IPMU Annual Report 2009

April 2009 — March 2010

IPMU ANNUAL REPORT 2009 April 2009 — March 2010

World Premier International Research Center Initiative

THE UNIVERSITY OF TOKYO

Institute for the Physics and Mathematics of the Universe (IPMU)

IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

IPMU ANNUAL REPORT 2009

April 2009—March 2010

INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

Institute for the Physics and Mathematics of the Universe
The University of Tokyo
5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8583, Japan
Tel: +81-4-7136-4940   Fax: +81-4-7136-4941
http://www.ipmu.jp/
Print: KOHMURA Inc.

History of IPMU

(April 2009—March 2010)

2009 April
- Focus Week: Non-Gaussianities in the Sky
- IPMU-ICRR Joint Public Lecture

May
- Focus Week: New Invariants and Wall Crossing

June
- International Conference: Dark Energy (including Public Lecture)

July
- Public Lecture

August
- External Advisory Committee Meeting
- Site Visit by WPI Program Director and Program Officers
- Program to Inspire Female Students with Science

September
- Yukawa-Tomonaga Memorial Prize to Shigeki Sugimoto
- "SuMIRe" Project Approved by the Council for Science and Technology Policy
- Press release "The Most Luminous Type Ia Supernova"
- Focus Week: Statistical Frontier of Astrophysics

October
- 2nd Anniversary of IPMU, All Hands Meeting and Reception
- Kashiwa Campus Open House, Public lecture and Exhibition
- IPMU-ICRR Joint Public Lecture

November
- Workshop: Quantizations, Integrable Systems and Representation Theory
- Nishina Memorial Prize to Hirosi Ooguri
- Focus Week: QCD in Connection with BSM Study at LHC
- Workshop: Recent Advances in Mathematics at IPMU
- Focus Week: Epoch of Re-ionization

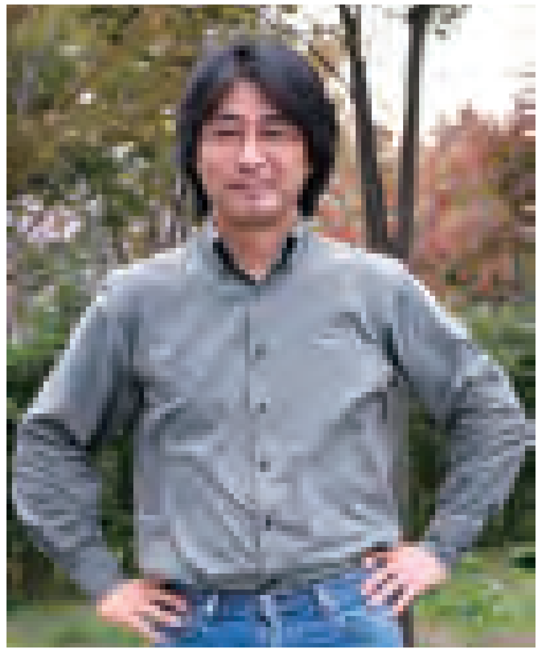
December
- Focus Week: Indirect Dark Matter Search
- Launch of IPMU Berkeley satellite

2010 January
- Workshop: Elliptic Fibration and F-Theory
- Site Visit by WPI Administrative Officers
- Move Into New IPMU Building
- "Science Cafe - Universe" (3 Public Lectures from January to March)
- Visit of MEXT Vice Minister Masaharu Nakagawa

February
- Inauguration Ceremony of NEW IPMU Building
- Focus Week: Condensed Matter Physics Meets High Energy Physics

March
- Workshop: Geometry of lattices and infinite dimensional Lie algebra
- Science Camp "New Encounter of Modern Mathematics and Modern Physics"
- UT President Award to Masaomi Tanaka
- ASJ Young Astronomer Award to Keiichi Maeda
- Yoji Totsuka Prize to Takaaki Kajita

1. Mission

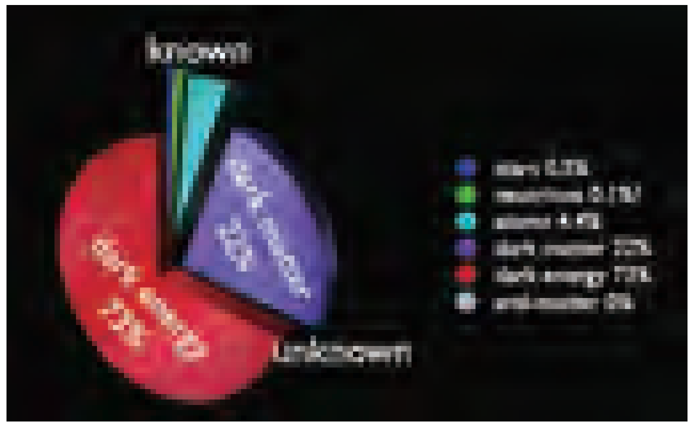


Hitoshi Murayama
IPMU Director

"Everything is made of atoms" has been the main driving force responsible for an impressive progress over the past two centuries to understand the nature around us. But this approach that dominated the way we see the universe went through a revolutionary change over the past ten years.

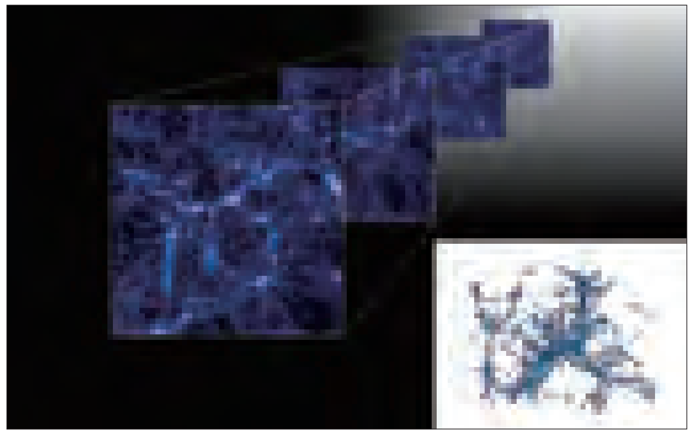
The whole thing started with a 1998 discovery that the speed of expansion of the universe is accelerating. The expansion itself was predicted by Einstein's theory of general relativity. Being a part of gravity phenomena, however, the expansion must behave like the motion of a ball thrown upwards, namely the gravitational pull should eventually slow down the expansion. Instead, the speed of expansion which appeared to have been slowing down shifted toward an accelerated increase since about 7 billion years ago. Equivalently, according to the Einstein's theory, the energy in the space is increasing. This is called dark energy, the energy which pops out of the universe as it expands. If true, this mysterious dark energy occupies approximately 73% of the universe. The discovery has been so shocking that some even conjectured that the Einstein's theory may be wrong. It has been a fascinating mystery among scientists worldwide, and fierce competition to settle the issue has been taking place in Europe and US, in particular.

Meanwhile, Japanese experiments Super-Kamiokande in the same year and KamLAND in 2002 revealed that neutrinos carry tiny but finite mass. Furthermore, it was established by 2003 that more than 80% of matter in the universe is made of something completely different from ordinary atoms. It is called dark matter. It does not emit light, and therefore invisible to us, so that the existence was established only by observing its gravitational pull with nearby objects. We now know that the universe is made of 4.4% ordinary atoms and 23% dark matter, of which neutrinos take up somewhere above 0.1% but less than 1%. In total, more than 95% of the universe is dominated by unknown object, altering our view of the origin of the universe and its future.



Composition of the universe

The universe is believed to have started as a hot fire-ball from the Big-Bang 13.7 billion years ago, as a flat and structure-less state at the beginning. But soon the dark matter began to cluster by the gravitational pull, and eventually pulling ordinary matter. They then evolved together into stars and galaxies. At IPMU, we are working to "see" the evolving processes of the universe from the very beginning, and to "predict" where we are heading.



■ Evolution of large-scale structure of the universe and dark matter distribution.

We develop an optical instrument that is attached to the Subaru telescope and allows observation of more than 30 million distant galaxies. This provides three-dimensional mapping of dark matter, and may also reveal the true nature of dark energy.

We use three underground detectors, Super-Kamiokande to study neutrino astronomy in general but putting emphasis on search for neutrinos from ancient supernova explosions, KamLAND to study neutrino geophysics but putting emphasis on search for neutrino-less double beta decay, and XMASS to directly search for dark matter in our galaxy.

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

Investigation of dark matter and dark energy requires further development of theory and mathematics. Superstring theory, which unifies general 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 in this problem. String theory, if indeed the ultimate theory, should give consistent answers to a wider subjects 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.

Contents

2. Introduction

This report covers research activities at IPMU during the JFY 2009 (April 2009 - March 2010). The JFY 2009 was an eventful, yet exciting and very productive year. In August, Council for Science and Technology Policy of the Government approved “SuMIRe (Subaru Measurement of Image and Red-shifts)”, a five year project to build a next generation camera for the Subaru telescope in collaboration with National Astronomical Observatory. This was a big boost for our goal to understand dark matter and dark energy. The new instrument will allow us to observe the distribution and spectra for more than 30 million distant galaxies within a few years time scale, thus providing unbiased information about the history of expanding universe. Then came a widely publicized “Government Revitalization Unit Hearing” to review more than 400 government-funded research programs. Fortunately the effect on IPMU was minimal.

In January the construction of anxiously waited new IPMU building was completed. An inauguration ceremony of the new 6,000 square meter building was held on February 23rd, 2010 at Piazza Fujiwara, a large open space that occupies the center of the building from the 3rd floor and up. Among the speakers in the ceremony was Hidetoshi Ohno, UT professor of the Graduate School of Frontier Sciences, who designed the building. He explained his design concept, which is to give the place a power to attract scientists and to induce interactions. Standing in the middle of the Piazza Fujiwara is an obelisk inscribing ancient Italian words

UNIVERSO É SCRITTO IN LINGUA MATEMATICA

meaning “The universe is written in the language of mathematics.” It was taken from Galileo’s 1623 work *Il Saggiatore* and describes precisely the concept of our institute, where mathematicians and physicists work together to solve the mysteries of the universe. It was chosen so that we remember a great man who lived at the dawn of modern cosmology.

The inauguration ceremony brought us not just a new building, but an extremely encouraging support from the university. The University of Tokyo President, Junichi Hamada, in his speech at the ceremony stated, “The University has actually been discussing an interdisciplinary system of Institute for Advanced Study as its permanent entity, and we are making progress towards its establishment. I express my commitment here that we will integrate IPMU into the University as one of such Institute; sustain IPMU beyond the duration of the WPI funding; and give tenure to a part of the IPMU faculty without sacrificing the traditional University positions.”

■ The University of Tokyo President Junichi Hamada addressing at the inauguration ceremony for the new IPMU building.

We expanded full time scientific staff to 11 professors, 8 associate professors, 5 assistant professors, and 36 postdoctoral fellows. Total number of scientific staff including principal investigators, full time staff, joint appointments, students and long-term visitors (more than one month) reached 165 as compared with 125 one year ago. We published 100 papers in refereed journals and produced 178 preprints, many of which are being submitted to refereed journals. Noteworthy is a paper by Hirosi Ooguri and Masahito Yamazaki on decoding quantum states of black holes using crystal melting model in superstring theory, and a paper by Ken'ichi Nomoto and collaborators on observation of most luminous type-Ia supernova. We hosted 11 international conferences and held 140 seminars. We were visited by 432 scientists, of which 345 from abroad.

■ Number of IPMU Research staff

	Number	Foreign	Female
Principal Investigators	19	6	1
Faculty (not including 5 PIs)	19	6	0
Postdoctoral Fellows	36	29	3
Joint Appointments	59	22	3
Long-term Visitors	30	29	3
Students	2	2	0
Total	165	92	10

■ Research Activities at IPMU in JFY2009

Conferences	11
Seminars	140
Visitors (foreign)	432 (345)
Preprints	178
Publications	100

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

Several IPMU staff members received honors and awards for their scientific achievements. Shigeki Sugimoto received Yukawa-Tomonaga Memorial Prize for his work on holographic QCD approach for understanding hadron physics, which is an important application of superstring theory to testable phenomena. Hirosi Ooguri received Nishina Memorial Prize on his contribution to topological superstring theory. Keiichi Maeda received Astronomical Society of Japan Young Astronomer Award for his work on theoretical and observational investigation of supernova explosions. Takaaki Kajita received the first Yoji Totsuka Prize for the discovery of atmospheric neutrino oscillation. Masaomi Tanaka was awarded the University of Tokyo President Award for his work on theoretical and observational investigation of supernova explosions.

■ Shigeki Sugimoto
Yukawa-Tomonaga Prize

■ Masaomi Tanaka
UT President Award

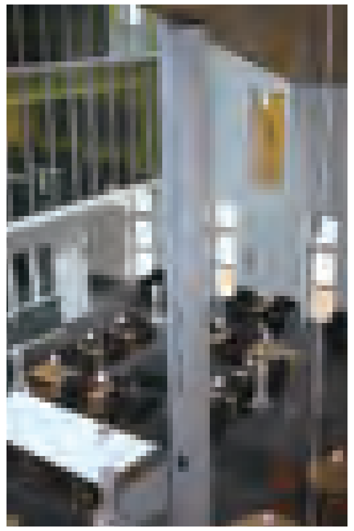
■ Takaaki Kajita
Yoji Totsuka Prize

■ Keiichi Maeda
ASJ Young Astronomer Award

■ Hirosi Ooguri at the Nishina Prize awarding ceremony.

The University of Tokyo Kashiwa Campus

New IPMU building



Obelisk standing in the middle of Piazza Fujiwara.

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 Meeting (EBM) regularly to ensure smooth operation of the Institute. The EBM 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 2010, the members consist of two Deputy Directors and five among IPMU's nineteen Principal Investigators, all appointed by the Director.

The SAC members as of March 2010

H. Aihara	IPMU Deputy Director
Y. Suzuki	IPMU Deputy Director
T. Kohno	Graduate School for Mathematical Sciences, U of Tokyo
H. Ooguri	Caltech
K. Saito	IPMU
D. Spergel	Princeton U
T. Yanagida	IPMU

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 EAC members as of March 2010

J. Ellis	CERN
M. Gonokami	U of Tokyo
N. Kaifu	NAOJ
Y.K. Kim	Fermilab/U of Chicago
S. Kojima	Titech
D. Morrison	UC Santa Barbara
R. Peccei	UCLA; Chair
S. Kahn	SLAC/Stanford U

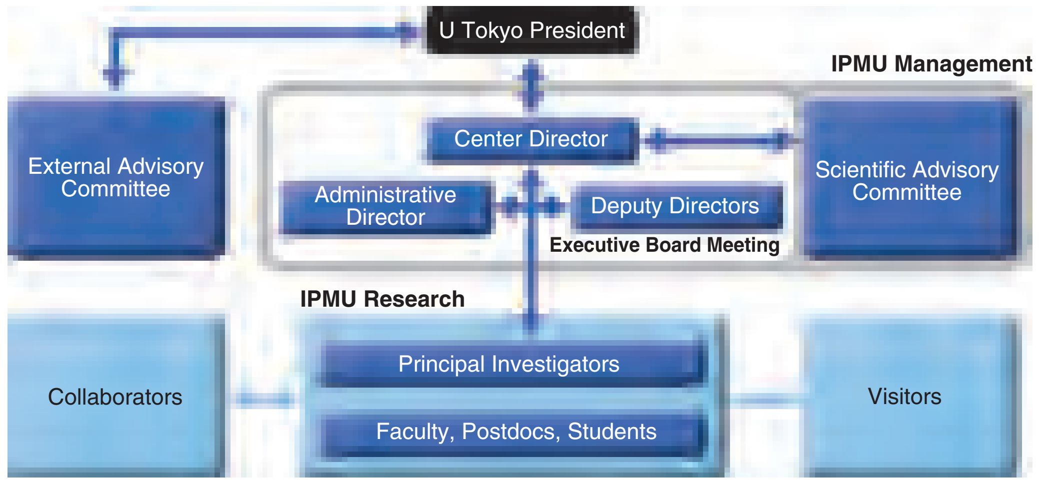
IPMU has rather unique approach in organizing the research objectives, where the world's leading scientists in their research fields are appointed as the Principal Investigators. There are nineteen of them at the moment and they are affiliated to IPMU and other departments in the Host Institution (U 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.

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

■ Foreign Institutions with 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
John's 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 Department
Max Planck Institute, Extra-terrestrial Physics Department
Max Planck Institute, Physics Department
European Southern Observatory (ESO)(The European Organization for Astronomical Research in the Southern Hemisphere)
National Taiwan University, Research Center for Cosmology and Particle Astrophysics

The administrative staff is an integral part of the Institute. Providing the best possible environment to the researchers in the Institute is of essential importance 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.



■ IPMU's research activities are conducted with a flat organization comprising of principal investigators as a core, IPMU staff including junior researchers, collaborators, and visitors.

■ Host Institution (University ofTokyo)

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

■ 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 Etudes Scientifiques (IHES)
High Energy Accelerator Research Organization (KEK)

4. Staff

Director
H. Murayama, Particle Theory, Cosmology

Deputy Directors
H. Aihara, High Energy Physics, Astrophysics
Y. Suzuki, Astroparticle Physics, Neutrino Physics

Principal Investigators
H. Aihara, High Energy Physics, Astrophysics
A. Bondal, Mathematics
M. Fukugita, Astrophysics
K. Inoue, Neutrino Physics
T. Kajita, Neutrino Physics
S. Katsanevas, Astroparticle Physics
T. Kohno, Mathematics
H. Murayama, Particle Theory, Cosmology
M. Nakahata, Astroparticle Physics
M. Nojiri, Particle Theory
K. Nomoto, Astronomy
H. Ooguri, Mathematical Physics, String Theory
K. Saito, Mathematics
K. Sato, Cosmology
H. Sobel, Astroparticle Physics
D. Spergel, Astrophysics
N. Sugiyama, Cosmology
Y. Suzuki, Astroparticle Physics, Neutrino Physics
T. Yanagida, Particle Theory

Faculty Members
P. Frampton, Particle Theory
S. Hellerman, String Theory
K. Hori, String Theory
S. Kondo, Mathematics
K. Maeda, Astronomy
K. Martens, Astropharticle Physics
A. Mikhailov, Mathematical Physics
S. Mukohyama, Cosmology
H. Murayama, Particle Theory, Cosmology
K. Nomoto, Astronomy
K. Saito, Mathematics
K. Sato, Cosmology
J. Silverman, Astronomy
S. Sugimoto, String Theory
M. Takada, Cosmology
F. Takahashi, Particle Theory
T. Takayanagi, String Theory
Y. Toda, Mathematics
A. Tsuchiya, Mathematics
M. Vagins, Astroparticle Physics
T. Yanagida, Particle Theory
N. Yasuda, Astronomy
N. Yoshida, Astrophysics
T. Watari, String Theory

Postdoctoral Fellows
C. Bambi, Cosmology
T. Basak, Mathematics
A. Bene, Mathematics
C.R. Chen, Particle Theory
W.S. Cho, Particle Theory
D. Easson, Cosmology
J. Evans, Particle Theory
S. Galkin, Mathematics
D.F. Gao, String Theory
A. Getmanenko, Mathematics
M. Huang, String Theory
K. Izumi, Cosmology
I. Kayo, (JSPS Fellow) Astrophysics
A. Kozlov, Neutrino Physics
D. Krefl, String Theory
T.Y. Lam, Astrophysics
G. Lambard, Astroparticle Physics
W. Li, String Theory
Y.T. Lin, Astrophysics
T. Nozawa, Astronomy
D. Orlando, Mathematics
S.C. Park, Particle Theory
M. Pichot, Mathematics
S. Reffert, Mathematics
K. Shackleton, Mathematics
K. Shimizu, (JSPS Grant-in-Aid), Astrophysics
J. Shu, Particle Theory
Y. Srivastava, String Theory
M. Sudano, Particle Theory
H. Takami, Astrophysics
M. Tanaka, Astronomy
J.Y. Tang, Cosmology
M. Valdes (JSPS Fellow), Astrophysics
K. Wang, Particle Theory

Graduate Students
W.L. Klemm (UC Berkeley), Particle Theory
S. Mandal (UC Berkeley), Particle Theory

Joint Appointments
K. Abe (Tokyo ICRR), Astroparticle Physics
M. Aganagic (UC Berkeley), String Theory
R. Bousso (UC Berkeley), Cosmology
P. Decowski (NIKHEF), High Energy Physics
M. Doi (U Tokyo), Astronomy
Y. Efremenko (U Tennessee), Neutrino Physics
T. Eguchi (Kyoto YITP), Field Theory
M. Endo (U Tokyo), String Theory
S. Enomoto (U Washington), Neutrino Physics
A. Ferrara (S.N.S. Pisa), Astronomy
S. Freedman (LBNL), Neutrino Physics
B. Fujikawa (LBNL), Neitrino Physics
M. Fukushima (Tokyo ICRR), Astroparticle Physics

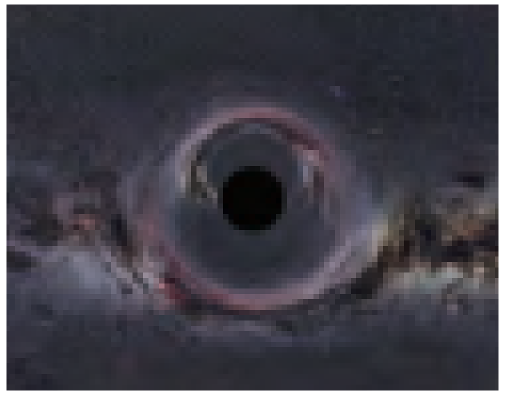
K. Hagiwara (KEK), Particle Theory
L. Hall (UC Berkeley), Particle Theory
K. Hamaguchi (U Tokyo), Particle Theory
Y. Hayato (Tokyo ICRR), Neutrino Physics
M. Hazumi (KEK), Astrophysics
K. Heeger (Wisconsin), Neutrino Physics
R. Hirschi (U Keele), Astronomy
J. Hisano (Tokyo ICRR), Particle Theory
P. Horava (UC Berkeley), String Theory
G. Horton-Smith (U Kansas), Neutrino Physics
S. Hosono (U Tokyo), Mathematical Physics
K. Izawa (Kyoto YITP), Particle Theory
K. Kaneyuki (Tokyo ICRR), Neutrino Physics
M. Kashiwara (Kyoto U), Mathematics
A. Kato (U Tokyo), Mathematical Physics
M. Kawasaki (Tokyo ICRR), Cosmology
E. Kearns (Boston U), Neutrino Physics
C. Kobayashi (Australia), Astronomy
T. Kobayashi (U Tokyo), Mathematics
M. Koga (Tohoku U), Neutrino Physics
E. Komatsu (U Texas), Cosmology
Y. Koshio (Tokyo ICRR), Neutrino Physics
T. Kubota (Osaka U), String Theory
A. Kusenko (UCLA), Particle Theory, Astrophysics
M. Limongi (INAF Rome), Astronomy
S. Moriyama (Tokyo ICRR), Neutrino Physics
T. Moroi (Tohoku U), Particle Theory
K. Nakamura (Tohoku U), Neutrino Physics
T. Nakaya (Kyoto U), High Energy Physics
Y. Nomura (UC Berkeley), Particle Theory
S.T. Petkov (SISSA), Particle Theory
A. Piepke (U Alabama), Neutrino Physics
Y. Saito (U Tokyo), Mathematics
K. Scholberg (Duke U), Neutrino Physics
H. Sekiya (Tokyo ICRR), Neutrino Physics
M. Shiozawa (Tokyo ICRR), Neutrino Physics
M. Smy (UC Irvine), Neutrino Physics
J. Stone (Boston U), High Energy Physics
Y. Takeuchi (Tokyo ICRR), Neutrino Physics
A. Taruya (Tokyo RESCEU), Astrophysics
N. Tominaga (Konan U), Astrophysics
E.L. Turner (Princeton U), Astrophysics
C.W. Walter (Duke U), Neutrino Physics
J. Yokoyama (Tokyo RESCEU), Astrophysics
K. Yoshikawa (U Tokyo), Mathematics

Long-term Visitors (more than 1 month)
S. Blinnikov, ITEP (Russia)
I. Nisoli, Pisa (Italy)
A. Vicente, IFIC (Spain)
M. Bersten, Chile (Chile)
M. Yamaguchi, Tohoku (Japan)
L. Uruchurtu, Cambridge (UK)
B. Michel, Harvard (USA)
C. S. Kim, Yonsei (Korea)
M. Verbitsky, ITEP (Russia)
B. Webber, Cambridge (UK)
P. F. de Medeiros, Edinburgh (UK)
D. Hernandez-Diaz, Madrid (Spain)
R. Janik, Jagiellonian (Poland)
E. Mendez-Escobar, Edinburgh (UK)
Z. Bajnok, Hungarian Acad. Sci. (Hungary)
M. Pevzner, Reims (France)
C. Schmidt-Colinet, ETH-Zurich (Switzerland)
S. R. Das, Kentucky (USA)
P. Hut, IAS (USA)
Y. Nakayama, UC Berkeley (USA)
M. Wolk, Paris 6 (France)
X. F. Wang, Tsinghua (China)
C. Weniger, DESY (Germany)
J. Schmidt, DESY (Germany)
B. Venkov, Steklov Inst (Russia)
S. T. Petcov, SISSA (Italy)
Z. Kunszt, ETH-Zurich (Switzerland)
C. Beil, UC Santa Barbara (USA)
T. O'Donnell, Berkeley (USA)

Administrative Division (*section head)
Director K. Nakamura
Head S. Sugimura
Chief A. Ito
General Management and Personnel
M. Minami*, K. Oomoto, Y. Enomoto, K. Kawajiri,
M. Miura, F. Miyazoe,
T. Shiga, R. Tamura, R. Tamura
Salary and Travel Expenses
Y. Ootaka, N. Ishida, N. Kubo, H. Yoshida
International Relations
M. Ozawa*, H. Furuya, H. Kuboshima,
K. Nakamura,
M. Nishikawa, R. Ujita,
Finance Planning and Budget Control
Y. Kato*, T. Yamanaka
Contract and Purchasing
N. Abe*, H. Ezawa, S. Utsumi
Library
K. Kubota
Computer and Network
H. Tanaka, A. Tsuboi
Documentation
K. Abe
Kamioka Satellite
M. Nishikawa*, S. Higashi, M. Kanazawa, Y. Shimizu
Facilities
N. Watanabe

5. Research Program

Alternative Gravity Theories


Credit: Creative Commons Attribution-Share Alike 2.0 Germany

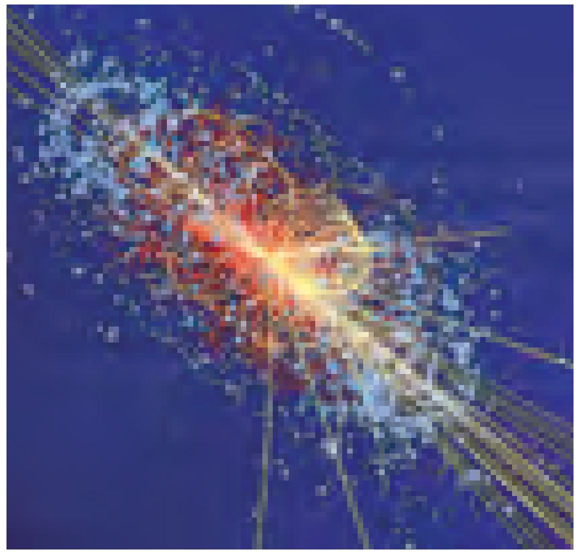
Einstein's theory of relativity unifies a 3-dimensional space and a 1-dimensional time as a spacetime and describes gravity as a fabric of curved spacetime. This picture has been very successful in explaining and predicting many gravitational phenomena. Experimentally, however, we do not know how gravity 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.

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 Mukohyama	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

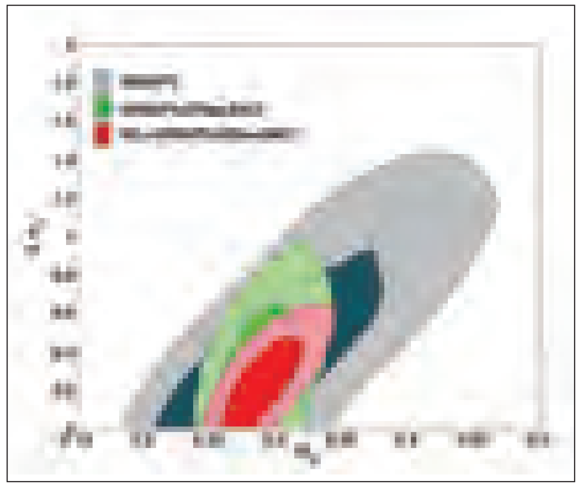


IPMU collider phenomenology group members pursue a broad range of research in testing physics of the Standard Model and beyond the Standard Model at the colliders, especially the CERN Large Hadron Collider(LHC). With the LHC turn-on in 2009, we have great opportunities in exploring physics at the TeV scale. This machine enables 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 now preparing 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.
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. MC generator for black hole events (BlackMax).
Jing Shu	Physics of top, Z', and higgs.
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



As more massive cosmological data sets are being available, statistics and more sophisticated statistical methods are becoming increasingly important in order to extract cosmological information from such data sets as well as deal with large and complex data sets. The relevant issues that are actively discussed in this field are model selection, parameter estimation methods, Bayes' theorem and so on.

One of researches we are carrying out at IPMU is gravitational lensing, tiny distortion of distant galaxy images caused by gravitational lensing due to their foreground large-scale structures of the Universe. To extract the tiny distortion signal from observed galaxy images, galaxy shapes need to be modeled in a mathematically rigorous manner and be precisely disentangled from observational effects of sampling, convolution and noise. Statistical tools/knowledges mentioned above sometimes help study these shape measurement issues.

Thus we are actively working on these cosmology-statistics issues by inviting and/or interacting with world-class leading 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 about 2 orders of magnitude better than the current best limit. We will soon step in to the discovery region.

In 2008, an underground cavity to house the experiment was completed and following that, the 10m high cylindrical water tank which contains 800 tons of water to shield gamma rays and neutrons from nearby rocks was constructed. The major parts of the detector was assembled during the summer and autumn in 2009, and we are in the middle of final tuning of the detector and data handling system.

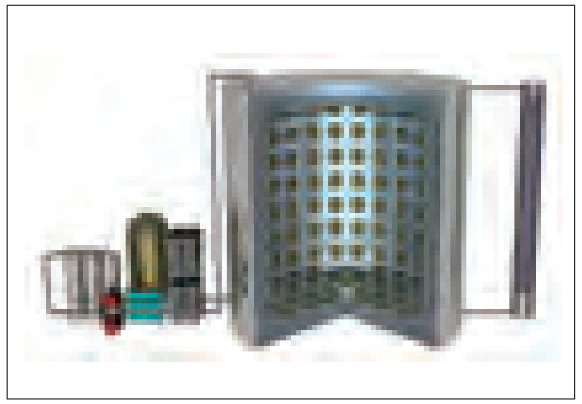
■ Dark Matter Experiment Group

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.

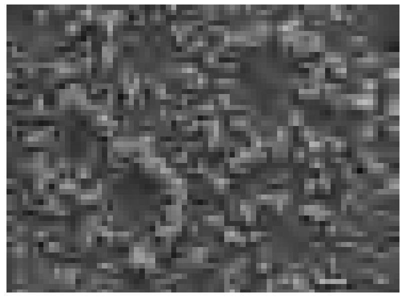
Active detector development provides the means to extend the reach of current and future experiments - and very possibly new technology that may well find its way back into your living room or workshop. It is a vital ingredient in our quest to understand the Universe. The projects below are as diverse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

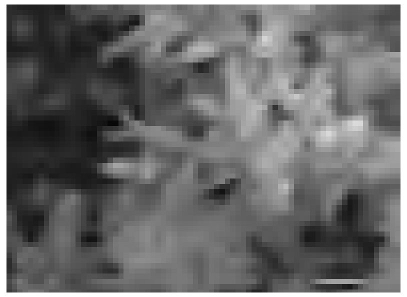


■ EGADS Project (Evaluating Gadolinium's Action on Detector Systems), which is now under construction in the Kamioka mine, will be used to establish the viability of gadolinium-enhanced water Cherenkov detector for detecting supernova relic neutrinos.

