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The Mathematical Society of Japan

2018 Annual Meeting

Titles and Short Summaries of the Talks

March, 2018

at The University of Tokyo

2018 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 18th (Sun)–21st (Wed), 2018

Venue: Graduate School of Mathematical Sciences,
The University of Tokyo
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	MSJ Prizes Presentation (Lecture Theater) ····· (14:50–15:20) Plenary Talks (Lecture Theater) Spring Prize Winner ····· (15:30–16:30) Takao Yamaguchi (Kyoto Univ.) ····· (16:45–17:45) Official Party (Komaba Faculty House) ····· (18:00–20:00)								
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Plenary Talks

March 19th (Mon) Rm. 900, Lecture Theater

Spring Prize Winner ..... (15:30–16:30)

Takao Yamaguchi (Kyoto Univ.) Collapsing Riemannian manifolds with boundary ..... (16:45–17:45)

Summary: As the Gauss-Bonnet theorem shows, there are relations between curvature and topology of Riemannian manifolds, and studying such relations has been one of the main problems in Differential geometry. The theory of Gromov-Hausdorff convergence of Riemannian manifolds is known to be an effective method in this direction. In this theory, we consider a certain family of closed Riemannian manifolds with a lower curvature bound. The lower curvature bound ensures the precompactness of the family, and one can expect that some topological, geometric or analytic invariants should be bounded on that family. Moreover, it is natural to ask deeper information on manifolds themselves through the convergence. The theory of collapsing Riemannian manifolds answers this question and turns out to be quite effective in some cases. For example, the theory of collapsing Riemnnian three-manifolds was used in Perelman's work on the geometrization conjecture to determine the topology of the collapsed part of a closed three-manifold under the Ricci flow. In this lecture, after a brief survey of the development of the collapsing theory for closed manifolds, I will mainly focus on recent development of the theory of collapsing Riemannian manifolds with boundary, based on joint works with Zhilang Zhang.

Featured Invited Talks

March 18th (Sun)

Conference Room VI

Akihisa Tamura (Keio Univ.) Discrete convex analysis and mathematical economic models ..... (13:00–14:00)

Summary: Discrete convex analysis is a unified framework of discrete optimization and two concepts, called L-convexity and M-convexity, play important roles in this framework. Structural results of discrete convex analysis include the conjugacy theorem between L-convexity and M-convexity, separation theorems for L-convex/L-concave functions and for M-convex/M-concave functions, and the Fenchel-type discrete duality theorem. Algorithmic aspects of L-convex and M-convex functions have also been discussed in discrete mathematics. In mathematical economics, discrete convex analysis has been applied to models with indivisible commodities. In this talk, I will cover these fundamental topics and recent developments.

Conference Room IX

Mariko Yasugi On "Takeuti's Proof Theory" ..... (13:00–14:00)

Summary: Gaisi Takeuti has left us numerous distinguished works in various fields of the foundations of mathematics. Among them, "proof theory" can be proclaimed to have been the matter of his foremost concern. It was deeply related to his desire (dream) to understand the true nature of "sets".

He formulated second order logic (and higher order ones), which is a formalized framework for mathematics, and posed a conjecture, known as "Takeuti's fundamental conjecture", which would provide many logical facts, including the consistency, of the formal systems. An attempt of (partially) proving the conjecture is called, as a catchword, "cut elimination" or "consistency proof".

The fundamental conjecture claims that its proofs must be performed within "Hilbert's Program", that is, the metamathematical proofs of formal systems must abide by the "finitist viewpoint". Formalism and finitist viwrpoint are the important thoughts behind Takeuti's mathematical achievements.

In order to prove the fundamental conjecture, Takeuti created and developed a theory of constructive well-ordered structures of notations, called "ordinal diagrams". Applying this theory, he made a monumental advance of the consistency proof.

I will introduce Takeuti's proof-theoretical results along with the background thoughts, which determined the direction of "Takeuti's proof theory".

March 20th (Tue)

Conference Room III

Junzo Watanabe (Tokai Univ.*) The Lefschetz properties of graded Artinian Gorenstein algebras ····· (13:00–14:00)

Summary: The strong Lefschetz property for Artinian Gorenstein algebras is a ring-theoretic abstraction of the Hard Lefschetz Theorem for compact Kähler manifolds.
Suppose that $A = \bigoplus_{i=0}^{d} A_i$ is a graded Artinian Gorenstein algebra. We say that A has the **strong Lefschetz property** if there exists a linear element $l \in A$ such that the multiplication map

$$\times l^{d-2i} : A_i \to A_{d-i}$$

is bijective for all $i = 0, 1, 2, \ldots, [d/2]$.
This can be defined for graded vector spaces and basic properties can be derived as properties of an endomorphism of graded vector spaces. As a consequence, it can be proved that "almost all" Artinian Gorenstein algebras have the strong Lefschetz property. It gives us new problems to ask (1) what classes of Gorenstein algebras have the strong/weak Lefschetz property without exception and (2) what Gorenstein algebras fail to have the strong/weak Lefschetz property. I would like to speak about known results, methods to prove them, applications and problems of the Lefschetz properties of Artinian Gorenstein algebras.

Conference Room VI

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Satoru Iwata (Univ. of Tokyo) Matroid parity ····· (13:00–14:00)

Summary: This talk provides an overview on matroid parity, which was introduced in the 70s as a common generalization of matching and matroid intersection. In particular, we present a combinatorial, deterministic, polynomial-time algorithm for the weighted linear matroid parity problem.

Conference Room IX

Kazuo Habiro (Kyoto Univ.) Category-theoretic structures in 3-dimensional topology ··· (13:00–14:00)

Summary: We will review algebraic and category-theoretic structures in 3-dimensional topology. The most well-known structures of such kind are topological quantum field theories, which are vector-space-valued functors on the category of closed surfaces and 3-dimensional cobordisms. We will mainly focus on the category Cob of once-punctured surfaces and cobordisms between them, introduced by Crane and Yetter and by Kerler, and some of its subcategories. The category Cob has a structure of a braided monoidal category, and it is equipped with a Hopf algebra object. We will consider braided subcategories sLCob and LCob of Cob, which are called the category of special Lagrangian and Lagrangian cobordisms, respectively, where sLCob is also a subcategory of LCob. The category sLCob may be identified with the opposite of the category H of handlebodies and "disc-based" embeddings. We will also discuss functors on these categories, which may be regarded as functorial 3-manifold invariants.

March 21st (Wed)

Conference Room VI

Toshiyuki Tanisaki (Osaka City Univ.) Quantized flag manifolds and representations of quantum groups ····· (13:00–14:00)

Summary: By the work of Brylinsiki-Kashiwara and Belinson-Bernstein we can localize representations of complex simple Lie algebras on the flag manifolds. There is also a similar theory in positive characteristics due to Bezrukavnikov-Mirkovic-Rumynin.
In this talk I would like to talk about the corresponding results for quantized enveloping algebras using the quantized flag manifolds. The quantized flag manifold is not an algebraic variety in the ordinary sense; it is a non-commutative scheme equipped with non-commutative ring of functions. Nevertheless, we have the notion of D-modules on the quantized flag manifolds, by which we can localize representations of quantized enveloping algebras on the quantized flag manifolds.

