

No.46

Name	Nami Uchikata
Department	Astronomy
Position	D3
Research Title	RA/Initiative A: New solutions of charged regular black holes and their stability

I. Summary of Research

1. Regular black holes are black holes without spacetime singularities. One of the regular black hole models is composed of two distinct spacetimes separated by a thin shell. Mostly, the inner spacetime is de Sitter spacetime and the outer one is black hole spacetime (Frolov et al. 1989, Balbinot & Poisson 1990, Lemos & Zanchin 2011). I have considered a model, which is constructed of a de Sitter core within a thin shell and Reissner-Nordström spacetime outside the shell. I have assumed the shell is dust and timelike, which is an extended study of the massless shell case (Lemos & Zanchin 2011). I have numerically obtained new solutions of such a regular black hole model and also examined the stability against the displacement of the shell's radius. These are obtained simultaneously by examining the equation of motion of the shell. The stability of the solutions means the stability of the shell, since if the shell is unstable and collapses, the black hole cannot exist as a regular black hole. The black hole parameters of the stable solutions obtained in this study range in $0.87L < m < 2L$ and $Q/m > 0.86$, where m , L , and Q are the mass of the black hole, the de Sitter horizon radius, and the charge of the black hole, respectively. If we assume the de Sitter horizon radius L as some scales of the vacuum phase transition, these stable regular black holes are about the size of the primordial black holes.

II. Publications

1. "New solutions of charged regular black holes and their stability", N. Uchikata, S. Yoshida, and T. Futamase, Physical Review D, **86**, 084025, (2012).

III. Presentations

1. "New solutions of charged regular black holes and their stability", N. Uchikata, S. Yoshida, and T. Futamase, 13th Marcel Grossmann Meeting (July 1-7, 2012, Stockholm University and AlbaNova University Center, Stockholm, Sweden).
2. "New solutions of charged regular black holes and their stability", N. Uchikata, S. Yoshida, and T. Futamase, Japan Physical Society 2012 Autumn Meeting (September 11-14, 2012, Kyoto Sangyo University, Kyoto, Japan).
3. "New solutions of charged regular black holes and their stability", N. Uchikata, S. Yoshida, and T. Futamase, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter

Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan).

No.47

Name Mariko Kubo
Department Astronomy
Position D2
Research Title RA/Initiative A: The formation of the massive galaxies in the protocluster at redshift $z=3.09$

I. Summary of Research

In this year, we worked for the study of the SSA22 protocluster at $z=3.09$. This protocluster is known to be one of the most outstanding structures at high redshift. We studied this protocluster using rest-frame optical to MIR multi-wavelength data.

Most outstanding result was the result of the NIR spectroscopy of the galaxies in this protocluster. We were approved of the proposal of the observation on Subaru Telescope and conducted the observation in this year. We conducted the Near-InfraRed spectroscopy of the NIR selected galaxies in the SSA22 field at September to October, 2012 for 3 nights (Principal Investigator; M. Kubo). Our aim was to confirm the candidates of the member of the SSA22 protocluster at $z=3.09$ selected from MOIRCS study. It enables us to reveal the stellar mass formation and the evolution of the kinematic stage of the galaxies in the cluster of the galaxies. Then I worked for the reduction and analysis of these data.

As a result, we successfully confirmed about half of 67 observed galaxies. 20 of them are certainly the member of the protocluster at $z=3.09$. It is a first time to confirm such a large number of the galaxies at $z=3.09$ from NIR spectroscopy.

We also submitted a number of other proposals for the observation of the SSA22 protocluster on several telescopes. They were rejected but are important steps to promote our studies.

II. Publications

1. "The formation of the massive galaxies in the SSA22 $z=3.1$ protocluster.", M. KUBO, Y. K. UCHIMOTO, T. YAMADA, M. KAJISAWA, T. ICHIKAWA, Y. MATSUDA, M. AKIYAMA, T. HAYASHINO, M. KONISHI, T. NISHIMURA, K. OMATA, R. SUZUKI, I. TANAKA, T. YOSHIKAWA, D. M. ALEXANDER, G.G. FAZIO, J.-S. HUANG, B.D. LEHMER, *Astrophysics Journal* submitted in 2012

III. Presentations

1. "The formation of the massive galaxies in the SSA22 $z=3.09$ protocluster", M. Kubo et al, "The Load map for 2020", (August 9-10, 2012, NAOJ, Mitaka Tokyo, Japan)

2. "The formation of the massive galaxies in the SSA22 $z=3.09$ protocluster", M. Kubo et al, "Growing-up at high-redshift: from proto-clusters to galaxy clusters", (September 10-13, 2012, ESA, Madrid, Spain)
3. "The experiments for the filter exchanger for WISH telescope", M. Kubo et al, "Space Science Symposium2013", (January 8-9, 2013, JAXA, Sagamihara Kanagawa, Japan)
4. "The formation of the massive galaxies in the SSA22 $z=3.09$ protocluster", M. Kubo et al, "Subaru Users meeting2012", (January 15-17, 2013, NAOJ, Mitaka Tokyo, Japan)
5. "The formation of the massive galaxies in the SSA22 $z=3.09$ protocluster", M. Kubo, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)
6. "The formation of the massive galaxies in the SSA22 $z=3.09$ protocluster", M. Kubo et al, "Astronomical Society Japan 2013 Spring meeting", (March 20-23, 2013, Saitama University, Saitama, Japan)

No.48

Name	Masaki Takayama
Department	Astronomy
Position	D1
Research Title	RA: Pulsation models of OSARG variables

I. Summary of Research

1. Determination of the pulsation modes of RGB OSARGs by comparing OGLE data with our theoretical pulsation periods and period ratios.
RGB OSARGs show three ridges on the PL diagram. Comparing their periods and period ratios with our theoretical models, I have found that the PL relations correspond to the radial 1st – 3rd overtones and, the nonradial dipole p4 and quadrupole p2 mode of RGB stars with initial mass of ~0.9-1.4Msun.
2. Suggestion for the excitation mechanism of OSARG variables as the stochastic excitation due to comparison of their periods with the scaled optimal frequency, ν_{\max} , for the solar-like oscillations.
OSARG variables show relatively small amplitude and irregular, i.e., multi-periodic variability. Those properties similar to its of solar-like oscillations. Then calculating the scaled optimal frequency, ν_{\max} , using our best fit models(see above), I have found that the relation between their frequency and luminosity corresponds to the observed PL relations. Also I have succeeded to show that the numerical ν_{\max} using the low mass RGB star models roughly correspond to the OSARG's frequency regardless of the model parameters (metallicity, mixing length parameter).

II. Publications

1. "On the pulsation modes of OGLE small amplitude red giant variables in LMC",
M. Takayama, H. Saio, Y. Ita, Monthly Notices of the Royal Astronomical Society, 2012, submit.

III. Presentations

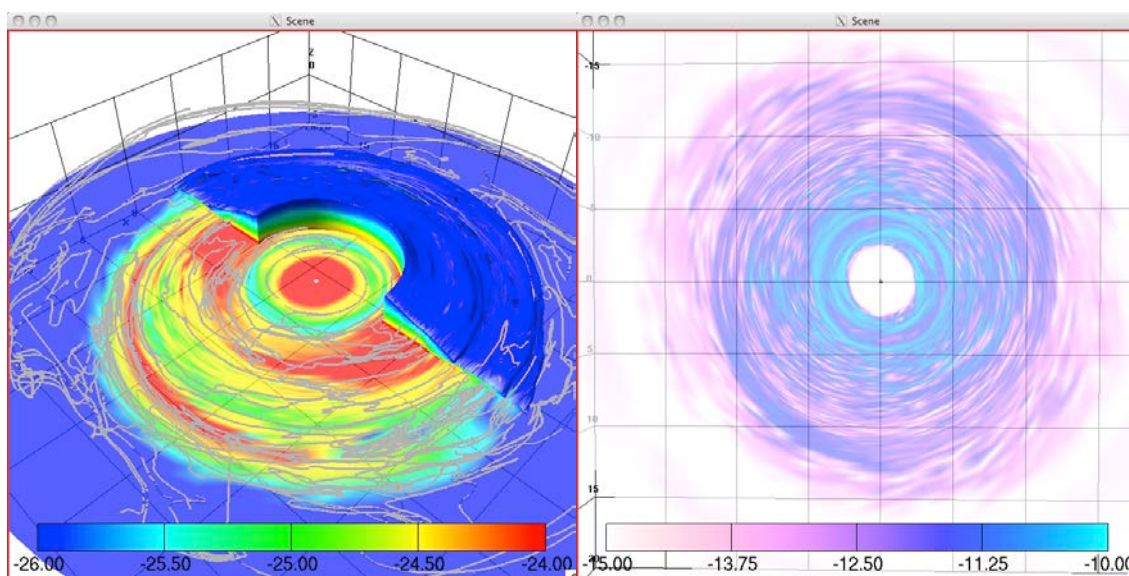
1. "On the pulsation modes and masses of OSARG variables",
M. Takayama, H. Saio, Y. Ita, 220th Meeting of the American Astronomical Society, (June 10-14, 2012, Anchorage, Alaska, USA)
2. "On the pulsation modes and masses of RGB OSARGs",
M. Takayama, H. Saio, Y. Ita, 40th Liege International Astrophysical Colloquium, (July, 9-13, 2012, University de Liege, Liege, Belgium)
3. "On the pulsation modes of OSARGs in the LMC",
M. Takayama, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.49

Name	Sho Nakamura
Department	Astronomy
Position	D1
Research Title	RA: Construction of Global Magnetic Field Structure Model in Spiral Galaxies with three-dimensional Magneto-hydrodynamic Simulations

I. Summary of Research

1. We carried out global three-dimensional ideal magneto-hydrodynamic simulation of spiral galactic gaseous disks to investigate how the global magnetic field structure in spiral galaxies is evolved and maintained. We examined effect of the spiral gravitational potential on the nonlinear evolution of the galactic magnetic field at the first time. We found that spiral shocks are generated due to existence of the spiral gravitational potential. When radiative cooling energy loss is not taken into account, the spiral shock layers are dulled with time and shocks are disappeared. The magnetic field strength are amplified by magneto-rotational instability and shock waves. However, saturated field strength is tenth of thermal energy of gas and is ten times less than observed galactic magnetic field strength. When radiative cooling loss is taken into account, the spiral shocks become isothermal. The generated isothermal shocks are maintained at least for 2Gyr. Numerical results showed that magnetic fields strength are amplified up to energy equipartition values. We also found the magnetic field direction reversal in the vertical direction as expected from galactic dynamo theory.