■ Detector Development Group

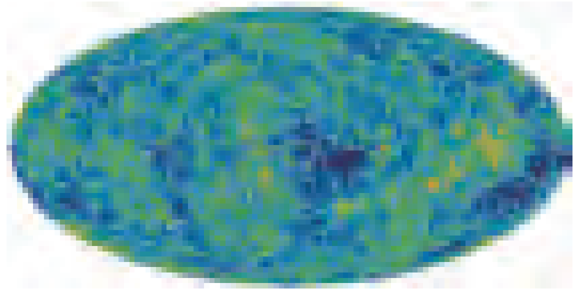
Member	Main Interest
Karsten Heeger	Liquids scintillator, water Cherenkov, and bolometric detectors. Ultra-low background detectors and techniques.
Kunio Inoue	Neutrino oscillation, neutrino geophysics, neutrino astrophysics, neutrinoless double beta decay, and directional measurement of anti-neutrinos.
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.





■ Scanning Electron Microscope pictures taken at the IPMU Kamioka Satellite. The pictures show copper dendrites that were grown for their sharp tips to use field emission to inject currents to clean up liquid noble gases like Xenon and Argon.

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 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 non-standard infationary theories.
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).
Minxing Huang	Non-Gaussianities in the Cosmic Microwave Background from inflation models.
Ken-iti 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 $f(\varphi)R$ term, so called the nonminimal coupling term. The (p) reheating of the inflation theory with the non-minimal coupling term.
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

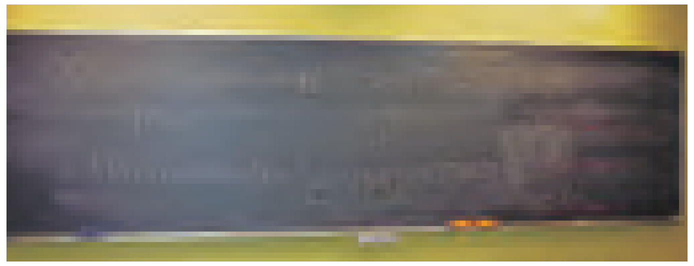
In the 17th century, Newton found differential and integral calculus, giving a language and method to describe the law of dynamics in nature. This is a good example of mathematics providing the scientific community, and sometimes society in general, with a common language and method to describe phenomena in their study. This in turn helps to establish 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 non-commutative geometry is better described in this language. Recent research is focused on finding a more complicated structure than that of a triangulated category. DG-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. One basic example of an algebraic structure is a group or a group action. Groups are everywhere in mathematics from Galois groups in number theory to mapping class groups in topology. A group describes the symmetry of things. Study of groups, or representation theory, will then lead to the explanation of the phenomena caused by the symmetry.

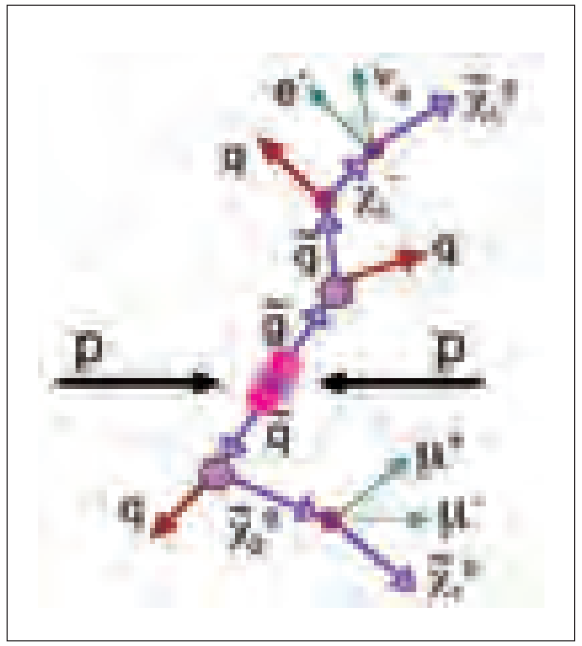
■ Mathematics Group (Geometry)

Member	Main Interest
Alex Bene	Mapping class groups of surfaces, their representations, and their relations to 3-manifolds, with a primary focus on the combinatorial description of these groups in terms of fatgraphs.
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 symplectice 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.
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.
Ken 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.
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
Tathagata Basak	The crossroads of representation theory, geometry and number theory. New connection between the monster simple group and a thirteen dimensional complex hyperbolic orbifold coming from the automorphism group of a hermitian lattice. This leads to study of fundamental groups of hyperplane complements and uniformizations of locally symmetric varieties by automorphic forms.
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.
Akihiro Tsuchiya	Conformal field theory based on representation theory of infinite dimensional algebra and the theory of D-modules.
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 J. Shackleton	Geometric group theory. Hyperbolic and relatively hyperbolic groups. Low-dimensional topology. Teichm"uller theory and mapping class groups. Curve complexes, pants complexes.

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 non-zero 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 has one scalar field, and just one? Why does its condensation develop?

- The Newton constant $G_N \simeq 6.7 \times 10^{-11}$m^{3}kg/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.

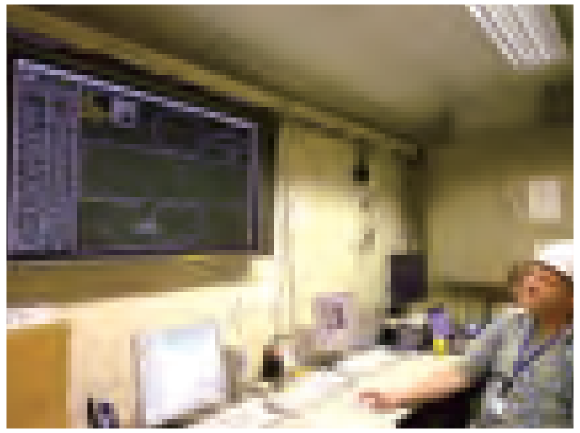
For non-experts

After K_β , 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} $\mathring{A}$, 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.
Paul Frampton	Model building. Chiral color.
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-iti 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.
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.
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.
Vikram Rentala	Spin determination using quantum interference at the LHC.
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.
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 anti-neutrinos.
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.
Jan Schuemann	Improving the Super-Kamiokande detector by introducing Gadolinium. Detection of neutrinos from distant supernovae.
Henry W. Sobel	Super-Kamiokande and T2K experiments. Neutrino physics. Supernova. Proton decay.
Yoichiro Suzuki	Experimental study on neutrino oscillations by using extra-terrestrial 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 worked on measurements from current surveys and are actively involved in the planning and design of the future survey with Subaru Telescope, 8.2 meter optical-infrared telescope at the summit of Mauna Kea (4,200m), Hawaii.

Weak gravitational lensing:

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.

Hyper Suprime Camera (HSC):

The HSC, currently under construction, is the project to replace the prime focus camera of Subaru Telescope 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 redshifts 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:

Over the next six years (2008-2014), the SDSSIII will exploit the unique wide-field spectroscopic capability of the Apache Point Observatory's 2.5-meter telescope, extending the previous SDSS surveys to a deeper universe with the improved spectrograph. We, IPMU members, are involved in SDSSIII and can freely access to the data sets before the public data release. In particular, one of the planned surveys, the Baryon Oscillation Spectroscopic Survey (BOSS)will map 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, thereby enabling to test the models of dark energy. We are planning to develop an optimal method for measuring properties of galaxy clustering in order to obtain unbiased estimates on the acoustic scale as well as on cosmological parameters.

■ Observational Cosmology Group

Member	Main Interest
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.
Issha Kayo	Extraction of cosmological information from the large-scale structure of the Universe, particularly using the data from Sloan Digital Sky Survey and 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.
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.
Jan Schuemann	Study of neutrino fluxes and their origin using Super-Kamiokande. Improving the Super-Kamiokande by adding Gadolinium.
John Silverman	Evolution of galaxies and supermassive black holes. Large optical/near-infrared spectroscopic surveys of galaxies in deep fields such as COSMOS and the Chandra Deep Field South. X-ray observations of Active Galactic Nuclei up to high redshift and in nearby galaxy groups.
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

Credit: X-ray: NASA/CXC/CfA/M.Markevitch et al.; Optical: NASA/STScI; Magellan/U.Arizona/D.Clowe et al.; Lensing Map: NASA/STScI; ESO WFI; Magellan/U.Arizona/D.Clowe et al.

There are various kinds of high energy phenomena in the galaxy and the universe, from which we can gain insight into particle physics. In a sense the universe is a laboratory where we can test high-energy theory; it has a great advantage over accelerator experiments in that the typical energy scale can be much higher than the presently attainable energy scale. Most importantly, we can search extremely weakly interacting particles, which is difficult to do with ground-based experiments. These particles include dark matter particle and axion.

We are working on the following topics to look for observational evidence of underlying fundamental physics and its implication for cosmology.

Particle dark matter models and phenomenology:

The existence of dark matter has been firmly established by observation. However it is not known yet what makes up the dark matter, and the question remains a big mystery in cosmology as well as particle physics.

Dark matter could annihilate or decay, producing high-energy particles. Those energetic particles contribute to high-energy cosmic rays, which may be observed as an excess over astrophysical background. In particular, dark matter annihilation rate is enhanced where the dark matter density is high: e.g. the Galactic Center, dwarf spheroidal galaxies, substructures in the Milky Way halo, and the early universe.

The measurements of cosmic-rays from these regions therefore may detect the dark matter signature. Recently a steep rise in the cosmic-ray positron fraction was observed by the PAMELA satellite, and many dark matter models were proposed to explain the excess. Although the interpretation of the PAMELA anomaly is still under debate, this may already be telling us a hint of what makes up the dark mater.

Axion and astrophysics:

The axion was originally proposed by Peccei and Quinn in 1977 as a solution to the strong CP problem in the quantum chromodynamics(QCD). The axion has couplings to the standard model particles, but they must be weak enough, since otherwise the evolution of the main sequence stars or the supernovae cooling argument would be significantly modified. Due to its extremely weak interactions, the axion is very light, and therefore stable in a cosmological time scale. In fact, the axion is one of the candidates for cold dark matter.

The axion plays an important role in cosmology and astrophysics. If dark matter consists of axion, we may be able to detect them through microwave cavity experiment. Although the interactions are weak, axions can be produced in the interior of stars (e.g. the Sun) and supernovae. Also some fraction of gamma-rays emitted from a distant source may be converted to axions on the way to the Earth.

Detailed study of such cosmological and astrophysical effects may reveal the presence of the axion. It is known that many axion-like particles are present in the string theory. Interestingly, the detection of very light axion from ground-based axion search or astrophysical observation may shed light on the high-energy theory.

Neutrino physics:

In 1930 Wolfgang Pauli put forward hypothesis of the existence of the neutrino from apparent non-conservation of energy in beta decay. The hypothesis was confirmed 25 years later, and the neutrinos have been extensively studied since then. Nevertheless, the neutrino remains one of the least understood particles.

The SuperKamiokande collaboration measured the atmospheric and solar neutrinos and found evidence that the neutrino of a certain flavor oscillates into other flavors as it travels. The neutrino flavor oscillations suggest that (at least the two of) the neutrinos have tiny non-zero masses. The origin of the neutrino mass is not known, and it may be related to the origin of the baryon asymmetry. The tiny neutrino mass scale also suggests a high mass scale for the right-handed neutrino through the see-saw mechanism.

Our universe is filled with cold neutrinos produced in the very early universe. High-energy neutrinos are produced from astrophysical objects e.g. supernovae, supernova remnants, active galactic nuclei(AGN), gamma-ray bursts, etc.

The neutrino can also be produced from dark matter annihilation or decay. Those neutrinos can be detected by neutrino detectors such as SuperKamiokande and IceCube at the South Pole. The indirect dark matter search using the neutrino will provides us with complementary information on the nature of dark matter.

Ultra-high-energy cosmic rays

Cosmic rays are considered to be produced by supernovae remnants in our Galaxy for $E < 10^{15.5}$eV.

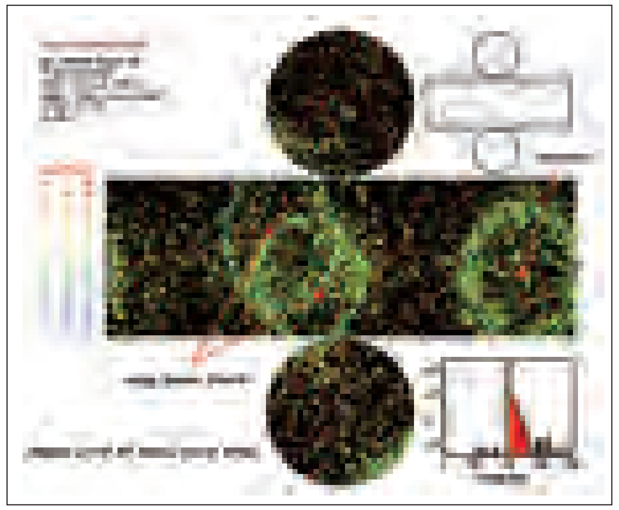
Those cosmic-ray particles with a higher energy are believed to have their origin outside our Galaxy. They travel from extra galaxies to the Milky Way. If we go to even higher energies, there is a well-known upper bound on the cosmic-ray energy, $E < 5\times10^{19}$eV, known as the Greisen-Zatsepin-Kuzmin(GZK) limit; a proton with energy above this cut-off cannot propagate a cosmological distance because pions are produced from the interactions with the ambient CMB photons. Studying the ultra-high-energy cosmic rays has two sides; one is to study the astrophysical origin of the cosmic-rays at very large energy and its propagation to us. The other is to search an exotic source for the ultra-high-energy cosmic-rays. The excess beyond the GZK limit, if any, may be due to an exotic source such as the cosmic string. For instance very heavy particles can be produced from the cusp of the string loop or when the strings interconnect, and the decay product may contribute to the ultra-high-energy cosmic rays.

Since the ultra-high-energy cosmic-ray particles have the highest energy that human beings have ever measured, it can directly probe physics at very high energy scales.

■ 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 ($\tau/\beta > 8.2 \times 10^{33}$ yr, 90% CL) comes from a 141 kton-yr exposure of Super-Kamiokande. The detection efficiency of 44% 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 limit on this mode is $\tau/\beta > 2.3 \times 10^{33}$ 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.
Jan Schuemann	Updated proton lifetime measurement using Gadolinium-enriched Super-Kamiokande.
Henry W. Sobel	Updated measurement of proton decay.
Yoichiro Suzuki	Future large water Cherenkov detectors and also future multi-purpose 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 next-generation, megaton-scale experiments for proton decay.

String Theory

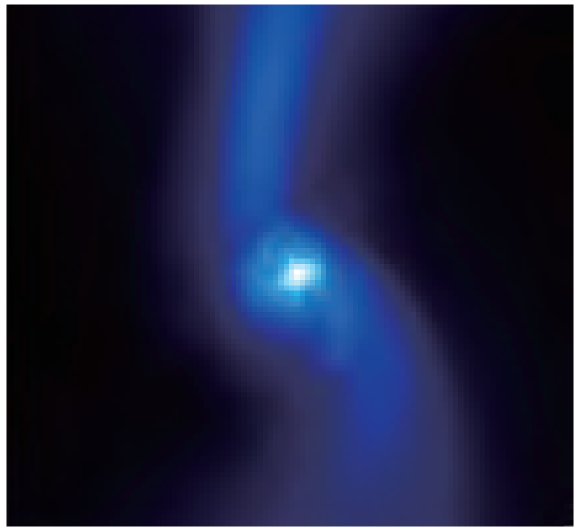
In the past few hundred years, scientists have searched for fundamental laws of nature by exploring phenomena at shorter and shorter distances. Does this progression continue indefinitely? Surprisingly, there are reasons to think that the hierarchical structure of nature will terminate at 10^{-35} meter, 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
Damien Easson	Building models of inflation from string theory. Time dependent solutions in string theory. Brane Gas model of string cosmology.
Dongfeng Gao	Mathematical aspects of string theory.
Jose Figueroa O'Farrill	AdS/CFT, M2-brane theories, and supergravity solutions.
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.
Daniel Krefl	Topological string theory and mirror symmetry with O-planes and D-branes.
Wei Li	Black holes. Gauge/Gravity correspondence. 3D quantum gravity.
Andrei Mikhailov	String worldsheet theory, Green-Schwarz and pure spinor formalism, AdS/CFT, integrability.
Shinji Mukohyama	String cosmology.
Tatsuma Nishioka	Gauge/Gravity Duality, Black Hole Physics.
Hirosi Ooguri	Development of theoretical tools to apply string theory to questions relevant to high energy physics, astrophysics, and cosmology.
Domenico Orlando	Exact CFT solutions. Topological strings. Effective descriptions for M-theory.
Susanne Reffert	String compactifications. Topological string theory.
Ken 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.
Yogesh Srivastava	Black Holes in String Theory, Gauge-Gravity correspondence and its applications in various fields.
Shigeki Sugimoto	Conjectured duality between string theory and gauge theory, and its application to QCD and hadron physics.
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.

Structure Formation



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 are generated through a rapid expansion phase called inflation in the very early universe. These primeval density fluctuations grow by the action of gravity, eventually forming luminous objects such galaxies.

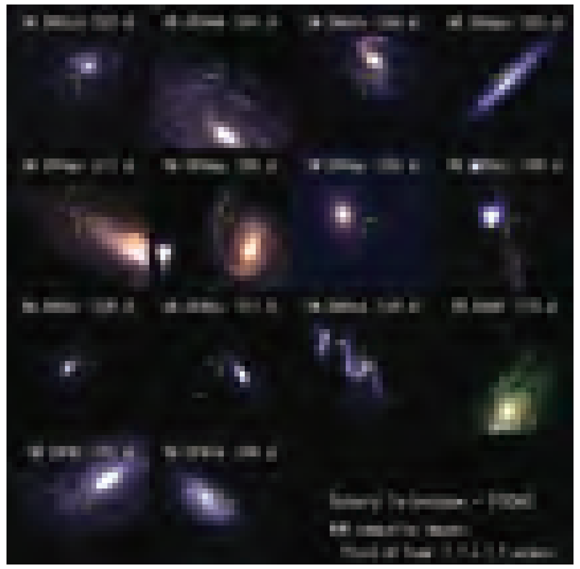
The energy content of the universe and basic statistic that describe the condition of the early universe have been determined with great accuracy from recent observations of cosmic microwave background radiation, large-scale galaxy distribution and distant supernovae. Cosmology is now at a stage where theory can make solid predictions, whereas a broad class of observations can be directly used to verify them.

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 next generation large observational programs such as Subaru-HSC dark energy survey.

■ Structure Formation Group

Member	Main Interest
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.
Ikkoh Shimizu	Theoretical models of high redshift galaxies.
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.
Rajat Mani Thomas	21cm observations of the epoch of reionization. Fast computation of HII bubble growth in the early universe.
Marcos Valdes	Cosmic reionization and the nature of dark matter. High-energy astrophysics.
Naoki Yoshida	Formation of stars, galaxies and the large-scale structure of the universe using supercomputer simulations.

Supernova



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 can not 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; Evolution of stars toward supernovae (K. Nomoto), theory of core-collapse and explosion (K. Sato), theory of neutrinos from supernovae (K. Sato) and attempt to detect these neutrinos at Kamioka (M. Vagins), theory of thermonuclear explosion (K. Nomoto), nucleosynthesis of elements up to iron (K. Maeda) and beyond (S. Wanajo), formation of dust grains (T. Nozawa), theory of optical emission from supernovae and evaluation of their use as cosmological distance indicators (K. Nomoto, K. Maeda), and observations using the Subaru telescope (K. Maeda). By unifying these attempts, we aim to comprehensively understand supernovae and their influences on the evolution of the Universe.

■ Supernova Group

Member	Main Interest
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.
Jan Schuemann	Gadolinium-upgrade for Super-Kamiokande for observing neutrinos from supernova formations, past and present.
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.
Shinya Wanajo	Origin of elements that are synthesized in supernovae. Nucleosynthesis of r-process species (e.g., gold, platinum, uranium, etc.) in core-collapse supernovae.
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

The Most Luminous Type Ia Supernova

The acceleration of the expansion of our universe was revealed at the end of the 20th century by the observations of distant Type Ia supernovae (SNe). Type Ia SNe are the explosions of white dwarfs. The explosion is triggered when the mass of the white dwarf becomes close enough to a limiting mass, so called the Chandrasekhar limit (1.4 solar mass). Thanks to this property, Type Ia SNe have a nearly constant luminosity. This uniformity, as well as its brilliant luminosity, is the reason why Type Ia SNe can be used as a distance indicator in the universe.

■ Optical image of the most luminous Type Ia SN 2009dc in UGC 10064, taken with the KANATA telescope, Higashi-Hiroshima observatory, Hiroshima University. The SN is marked with the two lines. The image size is 3 arcmin x 3 arcmin.

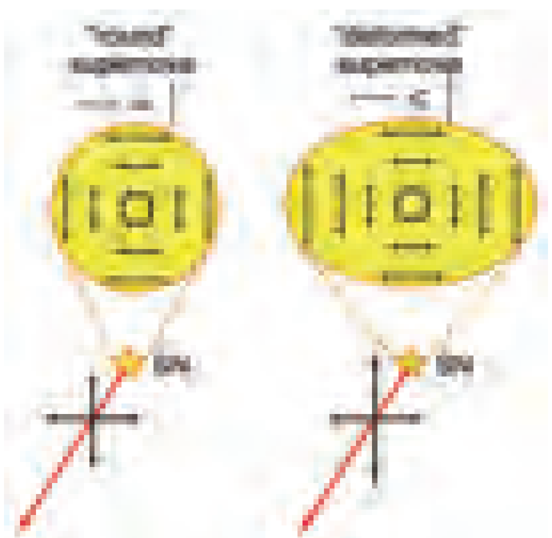
However, an interesting Type Ia SN, named SN 2009dc, was discovered in 2009 April. Masaomi Tanaka, together with a team of collaborators, conducted intensive observations for this SN with Subaru telescope and domestic telescope. As a result, the research group has revealed that this SN is the most luminous Type Ia SN in history. The luminosity is nearly 3 times as luminous as other Type Ia SNe (and is 8 billion times as luminous as the sun!).

To emit this huge luminosity, 1.6 solar mass of radioactive 56Ni, the heating source of SNe, is required. This means that the progenitor white dwarf exceeds the Chandrasekhar limit! Before 2009, two other extremely luminous SNe 2003fg and 2006gz have been already discovered (although they are less luminous than SN 2009dc). For these two objects, ``super-Chandrasekhar mass'' white dwarf has also been suggested. However, there is also a scenario that these extremely luminous SNe are caused by a highly asymmetric explosion of a Chandrasekhar-mass white dwarf. Unfortunately, we cannot ``see'' the shape of the SN explosion because SNe are discovered in distant galaxies (about a few million light years away).

Thus, the research group performed the polarization measurement of this SN with the Subaru telescope equipped with an instrument, FOCAS. If the explosion is not round, we would detect a variation in the strength of the light, depending on the oscillating direction of electromagnetic wave (``deformed'' case in the figure). This is the first polarization measurement for the candidate of``super-Chandrasekhar'' mass SN. With accurate measurements, the polarization was found to be only less than 0.3%. Therefore, the most luminous Type Ia SN 2009dc is almost round, and thus, it is concluded that the progenitor has a ''super-Chandrasekhar'' mass.

The progenitor star of SN 2009dc is thought to be rapidly rotating so that it can support the large mass. The uniformity is an important property of Type Ia SNe as a distance indicator. The newly discovered,``super-Chandrasekhar'' mass Type Ia SN casts questions on the current theoretical scenario of Type Ia SNe and their use in cosmology. The research was conducted by the team of IPMU (Masaomi Tanaka, Ken ichi Nomoto, and Keiichi Maeda), Hiroshima University (led by Masayuki Yamanaka), National Astronomical Observatory of Japan, Gunma Astronomical Observatory, Kagoshima University, Tokyo Institute of Technology, Max Planck institute for Astrophysics, and Scuola Normale Superiore di Pisa.

Further reading: The Astrophysical Journal 2010, Vol. 714, pp. 1209-1216, The Astrophysical Journal Letters 2009, Vol. 707, pp. L118-L122.



■ A schematic illustration of the polarization property of a SN. If the explosion is round, the strength of the emission is independent on the oscillation direction. On the other hand, if the explosion is not round (``deformed''), the strength of the emission depends on the oscillation direction. The research group revealed that the emission from the most luminous Type Ia SN 2009dc is consistent with the ``round'' case.

Topological String and Black Hole Microstates

In theoretical physics, toy models play important roles. They are simplified versions of physical systems, capturing their essential features. For example, the harmonic oscillator is a toy model of pendulum motion, and it provides a good approximation to small-angle swings. It turned out that the harmonic oscillator can be used to describe a variety of other physical phenomena, such as vibrations of elastic bodies, hydrodynamic and electromagnetic waves, electrical circuits, and creation and annihilation of elementary particles. Simplicity of toy models often leads to a broad range of applications.

Superstring theory is an ambitious attempt to combine quantum mechanics and general relativity and to construct the ultimate unified theory of elementary particles. Superstring theory is defined in 9 space and 1 time dimensions. Since we live in the world with only 3 space dimensions, 6 extra dimensions, if exist, must be hidden from our sight. One way it can happen is that the extra dimensions are curled up to form a “compact” space so small that we need extremely high energy to see it. Geometrical properties of such 6-dimensional spaces are actively studied by mathematicians and physicists, but many problems remain. For example, we do not even know an expression for its metric tensor - the most fundamental geometric quantity to describe a curved space. Without knowing the metric tensor, it would not be easy to compute physical quantities from superstring theory, or so it seemed.

Topological string was invented by Edward Witten as a toy model of superstring theory. In 1993, Hirosi Ooguri and his collaborators developed powerful mathematical tools to compute quantum amplitudes of this toy model. They also showed that these amplitudes can be used to compute certain scattering amplitudes in superstring theory, when 6 extra dimensions are curled up to a compact space as described in the above paragraph. The simplicity of topological string makes it possible to compute these amplitudes without knowing details of the metric tensor in 6 dimensions. However, physical significance of these superstring amplitudes was not clear at that time.

It took 11 years for Ooguri and collaborators to find a compelling question in physics to which these amplitudes give an answer. In 2004, Ooguri together with Andrew Strominger and Cumrun Vafa of Harvard discovered that topological string can be used to count the number of microscopic quantum states of a black hole. In the early 1970’s, Bekenstein and Hawking proposed a formula for the entropy of black holes based on a remarkable mathematical analogy between thermodynamics and black hole mechanics and on the semi-classical theory of black hole radiance. Ooguri and the collaborators found that, by using the topological string theory, one can go beyond the semi-classical theory and incorporate quantum effects near black holes in the computation. They showed that the quantum corrected entropy formula can be concisely expressed in terms of the topological string amplitudes.

In superstring theory, D-branes can be used to describe black holes. For such black holes, microscopic quantum states are described as bound states of D-branes. The black hole entropy should then be equal to the logarithm of the number of D-brane bound states. In the past few years, methods to count D-brane bound states have made dramatic progress. In particular, its relation to topological string has been much clarified.

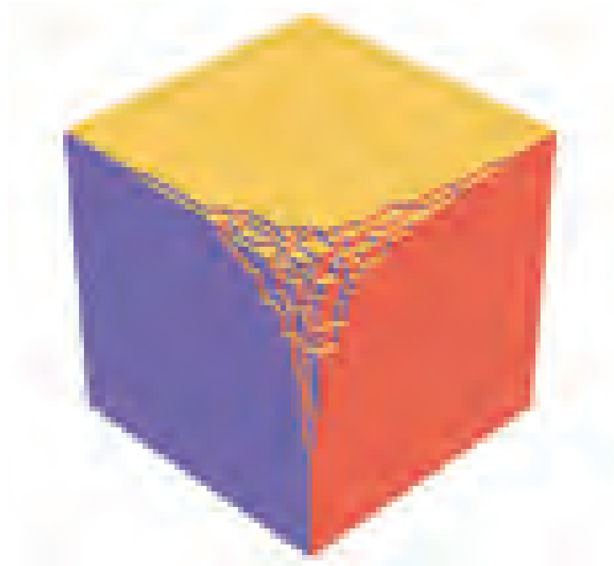
In 2009, Ooguri with IPMU graduate student Masahito Yamazaki discovered a new description of quantum states of black holes. They showed that, when the extra 6-dimensional space is curled up to a class of spaces called ``toric Calabi-Yau manifolds'', each quantum state of a black hole constructed by D-branes is in one-to-one correspondence with a configuration of a molten crystal in 3 dimensions.

An ice is a crystal of water molecules. When it melts, it starts losing molecules from its corners. Similarly, according to the work by Ooguri and Yamazaki, the space-time without a black hole corresponds to a perfect crystal. As the crystal loses molecules or atoms, the black hole grows larger, as shown in the figure. The geometry of the Calabi-Yau manifold is encoded in the combinatorial structure of the crystal.

In the subsequent paper, Ooguri and Yamazaki showed how the smooth geometry of Calabi-Yau manifolds emerges from the thermodynamic limit of the crystal melting model, where a macroscopic number of atoms are removed from the crystal. In this model, atoms of the crystal are fundamental constituents of space and time.

In the unified theory of quantum mechanics and general relativity, it is expected that space and time do not exist at distance shorter than the Planck length, which is about 10^{-36} meters. Rather, they should emerge from more fundamental concepts. The crystal melting model discovered by Ooguri and Yamazaki will be an important toy model as we explore physics at the Planck scale.

Further reading: Communications in Mathematical Physics 292 (2009) 179, Physical Review Letters 102 (2009) 161601.



An ice is a crystal of water molecules. When it melts, it starts losing molecules from its corners. Similarly, the space-time without a black hole corresponds to a perfect crystal. As the crystal loses molecules or atoms, the black hole grows larger. The geometry of the Calabi-Yau manifold is encoded in the combinatorial structure of the crystal.

Topological Insulators from String Theory

The main aim of string theory is a quantization of gravity and a unification of all forces in our universe. Therefore, in principle, we expect that we can calculate any quantities in physics from string theory. Even though the properties of quantum gravity which string theory presents us still have not been completely understood till now, many interesting applications of string theory to condensed matter systems have been attempted for these several years, such as superfluid, quantum Hall effects, cold atoms and high Tc superconductors. Indeed, Hirosi Ooguri and Tadashi Takayanagi at IPMU, together with Hideo Aoki in the University of Tokyo, Masaki Oshikawa at the Institute for Solid State Physics and Shinsei Ryu in University of California at Berkeley, organized an IPMU Focus week entitled ``Condensed Matter Physics Meets High Energy Physics'' in February 2010.

An important reason why string theory can be useful to condensed matter physics stems from the relation called holography, which means an equivalence between quantum gravity on various spacetimes and quantum manybody systems. This is remarkable in that we can describe a gravitational theory equally by a theory without gravity. Another attractive point of holography is that it relates a strongly coupled quantum system to a weakly coupled gravity theory. This means that we can calculate physical quantities in complicated quantum systems analogous to e.g. some types of superconductors from the Einstein's general relativity.

Originally, the idea of holography was found by analyzing properties of remarkable objects, called D-branes, in string theory. A Dp-brane is a (p+1) dimensional hypersurface where open strings can end, embedded in the ten dimensional spacetime of string theory. Since an open string generates a gauge field, N coincident Dp-branes is described by a (p+1) dimensional U(N) gauge theory. On the other hand, since D-branes are massive objects, they will bend the spacetime metric according to the general relativity. Thus, eventually, we can replace D-branes with a curved spacetime. This equivalence between two different viewpoints of D-branes lead to the idea of holography.