Conference Room IX

Naoki Tanaka (Shizuoka Univ.) Semigroups of operators and mutational equations in metric spaces ····· (13:00–14:00)

Summary: The nonlinear Hille–Yosida theorem in Hilbert spaces was established in 1967 by Kōmura. After his pioneering work, a generation theorem of semigroups of contractions in general Banach spaces was proved in 1971 by Crandall and Liggett. The notion of semigroups of Lipschitz operators in Banach spaces was introduced by Kobayashi in 1990's as a nonlinear analogue of strongly continuous semigroups of bounded linear operators. Metric-like functionals, not the metrics induced by norms, play an important role in characterizing such semigroups with continuous generators. What happens if we avoid using not only norms but also linear structures? I will talk about mutational equations described by 'transitions' and 'mutations', which are mathematical tools extending the concept of differential equations to the case of metric spaces. The mutational analysis was initiated by Aubin in 1990's to analyze varying shapes, and has been recently developed by Lorenz to give a unified way to various types of evolution equations. Their abstract results can be extended to apply to quasilinear evolution equations due to Kato.

Foundation of Mathematics and History of Mathematics

March 18th (Sun) Conference Room V

9:00–11:30

1 Shotaro Tanaka * To express fractions into power series by Suida expansion ····· 15

Summary: The fraction $1/(z^2+1)$ has two singularities $z=i,-i$. Expand in $z=2i$. (1) Devide the domain into $0 \leq |z-2i| < 1$, $1 < |z-2i| < 3$, $3 < |z-2i|$. (2) Decomposite it into partials: $(i/2)\{1/(z+1)-i/(z-i)\}$. Ex. $1/(z+1) = 1/\{(z-2i)+3i\}$. Let us omit Laurent's expansion. Wada's theorem: $1/(\square-\triangle)^{p+1} = \Sigma(k=1\to\infty)d_p(k)\square^{-p-k}\triangle^{k-1}, 0<|\triangle/\square|<1$, where integers $p\geq 0$; $k\geq 1$ and $d_p(k) \equiv (k+p-1)!/p!(k-1)!$, named Suida expansion. If $1 \div \{(z-2i)-(-3i)\}^{0+1} = \Sigma(k=1\to\infty)d_0(k)(z-2i)^{-0-k}(-3i)^{k-1}$, $0<|-3i/(z-2i)|<1$. Then $\Sigma(k=1\to\infty)\ (-3i)^{k-1}(z-2i)^{-k}$, $3<|z-2i|$. If $1/\{3i-(-(z-2i))\}^{0+1} = \Sigma(k=1\to\infty)d_0(k)(3i)^{-0-k}(-(z-2i))^{k-1}$, $0<|-(z-2i)/3i|<1$. Then $\Sigma(k=1\to\infty)d_0(k)(-1)^{k-1}(1/3i)^k(z-2i)^{k-1}$, $0<|z-2i|<3$.

2 Shigeru Masuda (Kyoto Univ.) Mathematical principles treated in mechanics by Poisson ····· 15

Summary: Maupertuis treats principle of minimum action and Clairaut discuss effort and principles of equilibrium on earth. Poisson issues Study of Mechanics in 1833, which consists the second book of three books, entitled A Study of Mathematical Physics. He discusses the mathemetical principles from many side of mathematics. Our present to this session shows the points of mathematical scopes in mechanics by Poisson.

3 Shigeru Masuda (Kyoto Univ.) Proof of rise of capillary surface by Poisson ····· 15

Summary: Providing capillary action in the equilibrium, Poisson assures that the rise of the surface of water is due to the abrupt variation of density in the neighborhood of the wall and of the surface. Poisson discusses this problem in 1831, in the rivalry to the paper/book of Laplace 1806–7 and Gauss 1831. We show Poisson's discussion.

4 Michiyo Nakane An introduction of an idea of transformation to Hamilton–Jacobi theory in the beginning of twentieth century ····· 15

Summary: In the early twentieth century, mathematicians began to eagerly discuss transformations of variables that keep the canonical form of the differential equations, the so-called "contact transformation" or "canonical transformation". This paper examines origins of these two transformations. We also discuss a process how these two transformations were bound and how they were introduced to the Hamilton–Jacobi theory.

5 Toshio Harikae (Osaka Sangyo Univ.) On 'Toshoku' problems in "Shu" ····· 15

Summary: Two 'Toshoku (doushi)' problems contained in the book "Shu", and one of them had been left undeciphered. In this talk, we decipher the problem from the other deciphered problem, and discuss that the method used in Toshoku problems is 'shaoguang-shu.'

6 Katsushi Waki (Yamagata Univ.)
Takuma Tsutihashi (Meiji Univ.)
Kazushi Ahara (Meiji Univ.)
The similarity evaluation of geometric problems in WASAN by NMF ····· 10

Summary: We try to evaluate the similarity of geometric problems in WASAN using NMF (Non-negative Matrix Factorization). In our study, we calculate characteristic vectors of geometric problems in "SAN-POUTENSEISHINAN" written by "AIDA YASUAKI" by NMF. And we try to evaluate the similarity of geometric problems by these characteristic vectors.

7 Mitsuo Morimoto (Yokkaichi Univ./Sophia Univ.*) Daily Mathematics in the Taisei Sankei ····· 15

Summary: Volumes 8 and 9 of th Taisei Sankei (Great Accomplished Mathematical Treatise, 1710 or 11) are entitled Daily Mathematics and contain 220 problems of mathematics stemmed from daily lives. Because of their elementary character, they have been neglected by historians of Japanese mathematics; for example, in the Meijizen Hihon Sūgakushi (History of Mathematics before the Meiji Restoration), Fujiwara Matsusaburo paid almost no attention to them. Takebe Katahiro, one of three authors of the Taisei Sankei published the Sangaku Keimō Genkai Taisei (Great Colloquial Commentary on the Suanxue Qimeng) in 1690. The Suanxue Qimeng (Introduction to Mathematics, 1299), written by Zhu Shijie of the Yuan dynasty, was a collection of mathematical problems. We shall discuss the relation of the Daily Mathematics with the Suanxue Qimeng.

8 Tsukane Ogawa (Yokkaichi Univ.) Mathematical philosophy of Aida Yasuaki, part 2 ····· 15

Summary: Aida Yasuaki (1747–1817) wrote the 6 volume *Sanpou Kokon Tsuuran* in 1797, which incisively criticized 19 already published books of mathematics. I have discussed the first volume of Aida's work, which contained comments on 7 books from the *Sanpou Kongen Ki* (1666) to the *Katsuyou Sanpou* (1712). In this instance, I examined the second volume, which contained comments on 8 books from the *Kagaku Sanpou* (1715) to the *Meigen Sanpou* (1764). Though some comments were the same as those found in volume 1, some were new. I will comment on the history of difficult problems, and on the relationship between solutions using equations and solutions using the abacus.

9 Takuma Tsuchihashi (Meiji Univ.)
Katsushi Waki (Yamagata Univ.)
Kazushi Ahara (Meiji Univ.)
Automatic tagging to geometric problems in Japanese mathematics (wasan) based on image recognition ····· 15

Summary: In recent years, construction of image databases from digitized historical documents of Japanese mathematics (wasan) has been progressing. Since previous studies, the authors have proposed ideas for automatic tagging in these image databases of wasan based on geometric elements (triangles, squares, circles and so on) and those relationship (tangency of circles, number of elements and so on). In this study, the authors implement the program that tags images of geometric problems in wasan automatically and verify the effectiveness of our proposal for geometric problems included in actual documents of wasan. As a result, it is found that automatic tagging succeeds for geometric problems of more than 80 percent in "Sanpo tensei-ho shinan" by Yasuaki Aida.