left : logarithm of the density distribution (color scale)

and magnetic field lines (gray curves) at $t=2.0\text{Gyr}$

right : logarithm of the magnetic field energy distribution at $t=2.0\text{Gyr}$

II. Publications

III. Presentations

1. "Construction of Global Magnetic Field Structure Model in Spiral Galaxies with Three-Dimensional Magnetohydrodynamic Simulations", Sho Nakamura, Makoto Hattori, Takahiro Morishima, ALMA workshop 2013 (January 26-28, 2013, Hokkaido University, Hokkaido, Japan)
2. "A large number of time-step galactic gaseous disk simulation in cylindrical coordinate", Sho Nakamura, astronomical magnetohydrodynamics and plasma simulation workshop 2013, (February 18-19, 2013, Chiba University, Chiba, Japan)
3. "Construction of Global Magnetic Field Structure Model in Spiral Galaxies with Three-Dimensional Magnetohydrodynamic Simulations", Sho Nakamura, Makoto Hattori, Takahiro Morishima, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.50

Name	Kohei Hayashi
Department	Astronomy
Position	D1
Research Title	RA/Initiative A: Formation and evolution of nearby galaxies based on chemodynamical studies of the old stellar populations

I. Summary of Research

1. I studied the properties of dark matter in the Galactic satellites. Prof. M. Chiba and I constructed axisymmetric mass models for dwarf spheroidal (dSph) galaxies in the Milky Way to obtain more plausible limits on the non-spherical structures of dark halos. This is motivated by the fact that the observed luminous parts of the dSphs are actually non-spherical and Cold Dark Matter (CDM) models predict non-spherical virialized dark halos. Applying these models to six of the bright dSphs in the Milky Way, we find that the best-fitting cases for most of the dSphs yield oblate and flattened dark halos, irrespective of assumed density profiles in their central parts. We also find that the total mass of the dSphs enclosed within 300 pc provide a different picture on previous studies, namely the mass constancy within inner 300 pc as argued by spherical models is not necessarily the case. Furthermore, it is found that dark halos of the Galactic dSphs are systematically more flattened than Λ CDM-based N-body predictions. About the above results, I submitted the paper and have already been accepted by *Astrophysical Journal*.
2. I also studied the global structure of Andromeda galaxy. Because Andromeda provide a unique laboratory to test Λ Cold Dark Matter (Λ CDM) theory of galaxy formation and evolution. It is thus of importance to derive how dark matter is actually distributed in a galaxy scale like Andromeda, to get useful insight into the role of dark halos in galactic structure and evolution in the framework of Λ CDM models. Therefore we adopted axisymmetric models constructed by Hayashi & Chiba (2012) and applied these models to latest kinematic data of globular clusters and dwarf spheroidal galaxies in the halo of Andromeda. We found that the most plausible cases for Andromeda yield not spherical but prolate shape for its dark halo. This result is consistent with the Λ CDM-based hypothesis that brightest satellites are distributed along the elongated disk-like structure that has its long axis aligned with the major axis of the host dark matter halo as a consequence of the preferential infall of satellites along a few filaments of the cosmic web.

II. Publications

1. "Probing non-spherical dark halos in the Galactic dwarf galaxies", K. Hayashi, M. Chiba, *The Astrophysical Journal*, 755, 145, (2012)
2. "Dark matter profiles in the Galactic satellites: constraints from non-spherical mass models", K. Hayashi & M. Chiba, *ASP Conference Proceedings*, 458, 383, (2012)

III. Presentations

1. "Dynamical study of dSph galaxies in the Milky Way", K. Hayashi, The PFS 3rd General Collaboration Meeting, (August 13-16, 2012, California Institute of Technology, Pasadena, US)
2. "Nature of dark matter halos in the Galactic satellites based on non-spherical mass models", K. Hayashi, M. Chiba ESO@50 THE FIRST 50 YEARS OF ESO, (September 3-7, 2012, European Southern Observatory, Garching, Germany)

3. "Non-spherical dark halos in the Galactic satellites: New discrepancy of Λ CDM theory", K. Hayashi, Astronomy & Astrophysics summer school, (August 1-4, 2012, Mikuni-Kanko Hotel, Sakai Japan)
4. "The Prolate Dark Halo of Andromeda Galaxy", K. Hayashi, M. Chiba Subaru user's meeting, (January 15-17, 2013, National Astronomical Observatory of Japan, Mitaka, Japan)
5. "The global structure of Andromeda galaxy", K. Hayashi, M. Chiba, The annual meeting of ASJ in 2013 spring, (March 20-23, 2013, Saitama University, Saitama, Japan)
6. "The prolate dark halo of Andromeda galaxy", K. Hayashi, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.51

Name	Kazuya Fujio
Department	Astronomy
Position	D3
Research Title	RA: The anisotropy in loop quantum cosmology

I. Summary of Research

We investigate behavior of the solutions of quantum Bianchi type I spacetime with massless scalar field within the framework of loop quantum cosmology.

We derive the effective action for this model by using the path integral method proposed by Ashtekar, Campiglia, and Henderson. From this action, we obtain the effective equations of motion which contain non-trivial quantum corrections. Instead of ordinary canonical pair (c_i, p_j) , we construct a new formulation written in (C_1, C_2, b) which is preferable to study Bianchi type I spacetime.

New formulation clarifies the existence of invariants, and makes it possible to construct the solution space. In addition to solutions which evolve into classical universes, we found the cyclic and the stationary solutions which are dominated by quantum effect for all time. We also show the asymmetric behavior and construct the rule of Kasner transition behaviors across the bounce.

The 'probability' to have classical isotropic universe is estimated by using the measure defined in the solution space. Although we find that isotropic classical universes are disfavored in our model with massless scalar field, we argue that LQC can explain the present isotropy if we consider more realistic model.

II. Publications

1. "Behavior of Bianchi type I spacetime by path integral approach in LQC",
Kazuya Fujio and Toshifumi Futamase, Physical Review D, vol. 85, Issue 12 (2012)
2. "Solution space of Bianchi type I spacetime in loop quantum cosmology",

Kazuya Fujio and Toshifumi Futamase, Physical Review D (accepted) (2013)

III. Presentations

1. "Study of Bianchi type I spacetime in Loop Quantum Cosmology",
Kazuya Fujio, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.52

Name	Takayuki Maebayashi
Department	Astronomy
Position	D2
Research Title	RA/Initiative A: The Origin of Low-luminosity AGN/AGN-like Activities in Red Early-type Galaxies.

I. Summary of Research

1. The ionizing mechanisms of LINER class galaxies proposed so far fall roughly into four categories: a) photoionization from AGN, b) shock excitation, c) photoionization from old stars, d) photoionization from hot ISM. In this year, I examined these models of (a) and (c) in my early-type galaxy (ETG) sample by using the GALEX data and SDSS data. It is very useful for us to combine UV data with optical data because UV radiation has a direct connection to photoionizing processes. To be more precise, it is expected that a NUV-r' color should be redder than about 5.0 AB mag in the case of model (c) because old stars typically radiate these red spectra as well as photoionizing spectra. Therefore, I firstly examined all correlations among a NUV-r' color, a stellar mass, some optical colors and notable emission-line ratios. As a result, however, I found that about half of LINERs show "bluer" color than NUV-r'=5.0 AB mag. Therefore, this result might suggest that these "blue" LINERs have some UV sources other than old stars, i.e., possibly have low-luminosity AGN and/or small amount of young stars. Therefore, I secondly examined FUV-NUV color vs. NUV-r' color and found that these blue LINERs show the color-color distribution which is similar to that of star-forming ETGs. Although I couldn't exclude AGN as a candidate of UV sources, this additional result might suggest that small amount of OB stars are contributing to the ionizing radiation even in ETGs (in which old stars are usually thought to be dominating). If this is the case, I must modify the photoionization model of (c) to consider a UV contribution from OB stars.
2. These origins of LINERs also have a connection to some X-ray emitting processes, i.e., (a) and (d). Therefore, I also checked some X-ray data by the ROSAT All Sky Survey in combination with SDSS data. As a result, however, there were only few ETGs left after a cross-matching process. Therefore, I couldn't construct an available sample for my investigation.

II. Publications**III. Presentations**

1. "The Origin of Low-luminosity AGN/AGN-like Activities in Early-type Galaxies", T. Maebayashi; T. Murayama, The 42th Summer School in Astronomy and Astrophysics for Young Researchers (August 1-4, 2012, Mikuni Kanko Hotel, Sakai, Fukui, Japan)
2. "The Origin of Low-luminosity AGN/AGN-like Activities in Early-type Galaxies", T. Maebayashi; T. Murayama, GALEX FEST A Conference to Celebrate Nine Years of Exploring the Ultraviolet Universe, (September 4-7, 2012, The Huntington Library and Gardens, Pasadena, California, USA)
3. "The Origin of Low-luminosity AGN/AGN-like Activities in Early-type Galaxies", T. Maebayashi; T. Murayama, The Astronomical Society of Japan 2012 Autumn Meeting, (September 19-21, 2012, Ooita University, Ooita, Ooita, Japan)
4. "Low-luminosity AGN/AGN-like Activities in Early-type Galaxies from the GALEX view", T. Maebayashi; T. Murayama, Science by the Subaru/HSC survey, (September 26-28, 2012, NAOJ, Mitaka, Tokyo, Japan)
5. "Low-luminosity AGN/AGN-like Activities in Early-type Galaxies; from the GALEX view", T. Maebayashi; T. Murayama, Seminar at the Research Center for Space and Cosmic Evolution, (October 29-31, 2012, Ehime University, Matsuyama, Ehime, Japan)
6. "The UV-excess Properties of LINER/Quiescent Early-type Galaxies", T. Maebayashi; T. Murayama, Supermassive Black Holes in the Universe: The Era of the HSC Surveys, (December 18-20, 2012, Ehime University, Matsuyama, Ehime, Japan)
7. "The UV-excess Properties of LINER/Quiescent Early-type Galaxies", T. Maebayashi, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

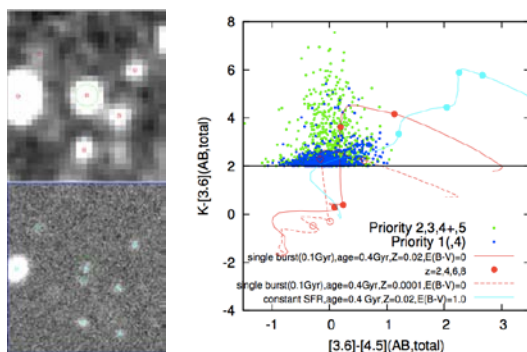
No.53

Name	Ken Mawatari
Department	Astronomy
Position	D1
Research Title	RA/ Initiative A: Search for proto-clusters of galaxies in the distant universe

I. Summary of Research

1. Now I work at Smithsonian Astrophysical Observatory (U.S.A.) with the Spitzer IRAC team. IRAC is the infrared camera equipped with Spitzer Space telescope. I have analyzed the imaging data that is taken with IRAC in Spitzer Extended Deep Survey (SEDS), searching for red galaxies that have $K - [3.6]$ color (color between $2.2\mu\text{m} - 3.6\mu\text{m}$) redder than 2. From the simulation using stellar population synthesis model, three kinds of galaxies are expected to satisfy this color criterion: (1) passive galaxies

at $z > 5$, (2) dusty star forming galaxies at $z < 2$, and (3) emission line galaxies at $z \sim 6$ ([OIII] and H α). The hundreds of candidates with $K - [3.6] > 2$ were detected while they are still under the careful inspection (very deep infrared data like SEDS requires very careful treatment). Figure 1 and 2 shows an example of appearance of detected galaxies and their distribution in the two color diagram, respectively. I consider that it is important to separate and investigate passive galaxies at $z > 5$ because they are new population galaxies and worthwhile to investigate the nature.



