandates (1) world class research, (2) internationalization by adopting English as the official language and employing a large number of non-Japanese researchers, (3) scientific breakthroughs by fusion of disciplines, (4) new organizational structure unprecedented in Universities in Japan. This way, IPMU is required to achieve a high visibility to the worldwide scientific community.

"We are ushering in a time of great change. At this critical juncture, society expects universities and scholarship to play an important role in steering that change for the betterment of the world," commented Junichi Hamada, the president of the University of Tokyo on this occasion, and went on saying, "As part of the measures to achieve these goals, we have established TODIAS as a university-wide organization. It will comprise research institutes that can function as a world-leading center of knowledge, aiming to enhance the University's academic excellence as a whole and further advance our internationalization."

Junichi Hamada
UT President

Sadanori Okamura
TODIAS Director

"It is a tremendous honor and privilege that President Hamada has given me," said Sadanori Okamura who was appointed to the founding director of TODIAS. He commented, "At the inaugural steering committee on Jan.11, 2011, the members were in consensus that IPMU was a suitable organization that met all the criteria. We have decided to designate IPMU as the first institute within TODIAS," and concluded by saying "I am deeply committed to providing the best possible research environment for IPMU so that it can conduct research activities more quickly, flexibly and actively under stable management."

Public lecture was held to celebrate the inauguration of the Todai Institutes for Advanced Study on March 9, 2011.

Inauguration of TODIAS was celebrated on March 9, 2011 at Yasuda Auditorium. Following speeches by the University of Tokyo President Junichi Hamada and the TODIAS Director Sadanori Okamura, public lecture was presented by the IPMU Director Hitoshi Murayama and a distinguished guest David Gross, the Director of Kavli Institute for Theoretical Physics of the University of California, Santa Barbara and the 2004 Nobel laureate in physics.

IPMU research staff gathered for the all hands meeting in October.

Starting from scratch, IPMU has been appointing researchers from around the world, setting its research agenda, and building up its infrastructure in a dizzying pace. In three years it has grown to a research institute of 67 full-time research staff (10 professors, 9 associate professors, 5 assistant professors, 43 postdoctoral fellows) and 38 administrative and support staff.

Total number of scientific staff including principal investigators, full time staff, joint appointments, students and long-term visitors (more than one month) reached 194 as compared with 165 one year ago. The JFY 2010 was another very productive one year for the IPMU scientists. We published 236 papers in refereed journals and produced 234 preprints, many of which are being submitted to refereed journals. We hosted 16 international conferences and held 186 seminars. We were visited by 862 scientists, of which 478 from abroad.

Number of IPMU Research staff (March 2011)

	Number	Foreign	Female
Principal Investigators	18	4	1
Faculty (including 4 PIs)	24	5	0
Postdoctoral Fellows	43	33	5
Joint Appointments	61	24	3
Long-term Visitors	32	32	1
Students	20	2	0
Total	194	100	10

Research Activities in JFY2010

Conferences	16
Seminars	186
Visitors (foreign)	862 (478)
Preprints	234
Publications	236

3 Organization

The IPMU Director is appointed by the President of the University of Tokyo and reports directly to the President. The Director has a complete authority of making a wide range of decisions including proposing recruitment of the Principal Investigators to the President, and appointing other research staff and administrative staff. The Director is assisted by two Deputy Directors and Administrative Director. They hold the Executive Board (EB) regularly to ensure smooth operation of the Institute. The EB has direct access to the Office of the President for consultations on both scientific and administrative matters.

The Scientific advisory Committee (SAC) gives advice to the Director on hiring scientific staff and setting scientific strategies. As of March 2011, the members consist of two Deputy Directors and five among IPMU's 18 Principal Investigators, all appointed by the Director.

Since IPMU has become a permanent member–institute of TODIAS in January 2011, the IPMU Director is now required to report the appointments of new principal investigators and faculty members to the TODIAS Director. Also, to clear the university's formality in hiring faculty members, the IPMU decisions have to be endorsed by the IPMU's Steering Committee consisting of the EB members plus two faculty members, Kyoji Saito and Tsutomu Yanagida.

The Scientific Advisory Committee members (March 2011)

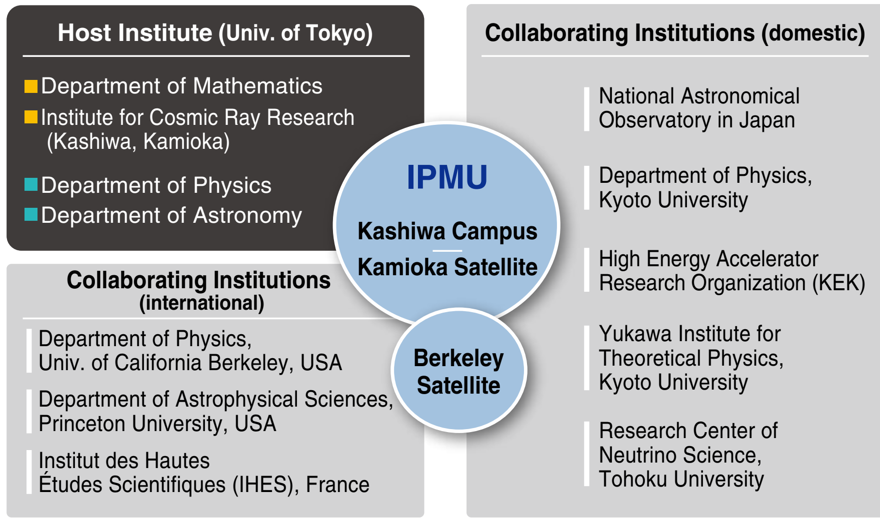
Hiroaki Aihara	U of Tokyo, high energy physics
Yoichiro Suzuki	U of Tokyo, ICRR, astroparticle physics
Toshitake Kohno	U of Tokyo, mathematics
Hirosi Ooguri	Caltech, particle theory
Kyoji Saito	IPMU, mathematics
David Spergel	Princeton U, astrophysics
Tsutomu Yanagida	IPMU, particle theory

The External Advisory Committee (EAC), appointed by the University President, reviews annually the scientific achievement and activities of the Institute and advises the President on scientific priorities and the research activities to keep the Institute stay on the course of their objectives.

The External Advisory Committee members (March 2011)

John Ellis	CERN, particle theory
Makoto Gonokami	U of Tokyo, quantum optics
Young-Kee Kim	Fermilab/U of Chicago, high energy physics
Sadayoshi Kojima	Tokyo Tech, mathematics
David Morrison	UC Santa Barbara, mathematics and physics
Roberto Peccei	UCLA; Chair, particle theory
Steven Kahn	SLAC/Stanford U, astrophysics
Nicolai Reshetikhin	UC Berkeley, mathematics

IPMU has rather unique approach in organizing the research objectives, where the world's leading scientists in their research fields are appointed as the Principal Investigators. There are 18 of them at the moment and they are affiliated to IPMU and other departments in the Host Institution (U of Tokyo) as well as other institutions. The Principal Investigators have a large autonomy in the research they conduct. They can make proposals to the Director to hire research staff at IPMU to help their research. The Director's approval on the proposed appointments will reflect the scientific vision and priorities set by the Director, who may consult the SAC as needed.



Collaboration takes place with many institutions.

Collaborating Branches within the Host Institution (University of Tokyo)

Department of Physics
Institute for Cosmic Ray Research
Graduate School of Mathematical Sciences
Department of Astronomy

IPMU tries to have close relations with similar research institutions in the world for encouraging research and educational exchanges. We have signed either agreements or memorandum of understanding with those institutions.

The administrative staff is an integral part of the Institute. Providing the best possible environment to the researchers in the Institute is important for the IPMU's mission. This part is headed by the Administrative Director. Its function also enables the Director to spend more time to consider the Institute at large and focus on the direction of the research.

Collaborating Institutions

National Astronomical Observatory of Japan (NAOJ)
Yukawa Institute for Theoretical Physics, Kyoto University
Department of Physics, Kyoto University
Research Center for Neutrino Science, Tohoku University
Department of Physics, University of California Berkeley
Department of Astrophysical Sciences, Princeton University
Institut des Hautes Études Scientifiques (IHES)
High Energy Accelerator Research Organization (KEK)

Foreign Institutions having exchange program with IPMU

University of California Berkeley, Physics Department
University of Chicago, Department of Astronomy and Astrophysics
Institute for Advanced Study, School of Natural Sciences
Johns Hopkins University, Department of Physics and Astronomy
New Mexico State University, Astronomy Department
Princeton University, Department of Astrophysical Sciences
University of Washington, Astronomy Department
Washington State University, Department of Mathematics
Stanford University, Kavli Institute for Particle Astrophysics and Cosmology (KIPAC)
Technical University of Munich, Physics Department
Ludwig Maximilian University of Munich, Physics Department
Max Planck Institute, Astronomy and Astrophysics
Max Planck Institute, Extra-terrestrial Physics
Max Planck Institute, Physics Department
European Southern Observatory (ESO)
National Taiwan University, Research Center for Cosmology and Particle Astrophysics

4 Staff

Director
Hitoshi Murayama, particle theory, cosmology

Deputy Directors
Hiroaki Aihara, high energy physics, astrophysics
Yoichiro Suzuki, astroparticle physics, neutrino physics

Principal Investigators
Hiroaki Aihara, high energy physics, astrophysics
Alexey Bondal, mathematics
Masataka Fukugita, astrophysics
Kunio Inoue, neutrino physics
Takaaki Kajita, neutrino physics
Stavros Katsanevas, astroparticle physics
Toshitake Kohno, mathematics
Hitoshi Murayama, particle theory, cosmology
Masayuki Nakahata, astroparticle physics
Mihoko Nojiri, particle theory
Ken'ichi Nomoto, astronomy
Hirosi Ooguri, mathematical physics, string theory
Kyoji Saito, mathematics
Henry Sobel, astroparticle physics
David Spergel, astrophysics
Naoshi Sugiyama, cosmology
Yoichiro Suzuki, astroparticle physics
Tsutomu Yanagida, particle theory

Faculty Members
Paul Frampton (till May 2010), particle theory
Simeon Hellerman, string theory
Kentaro Hori, string theory
Hiroshi Karoji, astronomy
Satoshi Kondo, mathematics
Keiichi Maeda, astronomy
Kai Martens, astrophParticle physics
Andrei Mikhailov (till June 2010), string theory
Shigeki Matsumoto, cosmology
Todor Milanov, mathematics
Shinji Mukohyama, cosmology
Hitoshi Murayama, particle theory, cosmology
Ken'ichi Nomoto, astronomy
Kyoji Saito, mathematics
John Silverman, astronomy
Shigeki Sugimoto, string theory
Yuji Tachikawa, string theory
Masahiro Takada, cosmology
Fuminobu Takahashi (till January 2011), particle theory
Tadashi Takayanagi, string theory
Yukinobu Toda, mathematics
Akihiro Tsuchiya, mathematics
Mark Vagins, astroparticle physics
Tsutomu Yanagida, particle theory
Naoki Yasuda, astronomy
Naoki Yoshida, astrophysics
Taizan Watari, string theory

Postdoctoral Fellows
Cosimo Bambi, cosmology
Tathagata Basak (till August 2010), mathematics
Alex Bene (till August 2010), mathematics
Melina Bersten, astronomy
Scott Carnahan, mathematics
Chuan-Ren Chen, particle theory
Won Sang Cho, particle theory
Rafael Da Silva De Souza, cosmology
Damien Easson (till December 2010), cosmology
Jason Evans, particle theory
Brian Feldstein, particle theory
Gaston Folatelli, astrophysics
Sergey Galkin, mathematics
Alexander Getmanenko, mathematics
Ahmet Emir Gumrukcuoglu, cosmology
Minxin Huang, string theory
Emille Ishida, cosmology
Keisuke Izumi, cosmology
Issha Kayo, (JSPS Fellow) astrophysics
Johanna Knapp, string theory
Alexandre Kozlov, neutrino physics
Daniel Krefl (till September, 2010), string theory
Tsz Yan Lam, astrophysics
Guillaume Lambard (till September 2010), astroparticle physics
Wei Li, string theory
Yen-Ting Lin (till September 2010), astrophysics
Jing Liu, astroparticle physics
Sourav Mandal, particle theory
Takahiro Nishimichi, astrophysics
Atsushi Nishizawa, astronomy
Takaya Nozawa, astronomy
Yutaka Ookouchi, particle theory
Domenico Orlando, string theory
Seong Chan Park, particle theory
Michael Pichot, mathematics
Susanne Reffert, string theory
Tomoki Saito, astronomy
Kenneth Shackleton, mathematics
Cornelius Schmidt-Colinet, string theory
Kazuhiro Shimizu, (JSPS Grant-in-Aid), astrophysics
Jing Shu, particle theory
Yogesh Srivastava (till July 2010), string theory
Charles Steinhardt, astronomy
Matthew Sudano, particle theory

Hajime Takami, astrophysics
Masaomi Tanaka, astronomy
Masayuki Tanaka, astronomy
Jiayu Tang, cosmology
Masahito Yamazaki (till August 2010), string theory
Marcos Valdes (JSPS Fellow) (till November 2010), astrophysics
Mircea Voineagu, mathematics
Kai Wang, particle theory

Graduate Students
Kouta Usui, particle theory
Gen Chiaki, astrophysics
Tomohiro Fujita, particle theory
Keisuke Harigaya, particle theory
Ayuki Kamada, particle theory
Yasuomi Kamiya, astronomy
William Klemm, particle theory
Sogo Mineo, high energy physics
Hironao Miyatake, high energy physics
Takashi Moriya, astronomy
Kimihiko Nakajima, astronomy
Ryoichi Nishio, particle theory
Ryosuke Sato, particle theory
Masato Shirasaki, astrophysics
Kohsaku Tobioka, particle theory
Tomonori Ugajin, particle theory
Wen Yin, particle theory
Kazuya Yonekura, particle theory
Xu-Feng Wang, particle theory
Satoshi Shirai, particle theory

Joint Appointments
Kou Abe (Tokyo ICRR), astroparticle physics
Mina Aganagic (UC Berkeley), string theory
Raphael Bousso (UC Berkeley), cosmology
Patrick Decowski (NIKHEF), high energy physics
Mamoru Doi (U Tokyo), astronomy
Yuri Efremenko (U Tennessee), neutrino physics
Tohru Eguchi (Kyoto YITP), field theory
Motoi Endo (U Tokyo), string theory
Sanshiro Enomoto (U Washington), neutrino physics
Andrea Ferrara (S.N.S. Pisa), astronomy
Stuart Freedman (LBNL), neutrino physics
Brian Fujikawa (LBNL), neutrino physics
Masaki Fukushima (Tokyo ICRR), astroparticle physics
Kaoru Hagiwara (KEK), particle theory
Lawrence Hall (UC Berkeley), particle theory
Koichi Hamaguchi (U Tokyo), particle theory
Yoshinari Hayato (Tokyo ICRR), neutrino physics
Masashi Hazumi (KEK), astrophysics
Karsten Heeger (Wisconsin), neutrino physics
Raphael Hirschi (U Keele), astronomy
Junji Hisano (Tokyo ICRR), particle theory
Petr Horava (UC Berkeley), string theory
Glen Horton-Smith (U Kansas), neutrino physics
Shinobu Hosono (U Tokyo), mathematical physics
Ken'ichi Izawa (Kyoto YITP), particle theory
Masaki Kashiwara (Kyoto U), mathematics
Akishi Kato (U Tokyo), mathematical physics
Masahiro Kawasaki (Tokyo ICRR), cosmology
Edward Kearns (Boston U), neutrino physics
Chiaki Kobayashi (Australia), astronomy
Toshiyuki Kobayashi (U Tokyo), mathematics
Masayuki Koga (Tohoku U), neutrino physics
Eiichiro Komatsu (U Texas), cosmology
Yusuke Koshio (Tokyo ICRR), neutrino physics
Takahiro Kubota (Osaka U), string theory
Alexander Kusenko (UCLA), particle theory, astrophysics
Marco Limongi (INAF Rome), astronomy
Shigetaka Moriyama (Tokyo ICRR), neutrino physics
Takeo Moroi (U Tokyo), particle theory
Kengo Nakamura (Tohoku U), neutrino physics
Tsuyoshi Nakaya (Kyoto U), high energy physics
Yasunori Nomura (UC Berkeley), particle theory
Masami Ouchi (Tokyo ICRR), astronomy
Serguey Petkov (SISSA), particle theory
Andreas Piepke (U Alabama), neutrino physics
Yoshihisa Saito (U Tokyo), mathematics
Kate Scholberg (Duke U), neutrino physics
Hiroyuki Sekiya (Tokyo ICRR), neutrino physics
Masato Shiozawa (Tokyo ICRR), neutrino physics
Fedor Smirnov (Paris 6), mathematics
Michael Smy (UC Irvine), neutrino physics
James Stone (Boston U), high energy physics
Yasuo Takeuchi (Tokyo ICRR), neutrino physics
Atsushi Taruya (Tokyo RESCEU), astrophysics
Nozomu Tominaga (Konan U), astrophysics
Edwin Turner (Princeton U), astrophysics
Alexander Voronov (U Minnesota), mathematics
Christopher Walter (Duke U), neutrino physics
Jun'ichi Yokoyama (Tokyo RESCEU), astrophysics
Ken-ichi Yoshikawa (U Tokyo), mathematics

Long-term Visitors (more than 1 month)
C. S. Kim (Yonsei U), particle theory
Alexey Bondal (U Aberdeen), mathematics
Sanjoy Biswas (Harish-Chandra Inst), particle theory
Eiichiro Komatsu (U Texas), cosmology
Devendra Kumar Sahu (IIAP), astronomy
Serguey Petcov (SISSA), particle theory
Luc Dessart (QAMP), astronomy
Massimo Porrati (NYU), cosmology
James Kenneth Sully (UCSB), mathematics
Tatsuma Nishioka (Princeton U), particle theory
Christoph Weniger (Max Plack), astroparticle physics
Jonas Schmidt (DESY), particle theory
Kentaro Nagamine (U Nevada), astrophysics
Ting-Wen Lan (ASIAA), astronomy
Chang Soon Park (Caltech), string theory
Zoltan Kunszt (ETH), particle theory
Edwin L Turner (Princeton U), astrophysics
Raphael Flauger U Texas), cosmology
Alexander Kusenko (UCLA), particle theory
Sergei Blinnikov (ITEP), astronomy
David Fallest (NCS), astrophysics
Vikram Rentala (Arizona), particle theory
Agnieszka Maria Bodzenta-Skibinska (Warsaw), mathematics
Stepan Paul (UCSB), mathematics
Charlie Beil (UCSB), mathematics
Brice Menard (CITA), astrophysics
Thomas O'Donnell (LBL), neutrino physics
Richard Eager (UCSB), mathematics
Alexander Voronov (Minnesota), mathematics
John Mangual (UCSB), mathematics
David R. Morrison (UCSB), mathematics
Yen-Ting Lin (ASIAA), astrophysics

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Kenzo Nakamura, Administrative Director (Project Professor)
Seiji Sugimura, General Manager, Administrative Division
Yonetaka Takano, Senior Specialist
Akira Ito, Chief Administrator

General Affairs
Masato Minami, Rieko Tamura, Mika Miura, Kazuko Oomoto

Accounting
Yonetaka Takano, Naoko Ishida, Nao Kubo, Hiromi Yoshida

Purchasing
Noboru Abe, Hiroyuki Ezawa, Yoshiya Ootaka, Satomi Utsumi

Financing
Yasuhiro Kato, Tomoko Yamanaka

SuMIRe Project
Hideaki Maruyama, Chihiro Imai

International Relations
Midori Ozawa, Kenichi Nakamura, Rie Ujita (Symposium), Hiromi Kuboshima, Masami Nishikawa (Japanese instructor),

Public Relations
Fusae Miyazoe

Secretarial Support
Yuuko Enomoto (Director's office), Tomoko Shiga, Rika Yamada, Kotoe Kawajiri

Library
Kayoko Kubota

Computing and Website
Hideki Tanaka (Project Assistant Professor), Aya Tsuboi

Documentation
Kazuo Abe

Kamioka Satellite Office
Hiroyuki Kanda, Sumiko Higashi, Motoichi Kanazawa, Yoko Shimizu

IPMU research staff (October 2010)

5 Research Program

Alternative Gravity Theories

Einstein's theory of relativity unifies a 3-dimensional space and a 1-dimensional time as a spacetime and describes gravity as a fabric of curved spacetime. This picture has been very successful in explaining and predicting many gravitational phenomena. Experimentally, however, we do not know how gravity behaves at distances shorter than 0.01 mm. At shorter distances, gravity may behave completely differently from what we expect. For example there may be hidden dimensions at short distances. In fact, many theories, including superstring theories and M-theory, require the existence of such extra dimensions. Extra dimensions may exist everywhere in our universe, but they are somehow hidden from us. One possibility recently investigated very actively is called the brane-world scenario. In this scenario our universe is supposed to be a 3-dimensional surface, called brane, floating in higher-dimensional space. Although we cannot see extra-dimensions directly, we may hope to detect some indirect evidence of extra-dimensions in high-energy experiments or cosmological observations.

$$K_{ij} = -\mathcal{G}_{ijkl}\frac{1}{\sqrt{g}}\frac{\delta S_{\rm cl}}{\delta g_{kl}} + \eta^{\alpha\beta}E_{\alpha\beta}{}^{ij}$$

$$\mathcal{G}^{ijkl} = \frac{1}{2}\left(g^{ik}g^{jl} + g^{il}g^{jk}\right) - \lambda\, g^{ij}g^{kl}$$

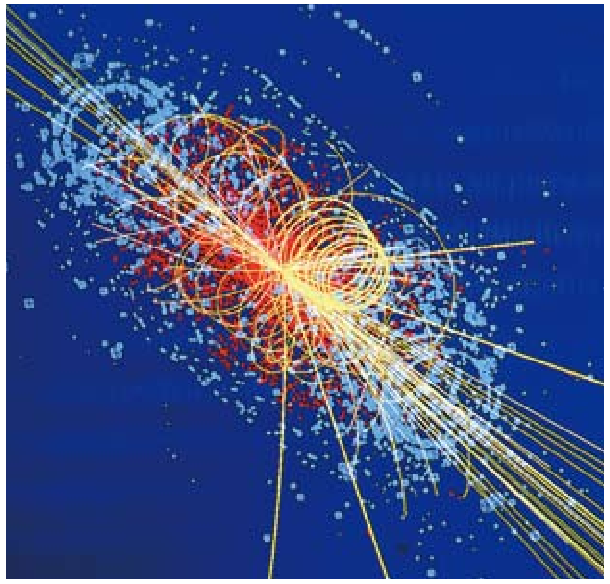
Gravity at very long distances (for example, billions of light-years) may also be as weird as at short distances. Precision observational data recently revealed that the expansion of our universe is accelerating. If Einstein's theory is correct, this requires that more than 70% of our universe is filled with invisible, negative pressure, energy. This energy is named dark energy, but we do not know what it really is. This situation reminds us of a story in the 19th century: when the perihelion shift of Mercury was discovered, some people hypothesized the existence of an invisible planet called Vulcan, a so-to-speak dark planet, to explain the anomalous behavior of Mercury. However, as we all know, the dark planet was not real and the correct explanation was to change gravity, from Newton's theory to Einstein's. With this in mind, we wonder if we can change Einstein's theory at long distances to address the mystery of dark energy.

Alternative Gravity Theories Group

Member	Main Interest
Cosimo Bambi	General Relativity is our current and successful theory of gravity, but it has been tested essentially only in the perturbative and weak field limit. The challenge is to figure out if its predictions are still reliable in other contexts, such as the description of the universe or black hole physics.
Damien Easson	Alternatives to dark energy to explain the acceleration of the Universe. Constraining gravitational models using observational data and theoretical considerations.
Shinji Mukohyam	Brane world scenarios and the Higgs phase of gravity.
Seong Chan Park	Study of various approaches.
Naoshi Sugiyama	Testing alternative gravity theories using observational data.
Atsushi Taruya	Modeling and testing structure formation scenario in modified theories of gravity from large-scale structure data.
Jun'ichi Yokoyama	Model building and constraints on dark energy.

Collider Phenomenology

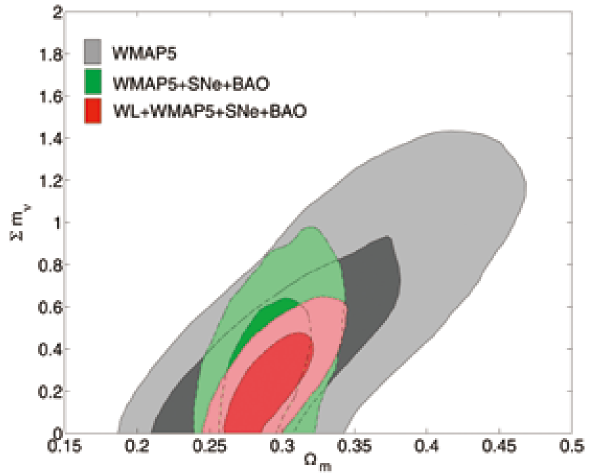
IPMU collider phenomenology group members pursue a broad range of research in testing physics of the standard model and beyond standard model at the colliders, especially the CERN Large Hadron Collider (LHC). With the LHC turn-on in 2009, we have great opportunities in exploring physics at the TeV scale. This machine enable us to systematically investigate electroweak symmetry breaking, to probe new physics like low energy supersymmetry, extra dimensions or other unexpected exotics. Researchers in the group are working on the theoretical tools to investigate these exciting physics. We also seek the connection between collider physics and dark matter/cosmic ray physics.



Collider Phenomenology Group

Member	Main Interest
Chuan-Ren Chen	Collider phenomenology of the Standard Model (SM) and Models Beyond the Standard Model (BSM).
Won Sang Cho	New physics search/discrimination, mass/spin measurements of new particles, and CP violation at the LHC.
Motoi Endo	Supersymmetric models, including collider phenomenology and particle cosmology.
Koichi Hamaguchi	BSM, in particular, SUSY models, their LHC phenomenology and application to cosmology (baryogenesis, BBN constraints, dark matter and its signatures).
Junji Hisano	Flavor physics and collider physics of BSM.
William Klemm	How to discover BSM and distinguish from one another at collider. Determination of spins of new particles.
Sourav Mandal	Models beyond the Standard Model, and their signatures in astrophysics, cosmic rays and colliders.
Shigeki Matsumoto	Collider signals of New Physics models at the TeV scale (SUSY, Little Higgs, Extra-dimensions, Gauge-Higgs Unification) at the LHC and ILC.
Hitoshi Murayama	Determination of spin and mass of BSM particles.
Mihoko Nojiri	New physics searches and measurements at LHC
Seong Chan Park	Search for BSM, in particular, extra dimensions and black holes at the LHC. Search for golden channel for finding black holes at the LHC. Monte Carlo event generator for black hole events (Black- Max).
Serguey Petcov	Tests of models of neutrino mass generation at colliders.
Jing Shu	Physics of top, Z', and higgs.
Kohsaku Tobioka	Discovery of BSM and mass measurements of new particles at the LHC.
Kai Wang	Search for BSM and test of SM at the LHC.
Tsutomu Yanagida	Finding theories beyond the standard model.Theories for strongly interacting gauge mediation and possible explanations on the anomalies observed in PAMELA experiments of cosmic rays.

Cosmology and Statistics



The size of data set in cosmological observations is huge. For example, the Sloan Digital Sky Survey-III (SDSS-III) creates a color image of more than a trillion pixels. That is so big and detailed that one would need 500,000 high-definition TVs to view it at its full resolution. This trend will continue at even faster rates as larger telescopes become available in near future. For handling these massive data set and extracting maximum amount of information, we must keep developing more and more sophisticated statistical methods. Relevant issues that are actively pursued are selecting models, methods of estimating parameters, Bayes' theorem and other statistical techniques.

In the study of gravitational lensing which is actively carried out at IPMU, as an example, we try to extract tiny distortion of the observed image of a galaxy from its true shape. We do so by modeling the galaxy shape in a mathematically rigorous manner and convolving the sampling effects and noise in the observation. This type of data analysis requires close collaboration between cosmologists and statisticians.

Dark Matter Experiment

We know that about 23% of the total energy and matter of the Universe is dark matter, but we do not know what that is made of. The aim of the dark matter search experiment, XMASS, is to directly observe interactions of the cold dark matter in the large detector placed underground and to reveal the character of dark matter—its interactions, mass and so on.

We use 1 ton liquid Xenon detector cooled down at the temperature of -100 degree Celsius and measure the scintillation light emanated from the interaction of the dark matter in the detector. The experimental sensitivity is roughly two orders of magnitude better than the currently available best limit.

Excavation of the cavity for housing the detector and construction of the 10-meter-high and 800-ton-weight cylindrical water tank for shielding gamma rays and neutrons from nearby rocks were completed in 2008. Assembling of major detector-components was completed in 2009. Most part of 2010 was devoted for final tuning of the detector and data handling system. We are very close to start the data taking.

Dark Matter Experiment Group

Member	Main Interest
Karsten Heeger	Direct dark matter searches in low-energy experiments.
Jing Liu	Direct Dark Matter search using the XMASS detector.
Kai Martens	Identification of particle candidates for Dark Matter. Super low background experiments.
Shigetaka Moriyama	Direct detection of Dark Matter.
Masayuki Nakahata	Purification of Xenon for low background experiments.
Yoichiro Suzuki	Discovery of Dark Matter.
Yasuo Takeuchi	Dark Matter search at XMASS.

Detector Developments

Experimental physics and observational astronomy rely on cutting-edge technologies to build detectors that push the frontier of knowledge with the data they deliver. Data is the lifeblood of science, as the scientific method demands that every insight be tested against the hard evidence of experimental data. The art of experimentation is to provide both reliable and pertinent data to test the theories that the disciplined use of knowledge and imagination conjure from the massive body of scientific data already accumulated.

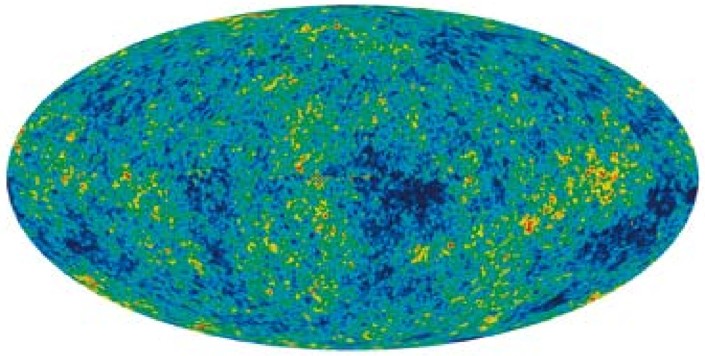
Active detector development provides the means to extend the reach of current and future experiments—and very possibly new technology that may well find its way back into your living room or workshop. It is a vital ingredient in our quest to understand the Universe. The projects below are as diverse as the problems encountered and the individuals working on them.

EGADS Project (Evaluating Gadolinium's Action on Detector Systems), which is now under construction in the Kamioka mine, will be used to establish the viability of gadoliniumenhanced water Cherenkov detector for detecting supernova relic neutrinos.