11:30–12:00 Mathematics History Team Meeting

14:10–16:50

10 Toshio Suzuki (Tokyo Metro. Univ.) Non-depth-first search of an AND-OR tree ····· 15

Summary: Liu and Tanaka (2007) asserted that among independent distributions on a uniform binary AND-OR tree, the minimum cost (achieved by an algorithm) is maximized only by an independent and identical distribution. In this decade, the assertion has been justified under a hypothesis that only depth-first algorithms are taken into consideration. The uniform binary tree case was shown by S. and Niida (2015). Balanced multi-branching tree case was shown (with a certain hypothesis) by Peng et al. (2017). We extend the results of S.–Niida and Peng et al. to the case where non-depth-first algorithms are taken into consideration.

Summary: In 2007, Liu and Tanaka characterized the eigen-distributions that achieve the distributional complexity for AND-OR trees, and among others, they proved the uniqueness of eigen-distribution for a uniform binary tree. Later, Suzuki and Nakamura showed that the uniqueness fails if only directional algorithms are considered. In this talk, we introduce the weighted trees, namely, trees with weighted cost depending on the value of a leaf. Using such models, we prove that for balanced multi-branching trees, the uniqueness of eigen-distribution holds w.r.t. all deterministic algorithms, but fails w.r.t. only directional algorithms.

Summary: Solovay reducibility is a well-known and inmoprtant notion in theory of randomness. We defined pseudo Solovay reducibility to generalize Solovay reducibility. We have some results of pseudo Solovay reducibility.

Summary: The indicator argument is a model-theoretic framework to obtain independence and conservation results in the study of first-order arithmetic. In the talk, we will consider new formulation of indicator arguments with the idea of generic cuts and forcing. With this method, we will analyze the conservation results for bounding principle and Ramsey's theorem for pairs.

Summary: The notion of probability plays a crucial role in quantum mechanics. It appears as the Born rule. In this talk we reveal that every event with probability one occurs certainly in quantum measurement.

Summary: It is proved that every C^*-embedded subset in $\mathbb{N}^{\omega_1}$ is C-embedded in $\mathbb{N}^{\omega_1}$ under a certain set-theoretic assumption, where $\mathbb{N}^{\omega_1}$ denotes the product of ω_1 copies of natural numbers $\mathbb{N}$. As a consequence, it is independent of ZFC that there is a (closed) C^*-embedded subset in $\mathbb{N}^{\omega_1}$.

Summary: For a topological space X, the Lindelöf degree of X is the minimal cardinal κ such that every open cover of X has a subcover of size $\leq \kappa$. If S is the Sorgenfrey line, then its product $S \times S$ has the Lindelöf degree 2^ω. On the other hand, it is unknown whether there are Lindelöf spaces X and Y with $L(X \times Y) > 2^\omega$. In this talk, we prove that, in the Cohen forcing extension, the Lindelöf degree of the product of two regular Lindelöf spaces can be arbitrary large up to the least ω_1-strongly compact cardinal. We also show that if there is no such Lindelöf spaces, then ω_2 is weakly compact in L.

Summary: The forcing notion which adds an uncountable antichain through an Aronszajn tree has two similar combinatorial properties, which are called the rectangle refining property and the property $\mathsf{R}_{1,\aleph_1}$. By a viewpoint of specialization of an Aronszajn tree, we can conclude that two properties are different.

18 Diego A. Mejía (Shizuoka Univ.) Forcing theory and combinatorics of the real line · · · · · · · · · · · · · · · · · · · 15

Summary: We present recent developments in forcing theory that have been motivated by problems on combinatorics of the real line. Concretely, the construction of tree-dimensional arrangements of forcing generic extensions (joint work with Fischer, Friedman and Montoya), and the incorporation of ultrafilter limits in two-dimensional arrangements of generic extensions (joint with Brendle and Cardona). These techniques work to construct models where the cardinals in Cichoń's diagram (classical diagram of cardinal numbers associated with combinatorial properties of the real line) can be divided into 7 different values, which is the maximum number known modulo ZFC alone.

19 Hiroshi Sakai (Kobe Univ.) Embeddability of uncountable LO into models generated by uncountable indiscernible sequences · 15

Summary: We discuss what kinds of uncountable linearly ordered sets are embeddable into models generated by uncountable indiscernible sequences.

17:00–18:00 Talk Invited by Section on Foundation and History of Mathematics

Sakaé Fuchino (Kobe Univ.) Set-theoretic reflection principles

Summary: For a class $\mathcal{C}$ of structures (with a fixed notion $\mathcal{N}$ of substructure) and a property $\mathcal{P}$, the reflection cardinal of $(\mathcal{C}, \mathcal{P})$ is the minimal cardinal κ such that, for any $M \in \mathcal{C}$ of cardinality $> \kappa$, if M does not satisfies the property P, then there are stationarily many substructures N of M of cardinality $< \kappa$. If *kappa* is the reflection cardinal of $(\mathcal{C}, \mathcal{N})$, we shall write $\kappa = Ref(\mathcal{C}, \mathcal{P})$.

By choosing $\mathcal{C}$, $\mathcal{N}$ and $\mathcal{P}$, we can represent many set-theoretic reflection statements. If, for example $\mathcal{P}$ is simply a contradiction, and $\mathcal{N}$ is the elementary submodel relation for some logic $\mathcal{L}$, then $\kappa = Ref(\mathcal{C}, \mathcal{P})$ is the strong form of Downward Löwenheim-Skolem Theorem down to $< \kappa$ for $\mathcal{L}$.

Of these reflection statements, the cases $\alpha_2 = Ref(\mathcal{C}, \mathcal{P})$ and $2^{\aleph_0} = Ref(\mathcal{C}, \mathcal{P})$ seems to be of special interest. The former may be interpreted as a pronouncement that the first uncountable cardinal $\aleph_1$ captures the situation $\neg\mathcal{P}$ good enough while the latter as the pronouncement that the continuum is large enough in connection with the property $\mathcal{P}$.

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Of these reflection statements, the cases $\aleph_2 = Refl(\mathcal{C}, \mathcal{P})$ and $2^{\aleph_0} = Refl(\mathcal{C}, \mathcal{P})$ seems to be of special interest. The former may be interpreted as a pronouncement that the first uncountable cardinal $\aleph_1$ captures the situation $\neg\mathcal{P}$ good enough while the latter as the pronouncement that the continuum is large enough in connection with the property $\mathcal{P}$.

The stronger assertions among $\aleph_2 = Refl(\mathcal{C}, \mathcal{P})$ imply the Continuum Hypothesis while assertions of the form $2^{\aleph_0} = Refl(\mathcal{C}, \mathcal{P})$ tend to imply that the continuum is extremely large.

Most of the natural assertions of the form $\aleph_2 = Refl(\mathcal{C}, \mathcal{P})$ or $2^{\aleph_0} = Refl(\mathcal{C}, \mathcal{P})$ involves some kind of countability in the property $\mathcal{P}$. This is the case with the reflection assertion $\aleph_2 = Refl(\mathcal{C}, \mathcal{P})$ where $\mathcal{C}$ is the class of all graphs with induced subgraphs as the notion of substructure and $\mathcal{P}$ is the property "of countable coloring number". It is shown that this assertion is equivalent to the Fodor-type Reflection Principle (FRP). We can also consider the reflection number for the property obtained from these properties of countable character by replacing the countability by of cardinality κ. Recently many interesting results about reflection statements in this vein are obtained.