Topological insulators are very interesting materials which have been studied recently by experiments and have been analyzed energetically by condensed matter theorists. The definition of a topological insulator is very simple (see the left figures).

The material itself is an insulator and thus no currents flow in its bulk. However, if it has a boundary by cutting its edge, then along this boundary some currents (such as the electric, spin or heat current) can flow. We can regard topological insulators as generalizations of the quantum Hall effect. In quantum Hall effect, an electric current will be generated at the boundary of (2+1) dimensional material with a magnetic flux so that the current is orthogonal to the electric field. One relatively new example of topological insulators is the spin quantum Hall effect. This phenomena occurs in insulators with a time reversal symmetry and the spin current at the boundary is induced in the presence of an orthogonal electric field. Even though several topological insulators are known at present, their systematical classifications and possibilities of undiscovered new insulators have not been understood well. In particular, this problem has been known to be very difficult in strongly coupled systems. Thus the holography may be able to resolve some of the related issues.

Motivated by this, Takayanagi studied this problem with a condensed matter theorist Ryu from string theory viewpoints. They eventually found that all known topological insulators can be realized as systems of Dp-branes and Dq-branes in superstring theory with or without another object called orientifolds (see the right-hand side of the figure). Different types of topological insulators correspond to different choices of the dimensions (i.e. p and q) of D-branes and orientifolds. This also fits nicely with a mathematical framework called K-theory. Our D-brane construction offers us a convenient way to write down an effective quantum field theory which describes each of topological insulators taking into account interactions. At the same time, this leads to the construction of their holographic duals.

As the most important example of such holography, Ryu and Takayanagi, together with Wei Li at IPMU and Mitsutoshi Fujita in Kyoto University constructed a holographic dual of fractional quantum Hall effect based on string theory for the first time. They calculated the Hall conductivity and topological entanglement entropy and found they agree with what we expect.

Further reading: Journal of High Energy Physics 06, 066 (2009) and arXiv:1001.0763.

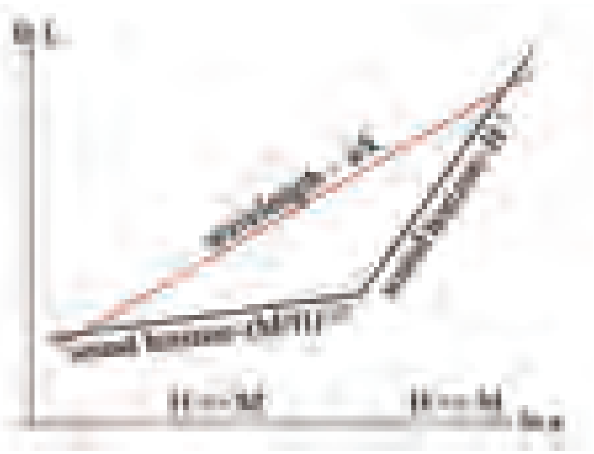
■ A schematic structure of topological insulators (left) and their D-brane constructions in string theory (right). The upper or lower left figure shows a sketch of quantum Hall effect or spin quantum Hall effect, respectively. In the quantum Hall effect, the time reversal symmetry is broken by the magnetic flux and only up spin electron moves along the edge of the (2+1) dimensional material. On the other hand, in the latter case, the time reversal symmetry requires that an up spin electron should always be accompanied with a down spin electron moving in a opposite way. Thus there is no net charge current, but is a spin current. We show in the two right figures their D-brane configurations in superstring theory. In the upper right figure, the open string between the D7 and D3-brane leads to a massive Dirac fermion in (2+1) dimension which is identified with an electron with the up spin in the quantum Hall systems. Notice that the (2+1) dimension spacetime extends in the common directions of D7 and D3-brane world-volume. In the lower right figure, we have an orientifold 3-plane in addition, we will have two fermions by considering the mirror image of D3-brane which is an anti D3-brane. Accordingly we will have two kinds of open strings and they are identified with up and down spin electrons, respectively. The time reversal symmetry of spin quantum Hall effect is now mapped to the orientifold projection in string theory.

Cosmological implications of new quantum gravity theory

Let us imagine the time is reversed and we go back toward the beginning of the universe. The universe in the early epoch was denser, more energetic and more curved. At some point, quantum fluctuations become so significant that the usual description based on classical theory totally breaks down. In this realm of quantum physics, even Einstein's theory of general relativity won't work. Therefore, in order to understand the beginning of the universe we need ``quantum gravity'', a dream theory reconciling Einstein's general relativity and quantum theory.

For this and many other reasons, finding an ultimate theory of quantum gravity has been one of the greatest dreams in theoretical physics. In January 2009, Petr Hořava's proposed a new candidate theory for quantum gravity. This theory has a property called ''power-counting renormalizability'', which is an indication of good behavior of the theory at high energies. Having a new candidate theory for quantum gravity, it is important to investigate its cosmological implications.

Shinji Mukohyama at IPMU showed that Hořava's new theory does not precisely recover general relativity at low energy but can instead mimic general relativity plus dark matter. Keisuke Izumi at IPMU, along with Mukohyama, strengthened this picture by proving that there is no spherically-symmetric, exactly static stellar solution in this theory: the ''dark matter'' slowly accelerates toward a star and thus makes the stellar center slightly dynamical. The existence of built-in ``dark matter'' is an inevitable prediction of the theory and might solve the mystery of dark matter. If we believe Einstein's general relativity then we need dark matter to explain observational data. On the other hand, if Hořava's new theory is right then it might be the case that we do not need dark matter at all because gravity behaves differently from what we think we know.



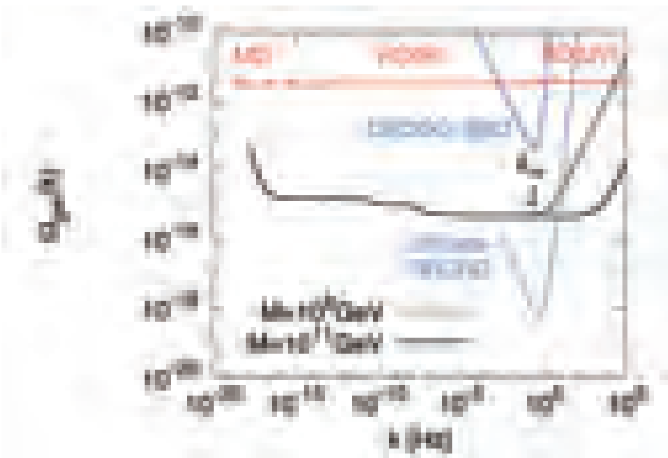
■ Physical wavelength (red) vs. sound horizon scale (black). Physical wavelength ($\sim a/k$) exits the sound horizon ($\sim (M^2H)^{-1/3}$) in the high-energy epoch ($H \gg M$) and re-enters the horizon ($\sim H^{-1}$) in the low-energy epoch ($H \ll M$), where k is the comoving wave number, a is the scale factor of the universe, $H=\dot{a}/a$ is the Hubble expansion rate and M is the energy scale above which the anisotropic scaling becomes important. In this figure, a power-law expansion $a \propto t^p$ with $1/3<p<1$ is supposed.

One of the most essential ingredients of the new theory is a short-distance behavior called anisotropic scaling. Indeed, the``power-counting renormalizability'' mentioned above stems from it. Based on the anisotropic scaling, Mukohyama proposed a new mechanism to generate scale-invariant cosmological perturbations without relying on cosmic inflation. The first figure illustrates the basic idea of the mechanism. Physical wavelength (red) exits the sound horizon (black) in the high-energy epoch (left) and re-enters the horizon (black) in the low-energy epoch (right). This mechanism, as confirmed by many authors, can seed the rich structures in the universe such as galaxies and clusters of galaxies.

Fuminobu Takahashi and Shinji Mukohyama at IPMU, in collaboration with Kazunori Nakayama (U. Tokyo) and Shuichiro Yokoyama (Nagoya U.), investigated other cosmological implications of the anisotropic scaling such as enhancement of baryon asymmetry and gravitational waves. Second figure shows the gravitational wave background spectrum for $M=10^{11}(10^{8})$~GeV, where M is the energy scale above which the anisotropic scaling becomes important. Future gravitational wave detectors may have a chance to detect characteristic spectral shape of the gravitational waves if M happens to be close to the current observational bound.

While we have found a number of intriguing cosmological implications, this theory is still in its infancy as a candidate theory of quantum gravity. Further theoretical studies are needed. Also, it is important to seek signatures of the theory in various experiments such as FERMI, H.E.S.S., MAGIC, DECIGO, BBO, etc.

Further reading: Physical Review D80 (2009) 064005; Journal of Cosmology and Astroparticle Physics 0906 (2009) 001; Physics Letters B679 (2009) 6.



■ Predicted gravitational wave background spectrum. Solid (dashed) black line corresponds to $M=10^{11}(10^{8})$GeV. A mode enters the horizon in the matter dominated era, radiation dominated era with IR regime and radiation dominated era with UV regime as shown by MD, RD(IR) and RD(UV) on the top of the figure, respectively. Sensitivities of DECIGO (BBO) and ultimate-DECIGO are also shown by blue dotted lines.

Fano Varieties in the Mirror

The basic object of study in algebraic geometry is *algebraic variety* --- the set of solutions to a system of polynomial equations over complex numbers. For instance, the equation $xy = zw$ defines a three-dimensional quadratic cone (which is singular at the origin) and its projectivization defines a smooth projective quadric surface in 3-dimensional projective space. Imposing an extra equation $w=z$ defines a section --- *complex projective curve* called conic. Projection from a point on a conic establishes its isomorphism with a complex projective line, it has a topology of two-dimensional sphere and one can introduce a metric of positive curvature on it.

Positively curved complex projective varieties are called *Fano varieties*. Projective spaces and smooth quadrics are of this kind. Kollar, Miyaoka and Mori proved that there are only a finite number of possible topologies for smooth Fano varieties in any given dimension. The only Fano curve is a conic, Fano surfaces (known also as del Pezzo surfaces) are either quadric or blowups of the projective plane in d generic points with d<8. A complete classification of smooth Fano threefolds is due to Iskovskikh, Mori and Mukai. Yet there is no classification or any conceptual description for Fano varieties in dimensions higher than 3. Most of the known examples are homogeneous varieties, complete intersections therein, and their blowups.

One may tackle the geometry of these spaces with the new mathematics influenced by the homological algebra and the string theory. Bondal and Orlov have shown that a Fano variety can be reconstructed from its derived category of coherent sheaves. Two points on a Fano variety are connected by a rational curve (image of projective line), so it has a rich theory of genus--zero Gromov--Witten invariants (quantum cohomology) which can be elegantly packed into one quantum differential equation (QDE). Finally, there is a conjectural mirror duality between Fano varieties and Landau−-Ginzburg models (functions of multiple argument of a certain kind).

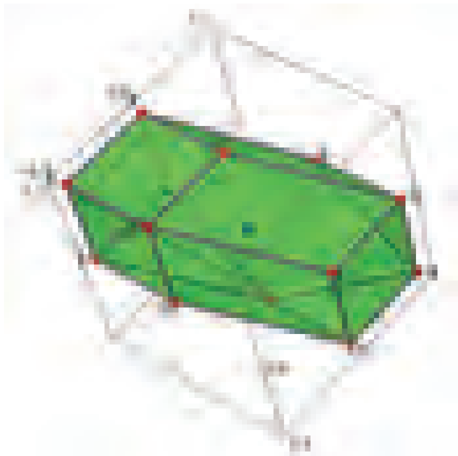
Can any of these ``physical'' ideas help us in understanding (or predicting) the answer to questions in geometry like ``how to classify Fano varieties'',``what can one say about their topologies'' or ``how to degenerate a given variety?''

The research of the IPMU mathematician Sergey Galkin and his collaborators addresses the latter two questions and provides a new hope for the first one.

In order to classify Fano varieties by using mirror symmetry, one needs first to determine the shape of the objects on the mirror side and the properties that distinguish them among similar objects. In other words, one needs to know what is special about differential equations that come from the quantum cohomology, and what properties determine the Landau--Ginzburg models (Laurent polynomials) that are mirror dual to the Fano varieties.

In his pioneering work unveiling the modular nature of QDE's for threefolds with the second Betti number equal to one, Vasily Golyshev found mirror--dual variations to all 17 families of threefolds on Iskovskikh's list and predicted their Gromov-Witten invariants. In order to extend this method to higher dimensions, one needs more fundamental ideas as to the properties that distinguish the QDEs in the set of differential equations, and also the geometric properties that characterize Landau--Ginzburg potentials among other functions.

Mirror symmetry would also imply the existence of a natural integral structure in the quantum cohomology, i.e. a flat lattice with respect to the quantum connection. This integral structure comes from the integral structure in the K-theory of holomorphic cycles as its mirror transform by the *cohomological Gamma-class*, as shown by Hiroshi Iritani in the case of toric stacks. In a different development, Sergey Galkin has introduced the Apery class which is an explicit invariant of a Fano variety derived from its quantum cohomology ring and QDE. Galkin and Iritani conjectured that these two cohomology classes coincide for a large class of varieties, and together with Golyshev were able to prove it for varieties similar to Grassmannians. This conjecture (in conjuction with standard conjectures on algebraic independence of values of Riemann's zeta-function) allows one to read off characteristic numbers of a variety from its QDE.



An extraordinary, in many respects, family of prime Fano threefolds V_{22} has a small toric degeneration T_{22}, which is quite extraordinary, too. Toric Fano varieties are encoded by lattice polytopes, and the polytope of T_{22} is the only self-dual polytope with quadratic cone singularities in dimension 3. It has 9 rectangular faces that correspond to 9 singular points and 4 triangular faces that correspond to 4 smooth torus-fixed points and the 4-dimensional cohomology of V_{22}. The mirror is given by the Laurent polynomial

$$X+\frac{1}{X}+Y+\frac{1}{Y}+Z+\frac{1}{Z}+\frac{X}{Y}+\frac{Y}{X}+\frac{X}{Z}+\frac{Z}{X}+\frac{YZ}{X}+\frac{X}{YZ}+\frac{1}{YZ}$$

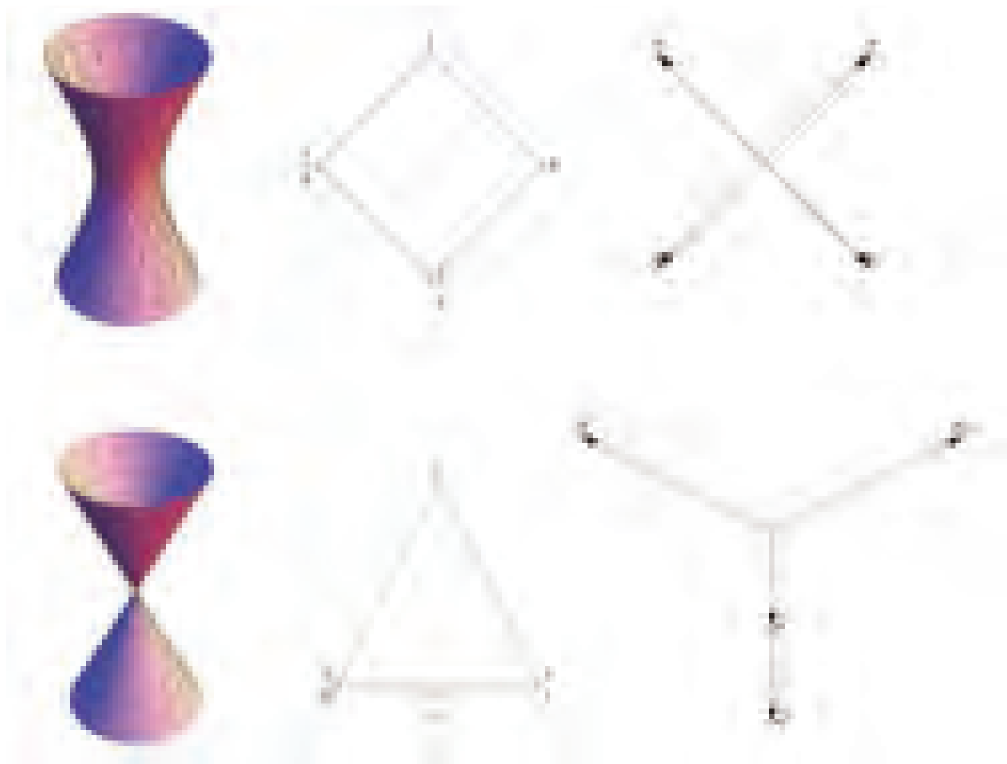
The other approach (*toric degeneration hypothesis*) is currently but a phenomenology. The known smooth Fano varieties tend to admit a degeneration to a singular toric variety(e.g. see the figure above) or a complete intersection therein. Thus, a smoothable toric Fano variety may suggest a mirror dual Landau--Ginzburg model of the Fano smoothing and enable one to predict its properties and numerical invariants.

In the case of smooth toric Fano varieties the ``toric degeneration hypothesis'' has been proven by Givental: the mirror of such variety is a Laurent polynomial $\sum_m x^m$ where *m* runs over all vertices of its toric fan. For example, a quadric surface and a projective plane are known to have the mirror as Laurent polynomials $X+Y+\frac{1}{X}+\frac{1}{Y}$ and $X+Y+\frac{1}{XY}$, respectively. It is conjectured that the hypothesis also holds for degenerations of smooth varieties into toric varieties with singularities similar to the singularity of a quadratic cone at the origin. In the case of the general toric degenerations no method of assigning coefficients to the monomials inside the corresponding polytope is known.

However, one can relate the Laurent polynomials to different degenerations of a given variety by special birational transformations which preserve the volume form $\prod \frac{dxi}{xi}$. Thus recently Sergey Galkin and Alexander Usnich have shown that, starting from a Laurent polynomial which is mirror dual to a del Pezzo surface, one can consecutively apply the cluster mutations (e.g. see the figure below) and predict the infinite hierarchy of toric degenerations for a given variety.

We remark that the complete list of toric degenerations is known so far only in the case of the projective plane. Moreover the very conditions of mutability impose strong restrictions on coefficients of the Laurent polynomials. Are these restrictions sufficient to pinpoint the polynomials?

Further reading: http://sergey.ipmu.jp



All varieties in the family of quadric surfaces *xy=z* (*z-cw*) that depend on the parameter *c* are toric. For $c \neq 0$ all these surfaces are isomorphic to the smooth one which is a cartesian square of a line (upper figures). The degenerate fiber *c*=0 is a cone over a conic (lower figures). The respective Laurent polynomials are $X+Y+\frac{1}{X}+\frac{1}{Y}$ and $Y++\frac{X+3+\frac{1}{X}}{Y}$. These polynomials are related by the transformation $(X,Y)\rightarrow(\frac{XY}{1+X},\frac{Y}{1+X})$ which preserves the volume form $\frac{dX}{X}\wedge\frac{dY}{Y}$. On the cluster level it is seen as a transformation between two quadruples of integer vectors.

7. Seminars

JFY2009

Apr 1, Henry Tye, Cornell
Is there eternal inflation in the cosmic landscape?

Apr 2, Wei Song, Inst. Theo. Phys., Chinese Acad.Sci.
The Kerr/CFT Correspondence

Apr 9, Elias Kiritsis, Univ. Creta
Improved Holographic QCD

Apr 15, Christophe Grojean, CERN
Composite Higgs Physics

Apr 16, JoAnne Hewett, SLAC
Supersymmetry Without Prejudice

Apr 21, Florian Gmeiner, NIKHEF
The Landscape of Intersecting Brane Models

Apr 27, Todor Eliseev Milanov, North Carolina State Univ.
Gromov-Witten Theory and Integrable Hierarchies

May 8, Ken-Ichi Yoshikawa, Univ. Tokyo
K3 surfaces with involution and Borcherds products

May 28, Smadar Naoz, Tel Aviv
The first generation of galaxies and 21cm fluctuations

May 28, Lotte Hollands, Univ. Amsterdam
Quantum Curves and D-Modules

Jun 1, Paschal Coyle, Marseille
The ANTARES Deep-Sea Neutrino Telescope

Jun 2, Ue-LiPen, CITA
21cm cosmology

Jun 4, Sergei Galkin, IPMU
Apery and Gamma

Jun 4, Douglas Bryman, Univ. British Columbia
Rare Opportunities: Seeking New Physics with Rare Decays of Light Particles

Jun 4, Joseph Maher, Titech
Generic elements of the mapping class group

Jun 5, Darren Reed, Los Alamos
Cosmological Simulations of Early Structure Formation

Jun 8, Kiyonori Gomi, Kyoto Univ.
Multiplication in differential cohomology and cohomology operation

Jun 10, Raphael Hirschi, Keele Univ.
Massive Stars: Key Players in the Early Universe

Jun 10, Georg Raffelt, Max Planck Inst.
Axions in Particle Physics and Cosmology

Jun 11, Marina Cortes, Univ. Sussex
Viable inflationary models ending with a first-order phase transition

Jun 11, Gaston Giribet, Univ. Buenos Aires and CONICET
On three-dimensional chiral gravity

Jun 12, Shinji Mukohyama, IPMU
Aspects of Horava-Lifshitz cosmology

Jun 12, Tadashi Takayanagi, IPMU
Holographic Lifshitz-like Fixed Point in String Theory

Jun 12, Tatsuma Nishioka, Kyoto Univ.
Horava-Lifshitz Holography

Jun 16, Kendrick Smith, Univ. Cambridge
Primordial non-Gaussianity and constraints from WMAP

Jun 17, Eiichiro Komatsu, Univ. Texas
Lecture on B-mode polarization and Primordial non-Gaussianity: Two big things to expect from the Planck data

Jun 18, Mihoko M. Nojiri, IPMU/KEK
Novel reconstruction technique for New Physics processes with initial state radiation

Jun 19, Ken-Ichi Yoshikawa, Univ. Tokyo
K3 surfaces with involution, equivariant analytic torsion and automorphic forms

Jun 29, Subhabrata Majumdar, TIFR
Two Topics in Cluster Cosmology: Studying Dark Energy and Sigma8

Jun 30, Kin-Wang Ng, Inst. Phys. Taiwan
Some thoughts on the large-scale CMB anomalies

Jul 2, Kazunori Nakayama, ICRR
Cosmological and astrophysical probes of dark matter annihilation

Jul 9, Michihisa Takeuchi, ICRR
Collider phenomenology of split-UED

Jul 15, Kunihito Ioka, KEK
Cosmic-Ray Positrons and Supernova/Pulsar/GRB Remnants

Jul 15, Tsutomu Yanagida, IPMU
Dark Matter and PAMELA / Fermi Anomalies

Jul 16, Kentaro Nagamine, Univ. Nevada
Escape fraction of ionizing photons in high-z galaxies

Jul 16, Matthias Gaberdiel, ETH Zurich
Extremal (super-) conformal field theories

Jul 21, Ingo Runkel, King's College London
Defects and symmetries

Jul 23, Yuu Niino, Kyoto Univ.
Modeling GRB Host Galaxies

Jul 23, Bernard Nienhuis, Amsterdam Univ.
Entanglement in quantum chains

Jul 27, Misha Verbitsky, ITEP Moscow/IPMU
Mapping class group for hyperkaehler manifolds

Aug 5, Kazuaki Ota, RIKEN
Deep Surveys of z=7 Ly-alpha Emitting Galaxies with Subaru Telescope:Implications for Galaxy Evolution and Reionization

Aug 5, Ian Low, Argonne/Northwestern Univ.
Theoretical Constraints on the Higgs Effective Couplings

Aug 6, Hiroya Yamaguchi, RIKEN
Recent studies on supernova nucleosynthesis with X-ray observations of supernova remnants

Aug 6, Nick Dorey, DAMTP
Spiky strings and spin chains

Aug 11, John Ellis, CERN
Last bets for Higgs and Supersymmetry before the LHC starts

Aug 12, Nanhua Xi, Chinese Acad.Sci.
Kazhdan-Lusztig Theory

Aug 13, Katsuyuki Naoi, Univ. Tokyo
Categorical approach for Weyl modules, after Chari-Fourie-Khandai

Aug 19, Hiroshi Ohta, Nagoya Univ.
Lagrangian intersection Floer theory -- the foundation and some calculations

Aug 19, Young-Kee Kim, Fermilab
Fermilab Plan with an Intensity Frontier Accelerator

Aug 20, Goh Hock-seng, Berkeley
Twin Higgs and Lepton Number Violation at the LHC

Aug 20, Brian Feldstein, Boston Univ.
Form Factor Dark Matter

Aug 25, David Morrison, UCSB
Non-geometric heterotic compactifications

Aug 25, Min-Su Shin, Princeton Univ.
Testing AGN feedback models and simulating environmental effects on AGN activities

Aug 28, Paul Zinn-Justin, Univ. Pierre et Marie Curie
Exactly solvable models of tilings and Littlewood--Richardson coefficients

Aug 31, Misha Verbitsky, IPMU
Global Torelli theorem for hyperkaehler manifolds

Sep 8, Toshi Oshima, Univ. Tokyo
Fractional calculus of Weyl algebra and its application to ordinary differential equations on the Riemann sphere

Sep 8, Bryan Webber, Univ. Cambridge
1st lecture: Deep inelastic scattering, parton distributions and parton showering

Sep 9, Stuart Freedman, Berkeley and IPMU
Oscillating Neutrinos and Oscillating Decay Probabilities

Sep 14, Bryan Webber, Univ. Cambridge
2nd lecture: Jet fragmentation, hadronization and hadron-hadron processes

Sep 15, Minxin Huang, IPMU
Topological strings, black holes, and matrix models

Sep 17,Hiroshi Iritani, Kyushu Univ.
Quantization in semi-infinite Hodge theory

Sep 18, Peter Zograf, Steklov Inst. St.Petersburg Dept.
Volumes of moduli spaces of algebraic curves

Sep 24, Rajat Mani Thomas, IPMU
Fast Reionization Simulations for LOFAR

Sep 25, Paul H. Frampton, UNC and IPMU
p-adic strings

Oct 2, Elizabeth Tasker, Univ. Florida/NAOJ
The Evolution of Giant Molecular Clouds in Global Disk Galaxy Simulations

Oct 7, Saul Ramos-Sanchez, DESY
Heterotic Orbifold Phenomenology: Status and Prospects

Oct 9, Martin Crocce, Inst. Space Science, Spain
The MICE simulations : Abundance of Massive Clusters and Large Scale Clustering

Oct 9, Yuji Tachikawa, IAS
2d Liouville correlators from 4d gauge theories

Oct 14, Paul Frampton, UNC and IPMU
1st lecture: Neutrino Masses and Mixings

Oct 15, Maxim Kontsevich, IHES
Stability and Wall-crossing for Derived Categories I

Oct 15, Jason Evans, IPMU
Higgs Exempt No-Scale Supersymmetry

Oct 16, Maxim Kontsevich, IHES
Stability and Wall-crossing for Derived Categories II

Oct 20, Zoltan Bajnok, Hungarian Acad.Sci.
Finite size effects in integrable models: planar AdS/CFT

Oct 21, Paul Frampton, UNC and IPMU
2nd lecture: Studies of T' Flavor Symmetry

Oct 21, Matt Sudano, IPMU
General Gauge Mediation with Gauge Messengers

Oct 22, Issha Kayo, IPMU
A model independent method to measure velocity dispersion of galaxies

Oct 22, Romuald Janik, Jagiellonian Univ.
Perturbative gauge theory results from strings in AdS_5xS5

Oct 27, Bernard de Wit, Utrecht Univ.
Supersymmetric deformations, gauged supergravities

Nov 2, Masaki Shigemori, Univ. Amsterdam
Brownian motion in AdS/CFT

Nov 4, Paul Frampton, UNC and IPMU
3rd lecture: Cyclic Cosmology and Infinite Past

Nov 5, Rong-Gen Cai, Inst.Theo.Phys./ Chongqing Univ. of Posts and Telecom.
Horizon Thermodynamics and Einstein Equations

Nov 9, Makoto Sakurai, Univ. Tokyo
Differential Graded Categories and heterotic string theory

Nov 10, Horatiu Nastase, Titech
Fuzzy spheres and M2-M5 systems in ABJM

Nov 18, Paul Frampton, UNC and IPMU
4th lecture: Identifying Dark Matter as Black Holes

Nov 19, Marco Drewes, Lausanne
Towards a Quantum Theory of Leptogenesis

Nov 24, Junya Yagi, Rutgers Univ.
Chiral Algebras of (0, 2) Models: Beyond Perturbation Theory

Nov 24, Alexei A. Starobinsky, Landau Inst./RESCEU
To the local beginning of inflation and beyond

Nov 24, Masato Minamitsuji, Sogang Univ.
Scalar field in the anisotropic Universe

Nov 24, Antonio Enea Romano, YITP
Apparent cosmological acceleration, dark energy and inhomogeneities

Nov 25, Paul Frampton, UNC and IPMU
5th lecture: Conformality from AdS/CFT at TeV Scale, Axigluon as Explanation of Top Asymmetry in p-pbar Collisions

Nov 26, David Koswer, Saclay
Next-to-Leading Order Jet Physics with BlackHat

Nov 27, Dmitry Tamarkin, Northwestern Univ.
Microlocal condition for non-displaceability of Lagrangian submanifolds

Nov 30, Junya Yagi, Rutgers Univ.
Chiral Algebras of (0, 2) Models: Beyond Perturbation Theory

Dec 1, Jiro Sekiguchi, Tokyo Univ.of Agri. and Tech.
System of uniformization equations and hyperelliptic integrals

Dec 3, Tsz Yan Lam, IPMU
Signature of primordial non-Gaussianity on large scale structure

Dec 4, Michael Dine, UCSB
Discrete R Symmetries and Low Energy Supersymmetry

Dec 4, Yogesh Srivastava, IPMU
Shaving the black hole

Dec 4, Giovanni Felder, ETH Zurich
Periodic cyclic homology in deformation quantization

Dec 7, Janet Hung, Perimeter Inst.
Holographic quantum liquids in 1+1 d

Dec 7, Weiping Zhang, Chern Inst. Math. Nankai Univ.
Geometric quantization on noncompact manifolds

Dec 8, Sergey Ketov, Tokyo Met. Univ.
Modified Supersymmetry and Dynamical Dark Eenergy

Dec 8, Giovanni Felder, ETH Zurich/IPMU
Gaudin subalgebras and stable rational curves

Dec 10, Harald Fritzsch, Univ. Muenchen
Flavor Mixing, Neutrino Masses and Neutrino Oscillations

Dec 10, Giovanni Felder, ETH Zurich
Deformation quantization and branes

Dec 11, Giovanni Felder, ETH Zurich
Deformation quantization and branes

Dec 14, Surjeet Rajendran, MIT
Gravitational Wave Detection with Atom Interferometry

Dec 17, Ryuichiro Kitano, Tohoku Univ.
Non-linear SUSY and Hidden Gravity

Dec 28, Shushi Harashita, Kobe Univ.
Remarks on pavings of the Siegel modular varieties

Jan 08, 2010, Doug Spolyar, Fermilab
Dark Matter and The First stars more

Jan 12, Sumit Das, Kentucky Univ.
Dilation cosmologies and their gauge theory duals

Jan 14, Ken'ichiro Nakazato, Kyoto Univ.
Exploring Hadron Physics in Black Hole Formations: a New Promising Target of Neutrino Astronomy

Jan 19, Sergey Galkin, IPMU
Mirror symmetries of P2 enumerated by Markov triplets

Jan 26, Daniel Krefl, IPMU
Aspects of orientifolds in topological string theory

Jan 28, Masayuki Tanaka, IPMU
The environmental dependence of galaxy properties at 0<z<2

Jan 28, James M. Lattimer, SUNY
Neutron Stars and the Dense Matter Equation of State

Feb 01, Timur Sadykov, Siberian Federal Univ.
Bases in the solution space of the Mellin system

Feb 02, Volker Schomerus, DESY
Solving Complex Projective Superspace

Feb 04, Masato Yamanaka, ICRR
Implications of CDMS II result on Higgs sector in the MSSM

Feb 04, Jing Shu, IPMU
Neutrino Constraints on Inelastic Dark Matter after CDMS II

Feb 05, Shinsei Ryu, UC Berkeley
Ten-fold classification of topological insulators and superconductors

Feb 09, Aya Bamba, Dublin/JAXA
The Next Generation X-ray satellite: ASTRO-H

Feb 11, Nathan Berkovits, Univ. São Paulo
Holography from the AdS_5xS^5 Pure Spinor Formalism

Feb 11, Barton Zwiebach, MIT
T-duality, field theory, and Courant brackets

Feb 17, Masahiro Takada, IPMU
Cosmic structure formation and weak gravitational lensing

Feb 22, Andrew Tolley, Perimeter Inst.
Non-gaussianities and the Inflationary Initial State

Feb 22, Olaf Scholten, KVI / Groningen
Improved flux limits for neutrinos with energies above 10^{22} eV from NuMoon observations

Feb 23, Ernesto Lupercio, CINVESTAV
Nearly Frobenius Structures and Quantum Field Theory

Feb 25, David Wands, Univ. Portsmouth
Primordial density perturbations from inflation

Mar 02, Robert Penner, Aarhus Univ/USC/Caltech
Finite type invariants and the Ptolemy groupoid

Mar 04, Bernard Carr, Queen Mary Univ. London/ RESCEU
New cosmological constraints on primordial black holes

Mar 09, Ryo Suzuki, Trinity Colledge, Dublin
Thermodynamic Bethe Ansatz for Konishi-like states in AdS_5 x S5

Mar 11, Nozomu Kawakatu, Univ. Tsukuba
Fate of young radio-loud AGN: Dead or alive ?