Detector Development Group

Member	Main Interest
Karsten Heeger	Liquids scintillator, water Cherenkov, and bolometric detectors. Ultralow background detectors and techniques.
Kunio Inoue	Neutrino oscillation, neutrino geophysics, neutrino astrophysics, neutrinoless double beta decay, and directional measurement of anti-neutrinos.
Kai Martens	Continuous removal of radon from liquid xenon.
Yasuo Takeuchi	Development of high sensitivity radon detectors in air, in water, and in xenon. Development of impurity measurement systems in xenon.
Mark Vagins	Improving the neutrino response of water Cherenkov detectors.

Inflation and Early Universe



Credit: NASA/WMAP Science Team

The Universe is expanding; the further away a galaxy is, the faster it is moving, which is known as the Hubble's law. This observational fact implies that, if we go back in time, the Universe was small, dense and extremely hot. The evolution of the early universe is described by the Friedmann-Lemaitre-Robertson-Walker (FLRW) universe, a homogeneous and isotropic solution of the Einstein equations of the general relativity, and the standard big bang theory is based on the FLRW universe. The Hubble's law, the big bang nucleosynthesis (BBN), the comic microwave background (CMB) radiation provide key support for the standard big bang theory. Those three observations still remain important probes of the early Universe.

Despite its great success the big bang theory is plagued with serious theoretical issues such as the horizon problem, the flatness problem, and the monopole problem. Those problems are beautifully solved by the introducing an inflationary expansion at the very early stage of the Universe. What is more important about inflation is that quantum fluctuations of a scalar field driving the inflation (called an inflaton) generate tiny density perturbations, which can account for the seed of the structures such as galaxies and clusters of the galaxies seen in the current Universe. The properties of the density perturbations depend on the inflation models, which can be probed by studying tiny inhomogeneities in the CMB temperature anisotropy.

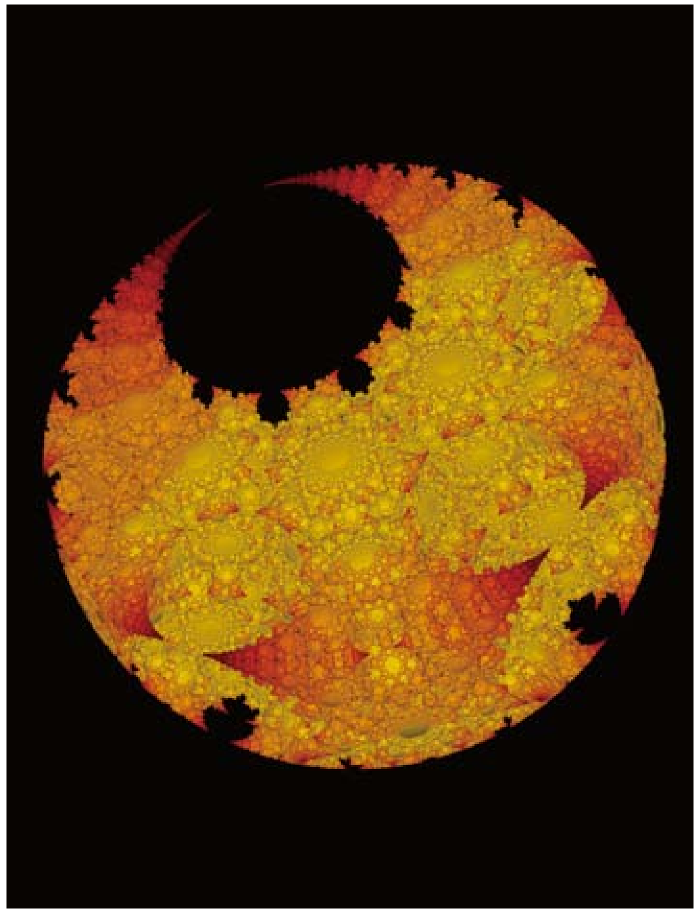
The recent progress in observational techniques has enabled us to study the evolution of the early universe with unprecedented precision, and our understanding of the Universe has significantly increased. Nevertheless it is not fully known how the inflation occurred, how the universe was reheated after inflation, how the dark matter as well as the baryon asymmetry were created, whether there is large non-Gaussianity in the density perturbations or not, and so on. We would like to tackle those questions in order to reveal how the universe evolved from the inflationary epoch into what it looks like at present.

Inflation and Early Universe Group

Member	Main Interest
Cosimo Bambi	General Relativity is our current and successful theory of gravity, but it has been tested essentially only in the perturbative and weak field limit. The challenge is to figure out if its predictions are still reliable in other contexts, such as the description of the universe or black hole physics.
Damien Easson	Building concrete models of infation from string theory. Observable predictions of nonstandard infationary theories.
Motoi Endo	Supersymmetric models, including collider phenomenology and particle cosmology.
Emir Gumrukcuoglu	Models of inflation that give rise to new signatures, such as nongaussianity and/or broken statistical isotropy. The effect of supersymetric flat directions on the time scale of thermalization. Gravitational waves from cosmological sources, in particular, from the preheating of flat directions.
Koichi Hamaguchi	BSM, in particular, SUSY models, their LHC phenomenology and application to cosmology (baryogenesis, BBN constraints, dark matter and its signatures).
Minxin Huang	Non-Gaussianities in the Cosmic Microwave Background from inflation models.
Ken'ichi Izawa	Gauge/gravity-mediated supersymmetry breaking, supersymmetric inflation, united models.
Takeshi Kobayashi	Cosmology of the early universe through string theory.
Alexander Kusenko	Dark matter, baryogenesis, phase transitions.
Shinji Mukohyama	Inflation and brane cosmology.
Hitoshi Murayama	Leptogenesis. Models of inflation.
Seong Chan Park	Two different types of infation models, the orbifold GUT inflation and the theory with $f(\phi)R$ term, so called the nonminimal coupling term. The (p) reheating of the inflation theory with the nonminimal coupling term.
Serguey Petcov	Leptogenesis. Low energy leptonic CP violation and leptogenesis.
Naoshi Sugiyama	Setting constraints on the inflation models and early universe phenomena such as big bang nucleosynthesis by using observational data.
Fuminobu Takahashi	Mechanism of inflation and subsequent reheating processes. Origin of density perturbations and non-Gaussianity. Baryogenesis. Big Bang nucleosynthesis.
Atsushi Taruya	Probing the early epoch of the Universe through direct and indirect measurements of the stochastic background of gravitational waves via laser interferometers or observations of CMB anisotropies.
Tsutomu Yanagida	Finding theories beyond the standard model.Theories for strongly interacting gauge mediation and possible explanations on the anomalies observed in PAMELA experiments of cosmic rays.
Jun'ichi Yokoyama	Inflation models. Generation of fluctuations. Stochastic inflation.

Mathematics

In the 17th century, Newton found differential and integral calculus, giving a language and method to describe the law of dynamics in nature. This is a good example of mathematics providing the scientific community, and sometimes society in general, with a common language and method to describe phenomena in their study. This in turn helps to establish a mathematician's original concepts. Particularly in recent years the interaction between mathematics and physics has been in full flow.



Gauge theory, quantum field theory, general relativity, superstring theory and the theory of integrable systems in physics have provided major influences in the development of mathematics such as algebraic geometry, differential geometry, topology, representation theory, algebraic analysis and number theory. A large scale development has been newly emerging.

This close collaboration between mathematics and physics is particularly important for advancing the study of the concept of space and universe that have been developed by scientists such as Kepler, Newton, Gauss, Riemann, Maxwell, Einstein and many others.

For the past twenty years, methods of quantum field theory have had a major influence on mathematics. Since quantum field theory treats the differential and integral calculus of an infinite number of degrees of freedom, the rigorous development of quantum field theory in mathematics has yet to be established. Nevertheless, in these twenty years, a lot of concepts arising from quantum field theory such as quantum groups have had a major influence on modern mathematics and physics.

Mathematicians at IPMU are working to develop modern mathematics by closely working with physicists. The following are the fields of mathematics studied at IPMU. We divided the fields into geometry and algebra.

Geometry:

Geometric objects we study in mathematics include several kinds of spaces, such as topological spaces, differentiable manifolds, symplectic manifolds, complex manifolds and algebraic varieties. Recently these various branches of geometries are deeply connected and influence each other. For instance, mirror symmetry is a conjectural duality between symplectic manifolds and algebraic varieties, which was found by the duality between different types of string theories. One of the research focus of our geometry group is to invent and investigate the mathematical notions which describe the mirror symmetry, and give some applications to the geometric problems we are interested in.

In the theory of mirror symmetry, a Calabi-Yau 3-fold plays an important role. A Calabi-Yau 3-fold is a complex manifold of real dimension 6 with a Ricci flat metric. In string theory, the spacetime is expected to be 10-dimensional, and the extra 6-dimensional space is expected to take the form of a Calabi-Yau 3-fold. On a Calabi-Yau 3-fold, we can define the quantum invariant counting Riemann surfaces on it, called Gromov-Witten (GW) invariant. One of the ways to describe the mirror symmetry is to establish the relationship between GW-invariants and the period map on the mirror manifold. In our group, S. Galkin studies GW-invariant, K. Saito studies the period map, and they develop these theories.

Another way to describe the mirror symmetry is to use the homological algebra proposed by M. Kontsevich. It is stated as an equivalence of triangulated categories between derived category of coherent sheaves and derived Fukaya category on the mirror manifold. In our group, A. Bondal develops the theory of triangulated categories, and describes the structure of several triangulated categories, e.g. to show the existence of the exceptional collections. The development of this theory is relevant in understanding the mirror symmetry.

On a Calabi-Yau 3-fold, we can define another quantum invariant, called Donaldson-Thomas (DT) invariant. It counts D-branes in terms of string theory, and is expected to be equivalent to the GW-invariant. (GW/DT correspondence). The DT-theory depends on a choice of a stability condition on the derived category, and the set of stability conditions form a complex manifold, which is expected to be a stringy Kahler moduli space. Understanding DT-invariants and the structure of the space of stability conditions is important in connection with string theory, and Y. Toda studies these theories. Also the theory of quantum invariants of low dimensional manifolds has begun with the study of quantum theory such as integrable systems, soliton equations and the conformal field theory. These quantum invariants turn out to have a deep connection with GW-theory, and T. Kohno studies these invariants.

Algebra:

Algebra is a collection of branches of mathematics, which studies the system of numbers such as integers and polynomials. Some examples of the branches are set theory, group theory, (commutative) ring theory, (algebraic) number theory, category theory, algebraic geometry, combinatorics and representation theory. Of course, each branch may not be fully contained in algebra, and may lie in between geometry.

Algebra studied at IPMU includes homological algebra and category theory. Homological algebra began as a study of homology groups of topological spaces. K-theory is an example of cohomology theories. Recall that in connection with string theory, an interesting and basic example is that an element of a K-group of a certain topological space has a physical interpretation. This enables us to use the powerful machinery of homological algebra to the study of string theory.

Nowadays, a basic algebraic invariant associated with a geometric object is a triangulated category. For example, this appears from an algebraic variety as the derived category of coherent sheaves. The notion of triangulated category is so abstract that they appear everywhere in mathematics. We know that some noncommutative geometry is better described in this language. Recent research is focused on finding a more complicated structure than that of a triangulated category. Differential graded categories and model categories are examples of objects that are equipped with more structure than a triangulated category. We seek to reveal the algebraic structure common to various phenomena (which may or may not look unrelated) occurring in mathematics and physics.

Another basic example of an algebraic structure is a group or a group action. A group describes the symmetry of things. Groups are everywhere in mathematics from Galois groups in number theory to mapping class groups in topology. Study of groups, or representation theory, will then lead to the explanation of the phenomena caused by the symmetry. Let us give a list of those groups (or algebras) our researchers are interested in, just to give an idea on how diverse we are. The groups (or algebras) that appear are vertex operator algebras, Lie groups (algebras), braid groups, Galois groups, and mapping class groups. We refer to the table below of group members for more information on how each deals with the group in his research.

We certainly hope to go the other direction. An example question would be if the product structure in K-theory has an interpretation. We can ask if it has a physical interpretation. The "distance" of algebra from physics, compared with geometry, is greater, in the sense that many of the problems in physics are first stated using (quantum) field theory. While geometry is used to describe the universe rather directly as if taking a picture, algebra tends to seek for the exact laws behind the phenomena.

Mathematics Group (Geometry)

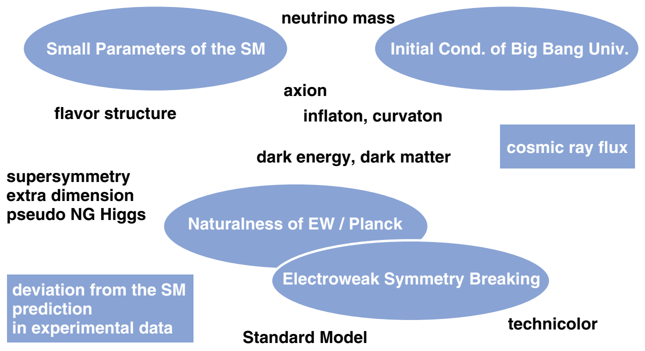
Member	Main Interest
Tomoyuki Abe	Arithmetic geometry by using the p-adic analysis especially arithmetic D-modules, and its application to the Langlands program for function field in the p-adic setting.
Scott Carnahan	Moduli problems, logarithmic geometry, formal geometry, geometric representation theory.
Kwokwai Chan	Mirror symmetry for Calabi-Yau and toric manifolds, the SYZ conjecture and its applications to mirror symmetry, open Gromov-Witten theory.
Sergey Galkin	Fano varieties, their classification, degenerations, Gromov-Witten invariants, mirror dual Landau-Ginzburg models.
Alexander Getmanenko	Comlpex analytic methods for differential equations, with an application towards Witten Morse theory and the Fukaya category.
Kentaro Hori	Mirror symmetry as a bridge between symplectic geometry and complex geometry, real algebraic geometry, homological algebra, and their application to string theory.
Shinobu Hosono	Mirror symmetry of Calabi-Yau manifolds, and its applications to Gromov-Witten theory.
Toshiyuki Kobayashi	Discontinous groups for homogeneous manifolds preserving indefinite-Riemannian structure, rigidity and deformation of discontinuous groups, and spectrum on locally indefinite-Riemannian symmetric spaces. Synthetic and systemetic study of multiplicity-free representations by the original idea of "visible actions" on complex manifods.
Toshitake Kohno	Construction of topological invariants for braids, knots and 3 dimensional manifold based on quantum groups and conformal field theory. Algebraic structures of the homology of the loop spaces of configuration spaces.
Todor Milanov	Gromov–Witten theory, singularity theory, and representations of infinite-dimesnional Lie algebras.
Hirosi Ooguri	Application of new mathematical techniques emerging at the interface of string theory and geometry to solve mysteries of quantum gravity.
Susanne Reffert	Calabi-Yau geometries in the framework of String compactifications.
Kyoji Saito	Construction of primitive forms and associated period maps by use of infinite dimensional Lie algebras (e.g. elliptic algebras and cuspidal algebras) and their representation theory. Partition functions of Ising models on (non-commutative) discrete groups and monoids.
Yoshihisa Saito	Representation theory of infinite dimensional Lie algebras and quantum groups, especially in geometric approach to these subjects. Areas around these subjects such as integrable systems, combinatrics, finite dimensional algebras, algebraic groups, Hecke algebras and D-modules.
Kenneth Shackleton	Large-scale geometry of groups (eg. mapping class groups), in the sense of Gromov combinatorial rigidity in families of groups hyperbolic and relatively hyperbolic groups.
Yuji Tachikawa	String-inspired phenomena in mathematics (hyperkhler manifolds, geometric representation theory etc.).
Yukinobu Toda	Derived categories of coherent sheaves on algebraic varieties and the theory of stability conditions on them. It is motivated by several backgrounds, such as minimal model theory or homological mirror symmetry. Construction of generalized Donaldson-Thomas type invariants, counting semistable objects in the derived category.
Mikael Pichot	Nonpositively curved geometry and geometric group theory (especially CAT(0) and hyperbolic). Foliation theory and topological dynamical systems.
Akihiro Tsuchiya	Conformal field theory based on representation theory of infinite dimensional algebra and the theory of D-modules.

Mathematics Group (Algebra)

Member	Main Interest
Scott Carnahan	Vertex algebras, infinite dimensional Lie algebras, automorphic forms, moonshine.
Sergey Galkin	Arithmetics of Landau-Ginzburg models, cluster categories, derived categories.
Satoshi Kondo	Arithmetic geometry. Use of tools from algebraic geometry to study problems in number theory.
Mikael Pichot	Bruhat-Tits buildings. Group theory and group algebras. K-theory, the Baum–Connes conjecture and the property of rapid decay. Noncommutative geometry.
Kyoji Saito	Construction of primitive forms and associated period maps by use of infinite dimensional Lie algebras (e.g. elliptic algebras and cuspidal algebras) and their representation theory. Partition functions of Ising models on (non-commutative) discrete groups and monoids.
Toshiyuki Kobayashi	1. Discretely decomposable branching laws of the restriction of infinite dimensional representations of reductive groups, and its application to modular varieties. 2. Minimal representations are buiding blocks of unitary representations. Focus on geometric analysis on minimal representations, in particular, construction of generalized Fourier transforms.
Hirosi Ooguri	Conformal field theories in diverse dimensions that are relevant to dynamics of strings and branes in superstring theory. Application of conformal field theory techniques to study the landscape of string vacua.
Domenico Orlando	Spin chains (XXZ model and related two-dimensional lattices) in connection to dimer models and topological strings.
Susanne Reffert	(Quantum) dimer models. (Quantum) crystal melting and spin chains.
Yoshihisa Saito	Representation theory of infinite dimensional Lie algebras and quantum groups, especially in geometric approach to these subjects. Study of the area around these subjects, for example, integrable systems, combinatrics, finite dimensional algebras, algebraic groups, Hecke algebras and D-modules.
Kenneth Shackleton	Geometric group theory. Hyperbolic and relatively hyperbolic groups. Low-dimensional topology. Teichmüller theory and mapping class groups. Curve complexes, pants complexes.
Akihiro Tsuchiya	Conformal Feld theory based on representation theory of inFnite dimensional algebra and the theory of D-modules.
Simon Wood	Understanding the representation theory of vertex operator algebras in the context of conformal field theory.
Mircea Voineagu	Motivic and Morphic Cohomology. K-theory of algebraic varieties. Semi-topological K-theory.

Models beyond the Standard Model

Up to now, we have seen that a quantum field theory with quarks, leptons and vector bosons for three different forces describes reasonably well all the experimental data available so far. Among the vector bosons, however, those corresponding to the weak force (which is responsible for the β-decay of nucleons) are known to have masses. There are three such vector bosons, and they are called W^+, W^- and Z bosons, or weak bosons, as a whole. From the consistency of quantum field theories, it is known that something must be behind the nonzero masses of these vector bosons. It has not been confirmed experimentally yet how these masses are generated.



What is called the Standard Model provides a simple theoretical idea how the weak bosons acquire masses. According to the Standard Model, the masses originate from condensation of quanta of a new scalar boson, called Higgs boson. The Higgs boson is the last missing piece of the Standard Model, and will be discovered in experiments in near future, if the weak bosons have masses through the mechanism predicted by the Standard Model.

Is that the end of the story? Maybe ..., but maybe not. Let us think about the following questions.

- The Higgs boson is the only scalar field in the Standard Model; all other dynamical degrees of freedom in the Standard Model are either fermions or vector fields. Why does the Standard Model have one scalar field, and just one? Why does its condensation develop?
- The Newton constant $G_N \simeq 6.7\times10^{-11}\mathrm{m^3kg/s^2}$ corresponds to an energy scale $1/\sqrt{G_N \hbar /c^3} \sim 10^{19}$ GeV. Why is there a huge hierarchy of order 10^{17} between this energy scale and the weak boson masses of order 10^2 GeV, and how can the weak boson masses remain so small under quantum corrections?

In order to solve these questions theoretically, various models beyond the Standard Model have been constructed so far, and we still continue to do so in quest of a better solution to these problems. Once we have concrete models, we can examine whether such models are really consistent with all the available experimental data, predict what kind of signals can be expected in future experiments, and even propose experiments to confirm such models.

The origin of the masses of the weak bosons is not the only puzzle of the Standard Model. It is known that huge fraction of the universe consists of dark matter and dark energy. It is very unlikely that dark matter is actually the ordinary matter particles in the Standard Model.

This is where we find another motivation to extend the Standard Model. Our universe may have become so large because of an inflationary process in the early universe, and quantum fluctuations of a scalar field may become the fluctuations of density in the early universe, which eventually become galaxies and clusters of galaxies. So, here is another motivation to introduce a new degree of freedom and extend the Standard Model. Such cosmological issues as inflation, primordial density perturbations and dark matter motivate extensions of the Standard Model, and models in quantum field theories are the appropriate framework in order to work on these issues.

Recent reports of excess in high-energy cosmic ray fluxes, deviation from the Standard-Model prediction of the anomalous magnetic moment of muon, and some other reports of deviations from the Standard Model predictions may also be indications of some physics beyond the Standard Model. We therefore seek for theoretical models that account for these phenomena.

We also address the following problems. The Standard Model is described by a quantum field theory with about 30 parameters, and the values of these parameters can be determined only by measuring them experimentally. Would it be possible to determine them theoretically, by considering theoretical frameworks that contain the Standard Model?

The thermal history of early universe is described very well by the Standard Model at least back to the era with the temperature of order MeV, but it is only with several input parameter values of initial condition of the universe. Those initial condition parameters include baryon asymmetry, normalization of density contrast and the amount of dark energy. How are these initial condition parameters set? Once again, it is impossible to think about such problems without a model that extends the Standard Model.

For non-experts

After k_B, c and $\hbar$ are set to unity, [length] = [energy]$^{-1}$ is the only dimension left in physics. The fundamental law of physics in nature has been probed down to the length scale of order 10^{-3} fm = 10^{-8} Å, which is equivalent to the energy scale of order 10^2 GeV = 10^{11} eV. Nothing is known for sure yet, however, what is happening at even shorter distance scales.

Models Beyond the Standard Model Group

Member	Main Interest
Chuan-Ren Chen	Collider phenomenology of the Standard Model and models beyond the Standard Model, including SUSY and Little Higgs models. Interplay between the LHC phenomenology and cosmology.
Won Sang Cho	Supersymmetry/Extra Dimension models, and their collider and dark matter phenomenology.
Damien Easson	Physics beyond the Standard Model to explain the origin of the dark components of the Universe.
Motoi Endo	Supersymmetric models including collider phenomenology and particle cosmology.
Brian Feldstein	Lately my work has focussed primarily on properties of dark matter, and possible signatures in direct detection or other types of experiments. I am also interested in cosmology, weak scale physics, etc.
Koichi Hamaguchi	SUSY models and their LHC phenomenology and application to cosmology (baryogenesis, BBN constraints, dark matter and its signatures).
Junji Hisano	Supersymmetric models. Search for clues in accelerator and non-accelerator physics. Construction of realistic models at TeV and at GUT scales.
Ken'ichi Izawa	Gauge/gravity-mediated supersymmetry breaking. Supersymmetric inflation. United models.
William Klemm	Signatures from various beyond the standard models. Distinguishing from one another at a collider. Determination of spins of new particles.
Sourav Mandal	Models beyond the Standard Model, and their signatures in astrophysics, cosmic rays and colliders.
Shigeki Matsumoto	New Physics models at the TeV scale (SUSY, Little Higgs, Extradimensions, Gauge-Higgs Unification).
Hitoshi Murayama	Supersymmetry breaking models and phenomenology.
Hirosi Ooguri	General constraints on low energy effective theories that arise from superstring theory or any other consistent theory of quantum gravity. Supersymmetry breaking mechanisms in gauge theories and superstring theory.
Yutaka Ookouchi	Model building with supersymmetric gauge theories. Application of gauge/gravity duality to problems in particle physics.
Seong Chan Park	Various ideas of the BSM: warped extra dimension, model of EWSB in the context of Gauge-Higgs unification, orbifold GUT, little Higgs etc.
Serguey Petcov	Models of neutrino masses and mixing. Phenomenology of lepton flavour violation.
Jing Shu	Warped extra dimension models. Strongly coupled theory.
Matt Sudano	Dynamical supersymmetry breaking and its mediation.
Fuminobu Takahashi	Supersymmetry. Link between supersymmetric models and cosmology, such as SUSY breaking, dark matter, and SUSY inflation models.
Kohsaku Tobioka	LHC Phenomenology of supersymmetry and extra dimensions.
Kai Wang	Model building of BSM physics, in particular SUSY models as well as neutrino models. Their collider tests at the CERN LHC.
Taizan Watari	Model building and phenomenology beyond the Standard Model in general. SUSY breaking and mediation, flavor pattern, GUT, inflation, Peccei-Quinn axion, quintessence, landscapes.
Tsutomu Yanagida	PAMELA and ATIC data searching for a convincing model that explains the observed anomalies.

Neutrino Physics

What are the building blocks of nature? Most people have heard of electrons, which are indeed (as far as we can tell) fundamental particles, as well as protons and neutrons, which are themselves composite objects composed of much smaller fundamental particles called quarks. But there are much more unusual fundamental particles, too, and perhaps the most mysterious of these are the neutrinos.

The Standard Model of particle physics contains three generations of fundamental particles. In each of these generations, or families, there are two quarks and two much less massive particles called leptons. In the first family one such lepton is the electron, which carries an electric charge, and the other first-generation lepton is called the electron neutrino, which is electrically neutral. The second generation contains two more types of quarks, a charged lepton called the muon, and the muon neutrino, while the third family contains a final pair of quarks, a charged lepton called the tau, and a tau neutrino.

The three types of neutrinos, the electron neutrino, the muon neutrino, and the tau neutrino, are exceedingly challenging to study, because they hardly interact with matter at all. That means neutrino detectors need to be very big, very sensitive, or both. At IPMU we have teams of researchers working on some of the best and most famous neutrino detectors in the world.

The Super-Kamiokande [Super-K] detector is a 50,000 ton tank of water buried deep under the Japanese Alps. By studying neutrinos generated by cosmic ray interactions in the Earth's atmosphere, in 1998 Super-K made the stunning discovery that different types of neutrinos can spontaneously transform from one type to another, a process known as neutrino oscillation. This also implied that at least two of the three neutrinos have a small, but non-zero mass, something not predicted by the Standard Model. This was the first time since its inception that the Standard Model needed to be revised based on solid experimental data. In 2001 Super-K made a crucial contribution to the solution of the solar neutrino problem by indicating that solar neutrinos produced by the Boron-8 reaction in the Sun could change their flavor while in flight, and uniquely selected the large mixing angle solution to the problem. IPMU members are now working on GADZOOKS!, an initiative to enrich the ultrapure water inside Super-Kamiokande with the element gadolinium. This will greatly reduce backgrounds and, among many other physics benefits, should allow the first-ever detection of a constant stream of neutrinos from distant supernovas.

The KamLAND neutrino detector is located in the same ancient zinc mine as Super-Kamiokande, but instead of water it is filled with 1,000 tons of liquid scintillator. This makes it very sensitive, especially to low energy neutrinos from nuclear reactors and those generated by radioactive decays within the Earth itself. In 2002 KamLAND was the first experiment to observe disappearance of reactor neutrinos, which matched other experiments' solar neutrino data in spectacular fashion. After lowering the energy threshold at which their data could be analyzed, in 2005 KamLAND was the first experiment to detect geoneutrinos, ushering in an entirely new way to study the Earth's interior. Also in 2005, KamLAND saw evidence of spectral distortions in the reactor neutrino signal; clear proof of neutrino oscillations. IPMU members are currently working on modifying KamLAND to detect very low energy solar neutrinos produced by the Beryllium-7 reaction in the Sun, as well as transforming the KamLAND detector into a huge neutrinoless double beta decay experiment via the addition of Xenon-136 to the detector volume.

As we continue to understand the mysterious neutrinos, as well as the varied processes which produce them within the Earth, upon the Earth, above the Earth, within the Sun, and inside exploding stars, IPMU researchers are using these tiniest of particles to probe the most inaccessible places and farthest reaches of the universe itself.

Neutrino Physics Group

Member	Main Interest
Karsten Heeger	Neutrino oscillation experiments with reactor neutrinos. Search for neutrinoless double beta decay.
Glenn Horton-Smith	KamLAND experiment. Neutrino oscillation.
Kunio Inoue	Neutrino oscillation. Neutrino geophysics. Neutrino astrophysics. Neutrinoless double beta decay. Directional measurement of antineutrinos.
Takaaki Kajita	Atmospheric neutrino. Long baseline experiments. Neutrino oscillations.
Alexander Kusenko	Supernova neutrinos, sterile neutrinos.
Kai Martens	Super-Kamiokande experiment for detecting neutrinos from galactic supernova (type II) explosion.
Sourav Mandal	Models beyond the Standard Model, and their signatures in astrophysics, cosmic rays and colliders.
Hitoshi Murayama	Neutrino oscillation phenomenology. KamLAND.
Masayuki Nakahata	Boron-8 solar neutrino measurement by Super-Kamiokande detector. Precise measurement of the energy spectrum for the confirmation of matter effect of the neutrino oscillation.
Serguey Petcov	All aspects of the physics of massive neutrinos, neutrino mixing and of neutrino oscillations. The problems of determining, i) the nature (Dirac or Majorana) of massive neutrinos, and ii) the type of spectrum (with normal or inverted ordering) the neutrino masses obey. Tests of the “non-standard” mechanisms of neutrinoless double beta decay. Leptonic (Dirac and/or Majoran) CP violation and its possible manifestations.
Henry W. Sobel	Super-Kamiokande and T2K experiments. Neutrino physics. Supernova. Proton decay.
Yoichiro Suzuki	Experimental study on neutrino oscillations by using extraterrestrial neutrinos and also by using man-made neutrinos. Double beta decay experiments.
Yasuo Takeuchi	Low-energy neutrino observations in Super-Kamiokande.
Mark Vagins	Measurements of neutrinos and antineutrinos from supernovae, the sun, and nuclear power reactors. T2K experiment. GADZOOKS experiment.

Observational Cosmology

Understanding the nature and origin of large-scale structure in the Universe is one of most compelling issues in observational cosmology. The currently most conventional scenario is given by the cold dark matter (CDM) dominated model, where gravitational instability mainly driven by spatial inhomogeneities of CDM distribution amplifies the seed density perturbations to form the present-day hierarchical structures. Therefore revealing distribution and amount of CDM is crucial to understanding the formation of large-scale structure. In addition the presence of dark energy drives the accelerating cosmic expansion, and therefore affects the growth of structure formation. The dark matter distribution and the nature of dark energy can be explored from massive galaxy surveys.

We have been actively working both on the measurements using currently available telescope facilities and on the planning of future instruments. The two powerful investigative tools are the gravitational lensing effect and the baryon acoustic oscillation.

Gravitational lensing effect:

The path of light ray emitted by a distant galaxy is bent by gravitational force of intervening large-scale structure during the propagation, causing the image to be distorted—the so-called weak lensing shear. Conversely, measuring the coherent shear signals between galaxy images allows us to reconstruct the distribution of invisible dark matter. Moreover, since the weak lensing shear deals with the light propagation on cosmological distance scales, the lensing strengths depend on the cosmic expansion history that is sensitive to the nature of dark energy. Thus weak lensing based observables offer a powerful way for studying the nature of invisible components, dark matter and dark energy. We are carrying out observational and theoretical studies of weak lensing phenomena using our own Subaru data sets as well as simulations of large-scale structure.