(Left: Figure1) An example of red galaxies detected from SEDS (green circle). Top panel is 3.6 μ m band image and bottom is K band (2.2 μ m) image.

(Right: Figure2) The red galaxy candidates in $[3.6]-[4.5]$ vs $K-[3.6]$ two color diagram (blue and green dots). Three lines show the model galaxies that can explain observed colors.

- My original research plan was to search for clusters of galaxies and investigate environmental dependency at high redshift. Although I changed my main research because of the hot and new SEDS data (which is not yet released to world), I have continued the old project. I am under the work to check the accuracy of "Rareness Probability" which I introduced to quantify rareness of structure including clusters in Mawatari et al. (2012). The analysis method using Rareness Probability will be useful to investigate the environmental dependency of the SEDS red galaxies at $z > 5$ that I detected.

II. Publications

- "Characterization of the Distribution of the Ly α Emitters in the 53w002 Field at $z = 2.4$ ", Mawatari, K., Yamada, T., Nakamura, Y., Hayashino, T., Matsuda, Y., *Astrophysical Journal*, 759, 133, (2012)

III. Presentations

- "Characterization Of The Distribution Of The Ly α Emitters In The 53W002 Field At $z = 2.4$ ", Mawatari, K., Yamada, T., Nakamura, Y., Hayashino, T., Matsuda, Y., American Astronomical Society 220th meeting (June 11-14, 2012, Anchorage, Alaska, America)
- "Wide-field Imaging Surveyor for High-redshift (WISH) mission: filter exchanging system", Mawatari, K., Yamada, T., Iwata, I., Yabe, K., Tamura, T., Morokuma, T., Iwamura, T., The Astronomical Society of Japan meeting (September 18-22, 2012, Oita University, Oita, Japan)
- "Search for red $K - [3.6] > 2$ galaxies revealed with the Spitzer SEDS survey", Ken Mawatari, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

7. "Test of significant size evolution of massive quiescent galaxies in MODS, without measuring the effective radius", Mohammad Akhlaghi. The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.55

Name Ryunosuke Ozawa
Department Mathematics
Position D1
Research Title RA/Initiative A: Research of sequences of spaces with its dimensions diverge to infinity

I. Summary of Research

In this year, I studied an extension of the observable diameter. This is joint research with Takashi Shioya (Tohoku University). M. Gromov introduced the observable distance between two metric measure spaces. Using the observable distance function, we can find the sequence of compact Riemannian manifolds with its dimensions diverge to infinity such that it converges to one point metric measure space. Moreover he introduced observable diameter. It is defined on the set of metric measure spaces. Its value measures nearness between a metric measure space and one point metric measure space. The topology generated by the observable distance function is very difficult. To research the topology, Gromov defined the pyramid. The pyramid is special closed subset of the set of metric measure spaces. The set of pyramids with special metric is compactification of the set of metric measure spaces with observable distance function. In this year, we extend the observable diameter to elements of the completion of the set of metric measure spaces with observable distance function and pyramids.

II. Publications

1. "Distance between metric measure spaces and distance matrix distribution", R. Ozawa, preprint.

III. Presentations

1. "Distance between metric measure spaces and distance matrix distribution", R. Ozawa, Geometry and Probability (October 19-21, 2012, University Consortium Yamagata YOU campus station, Yamagata, Yamagata, Japan)
2. "Extensions of observable diameter", R. Ozawa, Geometry Seminar, (January 8, 2013, Tohoku University, Sendai, Japan)
3. "Extensions of observable diameter", R. Ozawa, Joint symposium of 6 departments, (February 21, 2013, Tohoku University, Sendai, Japan)
4. "Extensions of observable diameter", R. Ozawa, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University,

Sendai, Japan)

No.56

Name	Yosuke Saito
Department	Mathematics
Position	D1
Research Title	RA/Initiative A: Research of q-deformation of conformal field theory

I. Summary of Research

1. Elliptic Ding-Iohara algebra and the free field realization of the elliptic Macdonald operator.

Ding-Iohara algebra is a quantum group arising from the free field realization of the Macdonald operator. On the other hand, the elliptic analog of the Macdonald operator (elliptic Macdonald operator) is known. If the free field realization of the elliptic Macdonald operator is available, thereby we would be able to get an elliptic analog of the Ding-Iohara algebra. From the elliptic kernel function introduced by Komori, Noumi, and Shiraishi, I constructed the elliptic Ding-Iohara algebra and the free field realization of the elliptic Macdonald operator.

2. Applications of the elliptic Ding-Iohara algebra.

In the free field realization of the elliptic Ding-Iohara algebra, boson operators are used which reproduces the theta functions or the elliptic gamma functions. On the other hand, it is realized that the elliptic q -hypergeometric integrals are crucial for study of the superconformal indices which are partition functions of supersymmetric gauge theory. Then by using boson operators which are used in the free field realization of the elliptic Ding-Iohara algebra, I obtained a method of reproducing the elliptic q -hypergeometric integrals from the vacuum expectation of the boson operators. By the method, some superconformal indices are also reproduced by the boson operators. Hence the relation between the representation of the elliptic Ding-Iohara algebra and the superconformal index should be more studied. As another material, it is known that from the representation of the Ding-Iohara algebra and the trigonometric Feigin-Odesskii algebra, we can construct the commutative family of the Macdonald operators. I noticed the elliptic analog of the fact, i.e. by the representation of the elliptic Ding-Iohara algebra and the elliptic Feigin-Odesskii algebra, we can get the commutative family of the elliptic Macdonald operators.

II. Publications

III. Presentations

1. "Elliptic Ding-Iohara Algebra and the Free Field Realization of the Elliptic Macdonald Operator", Poster presentation, Yosuke Saito, The 5 th GCOE International Symposium, March 4 ~ 6, Tohoku university, Japan.
2. "Elliptic Ding-Iohara algebra and the free field realization of the elliptic Macdonald Operator",

“Elliptic q -Virasoro algebra and its free field realization”, Yosuke Saito, MSJ Spring Meeting 2013, March 20 ~ 23, The Mathematical Society of Japan, Kyoto university, Japan.

No.57

Name Kazuki Sato
Department Mathematics
Position D1
Research Title **RA: Chow groups of zero-cycles on quadratic fibrations**
Initiative A: Algebraic cycles on algebraic varieties over arithmetic fields

I. Summary of Research

In this year, I studied the injectivity of the global-to-local map for the Chow group of zero-cycles on a quadric fibration.

Given a polynomial equation with rational coefficients, if it has a rational solution, then it has a p -adic solution for all prime numbers p and a real solution. We can ask whether the converse holds, that is, if a polynomial equation with rational coefficients has a p -adic solution for all primes p and a real solution, does it have a rational solution? This property is called the local-global principle (or the Hasse principle). The Hasse-Minkowski Theorem states that the Hasse principle holds for quadratic forms over the rational numbers (more generally, over any number fields). Since the reduced norm over a quaternion algebra is represented by a quadratic form of rank 4, a quaternion algebra over a number field splits if and only if it splits over all completions of the number field. By the Albert-Brauer-Hasse-Noether theorem, the same argument holds for any central simple algebras over number fields. Their result is equivalent to say that the global-to-local map for the Brauer groups of number fields is injective.

The global-to-local map can be considered also for the Chow group of zero-cycles on an algebraic variety over a number field. For an algebraic variety, a formal sum of points on it with rational integer coefficients is called a zero-cycle. Zero-cycles on a variety forms an infinitely generated free abelian group, and we define the Chow group of zero-cycles on a variety as a group of rational equivalent classes of zero-cycles.

In this year, we gave a sufficient condition for the injectivity of the global-to-local map for the (relative) Chow group of zero-cycles on a quadric fibration over a smooth projective curve. Parimala and Suresh proved that for a quadric fibration with the generic fiber defined by Pfister neighbour of rank at least 5, the global-to-local map is injective. When the generic fiber is defined by a quadratic form of smaller rank, we showed that if the fibration is birationally constant, then the global-to-local map is injective. In addition, we constructed a quadric fibration for which the global-to-local map is injective, but the global-to-local map restricted to real places is not injective.

II. Publications

III. Presentations

1. "Chow groups of zero-cycles on quadric fibrations", Kazuki Sato, Number theory Seminar (May 21, 2012, Tohoku University, Sendai, Japan)
2. "Chow groups of zero-cycles on quadric fibrations", Kazuki Sato, Algebraic Geometry Seminar (June 1, 2012, Tohoku University, Sendai, Japan)
3. "Chow groups of zero-cycles on quadric fibrations", Kazuki Sato, The 11th Sendai Hiroshima Workshop on Number theory (July 17-20, 2012, Tohoku University, Sendai, Japan)
4. "Hasse principle for the Chow groups of zero-cycles on quadratic fibrations", Kazuki Sato, Number Theory Joint Seminar (November 16, 2012, Kyoto University, Kyoto, Japan)
5. "Hasse principle for the Chow groups of zero-cycles on quadric fibrations", Kazuki Sato, The 5th GCOE International Symposium, (March 4-6, 2013, Tohoku University, Sendai, Japan)
6. "Hasse principle for the Chow groups of zero-cycles on quadric fibrations" Kazuki Sato, Number Theory Workshop at Waseda University (March 16-18, 2013, Waseda University, Tokyo, Japan)

No.58

Name	Noboru Chikami
Department	Mathematics
Position	D1
Research Title	RA/Initiative A: The regularity and the asymptotic behavior of the solution of the compressible Navier-Stokes-Poisson system

I. Summary of Research

In this year, I studied the barotropic compressible Navier-Stokes system with various potential terms. For the system with a Yukawa-type potential term describing the hydrodynamical motion of a nuclear matter, the local existence and uniqueness of the solution are obtained in the whole domain. Moreover, for the local strong solution, the corresponding blow-up criterion has been proven, which improves previous results. The result has been compiled to a paper and now being assessed by a responsible publisher. For the compressible Navier-Stokes-Poisson system which is the model of a semiconductor device, the local solution in the critical Besov space has been obtained, which improves the spacial condition of former results.