Mar 15, Anthony J. Leggett, Univ. Illinois, Urbana-Champaign
Introduction to High Energy Low Temperature Physics

Mar 16, Jacopo Stoppa, Cambridge
D0-D6 states counting and Gromov-Witten invariants

Mar 18, Won-Sang Cho, IPMU
New particle mass spectrometry at the LHC

Mar 25, Zoltan Kunszt, ETH Zurich
Calculating multi-leg one loop amplitudes with unitarity cut method more

8. Conferences

JFY2009

April 6 - 10
Focus Week: Non-Gaussianities in the Sky

May 18 - 22
Focus Week: New Invariants and Wall Crossing

June 22 - 26
International Conference: Dark Energy

September 28 - October 2
Focus Week: Statistical Frontier of Astrophysics

November 6
Workshop: Quantizations, Integrable Systems and Representation Theory

November 10 - 13
Focus Week: QCD in Connection with BSM Study at LHC

November 16 - 18
Workshop: Recent Advances in Mathematics at IPMU

November 30 - December 3
Focus Week: Epoch of Reionization

December 7 - 11
Focus Week: Indirect Dark Matter Search

January 4 - 8
Workshop: Elliptic Fibrations and F-Theory

February 8 - 12
Focus Week: Condensed Matter Physics Meets High Energy Physics

March 17 - 19
Workshop: Geometry of Lattices and Infinite Dimensional Lie Algebra

9. Conference Talks

(including seminars given at other places)

JFY2009

Seminar at Arizona State University
(2009.03.23 - 2009.04.25, Arizona)
Damien Easson
"The Microphysics of the Inflationary Universe"

Experiment-Theory Co-Workshop on new physics search at LHC
(2009.04.01 - 2009.04.03, University of Tokyo)
Fuminobu Takahashi
"PAMELA/ATIC cosmic-ray anomalies and new physics"

IPMU Focus week on non- Gaussianities in the Sky
(2009.04.06 - 2009.04.10, IPMU)
Fuminobu Takahashi
"Non-Gaussianity as a probe of the early universe"
Shinji Mukohyama
"Higgs phase of gravity and non-Gaussianity from ghost inflation"

Seminar at University of Geneva
(2009.04.06, Geneva)
Damien Easson
"Searching for the Microphysics of the Inflationary Universe"

Seminar at NAOJ Mitaka Campus
(2009.04.10, Mitaka, Tokyo)
Cosimo Bambi
"Super-spinning black holes: is the Kerr bound a fundamental limit?"

Non-linear cosmological perturbations
(2009.04.13 - 2009.04.24, YITP, Kyoto University)
Shinji Mukohyama
"Scale-invariant cosmological perturbations from Horava-Lifshitz gravity without inflation"

Joint Theory Institute workshop "Dynamics of Symmetry Breaking"
(2009.04.13 - 2009.04.17, Argonne Nat'l Lab, USA)
Shigeki Sugimoto
"Dynamical Symmetry Breaking in Holographic QCD with Orientifolds"

GCOE international workshop "Non-linear cosmological perturbations"
(2009.04.13 - 2009.04.24, Kyoto)
Fuminobu Takahashi
"Non-Gaussianity as a probe of the early universe"

Seminar at Space Telescope Science Institute
(2009.04.13 - 2009.04.16, STScI, Baltimore)
Ken'ichi Nomoto
"Diversity of Core-Collapse Supernovae"

Presented to The Royal Society
(2009.04.16, London)
Damien Easson
"Modeling the Universe at Low and High Energies"

Workshop on Type Ia Supernova Progenitors
(2009.04.17 - 2009.04.18, Princeton University)
Ken'ichi Nomoto
"Single degenerate models for Type Ia supernova progenitors"

Seminar at the University of Tokyo
(2009.04.23, RESCEU, The University of Tokyo)
Damien Easson
"The Microphysics of Inflation"

DECIGO workshop
(2009.04.23, NAOJ)
Masahiro Takada
"Future dark energy experiments with optical/ infrared surveys"

Seminar at Chuo University
(2009.04.27)
Fuminobu Takahashi
"Inflation and the implication of non-Gaussianity"

Seminar at Chiba University
(2009.04.27, Chiba, Japan)
Cosimo Bambi
"How can we test the Carter-Israel conjecture?"

International Workshop: CosmoClusters
(2009.05.04 - 2009.05.06, Laboratoire d'Astrophysique de Marseille(LAM), France)
Masahiro Takada
"Subaru Weak Lens Study of LoCuSS Clusters"

Colloquium at Aoyama Gakuin University
(2009.05.08, Kanagawa, Japan)
Cosimo Bambi
"Black hole candidates and new physics"

Seminar at Osaka University
(2009.05.13, Osaka)
Cosimo Bambi
"Testing the black hole paradigm with future observations of SgrA*"

Seminar at Osaka City University
(2009.05.15, Osaka)
Cosimo Bambi
"Testing the Carter-Israel Conjecture with future observations of SgrA*"

Joint Subaru/Gemini Science Conference
(2009.05.18 - 2009.05.21, Kyoto University)
Masahiro Takada
"LoCuSS: Subaru Weak Lens Study of 30 Galaxy Clusters"
Ken'ichi Nomoto
"The Final Fates of Massive Stars: Theory vs. Observations"

Workshop on tests of gravity and gravitational physics
(2009.05.19 - 2009.05.21, Cleveland, USA)
Cosimo Bambi
"Super-spinning black holes: motivations and observational signatures"

Seminar at Tokyo Institute of Technology
(2009.05.20, Tokyo)
Shinji Mukohyama
"Scale-invariant cosmological perturbations from Horava-Lifshitz gravity without inflation"

Frontiers in Black Hole Physics at Dubna
(2009.05.25 - 2009.05.30, JINR, Dubna)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Beijing Program on Algebraic Topology 2009
(2009.05.25 - 2009.05.29, Chinese Academy of Sciences)
Toshitake Kohno
"Homology of local systems on configuration spaces and conformal field theory"

Planck 2009
(2009.05.25 - 2009.05.29, Padova, Italy)
Fuminobu Takahashi
"Dark Matter as a probe of the early Universe"

Frascati Workshop 2009: Multi-frequency Behaviour of High Energy Cosmic Sources
(2009.05.25 - 2009.05.30, Vulcano, Italy)
Keiichi Maeda
"Supernova Nucleosynthesis in the Early and Present Universe"

Seminar at The University of Tokyo (hadron theory group)
(2009.05.26, Tokyo)
Shigeki Sugimoto
"Properties of Baryons in Hologarphic QCD"

Seminar at YITP
(2009.06.02, Kyoto)
Fuminobu Takahashi
"Cosmic-ray anomalies as a probe of dark matter"

Seminar at The University of Tokyo (theoretical astrophysics group)
(2009.06.04, Tokyo)
Fuminobu Takahashi
"Cosmic-ray anomalies and dark matter"

17th International Conference on Supersymmetry and the Unification of Fundamental Interactions (SUSY 09)
(2009.06.05 - 2009.06.10, Boston)
Seong Chan Park
"Dark Matter and Collider Physics in Split-UED"

Summer School on String Theory
(2009.06.06 - 2009.06.19, Galileo Galilei Institute)
Hirosi Ooguri
"Topological String Theory"

KEK mini workshop
(2009.06.08 - 2009.06.09, KEK)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Seminar at Rikkyo University
(2009.06.09, Tokyo)
Cosimo Bambi
"Testing the black hole paradigm with future observations"

Ehrenfest Colloquium
(2009.06.10, University of Leiden)
Hirosi Ooguri
"Black Holes and Emergent Geometry"

Seminar at the University of Tokyo
(2009.06.15, Tokyo)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Kaehler and Sasaki geometry in Rome
(2009.06.16 - 2009.06.19, University of Rome "La Sapienza", Rome)
Jose Miguel Figueroa-O'Farrill
"Einstein manifolds and triple systems"

Conference Solstice
(2009.06.17 - 2009.06.19, University of Paris VII)
Toshitake Kohno
"Local systems on configuration spaces and the space of conformal blocks"

Seminar at Tsukuba University
(2009.06.17, Tsukuba)
Cosimo Bambi
"Testing the black hole paradigm with future observations of SgrA*"

Seminar at Tohoku University
(2009.06.18, Sendai)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

XXI Rencontres de Blois: Windows on the Universe
(2009.06.21 - 2009.06.26, Blois, France)
Cosimo Bambi
"Is the Carter-Israel conjecture correct?"

Strings 2009
(2009.06.22 - 2009.06.26, Rome)
Hirosi Ooguri
"Topological Strings and Crystal Melting Revisited"

IPMU international conference "dark energy: lighting up darkness!"
(2009.06.22 - 2009.06.26, IPMU)
Masahiro Takada
"LoCuSS: Subaru Weak Lens Study of 30 Galaxy Clusters"
Shinji Mukohyama
"Higgs phase of gravity and ghost condensation"
Ken'ichi Nomoto
"Progenitors of Type Ia Supernovae"

JEM-EUSO International Workshop
(2009.06.22 - 2009.06.23, Ewha Woman's University, Seoul)
Keiichi Maeda
"Hypernovae and Their Progenitors"

Seminar at Nihon University
(2009.06.24, Tokyo)
Fuminobu Takahashi
"Dark Matter and Cosmic-ray anomalies"

Annual Meeting of Presidents of the Association of Pacific Rim Universities
(2009.06.28 - 2009.06.30, Caltech, USA)
Hirosi Ooguri
"The Global Environment for Research"

Invisible Universe 2009
(2009.06.29 - 2009.07.03, Paris)
Shinji Mukohyama
"Higgs phase of gravity and ghost condensate"
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Current Problems in Extragalactic Dust
(2009.06.29 - 2009.07.03, Niels Bohr Institute)
Takaya Nozawa
"Formation and evolution of dust in hydrogen-poor supernovae"

Quantum Criticality and the AdS/CFT Correspondence
(2009.06.29 - 2009.07.24, KITP, UC Santa Barbara)
Tadashi Takayanagi
"Holographic Entanglement Entropy"

XXV Max Born symposium: the Planck scale
(2009.06.29 - 2009.07.03, University of Wroclaw, Poland)
Jose Miguel Figueroa-O'Farrill
"M2-branes and 3-algebras"

Field Theory and String Theory
(2009.07.06 - 2009.07.11, YITP, Kyoto)
Fuminobu Takahashi
"Dark Matter and Cosmic-ray anomalies"

MPA workshop on Type Ia supernovae
(2009.07.06 - 2009.07.10, Max-Planck-Institute, Garching, Germany)
Ken'ichi Nomoto
"Unusual Supernovae"

CQUeST Focus Program on Horava gravity
(2009.07.07 - 2009.07.09, CQUeST, Sogang University)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Seminar at Osaka University
(2009.07.07, Osaka)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Seminar at Tsukuba University
(2009.07.08, Tsukuba)
Masahiro Takada
"Gravitational lensing of galaxy clusters: dark matter and dark energy"

Fireworks workshop 2009
(2009.07.13 - 2009.07.17, Bonn, Germany)
Ken'ichi Nomoto
"Faint Supernovae from Massive Stars"

Seminar at Tokyo Metropolitan University
(2009.07.16, Tokyo)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Seminar at IoA, The University of Tokyo
(2009.07.16, Tokyo)
Masahiro Takada
"Gravitational lensing of galaxy clusters: dark matter and dark energy"

APCTP Focus Program "Aspects of Holography and Gauge/string duality"
(2009.07.20 - 2009.07.31, POSTECH, Pohang)
Shigeki Sugimoto
"O(N) and USp(N) QCD from String Theory"

Quantum Theory and Symmetries 6
(2009.07.20 - 2009.07.25, University of Kentucky, Lexington, USA)
Tadashi Takayanagi
"Holographic Entanglement Entropy, Fractional Quantum Hall Effect, and Lifshitz-like Fixed Points"

Santa Fe 2009 Summer Cosmology Workshop
(2009.07.20 - 2009.07.24, Santa Fe, USA)
Masahiro Takada
"Theoretical issues in weak lensing"

Seminar at Shizuoka University
(2009.07.22, Shizuoka, Japan)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Seminar at MPIA
(2009.07.31, Heidelberg, Germany)
Takaya Nozawa
"Formation and destruction of dust in Type IIb SN: Application to Cas A"

• Conference Talks

The 2nd MSJ-SI "Arrangements of Hyperplanes"
(2009.08.01 - 2009.08.13, Hokkaido University)
Toshitake Kohno
"Topology of the complements of hyperplane arrangements, local system homology and iterated integrals"

Summer Institute 2009
(2009.08.04 - 2009.08.06, Fujiyoshida, Japan)
Fuminobu Takahashi
"Dark Matter and Cosmic-rays"
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

HMS and Hodge Theory
(2009.08.08 - 2009.08.12, University of Vienna)
Sergey Galkin
"Apery Class"

IAU Symposium 265 on Chemical Abundances in the Universe: Connecting First Stars to Planets
(2009.08.10 - 2009.08.14, Rio de Janeiro, Brazil)
Ken'ichi Nomoto
"Nucleosynthesis of the Elements in Supernovae/Hypernovae"

KITP Conference on Stellar Death and Supernovae
(2009.08.17 - 2009.08.21, UC Santa Barbara)
Ken'ichi Nomoto
"Single Degenerate Ignition Conditions and Constraints"

KITP Workshop on Particle Acceleration in Astrophysical Plasmas
(2009.08.24 - 2009.09.11, UC Santa Barbara)
Ken'ichi Nomoto
"Explosion Energies of Supernovae"

GEOMAPS lecture at Niels Bohr Institute
(2009.09.01 - 2009.09.03, Copenhagen)
Shigeki Sugimoto
"String Theory and QCD (I,II)"

KIAS-KAIST-YITP workshop
(2009.09.02, KIAS, Korea)
Fuminobu Takahashi
"Dark Matter and Cosmic-rays"

Colloquium at Advanced Technology Center, NAOJ
(2009.09.02, NAOJ, Tokyo)
Masahiro Takada
"Gravitational lensing of galaxy clusters: dark matter and dark energy"

KIAS-KAIST-YITP workshop
(2009.09.03, KIAS, Korea)
Seong Chan Park
"Kaluza-Klein Dark Matter"

TAO-NIRCAM Workshop
(2009.09.11, Inst. Astronomy, The University of Tokyo, Mitaka Campus)
Keiichi Maeda
"Near-Infrared Frontiers of Supernova Study"

JSPS annual meeting
(2009.09.13, Kounan University, Kobe, Japan)
Fuminobu Takahashi
"Gravitino Problem and recent development"

Seminar at University of Toronto
(2009.09.14, CITA, Toronto)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Seminar at Perimeter Institute
(2009.09.15, Waterloo, Canada)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Shining Light on Black Holes Workshop
(2009.09.21 - 2009.09.25, University of Michigan)
Shinji Mukohyama
"Ghost condensate and black hole"

NIMS-APCTP Joint International workshop "String Theory and Cosmology - Quantum Gravity Dark Energy and Dark Matter"
(2009.09.24 - 2009.09.26, Daejeon, Korea)
Seong Chan Park
"Kaluza-Klein Dark Matter"
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"
Tadashi Takayanagi
"Can we really have string theory duals of non-relativistic fixed points ?"
Damien Easson
"Gravitational couplings in DBI inflation"

Statistical Frontiers of Astrophysics
(2009.09.28 - 2009.10.02, IPMU)
Masahiro Takada
"Non-Gaussian error properties of large-scale structure probes"

YITP workshop "Branes, Strings and Black holes"
(2009.09.28 - 2009.11.01, YITP, Kyoto University)
Tadashi Takayanagi
"Holographic Insulator/Superconductor Phase Transition at Zero Temperature"
Taizan Watari
"Flavor Structure in F-theory"

Lecture series at Nagoya University
(2009.09.28 - 2009.09.30, Nagoya)
Shinji Mukohyama
"Higgs phase of gravity"

KEK school "Galaxy and Dark Matter"
(2009.09.28 - 2009.10.02, Karuizawa, Japan)
Fuminobu Takahashi
"Dark matter and cosmic-rays"

Seminar at University of Tokyo
(2009.09.28, Tokyo)
Jose Miguel Figueroa-O'Farrill
"M2-branes, ADE and Lie superalgebras"

Seminar at Nagoya University
(2009.09.29, Nagoya)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Seminar at ICRR
(2009.10.09, Kashiwa, Japan)
Masahiro Takada
"Neutrino mass and cosmology"

Seminar at CUHK
(2009.10.12, The Chinese University of Hong Kong)
Tsz Yan Lam
"Signature of Primordial Non-Gaussianity on Large Scale Structure"

DENET workshop "Dark universe: from cosmology to planets"
(2009.10.14 - 2009.10.16, Hakone, Japan)
Masahiro Takada
"Gravitational lensing and HSC survey"

Colloquium at ASIAA
(2009.10.15, Taiwan)
Tsz Yan Lam
"Signature of primordial non-Gaussianity on large scale structure"

Seminar at Hirosaki University
(2009.10.15, Hirosaki, Japan)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Colloquium at NTHU
(2009.10.16, Taiwan)
Tsz Yan Lam
"Signature of primordial non-Gaussianity on large scale structure"

Galactic Center Workshop 2009
(2009.10.19 - 2009.10.23, Shanghai, China)
Cosimo Bambi
"Testing the black hole paradigm with future observations of SgrA*"

Lecture series at Nagoya University
(2009.10.26 - 2009.10.28, Nagoya)
Masahiro Takada
"Weak gravitational lensing"

Seminar at Nagoya University
(2009.10.27, Nagoya)
Masahiro Takada
"Neutrino mass and cosmology"

Seminar at Nihon University
(2009.10.28)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Seminar at National Taiwan University
(2009.11.05, Taiwan)
Fuminobu Takahashi
"Supersymmetric Cosmology -problems and prospects-"

Seminar at National Taiwan University
(2009.11.06, Taiwan)
Fuminobu Takahashi
"Gravitinos from Inflaton decay"

Seminar at Academia Sinica
(2009.11.06, Taiwan)
Fuminobu Takahashi
"New gravitino problem"

Gravity at a Lifshitz Point
(2009.11.08 - 2009.11.10, Perimeter Institute)
Shinji Mukohyama
"Cosmological implications of gravity at a Lifshitz point"

Seminars at Nat'l Center Theo Sci
(2009.11.10 , NCTS, Taiwan)
Fuminobu Takahashi
"Dark matter and cosmic-rays"
Fuminobu Takahashi
"Affleck-Dine baryogenesis and its recent development"
Fuminobu Takahashi
"Non-Gaussianity as a probe of the early Universe"

Tours Symposium on Nuclear Physics and Astrophysics VII
(2009.11.16 - 2009.11.20, Kobe, Japan)
Keiichi Maeda
"Nucleosynthesis in Type Ia Supernova Explosions and Observational Signatures"
Ken'ichi Nomoto
"Explosive Nucleosynthesis in Supernovae and Hypernovae"

Japan-Korea Science Seminar 2009 (JSPS/KOSEF) -- Galaxy Build-Up Across Cosmic Ages and Environments --
(2009.11.25 - 2009.11.28, Hiraizumi, Japan)
Masahiro Takada
"Subaru Weak Lens Study of 30 Galaxy Clusters"

AdS/CFT: strongly coupled systems and exact results
(2009.11.26 - 2009.11.27, Ecole Normale Supérieure /Institut Henri Poincaréacute, Paris)
Tadashi Takayanagi
"Holographic Insulator/Superconductor Phase Transition at Zero Temperature"

Geometry Seminar at Tokyo Metropolitan University
(2009.11.27, Tokyo)
Sergey Galkin
"Mirror Symmetry for del Pezzo surfaces"

Tropical Structures in Geometry and Physics
(2009.11.30 - 2009.12.04, MSRI, Berkeley)
Daniel Krefl
"Real enumerative geometry via the topological string"

JGRG19
(2009.11.30 - 2009.12.04, Rikkyo University, Tokyo)
Cosimo Bambi
"Numerical simulations of the accretion process in Kerr spacetimes with arbitrary value of the Kerr parameter"

Mirror Symmetry and Gromov-Witten invariants
(2009.12.07 - 2009.12.11, Graduate School of Mathematical Sciences, University of Tokyo)
Yukinobu Toda
"On a computation of rank two Donaldson-Thomas invariants"

Lecture Series at Rikkyo University
(2009.12.10 - 2009.12.12, Tokyo)
Tadashi Takayanagi
"AdS/CFT and its application to condensed matter physics"

SUBARU HSC Science on Variable and Transients
(2009.12.14, NCU, Taiwan)
Nozomu Tominaga
"Supernova Shock breakouts"

Algebraic Geometry seminar
(2009.12.14, Graduate School of Mathematical Sciences, University of Tokyo)
Sergey Galkin
"Invariants of Fano varieties via quantum D-module"

Miami 2009
(2009.12.15 - 2009.12.20, Miami)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Lecture Series at Tohoku University
(2009.12.16 - 2010.12.18, Sendai)
Tadashi Takayanagi
"AdS/CFT and its application to condensed matter physics"

Joint Seminars on Cosmology and Gravitation
(2009.12.18, RESCEU, The University of Tokyo)
Cosimo Bambi
"Violation of the cosmic censorship conjecture and its astrophysical implications"

22nd Rironkon Symposium
(2009.12.22, Nagoya University)
keiichi maeda
"Explosion Geometry of Type Ia Supernovae: Importance of Late-Time Observations in Optical and Infrared"

2nd Indo-Japan Workshop on Gravitation & Cosmology
(2009.12.29 - 2009.12.30, Jamia Millia Islamia, New Delhi)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Workshop on String Theory
(2010.01.05 - 2010.01.06, Rikkyo University)
Shigeki Sugimoto
"Mesons as Open Strings"

11th Singularity Workshop
(2010.01.09 - 2010.01.11, Shibaura Inst of Tech, Tokyo)
Cosimo Bambi
"Violation of the cosmic censorship conjecture and its astrophysical implications"

Essential Cosmology for the Next Generation
(2010.01.11 - 2010.01.15, Cancun, Mexico)
Masahiro Takada
"Lecture 1 "Weak gravitational lensing basics"
Masahiro Takada
"Lecture 2 "Cluster weak lensing"
Masahiro Takada
"Lecture 3 "Cosmic shear"

Open Questions in Gravity Workshop
(2010.01.17 - 2010.01.20, Beyond Center, Arizona State University)
Damien Easson
"Extra Dimensions and the CMB"

Seminar at Kyoto University
(2010.01.27, Kyoto)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

Inje Gravitation & Numerical Relativity meeting
(2010.01.28 - 2010.01.29, Busan, Korea)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology"

IPMU Focus Week, Condensed Matter Physics Meets High Energy Physics
(2010.02.08 - 2010.02.12, IPMU)
Tadashi Takayanagi
"Entanglement Entropy and Topological Insulators from String Theory"

The Future of Neutrino Mass Measurements: Terrestrial, Astrophysical, and Cosmological Measurements in the Next Decade
(2010.02.08 - 2010.02.11, Inst for Nucl Theo, U. Washington, Seattle)
Masahiro Takada
"Neutrino masses and cosmic simulations (invited review)"

GUT's and Strings 2010
(2010.02.12, MPI Munich)
Taizan Watari
"Flavor Structure in F-theory"

Komaba 2010
(2010.02.13 - 2010.02.14, Komaba Campus, Tokyo)
Hirosi Ooguri
"Instability with Chern-Simons Terms"

16th ICEPP Symposium
(2010.02.14 - 2010.02.15, Hakuba, Japan)
Shinji Mukohyama
"What is cosmology telling us about fundamental physics?"

Superstring theory and Cosmology
(2010.02.18 - 2010.02.20, Konosaki, Japan)
Shigeki Sugimoto
"Recent topics in holographic QCD"
Tadashi Takayanagi
"An application of Lifshitz fixed points to AdS/CFT"

Exploring Supernova Remnants and Pulsar Wind Nebulae in X-rays: before and after ASTRO-H
(2010.02.18 - 2010.02.19, ISAS/JAXA)
Keiichi Maeda
"Tackling Supernova Explosion Mechanism by Astro-H"

Workshop: Formation and evolution of black holes
(2010.02.14 - 2010.02.20, Aspen)
John Silverman
"Co-evolution of Supermassive Black Holes and galaxies in zCOSMOS"

XXII Workshop Beyond the Standard Model
(2010.03.08 - 2010.03.11, Physikzentrum Bad Honnef, Germany)
Daniel Krefl
"Aspects of the unoriented sector in topological string theory"

The First Stars and Galaxies: Challenges for the Next Decade
(2010.03.08 - 2010.03.11, University of Texas, Austin)
Ken'ichi Nomoto
"Nucleosynthesis in Hypernovae and Faint Supernovae"

HEDLA 2010: 8th International Conference on High Energy Density Laboratory Astrophysics
(2010.03.15 - 2010.03.18, Caltech, Pasadena)
Ken'ichi Nomoto
"Radiation Hydrodynamics of Extremely Bright and Extremely Faint Supernovae"

Physics of Compact Objects
(2010.03.16 - 2010.03.17, Okinawa, Japan)
Keiichi Maeda
"Hunting for Type Ia Supernova Explosion Mechanism"

The non-Gaussian universe
(2010.03.24 - 2010.03.26, Kyoto)
Shinji Mukohyama
"Aspects of Horava-Lifshitz cosmology and non-Gaussianity"

Seminar at MIT
(2010.03.25, Cambridge, USA)
Tadashi Takayanagi
"Insulators from String Theory"

Seminar at University of Aberdeen
(2010.03.25 , Aberdeen)
Sergey Galkin
"Degenerations in the mirror"

Crete Workshop on the Frontiers of Cosmology
(2010.03.28, Crete Center of Theo Phys, Greece)
Shinji Mukohyama
"Horava-Lifshitz gravity"

Workshop on Subgroups of Cremona groups
(2010.03.29 - 2010.03.30 , Edinburgh)
Sergey Galkin
"Prokhorov-Hacking degenerations in the mirror"

10. Visitors

JFY2009

S. Petcov, SISSA (Italy), particle theory, 3/20-4/17
A. Bondal, Aberdeen (UK), mathematics, 3/29-4/6
R. Gregory, Durham (UK), string theory, 3/30-4/9
H. Tye, Cornell (USA), particle theory, 3/30-4/3
W. Song, Inst.Theo.Phys.(China), particle theory, 3/30-4/3
F. Urban, UBC (Canada), cosmology, 3/31-4/2
N. Dalal, CITA (Canada), astronomy, 4/6-4/10
E. Komatsu, Texas (USA), cosmology, 4/6-4/10
L. Senatore, IAS (USA), particle theory, 4/6-4/10
B. Wandelt, Illinois (USA), astronomy, 4/6-4/10
D. Bond, CITA (Canada), cosmology, 4/6-4/10
A. Frolov, Simon Fraser (Canada), cosmology, 4/6-4/10
M. Sasaki, Kyoto (Japan), cosmology, 4/6-4/10
T. Takahashi, Saga (Japan), cosmology, 4/6-4/10
T. Tanaka, YITP (Japan), cosmology, 4/6-4/10
S. Yokoyama, Nagoya (Japan), cosmology, 4/6-4/10
K. Kohri, Lancaster (UK), cosmology, 4/6-4/10
Y.R. Garcia, UAN (Columbia), cosmology, 4/6-4/10
R. Crittenden, Portsmouth (UK), cosmology, 4/6 - 4/10
Y. Watanabe, Texas (USA), cosmology, 4/6-4/10
N. Barnaby, CITA (Canada), cosmology, 4/6-4/10
M. Nolta, CITA (Canada), cosmology, 4/6-4/10
J. Sievers, CITA (Canada), cosmology, 4/6-4/10
F. Vernizzi, CEA/Saclay (France), cosmology, 4/6-4/10
G. Rossi, KIAS (Korea), cosmology, 4/6-4/10
A. Curto, Cantabria (Spain), cosmology, 4/6-4/10
P. Vielva, IFCA Cantabria (Spain), cosmology, 4/6-4/10
B. Barreiro, IFCA Cantabria (Spain), cosmology, 4/6-4/10
E. Martinez-Gonzalez, IFCA Cantabria (Spain), cosmology, 4/6-4/10
A.E. Romano, YITP (Japan), cosmology, 4/6-4/10
H.W. Sobel, Irvine (USA), neutrino physics 4/6-4/15
E. Kiritsis, Crete (Greece), cosmology, 4/6-4/10
F. Bernardeau, CEA/Saclay (France), astronomy, 4/7-4/17
U. Seljak, Zurich (Swiss), cosmology, 4/8-4/10
M. Yamaguchi, Tohoku (Japan), particle theory, 4/13-9/30
J. Hewett, SLAC (USA), particle theory, 4/13-4/15
C. Grojean, CERN (Swiss), particle theory, 4/15-4/15
T. Suyama, Seoul (Korea), cosmology, 4/16-4/16
F. Gmeiner, NIKHEF (Netherlands), string theory, 4/19-4/25
J.D. Silverman, ETH-Zurich (Swiss), astronomy, 4/20-4/24
Y. Sekino, OIQP (Japan), string theory, 4/21-4/24
T. Higaki, Tohoku (Japan), particle theory, 4/23-4/23
T.E. Milanov, North Carolina State (USA), mathematics, 4/25-4/29
J. Wang, IHEP (China), cosmology, 4/26-4/30
L. Uruchurtu, Cambridge (UK), string theory, 4/28-5/27
M. Smy, Irvine (USA), neutrino physics, 4/28-5/17
Y.B. Ruan, Michigan (USA), mathematics, 5/6-5/13
K. Yoshikawa, Tokyo (Japan), mathematics, 5/8-5/8
M. Yamazaki, Tokyo (Japan), string theory, 5/11-5/29
A. Piepke, Alabama (USA), neutrino physics, 5/12-5/21
T. Suwa, Hokkaido (Japan), mathematics, 5/15-5/15
A. Voronov, Minnesota (USA), mathematics, 5/17-6/4
H. Nakajima, Kyoto RIMS (Japan), mathematics, 5/18-5/22
K. Fukaya, Kyoto (Japan), mathematics, 5/18-5/22
A. Hanany, Imperial College (UK), string theory, 5/18-5/22
D. Maulik, Columbia (USA), mathematics, 5/18-5/22
F. Denef, Harvard (USA), string theory, 5/18-5/22
M. Cheng, Harvard (USA), mathematics, 5/18-5/22
B. Szendroi, Oxford (UK), mathematics, 5/18-5/22
G. Mikhalkin, Geneve (Swiss), mathematics, 5/18-5/22
J. Bryan, UBC (Canada), mathematics, 5/18-5/22
Y. Soibelman, Kansas (USA), mathematics, 5/18-5/22
A. Neitzke, Harvard (USA), string theory, 5/18-5/22
T. Dimofte, Caltech (USA), string theory, 5/18-5/22
L. Hollands, Amsterdam (Netherlands), mathematics, 5/18-5/31
S. Naoz, Tel Aviv (Israel), cosmology, 5/18-5/22
J. Yoo, Fermilab (USA), cosmology, 5/20-5/22
P. Binetruy, Paris (France), particle theory, 5/20-5/22
S. Katsanevas, Paris (France), astroparticle phys, 5/21-5/22
E.L. Turner, Princeton (USA), astrophysics, 5/26-6/11
U.L. Pen, CITA (Canada), astrophysics, 5/28-6/7
K. Smith, Chicago (USA), cosmology, 6/1-6/8
B. Michel, Harvard (USA), particle theory, 6/1-8/15
E.T. Kearns, Boston (USA), neutrino physics, 6/3-6/8
D. Bryman, UBC (Canada), high energy phys, 6/4-6/5
M. Cortes, Sussex (UK), cosmology, 6/4-6/13
G. Giribet, Buenos Aires (Brazil), cosmology, 6/8-6/18
D. Spergel, Princeton (USA), astrophysics, 6/12-6/30
D. Eisenstein, Arizona (USA), astronomy, 6/17-6/25
S. Ho, LBL (USA), cosmology, 6/20-6/30
D. Clowe, Ohio (USA), astronomy, 6/21-6/26
L. Infante, UC (Chile), cosmology, 6/21-6/26
E. Saridakis, Athens (Greece), cosmology, 6/21-6/27
K. Homma, Hiroshima (Japan), high energy phys, 6/21-6/26
S. Jhingan, Jamia Millia Islamia (India), cosmology, 6/21-6/26
M. Shoji, Texas (USA), cosmology, 6/21-6/27
L. Hui, Columbia (USA), cosmology, 6/21-6/25
I. Gurwich, Ben-Gurion (Israel), cosmology, 6/21-6/27
S. Majumdar, TIFR (India), cosmology, 6/21-6/26
J. Jee, UC Davis (USA), astronomy, 6/21-6/27
M.S. Alam, Texas (USA), high energy physics, 6/21-6/27
Y. Fujii, Waseda (Japan), astronomy, 6/21-6/25
T. Shiromizu, Kyoto (Japan), string theory, 6/22-6/27
K. Mizutani, Saitama/Waseda (Japan), astrophysics, 6/22-6/26
A. Nishizawa, Tohoku (Japan), astronomy, 6/22-6/26