Baryon acoustic oscillation:

To measure properties of dark energy, one needs to measure the expansion history of the universe precisely. Because light travels at a finite speed, one can measure the expansion rate of the past by looking far. Comparing the expansion rate at varying distances would reveal the expansion history. The expansion itself is relatively easy to measure. The light emitted by a distant galaxy is stretched by the expansion of space and becomes redder, which can be measured by any decent spectrograph.

To measure the expansion history, however, we also need to know how far back in time the light was emitted from the galaxy, or equivalently, how far away it is. Measuring precise distances in cosmological scales is very challenging. Clustering of baryonic matter at a certain characteristic scale that is imprinted by baryon acoustic oscillation (BAO), or propagation of acoustic waves, in the early universe serves as a “standard ruler” for cosmological observations. This technique requires to study millions of galaxies in a wide field of view, and map the spatial distribution of luminous galaxies to detect the characteristic scale.

Hyper Suprime Camera (HSC):

The HSC, currently under construction, is the project to replace the prime focus camera of Subaru Telescope (8.2 meter optical-infrared telescope at the summit of 4,200m-Mauna Kea, Hawaii). with a new camera that has wider field-of-view than the current one by a factor of 10. Fully utilizing the unique capabilities of HSC, its survey speed and excellent image quality, we are planning and designing a massive galaxy survey that covers an area of a few thousands square degrees and reaches to the depth to probe the Universe up to red-shifts of a few. In fact these data sets will provide us an ideal data sets for exploring the nature of dark matter and dark energy via measurements of cosmological observables available from the data, weak lensing and galaxy clustering statistics. We, IPMU members, are actively involved in this HSC project, and working on the designing and planning of HSC galaxy survey and development of data analysis pipeline.

Sloan Digital Sky Survey III:

In January 2011, the SDSS-III collaboration released the largest digital color image of the sky ever made. The image has been put together over the last decade from millions of 2.8-megapixel images taken at the 2.5-meter telescope at the Apache Point Observatory in New Mexico, thus creating a color image of more than a trillion pixels. This new SDSS-III data release, along with the previous SDSS-I and SDSS-II data releases that it builds upon, gives astronomers the most comprehensive view of the night sky ever made. SDSS data have already been used to discover nearly half a billion astronomical objects, including asteroids, stars, galaxies and distant quasars.

IPMU has been a part of the SDSS-III and involved in the study of these rich images. But our focus has been to conduct a new survey to a deeper universe with the improved spectrograph. This survey, the Baryon Oscillation Spectroscopic Survey (BOSS), maps the spatial distribution of luminous galaxies and quasars to detect the characteristic scale imprinted by baryon acoustic oscillations in the early universe. Using the acoustic scale as a standard ruler, we can infer the angular diameter distance to the galaxy redshift. The BOSS has started to take data in 2009 and will continue until 2014. Its goal is to precisely measure how Dark Energy has changed over the recent history of the Universe.

PrimeFocusSpectrograph (PFS):

The PFS project that mounts a next generation spectrograph on the Subaru telescope and is planned to start data taking later this decade was overwelmingly endorsed at the Subaru Users meeting of January 2011. Using a wide angle view of Subaru telescope and the PFS, we can study several thousand galaxies at the same time and use the baryon acoustic oscillation technique.

In addition to BAO, there are a number of other measurements to constrain the properties of dark energy using this instrument. Furthermore, this type of spectrograph with a large field of view and a massive multi-object capability will be unique among the largest telescopes in the world, allowing for unprecedented studies of formation and evolution of galaxies, as well as the assembly history of our own Milky Way Galaxy.

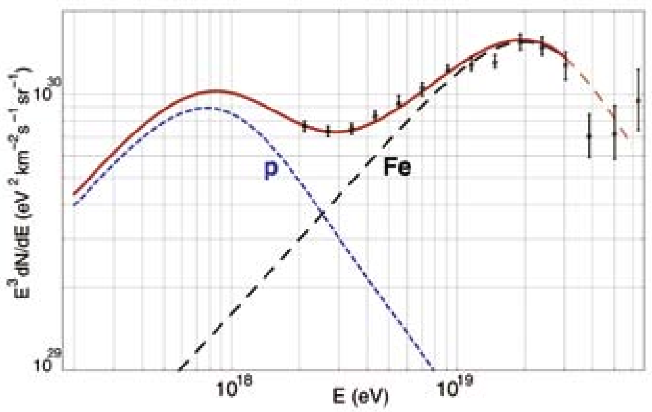
The strength of this project comes from exploiting the data using HyperSuprimeCam (HSC), a 3-tonne digital camera with 900 million pixels, slated for the first light later this year. The combination of imaging using HSC and spectroscopy using PFS on Subaru is dubbed SuMIRe, Subaru Measurement of Images and Redshifts. The SuMIRe project is expected to repeat and exceed the tremendous success of Sloan Digital Sky Survey (SDSS), but with a much deeper view of the Universe back to the era that formed early stars and supermassive black holes.

Observational Cosmology Group

Member	Main Interest
Rafael S. de Souza	Statistical analysis, PCA.
Emille Ishida	Supernova cosmology - wide field surveys - Observational strategies.
Issha Kayo	Extraction of cosmological information from the large-scale structure of the Universe, particularly using the actual data taken by the Sloan Digital Sky Survey and virtual data generated by N-body simulations. Construction of a homogeneous catalog of gravitationally lensed quasars to constrain the dark energy.
Tsz Yan Lam	Galaxy surveys to constrain cosmological models. Large-scale structure probes of primordial non-Gaussianity.
Yen-Ting Lin	Formation and evolution of galaxies. Roles of galactic mergers and feedback from supermassive blackholes on the formation of giant galaxies. Data analysis of BOSS survey and radio surveys to elucidate the phenomenon of radio-loud active galactic nuclei. Evolutionary connections between galaxies at z=0 and z=1 using future HSC data.
Keiichi Maeda	Supernova cosmology, especially in the evaluation of applicability of Type Ia supernovae as cosmological distance indicators.
Takaya Nozawa	Evolution of dust throughout the cosmic history. Evaluation of the impacts of dust on the observational cosmology using Type Ia supernovae as a standard candle.
Naoshi Sugiyama	Investigation of the Cosmic Microwave Background. Testing of dark energy models using observational data such as the baryon acoustic oscillation and gravitational lensing.
Masahiro Takada	Observational and theoretical studies of gravitational lensing caused by hierarchical structures of the universe. Nature of dark side of the universe, dark matter and dark energy, with the gravitational lensing observables. Future Subaru Weak Lensing Survey.
Masaomi Tanaka	Supernova cosmology. Observations and modelling of nearby Type Ia supernovae to understand the origin of their diverse properties.
Masayuki Tanaka	Observational studies of the formation and evolution of galaxies and large-scale structures using data from the Sloan Digital Sky Survey, Subaru telescope, and Very Large Telescope.
Atsushi Taruya	Modeling dynamics and statistics of large-scale structure of the Universe, and testing various cosmological scenarios and/or hypothesis through direct comparison between theory and observations. A pursuit of the prospects for future observations such as HSC and BOSS to constrain dark energy, massive neutrinos, primordial non-Gaussianity as well as to test theory of gravity.
Jun'ichi Yokoyama	Analysis of CMB anisotropy.
Naoki Yoshida	Large galaxy surveys and weak lensing observations. Computer simulations to generate a large number of mock catalogues for future observational programs.

Particle Astrophysics

High-energy phenomena naturally occurring in the universe provide a wealth of data and new valuable insights into particle physics and cosmology. IPMU researchers use the universe as a laboratory for testing new theories of dark matter and new physics beyond the Standard Model, and for understanding the basic properties of the universe. In the past year, several exciting developments in particle astrophysics were initiated by IPMU members.



Dark Matter

Its existence is supported by a substantial body of astrophysical evidence, but the identity of the dark matter particle (or particles) remains a mystery. Since one does not know the interactions of dark matter particles, besides their gravitational interactions, one must pursue a broad range of possibilities. IPMU researchers have studied several well-motivated possibilities, such as *number-theory dark matter, gravitino* in supersymmetric theories, *axions, sterile neutrinos, asymmetric, decaying,* and *universally leptophilic* dark matter.

Number-theory dark matter is an elegant and novel possibility proposed by Nakayama, Takahashi, and Yanagida. The stability of such dark-matter particles is due to a new symmetry, which is related to basic number theory and the Fermat theorem. (It is fitting that such a theory has emerged from an institute that has “physics and mathematics” ingrained in its name and in its mission.)

Matsumoto and collaborators have studied several dark matter candidates and their implications for cosmic-ray observations.

Kawasaki and collaborators have investigated cosmological aspects of inflation in supersymmetric axion models, as well as some general cosmological constraints on dark matter with velocity-dependent annihilation rates.

It is intriguing that the dark-matter particle can emerge from the neutrino sector in a natural and minimalistic fashion. Indeed, right-handed or sterile neutrinos are believed to exist at some scale, hence explaining the observed neutrino masses via the seesaw mechanism. If one of these additional fields appears to be light, as can happen in models with extra dimensions, the corresponding particle can account for cosmological dark matter. A simple model proposed by Kusenko, Takahashi, and Yanagida illustrates this possibility and motivates the search for sterile neutrinos. Loewenstein and Kusenko have began the first dedicated search for dark matter using three X-ray telescopes in space: *Chandra, XMM-Newton,* and *Suzaku.* The first published results include new limits on sterile dark matter, as well as a tantalizing feature in the Chandra data that may be the first hint of discovery. The search continues with scheduled new observations of dark-matter dominated dwarf spheroidal galaxies.

Ultra-high-energy cosmic rays

The UHECR presents a number of puzzles and scientific opportunities. Martens has spearheaded the experimental efforts at IPMU related to the Telescope Array experiment. On the theoretical side, Kusenko and collaborators have proposed that a non-negligible fraction of ultrahigh-energy nuclei in some energy range may come from past gamma-ray bursts and other unusual stellar explosions in our own Milky Way galaxy, thus explaining some recent data from Pierre Auger Observatory. While the protons leave the galaxy promptly, the nuclei get entangled in the web of galactic magnetic fields and bombard Earth over millions of years after the stellar explosion that produced them. This is first evidence of natural nuclear accelerators, such as gamma-ray bursts, in the past of our own galaxy.

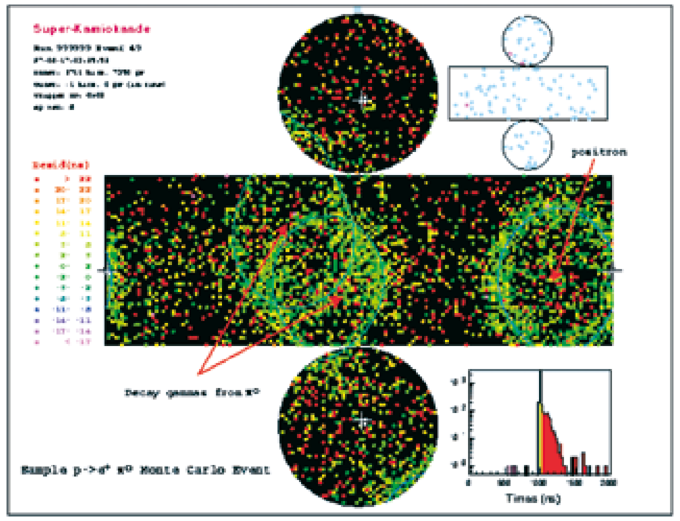
Very high energy gamma-rays

The VHEG from bright distant sources, such as supermassive black holes that accrete stellar matter and accelerate particles in gigantic jets, allow one to study both the most powerful objects in the universe and the properties of medium along the line of sight, such as the density of starlight photons and the intergalactic magnetic fields. Kusenko and collaborators have found a link between the observed gamma-ray signals from supermassive black holes and the cosmic rays produced in their jets. The surprising connection explains the observed spectra of the brightest gamma-ray sources in the universe, proves that cosmic rays are accelerated in active galactic nuclei, and sheds new light on cosmic backgrounds and magnetic fields. In particular, observational evidence points to the existence of universal magnetic fields of femtogauss (10^{-15} Gauss) strengths. Such fields may have astrophysical or primordial origin, and may permeate deep space since long before the stars and galaxies have formed.

Particle Astrophysics Group

Member	Main Interest
Cosimo Bambi	General Relativity is our current and successful theory of gravity, but it has been tested essentially only in the perturbative and weak field limit. The challenge is to figure out if its predictions are still reliable in other contexts, such as the description of the universe or black hole physics.
Koichi Hamaguchi	Physics beyond the standard model, in particular SUSY models, their LHC phenomenology and application to cosmology (baryogenesis, BBN constraints, dark matter and its signatures).
Karsten Heeger	Solar neutrinos.
Junji Hisano	Theoretical studies for dark matter detection.
Alexander Kusenko	Ultrahigh-energy cosmic rays and very high energy gamma rays, dark matter, astrophysical neutrinos.
Sourav Mandal	Models beyond the Standard Model, and their signatures in astrophysics, cosmic rays and colliders.
Kai Martens	The Telescope Array experiment studies the highest energy cosmic rays that permeate the Universe with the aim to positively identify their origin. On the way to that lofty goal I want to use hybrid events to better understand the air showers themselves.
Hitoshi Murayama	
Mihoko Nojiri	
Seong Chan Park	Dark matter is my primary concern. As a short term goal, I hope to explain the recently reported "anomalies" in astrophysical observations: The 511 keV line from the galactic center and the positron excess preliminarily reported by PAMELA. I am also interested in linking DM with inflaton.
Jing Shu	Baryogenesis, electroweak phase transition, topological defects, and dark matter.
Naoshi Sugiyama	Acceleration of cosmic rays and its relevance for structures of the universe.
Fuminobu Takahashi	High-energy cosmic rays from dark matter.
Mark Vagins	My work involves probing the reactions within the sun via its neutrino emissions, as well as measuring the dynamics of supernovas via their neutrino spectra and time structure. Neutron detection in large water Cherenkov detectors would allow early warning, up to a week in advance, of the impending stellar collapse of a large, relatively nearby star like Betelgeuse, and it would enable the detection of very late-time black hole formation following supernova explosions anywhere within our galaxy.

Proton Decay



The stability of the proton represents one of the greatest theoretical and experimental challenges in particle physics today. In most grand unified theories, particularly those with a TeV intermediate mass scale, the proton "wants" to decay. Experimentally, however, the proton seems determined to outlive us all. Beginning with the first large-scale searches in the 1980's, one promising theory after another has floundered on the shoals of nucleon decay. To date, no hint of a nucleon decay signal has emerged.

In spite of this, the study of nucleon decay provides one of the few approaches to the problem of confronting grand unified theories with experimental data, and any progress toward this goal has unique value for the future development of physics. This program has already been a success. The simplest unification model, minimal SU(5), has been ruled out by the experimental results. Every subsequent grand unification theory will remain only a mathematical construct if further experimental information is not available.

The search for nucleon decay requires massive detectors. A search with a sensitivity of 10^{33} years, for example, requires a detector with approximately 10^{33} nucleons. Since there are 6×10^{29} nucleons per ton of material, this implies detectors of multi-kiloton scale.

The "classical" proton decay mode, $p \rightarrow e+ \pi^0$, can be efficiently detected with low background. At present, the best limit on this mode ($\tau / \beta > 1.21 \times 10^{34}$ yr, 90% CL) comes from a 206 kton-yr exposure of Super-Kamiokande. The detection efficiency of 45% is dominated by final-state π^0 absorption or charge-exchange in the nucleus, and the expected background is 2 events/Mton-yr.

Supersymmetric theories favor the mode $p \rightarrow \nu K^+$, which is experimentally more difficult due to the unobservable neutrino. The present limit from Super-Kamiokande is the result of combining several channels, the most sensitive of which is $K^+ \rightarrow \mu^+ \nu$ accompanied by a de-excitation signature from the remnant ^{15}N nucleus. Monte Carlo studies suggest that this mode should remain background free for the foreseeable future. The present combined limit is $\tau / \beta > 3.3 \times 10^{33}$ yr (90% CL).

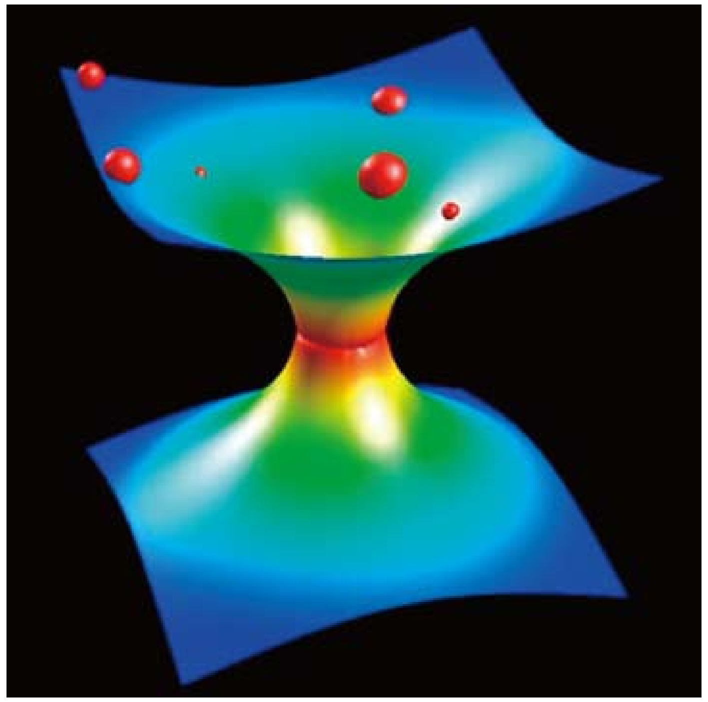
Recent theoretical work suggests that if super-symmetric SO(10) provides the framework for grand-unification, the proton lifetime (into the favored νK^+ decay mode) must lie within about one order of magnitude of present limits. Similarly, SO(10) theories suggest $\tau / \beta (e \pi^0) \approx 10^{35}$ years—about a factor of ten beyond the present limit. Thus, continued progress in the search for nucleon decay inevitably requires larger detectors.

Moreover, the enormous mass and exposure required to improve significantly on existing limits (and the unknowable prospects for positive detection) underline the importance of any future experiment's ability to address other important physics questions while waiting for the proton to decay. Proton decay experiments have made fundamental contributions to neutrino physics and particle astrophysics in the past, and any future experiment must be prepared to do the same.

Proton Decay Group

Member	Main Interest
Takaaki Kajita	Updated searches for proton decays.
Henry W. Sobel	Updated measurement of proton decay.
Yoichiro Suzuki	Future large water Cherenkov detectors and also future multipurpose detectors for dark matter, double beta decay and low energy solar neutrinos. Development of a new type of light sensor for such detectors.
Mark Vagins	Improving the proton decay measurement in water-based detectors via detection of free neutrons significantly suppressing atmospheric neutrino-induced proton decay backgrounds. Development of nextgeneration, megaton-scale experiments for proton decay.

String Theory



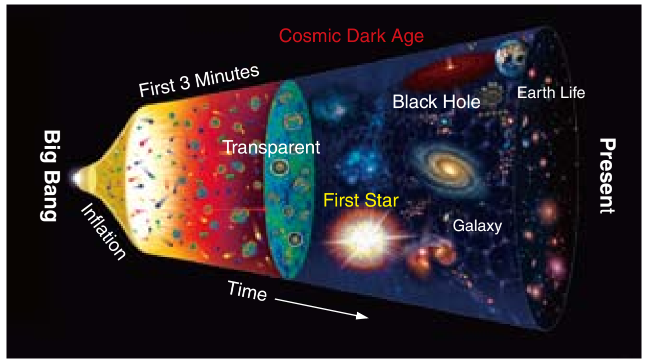
In the past few hundred years, scientists have searched for fundamental laws of nature by exploring phenomena at shorter and shorter distances. Does this progression continue indefinitely? Surprisingly, there are reasons to think that the hierarchical structure of nature will terminate at 10^{-35} meter, the so-called Planck length. Let us perform a thought-experiment to explain why this might be the case. Physicists build particle colliders to probe short distances. The more energy we use to collide particles, the shorter distances we can explore. This has been the case so far. One may then ask: can we build a collider with energy so high that it can probe distances shorter than the Planck length? The answer is no. When we collide particles with such high energy, a black hole will form and its event horizon will conceal the entire interaction area. Stated in another way, the measurement at this energy would perturb the geometry so much that the fabric of space and time would be torn apart. This would prevent physicists from ever seeing what is happening at distances shorter than the Planck length. This is a new kind of uncertainty principle. The Planck length is truly fundamental since it is the distance where the hierarchical structure of nature will terminate.

Space and time do not exist beyond the Planck scale, and they should emerge from a more fundamental structure. Superstring theory is a leading candidate for a mathematical framework to describe physics at the Planck scale since it contains all the ingredients necessary to unify general relativity and quantum mechanics and to deduce the Standard Model of particle physics. Superstring theory has helped us solve various mysteries of quantum gravity such as the information paradox of black holes posed by Stephen Hawking. The theory has given us insights into early universe cosmology and models beyond the Standard Model of particle physics. It provides powerful tools to study many difficult problems in theoretical physics—often involving strongly interacting systems—such as QCD (theory of quark interactions), quantum liquid and quantum phase transitions. It has also inspired many important developments in mathematics. All of these aspects of string theory are vigorously investigated at IPMU.

String Theory Group

Member	Main Interest
Mitsutoshi Fujita	Gauge/gravity correspondence, flavor branes, and condensed matter physics.
Simeon Hellerman	String theory and its connections to quantum gravity, cosmology, condensed matter, particle physics and mathematics. Development of tools to understand and apply string theory in generic environments.
Minxin Huang	Aspects of the AdS/CFT correspondence such as pp-waves, and giant gravitons. Topological string theory.
Kentaro Hori	4d N=1 string compactifications in various frameworks, especially, worldsheet approaches to Type II orientifolds with D-branes and fluxes, M-theory on G_ 2 holonomy manifolds, worldsheet approaches to heterotic strings. Topological strings as well as supersymmetric gauge theories in various dimensions.
Shinobu Hosono	Mirror symmetry of Calabi-Yau manifolds and its applications to Gromov-Witten theory.
Toshiya Imoto	Holographic QCD.
Johanna Knapp	Mathematical structure of the compact dimensions, dualities, such as mirror symmetry, which relate different string compactifications.
Wei Li	Black holes. Gauge/Gravity correspondence. 3D quantum gravity.
Todor Milanov	Topological string theory and its applications in geometry.
Shinji Mukohyama	String cosmology.
Hirosi Ooguri	Development of theoretical tools to apply string theory to questions relevant to high energy physics, astrophysics, and cosmology.
Yutaka Ookouchi	4D supersymmetric gauge theories and its application to problems in particle physics, including their work via string theories such as a gauge/gravity duality.
Domenico Orlando	Exact CFT solutions. Topological strings. Effective descriptions for M-theory.
Susanne Reffert	String compactifications. Topological string theory.
Johannes Schmude	Aspects of gauge/string duality, especially flavor-branes.
Kenneth Shackleton	Connection between string theory and the completion of the Weil-Petersson metric on Teichmueller space.
Cornelius Schmidt-Colinet	Conformal field theory and its applications in string theory.
Shigeki Sugimoto	Conjectured duality between string theory and gauge theory, and its application to QCD and hadron physics.
Yuji Tachikawa	Study of supersymmetric field theories in various dimensions using the help of string theory; study of mathematical structures behind string theory.
Tadashi Takayanagi	String theory as quantum gravity especially from the viewpoint of holography such as AdS/CFT duality. Relation between the entanglement entropy and the gravitational entropy such as the black hole entropy.
Taizan Watari	String phenomenology. Inflation (in the past). GUT and F-theory compactification.
Simon Wood	Conformal field theory and understanding its implications in string theory.

Structure Formation



Adapted from "Physics of the history of the universe" by Yasuo Fukui *et al.*

There are rich structures in the present-day universe, such as stars, galaxies, and large-scale structure. We study how these objects are formed using large computer simulations and sophisticated theoretical models.

The standard Big Bang model posits that the universe was nearly homogeneous and very hot when it was born. Tiny "ripples" in the distribution of matter were generated through a rapid expansion phase called inflation in the very early universe. These primeval density fluctuations grew by the action of gravity, eventually forming luminous objects such as galaxies.

The energy content of the universe and basic statistic that describe the condition of the early universe have been determined with great accuracy from recent observations of cosmic microwave background radiation, large-scale galaxy distribution and distant supernovae. Cosmology is now at a stage where theory can make solid predictions, whereas a broad class of observations can be directly used to verify them. Planned large astronomical surveys such as Sloan Digital Sky Survey III and Subaru HyperSprime Cam Survey will provide rich information on the nature of dark matter and dark energy. Accurate theoretical predictions are needed to make the full use of the observational data.

Our primary interests are in primordial star formation in the early universe, the formation and evolution of galaxies, and the formation of large-scale structure. Results from these studies will be used for making good plans and proposals for Subaru-HSC/PFS dark energy survey.

Structure Formation Group

Member	Main Interest
Rafael S. de Souza	Primordial magnetic fields, first stars, dark matter halos, primordial gamma ray bursts.
Issha Kayo	Extraction of cosmological information from the large-scale structure of the Universe, particularly using the actual data taken by the Sloan Digital Sky Survey and virtual data generated by N-body simulations. Construction of a homogeneous catalog of gravitationally lensed quasars to constrain the dark energy.
Tsz Yan Lam	Distributions of dark matter halos and dark matter field. Environmental dependence of halo formation.
Yen-Ting Lin	Atacama Cosmology Telescope (ACT) project, a large cluster survey that detects clusters via the Sunyaev-Zel'dovich effect (SZE). Analyses of the data from ACT, SDSS, and Subaru, to study the evolution of galaxies within clusters, as well as to use the statistical properties of clusters (such as clustering and abundance) to constrain cosmology.
Tomoki Saito	Observational studies of high-redshift galaxies using the data from Subaru Telescope, Very Large Telescope, and various telescopes ranging from radio to X-ray. Calibration studies for wide-field imaging surveys with the Hyper Suprime-Cam.
Ikkoh Shimizu	Theoretical models of high redshift galaxies.
John Silverman	Observational studies of active galactic nuclei and their host galaxies. The formation and evolution of supermassive black holes are being investigated in survey fields including COSMOS, Chandra Deep Field South and the Sloan Digital Sky Survey. For example, we are carrying out a near-infrared spectroscopic survey of AGNs and quasars with Subaru/FMOS to measure the distribution of black hole masses and determine whether the local black hole-host galaxy mass relation holds at high redshift. Additional studies include the role of galaxy mergers in triggering accretion onto supermassive black holes and the influence of larger scale structures such as galaxy groups and clusters.
Naoshi Sugiyama	Investigation of linear evolution of structure in the universe and effect of magnetic fields.
Masahiro Takada	Observational and theoretical studies of gravitational lensing caused by hierarchical structures of the universe. Nature of dark side of the universe, dark matter and dark energy, with the gravitational lensing observables. Future Subaru Weak Lensing Survey.
Masayuki Tanaka	Observational studies of the formation and evolution of galaxies and large-scale structures using data from the Sloan Digital Sky Survey, Subaru telescope, and Very Large Telescope.
Atsushi Taruya	Modeling dynamics and statistics of large-scale structure of the Universe, and testing various cosmological scenarios and/or hypothesis through direct comparison between theory and observations. A pursuit of the prospects for future observations such as HSC and BOSS to constrain dark energy, massive neutrinos, primordial non-Gaussianity as well as to test theory of gravity.
Naoki Yoshida	Formation of stars, galaxies and the large-scale structure of the universe using supercomputer simulations.

Supernova

Credit: Subaru telescope

Supernovae are explosions of stars at the end of their lives. Core-collapse supernovae (Type II, Ib, and Ic) are the outcome of the gravitational collapse of massive stars (i.e., more than ten times as massive as the Sun), followed by formation of a neutron star or a black hole, announced by a huge amount of neutrinos. Thermonuclear supernovae (Type Ia) are explosions driven by nuclear reactions within a white-dwarf star.

Supernovae provide natural laboratories for a range of physical processes, such as neutrino physics, some of which cannot be addressed by experiments on the Earth. Furthermore, they are the main contributors of heavy elements in the Universe; without them, baryons in the Universe would be only hydrogen, helium and some minor elements, although in reality the Universe is filled with about a hundred different sorts of elements. Their energy produced at the explosions is huge, and supernova explosions could play important roles even in formation and evolution of galaxies. Finally, importance of understanding their natures is highlighted by their use as cosmological distance indicators, leading to the discovery of the Dark Energy.

Our understanding of the above issues is still far from satisfying, with various issues still under investigation. At IPMU, we cover most of the topics related to supernovae both in theory and observation/experiment; Evolution of stars toward supernovae, theory of explosions, attempt to detect these neutrinos at Kamioka, nucleosynthesis of elements up to iron and beyond, formation of dust grains, theory of optical emission from supernovae and evaluation of their use as cosmological distance indicators, and observations using the Subaru telescope including future large survey planning with the HSC. By unifying these attempts, we aim to comprehensively understand supernovae and their influences on the evolution of the Universe.

Supernova Group

Member	Main Interest
Melina Bersten	Hydrodynamical models of core-collapse supernovae with the aim to study the physical properties of the progenitor stars.
Emille Ishida	Type Ia supernova-Influence on galaxies dark matter profile-Signatures in baryonic environment.
Rafael S. de Souza	Influence of the supernovae explosions in the dark matter density profile, magnetization of the universe by first supernovae.
Gaston Folatelli	Supernova observations, including searches and intensive photometric and spectroscopic follow up. The goal is to gain a deeper understanding of the physical processes involved in the explosion, and of the stellar evolution paths that lead to different types of supernovae.
Alexander Kusenko	Pulsar kicks, supernova neutrinos, supernova asymmetries.
Keiichi Maeda	Theory of nucleosynthesis and radiation transfer. Observations of individual supernovae.
Masayuki Nakahata	Search for supernova neutrinos using Super-Kamiokande detector. It covers both supernova burst neutrinos and supernova relic neutrinos.
Ken'ichi Nomoto	Type Ia supernova cosmology to provide precision constraints on cosmic acceleration and the equation of state of dark energy by clarifying the progenitors and explosion mechanism. Evolution and nucleosynthesis of first stars to study cosmic chemical evolution. Gamma-ray bursts and hypernovae to clarify the production mechanisms of huge explosion energy from black holes and neutron stars.
Takaya Nozawa	Evolution of dust at high redshifts, considering the formation of dust in supernovae and destruction of dust in the shock driven by supernovae.
Henry W. Sobel	Super-Kamiokande and T2K for studying neutrino physics, supernova, and proton decay.
Yoichiro Suzuki	Development of future multi-megaton detectors which can detect neutrino bursts from supernovae every year.
Yasuo Takeuchi	Real-time neutrino burst search in Super-Kamiokande.
Masaomi Tanaka	Observations of core-collapse and Type Ia supernovae especially with optical spectroscopy and spectropolarimetry. Numerical simulations of radiative transfer.
Mark Vagins	Detection of the diffuse neutrino background produced by distant supernovae. Improvement of Super-Kamiokande experiment's response to the arrival of a burst of neutrinos from a supernova within our galaxy.
Naoki Yoshida	Theory of evolution of very massive stars and core-collapse supernovae. Supernova light-curves and hunting for high redshift supernovae using groud-based and space telescopes.