II. Publications

1. "The local existence and blow-up criterion for the compressible Navier-Stokes system with a Yukawa-potential in Besov spaces", N. Chikami, preprint.

III. Presentations

1. "The local existence and blow-up criterion of the compressible Navier-Stokes-Yukawa system", N. Chikami, The 34th Wakte-Seminar on Evolution Equation, (Sep. 1-4, 2012, Miura, Kanagawa, Japan)
2. "The local existence and blow-up criterion for the compressible Navier-Stokes system with a Yukawa-potential in Besov spaces", N. Chikami, Mathematical Society of Japan 2012 AUTUMN MEETING, (Sep. 18-21, 2012, Kyushu University, Hakata, Fukuoka, Japan)
3. "The local existence and blow-up criterion of the compressible Navier-Stokes system with a Yukawa-potential", N. Chikami, The 7th Japanese-German International Workshop on Mathematical Fluid Dynamics(Nov. 5-8, 2012, Waseda University, Tokyo, Japan)
4. "The local existence and blow-up criterion of the compressible Navier-Stokes system with a Yukawa-potential", N. Chikami, Nonlinear Dispersive Equations and Fluid Mechanics -Well-posedness and Smoothing Effect-, (Dec. 12-14, 2012, Tohoku University, Sendai, Miyagi, Japan)
5. "The local existence and blow-up criterion of the compressible Navier-Stokes-Yukawa system", N. Chikami, The 5th GCOE International Symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (Mar. 4-6, 2013, Tohoku University, Sendai, Miyagi, Japan)
6. "The local existence and blow-up criterion of the compressible Navier-Stokes-Yukawa system", N. Chikami, The 14th Northeastern Symposium on Mathematical Analysis (March 4-6, 2013, Tohoku University, Sendai, Miyagi, Japan)

No.59

Name	Kenta Tottori
Department	Mathematics
Position	D1
Research Title	RA: Existence problem for a geodesic in the space of Kähler metrics

I. Summary of Research

In this year, I studied a geodesic in the space of Kähler metrics. It is important to study the geodesic because it is related to the existence and uniqueness problem of constant scalar curvature Kähler metrics. The geodesic corresponds to the solution of the homogeneous complex Monge-Ampère equation and it defines the Monge-Ampère foliation on $\Sigma \times M$ where M is a Kähler manifold and Σ is a strip domain in the complex plane \mathbb{C} . In last year, I got the necessary condition for the existence of the solution of the homogeneous complex Monge-Ampère equation. In this year, I got the equivalent condition for the existence of the solution. This condition is related to the Monge-Ampère foliation.

II. Publications**III. Presentations**

1. "A Monge-Ampère foliation associated with a geodesic in the space of Kähler metrics", K. Tottori, Doctoral Forum of Mathematics between Fudan and Kyoto Universities (December 8-12, 2012, Kyoto University, Kyoto, Japan)
2. "The solution of the Homogeneous Complex Monge-Ampère equation corresponding to a geodesic in the space of Kähler metrics", K. Tottori, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)
3. "The solution of the Homogeneous Complex Monge-Ampère equation corresponding to a geodesic in the space of Kähler metrics", K. Tottori, The 9th Mathematics Conference for Young Researchers (March 4-7, 2013, Hokkaido University, Hokkaido, Japan)

No.60

Name	Makoto Fujiwara
Department	Mathematics
Position	D1
Research Title	RA: Reverse mathematics for graph theory Initiative A: Reverse mathematical analysis of marriage theorems and refinement of reverse mathematics

I. Summary of Research

I have investigated the strength of many restricted marriage theorems in the context of reverse mathematics. In reverse mathematics, we classify mathematical theorems by the degree of incomputability based on computability. But we cannot classify a theorem which is uniformly computable and a theorem which is computable but not uniformly computable, because the base theory of reverse mathematics corresponds to "computable", and "uniformly computable" is stricter than just "computable". In previous researches of reverse mathematics, we have considered the strength of the sequential version of each computable theorem to classify them. In my research, we have found that the strength of sequential version reflects not only whether each computable theorem is uniformly computable or not, but also how the degree of non-uniformity of the computation is. Concretely speaking, I have shown the followings.

1. While it has been known by a previous research that (infinite) marriage theorem is equivalent to ACA, a restricted marriage theorem which has combinatorially strengthened assumption is provable in RCA_0 , namely computable.
2. The restricted marriage theorem seems not to be uniformly computable and the sequential version of it is actually equivalent to ACA.
3. If we strengthen the assumption still, the strength of the sequential version of them is going to weaken

to WKL and RCA by degrees, where the restricted marriage theorem of which sequential version is provable in RCA, is actually uniformly computable.

I gave two presentations about these results at Sendai Logic Seminar held at Tohoku University on 18 May and Computability in Europe 2012 held at University of Cambridge on 18-23 June.

II. Publications

III. Presentations

1. "Restricted marriage theorems and uniformity in the context of reverse mathematics", Makoto Fujiwara, Sendai logic seminar (May 18, 2012, Tohoku University, Sendai, Japan)
2. "Recursive marriage theorems and reverse mathematics", Makoto Fujiwara, Kojiro Higuchi and Takayuki Kihara, Computability in Europe 2012 on "How the World Compute" (June 18-23, 2012, University of Cambridge, UK)

No.61

Name	Yusuke Miura
Department	Mathematics
Position	D1
Research Title	RA/Initiative A: Ultracontractivity for Markov semigroups and quasi-stationary distributions

I. Summary of Research

In this year, I studied a quasi-stationary distribution for a symmetric Markov process \mathbf{M} with symmetry measure m . A quasi-stationary distribution is a distribution which is invariant under time evolution when the process is conditioned to survive. By using Fukushima's ergodic theorem, I proved that if there exists a ground state Φ which belongs to L^1 , then a quasi-stationary distribution for \mathbf{M} exists. Note that this assertion requires L^1 -integrability for Φ . When the measure m is not finite, this is not always true. By this reason, I used the property called intrinsic ultracontractivity, which is a sufficient condition for Φ being in L^1 . As a result, I obtain a new method : intrinsic ultracontractivity implies the existence of a quasi-stationary distribution. This method has advantage of being able to apply to multidimensional processes.

As an example, I dealt the logistic Feller diffusion process, that is, a one-dimensional diffusion process which appears in some biological models. It is already shown that this model has a quasi-stationary distribution. I gave another proof of this fact by using above method. To prove that this model has intrinsic ultracontractivity, we classified boundary points in the sense of Feller and used Tomisaki's result(2007).

II. Publications

1. "Ultracontractivity for Markov semigroups and quasi-stationary distributions", Y. Miura, submitted.

III. Presentations

1. "Ultracontractivity for Markov semigroups and quasi-stationary distributions", Y. Miura, Tohoku probability seminar (June 1, 2012, Tohoku University, Sendai, Japan)
2. "Ultracontractivity for Markov semigroups and quasi-stationary distributions", Y. Miura, six-departments joint symposium (February 21, 2013, Tohoku University, Sendai, Japan)
3. "Ultracontractivity for Markov semigroups and quasi-stationary distributions", Y. Miura, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)
4. "Ultracontractivity for Markov semigroups and quasi-stationary distributions", Y. Miura, Workshop on Probability at Kansai University (March 15-17, 2013, Kansai University, Osaka, Japan)

No.62

Name	Shota Murakami
Department	Mathematics
Position	D1
Research Title	RA/Initiative A: Independence results for Peano arithmetic

I. Summary of Research

In this year I studied independence results for formal systems, especially for Peano arithmetic (PA). Most of independence results for PA, for example Paris-Harrington theorem, were found by model theoretic methods. Because of this, I studied model theory of PA and studied definable models of PA in particular. I also studied modal dependence logic. I generalized this logic to have more expressive power and proved some model theoretic properties of this logic.

II. Publications

III. Presentations

1. "Introduction to model theory of arithmetic", Shota Murakami, Sendai logic seminar (December 14, 2012, Tohoku University, Sendai, Miyagi, Japan)
2. "Generalized modal dependence logic", Shota Murakami, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.63

Name	Nobuaki Naganuma
Department	Mathematics
Position	D2
Research Title	RA/Initiative A: Smoothness of densities of SDEs with non-Lipschitz continuous coefficients

I. Summary of Research

One of aim in this year was to show smoothness of densities of SDEs with non-Lipschitz continuous coefficients. However, since it seems difficult to obtain the smoothness, I changed my objective and worked on problems about approximations of solutions to stochastic differential equations (SDEs) driven by fractional Brownian motion (fBm).

In 2012, I considered asymptotic error distributions of the Crank-Nicholson scheme associated to one-dimensional SDEs. The Crank-Nicholson scheme is one of finite-difference methods and is known that its error is smaller than one of the Euler scheme. The difficulty in this analysis is that we cannot use the martingale theory since fBm is not martingale.

Here I state results obtained in this year. I found the exact error bounds of the Crank-Nicholson scheme and the limit distribution of the error with the suitable normalized constant. Namely, denoting by $X^{(n)}$ and X the Crank-Nicholson scheme with the ratio of time step $1/n$ and the solution of SDE, respectively, we have that $n^{3H-1/2}(X^{(n)} - X)$ converges to some process. In order to obtain the result, we need to know asymptotic behavior of the Hermite variations, which provide a lot of information of Wiener functionals. Using the information of the Hermite variations, I also showed the Itô formula for fBm. From these results, I obtained asymptotic error distributions of the Crank-Nicholson scheme.

II. Publications**III. Presentations**

1. "Smoothness of densities of generalized locally non-degenerate Wiener functionals", Nobuaki NAGANUMA, Tohoku Probability Seminar, June 1, 2012, Tohoku University, Sendai, Japan.
2. "Smoothness of densities of generalized locally non-degenerate Wiener functionals", Nobuaki NAGANUMA, Okayama Analysis and Probability Seminar, August 9, 2012, Okayama University, Okayama, Japan.
3. "Smoothness of densities of generalized locally non-degenerate Wiener functionals", Nobuaki NAGANUMA, Okayama Analysis and Probability Seminar, August 20-24, 2012, Suzuoka, Gamagori, Japan.
4. "Asymptotic error distributions of the Crank-Nicholson scheme for SDEs driven by fractional Brownian motion", Nobuaki NAGANAUMA, The 5th Scienceweb GCOE International Symposium, March 4-6, 2013, Tohoku University, Sendai, Japan.