S. Ichinose, Shizuoka (Japan), particle theory, 6/22-6/26
K. Bamba, Tsing Hua (Taiwan), cosmology, 6/22-6/26
H. Miyatake, Tokyo (Japan), cosmology, 6/22-6/26
T. Kobayashi, Waseda (Japan), cosmology, 6/22-6/26
H. Motohashi, Tokyo RESCEU (Japan), cosmology, 6/22-6/26
T. Moriya, Tokyo (Japan), astronomy, 6/22-6/26
S. Tsujikawa, TU Science (Japan), cosmology, 6/22-6/26
Y.C.M. Li, Tsing Hua (Taiwan), cosmology, 6/22-6/27
T. Chiba, Nihon (Japan), cosmology, 6/22-6/26
Y. Urakawa, Waseda (Japan), cosmology, 6/22-6/26
D. Jeong, Texas (USA), cosmology, 6/22-6/26
S. Saito, Tokyo (Japan), cosmology, 6/22-6/26
M. Kasai, Hirosaki (Japan), cosmology, 6/22-6/26
T. Nishimichi, Tokyo (Japan), astronomy, 6/22-6/26
A. Taruya, Tokyo RESCEU (Japan), astrophysics, 6/22-6/26
M. Nakashima, Tokyo RESCEU (Japan), astrophysics, 6/22-6/26
Y. Kamiya, Tokyo (Japan), astronomy, 6/22-6/26
M. Sumiyoshi, Kyoto (Japan), astrophysics, 6/22-6/26
M. Turner, Chicago (USA), cosmology, 6/22-6/25
L. Amendola, Astr.Obs.Rome (Italy), astronomy, 6/22-6/27
J.A. Gu, NTU (Taiwan), cosmology, 6/23-6/26
C.S. Kim, Yonsei (Korea), particle theory, 6/23-8/31
K.W. Ng, ASIAA (Taiwan), astrophysics, 6/24-7/2
T. Ishibe, Hiroshima (Japan), mathematics, 6/26-6/28
K. Nagao, Kyoto RIMS (Japan), mathematics, 6/30-7/2
N. Suzuki, Berkeley (USA), astrophysics, 7/7-7/11
M. Verbitsky, ITEP (Russia), mathematics, 7/8-9/4
M. Takeuchi, Tokyo ICRR (Japan), particle theory, 7/9-7/9
R. Nishio, Tokyo (Japan), particle theory, 7/13-7/15
M. Gaberdiel, ETH-Zurich (Swiss), mathematics, 7/13-7/17
K. Ioka, KEK (Japan), particle theory, 7/15-7/15
I. Runkel, King's College (UK), string theory, 7/21-7/21
B. Nienhuis, Amsterdam (Netherlands), particle theory, 7/22-7/26
Y. Niinou, Kyoto (Japan), astrophysics, 7/23-7/24
I. Low, Argon/Northwestern (USA), particle theory, 7/31-8/22
F.G. Malikov, USC (USA), mathematics, 8/1-8/19
T. Arakawa, Nara (Japan), mathematics, 8/3-8/31
N. Dorey, Cambridge (UK), high energy physics, 8/5-8/7
K. Ota, RIKEN (Japan), astronomy, 8/5-8/5
H. Yamaguchi, RIKEN (Japan), astronomy, 8/6-8/6
J. Ellis, CERN (Swiss), particle theory, 8/8-8/19
H.S. Goh, Maryland (USA), particle theory, 8/9-8/23
N. Xi, Chinese Acad.Sci. (China), mathematics, 8/9-8/12
S. Maeda, Kyoto (Japan), cosmology, 8/11-8/12
K. Naoi, Tokyo (Japan), mathematics, 8/13-8/13
B. Feldstein, Boston (USA), particle theory, 8/16-8/31
N. Reshetikhin, Berkeley (USA), mathematics, 8/16-8/20
R. Peccei, UCLA (USA), particle theory, 8/16-8/19
D.R. Morrison, UCSB (USA), mathematics, 8/17-9/1
S. Kahn, SLAC (USA), cosmology, 8/17-8/19
Y.K. Kim, Chicago/Fermilab (USA), high energy physics, 8/17-8/19
D. Ida, Gakushuin (Japan), cosmology, 8/17-8/21
A. Bondal, Aberdeen (UK), mathematics, 8/18-9/3
M. Gonokami, Tokyo (Japan), quantum optics, 8/18-8/18
N. Kaifu, Open U (Japan), astronomy, 8/18-8/18
S. Kojima, Titech (Japan), mathematics, 8/18-8/18
H. Ohta, Nagoya (Japan), mathematics, 8/19-8/20
G. Grantcharov, Maryland (USA), mathematics, 8/21-8/27
C.S. Park, Caltech (USA), string theory, 8/24-8/31
M.S. Shin, Princeton (USA), astrophysics, 8/24-8/26
H.N. Li, Inst. Phys (Tanwan), particle theory, 8/24-8/25
M. Yamazaki, Tokyo (Japan), string theory, 8/24-8/28
D. Kawata, Univ College (UK), astronomy, 8/25-8/25
P. Zinn-Justin, Pierre et Marie Curie (France), mathematics, 8/28-8/28
M. Yamazaki, Tokyo (Japan), string theory, 8/31-9/3
B. Webber, Cambridge (UK), particle theory, 9/1-9/30
S. Freedman, Berkeley (USA), neutrino physics, 9/5-9/11
T. Oshima, Tokyo (Japan), mathematics, 9/8-9/8
M. Hashimoto, W.Ontario (Canada), particle theory, 9/8-9/8
T. Ishibe, Hiroshima (Japan), mathematics, 9/11-9/13
M. Hashimoto, W.Ontario (Canada), particle theory, 9/14-9/14
P. Zograf, Steklov Inst (Russia), mathematics, 9/15-9/24
H. Iritani, Kyushu (Japan), mathematics, 9/17-9/19
M. Strauss, Princeton (USA), astrophysics, 9/23-9/30
R. Lupton, Princeton (USA), cosmology, 9/23-9/30
C. Loomis, Apache Point Obs. (USA), cosmology, 9/23-9/30
E.L. Turner, Princeton (USA), astrophysics, 9/24-0/10
I. Szapudi, Hawaii (USA), astronomy, 9/26-10/5
H. Peiris, Univ College (UK), astrophysics, 9/26-10/3
D. Mortlock, Imperial college (UK), astrophysics, 9/27-10/3
J.A. Rice, Berkeley (USA), mathematics, 9/27-10/3
C.M. Schafer, Carnegie Mellon (USA), mathematics, 9/27-10/3
D. Marinucci, Tor Vergata (Italy), mathematics, 9/27-10/3
X.L. Meng, Harvard (USA), mathematics, 9/27-10/1
J. Winn, MIT (USA), astrophysics, 9/27-10/3
P. Baines, Harvard (USA), mathematics, 9/27-10/2
J. Frost, cambridge (UK), high energy physics, 9/27-10/11
D. Savransky, Princeton (USA), astronomy, 9/27-10/3
T.J. Loredo, Cornel (USA), astronomy, 9/27-10/3
D.W. Hogg, New York U (USA), astronomy, 9/28-10/2
R. Shibata, Keio (Japan), mathematics, 9/28-10/2
P.F. de Medeiros, Edinburgh (UK), mathematical Phys, 10/1-12/24
D.H. Diaz, Madrid (Spain), student exchange, 10/2-1/2
Y. Tachikawa, Princeton (USA), string theory, 10/3-10/10
M.H. Crocce, ICE (Spain), cosmology, 10/4-10/13
S.R. Sanchez, DESY (Germany), particle theory, 10/4-10/10
R. Janik, Jagiellonian (Poland), particle theory, 10/8-11/16
A. Bondal, Aberdeen (UK), mathematics, 10/9-11/30
S. Zheng, Zhejiang (China), string theory, 10/10-10/25
E. Mendez-Escobar, Edinburgh (UK), mathematical Phys, 10/10-12/9
Z. Bajnok, Hungarian Acad.sci. (Hungary), string theory, 10/13-11/14
M. Kontsevich, IHES (France), mathematics, 10/15-10/16
M. Pevzner, Reims (France), mathematics, 10/17-11/24
B.Q.P.J. de Wit, Utrecht (Netherlands), atomic phys, 10/18-11/7
A. Nishizawa, Tohoku (Japan), astronomy, 10/19-10/21
I. Fleck, Siegen (Germany), particle theory, 10/22-11/18
T. Ishibe, Hiroshima (Japan), mathematics, 10/30-11/1
P. Zograf, Steklov (Russia), mathematics, 11/1-11/29
H. Minamoto, Kyoto (Japan), mathematics, 11/1-11/3
O. Iyama, Nagoya (Japan), mathematics, 11/1-11/3
S. Oppermann, NTNU (Norway), mathematics, 11/1-11/3
C. Schmidt-Colinet, ETH-Zurich (Swiss), string theory, 11/2-2010/10/31
M. Shigemori, Amsterdam (Netherlands), string theory, 11/2-11/6
Y. Sekiya, Nagoya (Japan), mathematics, 11/2-11/3
M. Smy, Irvine (USA), neutrino phys, 11/3-11/16
R.G. Cai, Chongqing (China), cosmology, 11/5-11/5
G. Heckman, Radboud U Nijmegen (Netherlands), mathematics, 11/5-11/6
H. Iritani, Kyushu (Japan), mathematics, 11/5-11/6
C. Olmos, Cordoba (Spain), mathematics, 11/5-11/6
D.H. Sternheimer, Bourgogne (France), mathematics, 11/5-11/6
M. Guest, Tokyo Met. (Japan), mathematics, 11/5-11/6
A. Rosly, ITEP (Russia), mathematics, 11/6-11/30
E.T. Kearns, Boston (USA), neutrino phys, 11/7-11/17
D. Krohn, Princeton (USA), particle theory, 11/8-11/14
G. Salam, Paris/CNRS (France), particle theory, 11/8-11/14
M. Schwartz, Harvard (USA), particle theory, 11/8-11/15
G. Zanderighi, Oxford (UK), particle theory, 11/8-11/15
P. Fox, Fermilab (USA), particle theory, 11/8-11/14
T. Logvinenko, Liverpool (UK), mathematics, 11/8-11/22
J. Alwall, SLAC (USA), particle theory, 11/9-11/14
R. Cavanaugh, Illinois-Chicago Circle (USA), particle theory, 11/9-11/15
L. Dixon, SLAC (USA), particle theory, 11/9-11/13
J. Gallicchio, Harvard (USA), particle theory, 11/9-11/14
W.S. Cho, Seoul (Korea), particle theory, 11/9-11/14
I. Lewis, Wisconsin (USA), particle theory, 11/9-11/13
Z. Kunszt, ETH-Zurich (Swiss), particle theory, 11/9-11/14
K. Mawatari, Heidelberg (Germany), particle theory, 11/9-11/14
H. Yokoya, CERN (Swiss), particle theory, 11/9-11/15
Q. Li, Karlsrue (Germany), particle theory, 11/9-11/14
R. Frederix, Zurich (Swiss), particle theory, 11/9-11/16
C. Yu, Korea (Korea), particle theory, 11/9-11/16
S. Lee, Weizmann Inst (Israel), particle theory, 11/9-11/14
C. Young, Kyoto (Japan), particle theory, 11/9-11/10
S. Asai, Tokyo (Japan), high energy physics, 11/10-11/13
K. Choi, KAIST (Korea), particle theory, 11/10-11/14
H. Nastase, Titech (Japan), particle theory, 11/10-11/10
H. Nishino, Nagoya (Japan), particle theory, 11/10-11/13
C.W. Chiang, Taiwan Inst Phys (Taiwan), particle theory, 11/10-11/13
C.W. Walter, Duke (USA), neutrino physics, 11/10-11/16
N.J. Berkovits, Estadual Paulista (Brasil), string theory, 11/10-11/12
J. Thaler, Berkeley (USA), particle theory, 11/10-11/13
P. Bressler, Max Planck (Germany), mathematics, 11/11-12/2
K. Scholberg, Duke (USA), neutrino physics, 11/11-11/16
T. Ishibe, Hiroshima (Japan), mathematics, 11/13-11/15
N. Yuichi, Tohoku (Japan), mathematics, 11/15-11/17
C. Ingalls, New Brunswick (Canada), mathematics, 11/17-11/18
M. Drewes, Lausanne (Swiss), particle theory, 11/19-11/19
J.M. Escude, Barcelona (Spain), astrophysics, 11/21-12/4
D. Kosower, CEA-Saclay (France), particle theory, 11/22-12/6
M. Minamitsuji, Sogang (Korea), cosmology, 11/23-11/28
C. Kobayashi, ANU (Australia), astronomy, 11/23-12/6
J. Yagi, Rutgers (USA), particle theory, 11/24-11/24
A.E. Romano, Kyoto (Japan), cosmology, 11/24-11/25
D. Tamarkin, Northwestern (USA), mathematics, 11/27-12/17
M. McQuinn, Berkeley (USA), astrophysics, 11/28-12/4
I. Iliev, Sussex (UK), astronomy, 11/28-12/3
X. Chen, Nat'l Astr. Obs. (China), astronomy, 11/29-12/6
B. Yue, Nat'l Astr. Obs. (China), astronomy, 11/29-12/3
A. Coley, Dalhousie (Canada), mathematics, 11/29-12/13
T. Yamada, Tohoku (Japan), astronomy, 11/29-12/3
G. Becker, Cambridge (UK), astrophysics, 11/29-12/5

G. Mellema, Stockholm (Sweden), astronomy, 11/29-12/3
S. Zaroubi, Groningen (Netherlands), astrophysics, 11/29-12/9
L.V.E. Koopmans, Groningen (Netherlands), cosmology, 11/29-12/3
A. Lidz, Harvard (USA), astronomy, 11/29-12/3
U.L. Pen, CITA (Canada), astrophysics, 11/29-12/6
H. Tashiro, IAS (USA), cosmology, 11/29-12/3
K.W. Ng, ASIAA (Taiwan), astrophysics, 11/29-12/3
S.R. Das, Kentucky (USA), string theory, 11/30-2010/3/3
J.H. Oh, Kentucky (USA), string theory, 11/30-12/22
N. Kashikawa, NAOJ (Japan), astronomy, 11/30-12/2
L.J. Greenhill, Harvard (USA), astrophysics, 11/30-12/3
V. Jelic, Groningen (Nethernlands), astrophysics, 11/30-12/3
J. Sekiguchi, Tokyo A&T (Japan), mathematics, 11/30-12/1
T. Ishibe, Hiroshima (Japan), mathematics, 11/30-12/2
G. Felder, ETH-Zurich (Swiss), mathematics, 12/2-12/19
P. Hut, IAS (USA), astrophysics, 12/3-2010/1/18
C.W. Walter, Duke (USA), neutrino physics, 12/3-12/14
A.E. Taklimi, IPM (Iran), particle theory, 12/4-12/13
Q. Yuan, IHEP (China), astrophysics, 12/5-12/20
J. Hung, Perimeter Inst (Canada), string theory, 12/5-12/14
P.F. Yin, Peking (China), astrophysics, 12/5-12/20
S. Rajendran, MIT (USA), particle theory, 12/6-12/15
P. Mertsch, Edinburgh (UK), particle theory, 12/6-12/12
D. Hooper, Fermilab (USA), particle theory, 12/6-12/12
A. Ibarra, TUM (Germany), particle theory, 12/6-12/12
P.D. Serpico, CERN (Swiss), astrophysics, 12/6-12/13
P. Gondolo, Utah (USA), cosmology, 12/6-12/12
C. Rott, Ohio State (USA), astrophysics, 12/6-12/12
K. Hirotani, ASIAA (Taiwan), astrophysics, 12/6-12/12
Y.G. Kim, KAIST (Korea), particle theory, 12/6-12/12
L. Visinelli, Utah (USA), particle theory, 12/6-12/12
O. Seto, Hokkai-Gakuen (Japan), particle theory, 12/6-12/11
A. Strumia, Pisa (Italy), particle theory, 12/6-12/13
X.J. Bi, IHEP (China), particle theory, 12/6-12/12
M. Casolino, INFN (Italy), particle theory, 12/7-12/11
S. Torii, Waseda (Japan), particle theory, 12/7-12/8
M. Hoshino, Tokyo (Japan), particle theory, 12/7-12/11
T. Jeltema, Santa Cruz (USA), astronomy, 12/8-12/12
S. Ketov, Tokyo Met. (Japan), cosmology, 12/8-12/8
S. Profumo, Santa Cruz (USA), particle theory, 12/8-12/12
H. Fritzsch, Muenchen (Germany), particle theory, 12/10-12/10
M. Gleiser, Dartmouth (USA), particle theory, 12/13-12/15
R. Kitano, Tohoku (Japan), particle theory, 12/17-12/17
R. Donagi, Pennsylvania (USA), mathematics, 12/25-2010/1/9
T. Pantev, Pennsylvania (USA), mathematics, 2010/01/02-01/15
D. Morrison, Santa Barbara (USA), mathematics, 01/02-01/09
J. Marsano, Enrico Fermi Inst. (USA), mathematics, 01/02-01/10
A. Grassi, Pennsylvania (USA), mathematics, 01/02-01/09
A. Bondal, Aberdeen (UK), mathematics, 01/02-01/11
S. Schafer-Nameki, KITP (USA), mathematics, 01/03-01/09
S. Katz, Illinois (USA), mathematics, 01/03-01/09
C. Cordova, Harvard (USA), mathematics, 01/03-01/11
J. Heckman, Princeton (USA), mathematics, 01/03-01/09
J. H. Oh, Kentucky (USA), string theory, 01/04-01/12
N. Nakayama, Kyoto (Japan), mathematics, 01/04-01/08
T. Shioda, Rikkyo (Japan), mathematics, 01/04-01/08
Y. Miyaoka, Tokyo (Japan), mathematics, 01/04-01/08
M. Saito, Kobe (Japan), mathematics, 01/04-01/08
T. Kawano, Tokyo (Japan), mathematics, 01/04-01/08
D. Spolyar, Fermilab (USA), cosmology, 01/06-01/14
M. Wolk, Paris 6 (France), cosmology, 01/10-02/26
T. Ishibe, Hiroshima (Japan), mathematics, 01/10-01/12
R. Lupton, Princeton (USA), cosmology, 01/12-01/23
K. Nakazato, Kyoto (Japan), astronomy, 01/14-01/14
E. Turner, Princeton (USA), astrophysics, 01/15-01/30
S. Bickerton, Princeton (USA), cosmology, 01/16-01/29
C. Loomis, Princeton (USA), cosmology, 01/16-01/29
A. Bondal, Aberdeen (UK), mathematics, 01/20-01/24
X. G. He, NTU (Taiwan), particle theory, 01/21-02/10
J. Lattimer, Stony Brook (USA), astronomy, 01/28-01/31
V. Schomerus, DESY (Germany), string theory, 01/30-02/19
Y. Hikida, Keio (Japan), string theory, 02/01-02/13
M. Ooguri, KIPAC (USA), cosmology, 02/01-02/04
G. Smoot, Berkeley (USA), astrophysics, 02/03-03/01
S. Ryu, Berkeley (USA), condensed matter, 02/04-02/13
M. Yamanaka, Saitama (Japan), particle theory, 02/04-02/04
S. Hartnoll, Harvard (USA), condensed matter phys, 02/07-02/13
N. Read, Yale (USA), applied math, 02/07-02/13
D. T. Son, Washington (USA), particle theory, 02/07-02/11
S. Kachru, KITP (USA), string theory, 02/07-02/12
S. Minwalla, TIFR (India), string theory, 02/07-02/13
H. Liu, MIT (USA), string theory, 02/07-02/13
E. Kiritsis, Crete (Greece), cosmology, 02/07-02/13
A. Kitaev, Caltech (USA), string theory, 02/07-02/13
A. Yarom, Princeton (USA), condensed matter, 02/07-02/12
C. Keeler, Harvard (USA), cosmology, 02/07-02/13
R. Meyer, Crete (Greece), string theory, 02/07-02/13
D. Hofman, Harvard (USA), string theory, 02/07-02/13
S. Kim, Seoul (Korea), particle theory, 02/07-02/12
P. Nag, TIFR (India), string theory, 02/07-02/13
M. Cheng, Harvard (USA), mathematics, 02/07-02/12

I. Fialkovskiy, St. Petersburg State U (Russia), particle theory, 02/07-02/12
H. C. Kao, Natl. Taiwan Normal U (Taiwan), string theory, 02/07-02/12
F. L. Lin, NTNU (Taiwan), string theory, 02/07-02/12
A. Garcia-Garcia, Lisbon (Portugal), string theory, 02/07-02/12
P. Koroteev, Minnesota (USA), cosmology, 02/07-02/12
D. K. Hong, Pusan (Korea), particle theory, 02/07-02/13
X. G. Wen, MIT (USA), condensed matter, 02/08-02/12
E. Fradkin, Illinois (USA), mathematical phys, 02/08-02/13
S. Fujimoto, Kyoto (Japan), condensed matter, 02/08-02/11
J. Trump, Arizona (USA), astronomy, 02/08-02/09
S. Zhang, Stanford (USA), condensed matter, 02/09-02/10
A. Bamba, JAXA (Japan), astronomy, 02/09-02/09
B. Zwiebach, MIT (USA), string theory, 02/10-02/12
N. Berkovits, São Paulo (Brazil), string theory, 02/10-02/12
T. Ishibe, Hiroshima (Japan), mathematics,02/12-02/14
B. Burton, Queensland (Australia), mathematics, 02/13-02/21
R. Budney, Victoria (Canada), mathematics, 02/13-02/21
T. Okuda, Perimeter Inst (Canada), string theory, 02/14-02/17
T. Kugo, Kyoto (Japan), particle theory, 02/22-03/31
K. Ichiki, Nagoya (Japan), cosmology, 02/22-02/24
D. Wands, Portsmouth (UK), cosmology, 02/23-02/26
E. Lupercio, Cinvestav (Mexico), mathematics, 02/23-02/23
X. F. Wang, Tsinghwa (China), particle theory, 02/25-02/28
C. Kobayashi, Australian Natl U (Australia), astronomy, 02/26-03/06
R. Penner, southern Cal (USA), mathematics, 02/28-03/06
T. Okamoto, Tsukuba (Japan), cosmology, 03/01-03/03
J. Fonseca, Portsmouth (UK), cosmology, 03/02-03/02
B. Carr, QMUL (UK), cosmology, 03/04-03/04
T. Ishibe, Hiroshima (Japan), mathematics, 03/04-03/07
J. Schmidt, DESY (Germany), particle theory, 03/07-05/08
C. Weniger, DESY (Germany), particle theory, 03/07-05/08
R. Suzuki, Cambridge (UK)), string theory, 03/08-03/10
R. Jimenez, Barcelona (Spain), astronomy, 03/08-03/29
L. Verde, Barcelona (Spain), astronomy, 03/08-03/29
B. Venkov, Steklov Inst (Russia), mathematics, 03/08-04/15
S. Petcov, SISSA (Italy), particle theory, 03/10-04/13
N. Kawakatu, NAOJ (Japan), astronomy, 03/11-03/11
N. Scheithauer, Darmstadt Tech (Germany), mathematics, 03/13-03/18
Z. Kunszt, ETH Zurich (Switzerland), particle theory, 03/15-05/15
A. J. Leggett, Illinois (USA), condensed matter theory, 03/15-03/15
J. Stoppa, Cambridge (UK), mathematics, 03/15-03/16
T. Ishibe, Hiroshima (Japan), mathematics, 03/16-03/19
S. Kondo, Nagoya (Japan), mathematics, 03/17-03/19
H. Aoki, Tokyo U of Sci. (Japan), mathematics, 03/17-03/19
D. Sternheimer, Bourgogne (France), mathematics, 03/17-03/17
J. Sekiguchi, Tokyo A&T (Japan), mathematics, 03/18-03/18
C. Beil, Santa Barbara (USA), mathematics, 03/24-06/18
T. O'Donnell, Berkeley (USA), neutrino physics, 03/27-06/25
M. Ratz, Tech U Munich (Germany), particle theory, 03/28-04/02

11. Publications

JFY2007

nu-Process Nucleosynthesis in Population III Core-Collapse Supernovae,
Takashi Yoshida, Hideyuki Umeda, and Ken'ichi Nomoto,
Astrophys. J. 672, 1043 (2008), IPMU07-0009

The r-Process in Supersonic Neutrino-driven Winds: The Role of the Wind Termination Shock,
Kuroda, T., Wanajo, S., and Nomoto, K.,
Astrophys. J. 672, 1068 (2008)

How Much ^{56}Ni Can Be Produced in Core-Collapse Supernovae? Evolution and Explosions of 30–100 $M_\odot$ Stars,
Umeda, H. and Nomoto, K.,
Astrophys. J. 673, 1014 (2008)

Asphericity in Supernova Explosions from Late-Time 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, 1220 (2008), IPMU 08-003

The broad-lined Type Ic supernova 2003jd,
Valenti, S., Benetti, S., Cappellaro, E., Patat, F., Mazzali, P., Turatto, M., Hurley, K., Maeda, K., Gal-Yam, A., Foley, R. J., Filippenko, A. V., Pastorello, A., Challis, P., Frontera, F., Harutyunyan, A., Iye, M., Kawabata, K., Kirshner, R. P., Li, W., Lipkin, Y. M., Matheson, T., Nomoto, K., Ofek, E. O., Ohyama, Y., Pian, E., Poznanski, D., Salvo, M., Sauer, D. N., Schmidt, B. P., Soderberg, A., and Zampieri, L.,
MNRAS 383, 1485 (2008)

Phase diagram of nuclear ``pasta" and its uncertainties in supernova cores,
Hidetaka Sonoda, Gentaro Watanabe, Katsuhiko Sato, Kenji Yasuoka, Toshikazu Ebisuzaki,
Phys. Rev. C 77, 035806 (2008), IPMU07-0006

Towards a Categorical Construction of Lie Algebras,
Kyoji Saito,
Advanced Studies in Pure Mathematics 50, 101 (2008), IPMU09-0015

JFY2008

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,
Astrophys. J. 677, 448 (2008), IPMU07-0018

Moduli stabilization in stringy ISS models,
Yu Nakayama, M. Yamazaki, T. T. Yanagida,
Phys. Lett. B 663, 281 (2008), IPMU 07-0001

A hybrid method for determining SUSY particle masses at the LHC with fully identified cascade decays,
Mihoko M. Nojiri , Giacomo Polesello, Daniel R. Tovey,
JHEP 05, 014 (2008), IPMU07-0008

Probing reheating temperature of the universe with gravitational wave background,
Kazunori Nakayama, Shun Saito, Yudai Suwa, Jun'ichi Yokoyama,
JCAP 06, 020 (2008), IPMU08-0122

Determining the mass of a ultra-light gravitino at LHC,
K. Hamaguchi, S. Shirai, and T.T. Yanagida,
Phys. Lett. B 663, 86 (2008), IPMU07-0015

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, and Ken'ichi Nomoto,
Astrophys. J. 679, 732 (2008), IPMU08-0005

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,
Phys. Rev. D 77, 103009 (2008), IPMU08-0119

Decaying D-branes and Moving Mirrors,
Tomoyoshi Hirata, Shinji Mukohyama and Tadashi Takayanagi,
JHEP 05, 089 (2008), IPMU08-0016

Single-field inflation, anomalous enhancement of superhorizon fluctuations, and non-Gaussianity in primordial black hole formation,
Ryo Saito, Jun'ichi Yokoyama, Ryo Nagata,
JCAP 06, 024 (2008), IPMU08-0123

Young and Massive Binary Progenitors of Type Ia Supernovae and Their Circumstellar Matter,
Izumi Hachisu, Mariko Kato, and Ken'ichi Nomoto,
Astrophys. J. 679, 1390 (2008), IPMU07-0010

Inclusive transverse mass analysis for squark and gluino mass determination,
Mihoko M. Nojiri, Yasuhiro Shimizu, Shogo Okada, Kiyotomo Kawagoe,
JHEP 06, 035 (2008), IPMU08-0006

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, and Paolo A. Mazzali,
Astrophys. J. 680, 580 (2008), IPMU07-0011

Gravitational Waves as a Probe of the Gravitino Mass,
Fuminobu Takahashi, T.T. Yanagida, and Kazuya Yonekura,
Phys. Lett. B 664, 194 (2008), IPMU08-0011

Test of Anomaly Mediation at the LHC,
Shoji Asai, Takeo Moroi, T.T. Yanagida,
Phys. Lett. B 664, 185 (2008), IPMU08-0009

Delayed pulsar kicks from the emission of sterile neutrinos,
Alexander Kusenko, Bhabani Prasad Mandal, Alok Mukherjee,
Phys. Rev. D 77, 123009 (2008), IPMU09-0155

Electromagnetic Properties of the Early Universe,
Keitaro Takahashi, Kiyotomo Ichiki, Naoshi Sugiyama,
Phys. Rev. D 77, 124028 (2008), IPMU07-0016