In this talk we will give a survey on these reflection statements.

March 19th (Mon) Conference Room V

9:00–11:30

20 Takashi Oyabu ♭ Number; number system, and other 5 talks ····· 5

Summary: (1) Axiomatic set theory: Construction of number system: Some problems are presented: Construction of mathematics::: From ZFC axioms:
(2) Entropy concept is introduced::: Theory of H-theorems: H=dAUlogU:
(3)Poincaré conjecture is discussed: AUT(R): —Mathematics:
(4)Our theories are in a sense: Analysis on manifold: i.e. global analysis:
(5) Some mathematical principles are presented: They are in a sense decisive:
(6) Phase transition: symmetry breaking: Some schemes are proposed:

21 Yoshifumi Ito (Tokushima Univ.*) Definition of the concept of sets and its existence theorem ····· 15

Summary: In this paper, we give the definition of sets and prove its existence theorem by using the axiomatic method. The system of axioms I used here is the system of axioms ZFC and the axiom of ordinary numbers and the axiom of transfinite induction.

22 Yoshihito Tanaka (Kyushu Sangyo Univ.) A predicate extension of the logic of provability ····· 15

Summary: In this talk, we introduce a Kripke complete predicate extension of the logic of provability, that is, the propositional modal logic defined by the Löb formula.
The proof system for the logic of the talk is a modal extension of Gentzen-style sequent calculus for predicate logic. It has a standard derivation rule for necessitation, but does not include the Löb formula as an axiom schema. Instead, it has a non-compact inference rule. We show the logic is complete with respect to the class of Kripke frames of bounded length.

23 Nobu-Yuki Suzuki (Shizuoka Univ.) Constructing uncountably many intermediate predicate logics having disjunction property but lacking existence property ····· 15

Summary: The disjunction and existence properties in intermediate predicate logics were revealed to be independent in our previous paper. In that paper, we constructed a continuum of intermediate predicate logics having existence property but lacking disjunction property. In this talk, we report the existence of a continuum of intermediate predicate logics having disjunction property but lacking existence property.

24 Ken-etsu Fujita (Gunma Univ.) The Church–Rosser Theorem and quantitative analysis of witnesses ·· 15

Summary: We analyze quantitative properties of witnesses of the Church–Rosser Theorem for beta-equality in terms of Takahashi translation and by using the notion of parallel reduction. We show that the proof method developed here can be applied to other reduction systems such as lambda-calculus with beta-eta-reduction, Girard's system F, and Gödel's system T as well.

25 Takahiro Seki (Niigata Univ.) Some relevant modal logics characterized by reduced frames ····· 15

Summary: In Routley–Meyer semantics, relevant logics or relevant modal logics are characterized by unreduced frames in general. In this talk, we consider modal extensions of Slaney's reduced modeling theorem for relevant logics without WI.

26 Taishi Kurahashi (Nat. Inst. of Tech., Kisarazu Coll.) Provability logics and decompositions of theories ····· 15

Summary: We proved that if L is one of the modal logics GL_α, D_β, S_β and GL_β^- where $\alpha \subseteq \omega$ is Σ_1 and $\beta \subseteq \omega$ is cofinite, then for any Σ_1-definable consistent extension U of Peano Arithmetic PA, there exists a Σ_1 definition $\tau(v)$ of some extension of $I\Sigma_1$ such that the provability logic $\mathsf{PL}_\tau(U)$ of $\tau(v)$ relative to U is exactly L. We proved this theorem by using Jeroslow's method of decomposing theories.

27 Masanori Itai (Tokai Univ.) A model theoretic Rieffel's theorem of quantum 2-tori ····· 15

Summary: We associate quantum 2-tori T_θ with the structure over $\mathbb{C}_\theta = (\mathbb{C}, +, \cdot, y = x^\theta)$, where $\theta \in \mathbb{R} \setminus \mathbb{Q}$, and introduce the notion of geometric isomorphisms between such quantum 2-tori.
We show that this notion is closely connected with the fundamental notion of Morita equivalence of non-commutative geometry. Namely, we prove a model theoretic version of Rieffel's theorem of quantum 2-tori.

28 Shunsuke Okabe (Kobe Univ.) On widths of automorphism groups on generic structures ····· 15

Summary: The automorphism group on the random graph is simple. Moreover, for all non identical element g of the automorphism group, every element can be denoted by a product of at most three conjugates of g or g^{-1}, by Truss in 2003. We call the number of the product *the width of the automorphism group*. It's known that the similar fact holds in generic structures analogues of the random graph. That is, if the generic structure has FAP (Free Amalgamation Property) and its automorphism group is transitive, then the group is simple and the width is less than or equal to 32. In this talk, we proof we can improve the width to 12.

29 Hirotaka Kikyo (Kobe Univ.) On Hrushovski's ab initio amalgamation class ····· 15
Shunsuke Okabe (Kobe Univ.)

Summary: Hrushovski defined an amalgamation class K_f by defining a concave increasing function f referring to an irrational number α with $1/2 < \alpha < 2/3$. His construction works for any real number α with $0 < \alpha < 1$. We obtained the following: (1) f is concave and strictly increasing. (2) K_f is an amalgamation class for any α. (3) f is unbounded if α is rational. (4) If $\alpha = m/d$ then $f(2x) \leq f(x) + 1/d$. Therefore, the generic model of K_f has a model complete theory. (5) There is α (e.g. $\alpha = 1/\sqrt{2}$) such that f is bounded. (6) If f is bounded then the generic model of K_f has no model complete theory. (7) We can give an α in a form of continued fractions where f is unbounded.

11:30–12:00 Research Section Assembly

13:15–14:15 Talk Invited by Section on Foundation and History of Mathematics

Takuya Matsuzaki (Nagoya Univ.) A computer program that solves pre-university mathematical problems

Summary: In a joint work with many people, we have developed a computer system that solves pre-university level math problems written in natural language. The system is comprised of two parts. One is a language processing pipeline, which translates a math problem into a logical formula. The other is a computer algebra system that derives an answer from the translated problem. In the talk, I will mainly talk about the former part. The main obstacle in the translation from a natural language into a logical language is the flexibility of the natural language, which enables us to convey complex meaning in a concise expression but makes the sentences highly ambiguous for a machine. I will explain how we combat with it using both logical and statistical means.

Algebra

March 18th (Sun) Conference Room Ⅲ

9:00–11:45

1 Yasutoshi Nomura * Quasi-linear cogruences of Aperiy-like numbers ····· 10

Summary: Based upon machine-experiment we assert that, if Apery-like numbers X(p-r) with prime p is not ultimately constant then X(p-r) is congruent to (xp-em)/q (mod p), where e=1 or -1 and m is divisible by prime u with X(u-r)=0 (mod p), and that, in case X(p-r) has the ultimate constant "Aperi quotient" W(p) satisfies similar congruence.