5. "Asymptotic error distributions of the Crank-Nicholson scheme for SDEs driven by fractional Brownian motion", Nobuaki NAGANAUMA, Soshun Probability Seminar, March 15-17, 2013, Kansai University, Osaka, Japan.

No.64

Name **Satoshi Ueki**
Department **Mathematics**
Position **D2**
Research Title **RA/Initiative A: Hamiltonian Volume Minimizing Problem**

I. Summary of Research

In this year, I studied the Hamiltonian volume minimizing problem for isotropic submanifolds in Kähler manifolds. This problem requires isotropic submanifolds which are volume minimizing under Hamiltonian deformations. For this problem, few examples have been given before. I tried to find minimal and stable isotropic submanifolds under Hamiltonian deformations or exact deformations. Exact deformation was introduced by B.Y. Chen and J-M. Morvan as an analogy to the Hamiltonian deformations of Lagrangian submanifolds. I showed the following results.

1. Let P be a real $2n$ -dim Kähler manifold and Q be a totally geodesic real $2k$ -dim Kähler submanifold of P ($k < n$). If M is a Hamiltonian minimal Lagrangian submanifold of Q , then M is an exact minimal isotropic submanifold of P .
2. Let P be a real $2n$ -dim Kähler manifold and Q be a totally geodesic real $2k$ -dim Kähler submanifold of P ($k < n$). Assume that P has nonpositive sectional curvature. If M is a Hamiltonian stable Lagrangian submanifold of Q which is minimal, then M is an exact stable isotropic submanifold in P .

Note that the assumption on the sectional curvature of P is necessary. For example, totally geodesic n -dim real projective space in $(n+1)$ -dim complex projective space is not exact stable (B.Y. Chen and J-M. Morvan).

II. Publications

1. "Leaf-wise intersections in coisotropic submanifolds", Satoshi Ueki, Kodai Mathematical Journal, to appear.

III. Presentations

1. "Integral geometry and its applications", S. Ueki, UK-Japan Mathematical Forum, (July 15-20, 2012, Keio University, Kawasaki, Kanagawa, Japan)
2. "Deformations of isotropic submanifolds", S. Ueki, Geometry seminar, (January 8, 2013, Tohoku University, Sendai, Miyagi, Japan)

3. "Deformations of isotropic submanifolds", S. Ueki, Differential geometry seminar, (January 16, 2013, Osaka City University, Osaka, Osaka, Japan)
4. "Volume minimization, minimality and stability under Hamiltonian deformations", S. Ueki, 6 specialty association symposium, (February 21, 2013, Tohoku University, Sendai, Miyagi, Japan)
5. "Deformations of isotropic submanifolds in Kähler manifolds", S. Ueki, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Miyagi, Japan)

No.65

Name Kota Uriya
Department Mathematics
Position D2
Research Title RA/Initiative A: Asymptotic behavior and regularity of a solution to the nonlinear Schrödinger system

I. Summary of Research

In this year, I study the quadratic nonlinear Schrödinger system from view point of asymptotic behavior and regularity of the solution. As a first result, I obtained a finite time blow up for the radial solution that has negative initial energy without finite moment assumption. This result showed that the violation of the regularity in finite time for the radial solution. As a second result, I obtained the specific asymptotic behavior of a solution which describes the mass transfer phenomenon under the mass resonance condition. This mass transfer phenomenon was expected from the special mass conservation structure of the system.

II. Publications

1. "Asymptotic behavior of solutions to a quadratic nonlinear Schrödinger system with mass resonance", Ogawa, T., Uriya, K., RIMS Kokyuroku Bessatsu, accepted.

III. Presentations

1. "Asymptotic behavior of solutions to a quadratic nonlinear Schrödinger system with mass resonance", Kota Uriya, Harmonic Analysis and Nonlinear Partial Differential Equations, (July 2-4, RIMS, Kyoto, Japan)
2. "Asymptotic behavior of solutions to a quadratic nonlinear Schrödinger system with mass resonance", Kota Uriya, Osaka University seminar on differential equation, (July 27, Osaka University, Osaka, Japan)
3. "Asymptotic behavior of solutions to a nonlinear Schrödinger system", Kota Uriya, The 34th Wakate Seminar on evolution equation, (September 1-4, 2012, Miura, Kanagawa, Japan)

4. "Asymptotic behavior of solutions to a nonlinear Schrödinger system", MSJ Autumn Meeting 2012, at Kyushu University, (September 18-21, Kyusyu University, Fukuoka, Hakata, Japan)
5. "Asymptotic behavior of solutions to a nonlinear Schrödinger system in two space dimensions", Nonlinear Dispersive Equations and Fluid Mechanics -Well-posedness and Smoothing Effect-, (December 12-14, Tohoku University, Sendai, Miyagi, Japan)
6. "Final state problem for the quadratic nonlinear Schrödinger system in two space dimensions", The 14th Northeastern Symposium on Mathematical Analysis, (February 18-19, Tohoku University, Sendai, Miyagi, Japan)
7. "Final state problem for the quadratic nonlinear Schrödinger system with mass resonance", Kota Uriya, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.66

Name	TKouich Kimura
Department	Mathematics
Position	D2
Research Title	RA: Homogeneous Reinhardt domains in \mathbb{C}^n

I. Summary of Research

1. The theme of my study in fiscal 2012 was the algebraic equivalence problem for Reinhardt domains containing the origin in \mathbb{C}^3 . The classification of general homogeneous Reinhardt domains in \mathbb{C}^n is conjectured to be as follows:

Conjecture. Let D be a Reinhardt domain in \mathbb{C}^n . There exist integers n_1, \dots, n_k but k may be 0, and non-negative integers l, m with $n_1 + \dots + n_k + l + m = n$ such that D is algebraically equivalent to $B_{n_1} \times \dots \times B_{n_k} \times \mathbb{C}^l \times (\mathbb{C}^*)^m$, where B_{n_i} is the complex n_i -unit ball.

It is expected that homogeneity implies pseudoconvexity in Reinhardt domains. But it is not proved at this moment, and so study of the conjecture is very difficult. Then under an additional condition i.e. D is pseudoconvex, We give a partial answer as follows:

Theorem. Let D be a unbounded proper Reinhardt domain containing the origin in \mathbb{C}^3 . If D is homogeneous, then D is algebraic equivalent to one of three canonical domains so that $B_1 \times \mathbb{C}^2$, $B_1 \times B_1 \times \mathbb{C}$, $B_2 \times \mathbb{C}$.

II. Publications

1. Satoru Shimizu and Kouichi Kimura, "Homogeneous Reinhardt domains containing no coordinate hyperplans", preprint

2. Kouichi Kimura, "Homogeneous Reinhardt domains containing the origin", be under writing.

III. Presentations

1. "Homogeneous Reinhardt domains containing the origin in the complex 3-space", Kouichi Kimura, The 5th International GCOE Symposium (March 4, 2013, Tohoku University, Sendai, Japan)

No.67

Name Rena Tateda
Department Mathematics
Position D2
Research Title RA: Problems concerning the number of integral points in the theory of heights

I. Summary of Research

A system of congruences $a_{i0} + \sum_{j=1}^k a_{ij}x_j \equiv 0 \pmod{m_i}$, $i = 1, \dots, t$ is called *covering* if every vector $[x_1, \dots, x_k] \in Z^k$ satisfies at least one of these congruences. We say the covering system is *incongruent* if all its moduli are distinct, and *composite* if each modulus is composite. We call the incongruent and composite system CICS.

For one dimensional system $k = 1$, there are principal results concerning such systems. We give analogues for covering systems in higher dimensions and their refinements for homogeneous covering systems, *i.e.* systems of the above form in which $b_{i0} = 0$ for all $0 \leq i \leq t$. Myerson showed that every homogeneous cover of Z^2 can be constructed from a CICS. The archetypal example of a homogeneous covering system is constructed using a CICS devised by John Selfridge which contains 20 moduli. Gerry asked whether any CICS exists with fewer than 20 moduli. We answer Gerry's question and show that besides Selfridge's example there are five other sets of 20 moduli which can be used to construct a CICS.

For $k = 1$, we describe the CICSs of minimum cardinality, and consider the following decision problem:

Instance : A multiset of integers $\{m_1, \dots, m_t\}$.

Question : Do there exist integers $\{a_1, \dots, a_t\}$ such that $\{x \equiv a_1 \pmod{m_1}, \dots, x \equiv a_t \pmod{m_t}\}$ is a covering system?

We call a Yes-instance of this question *good*. We construct an algorithm for testing whether or not a set of integers is good. Unfortunately, our algorithm cannot give a positive answer to this question: its output is either "No" or "Don't know". But using this algorithm, we can answer Gerry's question in the negative.

We expect that these results have the function field analogues, and we can apply these analogues towards estimating what fraction of a hypersurface sections of a given regular projective scheme over the integral

ring are regular.

II. Publications

III. Presentations

1. "On the some results for covering systems of congruences", Rena Tateda, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6-, 2013, Tohoku University, Sendai, Japan)

No.68

Name	Tomonori Nakayama
Department	Mathematics
Position	D2
Research Title	RA: On the formal group and the cohomology

I. Summary of Research

1. In this year, I studied formal groups and its cohomological nature. In the study of curves, it is important to show the explicit constructions of the formal groups. The formal group of a hyperelliptic curve can be constructed in two ways. One way is to expand the addition formula of the Jacobian and the other method is to use the expansion of a holomorphic differential of the Jacobian. In last year, I studied the result on the formal groups of a hyperelliptic curve by Sairaiji. He proved that two formal groups which are constructed in two ways are essentially the same. This is a generalisation of the result of Honda in 1968 which is in the case of elliptic curves. To further examine this relationship, I studied another method to construct the formal group which is done cohomologically from algebraic varieties this year. I also studied displays, which is an excellent tool to examine formal p -divisible groups.

II. Publications

III. Presentations

1. "On the formal groups arising from algebraic varieties", T. Nakayama, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.69

Name Keisuke Yoshii
Department Mathematics
Position D2
Research Title RA/Initiative A: Determinacy of Games in Second Order Arithmetic

I. Summary of Research

1. A goal of our research is to investigate logical strengths of determinacy of infinite games and to characterize them with some axiom systems in second order arithmetic, called inductive definition. We defined varieties of inductive definition and showed that determinacy of game on some class of Borel hierarchy are characterized by them.