6 Research Highlight

Shedding Light on Dark Radiation

One of the most important discoveries in cosmology is that the Universe is expanding. According to general relativity, the expansion rate is determined by the energy contained in the Universe. In fact, measuring the expansion rate has been one of the central issues, because it provides fundamental cosmic age and distance scales. For instance, a precise measurement of Type Ia supernovae revealed that the present Universe is filled with dark energy, which accelerates the cosmic expansion. It is even possible to infer the particle content of the Universe in the past, by measuring the primordial abundance of ^{4}He, the cosmic microwave background (CMB) anisotropies, and large scale structure (LSS).

The primordial abundance of ^{4}He was the key observational evidence for the big bang theory. The big bang nucleosynthesis (BBN) calculation agreed reasonably well with the observed ^{4}He mass fraction Y_p together with other light element abundances given in terms of a function of the baryon-to-photon ratio, η. In the post-WMAP era, η was determined to a very high accuracy, which allowed the internal consistency check of the BBN calculation based on the standard big bang cosmology. Recently, Izotov and Thuan claimed an excess of Y_p at the 2σ level which can be understood in terms of an extra light degrees of freedom, namely, dark radiation. The CMB and LSS data are also sensitive to the presence of such dark radiation after matter-radiation equality, and the recent analysis based on the CMB and LSS data shows a slight preference for dark radiation at the 2σ level. It is remarkable that, while the helium abundance, the CMB and LSS data are sensitive to the expansion rate of the Universe at vastly different times, all the data mildly favor dark radiation.

Suppose that there is indeed dark radiation. Question is then what it is made of. The dark radiation may be composed of unknown particles. Fuminobu Takahashi and Tsutomu Yanagida at IPMU, in collaboration with Kazunori Nakayama at KEK, tackled this timely and interesting issue and examined various theoretical possibilities from a cosmological, as well as from a particle physics point of view. Their main conclusion is that the most plausible candidate for dark radiation is a chiral fermion ψ charged under a new gauge symmetry, under which the standard model fermions such as quarks and leptons are also charged. Here the new gauge symmetry is to forbid a bare mass for the chiral fermion, and that is why it remains light and can be dark radiation. (If it had a large mass, it would be more like dark matter, not dark radiation.) In the early Universe, the chiral fermion ψ will be in thermal equilibrium through the new gauge interactions with the standard model particles. If the new gauge symmetry is spontaneously broken at TeV scale, the chiral fermion decouples from plasma after the QCD phase transition, and therefore accounts for dark radiation if it still remains light.

They also discussed a possible candidate for such new gauge symmetry. The simplest one is a U(1) gauge symmetry, which must be free from the quantum anomaly. One of the anomalyfree U(1)s is U(1)$_{B-L}$, which naturally appears in the SO(10) GUT. Actually, however, the U(1)$_{B-L}$ symmetry should be spontaneously broken at a scale much higher than the weak scale, in order to explain tiny neutrino masses through the see-saw mechanism. In fact, an additional anomaly-free U(1) often appears in the breaking pattern of a GUT gauge group with a higher rank. They showed that there is indeed a suitable candidate for the new U(1) gauge symmetry as well as the light chiral fermion ψ in an E_6-inspired GUT, which contains an additional U(1), as $E_6 \to SO(10) \times U(1)$.

The new gauge symmetry must be spontaneously broken at TeV scale, in order to account for the recent observations. Interestingly, therefore, it is in principle possible to directly probe the dark radiation sector at the collider experiments such as LHC! This was a rather unexpected result. The dark radiation may turn out to be a crucial key to understand not only the evolution of the early Universe, but also the high-energy physics from TeV scale up to the GUT scale.

Further reading: Physics Letters B **697**, 275 (2011).

Flat Dark-Matter Distribution

A team of researchers from Japan, Taiwan, and the United Kingdom has provided the first direct and clear evidence for an extremely flattened shape of dark-matter distribution in massive clusters of galaxies, a finding that confirms a major prediction of the prevailing dark matter model. The researchers took advantage of the gravitational lensing effect to make detailed measurements of the spatial distributions of dark matter in 20 massive clusters of galaxies. A thorough examination of the shape of dark-matter distribution in the cosmos may open up a new way to explore the nature of this enigmatic matter.

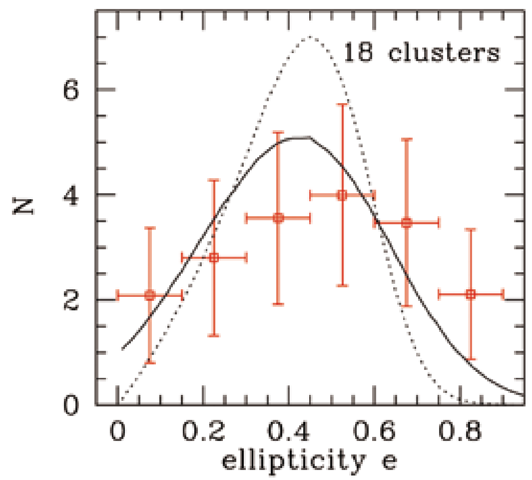
The nature of dark matter is still unknown and is currently a central problem in modern astronomy and physics. Dark matter is dark in a couple of ways. It is undetectable to visible light and has escaped detection at all electromagnetic wavelengths. Because it is invisible, its existence has to be inferred from its gravitational effect on other celestial objects as well as from theoretical models. Indirect evidence has established its relative abundance in our universe—probably five times greater than visible matter—in addition to its significance for understanding galaxy formation. For example, a considerable amount of dark matter probably sustains the structure of galaxies, because the gravitational force of visible matter cannot bind its member stars. The scientific challenge is how to study the nature of dark matter. Astronomers seek ways to use their observations to solve this puzzle.

One approach to a solution is to make detailed measurements of the spatial distribution of dark matter and then compare the data to predictions drawn from theoretical models. Both aspects of this approach have their difficulties. How can the distribution of dark matter be measured? What are plausible assumptions to include in models of dark matter?

A team led by Masamune Oguri at the National Astronomical Observatory of Japan and Masahiro Takada at IPMU decided to use gravitational lensing to measure and analyze the distribution of dark matter. Gravitational lensing provides a unique opportunity to explore dark matter distributions by measuring the distances that light travels from distant to foreground objects. Einstein's general theory of relativity predicts that light from a distant object will bend around a massive object in the foreground, e.g., a cluster of galaxies or a concentration of dark matter. By measuring the distortion pattern of many distant galaxies, it is possible to infer the mass(es) of the object(s) in the foreground. Since the technique does not rely on assumptions about the visibility of the matter bending the light, gravitational lensing can be a powerful probe of dark matter.

A Subaru image of the A2390 cluster region is superimposed with the analysis result for dark matter distribution. Purple hue shows the dark matter distribution, with the darker color indicating the denser dark matter concentration.

The team fine-tuned their research by observing 20 massive clusters of galaxies with the Subaru Telescope's Prime Focus Camera (Suprime-Cam). Clusters of galaxies are ideal sites for studying the distribution of dark matter, because they contain thousands of galaxies and are known to accompany a large amount of dark matter. The superb light-collecting power and excellent image quality of the Subaru Telescope gave the researchers an extra advantage. By using Suprime-Cam at prime focus, they could capture objects in a particularly wide field-of-view.



Ellipticity of the dark matter distribution for 18 galaxy clusters. Zero ellipticity means that the distribution is spherical, while a larger value indicates a more flattened distribution. The measurement peaks at around 0.5 (corresponding the 2:1 ratio of major to minor axes of the ellipse). The black curve shows a theoretical prediction based on the standard collisionless, cold dark matter model (Yipeng Jing and Yasushi Suto, 2002), in good agreement with the observation.

Observations with Suprime-Cam yielded wide-field images of 20 massive clusters of galaxies (typically located at 3 billion light years from Earth), which the team then used to measure and analyze dark matter distributions (first figure). From their detailed analysis of gravitational lensing effects in the images, the team obtained clear evidence that the distribution of dark matter in the clusters has, on average, an extremely flattened shape rather than a simple spherical contour (second figure). The measured degree of the flattening is quite large, corresponding to 2:1 in terms of the ratio of major to minor axes of the ellipse. This finding represents the first direct and clear detection of flattening in the dark matter distribution with the use of gravitational lensing.

In addition to the promise of using gravitational lensing for exploring the nature of dark matter, this research contributes to the theoretical modeling of dark matter. Detailed comparisons of the team's findings with theoretical model predictions show that the observed degree of the flattening is in excellent agreement with theoretical expectations.

Theoretical predictions depend on what kind of dark matter model is assumed. This research strongly supports the prevailing model, which begins with the assumption that dark matter consists of weakly interacting massive particles that are relics of the Big Bang. These particles are assumed to be "cold," i.e., thermal motions of the particles are negligibly small. According to this scenario, clusters of galaxies are dynamically young objects that form through the merging of many small objects. This theory predicts that the dark matter distribution in clusters of galaxies would be non-spherical, reflecting a large-scale structure of dark matter filaments (i.e, ribbons of cold material). Since the team's findings confirm a non-spherical distribution, they demonstrate the feasibility of exploring the nature of dark matter via flattening in the dark matter distribution.

Further reading: Monthly Notices of the Royal Astronomical Society 405, 2215, 2010.

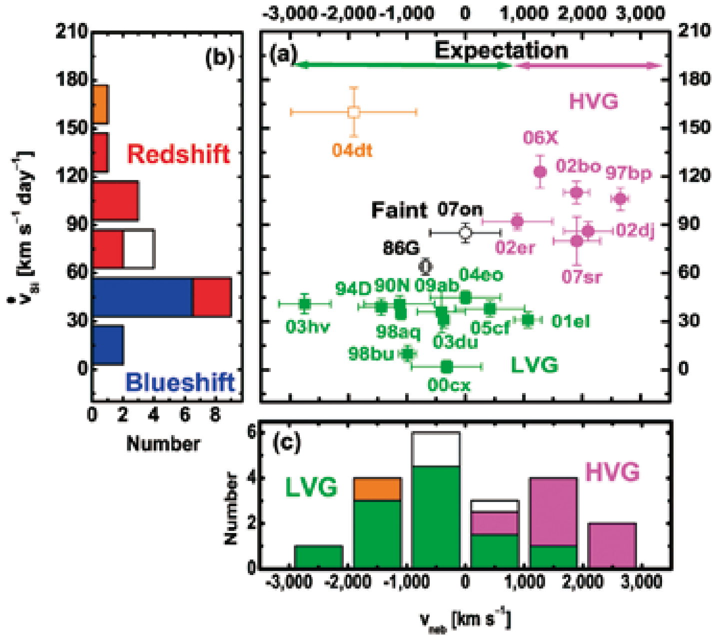
Research Highlight

Are "Standard Candles" Really Standard?

Type Ia supernovae have been playing a key role in cosmology and in the discovery of the Dark Energy, since they can be used to measure distances across the Universe. This relies on the well-developed relation between their brightness and the decline rates—brighter supernovae decline slower.

This single-parameter description of type Ia supernovae may well reflect the uniform nature of the progenitor system. Type Ia supernovae are explosions of a white dwarf consisting of carbon and oxygen. The explosion is triggered by sparks of thermonuclear flames ignited in the innermost part of the white dwarf, although how the explosion is initiated is still in debate. The explosion most likely takes place when the white dwarf reaches the so-called Chandrasekhar mass (about 1.4 times the Sun) through accreting materials from its binary companion or by merging with another white dwarf.

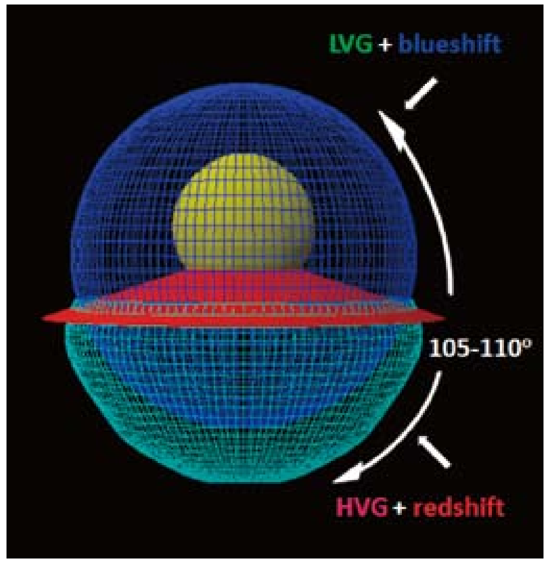
However, recent investigations have revealed that the true nature of type Ia supernovae is far more complicated. They indeed do not look like a uniform system in their spectral features: type Ia supernovae that look like twins concerning their luminosity evolution can demonstrate a quite different behavior in the speed with which their spectral features evolve (the so-called velocity gradient). This spectral evolution diversity was first noticed in the late 1980s, and quantified beyond the doubt in 2005. The origin of this diversity has not been clarified, raising a couple of concerns: Are they really good standard candles? Are they indeed from a uniform progenitor system?



(a) The relation between the velocity gradient (vertical axis, measuring the speed of spectral evolution) and the late-time emission velocity shift (horizontal axis, in which the wavelength shift is converted to the velocity shift). These two independent quantities have turned out to be correlated strongly, indicating that these diversities have the same physical origin. (b, c) The number of type Ia supernovae as a function of (b) the velocity gradient, and (c) the late-time emission shift.

The research group led by Keiichi Maeda (also including Ken'ichi Nomoto and Masaomi Tanaka of IPMU) has reported that they have finally identified the origin of the diversity. They have found that the velocity gradient is closely related to another independent observed quantity, namely the wavelength shift of emission lines in late-time spectra of type Ia supernovae taken about > 200 days after the explosion (first figure). This late-time emission-line shift has a straightforward interpretation that the shift can arise only if the innermost part of supernovae is asymmetric and the degree of the shift depends on the direction from which a SN is observed. Now the origin of the spectral evolution diversity must be the same: it is merely a consequence of the random directions from which an SN is viewed.

This finding is not only about uncovering the origin of the spectral diversity. It can get rid of a concern about using type Ia supernovae for cosmology, since this viewing angle effect will average out if we collect many supernovae for cosmology. In addition, the idea of the uniform progenitor system is rescued. Finally, this is the first strong observational indication about how the thermonuclear flames are ignited in the explosion: the finding points to asymmetric, off-centre explosions, as opposed to what most people had believed so far.



A schematic picture of structure of type Ia supernovae derived by the observations. The ash of the initial sparks is at an offset (yellow). Depending on the viewing direction from which a supernova is observed, a supernova manifests different spectral properties: If viewed from the offset direction, it appears as a Low-Velocity-Gradient SN and shows blueshift in late-times. From the opposite direction, a SN is a High-Velocity- Gradient SN and shows redshift (as is shoawn in the observational data in the first figure). Here, low- and high-velocity-gradients SNe are those showing a slow and rapid evolution in spectral features, respectively.

Further reading: Nature2010 July 1 issue.

Instantons and Two-dimensional Conformal Field Theories

Instantons, which were introduced in the 1970s, are elementary excitations of the four-dimensional gauge theory, localized in both spatial and temporal directions. They play important roles in the theoretical understanding of the dynamics of the quantum chromodynamics governing the "strong force", one of the four basic forces of nature. Not only that, instantons turned out to be a rich source of mathematics. They obey a non-linear partial differential equation, which was found to be exactly solvable on a flat four-dimensional space by Atiyah, Drinfeld, Hitchin and Manin. Furthermore, instantons were shown by Donaldson to provide a host of new insights into the geometry of four-dimensional curved manifolds, revolutionizing the field.

Conformal field theory describes a physical system which is invariant under the change of the length scale. This typically happens when the system is at the critical point, that is, when the parameter is chosen very carefully so that its phase is about to change. A magnet exactly at the temperature when it loses its magnetization is an example of such a system. Conformal field theories in two dimensions are particularly interesting objects, because they have an infinite-dimensional symmetry. In the middle of 1980s, Belavin, Polyakov and Zamolodchikov showed that this infinite-dimensional symmetry allows us, in some cases, to completely determine the dynamics by the symmetry alone. Such systems can be experimentally realized, and the observed values were in agreement with the theoretical predictions.

Both instantons and two-dimensional conformal field theories are rigorous subjects in mathematical physics intensively studied in the last thirty years. People had observed that there are tantalizing similarities between these two types of objects, and finally in 2009, string theorists Alday, Gaiotto and Tachikawa found a concrete way to relate the quantity on one side to another quantity on the other side. The most basic instance of the relation is as follows: on the side of the instantons, one considers a statistical-mechanical ensemble of instantons, and compute its partition function; on the side of the two-dimesnional conformal field theory, one studies a coherent state of the system, and take the norm of that coherent state. By a simple mapping of parameters, the partition function of the four-dimensional theory agrees with the norm of the coherent state.

Instantons are objects in four-dimensional spacetime, two-dimensional conformal field theories are obviously theories in two-dimensional spacetime. Therefore connecting them was a nontrivial manner, from a traditional point of view of mathematical physics, which usually dealt with phenomena in a definite number of spacetime dimensions, usually equal or less than four because our spacetime is four-dimensional. String theory was useful in the following manner. First, the consistency of string theory requires that the spacetime is either ten or eleven-dimesnional. This causes great trouble when string theory is thought of as providing a microscopic description of the real world, because our world is four-dimensional. However having a lot of dimensions comes in handy in this case. String theory has solitonic objects called M5-branes, which extend along six spacetime directions. The M5-branes, being six-dimensional, can be put on the product of a four-dimensional curved manifold and a two-dimensional curved manifold. Then, physical quantities associated to the M5-branes can be calculated either from the four-dimensional view-point, or from the two-dimensional viewpoint. The first route reduces to the calculation involving instantons, and the second route reduces to two-dimensional conformal field theory. Most simply put, the important relation is that 6=4+2: the six-dimensional physics can encompass both two-dimensional and four-dimenisonal physics. String theorists Yuji Tachikawa and Min-xing Huang at IPMU have worked and written papers on this subject.

This relation can be thought of as an instance of general phenomena, where a calculation of a physical quantity in string theory reduces to two completely different-looking calculations. Mirror symmetry which relates symplectic geometry and complex geometry is another famous instance of this general phenomena. String theory is not at all rigorous from the point of view of contemporary mathematics. However, the relation extracted from string theory, such as mirror symmetry or this relation between instantons and two-dimensional conformal field theories, can be formulated completely rigorously, and becomes a conjecture to be proved by serious mathematicians.

In this particular example, the mathematically formulated version of this relation is that the equivariant cohomology group of the moduli space of instantons should have a natural action of the infinite-dimensional Virasoro algebra. There is in fact a subfield of mathematics called geometric representation theory, where infinite-dimensional algebras are constructed in terms of geometric structures, and this relation gave a lot of impetus to the experts in this field. Simplified versions of this statement has already been proved in 2010, and the full proof is said to be quite close.

This division of labor between string theorists and mathematicians can be compared to the division of labor between theoretical physicists and experimental physicists. Experimental physicists perform experiments, which theoretical physicists interpret and come up with a theory; then theoretical physicists give predictions and experimental physicists either confirm or disprove them by real data. Similarly, mathematicians provide theorems, which string theorists interpret in string theory; then string theorists give further conjectures in mathematics, which mathematicians prove by rigorous means.

Further reading: arXiv:1009.1126 and arXiv:1102.0076.

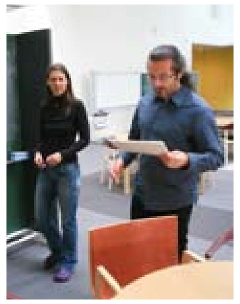
7 Awards

David Spergel won the Shaw Prize in Astronomy jointly with Charles Bennett of Johns Hopkins University and Lyman Page Jr of Princeton University in recognition of their pioneering work on the satellite experiment "Wilkinson Microwave Anisotropy Probe (WMAP)" that has contributed to breakthrough in better understanding the shape, makeup and age of the universe.

Ken'ichi Nomoto was awarded the Institut d'Astrophysique de Paris Medal for his theoretical contribution of the supernovae research. The IAP medal is awarded annually to an astrophysicist who made significant contribution in related fields on the occasion of IAP's annual colloquium.

Eiichiro Komatsu won the Nishinomiya-Yukawa Memorial Prize for his contribution to constrain the cosmology parameters such as the age of the universe and the dark energy, and to constrain the models of the early universe such as the inflation model using WMAP data.

Tadashi Takayanagi won the Yukawa-Kimura Prize for his contribution on "Holography and tachyon condensation in superstring theory." This prize is given annually to a scientist who made significant contribution to the fields of gravity theory, spacetime theories, and field theory. Selection is also based on if the recipients are likely to be expected to play a leading role in those fields in future.



Classical and Quantum Gravity (CQG) Journal has selected an article "The renormalizability of Horava-Lifshitz-type gravities" by Domenico Orlando and Susanne Reffert for one of the highlight papers of the period 2009-2010. This journal is well acknowledged among physicists, mathematicians and cosmologists in the fields of gravitation and the theory of spacetime.

Young Scientist Award of the Physical Society of Japan was awarded to Fuminobu Takahashi based on his three publications, “Gravitino overproduction in inflaton decay,” “The gravitino overproduction problem in inflationary universe” and “Inflaton Decay in Supergravity.”

Toshiyuki Kobayashi won the Inoue Science Prize for his important contribution on analysis of symmetry of infinite dimensions. The citation said “His work is a beautiful harmony of all areas of basic concepts that constitute mathematics, namely algebra, geometry and analysis. His work has given great impacts on many areas of mathematics and has pioneered new areas of research.”

The Young Scientist Award in Theoretical Physics was awarded to Seong Chan Park based on his publication “Rotating black holes at future colliders: Greybody factors for brane fields,” which treated black holes in detail, for the first time, for building a particle physics model beyond-the-standard-model containing extra dimensions.

Yoichiro Suzuki won the Bruno Pontecorvo Prize for his outstanding contribution to the discovery of atmospheric and solar neutrino oscillations in the Super-Kamiokande experiment. The prize, awarded annually since 1995 by the Joint Institute for Nuclear Research (JINR) in Russia, recognizes significant achievements in elementary particle physics.

Serguey Petcov won the Bruno Pontecorvo Prize for his fundamental contribution to the investigation of neutrino propagation in matter, $\mu \to e + \gamma$, $\mu \to 3e$ processes and Majorana properties of neutrinos.

8 Seminars

JFY2010

Masaomi Tanaka (IPMU)
Spectropolarimetric View of Supernova Explosions
Apr 01, 2010

Hiroyuki Fuji (Nagoya)
Volume Conjecture and Topological Recursion
Apr 06, 2010

Joshua Ruderman (Princeton)
Hiding the Higgs with Lepton Jets
Apr 08, 2010

Bertrand Toen (Montpellier)
Lecture 1: Generalities on dg-categories
Apr 13, 2010

Bertrand Toen (Montpellier)
Lecture 2: Moduli 1: moduli space of simple objects
Apr 14, 2010

Alexander Kusenko (UCLA)
A tale of two spectra: from a gamma-ray puzzle to cosmic rays and dark matter
Apr 15, 2010

Bertrand Toen (Montpellier)
Lecture 3: Moduli 2: moduli of non simple objects and higher stacks
Apr 15, 2010

Boris Tsygan (Northwestern)
Oscillatory Modules and Applications to Symplectic Geometry
Apr 15, 2010

Bertrand Toen (Montpellier)
Lecture 4: Topological and motivic invariants of dg-categories
Apr 16, 2010

Bruce Draine (Princeton)
New Views of Interstellar Dust
Apr 19, 2010

Masato Taki (YITP)
2D Conformal Symmetries, 4D Gauge Theories, & AGT Relations
Apr 20, 2010

Bruce Draine (Princeton)
Lecture 1 Observed Properties of Interstellar Dust
Apr 20, 2010

Bruce Draine (Princeton)
Lecture 2 Physics of Interstellar Dust (1)
Apr 21, 2010

Christoph Weniger (DESY)
Decaying dark matter, anisotropies, lines, and the Fermi LAT gamma-ray data
Apr 22, 2010

Bruce Draine (Princeton)
Lecture 3 Physics of Interstellar Dust (2)
Apr 22, 2010

Andrea Prudenziati (SISSA)
Taming open/closed string duality with a Losev trick
Apr 23, 2010

Bruce Draine (Princeton)
Lecture 4 Dust in Galaxies
Apr 26, 2010

Akira Ishii (Hiroshima)
Dimer models and exceptional collections
Apr 26, 2010

Akishi Ikeda (Tokyo)
The correspondence between Frobenius algebra of Hurwitz numbers and matrix models
Apr 26, 2010

Bruce Draine (Princeton)
Lecture 5 Evolution of Interstellar Dust
Apr 27, 2010

Chris Belczynski (LANL, Warsaw Observatory)
Double Compact Objects in Universe
May 06, 2010

Kazushi Ueda (Osaka)
Dimer models and exceptional collections (Part 1) Tropical coamoebas and A-infinity categories (Part 2)
May 10, 2010

Daniel Moskovich (JSPS/RIMS Kyoto)
Untying coloured knots
May 11, 2010

Wolfgang Lerche (CERN)
Matrix Factorizations, Contact Terms and Intersecting Branes
May 11, 2010

Wolfgang Lerche (CERN)
Matrix Factorizations, Contact Terms and Intersecting Branes
May 12, 2010

Wolfgang Lerche (CERN)
Matrix Factorizations, Contact Terms and Intersecting Branes
May 13, 2010

Charlie Beil (UC Santa Barbara)
The geometry of noncommutative singularity resolutions: shrinking exceptional loci to zero size
May 17, 2010

Antal Jevicki (Brown)
Classical AdS String : Solutions and Dynamics of Moduli
May 18, 2010

Frans Klinkhamer (Karlsruhe Inst Tech)
New approach to the cosmological constant problem: q-theory
May 18, 2010

Satoshi Kondo (IPMU)
Part 1: First introduction to number theory
May 19, 2010

Satoshi Kondo (IPMU)
Part 2: Algebraic varieties (schemes) and some conjectures in number theory
May 19, 2010

Shigeki Matsumoto (Toyama)
CDMS II result and Light Higgs Boson Scenario of the MSSM
May 21, 2010

Poshak Gandhi (ISAS, JAXA)
New constraints on accretion from Optical and X-ray rapid timing observations of black hole binaries
May 25, 2010

Johanna Knapp (IPMU)
Global SO(10) F-theory GUTs
May 25, 2010

Robert Quimby (Caltech)
The Illuminating Deaths of Massive Stars
May 25, 2010

Lawrence Krauss (Arizona State)
Cosmology as Science? From Inflation to Eternity
May 26, 2010

Lawrence Krauss (Arizona State)
Primordial Gravitational Waves as Probes of the Early Universe
May 27, 2010

Takahiro Sumi (Nagoya)
Study of the Galactic structure and halo dark matter by Gravitational microlensing
May 27, 2010

Matthew Headrick (Brandeis)
New approaches to numerical Calabi-Yau metrics
Jun 01, 2010

Daniel Greenwald (Max Planck Inst)
Muon Colliders & Frictional Cooling
Jun 01, 2010

Linda Uruchurtu (Imperial College London)
Warped anti-de Sitter spaces from brane intersections in type II string theory
Jun 08, 2010

Andreas Karch (U Washington, Seattle)
A Particle Physicist's Perspective on Topological Insulators
Jun 15, 2010

Martijn Wijnholt (Max Planck Inst)
MSW Instantons
Jun 15, 2010

Jounghun Lee (Seoul Nat U)
Bullet Cluster: A Challenge to LCDM Cosmology
Jun 17, 2010

Roger Blandford (KIPAC, Stanford)
Fermi's Restless Universe
Jun 18, 2010

Masahiro Futaki (Tokyo)
Homological mirror symmetry for toric Fano stack and suspension for directed Fukaya categories
Jun 21, 2010

Nakwoo Kim (Kyung Hee U)
Holographic superconductors from M5-branes
Jun 22, 2010

Almudena Arcones (Basel)
Heavy element synthesis in neutrino-driven neutron-star winds of core collapse supernovae
Jun 22, 2010

Kentaro Nagao (Nagoya)
Donaldson-Thomas theory and cluster algebras
Jun 28, 2010

Alexander Voronov (Minnesota)
Higher Categories and TQFTs
Jun 29, 2010

Brian Wecht (IAS)
Recursion Relations and String Theory Amplitudes
Jun 30, 2010

Andrei Frolov (Simon Fraser)
Non-linear dynamics and primordial curvature perturbations from preheating
Jul 06, 2010

Valery Rubakov (Moscow, INR)
Infrared modified gravity with dynamical connection
Jul 08, 2010

Daniel Holz (Los Alamos)
Cosmology from gravitational-wave standard sirens
Jul 09, 2010

Martin Guest (Tokyo Met U)
Differential equations aspects of quantum cohomology (Part 1) Some new solutions of the tt*-equations (Part 2)
Jul 12, 2010

Nobuhiko Katayama (KEK)
B is for BIRD
Jul 13, 2010

Alexander Voronov (Minnesota)
Introduction to Quantum Deformation Theory
Jul 13, 2010

Alexis Finoguenov (MPE)
Groups and clusters of galaxies in deep X-ray surveys
Jul 14, 2010

Daisuke Nagai (Yale)
Cosmology and Astrophysics with Galaxy Clusters: Recent Advances and Future Challenges
Jul 15, 2010

Alexander Voronov (Minnesota)
Quantum Deformation Theory
Jul 20, 2010

Yuu Niino (Kyoto)
Host Galaxies of "Dark" Gamma-Ray Bursts
Jul 21, 2010

Kentaro Nagamine (U Nevada Las Vegas)
Galaxy Formation with Cosmological Hydrodynamic Simulations in the JWST Era
Jul 21, 2010

Valya Khoze (IPPP Durham)
Phenomenology of Pure General Gauge Mediation
Jul 22, 2010

Ed Segal (Imperial college London)
The Calabi-Yau/Landau-Ginzburg correspondence for B-branes
Jul 26, 2010

Zheng Zheng (Yale)
Radiative Transfer Modeling of Lyman Alpha Emitters and New Effects in Galaxy Clustering
Jul 27, 2010

Alexander Voronov (Minnesota)
Quantum Deformation Theory
Jul 27, 2010

Yutaka Hosotani (Osaka)
Gauge-Higgs Unification: Stable Higgs, Dark Matter, and Colliders
Jul 29, 2010

Zohar Komargodski (IAS)
Methods in Supersymmetric Field Theories and Supergravity Theories
Aug 03, 2010

Massimo Porrati (New York U)
Strong Coupling and Causality in High-Spin Massive Particles: the Charged Spin 3/2 Example
Aug 04, 2010

Alexander Voronov (Minnesota)
Quantum Deformation Theory
Aug 05, 2010

Ragnar-Olaf Buchweitz (Toronto)
The Annihilator of the Derived Singularity Category
Aug 17, 2010

Alexander Voronov (Minnesota)
Quantum Deformation Theory
Aug 18, 2010

Masahito Yamazaki (IPMU)
Donaldson-Thomas invariants, wall-crossing and matrix models
Aug 23, 2010