Upperbound on Squark Masses in Gauge-Mediation Model with Light Gravitino,
Junji Hisano, Minoru Nagai, Shohei Sugiyama, and T. T. Yanagida,
Phys. Lett. B 665, 237 (2008), IPMU08-0021

Extremal C=(2,2) 2D Conformal Field Theories and Constraints of Modularity,
Matthias R. Gaberdiel, Sergei Gukov, Christoph A. Keller, Gregory W. Moore, and Hirosi Ooguri,
Communications in Number Theory and Physics 2, 743 (2008), IPMU08-0031

Metastable Vacua in Perturbed Seiberg-Witten Theories, Part 2: Fayet-Iliopoulos Terms and Kahler Normal Coordinates,
Joseph Marsano, Hirosi Ooguri, Yutaka Ookouchi, Chang-Soon Park,
Nucl. Phys. B 798, 17 (2008), IPMU 07-0003

The Peculiar Type Ib Supernova 2006jc: A WCO Wolf-Rayet Star Explosion,
N. Tominaga, M. Limongi, T. Suzuki, M. Tanaka, K. Nomoto, K. Maeda, A. Chieffi, A. Tornambe, T. Minezaki, Y. Yoshii, I. Sakon, T. Wada, Y. Ohyama, T. Tanabe, H. Kaneda, T. Onaka, T. Nozawa, T. Kozasa, K. S. Kawabata, G. C. Anupama, D.K. Sahu, U.K. Gurugubelli, T.P. Prabhu, and J. Deng,
Astrophys. J. 687, 1208 (2008), IPMU07-0012

Quantum Interference Effects Among Helicities at LEP-II and Tevatron,
Matthew R. Buckley, Beate Heinemann, William Klemm, and Hitoshi Murayama,
Phys. Rev. D 77, 113017 (2008), IPMU08-0017

Discriminating spin through quantum interference,
Matthew R. Buckley, Hitoshi Murayama, William Klemm,Vikram Rentala,
Phys. Rev. D 78, 014028 (2008), IPMU 07-0002

Affleck Dine leptogenesis via multiple flat directions,
Kohei Kamada, Jun'ichi Yokoyama,
Phys. Rev. D 78, 043502 (2008), IPMU08-0120

Solar neutrino measurements in Super-Kamiokande-II,
The Super-Kamiokande Collaboration,
Phys. Rev. D 78, 032002 (2008)

New Aspects of Heterotic-F Theory Duality,
Hirotaka Hayashi, Radu Tatar, Yukinobu Toda, Taizan Watari, and Masahito Yamazaki,
Nucl. Phys. B 806, 224 (2008), IPMU08-0024

Inflation at the GUT scale in a Higgsless universe,
Nemanja Kaloper, Lorenzo Sorbo, Jun'ichi Yokoyama,
Phys. Rev. D 78, 043527 (2008), IPMU08-0121

The Delay Time Distribution of Type Ia Supernovae and the Single Degenerate Model,
Izumi Hachisu, Mariko Kato, and Ken'ichi Nomoto,
Astrophys. J. Lett. 683, L127 (2008), IPMU08-0043

A Measurement of Neutralino Mass at the LHC in Light Gravitino Scenarios,
Koichi Hamaguchi, Eita Nakamura, Satoshi Shirai,
Phys. Lett. B 666, 57 (2008), IPMU08-0029

Early Formation of Dust in the Ejecta of Type Ib SN 2006jc and Temperature and Mass of the Dust,
Takaya Nozawa, Takashi Kozasa, Nozomu Tominaga, Itsuki Sakon, Masaomi Tanaka, Tomoharu Suzuki, Ken'ichi Nomoto, Keiichi Maeda, Hideyuki Umeda, Marco Limongi, Takashi Onaka,
Astrophys. J. 684, 1343 (2008), IPMU08-0004

GALEX Spectroscopy of SN 2005ay suggests a UV spectral uniformity among type II-P supernovae,
A. Gal-Yam, F. Bufano, T. Barlow, E. Baron, S. Benetti, E. Cappellaro, P.J. Challis, R.S. Ellis, A.V. Filippenko, R.J. Foley, D.B. Fox, R.P. Kirshner, D.C. Leonard, W. Li, D. Maoz, T. Matheson, P.A. Mazzali, M. Modjaz, K. Nomoto, E.O. Ofek, J. Simon, T. Small, G.P. Smith, M. Turatto, S.D. Van Dyk, and L. Zampieri,
Astrophys. J. Lett. 685, L117 (2008), IPMU08-0047

Hidden Grassmann Structure in XXZ Model II: Creation Operators,
H. Boos, M. Jimbo, T. Miwa, F. Smirnov, Y. Takeyama,
Commun. Math. Phys. 286, 875 (2009), IPMU08-0001

On the Eccentricity Distribution of Exoplanets from Radial Velocity Surveys,
Yue Shen and Edwin L. Turner,
Astrophys. J. 685, 553 (2008), IPMU09-0073

Non-Gaussianity from Symmetry,
Teruaki Suyama and Fuminobu Takahashi,
JCAP 09, 007 (2008), IPMU08-0015

Isocurvature fluctuations in Affleck-Dine mechanism and constraints on inflation,
Shinta Kasuya, Masahiro Kawasaki and Fuminobu Takahash,
JCAP 10, 017 (2008), IPMU08-0032

Empirical Abundance Scaling Laws and Implications for the Gamma Process in Core-Collapse Supernovae,
Hayakawa, T., Iwamoto, N., Kajino, T., Shizuma, T., Umeda, H., and Nomoto, K.,
Astrophys J. 685, 1089 (2008)

The metamorphosis of Supernova SN2008D/XRF080109: a link between Supernovae and GRBs/Hypernovae,
Paolo A. Mazzali, Stefano Valenti, Massimo Della Valle, Guido Chincarini, Daniel N. Sauer, Stefano Benetti, Elena Pian, Tsvi Piran, Valerio D'Elia, Nancy Elias-Rosa, Raffaella Margutti, Francesco Pasotti, L. Angelo Antonelli, Filomena Bufano, Sergio Campana, Enrico Cappellaro, Stefano Covino, Paolo D'Avanzo, Fabrizio Fiore, Dino Fugazza, Roberto Gilmozzi, Deborah Hunter, Kate Maguire, Elisabetta Maiorano, Paola Marziani, Nicola Masetti, Felix Mirabel, Hripsime Navasardyan, Ken'ichi Nomoto, Eliana Palazzi, Andrea Pastorello, Nino Panagia, Leonardo J. Pellizza, Re'em Sari, Stephen Smartt, Gianpiero Tagliaferri, Masaomi Tanaka, Stefan Taubenberger, Nozomu Tominaga, Carrie Trundle, Massimo Turatto,
Science 321, 1185 (2008), IPMU08-0049

Gauge Mediation with Sequestered Supersymmetry Breaking,
Satoshi Shirai, Fuminobu Takahashi, T. T. Yanagida and Kazuya Yonekura,
Phys. Rev. D 78, 075003 (2008), IPMU08-0053

Simulations of Baryon Accoustic Osccilations I: Growth of Large-Scale Density Fluctuations,
Ryuichi Takahashi, Naoki Yoshida, et al.
MNRAS 389, 1675 (2008)

The ground states of baryoleptonic Q-balls in supersymmetric models,
Ian M. Shoemaker, Alexander Kusenko,
Phys. Rev. D 78, 075014 (2008), IPMU09-0152

Growth functions associated with Artin monoids of finite type,
Kyoji Saito,
Proc. Japan Acad. Ser. A, 84, 179-183 (2008), IPMU08-0037

Handling jets + missing E(T) channel using inclusive m(T2),
Mihoko M. Nojiri, Kazuki Sakurai, Yasuhiro Shimizu, Michihisa Takeuchi,
JHEP 0810, 100 (2008), IPMU-08-0051

Study of the top reconstruction in top-partner events at the LHC,
Mihoko M. Nojiri, Michihisa Takeuchi,
JHEP 0810, 025 (2008), IPMU08-0010

Non-Gaussianity from isocurvature perturbations,
Masahiro Kawasaki, Kazunori Nakayama, Toyokazu Sekiguchi, Teruaki Suyama, Fuminobu Takahashi,
JCAP 11, 019 (2008), IPMU08-0050

Injection of Short-Lived Radionuclides into the Early Solar System from a Faint Supernova with Mixing Fallback,
Takigawa, A., Miki, J., Tachibana, S., Huss, G. R., Tominaga, N., Umeda, H., and Nomoto, K.,
Astrophys. J. 685, 1382 (2008)

Tycho Brahe's 1572 Supernova as a standard type Ia explosion revealed from its light echo spectrum,
Oliver Krause, Masaomi Tanaka, Tomonori Usuda, Takashi Hattori, Miwa Goto, Stephan Birkmann, Ken'ichi Nomoto,
Nature 456, 617 (2008), IPMU08-0108

Reconstruction of the primordial fluctuation spectrum from the five-year WMAP data by the cosmic inversion method with band-power decorrelation analysis,
Ryo Nagata, Jun'ichi Yokoyama,
Phys. Rev. D 78, 123002 (2008), IPMU08-0124

Optical Spectropolarimetry and Asphericity of Type Ic SN 2007gr,
Masaomi Tanaka, Koji S. Kawabata, Keiichi Maeda, Takashi Hattori, and Ken'ichi Nomoto,
Astrophys. J. 689, 1191 (2008), IPMU08-0045

Constraints on the time variation of the fine structure constant by the 5-year WMAP data,
Masahiro Nakashima, Ryo Nagata, Jun'ichi Yokoyama,
Prog. Theor. Phys. 120, 1207 (2008), IPMU08-0125

Holographic Baryons: Static Properties and Form Factors from Gauge/String Duality,
Koji Hashimoto, Tadakatsu Sasaki, and Shigeki Sugimoto,
Prog. Theo. Phys. 120, 1093 (2008), IPMU08-0027

Disordered Systems and Replica Method in AdS/CFT,
Mitsutoshi Fujita, Yasuaki Hikida, Shinsei Ryu and Tadashi Takayanagi,
JHEP 12, 065 (2008), IPMU08-0080

Optical photometry and spectroscopy of the type Ibn supernova SN2006jc until the onset of dust formation,
G. C. Anupama, D. K. Sahu, U. K. Gurugubelli, T. P. Prabhu, N. Tominaga, M. Tanaka, K. Nomoto,
MNRAS 392, 894 (2009), IPMU08-0111

Aspherical Properties of Hydrodynamics and Nucleosynthesis in Jet-induced Supernovae,
Nozomu Tominaga,
Astrophys. J. 690, 526 (2009), IPMU07-0014

Subaru and Keck Observations of the Peculiar Type Ia Supernova 2006gz at Late Phases,
Keiichi Maeda, Koji Kawabata, Weidong Li, Masaomi Tanaka, Paolo A. Mazzali, Takashi Hattori, Ken'ichi Nomoto, Alex V. Filippenko,
Astrophys. J. 690, 1745-1752 (2009), IPMU08-0073

Implications to Sources of Ultra-high-energy Cosmic Rays from their Arrival Distribution,
Hajime Takami and Katsuhiko Sato,
Astroparticle Physics 30, 306 (2009), IPMU08-0101

A note on Markov type constants,
Shin-ichi Ohta and Mikael Pichot,
Arch. Math. 92, No. 1, 80-88 (2009), IPMU08-0079

Impact of Rotation on Neutrino Emission and Relic Neutrino Background from Population III Stars,
Yudai Suwa, Tomoya Takiwaki, Kei Kotake, and Katsuhiko Sato,
Astrophys. J. 690, 913 (2009), IPMU08-0099

Neutrino mixing and mass hierarchy in Gaussian landscapes,
Lawrence J. Hall, Michael P. Salem and Taizan Watari,
Phys. Rev. D 79, 025010 (2009), IPMU08-0076

Constraints on Neutrino Masses from Weak Lensing,
Kiyotomo Ichiki, Masahiro Takada, Tomo Takahashi,
Phys. Rev. D 79, 023520 (2009), IPMU08-0083

Consistent Anti-de Sitter-Space/Conformal-Field-Theory Dual for a Time-Dependent Finite Temperature System,
Shunichiro Kinoshita, Shinji Mukohyama, Shin Nakamura, Kin-ya Oda,
Phys. Rev. Lett. 102, 031601 (2009), IPMU08-0055

Nonlinear superhorizon perturbations of non-canonical scalar field,
Yu-ichi Takamizu and Shinji Mukohyama,
JCAP 0901, 013 (2009), IPMU08-0056

Cosmological Moduli Problem from Thermal Effects,
Kazunori Nakayama, Fuminobu Takahashi,
Phys. Lett. B 670, 434 (2009), IPMU08-0085

Gamma rays and positrons from a decaying hidden gauge boson,
Chuan-Ren Chen, Fuminobu Takahashi, T. T. Yanagida,
Phys. Lett. B 671, 71 (2009), IPMU08-0058

Thermal Evolution of Hyperon-Mixed Neutron Stars,
Tsuruta, S., Sadino, J., Kobelski, A., Teter, M. A., Liebmann, A. C., Takatsuka, T., Nomoto, K., and Umeda, H.,
Astrophys J. 691, 621 (2009)

GeV Majorana Neutrinos in Top Decay at the LHC,
Zongguo Si and Kai Wang,
Phys. Rev. D 79, 014034 (2009), IPMU08-0068

Implications to Ultra-high energy cosmic rays for Transient Sources in the Auger Era,
Kohta Murase, Hajime Takami,
Astrophys J. Lett. 690, L14 (2009)

Cosmogenic neutrinos as a probe of the transition from Galactic to extragalactic cosmic rays,
Hajime Takami, Kohta Murase, Shigehiro Nagataki, Katsuhiko Sato,
Astropart. Phys. 31, 201 (2009)

Non-Gaussianity from Baryon Asymmetry,
Masahiro Kawasaki, Kazunori Nakayama, Fuminobu Takahashi,
JCAP 01, 002 (2009), IPMU08-0061

Hilltop Non-Gaussianity,
Masahiro Kawasaki, Kazunori Nakayama, Fuminobu Takahashi,
JCAP 01, 026 (2009), IPMU08-0072

A General Analysis of Non-Gaussianity from Isocurvature Perturbations,
Masahiro Kawasaki, Kazunori Nakayama, Toyokazu Sekiguchi, Teruaki Suyama, Fuminobu Takahashi,
JCAP 01, 042 (2009), IPMU08-0069

Apparent shape of super-spinning black holes,
Cosimo Bambi and Katherine Freese,
Phys. Rev. D 79, 043002 (2009), IPMU08-0095

Properties of newly formed dust by SN2006jc based on near-to-mid infrared observation with AKARI,
I. Sakon, T. Wada, Y. Ohyama, D. Ishihara, T. Tanabe, H. Kaneda, T. Onaka, N. Tominaga, M. Tanaka, T. Suzuki, H. Umeda, K. Nomoto, T. Nozawa, T. Kozasa, T. Minezaki, Y. Yoshii, S. Ohyabu, F. Usui, H. Matsuhara, T. Nakagawa, and H. Murakami,
Astrophys. J. 692, 546-555 (2009), IPMU07-0013

Current Correlators for General Gauge Mediation,
Hirosi Ooguri, Yutaka Ookouchi, Chang-Soon Park, and Jaewon Park,
Nucl. Phys. B 808, 121-136 (2009), IPMU08-0038

Solving Cosmological Problems of Supersymmetric Axion Models in Inflationary Universe,
Masahiro Kawasaki, Kazunori Nakayama,
Phys. Rev. D 77, 123524 (2008), IPMU08-0025

Type Ib Supernova 2008D associated with the Luminous X-ray Transient 080109: An Energetic Explosion of a Massive Helium Star,
Masaomi Tanaka, Nozomu Tominaga, Ken'ichi Nomoto, S. Valenti, D.K. Sahu, T. Minezaki, Y. Yoshii, M. Yoshida, G.C. Anupama, S. Benetti, G. Chincarini, M. Della Valle, P.A. Mazzali, E. Pian,
Astrophys. J. 692, 1131 (2009), IPMU08-0048

Cosmic rays from Leptonic Dark Matter,
Chuan-Ren Chen, Fuminobu Takahashi,
JCAP 02, 004 (2009), IPMU08-0071

Gravity with Perturbative Constraints: Dark Energy Without New Degrees of Freedom,
Alan Cooney, Simon DeDeo, Dimitrios Psaltis,
Phys. Rev. D 79, 044033 (2009), IPMU08-0098

A Holographic Dual of Bjorken Flow,
Shunichiro Kinoshita, Shinji Mukohyama, Shin Nakamura, Kin-ya Oda,
Prog. Theo. Phys. 121, 121-164 (2009), IPMU08-0039

Observational Characteristics and Possible Asphericity of Over-Luminous Type Ia Supernovae,
Keiichi Maeda and Koichi Iwamoto,
MNRAS 394, 239 (2009), IPMU08-0090

High-energy Cosmic-Ray Positrons from Hidden-Gauge-Boson Dark Matter,
Chuan-Ren Chen, Fuminobu Takahashi and T. T. Yanagida,
Phys. Lett. B 673, 255 (2009), IPMU08-0086

Color Sextet Scalars at the CERN Large Hadron Collider,
Chuan-ren Chen, William L. Klemm, Vikram Rentala, Kai Wang,
Phys. Rev. D 79, 054002 (2009), IPMU08-0084

Triplet Scalars and Dark Matter at the LHC,
Pavel Fileviez Perez, Hiren Patel, Michael Ramsey-Musolf, Kai Wang,
Phys. Rev. D 79, 055024 (2009), IPMU08-0091

GUT Relations from String Theory Compactifications,
Radu Tatar and Taizan Watari,
Nucl. Phys. B 810, 316 (2009), IPMU08-0035

The Interplay Between the "Low" and "High" Energy CP-Violation in Leptogenesis,
E. Molinaro, S. T. Petcov
Eur. Phys. J. C61, 93-109 (2009), IPMU08-0013

JFY2009

Spectral Energy Distribution of Radio Sources in Nearby Clusters of Galaxies: Implications for Sunyaev-Zel'dovich Effect Surveys,
Y.-T. Lin, R.B. Partridge, J. Pober, K. El Bouchefry, S. Burke, J. Klein, J. Coish, K. Huffenberger,
Astrophys. J. 694, 992 (2009), IPMU10-0030

Conformal Inflation, Modulated Reheating and WMAP5,
Takeshi Kobayashi and Shinji Mukohyama,
Phys. Rev. D 79, 083501 (2009), IPMU08-0060

The 21cm Signature of Early Relic HII Regions,
Midori Tokutani, Naoki Yoshida, S. Peng Oh, Naoshi Sugiyama,
MNRAS 395, 777 (2009)

Search for Proton Decay via $p \to e^+\pi^0$ and $p \to \mu^+\pi^0$ in a Large Water Cherenkov Detector,
The Super-Kamiokande Collaboration,
Phys Rev. Lett. 102, 141801 (2009)

No Evidence for Variability of Intervening Absorption Lines toward GRB 060206: Implications for the Mg II Incidence Problem,
Kentaro Aoki, Tomonori Totani, Takashi Hattori, Kouji Ohta, Koji S. Kawabata, Naoto Kobayashi, Masanori Iye, Ken'ichi Nomoto, and Nobuyuki Kawai,
Publ. Astron. Soc. Japan 61, 387 (2009), IPMU08-0066

Emergent Calabi-Yau Geometry,
Hirosi Ooguri and Masahito Yamazaki,
Phys. Rev. Lett. 102, 161601 (2009), IPMU09-0025

Nucleosynthesis of 56Ni in wind-driven Supernova Explosions and Constraints on the Central Engine of Gamma-Ray Bursts,
Keiichi Maeda and Nozomu Tominaga,
MNRAS 394, 1317 (2009), IPMU09-0001

A Possible Solution to the Strong CP Problem,
Fuminobu Takahashi,
Prog. Theo. Phys. 121, 711 (2009), IPMU08-0022

Tensors, non-Gaussianities, and the future of potential reconstruction,
Brian A. Powell, Konstantinos Tzirakis, William H. Kinney,
JCAP 04, 019 (2009), IPMU08-0114

Nucleosynthesis in Electron Capture Supernovae of Asymptotic Giant Branch Stars,
Wanajo, S., Nomoto, K., Janka, H.-T., Kitaura, F. S., and Müller, B.,
Astrophys. J. 695, 208 (2009)

First Study of Neutron Tagging with a Water Cherenkov Detector,
The Super-Kamiokande Collaboration,
Astropart. Phys. 31, 320-328 (2009)

Search for Neutrinos from GRB 08031B at Super-Kamiokande,
The Super-Kamiokande Collaboration
Astrophys. J. 697, 730-734 (2009)

The Impact of Non-Gaussian Errors on Weak lensing Surveys,
Masahiro Takada, Bhuvnesh Jain,
MNRAS 395, 2065-2086 (2009), IPMU08-0070

The Extremely Luminous Supernova 2006gy at Late Phase: Detection of Optical Emission from Supernova,
Kawabata, K., Tanaka, M., Maeda, K., Hattori, T., Nomoto, K., Tominaga, N., Yamanaka, M.,
Astrophys. J. 697, 676-683 (2009), IPMU09-0039

Formation of the First Stars and Galaxies,
Volker Bromm, Naoki Yoshida, Christopher McKee, Lars Hernquist,
Nature, 459, 49 (2009)

Coset construction for Duals of Non-relativistic CFTs,
Sakura Schafer-Nameki, Masahito Yamazaki, Kentaroh Yoshida,
JHEP 05, 038 (2009), IPMU09-0036

Decaying Hidden Gaugino as a Source of PAMELA/ATIC Anomalies,
Satoshi Shirai, Fuminobu Takahashi, T.T.Yanagida,
Phys. Lett. B 675, 73 (2009), IPMU09-0027

Dark Matter Model Selection and the ATIC/PPB-BETS anomaly,
Chuan-Ren Chen, Koichi Hamaguchi, Mihoko Nojiri, Fuminobu Takahashi, Shoji Torii,
JCAP 0905, 015 (2009), IPMU08-0113

The broad line type Ic supernova SN 2007ru: Adding to the diversity of type Ic supernovae,
D.K. Sahu, Masaomi Tanaka, G.C. Anupama, Uday K. Gurugubelli, and Ken'ichi Nomoto,
Astrophys. J. 697, 676 (2009), IPMU08-0044

Split universal extra dimension and dark matter,
Seong Chan Park and Jing Shu,
Phys. Rev. D 79, 091702(R) (2009), IPMU09-0003

Quasar Clustering from SDSS DR5: Dependences on Physical Properties,
Y. Shen, M.A. Strauss, N.P. Ross, P.B. Hall, Y.-T. Lin, G.T. Richards, D.P. Schneider, D.H. Weinberg, A.J. Connolly, X. Fan, J.F. Hennawi, F. Shankar, D.E. Vanden Berk, N.A. Bahcall, R.J. Brunner,
Astrophys. J. 697, 1656 (2009), IPMU10-0031

Decaying gravitino dark matter and an upper bound on the gluino mass,
Koichi Hamaguchi, Fuminobu Takahashi, Tsutomu Yanagida,
Phys. Lett. B677, 59-61 (2009), IPMU09-0005

Modeling Nonlinear Evolution of Baryon Acoustic Oscillations,
Takahiro Nishimichi, Akihito Shirata, Atsushi Taruya, Shun Saitoh, Kazuhiro Yahata, Yasushi Suto, Ryuichi Takahashi, Naoki Yoshida, Takahiko Matsubara, Naoshi Sugiyama, Issha Kayo, Yi-Peng Jing, Kohji Yoshikawa,
Publication of Astronomical Society of Japan 61, 32 (2009)

Toward First-Principle Simulations of Galaxy Formation II,
Takayuki Saitoh, Hiroshi Daisaka, Eiichiro Kokubo, Jun Makino, Takashi Okamoto, Kohji Tomisaka, Keiichi Wada, Naoki Yoshida,
Publication of Astronomical Society of Japan, 61, 481 (2009)

Configuration of the central streams in the moduli of abelian varieties,
Shushi Harashita,
Asian J. Math. 13, 215 (2009), IPMU08-0104

Runaway Dynamics and Supersymmetry Breaking,
Izawa K.-I., Fuminobu Takahashi, T.T.Yanagida, Kazuya Yonekura,
Phys. Lett. B 677, 195 (2009), IPMU09-0020

Kinematic reconstruction of atmospheric neutrino events in a large water Cherenkov detector with proton identification
The Super-Kamiokande Collaboration,
Phys. Rev. D 79, 112010 (2009)

Nebular emission-line profiles of Type Ib/c Supernovae - probing the ejecta asphericity,
S. Taubenberger, S. Valenti, S. Benetti, E. Cappellaro, M. Della Valle, N. Elisa-Rosa, S. Hachinger, W. Hillebrandt, K. Maeda, P.A. Mazzali, A. Pastorello, F. Patat, S.A. Sim, and M. Turatto,
MNRAS 397, 677 (2009), IPMU09-0051

Scale-invariant cosmological perturbations from Horava-Lifshitz gravity without inflation,
Shinji Mukohyama,
JCAP 0906, 001 (2009), IPMU09-0041

Thermodynamic and dynamical stability of Freund-Rubin compactification,
Shunichiro Kinoshita and Shinji Mukohyama,
JCAP 0906, 020 (2009), IPMU09-0031

Discriminating Electroweak-ino Parameter Ordering at the LHC and Its Impact on LFV Studies,
Junji Hisano, Mihoko M. Nojiri, Warintorn Sreethawong,
JHEP 0906, 044 (2009)

Fractional Quantum Hall Effect via Holography: Chern-Simons, Edge States, and Hierarchy,
Mitsutoshi Fujita, Wei Li, Shinsei Ryu, Tadashi Takayanagi,
JHEP 06, 066 (2009), IPMU09-0002

Neutrino-induced reactions on Fe56 and Ni56, and production of Mn55 in population III stars,
Suzuki, T., Honma, M., Higashiyama, K., Yoshida, T., Kajino, T., Otsuka, T., Umeda, H., and Nomoto, K.,
Phys. Rev. C 79, 061603 (2009)

Neutrinoless Double Beta Decay and Br($H^{\pm\pm} \to l^{\pm}l^{\pm}$) Decays in the Higgs Triplet Model,
S.T. Petcov, H. Sugiyama and Y. Takanishi,
Phys. Rev. D 80, 015005 (2009), IPMU09-0037

Gravitational waves from the fragmentation of a supersymmetric condensate,
Alexander Kusenko, Anupam Mazumdar, Tuomas Multamaki,
Phys. Rev. D 79, 124034 (2009), IPMU09-0151

Cross-correlation between UHECR Arrival Distribution and Large-scale Structure,
Hajime Takami, Takahiro Nishimichi, Kazuhiko Yahata, Katsuhiko Sato,
JCAP 06, 031 (2009), IPMU08-0102

The Onset of Star Formation in Primordial Halos,
Umberto Maio, Benedetta Ciardi, Naoki Yoshida, Klaus Dolag, Luca Tornatore,
Astronomy and Astrophysics, 503, 25 (2009)

Spectropolarimetry of the Unique Type Ib Supernova 2005bf: Larger Asymmetry Revealed by Later-Phase Data,
Tanaka, M., Kawabata, K.S., Maeda, K., Iye, M., Hattori, T., Pian, E., Nomoto, K., Mazzali, P.A., Tominaga, N.,
Astrophys. J. 699, 1119-1124 (2009), IPMU09-0077

Axion braneworld cosmology,
Cosimo Bambi, Masahiro Kawasaki, Federico R. Urban,
Phys. Rev. D 80, 023533 (2009), IPMU09-0033

Neutrinos from the terrestrial passage of supersymmetric dark matter Q-balls,
Alexander Kusenko, Ian M. Shoemaker,
Phys. Rev. D 80, 027701 (2009), IPMU09-0149

New Limits on Sterile Neutrinos from Suzaku Observations of the Ursa Minor Dwarf Spheroidal Galaxy,
Michael Loewenstein, Alexander Kusenko, Peter L. Biermann,
Astrophys. J. 700, 426 (2009), IPMU09-0035

On the Spin-Orbit Misalignment of the XO-3 Exoplanetary System,
Joshua N. Winn, John Asher Johnson, Daniel Fabrycky, Andrew W. Howard, Geoffrey W. Marcy, Norio Narita, Ian J. Crossfield, Yasushi Suto, Edwin L. Turner, Gil Esquerdo and Matthew J. Holman,
Astrophys. J. 700, 302-308 (2009), IPMU09-0074

Hidden Grassmann Structure in XXZ Model III: Introducing Matsubara direction,
M. Jimbo, T. Miwa, F. Smirnov,
J. Phys. A42, 304018 (2009), IPMU08-0116

Cosmological Constraints on a Massive Neutrino,
Masahiro Kawasaki, Katsuhiko Sato,
Prog. Theo. Phys. 122, 205 (2009), IPMU09-0109

Simulations of Baryon Acoustic Oscillations II,
Ryuichi Takahashi, Naoki Yoshida, Masahiro Takada, Takahiko Matsubara, Naoshi Sugiyama, Issha Kayo, Takahiro Nishimichi, Akihito Shirata, Atsushi Taruya, Shun Saitoh,
Astrophys. J. 700, 479 (2009)

Curvatons in Warped Throats,
Takeshi Kobayashi and Shinji Mukohyama,
JCAP 07 (2009) 032, IPMU09-0064

Relating Field Theories via Stochastic Quantization,
Robbert Dijkgraaf, Domenico Orlando, Susanne Reffert,
Nucl. Phys. B 824, 365 (2010), IPMU09-0030

Nebular Phase Observations of the Type Ib Supernova 2008D/X-ray Transient 080109: Side-Viewed Bipolar Explosion,
Tanaka, M., Yamanaka, M., Maeda, K., Kawabata, K.S., Hattori, T., Minezaki, T., Valenti, S., Della Valle, M., Sahu, D.K., Anupama, G.C., Tominaga, N., Nomoto, K., Mazzali, P.A., Pian, E.,
Astrophys. J. 700, 1680 (2009), IPMU09-0078

Phenomenological Aspects of Horava-Lifshitz Cosmology,
Shinji Mukohyama, Kazunori Nakayama, Fuminobu Takahashi, Shuichiro Yokoyama,
Phys. Lett. B679:6-9, 2009, IPMU09-0052

On the Renormalizability of Horava-Lifshitz-type Gravity,
Domenico Orlando and Susanne Reffert,
Class. Quant. Grav. 26, 155021 (2009), IPMU09-0053

Nuclear Force from String Theory,
Koji Hashimoto, Tadakatsu Sakai, Shigeki Sugimoto,
Prog. Theo. Phys. 122, 427 (2009), IPMU09-0010

Simulations of Wide-Field Weak Lensing Surveys I,
Masanori Sato, Takashi Hamana, Ryuichi Takahashi, Masahiro Takada, Naoki Yoshida, Takahiko Matsubara, Naoshi Sugiyama,
Astrophys. J. 701, 945 (2009)

Subaru High-Resolution Spectroscopy of Star G in the Tycho Supernova Remnant,
Kerzendorf, W. E., Schmidt, B. P., Asplund, M., Nomoto, K., Podsiadlowski, P., Frebel, A., Fesen, R. A., and Yong, D.,
Astrophys. J. 701, 1665 (2009)

Early Blackhole Formation by Accretion of Gas and Dark Matter,
Hideyuki Umeda, Naoki Yoshida, Ken'ichi Nomoto, Mei Sasaki, Sachiko Tsuruta,
JCAP 08, 024 (2009)

Decaying Hidden Gauge Boson and the PAMELA and ATIC/PPB-BETS Anomalies,
Chua-Ren Chen, Mihoko M. Nojiri, Fuminobu Takahashi, T.T. Yanagida,
Prog. Theor. Phys. 122, 553-559 (2009), IPMU08-0092