2 Yuta Suzuki (Nagoya Univ.) On relatively prime amicable pairs ····· 10

Summary: An *amicable pair* is a pair of distinct positive integers each of which is the sum of the proper divisors of the other. Gmelin (1917) conjectured that there is no relatively prime amicable pairs. Artjuhov (1975) and Borho (1974) proved that for any fixed positive integer K, there are only finitely many relatively prime amicable pairs (M, N) with $\omega(MN) = K$, where $\omega(n)$ denotes the number of the distinct prime factors of n. Recently, Pollack (2015) obtained an upper bound $MN < (2K)^{2^{K^2}}$ for such amicable pairs. In this talk, we improve this upper bound to $MN < \frac{\pi^2}{6} 2^{4^K - 2 \cdot 2^K}$.

3 Shigeru Iitaka (Gakushuin Univ.*) Ultimate perfect numbers and hyper perfect numbers ····· 10

Summary: Given an integer m and an odd prime P, if the following equality $(P-1)\sigma(a) = Pa - m$ holds then a is said to be a hyper perfect number with base P and translation parameter m.

4 Hajime Kaneko (Univ. of Tsukuba) On the number of digit exchanges in the beta expansion of real numbers
Makoto Kawashima (Osaka Univ.) ····· 10

Summary: Many mathematicians have researched the uniformity of the digit expansion of real numbers. In this talk we consider the beta expansion of algebraic numbers, which is a generalization of base-b expansion for a fixed integer $b \geq 2$. For instance, Borel conjectured for each integral base-b that any algebraic irrational number has uniform digits in its base-b expansion. For the study of the uniformity, Bugeaud suggested to consider the number of digit exchanges in the beta expansion of algebraic numbers. In our main result, we considerably improve known results on the asymptotic behavior of the number of digit exchanges.

5 Genki Shibukawa (Osaka Univ.) Some arithmetic properties of the elliptic Dedekind sums ····· 10

Summary: We prove some arithmetic properties of the elliptic Dedekind sums introduced by Egami. Further, we also talk about some conjectures of the elliptic Dedekind sums.

6 Kurt Fischer (Tokuyama Coll. of Tech.) The Zetafast algorithm to compute L functions to arbitrary precision as fast as the Riemann–Siegel formula ····· 10

Summary: We express the Riemann zeta function $\zeta(s)$ of argument $s = \sigma + i\tau$ with imaginary part τ in terms of three absolutely convergent series. The resulting simple algorithm allows to compute, to arbitrary precision, $\zeta(s)$ and its derivatives using at most $C(\epsilon)|\tau|^{\frac{1}{2}+\epsilon}$ summands for any $\epsilon > 0$, with explicit error bounds. It can be regarded as a quantitative version of the approximate functional equation. The numerical implementation is straightforward. The approach works for any type of zeta function with a similar functional equation such as Dirichlet L-functions.

Summary: In 2015, Li and Radziwiłł proved an approximate functional equation of the second moment of the Riemann zeta function $\zeta(s)$ on vertical arithmetic progressions on $\mathrm{Re}(s) = 1/2$. Using this formula, they could show that there is an at least $1/3$ proportion of points on arithmetic progressions on $\mathrm{Re}(s) = 1/2$ such that $\zeta(s)$ does not vanish. We are interested in finding the proportion of points on the line such that two consecutive values of $\zeta(s)$ differ. For this purpose, we need an approximate functional equation for the fourth moment of $\zeta(s)$ of Li and Radziwiłł's form. In this talk, we introduce this approximate functional equation we obtained.

Summary: We consider the existence of horizontal lines in critical strip on which a Dirichlet L-function takes its extreme values uniformly. This is an extension of the result for the Riemann zeta-function that was shown by Ramachandra and Sankaranarayanan in 1991. In addition, as an application of this theorem, we also obtain the estimate of the sum of derivatives of Dirichlet L-functions and certain Dedekind zeta-functions over the non-trivial zeros.

Summary: The study of zeros of zeta-functions is a classical topic in analytic number theory. The Riemann hypothesis assert that any nontrivial zeros of the Riemann zeta-function are located on the critical line. On the other hand, the Hurwitz zeta-function has zeros off the critical line in general. Then the upper and lower bounds for the number of such zeros has been considered. In this presentation, we obtain an asymptotic formula on the number of zeros of the Hurwitz zeta-function on the right side of the critical line, applying a certain density function related to the value-distribution of the Hurwitz zeta-function.

Summary: Let $k \geq 2$ and $m \geq 1$ be integers. Suryanarayana and Sitaramachandra Rao studied the number of k-free integers $n \leq x$ satisfying $(n, m) = 1$. We shall reconsider error terms in their formula.

Summary: Let $\zeta_2(s_1, s_2)$ be the double zeta-function of Euler–Zagier type $\zeta_2(s_1, s_2) = \sum_{m=1}^{\infty} \sum_{n=m+1}^{\infty} \frac{1}{m^{s_1} n^{s_2}}$. We shall give several bounds of an error of approximate formula of $\zeta_2(s_1, s_2)$.

Summary: We consider a family of integral operators arising from zeta functions, and state an equivalence condition of the Riemann hypothesis in terms of operators.

13 Shin-ya Koyama (Toyo Univ.) Convergence of Euler products of Selberg zeta functions ····· 10
Ikuya Kaneko
(Tsukuba Takezono Higashi Junior High School)

Summary: For any cocompact subgroup of $PSL(2,\mathbb{R})$, and its finite dimensional unitary representation ρ not containing the trivial representation, the Selberg zeta function $Z(s,\rho)$ is defined by the Euler product, which is regular at $s=1$. It is known that the Euler product is absolutely convergent in $\mathrm{Re}(s)>1$. In this talk we show convergence of the Euler product for $\mathrm{Re}(s)\geq 3/4$, under assuming the analog of the Riemann hypothesis for the Selberg zeta function.

14:20–17:20

14 Ryoko Tomiyasu (Yamagata Univ.) On the inifinite families of ternary quadratic forms with the same representations over $\mathbb{Z}$ in Kaplansky conjecture ····· 10

Summary: Kaplansky conjectured that if two positive-definite real ternary quadratic forms have perfectly identical representations over $\mathbb{Z}$, they are equivalent over $\mathbb{Z}$ or constant multiples of regular forms, or is included in either of two families parametrized by $\mathbb{Q}$. Firstly, the result of an exhaustive search for such pairs of integral quadratic forms is presented, in order to provide a concrete version of the Kaplansky conjecture. The obtained list contains a small number of non-regular forms that were confirmed to have the identical representations up to 3,000,000. Secondly, we prove that if two pairs of ternary quadratic forms have the identical simultaneous representations over $\mathbb{Q}$, their constant multiples are equivalent over $\mathbb{Q}$. This was motivated by the question why the other families were not detected in the search.

15 Ryoko Tomiyasu (Yamagata Univ.)[b] Problem on quadratic forms that is required to solve for determination of periodic point sets from their average theta series ····· 10

Summary: A problem that has been discussed in crystallography is introduced. When we consider a crystal structure as a periodic point set in R^n, this problem is equivalent to the determination of the periodic points set from its average theta series. We prove that the theta series can almost determine the smallest set that contains the difference set of the periodic point set and is invariant by the action of the automorphism group of the period lattice. This result explains how the problem is reduced to a problem about integral representations of quadratic forms.

16 Masataka Ono (Keio Univ.) Finite multiple zeta values associated with 2-colored rooted trees ····· 10

Summary: Finite multiple zeta values (FMZVs) were defined first by Kaneko and Zagier and studied by many mathematicians. In this talk, we introduce 2-colored rooted trees, which are some combinatorial objects, and define FMZVs associated with 2-colored rooted trees. We will show that they can be regarded as common generalizations of FMZVs and finite Mordell–Tornheim multiple zeta values defined first by Kamano. Moreover, we will explain that with a mild assumption, FMZVs associated with 2-colored rooted trees can be written as a sum of usual FMZVs. As a corollary, we will give another proof of the shuffle relation among FMZVs, which was first proved by Kaneko and Zagier.