Chris Brook (U Central Lancashire)
Forming Bulgeless Disk Galaxies
Aug 24, 2010

Alexander Voronov (Minnesota)
Quantum Deformation Theory
Aug 25, 2010

Cornelius Schmidt-Colinet (IPMU)
2-dimentional lattice models and renormalization
Aug 26, 2010

Kyoji Saito (IPMU)
Special Geometry (after Strominger)
Aug 27, 2010

Makoto Miura (Tokyo)
Toric degenerations of Grassmann manifolds and mirror symmetry
Aug 30, 2010

Mircea Voineagu (IPMU)
Semi-topological invariants of real algebraic varieties
Aug 31, 2010

Emanuel Scheidegger (Augsburg U)
The Yau-Zaslow conjecture and Noether- Lefschetz theory
Sep 01, 2010

Raphael Flauger (Yale)
Resonant Non-Gaussianity from Axion Monodromy Inflation
Sep 02, 2010

Shin Nakamura (Kyoto)
Negative Differential Registivity from Holography
Sep 02, 2010

Zengo Tsuboi (Osaka City U)
Wronskian solutions of T, Q and Y-systems for AdS/CFT
Sep 07, 2010

Adam Martin (Fermilab)
Boosting BSM Higgs discovery with jet substructure
Sep 09, 2010

Daniel Krefl (IPMU)
Instanton counting in Omega background and beyond
Sep 13, 2010

Scott Carnahan (IPMU)
Borcherds products in monstrous moonshine
Sep 14, 2010

Valeri Frolov (Alberta)
Motion of charged particles near weakly magnetized Schwarzschild black hole
Sep 16, 2010

Yutaka Ookouchi (IPMU)
Cosmological Aspects in Direct Gauge Mediation
Sep 22, 2010

Vincent Desjacques (ITP Zurich)
A discrete approach to halo and galaxy clustering
Sep 24, 2010

David Morrison (UC Santa Barbara/IPMU)
Quivers from Matrix Factorizations
Sep 27, 2010

Robbert Dijkgraaf (Amsterdam)
Gauge theories and matrix models
Oct 01, 2010

Domenico Orlando (IPMU)
Lectures on the Bethe Ansatz: the physical system and the original Bethe solution for the XXX1/2 spin chain
Oct 01, 2010

Nathan Broomhead (Leibniz)
Dimer models and noncommutative crepant resolutions
Oct 04, 2010

Alexei A. Starobinsky (Landau Inst)
Non-perturbative predictions of stochastic inflation and their dependence of initial conditions
Oct 07, 2010

Domenico Orlando (IPMU)
Lectures on the Bethe Ansatz: the Algebraic Bethe Ansatz for XXX1/2 spin chain
Oct 08, 2010

Washington Taylor (MIT)
Supergravity and string vacua in six dimensions
Oct 12, 2010

David Shih (IAS)
General Gauge Mediation at the Tevatron and LHC
Oct 13, 2010

Charles Steinhardt (IPMU)
New Puzzles in Supermassive Black Hole Evolution
Oct 14, 2010

Richard Eager (UC Santa Barbara)
Quivers, Non-Commutative Geometry, and AdS/CFT
Oct 14, 2010

Yifung (Bess) Ng (Case Western Reserve U)
The magnetized universe via CMB
Oct 14, 2010

Todor Milanov (IPMU)
Quasi-modular forms and Gromov–Witten theory of elliptic orbifold P^1
Oct 18, 2010

Todor Milanov (IPMU)
Gromov-Witten invariants and representations of infinite dimensional Lie algebras
Oct 19, 2010

Emille Ishida (IPMU)
The expanding Universe, PCA and supernova: an attempt to avoid dark energy parameterizations
Oct 19, 2010

Rafael da Silva de Souza (IPMU)
The Magnetized Universe
Oct 21, 2010

Koji Hashimoto (Riken)
Nuclear Matrix Model
Oct 26, 2010

Brian Feldstein (IPMU)
Luminous Dark Matter
Oct 28, 2010

Raphael Ponge (Tokyo)
Fefferman's program on conformal geometry and the Green functions of the conformal powers of the Laplacian
Oct 28, 2010

Yue Shen (CfA)
Searching for binary supermassive black holes: from tens of kpc to sub-pc scales
Nov 01, 2010

Ahmet Emir Gumrukcuoglu (IPMU)
Inflation, reheating and flat direction preheating
Nov 04, 2010

Luca Ciotti (Bologna)
Physical processes on stellar dynamics (relaxation, dynamical friction, phase-space consistency, etc)
Nov 04, 2010

Luca Ciotti (Bologna)
Tidal fields, stellar escape from galaxies in clusters
Nov 05, 2010

Domenico Orlando (IPMU)
Lectures on the Bethe Ansatz: the physical spectrum for the XXX1/2 spin chain
Nov 05, 2010

Davide Forcella (ENS)
Hydrodynamics, Holographic Optics and Negative Refractive Index
Nov 09, 2010

Hitoshi Murayama (IPMU)
Five Founding Questions of IPMU
Nov 11, 2010

Domenico Orlando (IPMU)
Lectures on the Bethe Ansatz: the XXZ spin chain and the SL(2)q quantum symmetry
Nov 12, 2010

Marco Baumgartl (LMU, Munich)
D-Brane Superpotentials: A Worldsheet Perspective
Nov 15, 2010

Ruben Minasian (CEA/Saclay)
String-Loop Corrections to c-a
Nov 16, 2010

Yoichi Mieda (Kyushu)
Lefschetz trace formula and the l-adic cohomology of the Rapoport-Zink spaces
Nov 16, 2010

Tomoyuki Abe (Tokyo)
The theory of arithmetic D-modules and characteristic cycles
Nov 17, 2010

Enrico Trincherini (SISSA)
The galileon
Nov 18, 2010

David Morrison (UC Santa Barbara)
Supersymmetric T^3 Fibrations
Nov 18, 2010

Alexey Bondal (IPMU/Aberdeen)
Mirror Symmetry for Minuscule Varieties
Nov 19, 2010

Domenico Orlando (IPMU)
Lectures on the Bethe Ansatz: recent developments
Nov 19, 2010

Sergei Gukov (Caltech)
Surface Operators and Wall Crossing
Nov 19, 2010

Yukiko Konishi (Kyoto)
Local B-model and mixed Hodge structure
Nov 22, 2010

Atsushi Nishizawa (IPMU)
Measurement of large scale fluctuation of CMB induced by large scale structure
Nov 25, 2010

Tomoki Nakanishi (Nagoya)
Dilogarithm identities in CFT and cluster algebras
Nov 25, 2010

Tomoo Matsumura (Cornell)
Hamiltonian torus actions on orbifolds and orbifold-GKM theorem (joint work with T. Holm)
Nov 26, 2010

Osamu Iyama (Nagoya)
Calabi-Yau triangulated categories and Cluster tilting
Nov 29, 2010

Scott Carnahan (IPMU)
Borcherds products in monstrous moonshine
Nov 29, 2010

Osamu Iyama (Nagoya)
Calabi-Yau triangulated categories and Cluster tilting
Nov 30, 2010

Krzysztof Gawedzki (ENS-Lyon)
Gerbes and Topological Actions in Field Theory
Nov 30, 2010

Krzysztof Gawedzki (ENS-Lyon)
Global Gauge Anomalies in Two Dimensions
Dec 01, 2010

Sergey Sibiryakov (Moscow INR)
Khrono-metric model: the low-energy limit of Horava-Lifshitz gravity
Dec 02, 2010

Robert Quimby (Caltech)
Charting the Transient Sky: The Palomar Transient Factory
Dec 03, 2010

Shri Kulkarni (Caltech)
The Next Generation Transient Facility
Dec 03, 2010

Martin Elvis (CfA)
Quasar Eclipses
Dec 06, 2010

Takeo Nishinou (Tohoku)
Toric degeneration and tropical curves
Dec 06, 2010

Takamitsu Miyaji (UNAM)
Clustering of AGNs from the ROSAT All-Sky Survey and Halo Occupation Distribution
Dec 07, 2010

Johannes Schmude (IPMU)
G-structures and calibrations in supergravity and steps towards SUSY breaking on the conifold
Dec 07, 2010

Alexey Bondal (IPMU/Aberdeen)
Degeneration of minuscule varieties, quiver toric varieties and mirror symmetry
Dec 08, 2010

Kevin Bundy (UC Berkeley)
How are Massive Galaxies Built Over Cosmic Time?
Dec 08, 2010

Toshiyuki Kobayashi (Tokyo)
Analysis on Minimal Representations
Dec 09, 2010

Masahide Shimizu (Hokkaido)
Open mirror symmetry for Pfaffian Calabi-Yau manifold
Dec 09, 2010

Constantin Teleman (UC Berkeley)
Lie group actions on linear categories
Dec 13, 2010

Serge Richard (U.Lyon, Tsukuba U)
Wave operators and a topological version of Levinson's theorem
Dec 14, 2010

Constantin Teleman (UC Berkeley)
The structure of 2D semi-simple field theories
Dec 14, 2010

Nemanja Kaloper (UC Davis)
Levitating Dark Matter
Dec 15, 2010

Shigeki Matsumoto (IPMU)
Fate of the False Vacuum Revisited
Dec 16, 2010

Xi Yin (Harvard)
Higher spin gauge theory and vector models
Dec 16, 2010

Gaston Folatelli (IPMU)
Distance Precision with Type Ia Supernovae
Jan 06, 2011

Albrecht Klemm (Bonn)
Wall-crossing holomorphic anomaly and mock modularity of multiple M5-branes
Jan 11, 2011

Fuminobu Takahashi (IPMU)
Another dark component of the Universe
Jan 13, 2011

Andrea Ferrara (Scuda Normale Superiore, Pisa)
First Stars and their Local Relics
Jan 21, 2011

Oscar Varela (MPG)
Consistent truncations from wrapped branes, and a Lifshitz solution
Jan 24, 2011

Maria J Rodriguez (MPI)
New nonspherical black holes and charged black rings
Jan 24, 2011

Luis Ho (Carnegie Observatories)
Supermassive Black Holes in Nearby Galaxies: Insights into Accretion and Jet Physics
Jan 24, 2011

Dongsu Bak (Seoul Nat U)
Phase Transitions in the U(1) Charged Sector of ABJM Theory
Jan 25, 2011

Luis Ho (Carnegie Observatories)
Coevolution of Black Holes and Galaxies: Recent Developments
Jan 26, 2011

Dmitry Kaledin (Steklov)
Witt vectors as a polynomial functor
Jan 31, 2011

Kwokwai Chan (IPMU)
Mirror symmetry for toric Calabi-Yau manifolds from the SYZ viewpoint
Jan 31, 2011

Melina Bersten (IPMU)
Comparing Hydrodynamic Models with Observations of Type II Plateau Supernovae
Feb 01, 2011

Kazuyuki Furuuchi (NCTS Hsinchu)
D-branes Wrapped on Fuzzy del Pezzo Surfaces
Feb 01, 2011

Stefano Liberati (SISSA)
Quantum Gravity phenomenology: achievements and challenges
Feb 03, 2011

Kwokwai Chan (IPMU)
The SYZ picture of mirror symmetry
Feb 04, 2011

Yoonbai Kim (Sungkyunkwan U)
Fluxes and BPS Vortices in ABJM model
Feb 08, 2011

Luc Dessart (Lab d'Astrophysique de Marseille)
Core-collapse supernovae: Cosmological probes and astrophysical laboratories for stellar evolution and explosion
Feb 09, 2011

Elena Sorokina (Sternberg Astronomical Inst)
Supernova Explosions inside Carbon-Oxygen Circumstellar Shells
Feb 10, 2011

Carsten Rott (Ohio State U)
Closing in on Dark Matter
Feb 15, 2011

Norikazu Yamada (KEK)
Search for Walking Technicolor theory using Lattice
Feb 17, 2011

Ed Turner (Princeton)
The Limits of Reductionism
Feb 18, 2011

Hiroshi Iritani (Kyoto)
Ruan's conjecture and integral structures in quantum cohomology
Feb 21, 2011

Roger Wendell (Duke)
Long and Longer Baseline Neutrino Oscillations: Searching for Symmetry Violation
Feb 22, 2011

Scott Dodelson (Fermilab/ U Chicago)
The Dark Sector vs. Modified Gravity
Feb 23, 2011

Yusei Koyama (Tokyo)
Panoramic mapping of star formation in and around distant clusters of galaxies
Feb 24, 2011

Michel Granger (Univ d'Angers)
Linear free divisors and quivers
Feb 28, 2011

Yuji Tachikawa (IPMU)
6 = 4+2
Mar 01, 2011

Hajime Sugai (Kyoto)
Active galaxies observed with integral field spectroscopy
Mar 03, 2011

Ezequiel Treister (Hawaii)
Super-massive Black Holes Across the Cosmic History
Mar 04, 2011

Takuya Okuda (Tokyo)
Exact results for 't Hooft loops in supersymmetric gauge theories
Mar 08, 2011

Shinobu Hosono (Tokyo)
Mirror symmetry and projective geometry of Reye congruences
Mar 10, 2011

Kentaro Hori (IPMU)
Motivation and Application of Recent Development in Supersymmetric Gauge Theories
Mar 10, 2011

Eibun Senaha (NCTS)
Electroweak baryogenesis in the MSSM revisited
Mar 31, 2011

9 Conferences

JFY2010

April 5–6
Workshop on Recent Advances in Mathematics at IPMU 2

April 28–29
Mini-Workshop on Cosmic Dust

June 28–July 2
CL J2010: from Massive Galaxy Formation to Dark Energy

July 13
IDEAS (IPMU Day of Extragalactic Astrophysics Seminars)
on Chemical Evolution

August 4–5
Workshop "Galaxy and Cosmology with Thirty Meter Telescope(TMT)"

September 9–10
Subaru Future Instrumentation Workshop

September 27–October 1
Horiba International Conference COSMO/CosPA 2010

October 4–8
Focus Week: String Cosmology

October 25–28
Workshop "Evolution of Massive Galaxies and Their AGNs with SDSS-III/BOSS Survey"

November 8–11
Mini Workshop on Neutrinos

November 15
Workshop on Population III Gamma-Ray Burst

December 1
The 4-th Meeting of OMEG Institute "Supernova Explosions and Nucleosynthesis"

December 9–10
PFS (Prime Focus Spectrograph) Science Workshop

February7–8, 2011
Workshop on Geometry and Analysis of Discriminants

February 24
Workshop "Log Hodge Theory and Elliptic Flat Invariants"

February 21–25
IPMU Workshop on Black Holes

10 Conference Talks

(including seminars given outside IPMU)

JFY2010

Seminar at SITP
(2010.04.13 - 05.02, Stanford University)
Simeon Hellerman
Cosmology and the large-D Matrix Model

Seminar at University of Kentucky
(2010.04.07 - 04.10, Lexington, Kentucky)
Simeon Hellerman
A Universal Inequality for CFT and Quantum Gravity

Seminar at Hsinchu University
(2010.04, Hsinchu, Taiwan)
Domenico Orlando
What is the next number in the sequence?

Theoretical AstroPhysics Including Relativity (TAPIR) Seminar
(2010.04.12, Caltech, Pasadena) Mark Vagins
GADZOOKS! Supernova Neutrinos Without the Annoying Wait

Colloquium at National Taiwan University
(2010.04.13, Taipei, Taiwan)
Chuan-Ren Chen
Recent Excitements in Particle Physics: LHC & Dark Matter

Seminar at National Taiwan University
(2010.04, Taipei, Taiwan)
Susanne Reffert
From Random Walks to non-Lorentz Invariant Field Theories

Strings at the LHC and in the Early Universe
(2010.04.17 - 05.07, KITP, Santa Barbara)
Taizan Watari
GUT's and Strings

Deciphering the Ancient Universe with Gamma-Ray Bursts
(2010.04.19 - 04.23, Kyoto)
Masahiro Takada
Hyper Suprime-Cam Survey
Ken'ichi Nomoto
Diversity of Supernovae and Its Relation to First Stars and GRBs

Seminar at IAS
(2010.04.23, Princeton)
Matthew Sudano
General Gauge Mediation with Gauge Messengers

Opening Meeting of the Program: Perspectives in Deformation Quantization and Noncommutative Geometry
(2010.06.26 - 06.28, RIMS, Kyoto)
Kentaro Hori
String theory and K-theory

Berkeley String Theory Seminar
(2010.04.27 - 04.28, UC Berkeley)
Simeon Hellerman
Dynamical Cobordisms in General Relativity and String Theory

KITP Theory Seminar
(2010.04.29 - 04.30, Kavli Institute for Theoretical Physics, UCSB)
Simeon Hellerman
A Universal Inequality for CFT and Quantum Gravity

ESI program on Quantum Field Theory on Curved Space-times and Curved Target Spaces
(2010.04.29, Erwin Schrödinger Institute, Vienna)
Tadashi Takayanagi
Holographic Entanglement Entropy

Seminar at LBL/Berkeley
(2010.04, Berkeley)
Jing Shu
Thinking about Tevatron Anomalies

Seminar at Cornell University
(2010.04, Ithaca, New York)
Jing Shu
New (theoretical) Ideas in Dark Matter

Seminar at UC Irvine
(2010.04, Irvine)
Jing Shu
New (theoretical) Ideas in Dark Matter

Seminar at UC Berkeley
(2010.04, Berkeley)
Jing Shu
New (theoretical) Ideas in Dark Matter

Conference on Interplay between Representation Theory and Geometry
(2010.05.03 - 07, Tsinghua University, Beijing)
Kentaro Hori
D-branes and Categories

Conference in honor of Claus Ringel and Kyoji Saito
(2010.05.05, Xinhoa university, Beijing)
Kyoji Saito
The lattice of vanishing cyceles of types $A_{\frac{1}{2}\infty}$ and $D_{\frac{1}{2}\infty}$

PHENO 2010
(2010.05.10 - 05.12, Madison, Wisconsin)
Chuan-Ren Chen
Higgs scenario from Peccei-Quinn mechanism at the LHC
Won Sang Cho
New particle mass spectrometry at the LHC

2nd Holographic Cosmology Workshop
(2010.05.10 - 05.11, McGill University)
Shinji Mukohyama
Cosmology with Gravity in the Higgs phase

Seminar at Tohoku University
(2010.05.10, Sendai)
Fuminobu Takahashi
Axion in the sky and at the LHC

Astronomy with Megastructures
(2010.05.10 - 14, Greece)
Masami Ouchi
Galaxy Formation and Young Universe II

CITA@25/Bond@60
(2010.05.12 - 05.16, CITA, Toronto)
Shinji Mukohyama
Cosmological implications of gravity at a Lifshitz point

Seminar at Kyoto University
(2010.05.12, Kyoto)
Fuminobu Takahashi
Axion from Cosmology and Collider Experiments

Seminar at Tohoku University
(2010.05.13, Sendai)
Matthew Sudano
General Gauge Mediation with Gauge Messengers

Seminar at Fermilab Theoretical Astrophysics group
(2010.05.14, Fermilab)
Masahiro Takada
Subaru Weak Lens Study of X-ray Luminous Clusters

IEU-APCTP Workshop: Cosmology and Fundamental Physics
(2010.05.16 - 05.19, IEU, Ewha Womans Univ, Korea)
Tsz Yan Lam
Primordial non-Gaussianity and Large-scale structure
Seong Chan Park
Split UED and Dark Matter

Institute for the Early Universe Inaugural Workshop
(2010.05.17, Seoul)
Hitoshi Murayama
Cosmology at IPMU

CERN Academic Training Lecture Committee
(2010.05.25, Geneva)
Hitoshi Murayama
Lepto and baryogenesis

APS DAMOP session on Early Universe
(2010.05.26, Houston, Texas)
Naoki Yoshida
Primordial gas chemistry in the early universe

Planck 2010
(2010.5.31 - 06.04, CERN)
Mihoko M. Nojiri
On weighting the superpartners at the "early stage" of LHC
Seong Chan Park
Kaluza-Klein Dark Matter
Fuminobu Takahashi
Probing Variant Axion Models at LHC
Brian Feldstein
Discoverying Asymmetric Dark Matter with Anti-Neutrinos
Hitoshi Murayama
Dark Matter and Dark Energy from Topology

Workshop on Geometry and Physics of the Landau-Ginzburg Model
(2010.05.31 - 06.04, Institut Fourier, Grenoble)
Kentaro Hori
Gauged Landau-Ginzburg models
Kyoji Saito
Primitive forms of types $A_{\frac{1}{2}\infty}$ and $D_{\frac{1}{2}\infty}$

Memorial lecture in honor of Andrjzej Jankovski
(2010.05.31, Gdansk, Poland)
Alexey Bondal
Derived categories of coherent sheaves on algebraic varieties

Seminar at Johns Hopkins University
(2010.05, Baltimore, Maryland)
Jing Shu
New (theoretical) Ideas in Dark Matter

Seminar at University of Maryland
(2010.05, College Park, Maryland)
Jing Shu
Thinking about Tevatron Anomalies

Arithmetic geometry workshop 2010
(2010.05, Okinawa)
Satoshi Kondo
On the product structures of motivic cohomology theories

Eurostrings
(2010.06, Madrid)
Domenico Orlando
Warped anti-de Sitter spaces in String Theory
Susanne Reffert
Relating Supersymmetric Gauge Theories via Gauge/Bethe Correspondence

KMI workshop on particle physics and cosmology
(2010.06.04, Kobayashi-Maskawa Inst for the Origin of Particles and the Universe (KMI), Nagoya)
Masahiro Takada
Recent progresses in gravitational lensing studies

QFT, String Theory & Mathematical Physics
(2010.06.07 - 08.13, KITP, Beijing)
Minxin Huang
Top quarks as a window to string resonances

Oort Workshop
(2011.06.07 - 10, Oort, Netherlands)
Masami Ouchi
Escape Fraction and the Reionization History

Long-term Workshop on "Gravity and Cosmology (GC2010)"
(2010.6.07 - 06.11, YITP, Kyoto)
Shigeki Sugimoto
Mesons as Open Strings in a Holographic Dual of QCD

CMB Workshop 2010
(2010.6.07 - 06.09, NAOJ, Mitaka, Tokyo)
Masahiro Takada
Gravtational lensing and CMB
Shinji Mukohyama
CMB and ultra high-energy physics

NEB 14: Recent Developments in Gravity
(2010.6.08 - 06.11, Ioannina, Greece)
Cosimo Bambi
Violation of the Carter-Israel conjecture and its astrophysical implications

Physics at LHC 2010
(2010.06.08, Hamburg)
Hitoshi Murayama
Theory of Beyond the Standard Model Physics

Cosmo Coffee
(2010.06.09, CERN)
Fuminobu Takahashi
Dark Matter and Split Seesaw

Gravity and Cosmology 2010
(2010.06.10 - 15, YITP, Kyoto)
Tadashi Takayanagi
Mini Black Holes and Quantum Quench from AdS/CFT
Shinji Mukohyama
Cosmological implications of gravity at a Lifshitz point

Seminar at Academia Sinica
(2010.06.10, Taipei)
Chuan-Ren Chen
The variant axion models at the LHC

The First Galaxies, Quasars & Gamma-Ray Bursts
(2010.06.14 - 16, USA)
Masami Ouchi
Statistics of 207 Lya Emitters at z-7

Workshop: Geometry, Quantum Fields, and Strings: Categorical Aspects
(2010.06.07-11, Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany)
Kentaro Hori
D-branes, T-duality, and Index theory, part II

Seminar at Riken
(2010.06.14, Riken, Japan)
Tadashi Takayanagi
Mini Black Holes and Quantum Quench from AdS/CFT

Seminar at Titec
(2010.06.16, Tokyo)
Shigeki Sugimoto
Mesons as Open Strings in a Holographic Dual of QCD

Seminar at Tubingen University
(2010.06.16, Tubingen, Germany)
Hitoshi Murayama
Why go beyond the Standard Model?

Neutrino 2010
(2010.06.19, Athens, Greece)
Mark Vagins
Detection of Supernova Neutrinos

Algebra and Geometry of Configuration Spaces and related structures
(2010.06.21 - 06.25, Centro de Ricerca Matematica Ennio De Giorgi, Pisa, Italy)
Toshitake Kohno
Quantum representations of mapping class groups and their images

Seminar at University of Tokyo
(2010.06.21, Hongo, Tokyo)
Tadashi Takayanagi
Mini Black Holes and Quantum Quench from AdS/CFT

Seminar at Tokyo Institute of Technology
(2010.06.23, Tokyo)
Tadashi Takayanagi
Mini Black Holes and Quantum Quench from AdS/CFT

Workshop on D-branes, Effective Actions and Homological Mirror Symmetry
(2010.06.23, Erwin Schrödinger Institute, Vienna)
Johanna Knapp
Normal Functions, Superpotentials and Mirror Symmetry

Seminar at SISSA
(2010.06.24, SISSA, Trieste, Italy)
Cosimo Bambi
Testing strong gravity with future VLBI observations

IAP Annual Colloquium: Progenitors and environments of stellar explosions
(2010.06.28 - 07.02, Institut d' Astrophysique de Paris)
Masaomi Tanaka
Spectropolarimetry of Type Ib/c Supernovae
Keiichi Maeda
Observational Diagnostics of Asymmetry in type Ia supernovae, and implications for progenitors and cosmology
Ken'ichi Nomoto
Unusual supernovae and their progenitors

Topics in Resurgence Theory
(2010.06.28 - 07.02, Kyoto)
Alexander Getmanenko
Towards constructing resurgent solutions of a linear ODE

New Mathematical Methods in Quantum Gauge Theories
(2010.06.28 - 07.24, Aspen Center for Physics)
Hirosi Ooguri
Wall Crossing As Seen By M-Theory And Matrix Models

YKIS2010 symposium: Cosmology – The Next Generation–
(2010.06.28, YITP, Kyoto)
Tadashi Takayanagi
Time-dependent Holography and Emergent Black Holes on D-branes
Fuminobu Takahashi
Chaotic Inflation with Running Kinetic Term

Seminar at Osaka University
(2010.06.30, Osaka)
Tadashi Takayanagi
Mini Black Holes and Quantum Quench from AdS/CFT

Frontier Physics Working Month
(2010.07, Beijing and Shanghai)
Jing Shu
Top Forward-backward Asymmetry

Seminar at Nagoya GCOE
(2010.07, Nagoya)
Susanne Reffert
From Random Walks to non-Lorentz Invariant Field Theories

CLJ2010+0628: from massive galaxy formation to dark energy
(2010.07.01, IPMU)
Masayuki Tanaka
Environmental dependence of galaxy properties at z > 1.5

Seminar at Nagoya University
(2010.07, Nagoya)
Domenico Orlando
What is the next number in the sequence?