The R-axion and non-Gaussianity,
Kazunori Nakayama, Fuminobu Takahashi,
Phys. Lett. B 679, 436 (2009), IPMU09-0082

Dark matter as integration constant in Horava-Lifshitz gravity,
Shinji Mukohyama,
Phys. Rev. D 80, 064005 (2009), IPMU09-0066

Large U_{e3} and Tri-bimaximal Mixing,
Srubabati Goswami, Serguey Petcov, Shamayita Ray, Werner Rodejohann,
Phys. Rev. D 80, 053013 (2009)

Successive extensions of minimal p-divisible groups,
Shushi Harashita,
Journal of Pure and Applied Algebra 213, 1823-1834 (2009), IPMU08-0105

Non-Gaussianity from Isocurvature Perturbations: Analysis of Trispectrum,
Etsuko Kawakami, Masahiro Kawasaki, Kazunori Nakayama, Fuminobu Takahashi,
JCAP 0909, 002 (2009), IPMU09-0059

Caustic avoidance in Horava-Lifshitz gravity,
Shinji Mukohyama,
JCAP 0909, 005 (2009), IPMU09-0081

Non-thermal Gravitino Dark Matter in Gauge Mediation,
Koichi Hamaguchi, Fuminobu Takahashi, Ryuichiro Kitano,
JHEP 09, 127 (2009), IPMU09-0088

Search for Astrophysical Neutrino Point Sources at Super-Kamiokande,
The Super-Kamiokande Collaboration,
Astrophys. J. 704, 503-512 (2009)

Cosmological Constraints on Rapid Roll Inflation,
Takeshi Kobayashi, Shinji Mukohyama, Brian A. Powell,
JCAP 09, 023 (2009), IPMU09-0050

Circumventing the eta problem,
Damien Easson and Ruth Gregory,
Phys. Rev. D 80, 083518 (2009), IPMU09-0009

SN 2003bg: A Broad-Lined Type IIb Supernova with Hydrogen,
Mazzali, P. A., Deng, J., Hamuy, M., and Nomoto, K.,
Astrophys. J. 703, 1624 (2009)

R-violating Decay of Wino Dark Matter and electron/positron Excesses in the PAMELA/Fermi Experiments,
Satoshi Shirai, Fuminobu Takahashi, T. T. Yanagida,
Phys. Lett. B 680, 485 (2009), IPMU09-0054

Conformal Supersymmetry Breaking in Vector-like Gauge Theories,
Izawa K.-I., Fuminobu Takahashi, T. T. Yanagida, and Kazuya Yonekura,
Phys. Rev. D 80, 085017 (2009), IPMU09-0057

Nonlinear galaxy power spectrum for a mixed dark matter model: perturbation theory approach and parameter forecasts,
Shun Saito, Masahiro Takada, Atsushi Taruya,
Phys. Rev. D 80, 083528 (2009), IPMU09-0084

Half-BPS quotients in M-theory: ADE with a twist,
Paul de Medeiros, Jose Figueroa-O'Farrill, Sunil Gadhia, Elena Mendez-Escobar,
JHEP 10, 038 (2009), IPMU09-0108

Crystal Melting and Toric Calabi-Yau Manifolds,
Hirosi Ooguri and Masahito Yamazaki,
Commun. Math. Phys. 292, 179-199 (2009), IPMU08-0087

Implications of primordial black holes on the first stars and the origin of the super-massive black holes,
Cosimo Bambi, Douglass Spolyar, Alexander D. Dolgov, Katherine Preese, Marta Volonteri,
MNRAS 399, 1347 (2009), IPMU08-0096

Like-sign Di-lepton Signals in Higgsless Models at the LHC,
Tao Han, Haishan Liu, Mingxing Luo, Kai Wang, Wei Wu,
Phys. Rev. D 80, 095010 (2009), IPMU09-0072

Accretion process onto super-spinning objects,
Cosimo Bambi, Katherine Freese, Tomohiro Harada, Rohta Takahashi, Naoki Yoshida,
Phys. Rev. D 80, 104023 (2009), IPMU09-0113

Photometric Variability in Earthshine Observations,
Sally V. Langford, J. Stuart, B. Wyithe and Edwin L. Turner,
Astrobiology 9(3), 305 (2009), IPMU09-0076

Growth functions for Artin monoids,
Kyoji Saito,
Proc. Jpn. Acad. Ser.A 85, Ser. A, No.7,84-88 (2009), IPMU09-0034

Simplicity in the Faulkner construction,
Jose Figueroa-O'Farrill,
J. Phys A 42, 445206 (2009), IPMU09-0069

AKARI Infrared Observations of the Supernova Remnant G292.0+1.8: Unveiling Circumstellar Medium and Supernova Ejetca,
Ho-Gyu Lee, Bon-Chul Koo, Dae-Sik Moon, Itsuki Sakon, Takashi Onaka, Woong-Seob Jeong, Hidehiro Kaneda, Takaya Nozawa, Takashi Kozasa,
Astrophys. J. 706, 441 (2009), IPMU09-0122

Properties of Type II Plateau Supernova SNLS-04D2dc: Multicolor Light Curves of Shock Breakout and Plateau,
N. Tominaga, S. Blinnikov, P. Baklanov, K. Nomoto,
Astrophys. J. Lett. 705, 10 (2009), IPMU09-0115

Cosmic-ray Electron and Positron Excesses from Hidden Gaugino Dark Matter,
Satoshi Shirai, Fuminobu Takahashi, T. T. Yanagida,
Prog. Theo. Phys. 122, 1277-1284 (2009), IPMU09-0065

Right-handed neutrinos in F-theory compactifications,
Radu Tatar, Yoichi Tsuchiya and Taizan Watari,
Nucl. Phys. B 823, 1 (2009), IPMU09-0047

Codimension-3 Singularities and Yukawa Couplings in F-theory,
Hirotaka Hayashi, Teruhiko Kawano, Radu Tatar and Taizan Watari,
Nucl. Phys. B 823, 47 (2009), IPMU09-0014

Early Phase Observations of Extremely Luminous Type Ia Supernova 2009dc,
Yamanaka, M., Kawabata, K. S., Kinugasa, K., Tanaka, M., Imada, A., Maeda, K., Nomoto, K., Arai, A., Chiyonobu, S., Fukazawa, Y., Hashimoto, O., Honda, S., Ikejiri, Y., Itoh, R., Kamata, Y., Kawai, N., Komatsu, T., Konishi, K., Kuroda, D., Miyamoto, H., Miyazaki, S., Nagae, O., Nakaya, H., Ohsugi, T., Omodaka, T., Sakai, N., Sasada, M., Suzuki, M., Taguchi, H., Takahashi, H., Tanaka, H., Uemura, M., Yamashita, T., Yanagisawa, K., and Yoshida, M.,
Astrophys. J. Lett. 707, 118 (2009)

O(N) and USp(N) QCD from String Theory,
Toshiya Imoto, Tadakatsu Sakai, Shigeki Sugimoto,
Prog. Theo. Phys. 122, 1433 (2009), IPMU09-0085

Bar complex, configuration spaces and finite type invariants for braids,
Toshitake Kohno,
Topology and its Appliations 157, 2 (2010), IPMU08-0030

Heavy sterile neutrinos and supernova explosions,
George M. Fuller, Alexander Kusenko, Kalliopi Petraki,
Phys. Lett. B 670, 281 (2009), IPMU09-0154

Nebular Spectra and Explosion Asymmetry of Type Ia Supernovae,
Keiichi Maeda, Stefan Taubenberger, Jesper Sollerman, Paolo A. Mazzali, Giorgos Leloudas, Ken'ichi Nomoto, Kentaro Motohara,
Astrophys. J. 708, 1703 (2010), IPMU09-0093

On the Perturbative Expansion around a Lifshitz Point,
Domenico Orlando and Susanne Reffert,
Phys. Lett. B 683, 61 \& 8211, 68 (2010), IPMU09-0105

Sterile neutrinos: the dark side of the light fermions,
Alexander Kusenko,
Phys. Rept. 481, 1 (2009), IPMU09-0148

Dark matter and collider phenomenology of split-UED,
Chuan-Ren Chen, Mihoko M. Nojiri, Seong Chan Park, Jing Shu, Michihisa Takeuchi,
JHEP 09, 078 (2009), IPMU08-0023

Gravitino dark matter from Q-ball decays,
Ian M. Shoemaker, Alexander Kusenko,
Phys. Rev. D 80, 075021 (2009), IPMU09-0147

Novel reconstruction technique for New Physics processes with initial state radiation,
Johan Alwall, Kenji Hiramatsu, Mihoko M. Nojiri, Yasuhiro Shimizu,
Phys. Rev. Lett. 103, 151802 (2009)

Will the Large Synoptic Survey Telescope Detect Extra-Solar Planetesimals Entering the Solar System?,
Moro-Martin, A., Turner, E. L. and Loeb, A.,
Astrophy. J. 704, 733 (2009)

Improved Measurement of the Rossiter-McLaughlin Effect in the Exoplanetary System HD 17156,
Narita, N., Hirano, T., Sato, B., Winn, J. N., Suto, Y., Turner, E. L., Aoki, W., Tamura, M. and Yamada, T.,
Publ. Astron. Soc. Japan 61, 991 (2009)

LHC signature of supersymmetric models with non-universal sfermion masses,
Sung-Gi Kim, Nobuhiro Maekawa, Keiko I. Nagao, Mihoko M. Nojiri, Kazuki Sakurai,
JHEP 10, 005 (2009)

The real topological vertex at work,
Daniel Krefl, Sara Pasquetti and Johannes Walcher,
Nucl. Phys. B 833, 153-198 (2010),

Gravitational waves from fragmentation of a primordial scalar condensate into Q-balls,
Alexander Kusenko, Anupam Mazumdar,
Phys. Rev. Lett. 101, 211301 (2008), IPMU09-0153

The initial shear field in models with primordial local non-Gaussianity and implications for halo and void abundance,
Tsz Yan Lam, Ravi K. Sheth, Vincent Desjacques,
MNRAS 399, 1482 (2009), IPMU10-0003

Majorana Phases and Leptogenesis in See-Saw Models with A_4 Symmetry,
C. Hagedorn, E. Molinaro, S.T. Petcov,
JHEP 0909, 115 (2009), IPMU09-0095

Evolution of Very Massive Population III Stars with Mass Accretion,
Takuya Ohkubo, Ken'ichi Nomoto, Hideyuki Umeda, Naoki Yoshida, Sachiko Tsuruta,
Astrophy. J. 706, 1184 (2009)

The Role of Type Ia Supernovae in Chemical Evolution I: Lifetime of Type Ia Supernovae and Metallicity Effect,
Chiaki Kobayashi, Ken'ichi Nomoto,
Astrophys. J. 707, 1466-1484 (2009), IPMU10-0005

A new interpretation of the gamma-ray observations of active galactic nuclei,
Warren Essey, Alexander Kusenko,
Astropart. Phys. 33, 81-85 (2010), IPMU09-0150

A Case of Subdominant/Suppressed "High Energy" Contribution,
E. Molinaro, S.T. Petcov,
Phys. Lett. B671, 60-65 (2009), IPMU08-0057

Observational Signatures of Gravitational Couplings in DBI Inflation,
Damien A. Easson, Shinji Mukohyama, Brian A. Powell,
Phys. Rev. D81, 023512 (2010), IPMU09-0114

Gamma-ray Constraints on Hadronic and Leptonic Activities of Decaying Dark Matter,
Chuan-ren Chen, Sourav K. Mandal, Fuminobu Takahashi,
JCAP 01, 023 (2010), IPMU09-0126

Tests of gravity from imaging and spectroscopic surveys,
Jacek Guzik, Bhuvnesh Jain, Masahiro Takada,
Phys. Rev. D 81, 023503 (2010), IPMU10-0015

Axigluon as Possible Explanation for ttbar Forward Backward Asymmetry at Tevatron,
Paul Frampton, Jing Shu and Kai Wang,
Phys. Lett. B 683, 294-297 (2010), IPMU09-0135

Supercomputer simulations of structure formation in the Universe,
Naoki Yoshida,
Computer Physics Communications 180, 625 (2009)

Simulations of the Microwave Sky,
N. Sehgal, P. Bode, S. Das, C. Hernandez-Monteagudo, K. Huffenberger, Y.-T. Lin, J. Ostriker, H. Trac,
Astrophys. J. 709, 920 (2010), IPMU10-0033

Explorations of the Top quark forward-backward asymmetry at the Tevatron,
Jing Shu, Tim Tait and Kai Wang,
Phys. Rev. D 81, 034012 (2010), IPMU09-0130

Cosmic-Ray Electron Excess from Pulsars is Spiky or Smooth?: Continuous and Multiple Electron/ Positron injections,
Norita Kawanaka, Kunihito Ioka, Mihoko M. Nojiri,
Astrophys. J. 710, 958-963 (2010)

Cascade Events at IceCube+DeepCore as a Definitive Constraint on the Dark Matter Interpretation of the PAMELA and Fermi Anomalies,
Sourav K. Mandal, Matthew R. Buckley, Katherine Freese, Douglas Spolyar, Hitoshi Murayama,
Phys. Rev. D 81, 043508 (2010), IPMU09-0143

Production of radioactive isotopes through cosmic muon spallation in KamLAND,
S. Abe, S. Enomoto, K. Furuno, Y. Gando, H. Ikeda, K. Inoue, Y. Kibe, Y. Kishimoto, M. Koga, Y. Minekawa, T. Mitsui, K. Nakajima, K. Nakajima, K. Nakamura, M. Nakamura, I. Shimizu, Y. Shimizu, J. Shirai, F. Suekane, A. Suzuki, Y. Takemoto, K. Tamae, A. Terashima, H. Watanabe, E. Yonezawa, S. Yoshida, A. Kozlov, H. Murayama, J. Busenitz, T. Classen, C. Grant, G. Keefer, D. S. Leonard, D. McKee, A. Piepke, T. I. Banks, T. Bloxham, J. A. Detwiler, S. J. Freedman, B. K. Fujikawa, F. Gray, E. Guardincerri, L. Hsu, K. Ichimura, R. Kadel, C. Lendvai, K.-B. Luk, T. O'Donnell, H. M. Steiner, L. A. Winslow, D. A. Dwyer, C. Jillings, C. Mauger, R. D. McKeown, P. Vogel, C. Zhang, B. E. Berger, C. E. Lane, J. Maricic, T. Miletic, M. Batygov, J. G. Learned, S. Matsuno, S. Pakvasa, J. Foster, G. A. Horton-Smith, A. Tang, S. Dazeley, K. E. Downum, G. Gratta, K. Tolich, W. Bugg, Y. Efremenko, Y. Kamyshkov, O. Perevozchikov, H. J. Karwowski, D. M. Markoff, W. Tornow, K. M. Heeger, F. Piquemal, J.-S. Ricol, M. P. Decowski,
Phys. Rev. C 81, 025807 (2010), IPMU10-0037

Neutrino mass from a hidden world and its phenomenological implications,
Seong-Chan Park, Kai Wang, T.T. Yanagida,
Phys. Lett. B685, 309-312 (2010), IPMU09-0104

Invisible Higgs boson from $B \to K\nu\bar{\nu}$,
C.S. Kim, Seongchan Park, Kai Wang, Guo-huai Zhu,
Phys. Rev. D 81, 054004 (2010), IPMU09-0103

Nucleosynthesis in Two-Dimensional Delayed Detonation Models of Type Ia Supernova Explosions,
Keiichi Maeda, Friedrich K. Roepke, Michael Fink, Wolfgang Hillebrandt, Claudia Travaglio, Friedel Thielemann,
Astrophys. J. 712, 624 (2010), IPMU09-0094

The nonlinear redshift space probability distribution function in models with local primordial non-Gaussianity,
Tsz Yan Lam, Vincent Desjacques, Ravi K. Sheth,
MNRAS 402, 2397 (2010), IPMU10-0004

12. Preprints

JFY2009

IPMU09-0039
Kawabaka, K., Tanaka, M., Maeda, K., Hattori, T., Nomoto, K., Tominaga, N., Yamanaka, M.,
The Extremely Luminous Supernova 2006gy at Late Phase: Detection of Optical Emission from Supernova,
Astrophys. J. 697, 676-683 (2009), arXiv:0902.1440 [astro-ph]

IPMU09-0040
Keiichi Maeda
Supernovae in Three-Dimension: A Link to Gamma-Ray Bursts,
Frascati Workshop 2007

IPMU09-0041
Shinji Mukohyama,
Scale-invariant cosmological perturbations from Horava-Lifshitz gravity without inflation,
JCAP 0906, 001 (2009), arXiv:0904.2190 [hep-th]

IPMU09-0042
Kazuhide Ichikawa, Masahiro Kawasaki, Mazunori Nakayama, Toyokazu Sekiguchi, Tomo Takahashi,
Constraining Light Gravitino Mass from Cosmic Microwave Background

IPMU09-0043
Masahiro Kawasaki, Kazunori Kohri, Kazunori Nakayama,
Diffuse Gamma-ray Background and Cosmic-ray positrons from Annihilating Dark Matter

IPMU09-0044
Sergei Blinnikov,
Notes on Hidden Mirror World,
Physics of Atomic Nuclei, arXiv:0904.3609 [astro-ph]

IPMU09-0045
S.I. Blinnikov, I.V. Panov, M.A.Rudzsky, K. Sumiyoshi,
The equation of state and composition of hot, dense matter in core-collapse supernovae,
Astronomy & Astrophysics, arXiv:0904.3849 [astro-ph]

IPMU09-0046
Shinta Kasuya, Masahiro Kawasaki,
Axion Isocurvature Fluctuations with Extremely Blue Spectrum

IPMU09-0047
Radu Tatar, Yoichi Tsuchiya and Taizan Watari,
Right-handed neutrinos in F-theory compactifications,
Nucl. Phys. B 823, 1 (2009), arXiv:0905.2289 [hep-th]

IPMU09-0048
Hitoshi Murayama and Vikram Rentala,
Randall-Sundrum graviton spin determination using azimuthal angular dependence

IPMU09-0049
Shirley Ho, Simon DeDeo, David Spergel,
A New Way to Find the Missing Baryons,
Physical Review D, arXiv:0903.2845 [astro-ph]

IPMU09-0050
Takeshi Kobayashi, Shinji Mukohyama, Brian A. Powell,
Cosmological Constraints on Rapid Roll Inflation
JCAP 09, 023 (2009), arXiv:0902.1798 [hep-th]

IPMU09-0051
S. Taubenberger, S. Valenti, S. Benetti, E. Cappellaro, M. Della Valle, N. Elisa-Rosa, S. Hachinger, W. Hillebrandt, K. Maeda, P.A. Mazzali, A. Pastorello, F. Patat, S.A. Sim, and M. Turatto,
Nebular emission-line profiles of Type Ib/c Supernovae - probing the ejecta asphericity,
MNRAS 397, 677 (2009), arXiv:0904.4632 [astro-ph]

IPMU09-0052
Shinji Mukohyama, Kazunori Nakayama, Fuminobu Takahashi, Shuichiro Yokoyama,
Phenomenological Aspects of Horava-Lifshitz Cosmology,
Phys. Lett. B679,6(2009), arXiv:0905.0055 [hep-th]

IPMU09-0053
Domenico Orlando and Susanne Reffert,
On the Renormalizability of Horava-Lifshitz-type Gravity,
Class. Quant. Grav. 26, 155021 (2009), arXiv:0905.0301 [hep-th]

IPMU09-0054
Satoshi Shirai, Fuminobu Takahashi and T. T. Yanagida,
R-violating Decay of Wino Dark Matter and electron/positron Excesses in the PAMELA/Fermi Experiments,
Phys. Lett. B 680, 485 (2009),arXiv:0905.0388 [hep-ph]

IPMU09-0055
Tatsuo Azeyanagi, Wei Li, Tadashi Takayanagi,
On String Theory Duals of Lifshitz-like Fixed Points,
arXiv:0905.0688 [hep-th]

IPMU09-0056
Tatsuma Nishioka, Shinsei Ryu, Tadashi Takayanagi,
Holographic Entanglement Entropy: An Overview

IPMU09-0057
Izawa K.-I., Fuminobu Takahashi, T. T. Yanagida, and Kazuya Yonekura,
Conformal Supersymmetry Breaking in Vector-like Gauge Theories,
Phys. Rev. D 80, 085017 (2009), arXiv:0905.1764 [hep-th]

IPMU09-0058
Hitoshi Murayama and Jing Shu,
Topological Dark Matter

IPMU09-0059
Etsuko Kawakami, Masahiro Kawasaki, Kazunori Nakayama, and Fuminobu Takahashi,
Non-Gaussianity from Isocurvature Perturbations: Analysis of Trispectrum,
JCAP 0909, 002 (2009), arXiv:0905.1552 [astro-ph]

IPMU09-0060
Koichi Hamaguchi, Kouhei Nakaji, Eita Nakamura,
Inverse Problem of Cosmic-Ray Electron/Positron from Dark Matter

IPMU09-0061
Hirosi Ooguri and Chang-Soon Park,
Supersymmetric Non-relativistic Geometries in M Theory

IPMU09-0062
Tatsuma Nishioka,
Horava-Lifshitz Holography,
arXiv:0905.0473 [hep-th]

IPMU09-0063
Junji Hisano, Kazunori Nakayama, and Masaki Yang,
Upward muon signals at neutrino detectors as a probe of dark matter properties

IPMU09-0064
Takeshi Kobayashi and Shinji Mukohyama,
Curvatons in Warped Throats,
JCAP 07 (2009) 032, arXiv:0905.2835 [hep-th]

IPMU09-0065
Satoshi Shirai, Fuminobu Takahashi, T. T. Yanagida,
Cosmic-ray Electron and Positron Excesses from Hidden Gaugino Dark Matter,
JHEP 0909, 115 (2009), arXiv:0905.3235 [hep-ph]

IPMU09-0066
Shinji Mukohyama,
Dark matter as integration constant in Horava-Lifshitz gravity,
Phys. Rev. D 80, 064005 (2009), arXiv:0905.3563 [hep-th]

IPMU09-0067
Satoshi Shirai and T. T. Yanagida,
A Test for Light Gravitino Scenario at the LHC

IPMU09-0068
Oleg Lychkovskiy, Sergei Blinnikov,
Spin flip of neutrinos with magnetic moment in core-collapse supernova,
Yadernaya Fizika (Physics of Atomic Nuclei), arXiv:0905.3658 [astro-ph]

IPMU09-0069
Jose Figueroa-O'Farrill,
Simplicity in the Faulkner construction,
J. Phys A 42, 445206 (2009), arXiv:0905.4900 [hep-th]

IPMU09-0070
Douglas Spolyar, Matthew Buckley, Katherine Freese, Dan Hooper, and Hitoshi Murayama,
High Energy Neutrinos As A Test of Leptophilic Dark Matter,
arXiv:0905.4764 [astro-ph]

IPMU09-0071
Izawa K.-I.,
A Note on Quasi-Riemannian Gravity with Higher Derivatives,
arXiv:0904.3593 [hep-th]

IPMU09-0072
Tao Han, Haishan Liu, Mingxing Luo, Kai Wang, Wei Wu,
Like-sign Di-lepton Signals in Higgsless Models at the LHC,
Phys. Rev. D 80, 095010 (2009), arXiv:0908.2186 [hep-ph]

IPMU09-0073
Yue Shen and Edwin L. Turner,
On the Eccentricity Distribution of Exoplanets from Radial Velocity Surveys,
Astrophys. J. 685, 553 (2008), arXiv:0806.0032 [astro-ph]

IPMU09-0074
Joshua N. Winn, John Asher Johnson, Daniel Fabrycky, Andrew W. Howard, Geoffrey W. Marcy, Norio Narita, Ian J. Crossfield, Yasushi Suto, Edwin L. Turner, Gil Esquerdo and Matthew J. Holman,
On the Spin-Orbit Misalignment of the XO-3 Exoplanetary System,
Astrophys. J. 700, 302-308 (2009), arXiv:0902.3461 [astro-ph]

IPMU09-0075
Norio Narita; Teruyuki Hirano; Bun'ei Sato; Joshua N. Winn; Yasushi Suto; Edwin L. Turner; Wako Aoki; Motohide Tamura & Toru Yamada,
Improved Measurement of he Rossiter-McLaughlin Effect in the Exoplanetary System HD 17156,
PASJ in press, arXiv:0905.4727 [astro-ph]

IPMU09-0076
Sally V. Langford, J. Stuart, B. Wyithe and Edwin L. Turner,
Photometric Variability in Earthshine Observations,
Astrobiology 9(3), 305 (2009), arXiv:0904.0845 [astro-ph]

IPMU09-0077
Tanaka, M., Kawabata, K.S., Maeda, K., Iye, M., Hattori, T., Pian, E., Nomoto, K., Mazzali, P.A., Tominaga, N.,
Spectropolarimetry of the Unique Type Ib Supernova 2005bf: Larger Asymmetry Revealed by Later-Phase Data,
Astrophys. J. 699, 1119-1124 (2009), arXiv:0906.1062 [astro-ph]

IPMU09-0078
Tanaka, M., Yamanaka, M., Maeda, K., Kawabata, K.S., Hattori, T., Minezaki, T., Valenti, S., Della Valle, M., Sahu, D.K., Anupama, G.C., Tominaga, N., Nomoto, K., Mazzali, P.A., Pian, E.,
Nebular Phase Observations of the Type Ib Supernova 2008D/X-ray Transient 080109: Side-Viewed Bipolar Explosion,
Astrophys. J. 700, 1680 (2009), arXiv:0906.1061 [astro-ph]

IPMU09-0079
Kawabata, K.S., Maeda, K., Nomoto, K., Taubenberger, S., Tanaka, M., Hattori, T., Itagaki, K.,
A unique Core-Collapse Supernova in An Elliptical Galaxy,
arXiv:0906.2811 [astro-ph]

IPMU09-0080
Jacek Guzik, Bhuvnesh Jain, Masahiro Takada,
Tests of Gravity from Imaging and Spectroscopic Surveys,
arXiv:0906.2221 [astro-ph]

IPMU09-0081
Shinji Mukohyama,
Caustic avoidance in Horava-Lifshitz gravity,
JCAP 0909, 005 (2009), arXiv:0906.5069 [hep-th]

IPMU09-0082
Kazunori Nakayama, Fuminobu Takahashi,
The R-axion and non-Gaussianity
Phys. Lett. B 679, 436 (2009)

IPMU09-0083
Gaston Giribet, Yasuaki Hikida, Tadashi Takayanagi,
Topological String on OSP(1–2)/U(1)

IPMU09-0084
Shun Saito, Masahiro Takada, Atsushi Taruya,
Nonlinear galaxy power spectrum for a mixed dark matter model: perturbation theory approach and parameter forecasts,
Phys. Rev. D 80, 083528 (2009), arXiv:0907.2922 [astro-ph]

IPMU09-0085
Toshiya Imoto, Tadakatsu Sakai, Shigeki Sugimoto,
O(N) and USp(N) QCD from String Theory,
Prog. Theo. Phys. 122, 1433 (2009), arXiv:0907.2968 [hep-th]

IPMU09-0086
William Klemm, Vikram Rentala, Zongguo Si and Kai Wang,
Top-top pair at the CERN LHC

IPMU09-0087
Toru Kanzaki, Masahiro Kawasaki and Kazunori Nakayama,
Effects of Dark Matter Annihilation on the Cosmic Microwave Background,
arXiv:0812.0219 [astro-ph]

IPMU09-0088
Koichi Hamaguchi, Fuminobu Takahashi, Ryuichiro Kitano,
Non-thermal Gravitino Dark Matter in Gauge Mediation
JHEP 09, 127 (2009)

IPMU09-0089
Sunghoon Jung, Hitoshi Murayama, Aaron Pierce, James D. Wells,
Top quark forward-backward asymmetry from new t-channel physics

IPMU09-0090
Wei Li, Tatsuma Nishioka, Tadashi Takayanagi,
Some No-go Theorems for String Duals of Non-relativistic Lifshitz-like Theories

IPMU09-0091
Mina Aganagic, Hirosi Ooguri, Cumrun Vafa, Masahito Yamazaki,
Wall Crossing and M-Theory,
Nucl. Phys. B

IPMU09-0092
M. Ibe, Izawa K.-I., Y. Nakai,
Studying Gaugino Mass in Semi-Direct Gauge Mediation,
arXiv:0907.2970 [hep-ph]

IPMU09-0093
Keiichi Maeda, Stefan Taubenberger, Jesper Sollerman, Paolo A. Mazzali, Giorgos Leloudas, Ken'ichi Nomoto, Kentaro Motohara,
Nebular Spectra and Explosion Asymmetry of Type Ia Supernovae,
Astrophys. J. 708, 1703 (2010)

IPMU09-0094
Keiichi Maeda, Friedrich K. Roepke, Michael Fink, Wolfgang Hillebrandt, Claudia Travaglio, Friedel Thielemann,
Nucleosynthesis in Two-Dimensional Delayed Detonation Models of Type Ia Supernova Explosions,
Astrophys. J. 712, 624 (2010)

IPMU09-0095
C. Hagedorn , E. Molinaro, S.T. Petcov,
Majorana Phases and Leptogenesis in See-Saw Models with A_4 Symmetry
JHEP 0909, 115 (2009)

IPMU09-0096
Paul de Medeiros, Jose Figueroa-O'Farrill, Elena Mendez-Escobar,
Superpotentials for superconformal Chern-Simons theories from representation theory,
J Phys A, arXiv:0908.2125 [hep-th]

IPMU09-0097
William Klemm, Hai-shan Liu, Kai Wang,
Probing spin of the resonance unitarizing WW Scattering at the LHC

IPMU09-0098
Jose Figueroa-O'Farrill,
M2-branes, Einstein manifolds and triple systems

IPMU09-0099
Shinji Mukohyama,
Can ghost condensate decrease entropy?,
arXiv:0908.4123 [hep-th]

IPMU09-0100
Cosimo Bambi, Katherine Freese, Rohta Takahashi,
Is the Carter-Israel conjecture correct?,
Arxiv:0908.3238

IPMU09-0101
Chuan-Ren Chen, Mihoko M. Nojiri, Seong Chan Park and Jing Shu,
Kaluza-Klein Dark Matter After Fermi,
arXiv:0908.4317 [hep-ph]

IPMU09-0102
Gian F. Giudice, Tao Han, Kai Wang, Lian-Tao Wang,
Nearly Degenerate Gauginos and Dark Matter at the LHC

IPMU09-0103
C.S. Kim, Kai Wang, Guo-huai Zhu,
Constraining Invisible Higgs from B¿ K+missing,

IPMU09-0104
Seong-Chan Park, Kai Wang, T.T. Yanagida,
Neutrino mass from a hidden world and its phenomenological implications,
Phys. Lett. B685, 309-312 (2010), arXiv:0909.2937 [hep-ph]

IPMU09-0105
Domenico Orlando and Susanne Reffert,
On the Perturbative Expansion around a Lifshitz Point,
Phys. Lett. B 683, 61 & 8211, 68 (2010), arXiv:0908.4429 [hep-th]

IPMU09-0106
H. Sung Cheon, Sin Kyu Kang, C. S. Kim,
Cosmic ray anomalies and DAMA experiment in an Extended Seesaw Model

IPMU09-0107
Chuan-Hung Chen, C. S. Kim,
Sommerfeld Enhancement for Dark Matter Annihilation from Unparticle Exchange

IPMU09-0108
Paul de Medeiros, Jose Figueroa-O'Farrill, Sunil Gadhia, Elena Mendez-Escobar,
Half-BPS quotients in M-theory: ADE with a twist,
JHEP, arXiv:0909.0163 [hep-th]

IPMU09-0109
Masahiro Kawasaki, Katsuhiko Sato,
Cosmological Constraints on a Massive Neutrino,
Prog. Theo. Phys. 122. 205 (2009), arXiv:0907.2007 [astro-ph]