II. Publications

1. "Infinite Games and Transfinite Recursion of Multiple Inductive Definitions", K. Yoshii, K. Tanaka, Lecture Notes in Computer Science, 7318, 374-383, Springer, (2012)
2. "Infinite Games, Inductive Definitions, and Transfinite Recursion", K. Mashiko, K. Yoshii, K. Tanaka, submitted to Annals of Pure and Applied Logic

III. Presentations

1. "Infinite Games and Transfinite Recursion of Multiple Inductive Definitions", K. Yoshii, K. Tanaka, Computability in Europe, (June 18-23, 2012, University of Cambridge, Cambridge, U.K)
2. "A Hierarchy of Game Determinacy in Second Order Arithmetic", K. Yoshii, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.70

Name Masaki Wada
Department Mathematics
Position D2
Research Title RA: Global stability of heat kernel estimates for non-local operators under perturbation by smooth measures

I. Summary of Research

In this fiscal year, I researched the perturbation of transient jump type Dirichlet form by a certain class of measure and established the necessary and sufficient conditions on measure for the stability of fundamental solution to hold.

Let $(\mathcal{E}, \mathcal{F})$ be a transient Dirichlet form associated with α -stable like process or relativistic α -stable like process on \mathbb{R}^d . Denote by \mathcal{L} the generator corresponding to $(\mathcal{E}, \mathcal{F})$ and consider the equation $\frac{\partial u}{\partial t} = \mathcal{L}u$.

It is proved by Z.-Q. Chen, P. Kim and T. Kumagai that the fundamental solution of this equation $p(t, x, y)$ admits the two sided estimates as follows:

$$C_1 \phi(C_2 t, C_3 |x - y|) \leq p(t, x, y) \leq C_4 \phi(C_5 t, C_6 |x - y|),$$

where ϕ is an appropriate function and C_i 's are positive constants.

Let μ be a positive Radon smooth measure on \mathbb{R}^d satisfying Green tightness and define the perturbed

form \mathcal{E}^μ by $\mathcal{E}^\mu(u, u) = \mathcal{E}(u, u) - \int_{\mathbb{R}^d} u^2 d\mu$. If we denote by \mathcal{L}^μ the associated generator, it is proved

by Albeverio, Blanchard and Ma that there exists a fundamental solution $p^\mu(t, x, y)$ of equation

$$\frac{\partial u}{\partial t} = \mathcal{L}^\mu u. \text{ If } p^\mu(t, x, y) \text{ satisfies the same two sided estimates as } p(t, x, y) \text{ up to the choice of positive}$$

constants, we call this phenomenon the stability of fundamental solution. Following the arguments of M.

Takeda, Z.-Q. Chen and T.-S. Zhang, I established the necessary and sufficient conditions on μ for the stability of fundamental solution. The precise statement is as follows;

Assume the measure μ satisfies $\iint G(x, y) \mu(dx) \mu(dy) < \infty$. Then the stability of fundamental solution is valid if and only if $\inf\{\mathcal{E}(u, u) \mid \int u^2 d\mu = 1, u \in \mathcal{F}\} > 1$.

I will have submitted this result to Journal of the Mathematical Society of Japan by the end of the first half of February.

II. Publications

1. "Continuity of harmonic functions for non-local Markov generators", Masaki Wada, Potential Analysis, published online: November 11, 2012.

III. Presentations

1. "Perturbation of Dirichlet forms and stability of fundamental solutions", Masaki Wada, Young summer seminar on probability theory 2012, (August 20-24, 2012, Hotel Suzuoka, Gamagohri, Japan)
2. "Perturbation of Dirichlet forms and stability of fundamental solutions", Masaki Wada, Stochastic Analysis and Applications, (September 24-28, 2012, Okayama University, Okayama, Japan)
3. "Perturbation of Dirichlet forms and stability of fundamental solutions", Masaki Wada, Doctorial forum between Fudan-Kyoto Universities, (December 8-12, 2012, Kyoto University, Kyoto, Japan)
4. "Perturbation of Dirichlet forms and stability of fundamental solutions", Masaki Wada, Symposium on Probability theory, (December 18-21, 2012, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan)

5. "Perturbation of Dirichlet forms and stability of fundamental solutions", Masaki Wada, Symposium for six majors in Graduate school of Science, Tohoku University. (February 21, 2013, Tohoku University, Sendai, Japan)
6. "Perturbation of Dirichlet forms and stability of fundamental solutions", Masaki Wada, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.71

Name	Hiroko Yamamoto
Department	Mathematics
Position	D2
Research Title	RA: Concentration of the ground-state solution for reaction-diffusion equation in heterogeneous media and the stability of the solution

I. Summary of Research

I studied about a concentration phenomenon appearing in the ground state of a reaction-diffusion equation in heterogeneous media. Gierer and Meinhardt proposed a 2x2 reaction-diffusion system as a model of biological pattern formation. Their system comprises two biochemicals called an activator and an inhibitor, and it is postulated that biological pattern formation is governed by chemical pattern produced by the interaction between the activator and the inhibitor. It is interpreted that the change in cells starts at the place where the activator exists more. Therefore I am interested in where the activator concentrates in the region, that is, where a change in cells begins. However the 2x2 system is difficult to analyse. So, I consider the Shadow System which is the limiting system as the diffusion coefficient of the inhibitor tends to infinity. The stationary problem of the Shadow system is reduced to the Neumann problem for a single semilinear elliptic PDE. I emphasize that the equation contains an inhomogeneous term which is independent of the unknown, called the basic production term.

I am interested in a "locator function" which consists of the coefficients of the equation. And I proved that the ground-state solution of the problem concentrates around a single point determined by the minimum point of the locator function. Moreover, I considered the structure of the locator function and showed how to find the concentration point when the basic production term is sufficiently small.

II. Publications**III. Presentations**

1. "Concentration in the ground state of a reaction-diffusion equation modeling biological pattern formation", H. Yamamoto, Turing Symposium on Morphogenesis (August 27-31, 2012, Sendai International Center, Sendai, Japan)

2. "Ground state of a reaction-diffusion equation with spatial heterogeneity", H. Yamamoto, 2012 Summer School for Doctoral Students of the HeKKSaGOn Consortium (September 17-26, 2012, Heidelberg University, Heidelberg, Baden-Württemberg, Germany)
3. "Effect of the heterogeneity on the concentration point in the ground-state solution of a reaction-diffusion equation", H. Yamamoto, AMS South-eastern Fall Section Meeting (October 13-14, 2012, Tulane University, New Orleans, LA, the USA)
4. "Concentration phenomenon appearing in the least-energy solution of the ground state for a reaction-diffusion equation with variable coefficients", H. Yamamoto, Meiji Nonlinear Mathematical Seminar (January 28, 2013, Meiji University, Kawasaki, Japan)
5. "Locator function for concentration points of solutions of a spatially heterogeneous reaction-diffusion equation", H. Yamamoto, The 14th North-eastern Symposium on Mathematical Analysis (February 18-19, 2013, Tohoku University, Sendai, Japan)
6. "Locator function for concentration points of solutions of a reaction-diffusion equation in heterogeneous media", H. Yamamoto, The 5th GCOE International symposium on "Weaving Science Web beyond Particle-Matter Hierarchy" (March 4-6, 2013, Tohoku University, Sendai, Japan)
7. "Concentration point in the ground state of a reaction-diffusion equation in heterogeneous media", H. Yamamoto, The Mathematical Society of Japan Spring Meeting 2013 (March 20-23, 2013, Kyoto University, Kyoto, Japan)

No.72

Name	Kazumasa Inaba
Department	Mathematics
Position	D3
Research Title	RA: Topology of singularities of plane curves

I. Summary of Research

Mixed polynomials are polynomials in complex variables and their conjugate. In this year, we study deformations of isolated singularities of mixed polynomials and show that there exist deformations of several classes of singularities of mixed polynomials such that their singularities are Morse singularities or fold singularities.

II. Publications

1. "On the enhancement to the Milnor number of a class of mixed polynomials", to appear, Journal of the Mathematical Society of Japan.

III. Presentations

1. "On deformations of singularities of mixed polynomials", Kazumasa Inaba, Geometry seminar, (July 17, 2012, Tohoku University, Sendai, Japan)
2. "On deformations of singularities of mixed polynomials", Kazumasa Inaba, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.73

Name Kazuaki Tajima
Department Mathematics
Position D3
Research Title RA: On unstable points for certain prehomogenous vector spaces

I. Summary of Research

1. In this year, I studied the local orbit space of certain prehomogenous vector spaces (Joint work with Professor Akihiko Yukie (University of Kyoto)). We determine the local orbit space of the space of quadratic forms, and the space of 3-tensors. And, we currently study the local orbit space of the space of pair of ternary quadratic forms.
2. Also, I studied explicit calculation of the local orbital zeta function of the space of 3-tensors.

II. Publications

III. Presentations

1. "On Z_p -orbit spaces of certain prehomogenous vector spaces", Kazuaki Tajima, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.74

Name Yasuhito Nishimori
Department Mathematics
Position D3
Research Title RA: Research on the pinned polymers modeled by branching processes

I. Summary of Research

We consider a localization of potentials. Let V and W be sub-critical non-negative bounded functions with compact supports on d -dimensional Euclidian space, that is, the Schrodinger type operators

$H(V) := (-\Delta)^{\alpha/2} - V$, where $0 < \alpha < 2$, and $H(W)$ possess Green functions. We set $W(x;R) = W(x+R)$. Our aim is to show the sub-criticality of $H(V+W(\cdot;R))$ for large $|R|$.

B. Simon shown (1980) this fact for $\alpha = 2$. Our work is a natural extension of his one. In order to show the sub-criticality, we use the gauge theorem (in probability theory). By the gauge theorem, the sub-criticality is equivalent to the integrability of the Feynman-Kac functional $\exp(\int_0^\infty V(X_s) + W(X_s; R) ds)$, where X_s is a symmetric α -stable process, namely, a Markov process generated by the fractional Laplacian $(-\Delta)^{\alpha/2}$. Our main result is that the integral of the Feynman-Kac functional is less than a geometric series. As a result, we prove the sub-criticality of the Schrodinger type operator for large $|R|$. Moreover, we can conclude that the integral of $\exp(\int_0^\infty V(X_s) + W(X_s; R) ds)$ converges to the maximum one, i.e., the integral of $\exp(\int_0^\infty V(X_s) ds)$ or $\exp(\int_0^\infty W(X_s) ds)$, as $|R| \rightarrow \infty$.