Lecture at Summer School on Mathematical String Theory
(2010.07.01, Virginia Tech, Blackburg, Virginia)
Cornelius Schmidt-Colinet
The vacuum amplitude of the bosonic string

Workshop on Low Energy Neutrinos at DeepCore
(2010.07.01 - 07.02, Penn State)
Sourav K. Mandal
Dark Matter in DeepCore: Complementary Uses of Track-like and Cascade Events

Seminar at Hokkaido University
(2010.07.02, Sapporo, Japan)
Tadashi Takayanagi
Artificial Black Holes on D-branes in AdS and Non-equilibrium Systems

Hadron square
(2010.07.03, Kyoto University)
Shigeki Sugimoto
Mesons as Open Strings in a Holographic Dual of QCD

Santa-Fe 2010, Los Alamos National Lab
(2010.07.04 - 07.09, Santa Fe, New Mexico)
Seong Chan Park
Split UED

Novel Searches for Dark Matter with Neutrino Telescopes
(2010.07.05 - 07.06, CCAPP, Ohio)
Sourav K. Mandal
Extrasolar Dark Matter Detection and Characterization in DeepCore

19th International Conference on General Relativity and Gravitation
(2010.07.05 - 07.09, Mexico City)
Cosimo Bambi
Violation of the Carter-Israel conjecture and its astrophysical implications

3rd workshop, Vacuum structure and quark dynamics based on QCD
(2010.07.07, Tsukuba University, Japan)
Shigeki Sugimoto
Analysis of QCD via superstring theory

Experimental Search for Quantum Gravity
(2010.07.12 - 07.16, Stockholm)
Cosimo Bambi
Searching for quantum gravity effects in astrophysical black hole candidates

Seminar at Max-Planck-Institut fur Astrophysik
(2010.07.13, MPA, Garching, Germany)
Ken'ichi Nomoto
The evolution and explosion of mass-accreting Pop III stars

IDEAS2010
(2010.07.13, IPMU)
Mark Vagins
GADZOOKS! Supernova Neutrinos Without the Annoying Wait

The 11th Symposium on Nuclei in the Cosmos
(2010.07.19 - 23, Heidelberg)
Ken'ichi Nomoto
Hypernovae and gamma-ray bursts

COSPAR Probing the High Redshift Universe
(2010.07.20, Bremen, Germany)
Naoki Yoshida
Star formation in the early universe

NAOJ, Theoretical Astrophysics Colloquium
(2010.07.21, NAOJ, Mitaka, Tokyo)
Keiichi Maeda
The explosion mechanism of type Ia supernovae and the origin of their observational diversity

YITP seminar
(2010.07.22, YITP, Kyoto)
Keiichi Maeda
Toward a unified picture of type Ia supernovae

What Drives the Growth of Black Holes?
(2010.07.26 - 07.29, Durham)
John Silverman
Co-evolving AGN activity and star formation within the zCOSMOS density field

Physics of Accreating Compact Binaries
(2010.07.26 - 07.30, Kyoto)
Masaomi Tanaka
Super-Chandrasekhar Mass White Dwarf as an Origin of Extremely Luminous Type Ia Supernovae
Keiichi Maeda
A new insight into type Ia supernova explosions and implications for the progenitor evolution
Ken'ichi Nomoto
Progenitors of Type Ia Supernovae

High Energy Strong Interactions 2010
(2010.07.27, YITP, Kyoto)
Shigeki Sugimoto
Hadrons in Holographic QCD

Kobayashi-Maskawa Institute Seminar
(2010.07.28, KMI, Nagoya)
Tadashi Takayanagi
Quantum Gravity explored by entanglement entropy

Bonji seminar at KMI
(2010.07.29, KMI, Nagoya)
Shigeki Sugimoto
Mesons as Open Strings

Seminar at Hokkaido University
(2010.07.30, Sapporo, Japan)
Daniel Krefl
Instanton counting in Omega background

Workshop on Arithmetic Geometry 2010
(2010.08.02 - 08.07, Okinawa, Japan)
Satoshi Kondo
On the product structure of motivic cohomology theories

Summer School on Astronomy & Astrophysics 2010
(2010.08.03, Toyohashi, Japan)
Shinji Mukohyama
String theory and brane inflation

Summer Institute 2010
(2010.08.04 - 08.14, Fuji-Yoshida, Japan)
Cosimo Bambi
Probing the space-time around astrophysical black hole candidates with future VBLI experiments
Tadashi Takayanagi
Introduction to AdS/CMT
Domenico Orlando
Relating Gauge Theories via Gauge/Bethe Correspondence
Seong Chan Park
Kaluza-Klein Dark Matter
Fuminobu Takahashi
Running Kinetic Inflation
Susanne Reffert
Relating Supersymmetric Gauge Theories via Gauge/Bethe Correspondence

ESI Programme on AdS Holography and the Quark-Gluon Plasma
(2010.08.02 - 10.29, Erwin Schrödinger Intitute, Vienna)
Shigeki Sugimoto
Hadrons in Holographic QCD
Shigeki Sugimoto
Mesons as open strings in holographic QCD

Wakate Summer School
(2010.08.06 - 08.07, Kishimadaira, Japan)
Tadashi Takayanagi
Lectures on AdS/CFT

Aspen workshop: Taking Supernova Cosmology into the Next Decade
(2010.08.09 - 20, Aspen, Colorado)
Ken'ichi Nomoto
Progenitors theory

Seminar at Hirosaki University
(2010.08.10, Hirosaki, Japan)
Masahiro Takada
Subaru Weak Lensing Study of Galaxy Clusters

SLAC Summer Institute
(2010.08.12 - 13, SLAC)
Mark Vagins
Atmospheric Neutrinos

The 4th International Conference on Representation Theory
(2010.08.13, Xian, China)
Kyoji Saito
Highest weight representation of Elliptic Lie Algebras

International conference and summer school on LHC physics
(2010.08.16 - 08.25, Tsinghua university, China)
Jing Shu
New Physics from the 3rd generation?
Jing Shu
Looking for New Physics in the 3rd Generation

ESI Programme on AdS Holography and the Quark-Gluon Plasma
(2010.08.17, ESI, Geneva)
Shigeki Sugimoto
Mesons as open strings in holographic QCD

APCTP Focus Program Aspects of Holography and Gauge/string duality
(2010.08.17 - 08.18, APCTP, Pohang, Korea)
Tadashi Takayanagi
Emergent Horizons on D-branes and Quantum Quench from AdS/CFT
Tadashi Takayanagi
Topological Insulators and Superconductors from String Theory

NAOJ Symposium
(2010.08.19, NAOJ, Mitaka, Tokyo)
Hitoshi Murayama
Status of SuMIRe project

SUSY 2010
(2010.08.23 - 08.28, University of Bonn)
Won Sang Cho
New Particle Mass Spectrometry at the LHC : M_CT2 for boosted decay systems

Mirror symmetry and differential equations
(2010.08.24, Tokyo Metropolitan University, Tokyo)
Sergey Galkin
(Mirror) modularity of Fano threefolds

DENET Dark Energy Summer School
(2010.08.30 - 09.01, Kochi University of Technology, Japan)
Masahiro Takada
The impact of massive neutrino on spherical collapse model

International Neutrino Summer School
(2010.08, KEK)
Takaaki Kajita
Experiments with atmospheric neutrinos

Aspects of multiple zeta values
(2010.09.06 - 09.10, RIMS, Kyoto University)
Toshitake Kohno
Gauss-Manin connections for the space of conformal blocks

Subaru Future Instrumentation Workshop
(2010.09.09 - 09.10, IPMU)
Keiichi Maeda
Supernova explosion mechanism probed by latetime NIR spectroscopy with AO
Masayuki Tanaka
From SDSS to PFS; a statistical study of galaxy evolution

JPS fall meeting
(2010.09.11 - 09.14, Kyushu kogyo University, Japan)
Fuminobu Takahashi
Dark Matter from Split Seesaw
Shigeki Sugimoto
Quark Confinement and Chiral Symmetry from String Theory

Nu TheME: Neutrino Theory, Models, and Experimental Perspective
(2010.09.15, Geneva)
Hitoshi Murayama
Perspective Talk in Neutrino Physics

Workshop: Observational signatures of type Ia supernova progenitors
(2010.09.20 - 24, Lorentz Center, Leiden, Netherlands)
Ken'ichi Nomoto
Single degenerate progenitor models

Workshop on Topologies for Early LHC Searches
(2010.09.22 - 09.25, SLAC)
Mihoko M. Nojiri
Class of Models with Jets+MET, Kinematics, Branches and Interactions

International Conference Japan-Mexico on Topology and its Applications
(2010.09.27 - 10.01, Colima University, Mexico)
Toshitake Kohno
Quantum representations of mapping class groups

COSMO/CosPA2010
(2010.09.27 - 10.01, Tokyo)
Shinji Mukohyama
Cosmological implications of gravity at a Lifshitz point
Fuminobu Takahashi
Higgs inflation with a running kinetic term
Chuan-Ren Chen
The variant axion models at the LHC
Emir Gumrukcuoglu
Signature from Anisotropic Inflation

Seminar at The Dark Cosmology Centre
(2010.09.30, The Dark Cosmology Centre, Copenhagen)
Ken'ichi Nomoto
The Evolution and Explosion of First Stars

KIAS workshop on flavor physics and CP violation
(2010.09, Seoul)
Jing Shu
Top Forward-backward Asymmetry

Neutrino oscillation workshop 2010
(2010.09, Conca Specchiulla, Italy)
Takaaki Kajita
Recent results from atmospheric neutrino experiments

Seminar at UC Davis
(2010.09, Davis, California)
Won Sang Cho
New particle mass spectrometry at the LHC

Japan Mathematical Society
(2010.09, Nagoya University)
Satoshi Kondo
On the product structures on motivic cohomology

Arithmetic goemetry and p-adic Sato theory
(2010.09, Tohoku University, Sendai)
Satoshi Kondo
Survey on θ and τ by Anderson I, II

Phenomenological ALMA-Subaru Workshop 2010
(2010.10.01, NAOJ)
Masayuki Tanaka
Galaxy formation in forming clusters

Lecture series at University of Tokyo
(2010.10 - 11, Hongo, Tokyo)
Domenico Orlando
Lectures on the Bethe Ansatz

Thirty Meter Telescope (TMT) workshop
(2010.10.04 - 10.05, NAOJ, Mitaka, Tokyo)
Masaomi Tanaka
Spectropolarimetry of Supernovae: Prospects for TMT
Keiichi Maeda
Supernova observations with TMT

The Observational Pursuit of Dark Energy after Astro2010
(2010.10.07 - 10.08, Caltech, Pasadena)
Masahiro Takada
panel discussion: Astro2010 and ground-based issues (as a panelist)
Masahiro Takada
Cosmology with SuMIRe HSC/PFS

Autumn Symposium on String/M Theory
(2010.10.14 - 10.17, KIAS, Korea)
Tadashi Takayanagi
Black Holes and Holographic Quantum Quench
Domenico Orlando
What is the next number in the sequence? (or, Sublattice counting and orbifolds)

Theoretical Physics Seminar at Hokkaido University
(2010.10.15, Sapporo, Japan)
Johanna Knapp
Global SO(10) F-theory GUTs

Theoretical Physics Seminar at KEK
(2010.10.19, KEK)
Johanna Knapp
Global SO(10) F-theory GUTs

The US/Japan HEP Collaboration 30th Anniversary Symposium
(2010.10.21, Hawaii)
Hitoshi Murayama
Physics Prospect

Kinosaki Symposium of Algebraic geometry
(2010.10.25, Kinosaki, Japan)
Kyoji Saito
Limit partition functions associated with Cancellative monoids

BOSS Evolution of Massive Galaxies and AGN Workshop
(2010.10.26 - 10.27, IPMU)
Masayuki Tanaka
A new method to identify AGNs
Masayuki Tanaka
BOSS spectrophotometry

New Development of Numerical Simulations in Low-Dimensional Quantum Systems
(2010.10.27 - 10.29, YITP, Kyoto)
Tadashi Takayanagi
Geometric Calculation of Entanglement Entropy via AdS/CFT

YITP Lecture series
(2010.10.27 - 10.28, YITP, Kyoto)
Tadashi Takayanagi
AdS/CFT from condensed matter viewpoints

Seminar at Max Planck Institute
(2010.10.28, MPP)
Fuminobu Takahashi
A theory of extra radiation in the Universe

Seminar at Technical University of Munich
(2010.10.29, TUM, Germany)
Fuminobu Takahashi
A theory of extra radiaion in the Universe

Colloquim at Kyoto University
(2010.10.29, Kyoto)
Charles Steinhardt
New Puzzles in Supermassive Black Hole Evolution

2010 Workshop on Major DUSEL Physics Topics
(2010.10, Rapid City, USA)
Takaaki Kajita
Results from atmospheric Neutrino experiments and future prospects

The special values of L-function and arithmetic geometry
(2010.10, Miyama, Kyoto)
Satoshi Kondo
On a formula expressing the local L and e factors in Hecke eigenvalues

AdS/CM duality and other approaches
(2010.11.01 - 11.05, KITPC, Beijing)
Tadashi Takayanagi
Entanglement Entropy and Quantum Quenches in AdS/CFT

Topical Workshop in Low Radioactivity Techniques
(2010.10, Sudbury, Canada)
M. Nakahata
Asian facilities

Conference on Real Singularities
(2010.11.01, RIMS, Kyoto)
Kyoji Saito
Singularities of the transcendental functions of types $A_{\frac{1}{2}\infty}$ and $D_{\frac{1}{2}\infty}$

Conference Talks

The 4th KIAS Workshop “Cosmology and Structure Formation”
(2010.11.03 - 11.06, KIAS, Korea)
Masahiro Takada
Subaru Weak Lensing Studies of X-ray Luminous Clusters

International Workshop on Dark Matter, Dark Energy and Matter-antimatter Asymmetry
(2010.11.05 - 11.06, Hsinchu, Taiwan)
Chuan-Ren Chen
Model Independent Studies of Dark Matter

Theory Seminar at UBC
(2010.11.08, UBC, Vancouver)
Cosimo Bambi
Measuring the spin parameter of astrophysical black hole candidates

ExDiP2010
(2010.11.09, KEK)
Shinji Mukohyama
Viability of Horava-Lifshitz theory

Cosmology seminar at SFU
(2010.11.09, Simon Fraser University, Canada)
Cosimo Bambi
Accretion process in Kerr space-time with arbitrary value of the spin parameter

Seminar in Relativity at UT Austin
(2010.11.12, Austin, Texas)
Cosimo Bambi
Constraining the quadrupole moment of black hole candidates through the continuum fitting method

Seminar at LSU
(2010.11.15, Baton Rouge, Louisiana)
Cosimo Bambi
Constraining the quadrupole moment of astrophysical black hole candidates through the continuum fitting method

Seminar at NCTS
(2010.11.17, NCTS, Taiwan)
Shigeki Matsumoto
Fate of False Vacuum Revisited

Workshop on Beyond Standard Models and the Dark Sides of Our Universe
(2010.11.18 - 11.20, Shanghai)
Chuan-Ren Chen
Cosmic-ray from decaying dark matter

Seminar at University of Tokyo
(2010.11.22, Hongo, Tokyo)
Shigeki Sugimoto
Mesons as Open Strings

ASH: Astronomy of Supernovae and Hypernovae
(2010.11.23 - 11.25, University of Iceland, Iceland)
Keiichi Maeda
Asymmetry in supernova explosions and their observational diversities

Seminar at Academia Sinica
(2010.11.26, Academia Sinica, Taiwan)
Shigeki Matsumoto
Fate of False Vacuum Revisited

Conference on Lattices, Reflection groups and Algebraic Geometry
(2010.11.26, Nagoya)
Kyoji Saito
Reflection groups of type $A_{\frac{1}{2}\infty}$ and $D_{\frac{1}{2}\infty}$

Seminar at Tokyo Metropolitan University
(2010.11.26, Tokyo)
Todor Milanov
Simple singularities and representations of affine Lie algebras

Seminar at Saitama Institute of Technokogy
(2010.11.26, SIT, Saitama, Japan)
Emir Gumrukcuoglu
Inflation, reheating and fate of flat directions

Seminar at University of Michigan
(2010.11.29, Ann Arbor, Michigan)
Cosimo Bambi
Testing Astrophysical Black Holes

Lecture Series at University of Tokyo
(2010.11.30 - 12.01, Komaba, Tokyo)
Shigeki Sugimoto
QCD and string theory

LC10
(2010.11.30 - 12.03, INFN - Frascati, Italy)
Shigeki Matsumoto
Dark Matter wants the Linear Collider

Seminar at University of Toronto
(2010.11, Toronto)
Brian Feldstein
Form Factor Dark Matter

International Workshop in Flavor Physics in the LHC Era
(2010.11, Singapore)
Takaaki Kajita
Neutrino Oscillation Experiments

Theory Seminar at Columbia University
(2010.12.06, Columbia University)
Tsz Yan Lam
Primoridal non-Gaussianity and large-scale structure

Focus Program: Frontiers of Black Hole Physics
(2010.12.07 - 09, APCTP, Korea)
Shinji Mukohyama
Cosmology and black holes in ghost condensate
Shinji Mukohyama
Status of Horava-Lifshitz gravity

2010 Topical Program at NCTS
(2010.12.08 - 12.10, NCTS, Taiwan)
Shigeki Matsumoto
Comprehensive Analysis on the Light Higgs Scenario in NUHM
Chuan-Ren Chen
Top quarks as a probe of heavy resonances at the LHC

PFS science workshop
(2010.12.09 - 12.10, NAOJ, Mitaka, Tokyo)
Masahiro Takada
Cosmology with SuMIRe HSC/PFS surveys
Hitoshi Murayama
PFS updates

Second Latin Congress on Symmetries in Geometry and Physics
(2010.12.13 - 12.17, Universidade Federal do Parana, Brazil)
Sergey Galkin
(Two constructions for) Mirrors of Fano varieties

SPICA Science Workshop 2010
(2010.12.16 - 12.17, NAOJ, Mitaka, Tokyo)
Masaomi Tanaka
Observations of Supernova Dust with SPICA
Tomoki Saito
Exploring the frontier of redshifted & obscured galaxies with SPICA/MIR

Lecture Series at Titech
(2010.12.13 - 12.22, Tokyo)
Shigeki Matsumoto (2010.12.13, 12.14)
WIMP Dark Matter and Cosmic-ray observatios
Tadashi Takayanagi (2010.12.20, 12.22)
AdS/CFT from condensed matter viewpoints

Lecture Series and Colloquium at University of Tokyo
(2010.12.14 - 12.15, Komaba, Tokyo)
Shigeki Sugimoto
QCD and string theory

Seminar at University of Tokyo
(2010.12.20, Hongo, Tokyo)
Shigeki Matsumoto
Fate of False Vacuum Revisited

Lecture series at University of Technology in Vienna
(2010.12.20 - 12.22, 2011.01.10 - 01.12, Vienna, Austria)
Johanna Knapp
String Theory I

Astro-H workshop
(2010.12.27, Tokyo University of Science, Tokyo)
Keiichi Maeda
Supernova Explosions and Nucleosynthesis
Masahiro Takada
Cluster physics with Astro-H and Subaru HSC surveys

Seminar at Max Planck Institute
(2010.12, Munich)
Susanne Reffert
Relating Supersymmetric Gauge Theories via Gauge/Bethe Correspondence

String theory seminar
(2010.12, Universita di Roma II “Tor Vergata”,Rome)
Susanne Reffert
Relating Supersymmetric Gauge Theories via Gauge/Bethe Correspondence

String Theory Seminar
(2010.12,Universita degli Studi di Napoli Federico II, Napoli)
Susanne Reffert
Relating Supersymmetric Gauge Theories via Gauge/Bethe Correspondence

Integrable systems, random matrices, algebraic geometry and geometric invariants
(2010.12, Kyoto University)
Satoshi Kondo
Expressions of local L and *e* factors in Hecke eigenvalues

Cosmology and String Theory program
(2011.01.03 - 08.31, Institute for Advanced Studies - Hong Kong)
Emille E. O. Ishida
Supernova Cosmology - observations and data analysis
Rafael de Souza
Exploring the cosmic dawn, the first light after dark ages

KIPAC Seminar
(2011.01.04, KIPAC, Stanford University)
Charles Steinhardt
New Puzzles in Supermassive Black Hole Evolution

Indian Strings Meeting
(2011.01.04 - 01.11, Puri, India)
Tadashi Takayanagi
Holographic Entanglement Entropy and Black Holes

Field theory and quantum gravity
(2011.01.05, Rikkyo University, Japan)
Shinji Mukohyama
Status of Horava-Lifshitz gravity

Japan-Vietnam Bilateral Program
(2011.01.05, Tohoku University, Sendai)
Kyoji Saito
Spectral decomposition of the Coxeter elements of types $A_{\frac{1}{2}\infty}$and $D_{\frac{1}{2}\infty}$

Niigata Winter Workshop 2011
(2011.01.06 - 01.08, Echigo-Yuzawa, Japan)
Shigeki Matsumoto
Fate of False Vacuum Revisited

TAPIR Seminar
(2011.01.07, Caltech)
Charles Steinhardt
New Puzzles in Supermassive Black Hole Evolution

Physics Beyond the Standard Model and Predictable Observables
(2011.01.07, Kobe University, Japan)
Shinji Mukohyama
Status of Horava-Lifshitz gravity

Seminar at NAOJ
(2011.01.07, Mitaka, Tokyo)
Hitoshi Murayama
Trends in Particle Physics, DUSEL/LHC

Lecture Series at Waseda University
(2011.01.12, 01.19, 01.26, Tokyo)
Shinji Mukohyama
Gravitation and Cosmology

Fields and Strings Seminar
(2011.01.13, LMU, Munich)
Johanna Knapp
Construction of Global F-theory GUTs

CIMPA-Vietnam School and Workshop on Braids in Algebra, Geometry and Topology
(2011.01.17 - 01.28, Institute of Mathematics, Hanoi, Vietnam)
Toshitake Kohno
Braid groups, configuration spaces and iterated integrals

Seminar at Drexel University
(2011.01.17, Philadelphia)
Charles Steinhardt
New Puzzles in Supermassive Black Hole Evolution

Subaru Users’ Meeting 2010
(2011.01.19 - 01.20, NAOJ, Mitaka, Tokyo)
Masahiro Takada
Cosmology with SuMIRe HSC/PFS surveys
Hitoshi Murayama
PFS Overview

Wunch Seminar
(2011.01.19, Princeton University)
Charles Steinhardt
New Puzzles in Supermassive Black Hole Evolution

Japan-France Advanced Science Symposium (JFFoS)
(2011.01.21, Tokyo)
Hitoshi Murayama
Dark Energy

Workshop on Mirror Symmetry and Related Topics
(2011.01.23 - 02.04, University of Miami, Florida)
Sergey Galkin
Laurent phenomenon for Landau-Ginzburg potential
Sergey Galkin
G-Fano threefolds and Mathieu group

Seminar at University of Tokyo
(2011.01.24, Hongo, Tokyo)
Matthew Sudano
Non-Renormalization Theorems and D-term SUSY Breaking

Extra Dimension 2011
(2011.01.24 - 01.25, Osaka University)
Shigeki Matsumoto
Indirect detections of dark matter using cosmic rays
Kohsaku Tobioka
Discovery of minimal UED at the LHC

ADC Colloquium
(2011.01.25, NAOJ, Mitaka, Tokyo)
Tomoki Saito
Survey for extended Ly-alpha sources toward re-ionization epoch

Conference on Derived Category
(2011.01.26, University of Tokyo, Komaba, Tokyo)
Kyoji Saito
The lattice of vanishing cycles of types $A_{\frac{1}{2}\infty}$ and $D_{\frac{1}{2}\infty}$
Alexey Bondal
Derived Categories of Coherent Sheaves

From Pixels to Shear (2011 GREAT Workshop 1)
(2011.01.26 - 01.28, e-Science Institute, Edinburgh)
Masahiro Takada
SuMIRe HSC/PFS Project
Hironao Miyatake
Shapes Using Multiple Exposures

Lecture series at Waseda University
(2011.01.26 , Tokyo)
Shinji Mukohyama
Gravitation and Cosmology

Lecture at International Christian University
(2011.01.27, ICU, Mitaka, Tokyo)
Ken'ichi Nomoto
Supernovae

Aspen conference: Strongly Correlated Systems and Gauge/Gravity Duality
(2011.01.31 - 2011.02.05, Aspen Center for Physics)
Tadashi Takayanagi
Holographic Quantum Quenches

Seminar at OIQP
(2011.01, Okayama, Japan)
Wei Li
Holography and Entanglement of Flat Space

Gravitational-wave Physics&Astronomy Workshop
(2011.01, Milwaukee, U.S.A.)
M. Nakahata
Neutrino observatories

Deciphering the Ancient Universe with Gamma-Ray Bursts, 4th symposium
(2011.02.07 - 2011.02.09, Tokyo Tech)
Masaomi Tanaka
Spectropolarimetry of Supernovae

Subaru seminar
(2011.02.10, NAOJ, Hilo, Hawaii)
Masayuki Tanaka
A new method to identify AGNs and the nature of low-luminosity AGNs

Seminar at KIAS
(2011.02.07, KIAS, Korea)
Issha Kayo
Velocity Power Spectrum of the SDSS Galaxies; Spherical Harmonics Analysis

The 4th Symposium on Deciphering the Ancient Universe with Gamma-Ray Bursts
(2011.02.07 - 09, Tokyo Tech)
Ken'ichi Nomoto
The evolution and final fate of mass accreting Pop III stars

2011 Shanghai Asia-Pacific School and Workshop on Gravitation
(2011.02.10, Shanghai Normal University, China)
Shinji Mukohyama
Alternative Gravity Theories

KIAS Geometry Seminar
(2011.02.11, 02.14, 02.21, KIAS, Korea)
Sergey Galkin
Mirror symmetry for minuscule varieties
Sergey Galkin
Degenerations, mirros and their mutations
Sergey Galkin
Mirrors for Fano threefolds

Unsolved Problems in Astrophysics and Cosmology
(2011.02.14, Velazquez, Spain)
Hitoshi Murayama
Neutrinos

Seminar at Cambridge University
(2011.02.16, 02.17, DAMTP, Cambrige)
Shigeki Sugimoto
Baryons as Solitons in Holographic QCD
Shigeki Sugimoto
Mesons as Open Strings in Holographic QCD

U.Tokyo GCOE-physics research assistant retreat
(2011.02.18, Izu-Nagaoka, Japan)
Taizan Watari
Is String Theory Useful for Particle Physics

Himeji PDE conference
(2011.02.19 - 2011.02.20, Himeji, Japan)
Alexander Getmanenko
Resurgent analysis of the Witten Laplacian in one dimension

Workshop on Fano Varieties and Extremal Laurent Polynomials
(2011.02.22 - 2011.02.25, Imperial College London)
Sergey Galkin
1. Beyond Minkowski ansatz,
2. Cones and Unsections; Tom, Jerry and Spike,
3. Special Cremona group gauge-equivalence principle: Cremona ansatz and towards "Usnich ansatz"

Colloquium at Excellence Cluster
(2011.02.23, Excellence Cluster, Garching)
Masayuki Tanaka
A new method to identify AGNs and the nature of low-luminosity AGNs

Seminar at King's College
(2011.02.24, King's College London)
Sergey Galkin
Mirrors for minuscule varieties

Colloquium at University of Toledo
(2011.02.25, Toledo, Spain)
Todor Milanov
Integrable systems in GW theory

Fireworks workshop 2011
(2011.02.22 - 25, Caltech, Pasadena)
Ken'ichi Nomoto
The evolution and explosion of mass-accreting Pop III stars

Integrable systems, random matrices, algebraic geometry and geometric invariants
(2011.02, Steklov Mathematical Institute, Moscow)
Satoshi Kondo
Expressions of local L and e factors in Hecke eigenvalues

Seminar at Carnegie Observatories
(2011.03.01, Carnegie Observatories, Pasadena)
Ken'ichi Nomoto
The Explosion of Pop III Stars and Extremely Metal-Poor Stars

Multi Messenger from Supernovae
(2011.03.01 - 2011.03.03, NAOJ, Tokyo)
Masaomi Tanaka
3D Geometry of Supernovae Revealed by Optical Spectropolarimetry

Seminar at Kinki University
(2011.03.04, Kinki University, Japan)
Tadashi Takayanagi
Holographic Entanglement Entropy

Long Term Workshop Geometry and Analysis (Japan France Sakura-project)
(2011.03.07, Kyoto University)
Kyoji Saito
F-functions associated with cancellative monoids

DENET 2011 Subaru HSC meeting
(2011.03.07, ASIAA, Taiwan)
Masayuki Tanaka
Photo-z working group progress report

Center for Cosmology and Particle Physics Seminar
(2011.03.08, Ohio State University)
Mark Vagins
GADZOOKS! How to See Extragalactic Neutrinos by 2016

Colloquium at National Central University
(2011.03.09, National Central University, Taiwan)
Tsz Yan Lam
Analytical modelings in large-scale structure

PHY 880 Guest Lecture
(2011.03.09, Ohio State University)
Mark Vagins
Chasing Neutrinos Around the World: A Personal History

Special Seminar at ASIAA
(2011.03.10, ASIAA, Taiwan)
Tsz Yan Lam
Analytical modelings in large-scale structure

Exponential Asymptotics and Virtual Turning Points
(2011.03.10 - 2011.03.11, RIMS, Kyoto)
Alexander Getmanenko
Resurgent analysis of the Witten Laplacian in one dimension

PFS Technical Meeting
(2011.03.10, Princeton)
Hitoshi Murayama
PFS Status

Electroweak Symmetry Breaking
(2011.03.11 - 2011.03.17, YITP, Kyoto Univ.)
Shigeki Matsumoto
Discussion: Composite Higgs models

Instantons in Complex Geometry
(2011.03.14 - 18, Moscow)
Alexey Bondal
Coherent sheaves on minuscule varieties

Cosmological Perturbation and Cosmic Microwave Background
(2011.03.15, Kyoto)
Shinji Mukohyama
Status of Horava-Lifshitz gravity

Rencontres de Moriond
(2011.03.20 - 2011.03.27, La Thuile, Aosta, Italy)
Cosimo Bambi
Compact objects with spin parameter $a_* > 1$
Shigeki Sugimoto
Holographic Description of Hadrons from String Theory

Spring meeting of the German Physical Society
(2011.03.21, Muenster, Germany)
Kai Martens
XMASS Experiment in Kamioka

Symposium on Future Applications of Germanium Detectors in Fundamental Research
(2011.03.23 - 2011.03.29, Beijing)
Jing Liu
Pulse shape simulation for segmented detectors

Branes and Bethe Ansatz in Supersymmetric Gauge Theories Workshop
(2011.03.23, Simons Center for Geometry And Physics)
Domenico Orlando
The Gauge-Bethe correspondence: Dualities and Branes

Joint Seminar on Number Theory of Laboratoire J.-V. Poncelet and Sector 4.1 IITP RAS
(2011.03.28, Independent University of Moscow)
Sergey Galkin
Fano and Mathieu

Seminar of the Department of Algebra
(2011.03.29, Steklov Mathematical Institute, Russia)
Sergey Galkin
Mutations of potentials

JPS Annual Meeting
(2011.03, Niigata, Japan)
Kohsaku Tobioka
Discovery of minumal UED at the LHC

11 Visitors

(This list includes principal investigators and joint appointment staff.)