IPMU09-0110
Daniel Krefl, Sara Pasquetti and Johannes Walcher,
The real topological vertex at work,
Nucl. Phys. B 833, 153-198 (2010), arXiv:0909.1324 [hep-th]

IPMU09-0111
Hajime Takami and Katsuhiko Sato,
Does Galactic Magnetic Field Disturb the Correlation of the Highest Energy Cosmic Rays with their Sources?,
Astrophys. J., arXiv:0909.1532 [astro-ph]

IPMU09-0112
Satoshi Maeda, Shinji Mukohyama and Tetsuya Shiromizu,
Primordial magnetic field from non-inflationary cosmic expansion in Horava-Lifshitz gravity,
arXiv:0909.2149 [astro-ph]

IPMU09-0113
Cosimo Bambi, Katherine Freese, Tomohiro Harada, Rohta Takahashi, Naoki Yoshida,
Accretion process in Kerr spacetimes with |a| > *M*
Phys. Rev. D 80, 104023 (2009)

IPMU09-0114
Damien A. Easson, Shinji Mukohyama, Brian A. Powell,
Observational Signatures of Gravitational Couplings in DBI Inflation
Phys. Rev. D81, 023512 (2010)

IPMU09-0115
N. Tominaga, S. Blinnikov, P. Baklanov, K. Nomoto,
Properties of Type II Plateau Supernova SNLS-04D2dc: Multicolor Light Curves of Shock Breakout and Plateau,
Astrophys. J. Lett. 705, 10 (2009), arXiv:0908.2162 [astro-ph]

IPMU09-0116
Takaya Nozawa, et al.,
Formation and Evolution of Dust in Type IIb Supernova with Application to the Cassiopeia A Supernova Remnant,
Astrophys. J., arXiv:0909.4145 [astro-ph]

IPMU09-0117
Yukinobu Toda,
Curve counting theories via stable objects II: DT/ncDT/flop formula,
arXiv:0909.5129 [math]

IPMU09-0118
Seong Chan Park, James Frost,
Warped Black Holes at the LHC and beyond,

IPMU09-0119
Seong Chan Park, Jing Shu,
Dark Matter and Collider Physics in Split-UED,

IPMU09-0120
Keiichi Maeda, Nozomu Tominaga, Hideyuki Umeda, Ken'ichi Nomoto, Tomoharu Suzuki,
Supernova Nucleosynthesis and Stellar Population in the Early Universe,

IPMU09-0121
Paul H. Frampton and Kevin Ludwick,
Number and Entropy of Halo Black Holes,

IPMU09-0122
Ho-Gyu Lee, Bon-Chul Koo, Dae-Sik Moon, Itsuki Sakon, Takashi Onaka, Woong-Seob Jeong, Hidehiro Kaneda, Takaya Nozawa, Takashi Kozasa,
AKARI Infrared Observations of the Supernova Remnant G292.0+1.8: Unveiling Circumstellar Medium and Supernova Ejetca,
Astrophys. J. 706, 441 (2009), arXiv:0910.0922 [astro-ph]

IPMU09-0123
Paul H. Frampton,
Alternative Version of Chiral Color as Alternative to the Standard Model,

IPMU09-0124
Ryosuke Sato, T.T.Yanagida, Kazuya Yonekura,
Relaxing the constraint on the number of messengers in a low-energy gauge mediation,

IPMU09-0125
Hirotaka Hayashi, Teruhiko Kawano, Yoichi Tsuchiya and Taizan Watari,
Flavor Structure in F-theory Compactifications,
arXiv:0910.2762 [hep-th]

IPMU09-0126
Chuan-ren Chen, Sourav K. Mandal, Fuminobu Takahashi,
Gamma-ray Constraints on Hadronic and Leptonic Activities of Decaying Dark Matter,
JCAP 01(2010)023, arXiv:0910.2639 [hep-ph]

IPMU09-0127
Masaomi Tanaka, Koji S. Kawabata, Masayuki Yamanaka, Keiichi Maeda, Takashi Hattori, Kentaro Aoki, Ken'ichi Nomoto, Masanori Iye, Toshiyuki Sasaki, Paolo A. Mazzali, Elena Pian,
Spectropolarimetry of Extremely Luminous Type Ia Supernova 2009dc: Nearly Spherical Explosion of Super-Chandrasekhar Mass White Dwarf,
Astrophys. J., arXiv:0908.2057 [astro-ph]

IPMU09-0128
M. Yamanaka, K. S. Kawabata, K. Kinugasa, M. Tanaka, A. Imada, K. Maeda, K. Nomoto, A. Arai, S. Chiyonobu, Y. Fukazawa, O. Hashimoto, S. Honda, Y. Ikejiri, R. Itoh, Y. Kamata, N. Kawai, T. Komatsu, D. Kuroda, H. Miyamoto, S. Miyazaki, O. Nagae, H. Nakaya, T. Ohsugi, T. Omodaka, N. Sakai, M. Sasada, M. Suzuki, H. Taguchi, H. Takahashi, H. Tanaka, M. Uemura, T. Yamashita, K. Yanagisawa, M. Yoshida,
Early Phase Observations of Extremely Luminous Type Ia Supernova 2009dc,
Astrophys. J. Lett., arXiv:0908.2059 [astro-ph]

IPMU09-0129
Shin Nakamura, Hirosi Ooguri, Chang-Soon Park,
Gravity Dual of Spatially Modulated Phase,
to be determined, , http://arxiv.org/abs/0911.0679

IPMU09-0130
Jing Shu and Tim Tait and Kai Wang,
Explorations of the Top quark forward-backward asymmetry at the Tevatron,
Phys. Rev. D 81, 034012 (2010), arXiv:0911.3237 [hep-ph]

IPMU09-0131
Hajime Takami, Takahiro Nishimichi, Katsuhiko Sato,
Systematic Survey of the Correlation between Northern HECR events and SDSS Galaxies,
JCAP, arXiv:0910.2765 [astro-ph]

IPMU09-0132
Kentaro Nagao, Masahito Yamazaki,
The Non-commutative Topological Vertex and Wall Crossing Phenomena,
arXiv:0910.5479 [hep-th]

IPMU09-0133
Masahiro Kawasaki, Toyokazu Sekiguchi,
Probing the primordial power spectra with inflationary priors,
JCAP,

IPMU09-0134
Tatsuma Nishioka, Shinsei Ryu and Tadashi Takayanagi,
Holographic Superconductor/Insulator Transition at Zero Temperature,

IPMU09-0135
Paul Frampton and Jing Shu and Kai Wang,
Axigluon as Possible Explanation for ttbar Forward Backward Asymmetry at Tevatron,
Phys. Lett. B 683:294-297,2010,
arXiv:0911.2955 [hep-ph]

IPMU09-0136
Keisuke Izumi and Shinji Mukohyama,
Stellar center is dynamical in Horava-Lifshitz gravity,
JHEP,

IPMU09-0137
Domenico Orlando, Susanne Reffert, Nicolai Reshetikhin,
On domain wall boundary conditions for the XXZ spin Hamiltonian,
arXiv:0912.0348 [math-ph]

IPMU09-0138
Kyoji Saito and Tadashi Ishibe,
Monoids in the fundamental groups of the complement of logarithmic free divisors in C^3,

IPMU09-0139
Qing-Hong Cao, C. B. Jackson, Wai-Yee Keung, Ian Low, Jing Shu,
The Higgs Mechanism and Loop-induced Decays of a Scalar into Two Z Bosons,
Phys.Rev.D., arXiv:0911.3398 [hep-ph]

IPMU09-0140
Kazunori Nakayama and Fuminobu Takahashi,
The Affleck-Dine Mechanism in Conformally Sequestered Supersymmetry Breaking,
Phys. Lett. B, arXiv:0911.5326 [hep-ph]

IPMU09-0141
Kenneth Intriligator and Matthew Sudano,
General Gauge Mediation with Gauge Messengers,

IPMU09-0142
Mina Aganagic and Masahito Yamazaki,
Open BPS Wall Crossing and M-theory,
arXiv:0911.5342 [hep-th]

IPMU09-0143
Sourav K. Mandal, Matthew R. Buckley, Katherine Freese, Douglas Spolyar, Hitoshi Murayama,
Cascade Events at IceCube+DeepCore as a Definitive Constraint on the Dark Matter Interpretation of the PAMELA and Fermi Anomalies,
Phys. Rev. D 81, 043508 (2010), arXiv:0911.5188 [hep-ph]

IPMU09-0144
Koji Ishiwata, Masahiro Kawasaki, Kazunori Kohri, Takeo Moroi,
Weak-scale Right-handed Sneutrino and Big-Bang Nucleosynthesis,
JCAP,

IPMU09-0145
Motoi Endo, Koichi Hamaguchi, Sho Iwamoto,
Lepton Flavor Violation and Cosmological Constraints on R-parity Violation,
arXiv:0912.0585 [hep-ph]

IPMU09-0146
Michael Loewenstein, Alexander Kusenko,
Dark Matter Search Using Chandra Observations of Willman 1, and a Spectral Feature Consistent with a Decay Line of a 5 keV Sterile Neutrino,
arXiv:0912.0552 [astro-ph]

IPMU09-0147
Ian M. Shoemaker, Alexander Kusenko,
Gravitino dark matter from Q-ball decays,
Phys. Rev. D 80, 075021 (2009), arXiv:0909.3334 [astro-ph]

IPMU09-0148
Alexander Kusenko,
Sterile neutrinos: the dark side of the light fermions,
Phys. Rept. 481,1 (2009), arXiv:0906.2968 [hep-ph]

IPMU09-0149
Alexander Kusenko, Ian M. Shoemaker,
Neutrinos from the terrestrial passage of supersymmetric dark matter Q-balls,
Phys. Rev. D 80, 027701 (2009), arXiv:0905.3929 [astro-ph]

IPMU09-0150
Warren Essey, Alexander Kusenko,
A new interpretation of the gamma-ray observations of active galactic nuclei,
Astropart. Phys. 33, 81-85 (2010), arXiv:0905.1162 [astro-ph].

IPMU09-0151
Alexander Kusenko, Anupam Mazumdar, Tuomas Multamaki,
Gravitational waves from the fragmentation of a supersymmetric condensate,
Phys. Rev. D 79, 124034 (2009), arXiv:0902.2197 [astro-ph]

IPMU09-0152
Ian M. Shoemaker, Alexander Kusenko,
The ground states of baryoleptonic Q-balls in supersymmetric models,
Phys. Rev. D 78, 075014 (2008), arXiv:0809.1666 [astro-ph]

IPMU09-0153
Alexander Kusenko, Anupam Mazumdar,
Gravitational waves from fragmentation of a primordial scalar condensate into Q-balls,
Phys. Rev. Lett. 101, 211301 (2008), arXiv:0807.4554 [gr-qc]

IPMU09-0154
George M. Fuller, Alexander Kusenko, Kalliopi Petraki,
Heavy sterile neutrinos and supernova explosions,
Phys. Lett. B 670, 281 (2009), arXiv:0806.4273 [astro-ph]

IPMU09-0155
Alexander Kusenko, Bhabani Prasad Mandal, Alok Mukherjee,
Delayed pulsar kicks from the emission of sterile neutrinos,
Phys. Rev. D 77, 123009 (2008), arXiv:0801.4734 [astro-ph]

IPMU09-0156
Koichi Hamaguchi, Eita Nakamura, Satoshi Shirai, Tsutomu T. Yanagida,
Low-Scale Gauge Mediation and Composite Messenger Dark Matter,

IPMU09-0157
Paul Frampton, Masahiro Kawasaki, Fuminobu Takahashi, Tsutomu T. Yanagida,
Primordial Black Holes as All Dark Matter,
arXiv:1001.2308 [hep-ph]

IPMU09-0158
Issha Kayo, Naohisa Inada, Masamune Oguri, Tomoki Morokuma, Patrick B. Hall, Christopher S. Kochanek, Donald P. Schneider,
Eight New Quasar Lenses from the Sloan Digital Sky Survey Quasar Lens SearchD",
AJ, arXiv:0912.1462 [astro-ph]

IPMU09-0159
Ryosuke Sato, Kazuya Yonekura,
Low Scale Direct Gauge Mediation with Perturbatively Stable Vacuum,
arXiv:0912.2802 [hep-ph]

IPMU09-0160
Yukinobu Toda,
On a computation of rank two Donaldson-Thomas invariants,
arXiv:0912.2507 [math]

IPMU09-0161
Masahiro Ibe and Tsutomu T. Yanagida,
Neutralino Dark Matter in Gauge Mediation in Light of CDMS-II,

IPMU09-0162
Qing-Hong Cao, Chuan-Ren Chen, Chong Sheng Li and Hao Zhang,
Effective dark matter theory - relic density, CDMS II, Fermi LAT and LHC,

IPMU09-0163
Motoi Endo, Satoshi Shrai, Kazuya Yonekura,
Phenomenological Aspects of Gauge Mediation with Sequestered Supersymmetry Breaking in light of Dark Matter Detection,

IPMU09-0164
Cosimo Bambi,
Numerical simulations of the accretion process in Kerr space-times with arbitrary value of the Kerr parameter,
arXiv:0912.4944 [gr-qc]

IPMU09-0165
Yu Nakayama,
Anisotropic scale invariant cosmology,

IPMU09-016
6Izutani, Natsuko; Umeda, Hideyuki; Tominaga, Nozomu,
Explosive Nucleosynthesis of Weak R-Process Elements in Extremely Metal-Poor Core-Collapse Supernovae,
Astrophys. J. 692, 1517(2009), arXiv:0810.5661 [astro-ph]

IPMU09-0167
Nomoto, Ken'ichi; Wanajo, Shinya; Kamiya, Yasuomi; Tominaga, Nozomu; Umeda, Hideyuki,
Chemical Yields from Supernovae and Hypernovae,

IPMU09-0168
Damien A. Easson,Mustapha Ishak, Jacob Moldenhauer, John Thompson,
Supernovae, BAO, and CMB surface distance constraints on *f*(*G*) higher order gravity models,
Phys. Rev. D,

IPMU10-0001
Cosimo Bambi,
Testing the Black Hole Paradigm with Future Observations of SgrA*,

IPMU10-0002
Jing Shu, Peng-fei Yin, Shou-hua Zhu,
Neutrino Constrains on Inelastic Dark Matter after CDMS II,
Phys. Rev. D,

IPMU10-0003
Tsz Yan Lam, Ravi K. Sheth, Vincent Desjacques,
The initial shear field in models with primordial local non-Gaussianity and implications for halo and void abundance,
MNRAS 399, 1482 (2009), arXiv:0905.1706 [astro-ph]

IPMU10-0004
Tsz Yan Lam, Vincent Desjacques, Ravi K. Sheth,
The nonlinear redshift space probability distribution function in models with local primordial non-Gaussianity,
MNRAS 402, 2397 (2010), arXiv:0908.2285 [astro-ph]

IPMU10-0005
Chiaki Kobayashi, Ken'ichi Nomoto,
The Role of Type Ia Supernovae in Chemical Evolution I: Lifetime of Type Ia Supernovae and Metallicity Effect,
Astrophys. J. 707, 1466-1484 (2009), arXiv:0801.0215 [astro-ph]

IPMU10-0006
Chiaki Kobayashi,
Chemo-dynamical simulations of galaxies,

IPMU10-0007
Chiaki Kobayashi,
Numerical Simulations of Elliptical Galaxies,

IPMU10-0008
Louis Funar, Toshitake Kohno,
On images of quantum representations of mapping class groups,
Quantum Topology, arXiv:0907.0568 [math]

IPMU10-0009
Toshitake Kohno,
The volume of a hyperbolic simplex and iterated integrals,

IPMU10-0010
Toshitake Kohno,
Loop spaces of configuration spaces and link homotopy invariants,

IPMU10-0011
Shinsei Ryu, Tadashi Takayanagi,
Topological Insulators and Superconductors from D-branes,
arXiv:1001.0763 [hep-th]

IPMU10-0012
Ryuichiro Kitano, Hirosi Ooguri, and Yutaka Ookouchi,
Supersymmetry Breaking and Gauge Mediation,

IPMU10-0013
Yu Nakayama,
Schrodinger-like (dilaton-)garvity,

IPMU10-0014
Masamune Oguri, Masahiro Takada, Nobuhiro Okabe, Graham P. Smith,
Direct measurement of dark matter halo ellipticity from two-dimensional lensing shear maps of 25 massive clusters,
Phys. Rev. D, 80, 083528 (2009)

IPMU10-0015
Jacek Guzik, Bhuvnesh Jain, Masahiro Takada,
Tests of gravity from imaging and spectroscopic surveys,
Phys. Rev. D 81, 023503 (2010), arXiv:0906.2221 [astro-ph]

IPMU10-0016
Daniel Krefl,
Wall Crossing Phenomenology of Orientifolds,
arXiv:1001.5031 [hep-th]

IPMU10-0017
Masahiro Kawasaki, Koichi Miyamoto, Kazunori Nakayama,
Gravitational waves from kinks on infinite cosmic strings,
Phys. Rev. D,

IPMU10-0018
Tomonori Furukawa, Shuichiro Yokoyama, Kiyotomo Ichiki, Naoshi Sugiyama, Shinji Mukohyama,
Ghost Dark Matter,
arXiv:1001.4634 [astro-ph]

IPMU10-0019
Cosimo Bambi, Tomohiro Harada, Rohta Takahashi, Naoki Yoshida,
Outflows from accreting super-spinars,
Phys. Rev. D 81, 104004 (2010)

IPMU10-0020
Kyoungchul Kong, Seong Chan Park, Thomas G. Rizzo,
Collider phenomenology of split-UED,

IPMU10-0021
Yu Nakayama,
Universal time-dependent deformations of Schrodinger geometry,

IPMU10-0022
Hiroyuki Hirashita, Takaya Nozawa, Huirong Yan, Takashi Kozasa,
Effects of grain shattering by turbulence on extinction curves in starburst galaxies,
MNRAS, arXiv:1001.2606 [astro-ph]

IPMU10-0023
Masahito Yamazaki,
Crystal Melting and Wall Crossing Phenomena,
TBA, arXiv:1002.1709 [hep-th]

IPMU10-0024
Takashi Hiramatsu, Masahiro Kawasaki, Ken'ichi Saikawa,
Gravitational Waves from Collapsing Domain Walls,
Phys. Rev. D,

IPMU10-0025
Amihay Hanany, Domenico Orlando, Susanne Reffert,
Sublattice Counting and Orbifolds,
arXiv:1002.2981 [hep-th]

IPMU10-0026
Paul H. Frampton,
Intermediate Black Holes as Dark Matter,
arXiv:0907.1704v1 [hep-th]

IPMU10-0027
Atsushi Nishizawa, Masahiro Takada, T. Hamana, H. Furusawa,
The impact of photometric redshift errors on weak lensing tomography: a clipping method of the catastrophic errors,
Astrophys. J., arXiv:1002.2476 [astro-ph].

IPMU10-0028
Takashi Hiramatsu, Masahiro Kawasaki, Fuminobu Takahashi,
Numerical study of Q-ball formation in gravity mediation,

IPMU10-0029
T.T.Yanagida and Kazuya Yonekura,
Semi-direct Gauge Mediation in Conformal Windows of Vector-like Gauge Theories,

IPMU10-0030
Y.-T. Lin, R.B. Partridge, J. Pober, K. El Bouchefry, S. Burke, J. Klein, J. Coish, K. Huffenberger,
Spectral Energy Distribution of Radio Sources in Nearby Clusters of Galaxies: Implications for Sunyaev-Zel'dovich Effect Surveys,
Astrophys. J. 694, 992 (2009), arXiv:0805.1750 [astro-ph]

IPMU10-0031
Y. Shen, M.A. Strauss, N.P. Ross, P.B. Hall, Y.-T. Lin, G.T. Richards, D.P. Schneider, D.H. Weinberg, A.J. Connolly, X. Fan, J.F. Hennawi, F. Shankar, D.E. Vanden Berk, N.A. Bahcall, R.J. Brunner,
Quasar Clustering from SDSS DR5: Dependences on Physical Properties,
Astrophys. J. 697, 1656 (2009), arXiv:0810.4144 [astro-ph]

IPMU10-0032
Yen-Ting Lin, Jeremiah P. Ostriker, Christopher J. Miller,
A New Test of the Statistical Nature of the Brightest Cluster Galaxies,
Astrophys. J., arXiv:0904.3098 [astro-ph]

IPMU10-0033
N. Sehgal, P. Bode, S. Das, C. Hernandez-Monteagudo, K. Huffenberger, Y.-T. Lin, J. Ostriker,H. Trac,
Simulations of the Microwave Sky,
Astrophys. J. 709, 920 (2010), arXiv:0908.0540 [astro-ph]

IPMU10-0034
A. Hincks et al,
The Atacama Cosmology Telescope (ACT): Beam Profiles and First SZ Cluster Maps,
Astrophys. J., arXiv:0907.0461 [astro-ph]

IPMU10-0035
J. Fowler et al,
The Atacama Cosmology Telescope: A Measurement of the 600 < ℓ < 8000 Cosmic Microwave Background Power Spectrum at 148 GHz,
Astrophys. J., arXiv:1001.2934 [astro-ph]

IPMU10-0036
Damien Easson, Paul H. Frampton and George F. Smoot,
Entropic Accelerating Universe,

IPMU10-0037
S. Abe, S. Enomoto, K. Furuno, Y. Gando, H. Ikeda, K. Inoue, Y. Kibe, Y. Kishimoto, M. Koga, Y. Minekawa, T. Mitsui, K. Nakajima, K. Nakajima, K. Nakamura, M. Nakamura, I. Shimizu, Y. Shimizu, J. Shirai, F. Suekane, A. Suzuki, Y. Takemoto, K. Tamae, A. Terashima, H. Watanabe, E. Yonezawa, S. Yoshida, A. Kozlov, H. Murayama, J. Busenitz, T. Classen, C. Grant, G. Keefer, D. S. Leonard, D. McKee, A. Piepke, T. I. Banks, T. Bloxham, J. A. Detwiler, S. J. Freedman, B. K. Fujikawa, F. Gray, E. Guardincerri, L. Hsu, K. Ichimura, R. Kadel, C. Lendvai, K.-B. Luk, T. O'Donnell, H. M. Steiner, L. A. Winslow, D. A. Dwyer, C. Jillings, C. Mauger, R. D. McKeown, P. Vogel, C. Zhang, B. E. Berger, C. E. Lane, J. Maricic, T. Miletic, M. Batygov, J. G. Learned, S. Matsuno, S. Pakvasa, J. Foster, G. A. Horton-Smith, A. Tang, S. Dazeley, K. E. Downum, G. Gratta, K. Tolich, W. Bugg, Y. Efremenko, Y. Kamyshkov, O. Perevozchikov, H. J. Karwowski, D. M. Markoff, W. Tornow, K. M. Heeger, F. Piquemal, J.-S. Ricol, M. P. Decowski,
Production of radioactive isotopes through cosmic muon spallationin KamLAND,
Phys. Rev. C 81, 025807 (2010), arXiv:0907.0066 [hep-ex]

IPMU10-0038
Takeshi Kobayashi and Shinji Mukohyama,
Effects of Light Fields During Inflation,
arXiv:1003.0076 [astro-ph]

IPMU10-0039
Damien Easson, Paul Frampton, George Smoot,
Entropic Inflation,

IPMU10-0040
Paul H. Frampton and Xiao-Gang He,
Unitarity Boomerang,

IPMU10-0041
Domenico Orlando, Linda I. Uruchurtu,
Warped anti-de Sitter spaces from brane intersections in type II string theory,

IPMU10-0042
Yu-ichi Takamizu, Shinji Mukohyama, Misao Sasaki, Yoshiharu Tanaka,
Non-Gaussianity of superhorizon curvature perturbations beyond delta N formalism,

IPMU10-0043
Dong Zhe, Tao Han, Min-xin Huang, Gary Shiu,
Top Quarks as a Window to String Resonances,

IPMU10-0044
Warren Essey, Oleg E. Kalashev, Alexander Kusenko, John F. Beacom,
Secondary photons and neutrinos from cosmic rays produced by distant blazars,
Phys. Rev. Lett. 104,141102 (2010), arXiv:0912.3976 [astro-ph]

IPMU10-0045
Satoshi Shirai, Masahito Yamazaki, Kazuya Yonekura,
Aspects of Non-minimal Gauge Mediation,
arXiv:1003.3155 [hep-ph]

IPMU10-0046
Masahiro Kawasaki, Koichi Miyamoto, Kazunori Nakayama,
B-mode polarization induced by gravitational waves from kinks on infinite cosmic strings,

IPMU10-0047
Paul Howard Frampton,
Black Holes Constitute All Dark Matter,

IPMU10-0048
Paul Howard Frampton,
Primordial Black Holes Constitute All Dark Matter,

IPMU10-0049
Yong-Seon Song, Issha Kayo,
Decomposition of Spectra from Redshift Distortion Maps,
arXiv:1003.2420 [astro-ph]

IPMU10-0050
Satoshi Kondo, Seidai Yasuda,
Product structures in motivic cohomology and higher Chow groups,

IPMU10-0051
Satoshi Kondo, Seidai Yasuda,
On two higher Chow groups of a scheme over a finite field,

PMU10-0052
T. Kugo and T.T. Yanagida,
Supersymmetric Nonlinear Sigma Models Coupled to Supergravity,

13. Outreach and Public Communications

We have been trying hard to convey the importance and excitement of the science we are pursuing to general public through public lectures and a variety of outreach programs, often putting very best researchers of the institute including the center director and principal investigators. We organized all of our public lectures with a plenty of discussion time after the lecture so that attendants were able to talk directly with the speakers. Up to now, all of our public lectures have been very successful. We have been noticing that general public is very curious about the universe and anxious to be part of our scientific quest.

Hitoshi Murayama answers questions from the audience during a public lecture.

This year, we started the outreach program which are specifically aimed toward attracting junior high school and high school students into physics and mathematics. We hosted a tour and discussion event for female junior high school and high school students. We hosted a science camp "New Encounter of Modern Mathematics and Modern Physics" for high school students.

We began to have active communication with public relation groups of other organizations both in Japan and abroad. Some of our public lectures were jointly hosted with other institutions as a result of this type of communication. The program for female students was a part of a whole UT Science Faculty activity. In April, we hosted a meeting of InterAction collaboration which is a worldwide network of communication specialists working at particle physics and astrophysics laboratories.

Our effort in outreach program is producing visible results. We view the approval of the SuMIRe proposal by the Council for Science and Technology Policy not just as a recognition of its scientific importance, but also as a result of our persistent efforts to convince the government and communities that high precision astronomical measurements have great potential to strengthen the scientific and technological basis of Japan. Effect from a widely publicized ''Government Revitalization Unit Hearing''to review government-funded research programs, that took place in November, was minimal to our institute. During this process, more than 900 letters were sent to the government in support of IPMU, some of which from people who attended our outreach program.

IPMU hosted InterAction collaboration meeting.

Public Lectures

We hosted the following public lectures.

1. The Biggest Magic in the History of the Universe - Missing Antimatter, Hitoshi Murayama, April 18, 2009, Tsukuba (IPMU-KEK Special Talk Show on Particle Physics)

2. Birth of Stars and Galaxies from Dark Universe, Naoki Yoshida, April 18, 2009, Kashiwa (ICRR-IPMU Joint Public Lecture "Let's Talk about the Universe")

3. Tokui - The singularities in the universe, the Big Bang and Black Holes, Hitoshi Murayama, April 25, 2009, Yasuda Hall

4. The Dark Side of the Universe, Michael Turner (Univ. Chicago), Kashiwa Campus, June 24, 2009

5. Exploring the Universe with Gravitational Waves, Katsuhiko Sato, June 30, 2009, Tokyo (Fujiwara Seminar "Worldwide Network for Gravitational Wave")

6. A Story of Milky Way Galaxy, Naoki Yoshida, July 7, 2009, Kashiwa

7. "Soramiru" (Looking into the Universe), Hitoshi Murayama, July 13, 2009, Komaba Campus

8. Further than the Edge of the Universe, Hitoshi Murayama
   Universe seen from Underground Kamiokande, Masayuki Nakahata
   October 10, 2009, Tokyo (ICRR-IPMU Joint Public Lecture)

9. Seeing the Dark Sector of the Universe with Gravitational Lensing, Masahiro Takada, October 30, 2009, Kashiwa Campus (UT Kashiwa Campus Open House)

10. SORAHAKU 2009 - Will the Universe Ever End?, Hitoshi Murayama, December 6, 2009, Tokyo International Forum

11. Exploring Dark Age of the Universe, Naoki Yoshida, December 20, 2009, Komaba Campus

12. Miracle of String Theory, Shigeki Sugimoto
    Searching for Dark Matter - dark hoarse of the universe-, Masahiro Takada
    Wrinkles and Seeds of the Universe, Hitoshi Murayama
    January 20, February 20, March 6, 2010, Science Cafe at Tama Rokuto Scinece Museum

Programs for Junior High School and High School Students

Attracting female students to science is an important task for us. In August, we organized, as a part of UT Science Faculty project, a special event for female junior high school and high school students and their parents (optional) to tour the B-factory accelerator at KEK, the site of experimental verification of Kobayashi-Maskawa theory of CP violation. Some 20 students and their parents joined the event. The tour was followed by lectures and discussion with scientists including IPMU female researchers. It is also important to bring the subject of mathematics

■ Program of tour and discussion for female students and their parents.

■ Science camp for high school students "New encounter of modern mathematics and modern physics"

into outreach program especially for young students. A recent government report expressed a concern that majority of young Japanese today study mathematics just as requirements or a tool for solving problems in other fields, but not as an attractive research subject of its own. We want to play a challenging role to reverse this trend. As a first step we hosted, jointly with JST, a science camp of mathematics for high school students in March 2010. We were pleasantly surprised to receive a large number of enthusiastic applications from all over Japan for the capacity of only 20. The students were fascinated to learn different geometries which result in the sums of three inner angles of the triangle being different from 180 degrees, or to "count infinity" using a toy model for Bose particles and Fermi particles.

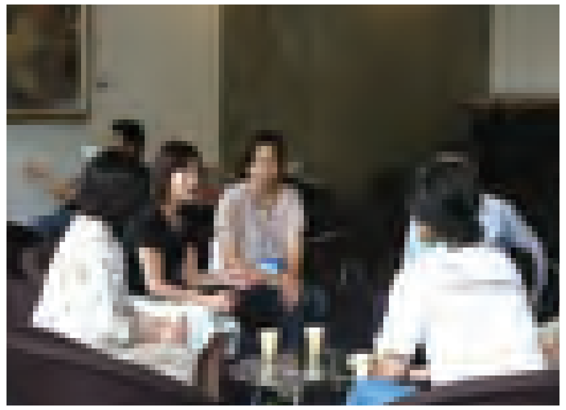
IPMU NEWS and Video Clips

We published 3 editions of IPMU news, covering a wide range of information including hosted conferences and seminars, research highlight, introduction of new members. They also feature interesting related research topics. We broadcasted 3 more short video clips, in which IPMU scientists explain technical scientific terms to general public in just one minute, on the website.

Communications in Different Ways

■ IPMU staff took extra precaution at a May 2009 Focus Week that was held in the middle of swine flu outbreak.[May 2009]

■ Children from Toyofuta Elementary School listen to IPMU researchers of various nationalities who explained their work while visiting Tokatsu Techno Plaza located right next to Kashiwa campus. [May 2009]



■ Members of IPMU volunteer group, who regularly assist our work in dealing with foreign staff and visitors, joined the coffee break at a June conference. [June 2009]

■ Children of Matsuba kindergarten listen to Naoki Yoshida's explanation about a miracle of the eclipse. [July 2009]

• Outreach and Public Communications

IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

Institute for the Physics and Mathematics of the Universe (IPMU)
The University of Tokyo
5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8583, Japan
Tel: +81-4-7136-4940 Fax: +81-4-7136-4941
http://www.ipmu.jp/