II. Publications

1. "Large deviations for symmetric stable processes with Feynman-Kac functionals and its application to pinned polymers", Yasuhito Nishimori, Tohoku Math. J., accepted.

III. Presentations

1. "Large Deviation Principle for Stable Processes Weighted by Feynman-Kac Functionals and its Application to Pinned Polymer Model", Yasuhito Nishimori, Tohoku Probability Seminar, Jan. 2013. Tohoku Univ., Sendai, Japan.
2. "A localization of potentials", Yasuhito Nishimori, The 5th GCOE International Symposium on "Weaving Science Web. Beyond Particle-Matter Hierarchy", Mar. 4-6, 2013, Tohoku Univ. Sendai, Japan. (Poster session)

No.75

Name	Masakuni Matsuura
Department	Mathematics
Position	D3
Research Title	RA: Stochastic calculus of Feynman-Kac Multiplicative Functionals

I. Summary of Research

1. We consider the penalization problem for generalized Feynman-Kac functionals with 0-energy parts. This is the joint work with D.Kim (Kumamoto University). He and Kuwae gave the characterization of the boundedness of the gauge function which is the expectation of Feynman-Kac multiplicative functionals when time is infinity.
2. We partially solve the Feynman-Kac penalization problem, that is, we give the limit measure when the

normalized Feynman-Kac multiplicative functional is restricted to an arbitrary finite time. The limit measure is given by a martingale multiplicative functional with the gauge function.

3. We further see that the limit measure is absolutely continuous with respect to the probability measure of the base process and that the gauge function is the harmonic function of the corresponding Schrodinger type operator.

II. Publications

1. M. Matsuura, *Feynman-Kac Penalization Problem for Additive Functionals with Jumping Functions*, J. Math. Soc. Japan, in press.

III. Presentations

1. M. Matsuura, *Asymptotic Behavior of Non-local Feynman-Kac Semigroups*, Kansai probability seminar, Kyoto University, Kyoto, June 29th 2012.
2. M. Matsuura, *Generalized Feynman-Kac Penalization of Symmetric Stable Processes*, Tohoku probability seminar, Tohoku University, Sendai, January 25th 2013.
3. "Penalizations for Generalized Feynman-Kac Functionals", M. Matsuura, The 5th GCOE International Symposium on "Weaving Science Web. Beyond Particle-Matter Hierarchy", Mar. 4-6, 2013, Tohoku Univ. Sendai, Japan. (Poster session)

No.76

Name	Ahmad Termimi Bin Ab Ghani
Department	Mathematics
Position	D3
Research Title	RA: Stochastic Games on Graphs

I. Summary of Research

1. In 2012 fiscal year, we studied infinite two-player stochastic games on graphs. The main concern is to give simple expressions of values of games and investigate the existence of optimal (ϵ -optimal) strategies for each player in games of increasing Borel complexity, namely a reachability, Buechi game, and etc. Moreover, we are interested in the questions of what type of optimal (ϵ -optimal) strategy exists for each player depending on the type of games. We first prove some basic facts on a generalized version of reachability games, called generalized reachability games. The results of generalized reachability games are used to show the value of Buechi games can be approximated as values of some generalized reachability games. Finally, we introduce games with a Boolean combination of reachability games.

II. Publications

1. "Values on generalized reachability games", Ahmad Termimi, A.G., Higuchi. K and Tanaka, K. In: Proceedings of Research Institute for Mathematical Sciences (RIMS) K^okyu^oroku, Kyoto University (2012) (To be appear)
2. "On the analysis of strategies in stochastic games", Ahmad Termimi, A.G., Higuchi. K. and Tanaka, K. (2012) (Preprint 20 pages)

III. Presentations

1. "Optimal Strategies for Infinite Games", Sendai Logic Seminar. (July 13, 2012, Tohoku University, Sendai, Japan)
2. "Optimal Strategies for Simultaneous Games", Workshop on Proof Theory and Complexity Theory (September 12-14, 2012, RIMS, Kyoto University, Japan)
3. "On Values of Concurrent Buechi Games", Sendai Logic Seminar. (Oct. 19, 2012, Tohoku University, Sendai, Japan)
4. "Values and Optimal Strategies of Stochastic Games", Sendai Logic Seminar. (Jan 23, 2013, Tohoku University, Sendai, Japan)

No.77

Name	Takanao Negishi
Department	Mathematics
Position	D3
Research Title	RA: On periodic complex functions in several variables

I. Summary of Research

I have studied the periodic decompositions of complex functions for the past few years. In particular, one of my interests is the applications of Leont'ev's results on the periodic decompositions of functions holomorphic on a convex polygonal domain. In the last year, I found some domains on which some similar results hold. Based on these results, I construct a special Riemann surface \mathbf{R} that has a natural projection to the complex plane and an appropriate difference operator on \mathbf{R} . Then if $f(z)$ is an entire function and we extend $f(z)$ to a holomorphic function on \mathbf{R} , we can decompose $f(z)$ into a sum of periodic functions with respect to our special difference. I expect that the idea of extending the domain of a function to a Riemann surface can be made use of in other situations of periodic decomposition problem.

II. Publications

1. "On periodic decomposition of entire functions of several variables", T.Negishi, Aequationes

mathematicae, submitted.

III. Presentations

1. "On the periodic decompositions of entire functions", T.Negishi, Hiroshima Mathematical Analysis Seminar (July 6, 2012, Hiroshima University, Higashihiroshima, Hiroshima, Japan)
2. "An application of periodic decompositions of functions holomorphic on convex polygonal domains", T.Negishi, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.78

Name	NingNing Peng
Department	Mathematics
Position	D3
Research Title	Initiative A: Study on Algorithmic Randomness and Game trees

I. Summary of Research

1. We study the notion of relative randomness. We give some new characterizations of \mathcal{W}^1 -schnorr randomness via relative randomness, where \mathcal{W}^1 denote the halting problem.
2. We investigate the distributional query complexity of some unbalanced game trees.
3. We investigate the reverse mathematics on two laws of large numbers. One of the main purposes of this study is to establish equivalence between law of large number theorems and set existence axioms of second order arithmetic.

II. Publications

1. "Relative Randomness for Martin-Lof random sets", NingNing Peng, Kojiro Higuci, Takeshi Yamazaki and Kazuyuki Tanaka, Lecture Notes in Computer Science, vol. 7318, pp. 581-588, (2012)
2. "A Report On Studies of Relative Randomness", NingNing Peng, To appear in RIMS KÔkyûroku, (2012)
3. "Characterization of \mathcal{W}^1 -schnorr randomness via relative randomness", Kojiro Higuci, NingNing Peng, Preprint.
4. "Reverse Mathematics On Laws of Large Numbers", NingNing Peng, Takeshi Yamazaki and Kazuyuki Tanaka, Preprint.

III. Presentations

1. "Relative Randomness for Martin-Lof random sets", NingNing Peng, Computability in Europe, (June 18-23, 2012, University of Cambridge, Cambridge, UK)
2. "On the Saks-Wigderson Conjecture", NingNing Peng, Workshop on Proof Theory and Complexity,

(September 12-14, 2012, Kyoto University, Kyoto, Japan)

3. "On the Notions of Relative Randomness", NingNing Peng, Workshop on Computability Theory and Foundations of Mathematics, (February 18-20, 2013, Tokyo Institute of Technology, Tokyo, Japan)

No.79

Name Abdullah Kizilay
Department Mathematics
Position D2
Research Title Initiative A: Various Geometric Flow Equations

I. Summary of Research

1. Study the curve shortening flow for plane curves, which are not necessarily embedded in the plane.
2. Began studying the curve shortening flow in a Riemannian manifold using level set representation.

II. Publications

III. Presentations

1. "Level Set Formulation of Curve Shortening Flow in a Riemannian Manifold", A. Kizilay, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6-, 2013, Tohoku University, Sendai, Japan)

No.80

Name Seunghwan Yang
Department Mathematics
Position D1
Research Title RA: Quasi-stationary distributions of markov processes

I. Summary of Research

In this year, I studied the problem of the existence and uniqueness of quasi-stationary distributions. I have treated the case of Markov processes on the positive integers for which the origin is an absorbing state. I considered the concept of quasi-stationary distribution, theoretical property and the condition for the existence of quasi-stationary distributions. By applying this result, I checked the existence and uniqueness of quasi-stationary distribution for three typical models of birth and death processes. I also investigated the application of quasi-stationary distribution on field of demography or biology. I have been considering these previous results for extension on the multidimensional Markov processes.

II. Publications

1. "Quasi-stationary distributions of Markov processes and its applications", S.H., Yang, Master thesis.

III. Presentations

1. "Quasi-stationary distributions of Markov processes and its applications", S.H., Yang, An announcement of the master thesis, (August 2, 2012, Tohoku University, Sendai, Japan)
2. "Quasi-stationary distribution of Markov processes and its applications", Seunghwan Yang, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6-, 2013, Tohoku University, Sendai, Japan)

No.81

Name	Xiaohan Wang
Department	Mathematics
Position	D1
Research Title	Initiative A: Optimal stopping and its applications to mathematical finance

I. Summary of Research

Optimal stopping problems often arise when we need to find the best time or the best decision rule to make actions. These kinds of problems often exist in economics and finance, for example, to find the optimal stopping time to exercise the American type options, to make firm investment and so on. For optimal stopping problems, our objectives are to characterize the value functions by an analytical form and to find the optimal stopping time to maximize the payoff.

Under the Ito diffusion models, the cases with continuous and bounded reward functions have already been thoroughly researched in the recent decades while the irregular reward function cases are still not so clear. During the recent several years, the usual method using the variational characterization has been extended to the irregular cases in some sense. Meanwhile, a new method using the relationship between the excessivity and the concavity of the value functions has been developed. This method is powerful, available for functions only required to be measurable and in many cases we can obtain the closed form of the value functions.

As an application to mathematical finance, I solved the explicit pricing formula of the perpetual gap option of American type by both the above methods and compared these two methods.