JFY2010

2010

Charlie Beil, UC Santa Barbara (USA), mathematics 03.24-06.18

Thomas O'Donnell, LBL (USA), neutrino physics 3.27-6.25

Michael Ratz, Technical U Munich (Germany), particle theory 3.28-4.02

George Smoot, LBL (USA), astrophysics 4.02-4.04

Alexandr Usnich, Zurich(Switzerland), mathematics 4.03-4.25

Alejandro Ibarra, Technical U Munich (Germany), particle theory 4.04-4.18

Alexey Bondal, Aberdeen (UK), mathematics 4.04-4.17

Alexander Kusenko, UCLA (USA), particle theory 4.05-6.05

Josh Ruderman, Princeton (USA), particle theory 4.05-4.11

Daniel Sternheimer, Bourgogne (France), mathematics 4.05-4.06

Tomoyuki Abe, Tokyo (Japan), mathematics 4.05-4.06

Ryo Ookawa, Tokyo Tech (Japan), mathematics 4.05-4.06

Masaaki Harada, Yamagata (Japan), mathematics 4.05-4.06

Akihiro Munemasa, Tohoku (Japan), mathematics 4.05-4.06

Makoto Sakurai, Tokyo (Japan), mathematics 4.05-4.06

Noriyuki Abe, Tokyo (Japan), mathematics 4.05-4.06

Nobuharu Sawada, Sophia U (Japan), mathematics 4.05-4.06

Ryosuke Kodera, Tokyo (Japan), mathematics 4.05-4.06

Roland de Putter, UC Berkeley (USA), astrophysics 4.06-4.12

Hiroyuki Fuji, Nagoya (Japan), astroparticle physics 4.06-4.06

Bertrand Toen, Montepelliler 2 (France), mathematics 4.11-4.23

Yi-Fu Cai, Chinese Academy of Sciences (China), cosmology 4.12-4.23

Boris Tsygan, Northwestern (USA), mathematics 4.13-4.16

Tomonori Totani, Kyoto (Japan), astroparticle Physics 4.14-4.14

Bruce Draine, Princeton (USA), astrophysics 4.16-5.02

Hsin-Wei Chen, IES Academia Sinica (Taiwan), astronomy 4.18-4.30

Andrea Prudenziati, SISSA (Italy), string theory 4.18-4.24

Johannes Heinonen, Cornell (USA), particle theory 4.19-5.02

Brice Menard, CITA (Canada), astrophysics 4.19-5.02

Daisuke Yamasawa, Hokkaido (Japan), astronomy 4.19-4.30

Masato Taki, Kyoto (Japan), string theory 4.20-4.21

Chris Belczynski, New Mexico State (USA), astronomy 4.24-5.08

Hiroyuki Hirashita, Academia Sinica (Taiwan), astronomy 4.25-5.01

Typhoon Lee, Academia Sinica (Taiwan), astrophysics 4.25-5.01

Akira Ishii, Hiroshima (Japan), mathematics 4.26-4.27

Sergei Blinnikov, ITEP (Russia), astronoly 4.27-5.11

Takashi Onaka, Tokyo (Japan), astrophysics 4.28-4.29

Itsuki Sakon, Tokyo (Japan), astronomy 4.28-4.29

Shinya Komugi, JAXA (Japan), astrophysics 4.28-4.29

Shintaro Koshida, Tokyo IoA (Japan), astronomy 4.28-4.29

Ryou Ohsawa, Tokyo (Japan), astronomy 4.28-4.29

Hinako Fukushi, Tokyo IoA (Japan), astronomy 4.28-4.29

Kazuyuki Omukai, Kyoto (Japan), astrophysics 4.28-4.29

Akio Inoue, Osaka Sangyo U (Japan), astrophysics 4.28-4.29

Poshak Gandhi, JAXA (Japan), astronomy 4.28-4.29

Hanindyo Kuncarayakti, Tokyo IoA (Japan), astronomy 4.28-4.29

Shogo Masaki, Nagoya (Japan), astrophysics 4.28-4.29

Hisanori Ohashi, Kyoto (Japan), mathematics 4.28-4.29

Nozomu Tominaga, Konan U (Japan), astrophysics 4.29-5.05

Tadashi Ishibe, Hiroshima (Japan), mathematics 4.30-5.02

Yuri Efremenko, Tennessee (USA), neutrino physics 5.02-5.12

Sanshiro Enomoto, Washington (USA), neutrino physics 5.09-5.18

Frans Klinkhamer, Karlsruhe (Germany), particle theory 5.10-6.05

Wolfgang Lerche, CERN (Switzerland), string theory 5.10-5.14

Kazushi Ueda, Osaka (Japan), mathematics 5.10-5.11

Mitsutoshi Fujita, Kyoto (Japan), particle theory 5.10-5.13

Daniel Moskovich, Kyoto (Japan), mathematics 5.11-5.11

Antal Jevicki, Brown (USA), field theory 5.13-6.04

Shigeki Matsumoto, Toyama (Japan), cosmology 5.17-5.22

Henry Sobel, UC Irvine (USA), astroparticle physics 5.18-5.23

Enrico Barausse, Maryland (USA), cosmology 5.23-6.05

Robert Quimby, Caltech (USA), astronomy 5.24-6.02

Atsushi Nishizawa, Tohoku (Japan), astronomy 5.24-5.26

Kiyotomo Ichiki, Nagoya (Japan), cosmology 5.24-5.27

Lawrence Krauss, Arizona State (USA), astronomy 5.25-6.01

Poshak Gandhi, JAXA (Japan), astronomy 5.25-5.25

Edwin Turner, Princeton (USA), astrophysics 5.27-6.15

Takahiro Sumi, Nagoya (Japan), astroparticle physics 5.27-5.28

Matthew Headrick, Brandeis (USA), string theory 5.28-6.05

Linda Uruchurtu Gomez, Cambridge (UK), string theory 5.29-6.21

Malte Schamm, Kyoto (Japan), astrophysics 5.31-6.04

Eiichiro Komatsu, Texas (USA), cosmology 6.01-7.01

Daniel Greenwald, MPI (Germany), high energy physics 6.01-6.01

Vikram Rentala, UC Berkeley (USA), particle theory 6.01-8.07

Alexander Voronov, Minnesota (USA), mathematics 6.02-8.30

Giovanni Marozzi, Inst Astro Paris (France), cosmology 6.05-6.13

Christopher Gauthier, Michigan Ctr Theo Phys (USA), cosmology 6.07-6.14

Sanjay Jhingan, Jamia Millia Islamia (India), cosmology 6.09-6.09

Sachiko Tsuruta, Montana State (USA), astrophysics 6.11-6.11

Jounghun Lee, SNU (Korea), cosmology 6.14-7.02

Andreas Karch, Washington (USA), string theory 6.15-6.16

Roger Blandford, KIPAC (USA), cosmology 6.17-6.18

Almudena Arcones, Basel (Switzerland), astrophysics 6.18-6.24

Masahiro Futaki, Tokyo (Japan), mathematics 6.21-6.21

Nakwoo Kim, Kyung Hee U (Korea), string theory 6.21-6.25

David Fallest, N Carolina State (USA), astrophysics 6.22-8.25

Steve Bickerton, Princeton (USA), astronomy 6.22-6.25

Craig Loomis, Princeton (USA), cosmology 6.22-6.25

Robert Lupton,Princeton (USA), cosmology 6.22-6.25

Nobuhiro Okabe, Academia Sinica (Taiwan), astronomy 6.22-7.08

Rachel Mandelbaum, Princeton (USA), cosmology 6.22-6.27

Kinya Oda, Osaka (Japan), particle theory 6.22-6.24

Yasuhiro Hashimoto, NTNU (Taiwan), astronomy 6.22-6.26

Bin Wei, NTNU (Taiwan), astronomy 6.22-6.26

Induk Lee, NCU (Taiwan), astronomy 6.22-6.26

Kentaro Nagamine, Nevada (USA), astrophysics 6.23-7.30

James Gunn, Princeton (USA), astrophysics 6.23-7.02

Michael Strauss, Princeton (USA), astronomy 6.23-7.02

Masashi Chiba, Tohoku (Japan), astronomy 6.23-6.25

Sebastien Foucaud, NTNU (Taiwan), astrophysics 6.23-6.25

Hisanori Furusawa, NAOJ Hawaii (Japan), astronomy 6.23-6.25

Tomotsugu Goto, Hawaii (USA), astronomy 6.23-6.24

Takashi Hamana, NAOJ (Japan), astronomy 6.23-6.23

Masao Hayashi, Tokyo (Japan), astronomy 6.23-6.23

Hiroyuki Ikeda, Ehime (Japan), astronomy 6.23-6.25

Hung-Yu Jian, NTU (Taiwan), astrophysics 6.23-6.25

Nobuhiko Katayama, KEK (Japan), high energy physics 6.23-6.25

Yusei Koyama, Tokyo (Japan), 6.23-6.23

Kenta Matsuoka, Ehime (Japan), cosmology 6.23-6.25

Sogo Mineo, Tokyo (Japan), astrophysics 6.23-6.25

Satoshi Miyazaki, NAOJ (Japan), astronomy 6.23-6.25

Tomoki Morokuma, NAOJ (Japan), astronomy 6.23-6.25

Tohru Nagao, Ehime (Japan), astronomy 6.23-6.25

Hiroaki Nishioka, Academia Sinica (Taiwan), astrophysics 6.23-6.25

Atsushi Nishizawa, Tokyo (Japan), astronomy 6.23-6.25

Masamune Ooguri, NAOJ (Japan), cosmology 6.23-6.25

Tomohiro Okamura, Tohoku (Japan), astronomy 6.23-6.25

Jun Okumura, Kyoto (Japan), astrophysics 6.23-6.25

Yuki Okura, NAOJ (Japan), astronomy 6.23-6.25

Kazuhiro Shimasaku, Tokyo (Japan), astronomy 6.23-6.25

Ken-ichi Tadaki, Tokyo (Japan), astronomy 6.23-6.25

Ryuichi Takahashi, Hirosaki U (Japan), astronomy 6.23-6.25

Mikito Tanaka, Tohoku (Japan), astronomy 6.23-6.25

Atsushi Taruya, Tokyo (Japan), astrophysics 6.23-6.25

Tsuyoshi Terai, Kobe (Japan), astronomy 6.23-6.25

Nozomu Tominaga, Konan U (Japan), astrophysics 6.23-6.25

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Keiichi Umetsu, Academia Sinica (Taiwan), astrophysics 6.23-6.25

Yousuke Utsumi, NAOJ (Japan), astronomy 6.23-6.25

Pin-Wei Wang, NTNU (Taiwan), astronomy 6.23-6.25

Yoshihiro Ueda, Kyoto (Japan), astrophysics 6.23-6.24

Chi-Hung Yan, ASIAA (Taiwan), astrophysics 6.23-6.23

Kohki Konishi, Tokyo ICRR (Japan), astronomy 6.23-6.25

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Toshihiro Kawaguchi, Tsukuba (Japan), astrophysics 6.25-6.25

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Paul Martini, Ohio State (USA), astrophysics 6.26-7.03

Johan Richard, Durham (UK), cosmology 6.26-7.08

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William Holzapfel, UC Berkeley (USA), astrophysics 6.27-7.02

Stefano Borgani, U Trieste (Italy), cosmology 6.27-7.03

James Bullock, UC Irvine (USA), cosmology 6.27-7.03

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Casey Papovich, Texas A&M (USA), astronomy 6.27-7.03

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Alessandro Rettura, UC Riverside (USA), astronomy 6.27-7.03

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Anja von der Linden, KIPAC (USA), astronomy 6.27-7.03

Ben Hoyle, Barcelona (Spain), cosmology 6.27-7.03

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Teresa Riehm, Stockholm (Sweden), astronomy 6.27-7.03

Martha Milkeraitis, UBC (Canada), astronomy 6.27-7.03

Alain Mazure, OAMP (France), astronomy 6.27-7.03

Hyunmi Song, SNU (Korea), astrophysics 6.27-7.03

Atsushi Nishizawa, Tokyo (Japan), astronomy 6.27-7.03

Ernst Kuiper, Leiden (Netherlands), astronomy 6.27-7.03

Mike Hudson, Waterloo (Canada), 6.27-7.03

Matthew Bayliss, Chicago (USA), astrophysics 6.27-7.03

Erwin Lau, Chicago (USA), astrophysics 6.27-7.03

Michitoshi Yoshida, Hiroshima (Japan), astronomy 6.27-7.03

Begoña Ascaso, UC Davis (USA), cosmology 6.27-7.03

Kimihiko Nakajima, Tokyo (Japan), astronomy 6.27-7.03

John Mulchaey, Carnegie Obs (USA), astronomy 6.27-7.03

Shogo Masaki, Nagoya (Japan), astrophysics 6.27-7.03

Joon Hyeop Lee, KASI (Korea), astronomy 6.27-7.03

Ben Granett, Hawaii (USA), astronomy 6.27-7.03

Alexander Fritz, Gemini Obs (USA), astronomy 6.27-7.03

Pasi Nurmi, Turku (Turkey), astronomy 6.27-7.03

Hung-Yu Jian, NTU (Taiwan), astrophysics 6.27-7.03

Hiroaki Nishioka, Academia Sinica (Taiwan), astrophysics 6.27-7.03

Kai-yang Lin, ASIAA (Taiwan), cosmology 6.27-7.03

Ana Lopes, Nature News & Views (UK), 6.27-7.03

Takayuki Tamura, JAXA (Japan), astronomy 6.27-7.03

Bianca Poggianti, INAF Padova (Italy), astronomy 6.28-7.03

Gilbert Holder, McGill (Canada), astrophysics 6.28-7.03

Tetsu Kitayama, Toho (Japan), cosmology 6.28-7.01

Tadayuki Kodama, NAOJ (Japan), astronomy 6.28-7.02

Graham Smith, Birmingham (UK), astronomy 6.28-7.08

Kaustuv Basu, MPI (Germany), astronomy 6.28-7.03

Arjen de Hoon, AIP (USA), astrophysics 6.28-7.02

Kentaro Nagao, Nagoya (Japan), mathematics 6.28-6.28

Sean Moran, Johns Hopkins (USA), astrophysics 6.28-7.02

Mathilde Jauzac, OAMP (France), astronomy 6.28-7.08

Yoshiki Matsuoka, Nagoya (Japan), astronomy 6.28-7.02

Stefano Ettori, INAF Bologna (Italy), astronomy 6.28-7.02

Naohisa Inada, Tokyo RESCEU (Japan), astronomy 6.28-7.02

Madoka Kawaharada, RIKEN (Japan), astrophysics 6.28-7.02

Tomoaki Ishiyama, NAOJ (Japan), astronomy 6.28-7.02

Naomi Ota, Tokyo Tech (Japan), astrophysics 6.28-7.02

Masayasu Kamimura, RIKEN (Japan), nuclear physics 6.29-7.01

Brian Wecht, IAS (USA), particle theory 6.29-7.06

C. S. Kim, Yonsei (Korea), particle theory 7.01-7.30

Chang Soon Park, Caltech (USA), string theory 7.02-8.13

Tadashi Ishibe, Hiroshima (Japan), mathematics 7.02-7.04

Lars Hernquist, Harvard (USA), astroparticle physics 7.02-7.08

Dan Marrone, KICP (USA), cosmology 7.03-7.08

Daniel Holz, Los Alamos (USA), astrophysics 7.04-7.14

Tao Liu, Chicago (USA), particle theory 7.04-7.12

Andrei Frolov, Simon Fraser (Germany), cosmology 7.04-7.07

Alexis Finoguenov, MPI (Germany), astronomy 7.05-7.16

Chiaki Hikage, Princeton (USA), cosmology 7.05-7.17

Eiichi Egami, Arizona (USA), astronomy 7.05-7.07

Andreas Piepke, Alabama (USA), neutrino physics 7.06-7.13

Hiromitsu Sato, York U (Canada), particle theory 7.07-7.07

Daisuke Nagai, Yale (USA), cosmology 7.07-7.16

Valery Rubakov, Russian Academy Sci (Russia), string theory 7.08-7.08

Kenji Kadota, Michigan (USA), particle theory 7.10-7.14

Martin Guest, Tokyo Metropolitan U (Japan), mathematics 7.12-7.12

Hsiang-nan Li, Inst Physics (Taiwan), particle theory 7.12-7.18

Nobuhiko Katayama, KEK (Japan), high energy physics 7.13-7.13

Kyoko Matsushita, Tokyo U Sci (Japan), astronomy 7.13-7.13

Wako Aoki, NAOJ (Japan), astronomy 7.13-7.13

Takashi Yoshida, NAOJ (Japan), astronomy 7.13-7.13

Ko Nakamura, NAOJ (Japan), astronomy 7.13-7.13

Natsuko Izutani, Tokyo (Japan), astronomy 7.13-7.13

Stavros Katsanevas, IN2P3.CNRS (France), astrophysics 7.17-7.20

Jean-Paul Kneib, OAMP (France), astronomy 7.18-7.22

Anne Ealet, CPPM (France), astronomy 7.18-7.22

Richard Ellis, Caltech (USA), astronomy 7.18-7.21

Ian Parry, Cambridge (UK), astronomy 7.18-7.21

Masashi Chiba, Tohoku (Japan), astronomy 7.19-7.20

Masayuki Akiyama, Tohoku (Japan), astronomy 7.19-7.20

Yu Niinou, Kyoto (Japan), astrophysics 7.20-7.22

Massimo Porrati, NYU (USA), cosmology 7.22-8.23

James Stone, Boston U (USA), high energy physics 7.23-7.29

Zheng Zheng, Yale (USA), cosmology 7.25-8.01

Ed Segal, Imperial Coll London (UK), mathematics 7.25-7.29

Henry Sobel, UC Irvine (USA), astrophysics 7.26-8.06

Hokuto Uehara, Tokyo Metropolitan U (Japan), mathematics 7.26-7.27

Masamune Oguri, NAOJ (Japan), cosmology 7.28-7.30

Zohar Komargodski, IAS (USA), particle theory 7.28-8.04

Yutaka Hosotani, Osaka (Japan), particle theory 7.29-7.29

Christopher Walter, Duke (USA), neutrino physics 8.02-8.22

Tadayuki Kodama, NAOJ (Japan), astronomy 8.04-8.05

Nobunari Kashikawa, NAOJ (Japan), astronomy 8.04-8.05

Kentaro Motohara, Tokyo IoA (Japan), astronomy 8.04-8.05

Toru Misawa, Shinshu U (Japan), astronomy 8.04-8.05

Tomonori Totani, Kyoto (Japan), astrophysics 8.04-8.05

Chihiro Toukoku, Tohoku (Japan), astronomy 8.04-8.05

Masamune Ooguri, NAOJ (Japan), cosmology 8.04-8.05

Masakazu Kobayashi, NAOJ (Japan), astronomy 8.04-8.05

Jonathan Trump, Arizona (USA), astronomy 8.05-8.05

Hiroaki Nishioka, Academia Sinica (Taiwan), astrophysics 8.15-9.09

Kate Scholberg, Duke (USA), neutrino physics 8.16-9.06

Keiichi Umetsu, Academia Sinica (Taiwan), astrophysics 8.16-8.17

Ragnar Buchweitz, Toronto (Canada), mathematics 8.17-8.17

Emanuel Scheidegger, Augsburg (Germany), mathematics 8.19-9.10

Chris Brook, Central Lancashire (UK), cosmology 8.21-8.26

Robert Lupton, Princeton (USA), cosmology 8.22-9.02

Craig Loomis, Princeton (USA), csmology 8.22-9.02

Pyungwon Ko, KIAS (Korea), high energy physics 8.22-8.25

Alexey Bondal, Aberdeen (UK), mathematics 8.22-9.20

Raphael Flauger, Texas (USA), cosmology 8.23-10.22

Shin Nakamura, Kyoto (Japan), particle theory 9.02-9.02

Sanjoy Biswas, Harish-Chandra Res Inst (India), particle theory 9.07-10.06

Zengo Tsuboi, OIQP (Japan), mathematical physics 9.07-9.07

Adam Martin, Fermilab (USA), particle theory 9.07-9.10

Dragan Huterer, Michigan (USA), cosmology 9.08-9.08

Valeri Frolov, Alberta (Canada), cosmology 9.12-9.20

John Mangual, UC Santa Barbara (USA), mathematics 9.16-12.14

Richard Eager, UC Santa Barbara (USA), mathematics 9.17-12.13

David R. Morrison, UC Santa Barbara (USA), mathematics 9.20-12.20

Leszek Roszkowski, Sheffield (UK), particle theory 9.21-10.01

Graziano Rossi, KIAS (Korea), cosmology 9.24-9.24

Vincent Desjacques, Zurich (Switzerland), astrophysics 9.24-9.24

Robert Brandenberger, McGill (Canada), cosmology 9.26-10.09

Kiwoon Choi, KAIST (Korea), particle theory 9.26-10.09

Petr Horava, UC Berkeley (USA), string theory 9.26-10.01

Urjit Yajnik, IIT Bombay (India), cosmology 9.26-10.08

Eva Silverstein, SLAC (USA), high energy physics 9.27-9.29

Siamak Akhshabi, UMZ (Iran), mathematics 9.27-10.01

Antusch Stefan, MPI (Germany), particle theory 9.27-10.01

Shoji Asai, Tokyo ICEPP (Japan), high energy physics 9.27-10.01

Guillermo Ballesteros, INAF Padova (Italy), 9.27-10.01

Kazuharu Bamba, Natl Tsing Hua (Taiwan), cosmology 9.27-10.01

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Kazumi Kashiyama, Kyoto (Japan), cosmology 9.27-10.01