17 Masataka Ono (Keio Univ.) Multiple zeta functions associated with 2-colored rooted trees ····· 10

Summary: In my recent study, I introduced a combinatorial object called 2-colored rooted tree and finite multiple zeta value (FMZV) associated with it to generalize FMZV of Euler–Zagier type and Mordell–Tornheim type simultaneously. In this talk, we introduce multiple zeta function (MZF) associated with 2-colored rooted trees and give some analytical properties. In particular, we give a conjecture on the singularities of MZFs associated 2-colored rooted trees and a new example of MZF satisfying this conjectures.

18 Tomoya Machide (Nat. Inst. of Information / JST ERATO) On an identity involving symmetric sums of regularized multiple zeta-star values ····· 10

Summary: An identity involving symmetric sums of regularized multiple zeta-star values of harmonic type was proved by Hoffman. In this talk, we prove an identity of shuffle type. In the proof, we meet Bell polynomials appearing in the study of set partitions.

Summary: In the spherical principal series representation of a p-adic group, we consider the space of Iwahori-fixed vectors, which has a natural basis and the so-called Casselman basis both indexed by the Weyl group. The latter is defined by using the intertwining integrals. We are interested in the transition matrix of these bases. In order to describe the matrix, we introduced a deformation of the Kazhdan–Lusztig R-polynomials, and proved certain functional equations and a duality formula.

Summary: We consider a quasi-split classical group G over a p-adic field F. By the local Langlands correspondence for G, which is recently established by Arthur, we have a natural partition of the set of irreducible smooth representations of $G(F)$ into finite sets which are parametrized by L-parameters. On the other hand, Gross and Reeder defined a some special class of supercuspidal representations which they call the simple supercuspidal representations. In this talk, I will explain a result on an explicit description of the local Langland correspondence for simple supercuspidal representations of quasi-split classical groups.

Summary: In this talk, we consider p-adic functions interpolating Dedekind–Rademacher sums and their reciprocity formula. The results are natural generalizations of the ones due to Rosen and Snyder.

Summary: The Mazur–Tate refined conjecture connects arithmetic invariants of modular forms with associated L-functions by using Mazur–Tate elements, which are certain elements of group rings of Galois groups and regarded as analogues of Stickelberger elements. In this talk, we discuss its rank-part, which compares the rank of Selmer groups with the order of zeros of Mazur–Tate elements, and our main result is as follows. Under some assumptions, we prove it for higher weight modular forms, generalizing our previous proof for elliptic curves.

Summary: We prove that Nekovář and Nizioł's syntomic cohomology and log rigid syntomic cohomology are isomorphic for a strictly semistable log scheme having a nice compactification and for non-negative twist. Key points of the proof are a generalization of Große–Klönne's log rigid cohomology theory and the compatibility of crystalline and rigid Hyodo–Kato maps on Frobenius eigenspaces.

Summary: The Brauer group of varieties has various application to algebraic geometry and number theory. Chernousov and Guletskii studied the 2-torsion part of the Brauer group of elliptic curves, especially its explicit generators represented by norm residue symbols and their relations. Using their method, we study the 3-torsion part of the Brauer group of diagonal cubic curves. In this presentation, we will explain our result in the case of Fermat curves of degree 3.

Summary: The notion of isoclinism was introduced by P. Hall in 1940 to classify finite p-groups. We show that this notion also plays an important role to classifying Galois groups of number fields.

26 Akinari Hoshi (Niigata Univ.)
Ming-chang Kang (Nat. Taiwan Univ.)
Aiichi Yamasaki (Kyoto Univ.)
Degree three unramified cohomology groups and Noether's problem for groups of order 243 10

Summary: Let k be a field, G be a finite group and G act on the rational function field $k(x_g : g \in G)$ by k-automorphisms defined by $h \cdot x_g = x_{hg}$ for any $g, h \in G$. Define $k(G) = k(x_g : g \in G)^G$. Noether's problem asks whether $k(G)$ is rational over k. The unramified cohomology groups $H^i_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z})$ are obstructions to the rationality of $\mathbb{C}(G)$. Theorem 1. Let G be a group of order 3^5. Then $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z}) \neq 0$ if and only if G belongs to the isoclinism family Φ_7. Moreover, if $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z}) \neq 0$, then $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z}) \simeq \mathbb{Z}/3\mathbb{Z}$. Theorem 2. Let G be a group of order p^5 where $p = 5$ or $p = 7$. Then $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z}) \neq 0$ if and only if G belongs to the isoclinism family Φ_6, Φ_7 or Φ_{10}. Moreover, if $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z}) \neq 0$, then $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z}) \simeq \mathbb{Z}/p\mathbb{Z}$. Theorem 3. Let G be a group of order 243. Then $\mathbb{C}(G)$ is $\mathbb{C}$-rational if and only if G belongs to the isoclinism family Φ_i where $1 \leq i \leq 6$ or $8 \leq i \leq 9$.

27 Akinari Hoshi (Niigata Univ.)
Ming-chang Kang (Nat. Taiwan Univ.)
Aiichi Yamasaki (Kyoto Univ.)
Computation of degree three unramified cohomology groups using GAP 10

Summary: We explain how to compute unramified cohomology group $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z})$ of degree three using Saltman–Peyre method and GAP.
Some algorithms are available from `https://www.math.kyoto-u.ac.jp/~yamasaki/Algorithm/UnramDeg3/`.

March 19th (Mon) Conference Room III

9:15–12:00

28 Fumitsuna Maruyama ♭
Masao Toyoizumi (Toyo Univ.)
Yozo Deguchi
On a certain method for determining the non-singularity of an integral matrix 10

Summary: It is a joint work with M. Toyoizumi and Y. Deguchi. The aim of our study is to give another algorism to determine the singularity or non-singularity of an integral matrix. Our method can give the result on large order integral matrices within a practical time.

29 Yuki Irie (Chiba Univ.) ♭
p-Saturations of Welter's game and the irreducible representations of symmetric groups 10

Summary: We establish a relation between the Sprague–Grundy function of p-saturations of Welter's game and the degrees of the ordinary irreducible representations of symmetric groups. We present a theorem on these degrees, and using this theorem we obtain an explicit formula for the Sprague–Grundy function of p-saturations of Welter's game.

30 Fumihito Oda (Kindai Univ.)
Yugen Takegahara (Muroran Inst. of Tech.)
Tomoyuki Yoshida (Hokusei Gakuen Univ.)
Axiomatic theory of Burnside rings I 10

Summary: We propose a construction of the Burnside ring of an essentially finite category admitting an epi-mono factorization and enough coequalizers. The main result of our talk is a vast generalization of the embedding theorem of the classical Burnside ring in its ghost ring, with finite cokernel of obstructions. This unifies many constructions and results relative to similar rings, such as various generalizations of the classical Burnside ring (monomial Burnside ring, section Burnside ring, crossed Burnside ring, slice Burnside ringetc), but also some of a seemingly different nature (such as the Möbius algebra of a poset).