II. Publications

III. Presentations

No.82

Name **Hiromichi Sugawara**
Department **Philosophy**
Position **D3**
Research Title **RA: Hume's Eclectic Method on Logic**

I. Summary of Research

1. In "Abstract of the Treatise", under the pretense of being a book reviewer of his own work, *A Treatise of Human Nature*, David Hume stated, "The author has finished what regards logic". That is, as a matter of form, it inductively pursues the principles of logic into the phenomenological world composed of ideas, rather than deductively in an axiomatic system that holds reasoning as valid from necessary premises. The objects to be treated in his reasoning are only our ideas, and therefore, he studies the mental or moral operations of humans, who are unintentionally engaged in reasoning concerned, as faculties or functions dependent on human nature.
2. It is generally interpreted that he divided reasoning into demonstrative and probable reasoning in the same manner as he divided its objects. He presents, however, the notion in the last section of Book I of *Treatise*, 'Conclusion of this book', that he could not sincerely devote himself, in his path of life, to only one aspect within the two species of reasoning. On the other hand, he also makes an unanticipated statement in *An Enquiry concerning Human Understanding* that "it is, at bottom, erroneous, at least, superficial".
3. In my research, I firstly showed the substantial relationship of reasoning mentioned above, not just from the perspective of abstract and rigid systems composed of ideas and rules as forms or essences, but from the perspective of ordinary humans who live in the temporal transition, which could make them use probable reasoning to assist demonstrative reasoning in all events. Secondly, I presented the view that the series of reasoning as above can be accounted for a kind of acts as means employed in the sense of our being directed toward the future ends.

II. Publications

III. Presentations

1. "Hume's Logic on his theory of Causation", Hiromichi Sugawara, Japanese Society of British Philosophy, The 37th Annual Conference (March 25-26, 2013, Tohoku University, Sendai, Japan)
2. "Hume's Eclectic Method on Logic", Hiromichi Sugawara, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan).

No.83

Name Satoshi Nikaido
Department Philosophy
Position D3
Research Title RA: On the stability of a free boundary problem with the curvature

I. Summary of Research

Throughout this year, I studied the phenomenology of Merleau-Ponty. Merleau-Ponty, a French phenomenological philosopher, mentions heroism in his works. his heroism is different from other older types of heroism. I attempted to define the heroism of Merleau-Ponty. And I studied the theory of other in comparing Merleau-Ponty and Sartre.

II. Publications

1. "Le Croisement des regards",
S.Nikaido,bunka,Tohoku bungakukai,No76,2013,submitted

III. Presentations

1. "From heroism to the politics of dialogue",
S. Nikaido, The th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy" (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.84

Name Masatoshi Echigo
Department Philosophy
Position D2
Research Title RA/ Initiative A: Foundation of sciences in Husserl's phenomenology

I. Summary of Research

I studied the sixth Investigation in Husserl's *Logical Investigations* this year. The aim of the study is to formulate in *Logical Investigations* the rank-structure of various entities that every logical notion has. The structure can be called "formal ontology". In this structure it matters that every rank is in "founding" relation. Two notions being in founding relation means that one notion can't exist without the other. The former "founds" the latter when the relation is realized. The relation is the key to explication of the formal ontology in *Logical Investigations*. I made a presentation on the formal structure in *Logical Investigations* and on the founding relation, and also I submitted a paper of the same theme. Also I studied Husserl's *Ideas*

I. I am making a poster presentation in 5th International GCOE symposium at Tohoku University about the influence on *Ideas I* by the schema of the formal structure in *Logical Investigations*.

II. Publications

III. Presentations

1. "On categorical forms in *Logical Investigations*", Echigo Masatoshi, Tohoku Philosophical Society 2012 (October 20-21, 2012, Tohoku University, Sendai, Japan)
2. "Formal Ontology in *Logical Investigations*", Echigo Masatoshi, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.85

Name	Marika Hirama
Department	Philosophy
Position	D2
Research Title	RA: Historicity of man in Heidegger and Dilthey Initiative A: The forming process of ontology in early Heidegger

I. Summary of Research

RA: Historicity of man in Heidegger and Dilthey

In this year, I focused on Dilthey's speculation about the individuality and historicity of man. In his late speculation, Dilthey shifted his interest from the analysis of the psychic structure of an individual mind to the interpretation of the historical and spiritual world in which we live and act. Yet even in his late arguments about historicity, the subject that forms this historical world is an individual, who grasps and feels the world and actively works on this world.

The purposiveness of this thinking, feeling, and willing individual mind's structure is, according to Dilthey, also ascribed to the productive nexus (*WirkungsZusammenhang*) of the community. The productive nexus (for example, a political or economic organization or cultural commune) formed each purposive system that is independent of an individual mind's purposive structure. Dilthey thinks that an individual mind's structural nexus and common productive nexus in the historical world is continuous and that each individual finds their meaning of life in the latter nexus, which influences him beyond his own life.

In this way, Dilthey loses sight of the finiteness and temporality of individual life, which is consistently important in his philosophy, because he ascribes more important roles to commonality and objectivity than to the finite individual action that forms the world. Here I think that Heidegger's interpretation of the

temporality of life helps resolve Dilthey's aporia of individuality and historicity or the objectivity of life.

Individual action is formed each time by the own psychic acquired nexus (*das erworbene Zusammenhang*) and common historical foundations of how to act. Also individual action is led by the will, which always tends toward the future. In this finite individual action seems to lie the point of contact between the historicity of the individual and the history of humankind.

Initiative A: The forming process of ontology in early Heidegger

In this year, I have focused on early Heidegger's forming process of his ontology in "*Sein und Zeit*". Particularly, I studied about the historicity of man, which is the most important viewpoint in early Heidegger's thinking. And this theme is elaborated under the influence of Dilthey's thinking of history. I'm interested in the contrast of considerations about historicity of man between Dilthey and Heidegger.

In the first half of this year, I focused on the problem of the "expression of life". In Dilthey, the problem is the objective expression of life, which can be universally understood. Against it, in Heidegger the problem is the expression of facticity of finite human life as the each individual action.

Each individual action is the historical one, which is formed by historical foundations of how to act and which is at the same time the expression of each individual history of life. In Dilthey, the history of individual isn't the main theme, because Dilthey admits the superiority of the objective and universal history of human spirit, and the finiteness or temporality of an individual is retired from the front of his argument.

In the latter half of this year, I focused on the "pragmatic" interpretation of Dilthey under the help of Heidegger. For example, Johach or M.Jung interprets the pragmatic relation between the individual and the world in Dilthey relating it to the "*In-der-Welt-sein*" in Heidegger. Like these interpreters, I think that under the help of Heidegger's considerations the historicity of man in Dilthey is more clearly elucidated. Since I think that in the temporality of man in Heidegger, in which the future has the superiority, the time as individual life history is took back into the interpretation of universal history in Dilthey.

II. Publications

III. Presentations

1. "Expression and being self –from the viewpoint of the critical reception of Dilthey by Heidegger", Marika Hirama, "*Shisaku*" Research Presentation Meeting (June 18, 2012, Tohoku University, Sendai, Japan)
2. "Individuality and historicity of life –from Dilthey's middle and late speculations-", Marika Hirama, The 5th International GCOE symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (March 4-6, 2013, Tohoku University, Sendai, Japan)

No.86

Name Tetsuya Yoshida
Department Philosophy
Position D1
Research Title RA: Frege on Logic and Philosophy of mathematics
Initiative A: Do mental actions conform to laws?

I. Summary of Research

This study elucidates the notion of unsaturatedness in Frege's works. In particular, it focuses on the difference between unsaturatedness and functions, which is a contentious issue in the construal of Frege's philosophy. The procedure of this study is as follows. First, it is ascertained that the concept—i.e., the reference of predicates—is called "unsaturated" and regarded as a kind of functions. This concept requires an object that serves as the reference of proper names. When we allocate an object for this concept, we obtain a truth value. This concept maps objects for truth values. Second, because it has been clarified that predicates and the sense of predicates are unsaturated, they cannot be functions. Predicates require a proper name, and the sense of predications requires the sense of proper names. Functions require a number as an argument. Number is an object, but proper names and the sense of proper names are not. Therefore, these are not arguments. In conclusion, unsaturatedness is not intrinsically related to functions, and predicates and sense of predicates do not have a faculty of mapping.

II. Publications**III. Presentations**

1. "From Thoughts to Truth: Frege on Judgment", Tetsuya Yoshida, The meeting of Sisaku, (June 11, 2012, Tohoku University, Sendai, Japan)
2. "Frege on Predicate", Tetsuya Yoshida, The meeting of the Philosophical Society of Tohoku, (October 20, 2012, Tohoku University, Sendai, Japan)
3. "Frege on Unsaturatedness", Tetsuya Yoshida, The 5th GCOE International Symposium on "Weaving Science Web beyond Particle-Matter Hierarchy", (Mar. 4-6, 2013, Tohoku University, Sendai, Japan)

No.87

Name Katsuyuki Kuriyama
Department Philosophy
Position D1
Research Title RA/Initiative A: On the problem of time and creation in Bergson's philosophy

I. Summary of Research

In this year, I did comparative studies of the concept of organism between Bergson and Kant. Organisms are peculiar natural phenomena. They have final forms, which are difficult to explain in terms of their natural mechanisms only. However, people hesitate to regard organisms as what a certain intelligence has intentionally produced according to a plan, because such an explanation, or teleology, results in blending supernatural factors—a transcendental intelligence, purposes, and so on—with an explanation of organisms as natural phenomena. Numerous philosophers have tackled this problem of organisms. Out of them, Bergson and Kant have been chosen as the objects of this comparative study because of the resemblance between the two philosophers' opinions, which both try to overcome both mechanism and teleology. This study clarified the ways in which Bergson and Kant try to overcome both mechanism and teleology in terms of the problem of organisms, and indicated the differences between them.

Kant's solution to the problem is to consider that a purpose, or that idea of the whole of an organism according which an organism is produced, is only grounds for cognition. In other words, Kant considered the finality in an organism to be the result of humankind's way of comprehending organisms, and did not commit himself to truly addressing the question of whether they are indeed produced by a transcendental intelligence and purposes have objective reality. In this way, Kant overcame both mechanism and dogmatical teleology, which insists that a transcendental intelligence and purposes exist objectively.

Bergson, on the other hand, rejected a common ground that mechanism and teleology both have: the reality of material elements that constitute an organism. He insisted that reality in an organism is not an aggregate of its elements, but a simple movement. In this way, Bergson overcame both mechanism and anthropomorphic teleology.

II. Publications

III. Presentations

1. "Order and time", Katsuyuki Kuriyama, The Association of the Philosophical Studies Tohoku University (June 4, 2012, Tohoku University, Sendai, Miyagi, Japan)
2. "Bergson and Kant —about their differentiations between organism and mechanism", Katsuyuki Kuriyama, The 15th North Japan Association of the Philosophical Studies (January 13, 2013, Hokkaido University, Sapporo, Hokkaido, Japan)
3. "Comparative studies of the concept of organism between Bergson and Kant", Katsuyuki Kuriyama, The 5th GCOE International Symposium (March 4-6, 2013, Tohoku University, Sendai, Miyagi, Japan)