Shinta Kasuya, Kanagawa (Japan), cosmology 9.27-10.01

Norita Kawanaka, KEK (Japan), particle theory 9.27-10.01

Masahiro Kawasaki, Tokyo ICRR (Japan), cosmology 9.27-10.01

Salomeh Khoeini Moghaddam, IPM (Iran), cosmology 9.27-10.01

Jihn E. Kim, SNU (Korea), particle theory 9.27-10.01

Daniel Figueroa, HIP (Finland), cosmology 9.27-10.01

Hajime Goto, KEK (Japan), cosmology 9.27-10.01

Tomohiro Fujita, Tokyo (Japan), cosmology 9.27-10.01

Takao Fukui, Dokkyo U (Japan), astronomy 9.27-10.01

Kensuke Fukunaga, Tokyo (Japan), cosmology 9.27-10.01

Stepan Paul, UC Santa Barbara (USA), mathematics 9.28-12.12

Devendra Kumar Sahu, IIAP (India), astronomy 9.30-10.30

Robbert Dijkgraaf, Amsterdam (Netherlands), mathematical physics 10.01-10.01

Nathan Broomhead, Bath (UK), mathematics 10.02-10.16

Daniel Baumann, IAS (USA), cosmology 10.03-10.09

Sumit Ranjan Das, Kentucky (USA), string theory 10.03-10.07

Tatsuo Kobayashi, Kyoto (Japan), particle theory 10.03-10.09

Gary Shiu, Wisconsin (USA), string theory 10.03-10.09

Kostas Skenderis, Amsterdam (Netherlands), string theory 10.03-10.09

Elias Kiritsis, Crete (Greece), cosmology 10.03-10.09

Cristiano Germani, LMU Munich (Germany), cosmology 10.03-10.09

Jinn-Ouk Gong, Leiden (Netherlands), cosmology 10.03-10.09

Alexander Vikman, CERN (Switzerland), cosmology 10.03-10.08

Oleg Evnin, ITP-CAS (China), string theory 10.03-10.09

Mark Jackson, Leiden (Netherlands), cosmology 10.03-10.09

Takahiro Tanaka, Kyoto (Japan), cosmology 10.03-10.09

Fabian Schmidt, Caltech (USA), cosmology 10.03-10.05

Sergey Ketov, Tokyo Metropolitan U (Japan), cosmology 10.04-10.08

Kei-ichi Maeda, Waseda (Japan), cosmology 10.04-10.08

Akihiro Ishibashi, KEK (Japan), cosmology 10.04-10.08

Hideo Kodama, KEK (Japan), cosmology 10.04-10.08

Osamu Seto, Hokkai-Gakuen U (Japan), particle theory 10.04-10.08

Hajime Goto, KEK (Japan), cosmology 10.04-10.08

Yosuke Sumitomo, TIFR (India), particle theory 10.04-10.08

Shuichiro Yokoyama, Nagoya (Japan), cosmology 10.04-10.08

Takeo Inami, Chuo (Japan), field theory 10.04-10.08

Masato Minamitsuji, Kwansei Gakuin U (Japan), cosmology 10.04-10.08

Sebastian Halter, MPI (Germany), string theory 10.04-10.08

Jiajun Xu, Wisconsin (USA), cosmology 10.04-10.08

Yasuhiro Sekino, OIQP (Japan), string theory 10.04-10.08

Kyung Kiu Kim, IEU Ewha Womans U (Korea), particle theory 10.04-10.08

Igmar Rosas-Lopez, Sokendai (Japan), particle theory 10.04-10.08

Gonzalo Palma, Chile (Chile), cosmology 10.04-10.08

Jun'ichi Yokoyama, Tokyo RESCEU (Japan), astrophysics 10.04-10.08

Shingo Torii, Tokyo (Japan), string theory 10.04-10.08

Ken'ichi Saikawa, Tokyo ICRR (Japan), string theory 10.04-10.08

Kenji Ikegami, Tokyo Dental College (Japan), relativity 10.04-10.08

Masayoshi Nakamura, Tokyo (Japan), string theory 10.04-10.08

Toshifumi Noumi, Tokyo (Japan), string theory 10.04-10.08

Koichi Miyamoto, Tokyo ICRR (Japan), string theory 10.04-10.08

Igmar Rosas-Lopez, Sokendai (Japan), cosmology 10.04-10.08

Jun Nishimura, KEK (Japan), particle theory 10.04-10.08

Yoshihisa Kitazawa, KEK (Japan), particle theory 10.04-10.08

Yuko Urakawa, Waseda (Japan), cosmology 10.04-10.08

Ryo Wakebe, Waseda (Japan), relativity 10.04-10.08

Masahiro Kawasaki, Tokyo ICRR (Japan), cosmology 10.04-10.08

Jong-Chul Park, KIAS (Japan), particle theory 10.04-10.08

Shoichi Ichinose, Shizuoka (Japan), particle theory 10.04-10.08

Yoji Koyama, Chuo (Japan), particle theory 10.04-10.08

Yuichi Fukazawa, Chuo (Japan), particle theory 10.04-10.08

Washington Taylor, MIT (USA), particle theory 10.06-10.20

David Shih, Rurgers (USA), high energy physics 10.06-10.20

Alexei Starobinsky, Landau Inst (fRussia), cosmology 10.07-10.14

Larry Weber, NSF Tokyo Office (USA), 10.08-10.08

Anne Emig, NSF Tokyo Office (USA), 10.08-10.08

Agnieszka Maria Bodzenta-Skibinska, Warsaw (Poland), mathematics 10.11-12.17

Edwin Turner, Princeton (USA), astrophysics 10.12-10.29

Yosuke Sumitomo, TIFR (India), particle theory 10.12-10.12

Tadashi Ishibe, Hiroshima (Japan), mathematics 10.14-10.16

Yifung (Bess) Ng, Case Western (USA), relativity 10.14-10.14

Alexey Bondal, Aberdeen (UK), mathematics 10.16-2011.01.31

Brian Fujikawa, LBL (USA), neutrino physics 10.18-11.09

Le Dung Trang, ICTP (Italy), mathematics 10.19-10.19

James Sully, UC Santa Barbara (USA), mathematics 10.20-11.21

Shirley Ho, LBL (USA), cosmology 10.21-10.30

Katarina Kovac, MPI (Germany), astrophysics 10.23-10.29

Yanmei Chen, Nanjing (China), astronomy 10.24-10.29

Guinevere Kauffmann, MPI (Germany), astrophysics 10.24-10.28

Guangtun Zhu, NYU (USA), astrophysics 10.24-10.29

Rita Tojeiro, Portsmouth (UK), cosmology 10.24-10.29

Khee-Gan Lee, Princeton (USA), astronomy 10.24-10.29

Timothy Heckman, Johns Hopkins U (USA), astrophysics 10.24-10.29

Kevin Bundy, UC Berkeley (USA), astronomy 10.24-10.29

Alexie Leauthaud, LBL (USA), astrophysics 10.24-10.29

Janine Pforr, Portsmouth (UK), astrophysics 10.24-10.29

Nikhil Padmanabhan, Yale (USA), astrophysics 10.24-10.29

Renbin Yan, NYU (USA), astrophysics 10.24-10.29

Claudia Maraston, Portsmouth (UK), cosmology 10.24-10.29

Daniel Thomas, Portsmouth (UK), cosmology 10.24-10.28

Jonas Johansson, Portsmouth (UK), astrophysics 10.24-10.29

Michael Strauss, Princeton (USA), astronomy 10.24-10.29

Robert Gibson, Washington (USA), astrophysics 10.24-10.29

Yue Shen, Harvard (USA), astronomy 10.24-11.03

David Wake, Yale (USA), astronomy 10.24-10.29

Brice Menard, CITA (Canada), astrophysics 10.24-10.29

Daryl Haggard, Washington (USA), astronomy 10.24-10.29

Nic Ross, LBL (USA), astrophysics 10.24-10.29

Luca Ciotti, Bologna (Italy), astrophysics 10.24-10.29

Xin Liu, Princeton (USA), astronomy 10.24-11.03

Christina Tremonti, Wisconsin (USA), astronomy 10.24-10.28

Ting-Wen Lan, ASIAA (Taiwan), astronomy 10.24-11.30

Mamoru Doi, Tokyo IoA (Japan), astronomy 10.25-10.28

Naohisa Inada, Tokyo RESCUE (Japan), astronomy 10.25-10.28

Yen-Ting Lin, ASIAA (Taiwan), astrophysics 10.25-12.31

Yuri Efremenko, Tennessee (USA), neutrino physics 10.25-11.03

Koji Hashimoto, RIKEN (Japan), particle theory 10.26-10.26

Nobuhiko Katayama, KEK (Japan), high energy physics 10.27-10.27

Raphael Ponge, Tokyo (Japan), mathematics 10.28-10.28

Kenta Matsuoka, Ehime (Japan), cosmology 11.01-11.05

Nobuhiko Katayama, KEK (Japan), high energy physics 11.01-11.01

Brice Menard, CITA (Canada), astrophysics 11.01-2011.1.21

Edward Kearns, Boston (USA), neutrino physics 11.06-11.14

Werner Rodejohann, MPI (Germany), neutrino physics 11.07-11.13

Morimitsu Tanimoto, Niigata (Japan), particle theory 11.07-11.11

Morgan Wascko, Imperial Coll. London (UK), neutrino physics 11.07-11.13

Alexander Himmel, Caltech (USA), high energy physics 11.07-11.11

Atsushi Watanabe, Niigata (Japan), neutrino physics 11.07-11.11

Hajime Ishimori, Niigata (Japan), particle theory 11.07-11.11

Yusuke Shimizu, Niigata (Japan), particle theory 11.07-11.11

Tadafumi Kishimoto, Osaka (Japan), high energy physics 11.08-11.09

Marco Baumgartl, LMU Munich (Germany), string theory 11.08-11.17

Jose Valle, Valencia (Spain), astrophysics 11.08-11.14

Kate Scholberg, Duke (USA), neutrino physics 11.08-11.14

Ryosuke Sato, Tokyo (Japan), particle theory 11.08-11.11

Ken-ichi Senda, KEK (Japan), particle theory 11.08-11.11

Takayuki Kiwanami, KEK (Japan), particle theory 11.08-11.11

Tsuyoshi Nakaya, Kyoto (Japan), high energy physics 11.09-11.11

Christopher Walter, Duke (USA), neutrino physics 11.09-11.14

Ruben Minasian, CEA-Saclay (France), string theory 11.13-11.19

Enrico Trincherini, SISSA (Italy), particle theory 11.14-11.29

Sanshiro Enomoto, Washington (USA), neutrino physics 11.15-11.24

Yoichi Mieda, Kyushu (Japan), mathematics 11.15-11.19

Yudai Suwa, Tokyo (Japan), astrophysics 11.15-11.15

Kunihito Ioka, KEK (Japan), particle theory 11.15-11.15

Kazuyuki Omukai, Kyoto (Japan), astrophysics 11.15-11.15

Takashi Hosokawa, Kyoto (Japan), astrophysics 11.15-11.15

Nozomu Tominaga, Konan U (Japan), astrophysics 11.15-11.15

Tomoyuki Abe, Tokyo (Japan), mathematics 11.16-11.19

Tadashi Ishibe, Hiroshima (Japan), mathematics 11.16-11.17

Le Dung Trang, ICTP (Italy), mathematics 11.16-11.16

Mitsutoshi Fujita, Kyoto (Japan), particle theory 11.16-11.19

Sergei Gukov, Caltech (USA), particle theory 11.19-11.20

Yukiko Konishi, Kyoto (Japan), mathematics 11.22-11.22

Sergey Sibiryakov, INR (Russia), mathematical physics 11.24-12.04

Luca Panizzi, IPNL (France), particle theory 11.24-11.24

Tomoki Nakanishi, Nagoya (Japan), mathematics 11.25-11.27

Krzysztof Gawedzki, Lyon (France), mathematical physics 11.28-12.08

Osamu Iyama, Nagoya (Japan), mathematics 11.29-11.30

Akitoshi Ueda, NAOJ (Japan), astronomy 11.29-11.29

Friedel Thielemann, Basel (Switzerland), astrophysics 12.01-12.01

Christian Ott, Caltech (USA), astrophysics 12.01-12.01

Nozomu Tominaga, Konan U (Japan), astrophysics 12.01-12.01

Kentaro Someya, JAXA (Japan), astrophysics 12.01-12.01

Tomoyuki Maruyama, Nihon (Japan), nuclear physics 12.01-12.01

Hiroari Miyatake, KEK (Japan), nuclear physics 12.01-12.01

Nobuya Nishimura, NAOJ (Japan), astronomy 12.01-12.01

Hiroki Nagakura, Waseda (Japan), astrophysics 12.01-12.01

Toshitaka Kajino, NAOJ (Japan), astronomy 12.01-12.01

David Kahl, Tokyo CNS (Japan), nuclear physics 12.01-12.01

Shigeru Kubono, Tokyo CNS (Japan), nuclear physics 12.01-12.01

Ko Nakamura, NAOJ (Japan), astronomy 12.01-12.01

Motohiko Kusakabe, Tokyo ICRR (Japan), particle theory 12.01-12.01

Sho Sato, Tokyo (Japan), astronomy 12.01-12.01

Hajime Goto, KEK (Japan), cosmology 12.01-12.01

Hidetoshi Yamaguchi, Tokyo CNS (Japan), nuclear physics 12.01-12.01

Keigo Takayama, Tokyo (Japan), relativity 12.01-12.01

Kaori Otsuki, Fukuoka (Japan), astrophysics 12.01-12.01

Tadaaki Isobe, Tokyo (Japan), astrophysics 12.01-12.01

Shrinivas Kulkarni, Caltech (USA), astronomy 12.03-12.03

Robert Quimby, Caltech (USA), astronomy 12.03-12.03

Martin Elvis, Harvard (USA), astrophysics 12.05-12.12

James Stone, Boston (USA), high energy physics 12.06-12.17

Takeo Nishinou, Tohoku (Japan), mathematics 12.06-12.06

Kevin Bundy, UC Berkeley (USA), astronomy 12.07-12.14

Masahide Shimizu, Hokkaido (Japan), string theory 12.07-12.11

Takamitsu Miyaji, Inst Astr Ensenada (Mexico), astronomy 12.07-12.08

Tatsuma Nishioka, Princeton (USA), particle theory 12.09-2011.01.13

Toshiyuki Kobayashi, Tokyo (Japan), mathematics 12.09-12.09

Tadashi Ishibe, Hiroshima (Japan), mathematics 12.10-12.12

Sergei Blinnikov, ITEP (Russia), astronomy 12.12-2011.02.12

Constantin Teleman, UC Berkeley (USA), mathematics 12.12-12.18

Xi Yin, Harvard (USA), string theory 12.14-12.20

Serge Richard, Lyon (France), mathematics 12.14-12.14

Nemanja Kaloper, UC Davis (USA), high energy physics 12.14-12.18

Reiko Toriumi, UC Irvine (USA), cosmology 12.16-12.18

2011

Alexey Bondal, Aberdeen (UK), mathematics 2010.10.16-1.31

Brice Menard, CITA (Canada), astrophysics 2010.11.01-1.21

Tatsuma Nishioka, Princeton (USA), particle theory 2010.12.09-1.13

Sergei Blinnikov, ITEP (Russia), astronomy 2010.12.12-2.12

Sachiko Tsuruta, Montana State (USA), astrophysics 1.05-1.05

Albrecht Klemm, Bonn (Germany), string theory 1.06-1.15

Patrick Decowski, Nikhef (Netherlands), high energy physics 1.11-1.16

Dongsu Bak, SNU (Korea), particle theory 1.17-1.30

Andrea Ferrara, SISSA (Italy), astronomy 1.18-1.22

Norihiro Iizuka, KIPT UCSB (USA), string theory 1.19-1.24

Oscar Varela, MPI (Germany), string theory 1.22-1.29

Maria Rodriguezâ, MPI (Germany), asring theory 1.22-1.29

Patrick Decowski, Nikhef (Netherlands), high energy physics 1.22-1.28

Luis Ho, Carnegie Obs (USA), astronomy 1.23-1.27

Malte Schamm, Kyoto (Japan), astronomy 1.23-1.26

Luc Dessart, OAMP (France), astronomy 1.28-2.28

Dmitry Kaledin, Steklov Inst (Russia), mathematics 1.29-2.02

Stefano Liberati, SISSA (Italy), astronomy 1.30-2.06

Elena Sorokina, Sternberg Astr Inst (Russia), astrophysics 2.01-2.28

Young-Hwan Hyun, Sungkyunkwan (Korea), string theory 2.04-2.18

Kiyoshi Takeuchi, Tsukuba (Japan), mathematics 2.08-2.09

Jiro Sekiguchi, Tokyo U of Agr & Tech (Japan), mathematics 2.08-2.09

Oksu Seon, Nagoya (Japan), high energy physics 2.10-2.10

Gordon Semenoff, UBC (Canada), string theory 2.15-2.15

Luis Lehner, Perimeter Inst (Canada), astrophysics 2.20-2.26

Samir Mathur, Ohio State (USA), cosmology 2.20-2.26

Jeffrey McClintock, Harvard (USA), astrophysics 2.20-2.26

Frans Pretorius, Princeton (USA), mathematical physics 2.20-2.26

Rohta Takahashi, RIKEN (Japan), astrophysics 2.20-2.25

Enrico Barausse, Maryland (USA), cosmology 2.20-2.26

Noriaki Ogawa, Kyoto (Japan), particle theory 2.20-2.26

Tatsuo Azeyanagi, Kyoto (Japan), particle theory 02.20-2.26

Thomas Hartman, Princeton (USA), particle theory 2.20-2.26

Massimo Dotti, MPI (Germany), astrophysics 2.20-2.26

Kei-ichi Maeda, Waseda (Japan), cosmology 2.21-2.25

Shin Mineshige, Kyoto (Japan), astrophysics 2.21-2.25

Tomohiro Takahashi, Kyoto (Japan), astrophysics 2.21-2.26

Chulmoon Yoo, Kyoto (Japan), cosmology 2.21-2.25

Robert Mann, Waterloo (Canada), mthematical physics 2.21-2.25

Marc Henneaux, Brussels Free U (Belgium), mathematical physics 2.21-2.25

Tomohiro Harada, Rikkyo (Japan), mathematical physics 2.21-2.25

Vincent Fish, MIT (USA), astronomy 2.21-2.25

Akihiro Ishibashi, KEK (Japan), cosmology 2.21-2.25

Hiroshi Iritani, Kyoto (Japan), mathematics 2.21-2.21

Kazunori Akiyama, Tokyo (Japan), astronomy 2.21-2.25

Yukinori Sasagawa, Waseda (Japan), cosmology 2.21-2.25

Yuki Yokokura, Kyoto (Japan), particle theory 2.21-2.25

Tatsuo Azeyanagi, Kyoto (Japan), particle theory 2.22-2.26

Kiyotomo Ichiki, Nagoya (Japan), cosmology 2.22-2.23

Masanori Sato, Nagoya (Japan), astrophysics 2.22-2.23

Samir Mathur, Ohio State (USA), particle theory 2.23-2.26

Shin Nakamura, Kyoto (Japan), particle theory 2.23-2.24

Yusei Koyama, Tokyo (Japan), astronomy 2.24-2.24

Atsushi Takahashi, Osaka (Japan), mathematics 2.24-2.24

Sampei Usui, Osaka (Japan), mathematics 2.24-2.24

Ikuo Satake, Osaka (Japan), mathematics 2.24-2.24

Masataka Chida, Kyoto (Japan), mathematics 2.24-2.27

Shigeyuki Kondo, Nagoya (Japan), mathematics 2.24-2.24

Daniel Sternheimer, Bourgogne (France), mathematics 2.24-2.24

Toshiyuki Katsura, Hosei (Japan), mathematics 2.24-2.24

Takashi Otofuji, Nihon U (Japan), mathematics 2.24-2.24

Akishi Ikeda, Tokyo (Japan), mathematics 2.24-2.24

Hidemasa Oda, Tokyo (Japan), mathematics 2.24-2.24

Xu-Feng Wang, Hefei (China), particle theory 2.25-2.28

Paul Price, Princeton (USA), astrophysics 2.26-3.06

Craig Loomis, Princeton (USA), cosmology 2.26-3.05

Robert Lupton, Princeton (USA), cosmology 2.26-3.06

Chiaki Kobayashi, Australian Natl U (Australia), astronomy 2.28-3.01

Michel Granger, U Angers (France), mathematics 2.28-2.28

Steve Bickerton, Princeton (USA), astronomy 3.01-3.16

Serguey Petcov, SISSA (Italy), particle theory 3.01-4.18

Ezequiel Treister, Hawaii (USA), astronomy 3.03-3.04

Hajime Sugai, Kyoto (Japan), astronomy 3.03-3.03

Binata Panda, Inst Phys, Bhubaneswar (India), string theory 3.07-3.11

Takuya Okuda, Tokyo (Japan), string theory 3.08-3.08

Yuri Efremenko, Tennessee (USA), neutrino physics 3.08-3.16

Salman Habib, Los Alamos (USA), csmology 3.10-3.11

Shinobu Hosono, Tokyo (Japan), mathematical physics 3.10-3.10

Hui Luo, Zhejiang (China), particle theory 3.13-3.15

Shun Saito, UC Berkeley (USA), cosmology 3.22-3.25

Ken Mawatari, Tohoku (Japan), astrophysics 3.23-4.03

Tadashi Ishibe, Hiroshima (Japan), mathematics 3.24-3.29

Wataru Kasai, Tohoku (Japan), astronomy 3.25-4.09

Eibun Senaha, NCTS (Taiwan), high energy physics 3.29-4.05

12 Publications

JFY2007

1. **Multidimensional simulations for early-phase spectra of aspherical hypernovae: SN 1998bw and off-axis hypernovae,**
   Masaomi Tanaka, Keiichi Maeda, Paolo A. Mazzali, Ken'ichi Nomoto,
   Astrophysical Journal, 668, (1), pp. L19-L22, 2007, OCT 10 2007.

2. **The aspherical properties of the energetic type Ic SN 2002ap as inferred from its nebular spectra,**
   P. A. Mazzali, K. S. Kawabata, K. Maeda, R. J. Foley, K. Nomoto, J. Deng, T. Suzuki, M. Iye, N. Kashikawa, Y. Ohyama, A. V. Filippenko, Y. Qiu, J. Wei,
   Astrophysical Journal, 670, (1), pp. 592-599, 2007, NOV 20 2007.

3. **The r-process in supersonic neutrino-driven winds: The role of the wind termination shock,**
   Takami Kuroda, Shinya Wanajo, Ken'ichi Nomoto,
   Astrophysical Journal, 672, (2), pp. 1068-1078, 2008, JAN 10 2008.

4. **nu-process nucleosynthesis in population III core-collapse supernovae,**
   Takashi Yoshida, Hideyuki Umeda, Ken'ichi Nomoto,
   Astrophysical Journal, 672, (2), pp. 1043-1053, 2008, JAN 10 2008.

5. **Estimation prospects of the source number density of ultra-high-energy cosmic rays,**
   Hajime Takami, Katsuhiko Sato,
   Astroparticle Physics, 28, (6), pp. 529-539, 2008, JAN 2008.

6. **How much Ni-56 can be produced in corecollapse supernovae? Evolution and explosions of 30-100 M-circle dot stars,**
   Hideyuki Umeda, Ken'ichi Nomoto,
   Astrophysical Journal, 673, (2), pp. 1014-1022, 2008, FEB 1 2008.

7. **Gravitino dark matter from inflaton decay,**
   Fuminobu Takahashi,
   Physics Letters B, 660, (3), pp. 100-106, 2008, FEB 21 2008.

8. **Asphericity in supernova explosions from latetime spectroscopy,**
   Keiichi Maeda, Koji Kawabata, Paolo A. Mazzali, Masaomi Tanaka, Stefano Valenti, Ken'ichi Nomoto, Takashi Hattori, Jinsong Deng, Elena Pian, Stefan Taubenberger, Masanori Iye, Thomas Matheson, Alexei V. Filippenko, Kentaro Aoki, George Kosugi, Youichi Ohyama, Toshiyuki Sasaki, Tadafumi Takata,
   Science, 319, (5867), pp. 1220-1223, 2008, FEB 29 2008.

9. **Phase diagram of nuclear "pasta" and its uncertainties in supernova cores,**
   Hidetaka Sonoda, Gentaro Watanabe, Katsuhiko Sato, Kenji Yasuoka, Toshikazu Ebisuzaki,
   Physical Review C, 77, (3), 035806, 2008, MAR 2008.

JFY2008

1. **Cosmic microwave background-weak lensing correlation: Analytical and numerical study of nonlinearity and implications for dark energy,**
   Atsushi J. Nishizawa, Eiichiro Komatsu, Naoki Yoshida, Ryuichi Takahashi, Naoshi Sugiyama,
   Astrophysical Journal Letters, 676, (2), pp. L93-L96, 2008, APR 1 2008.

2. **The outermost ejecta of Type Ia supernovae,**
   Masaomi Tanaka, Paolo A. Mazzali, Stefano Benetti, Ken'ichi Nomoto, Nancy Elias-Rosa, Rubina Kotak, Giuliano Pignata, Vallery Stanishev, Stephan Hachinger,
   Astrophysical Journal, 677, (1), pp. 448-460, 2008, APR 10 2008.

3. **Probing nonstandard neutrino physics by two identical detectors with different baselines,**
   Nei Cipriano Ribeiro, Hiroshi Nunokawa, Takaaki Kajita, Shoei Nakayama, Pyungwon Ko, Hisakazu Minakata,
   Physical Review D, 77, (7), 073007, 2008, APR 2008.

4. **Metastable vacua in perturbed Seiberg-Witten theories,**
   Hirosi Ooguri, Yutaka Ookouchi, Chang-Soon Park,
   Advances In Theoretical And Mathematical Physics, 12, (2), pp. 405-427, 2008, APR 2008.

5. **Toward unravelling the structural distribution of ultra-high-energy cosmic ray sources,**
   Hajime Takami, Katsuhiko Sato,
   Astrophysical Journal, 678, (2), pp. 606-613, 2008, MAY 10 2008.

6. **Determining the mass for an ultralight gravitino at LHC,**
   K. Hamaguchi, S. Shirai, T. T. Yanagida,
   Physics Letters B, 663, (1-2), pp. 86-94, 2008, MAY 15 2008.

7. **Impact of massive neutrinos on the nonlinear matter power spectrum,**
   Shun Saito, Masahiro Takada, Atsushi Taruya,
   Physical Review Letters, 100, (19), 191301, 2008, MAY 16 2008.

8. **Chemical abundances of the secondary star in the black hole X-ray binary XTE J1118+480,**
   Jonay I. Gonzalez Hernandez, Rafael Rebolo, Garik Israelian, Alexei V. Filippenko, Ryan Chornock, Nozomu Tominaga, Hideyuki Umeda, Ken'ichi Nomoto,
   Astrophysical Journal, 679, (1), pp. 732-745, 2008, MAY 20 2008.

9. **Moduli stabilization in stringy ISS models,**
   Yu Nakayama, Masahito Yamazaki, T. T. Yanagida,
   Physics Letters B, 663, (3), pp. 281-285, 2008, MAY 22 2008.

10. **Constraints on scalar-tensor models of dark energy from observational and local gravity tests,**
Shinji Tsujikawa, Kotub Uddin, Shuntaro Mizuno, Reza Tavakol, Jun'ichi Yokoyama,
Physical Review D, 77, (10), 103009, 2008, MAY 2008.

11. **A hybrid method for determining particle masses at the Large Hadron Collider with fully identified cascade decays,**
Mihoko M. Nojiri, Giacomo Polesello, Daniel R. Tovey,
Journal Of High Energy Physics, (5), 0147, 2008, MAY 2008.

12. **Decaying D-branes and moving mirrors,**
Tomoyoshi Hirata, Tadashi Takayanagi, Shinji Mukohyama,
Journal Of High Energy Physics, (5), 089, 2008, MAY 2008.

13. **Young and massive binary progenitors of type Ia supernovae and their circumstellar matter,**
Izumi Hachisu, Mariko Kato, Ken'ichi Nomoto,
Astrophysical Journal, 679, (2), pp. 1390-1404, 2008, JUN 1 2008.

14. **The evolution of the peculiar Type Ia supernova SN 2005hk over 400 days,**
D. K. Sahu, Masaomi Tanaka, G. C. Anupama, Koji S. Kawabata, Keiichi Maeda, Nozomu Tominaga, Ken'ichi Nomoto, Paolo A. Mazzali, T. P. Prabhu,
Astrophysical Journal, 680, (1), pp. 580-592, 2008, JUN 10 2008.

15. **Test of anomaly mediation at the LHC,**
Shoji Asai, Takeo Moroi, T. T. Yanagida,
Physics Letters B, 664, (3), pp. 185-189, 2008, JUN 19 2008.

16. **Gravitational waves as a probe of the gravitino mass,**
Fuminobu Takahashi, T. T. Yanagida, Kazuya Yonekura,
Physics Letters B, 664, (3), pp. 194-198, 2008, JUN 19 2008.

17. **Inclusive transverse mass analysis for squark and gluino mass determination,**
Mihoko M. Nojiri, Yasuhiro Shimizu, Shogo Okada, Kiyotomo Kawagoe,
Journal Of High Energy Physics, (6), 035, 2008, JUN 2008.

18. **Space-based gravitational-wave detectors can determine the thermal history of the early Universe,**
Kazunori Nakayama, Shun Saito, Yudai Suwa, Jun'ichi Yokoyama,
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IPMU10-0186
Toshitake Kohno
Hyperplane arrangements, local system homology and iterated integrals
ASPM

IPMU10-0187
Toshitake Kohno
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IPMU10-0188
Yuichiro Nakai and Yutaka Ookouchi
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IPMU10-0189
Kazunori Nakayama, Fuminobu Takahashi, Tsutomu T Yanagida
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Yoonbai Kim and Seong Chan Park
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IPMU10-0199
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IPMU10-0202
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Richard Eager, Michael Gary and Matthew M. Roberts
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IPMU10-0214
Satoshi Kondo and Seidai Yasuda
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IPMU10-0215
Charles L. Steinhardt, Martin Elvis
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IPMU10-0216
Hitoshi Murayama, Vikram Rentala, Jing Shu and Tsutomu T. Yanagida
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Domenico Orlando and Susanne Reffert
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IPMU10-0218
Jason Evans, Matthew Sudano, Tsutomu Yanagida
Higgs Messengers
JHEP

IPMU10-0219
Valeri P. Frolov and Shinji Mukohyama
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Takeshi Hiramatsu, Masahiro Kawasaki and Ken'ichi Saikawa
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JCAP

IPMU10-0222
Masahiro Ibe, Ryosuke Sato, Tsutomu T. Yanagida and Kazuya Yonekura
Gravitino Dark Matter and Light Gluino in an R-invariant Low Scale Gauge Mediation

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Motoi Endo and Norimi Yokozaki
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IPMU10-0229
Takashi Hiramatsu, Masahiro Kawasaki, Toyokazu Sekiguchi, Masahide Yamaguchi and Jun'ichi Yokoyama
Improved estimation of radiated axions from cosmological axionic strings
JCAP

IPMU10-0230
Simeon Hellerman and Eric Sharpe
Sums over Topological Sectors and Quantization of Fayet-Iliopoulos Parameters

IPMU10-0231
Yoshio Kikukawa and Kouta Usui
Reflection Positivity of N=1 Wess-Zumino model on the lattice with exact $U(1)_R$ symmetry

IPMU10-0232
Yoshio Kikukawa and Kouta Usui
Direct Proof of Reflection Positivity of Free Overlap Dirac Fermion

IPMU10-0233
Mihoko M. Nojiri and Jing Shu
Two jets and missing ET signature to determine the spins of the new particles in early stage of the discovery

IPMU11-0001
Fuminobu Takahashi and Tsutomu T. Yanagida
Why have supersymmetric particles not been observed?

IPMU11-0002
Cosimo Bambi
Spinning super-massive objects in galactic nuclei up to $a_* > 1$

IPMU11-0003
Ryoichi Nishio and Taizan Watari
High-Energy Photon-Hadron Scattering in Holographic QCD

IPMU11-0004
Tsz Yan Lam, Takahiro Nishimichi and Naoki Yoshida
The pairwise velocity probability density function in models with local primordial non- Gaussianity

IPMU11-0005
K. Maeda, G. Leloudas, S. Taubenberger, M. Stritzinger, J. Sollerman, N. Elias-Rosa, S. Benetti, M. Hamuy, G. Folatelli, P. A. Mazzali
Effects of Explosion Asymmetry and Viewing Angle on the Type Ia Supernova Color and Luminosity Calibration

IPMU11-0006
Johanna Knapp, Maximilian Kreuzer, Christoph Mayrhofer, Nils-Ole Walliser
Toric Construction of Global F-Theory GUTs

IPMU11-0007
M. Kawasaki, M. Kusakabe
Destruction of ^{7}Be in big bang nucleosynthesis via long-lived sub-strongly interacting massive particles as a solution to the Li problem

IPMU11-0008
Edmond Berger, Qing-Hong Cao, Chuan-Ren Chen, Chong-Sheng Li, Hao Zhang
Top Quark Forward-Backward Asymmetry and Same-Sign Top Quark Pairs

IPMU11-0009
Koji Ishiwata, Shigeki Matsumoto, Takeo Moroi
Decaying Dark Matter in Supersymmetric Model and Cosmic-Ray Observations

IPMU11-0010
Naoyuki Haba, Yuji Kajiyama, Shigeki Matsumoto, Hiroshi Okada, Koichi Yoshioka
Universally Leptophilic Dark Matter From Non-Abelian Discrete Symmetry

IPMU11-0011 Naoyuki Haba, Shigeki Matsumoto, Rhosuke Sato
Sneutrino Inflation with Asymmetric Dark Matter

IPMU11-0012
Masaki Asano, Keisuke Fujii, R. S. Hundi, Hideo Itoh, Shigeki Matsumoto, Nobuchika Okada, Tomoyuki Saito, Taikan Suehara, Yosuke Takubo, Hitoshi Yamamoto
Discrimination of New Physics Models with the International Linear Collider

IPMU11-0013
Cosimo Bambi
Constraint on the quadrupole moment of supermassive black hole candidates from the estimate of the mean radiative efficiency of AGN

IPMU11-0014
Yuji Tachikawa
On W-algebras and the symmetries of defects of 6d N=(2,0) theory

IPMU11-0015
Junji Hisano, Masahiro Kawasaki, Kazunori Kohri, Takeo Moroi, Kazunori Nakayama, and Toyokazu Sekiguchi
Cosmological constraints on dark matter models with velocity-dependent annihilation cross section

IPMU11-0016
H. Kawahara, H. Yoshitake, T. Nishimichi and T.Sousbie
Suzaku Observation of a New Merging Group of Galaxies at a Filamentary Junction

IPMU11-0017
P. Valageas and T. Nishimichi
Combining perturbation theories with halo models for the matter bispectrum

IPMU11-0018
A. Taruya, S. Saito and T. Nishimichi
Forecasting the Cosmological Constraints with Anisotropic Baryon Acoustic Oscillations from Multipole Expansion

IPMU11-0019
Jiayu Tang, Issha Kayo, Masahiro Takada
Likelihood reconstruction method of real-space density and velocity power spectra from a redshift galaxy survey

IPMU11-0020
Kazunori Nakayama, Fuminobu Takahashi, Tsutomu T. Yanagida
Number-Theory Dark Matter

IPMU11-0021
Izawa K.-I., Yuichiro Nakai, Takashi Shimomura
Higgs Portal to Visible Supersymmetry Breaking

IPMU11-0022
T. Kohno and A. Pajitnov
Circle-valued Morse theory for complex hyperplane arrangements

IPMU11-0023
Amir Hajian et al (including Y.-T. Lin)
Correlations in the (Sub)millimeter background from ACTxBLAST

IPMU11-0024
Nick Hand et al (including Y.-T. Lin)
The Atacama Cosmology Telescope: Detection of Sunyaev-Zel'dovich Decrement in Groups and Clusters Associated with Luminous Red Galaxies

IPMU11-0025
D. Eisenstein et al (including H. Aihara, N. Yasuda, Y.-T. Lin, M. Tanaka)
SDSS-III: Massive Spectroscopic Surveys of the Distant Universe, the Milky Way Galaxy, and Extra-Solar Planetary Systems

IPMU11-0026
H. Aihara et al (including N. Yasuda, Y.-T. Lin, M. Tanaka)
The Eighth Data Release of the Sloan Digital Sky Survey: First Data from SDSS-III

IPMU11-0027
Warren Essey, Oleg Kalashev, Alexander Kusenko, John F. Beacom
Role of line-of-sight cosmic ray interactions in forming the spectra of distant blazars in TeV gamma rays and high-energy neutrinos

IPMU11-0028
Alexander Kusenko
Ultrahigh-energy nuclei, photons, and magnetic fields

IPMU11-0029
Kyoji Saito
Coxeter Elements of Vanishing Cycles of Types $A_{\frac{1}{2}\infty}$ and $D_{\frac{1}{2}\infty}$

IPMU11-0030
Edmond Berger, Qing-Hong Cao, Chuan-Ren Chen and Hao Zhang
Top Quark Polarization As A Probe of Models with Extra Gauge Bosons

IPMU11-0031
Shinya Kanemura, Shigeki Matsumoto, Takehiro Nabeshima, and Hiroyuki
Testing Higgs portal dark matter via Z fusion at a linear collider

IPMU11-0032
Masahiro Kawasaki, Ken'ichi Saikawa
Study of gravitational radiation from cosmic domain walls

IPMU11-0033
Shoji Asai, Yuya Azuma, Motoi Endo, Koichi Hamaguchi, Sho Iwamoto
Stau Kinks at the LHC

IPMU11-0034
Satoshi Kondo, Seidai Yasuda
On the first and second K-groups of an elliptic curve over a global field of positive characteristic

IPMU11-0035
N. Tominaga, T. Morokuma, S.I. Blinnikov, P. Baklanov, E.I. Sorokina, K. Nomoto
Shock Breakout in Type II Plateau Supernovae: Prospects for High Redshift Supernova Surveys

IPMU11-0036
H. Uchida, H. Tsunemi, N. Tominaga, S. Katsuda, M. Kimura, H. Kosugi, H. Takahashi, S. Takakura
First Detection of Ar-K Line Emission from the Cygnus Loop

IPMU11-0037
Cosimo Bambi
On the effect of higher order multipole moments on the estimate of the quadrupole of astrophysical black hole candidates

IPMU11-0038
Masahiro Kawasaki, Toyokazu Sekiguchi, Tomo Takahashi
Differentiating CDM and Baryon Isocurvature Models with 21 cm Fluctuations

IPMU11-0039
Chiaki Kobayashi & Naohito Nakasato
Chemodynamical Simulations of the MilkyWay Galaxy

IPMU11-0040
Chiaki Kobayashi, Nozomu Tominaga, & Keni'chi Nomoto
Chemical Enrichment in the Carbon-enhanced Damped Lyα System by Population III Supernovae

IPMU11-0041
Chiaki Kobayashi, Amanda Karakas, & Hideyuki Umeda
The Evolution of Isotope Ratios in the Milky Way Galaxy

IPMU11-0042
Amand Faessler, A. Meroni, S.T. Petcov, F. Simkovic and J. Vergados
Uncovering Multiple CP-Nonconserving Mechanisms of bb0nu-Decay

IPMU11-0043
A. Ibarra, E. Molinaro and S.T. Petcov
Low Energy Signatures of the TeV Scale See-Saw Mechanism

IPMU11-0044
Johanna Knapp, Maximilian Kreuzer
Toric Methods in F-theory Model Building

IPMU11-0045
Charles L. Steinhardt
Effects of Biases in Virial Mass Estimation on Cosmic Synchronization of Quasar Accretion

IPMU11-0046
Junji Hisano, Koji Ishiwata, Natsumi Nagata, and Tomohiro Takesako
Direct Detection of ElectroWeak-Interacting Massive Particles in the Universe

IPMU11-0047
H.-J. Seo, M. Sato, S. Dodelson, B. Jain, M. Takada
Re-capturing Cosmic Information

IPMU11-0048
Jason L. Evans, Masahiro Ibe, Matthew Sudano, Tsutomu T. Yanagida
Simplified R-Symmetry Breaking and Low-Scale Gauge Mediation

IPMU11-0049
Cosimo Bambi
Evolution of the spin parameter of accreting compact objects with non-Kerr quadrupole moment

IPMU11-0050
Jing Shu, Kai Wang, Guohuai Zhu
A revisit to top quark forward-backward asymmetry

IPMU11-0051
Takumi Ito, Kouhei Nakaji, Satoshi Shirai
Identifying the Origin of Longevity of Long- Lived Stau at the LHC

IPMU11-0052
K. Abazajian et al. (including M. Takada)
Cosmological and Astrophysical Neutrino Mass Measurements

IPMU11-0053
Shinsei Ryu, Tadashi Takayanagi, Tomonori Ugajin
Holographic Conductivity in Disordered Systems

14 Outreach and Public Communications

We continue to convey the importance and excitement of our research activities to general public through public lectures and a variety of outreach programs. For the public lectures, we have established a tradition of having enough time for discussion after each lecture so that the audience can directly ask questions to the speaker. We organized fifteen public lectures in this period.

Attracting young people into science is an important part of our outreach programs. We organized, as a part of UT Science Faculty project, a special event for motivating the scientific mind of female junior high school and high school students. Optionally, their parents were also allowed to participate because we think the mindsetting of the parents plays an important role in this effort.

We published four more editions of IPMU NEWS in this period, covering a wide range of information including conferences and seminars, research highlights and newly arrived members. They also feature interesting topics in other research fields. We broadcasted six more "Ask a Scientist" video clips on the website, in which IPMU scientists explain technical terms to general public in just one minute.

We actively participated in various events within our capacity for the promotion of science in general and IPMU's activity. Good communication with the local community as well as within the institute helps quality of life, especially for those from abroad, which reflect to their research output. We have valuable support from "IPMU Volunteers." Daily teatime is not just for science talks, but occasionally, for happy gatherings.

George Smoot of UC Berkeley, Nobel laureate of 2006, talks about Creation and History of the Universe with the help of Naoshi Sugiyama's translation.

Shinji Mukohyama answers questions after the public lecture on the Universe Beyond the Four Dimensions.

Female students from junior high-school and senior high-school are trying to have good feel about the scale of the universe.

Public Lectures

- The creation and history of the universe
  George Smoot (2006 Nobel laureate in physics), April 3, Yayoi Hall.
- Miraculous string theory—towards the final theory of matter
  Shigeki Sugimoto, April 17, The 3rd Joint ICRR-IPMU Public Lecture.
- Relativity, elementary particles and cosmology
  Naoki Yoshida, June 26, Kawagoe High School.
- Mystery of dark energy that fills the universe
  Hiroshi Karoji, June 26, Nayoro, Hokkaido.
- Final theory of elementary particles
  Hirosi Ooguri, September 12, Science cafe in Nagoya.
- Galaxies living in the universe
  Masayuki Tanaka, October 29, Kashiwa Open Campus Day.
- Evolution of the universe explored by supernovae
  Ken'ichi Nomoto, October 30, Kashiwa Open Campus Day.
- Gravitational lensing
  Masahiro Takada, November 11, Chienkan High School, Saga.
- Dark-matter dominated universe
  Naoki Yoshida, November 12, Science cafe in Kogakuin University.
- The universe beyond the four dimensions
  Shinji Mukohyama, November 14, The 4th ICRR-IPMU Public Lecture.
- Einstein's dream—mystery of gravity and string theory—
  Shigeki Sugimoto, December 10, Science cafe in Kogakuin University.
- Birth of stars, galaxies and black holes
  Naoki Yoshida, January 22, Suwa-Seiryo High School, Nagano.
- Dark universe and luminous stars
  Naoki Yoshida, February 9, Roppongi Astronomy Club.
- What is the universe made of?
  Hitoshi Murayama, March 9, TODIAS Inauguration Public Lecture, Yasuda Hall.
- The frontiers of fundamental physics
  David Gross (2004 Nobel Laureate in physics), March 9, TODIAS Inauguration Public Lecture, Yasuda Hall.

Video Clips

- Hadrons and String Theory by Shigeki Sugimoto in April
- Super-massive Black Hole by John Silvermann in September
- Supersymmetry by Kai Wang in November
- Cosmology by Shinji Mukohyama in December
- Holographic Principle by Tadashi Takayanagi in January
- Baryon Acoustic Oscillation by Yen-Ting Lin in February

IPMU NEWS

IPMU joined other WPI centers at the Science Festa that took place in Kyoto. [June 2010]

IPMU NEWS hosted a round table discussion by foreign researchers on “life in Japan, life at IPMU.” [June 2010]

Midori Ozawa of International Relations section presented “Dealing with Foreign Scientists” during the Open Campus Day. [October 2010]

Members of Japanese class play a well-known Japanese fairly tales “Momotaro” during the Open Campus Day. [October 2010]

Murayama hosted a teatime for IPMU-volunteer members. [October 2010]

Marriage of Liqin and Minxin was celebrated during a daily teatime with special home-made cakes. [December 2010]

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