Summary: In this talk, I will discuss the structure of the unit group of the partial Burnside ring relative to the set of parabolic subgroups of a finite reducible Coxeter group of type A.

Summary: We describe the multiplicity of the irreducible components of tensor products in even numbers for spin representations.

Summary: For symmetric plane partitions we have generating functions which can be nicely factored, such as the size generating function, half-the-size generating function and Gansner–Nakada's generating function that respects the diagonal sums. In this talk we show two conjectural formulas which refine the above nice generating functions. Pfaffian expressions for those formulas are also given.

Summary: The $\mathcal{W}$-algebras are vertex algebras defined by the generalized Drinfeld–Sokolov reductions. Using the Wakimoto representations of affine Lie algebras, we describe the explicit formulae of the screening operators for the $\mathcal{W}$-algebras with generic level. As applications, we show that the $\mathcal{W}$-algebras of type A have the "coproduct" structures related to affine Yangians.

Summary: The notion of affine highest weight category introduced by Kleshchev generalizes the notion of highest weight category and axiomatizes certain homological structures of some non-semisimple abelian categories of Lie theoretic origin. In this talk, we see the existence of a special kind of tilting module in an affine highest weight category with a large categorical center. As an application, we can prove that a block of the BGG category of $\mathfrak{gl}_m(\mathbb{C})$ is embedded fully faithfully into the module category of finite-dimensional modules over the degenerate affine Hecke algebra of GL_n by the Arakawa–Suzuki functor.

Summary: For a Dynkin quiver Q (of type ADE), Hernandez–Leclerc defined a good monoidal subcategory $\mathcal{C}_Q$ inside the category of finite-dimensional modules over the quantum loop algebra $U_q(L\mathfrak{g})$ based on its relationship with the Auslander–Reiten quiver of Q. By using the geometric construction of $U_q(L\mathfrak{g})$-modules with quiver varieties due to Nakajima, we see that a completion of the category $\mathcal{C}_Q$ has a structure of affine highest weight category. As an application, we can prove that Kang–Kashiwara–Kim's generalized quantum affine Schur–Weyl duality functor gives an equivalence of monoidal categories between the category of finite-dimensional modules over the quiver Hecke (KLR) algebra associated to Q and Hernandez–Leclerc's category $\mathcal{C}_Q$.

Summary: In 1941, Brauer–Nesbitt established a characterization of a block with trivial defect group as a block B with $k(B) = 1$. In 1982, Brandt established a characterization of a block with defect group of order two as a block B with $k(B) = 2$. These correspond to the cases when the block is Morita equivalent to the one-dimensional algebra and to the non-semisimple two-dimensional algebra respectively. In this talk, we redefine $k(A)$ to be the codimension of the commutator subspace $K(A)$ of a finite-dimensional algebra A and show analogous statements for arbitrary finite-dimensional algebras.

38 Hiroki Sasaki (Shinshu Univ.)* Cohomology rings of block ideals with extraspecial defect groups ····· 10

Summary: Let b be a block ideal of the finite group algebra kG with a defect group S which is extraspecial of order p^3 and of exponent p. Let i be a source idempotent. We shall examine the module structure of the source algebra $ikGi$ of the block ideal b and show that the image of the tranfer map $t : H^*(S, k) \to H^*(S, k)$ induced by $ikGi$ coincides with the cohomology ring of the block b wih respect to the source idempotent i.

39 Shigeo Koshitani (Chiba Univ. / Chiba Univ.⋆) ♭ Brauer indecomposabilities of the Scott modules ····· 10
Radha Kessar (City, Univ. of London)
Markus Linckelmann (City, Univ. of London)

Summary: We shall be talking about Brauer indecomposabilities of the Scott modules. The Scott module is an indecomposable p-permutation kG-module which contains the trivial kG-module (where G is a finite group and k is an algebraically cloased field of characteristic $p > 0$). This plays an imporant role to try to prove so-called global-local conjecture in the representation theory of finite groups.

40 Shigeo Koshitani (Chiba Univ. / Chiba Univ.⋆) ♭ A remark on the projective cover of the trivial module ····· 10
Jürgen Müller (Wuppertal Univ.)

Summary: We shall be talking on the projective cover of the trivial module for the group algebra kG where G is a finite group and k is a field of characteristic $p > 0$. Especially we will be interested in the case when p is odd and G is a finite simple group of Lie type defined over a finite field of the same characteristic p.

41 Shigeo Koshitani (Chiba Univ. / Chiba Univ.⋆) ♭ Locations of simple modules for finite group algebras in the Auslander–Reiten quivers ····· 10
Caroline Lassueur (Kaiserslautern Univ.)

Summary: We will be talking on the positions of simple modules for finite group algebras in connected components of the stable Auslander–Reiten quivers to which the simple modules belong.

13:15–14:15 Talk Invited by Algebra Section

Kenichi Shimizu (Shibaura Inst. of Tech.) Recent developments of 'non-semisimple' modular tensor categories

Summary: A modular tensor category is usually defined as a semisimple ribbon category satisfying a certain non-degeneracy condition. Nevertheless, with motivation coming from CFT and TQFT, it is important and interesting to drop the semisimplicity assumption from the definition of a modular tensor category. Lyubashenko has formulated such a 'non-semisimple' modular tensor category and showed that, as in the semisimple case, a 'non-semisimple' modular tensor category yields an invariant of closed 3-manifolds and a projective representation of the surface mapping class groups. In this talk, while introducing several category-theoretical techniques that are important in the recent study of tensor categories, I will review recent developments of 'non-semisimple' modular tensor categories. I will, especially, mention the recent result that a ribbon finite tensor category is modular if and only if its Müger center is trivial. This criterion yields several new examples of modular tensor categories and factorizable (quasi-)Hopf algebras.

March 20th (Tue) Conference Room III

9:15–12:00

42 Takuo Matsuoka — Filtration of a stable infinity 1-category ····· 10

Summary: **Stability** is the appropriate notion of linearity in *homotopical algebra*, which supersedes *Abelianness* in classical algebra. Thus, stable homotopical algebra is useful e.g., for refining the method of *derived categories*. While homotopical algebra can conveniently be formulated in a $(\infty, 1)$-category, to be simply called "**category**" here, stable homotopical algebra can be understood as algebra in a "stable" such. We discuss the theory of *filtration* of a stable category, which is useful for controlling behaviour of limits in stable homotopical algebra, and can be applied e.g., for the study of the *Koszul duality* and *higher Morita categories*. Examples of a filtration include a *t-structure*, and a natural filtration on the category of *filtered objects* in a stable category. Both may come with a compatible symmetric monoidal structure in practice.

43 Izuru Mori (Shizuoka Univ.)
Kenta Ueyama (Hirosaki Univ.)
A categorical characterization of noncommutative projective spaces ··· 10

Summary: The noncommutative projective scheme associated to an AS-regular algebra is considered as a noncommutative projective space, and has been studied deeply and extensively in noncommutative algebraic geometry. In this talk, we will characterize a k-linear abelian category $\mathcal{C}$ such that $\mathcal{C}$ is equivalent to the noncommutative projective scheme associated to some AS-regular algebra.

44 Ayako Itaba (Tokyo Univ. of Sci.)
Masaki Matsuno (Shizuoka Univ.)
3-dimensional quadratic AS-regular algebras corresponding to elliptic curves ····· 10

Summary: In this talk, we determine the automorphism group of an elliptic curve E in $\mathbb{P}^2$ depending on its j-invariant $j(E)$. By using the automorphism σ of E, we calculate the defining relations of a 3-dimensional quadratic AS-regular algebra corresponding to the pairs (E, σ). By this calculations, we find a counterexample to the conjecture that any 3-dimensional quadratic AS-regular algebra Λ corresponding to an elliptic curve is isomorphic to a twist A^{φ} of a Sklyanin algebra A by $\varphi \in \operatorname{Aut} A$.

45 Ayako Itaba (Tokyo Univ. of Sci.)
Diego Alejandro Mejía (Shizuoka Univ.)
Teruyuki Yorioka (Shizuoka Univ.)
On some non-projective infinitely generated modules over path algebras ····· 10

Summary: It is known that for any finite dimensional algebra Λ of finite global dimension and any finitely generated Λ-module M, if $\operatorname{Ext}^{\geq 1}_{\Lambda}(M, \Lambda) = 0$, then M is projective. Let Q be the following quiver:

$$\circ \to \circ \to \cdots \circ \to \circ \to$$

and K an algebraically closed field. Using the compactness theorem of Mathematical Logic, we prove that for any finitely dimensional K-representation $\mathcal{K}$, if $\operatorname{Ext}^1_{KQ}(\mathcal{K}, KQ) = 0$, then $\mathcal{K}$ is projective. It is also proved that, under Martin's Axiom (which is a combinatorial statement consistent with Axiomatic Set Theory), there exists a non-projective KQ-module M such that $\operatorname{Ext}^1_{KQ}(\mathcal{K}, KQ) = 0$.

46 Hideyuki Koie (Tokyo Univ. of Sci.)
Tomohiro Itagaki (Tokyo Univ. of Sci.)
Katsunori Sanada (Tokyo Univ. of Sci.)
On presentations of Hochschild extension algebras for a class of self-injective Nakayama algebras ····· 10

Summary: For a bound quiver algebra satisfying the condition that the every oriented cycles in the quiver are vanished in the algebra, Fernádez and Platzeck determined the bound quiver algebra which is isomorphic to the trivial extension algebra. In this paper, we consider a Hochschild extension algebra which is a generalization of a trivial extension algebra. Our aim is to determine the bound quiver algebras which are isomorphic to Hochschild extension algebras of some finite dimensional self-injective Nakayama algebras.

Summary: In this talk, we determine the Batalin Vilkovisky algebra structure on the Hochschild cohomology of self-injective Nakayama algebras over an algebraically closed field.

Summary: Mizuno gave an isomorphism of lattices from a Coxeter group of Dynkin type to the set of torsion-free classes in the module category of the corresponding preprojective algebra. Combining it with my bijection on semibricks, we obtain a bijection from the Coxeter group to the set of semibricks over the preprojective algebra. My aim is to explicitly describe the semibrick associated to each element in the Coxeter group in this bijection. In this process, a combinatorial notion "canonical join representations" introduced by Reading, is very useful. I observed that the canonical join representation of an element in the Coxeter group gives the decomposition of the corresponding semibrick into bricks. I will talk about such theoretic strategies to determine the semibrick.

Summary: This talk is based on joint work with Yuji Yoshino. Let R be a commutative Noetherian ring. We denote by $\mathcal{D}$ the unbounded derived category of R. An exact functor $\lambda : \mathcal{D} \to \mathcal{D}$ is called a localization functor if there is a morphism $\eta : \mathrm{id}_{\mathcal{D}} \to \lambda$ such that $\lambda\eta$ is invertible and $\lambda\eta = \eta\lambda$. This notion was introduced by A. K. Bousfield in his topological work (1979). In this talk, we give a concrete way to compute localization functors on $\mathcal{D}$ by using the notions of cosupport and Čech complexes. As an application, we can obtain a functrial way to construct pure-injective resolutions for complexes of flat R-modules and complexes of finitely generated R-modules.

Summary: The singularity category $D_{sg}(R)$ of a commutative Noetherian ring R is a triangulated category which measures singularity of R. Two commutative Noetherian rings R and S are said to be singularly equivalent if their singularity categories are equivalent as triangulated categories. Singular equivalence have deeply been studied in non-commutative setting and various examples are known, while in commutative setting, only a few examples of singular equivalence are known. The aim of this talk is to give a necessary condition for singular equivalence by using singular loci. The key tool to prove our main result is the support theory for triangulated categories without tensor structure.

Summary: I will talk on syzygies of (maximal) Cohen–Macaulay modules over one dimensional Cohen–Macaulay local rings. We compare these modules to Cohen–Macaulay modules over the endomorphism ring of the maximal ideal. After this comparison, we give several characterizations of almost Gorenstein rings in terms of syzygies of Cohen–Macaulay modules.

Summary: Reduction of ideals introduced by Northcott and Rees plays an important role in the study of local rings, especially the multiplicity theory of ideals. This notion is extended to the multigraded modules and used in the study of asymptotic properties of them. In this talk, I will give a result about existence of certain complete reductions of multigraded modules. By applying the result to multi-Rees algebras of finitely many ideals, we obtain a result on normality of monomial ideals, which extends and improves several known results on this topic.

53 Shinya Kumashiro (Chiba Univ.) When is $R \ltimes I$ an almost Gorenstein local ring? 10
Shiro Goto (Meiji Univ.*)

Summary: Let R be a Noetherian local ring and M be a nonzero finitely generated R-module. The notion of almost Gorenstein rings is one of the generalization of the notion of Gorenstein rings. The purpose of this talk is to explore the question of when the idealization $R \ltimes M$ of M is an almost Gorenstein local rings. Although this problem was investigated by S. Goto, R. Takahashi, and N. Taniguchi, it is still open.

54 Ryotaro Isobe (Chiba Univ.) Characterization of generalized Gorenstein rings 10
Shiro Goto (Meiji Univ.*)
Naoki Taniguchi (Waseda Univ.)
Shinya Kumashiro (Chiba Univ.)

Summary: The notion of a generalized Gorenstein local ring (GGL ring for short) is one of the generalizations of Gorenstein rings. Similarly for almost Gorenstein local rings, the notion is given in terms of a certain specific embedding of the rings into their canonical modules. In this talk, we give a characterization of GGL rings in terms of their canonical ideals and related invariants.

14:15–14:30 Presentation Ceremony for the 2017 MSJ Algebra Prize

14:30–15:30 Award Lecture for the 2018 MSJ Algebra Prize

Kanetomo Sato (Chuo Univ.) A new cohomology theory for arithmetic schemes and its applications

Summary: In this talk, I would like to explain an approach to motivic cohomology in the étale topology with $\mathbb{Z}/p^n\mathbb{Z}$-coefficients of an arithmetic scheme X which has good or semistable reduction at all primes dividing p. We construct a complex of étale sheaves $\mathbb{Z}/p^n\mathbb{Z}(r)$ on X for $r \geqq 0$ by gluing the r-fold tensor power of the locally constant sheaf μ_{p^n} on $X[p^{-1}]$ with a certain differential sheaf on the fiber over p via the boundary map of Galois cohomology groups due to K. Kato. In the good reduction case, the object $\mathbb{Z}/p^n\mathbb{Z}(r)$ is already considered by J. S. Milne and P. Schneider about 30 years ago. What I did on this object is that I defined it in the semistable reduction case and proved a global duality result for étale cohomology with coefficients in $\mathbb{Z}/p^n\mathbb{Z}(r)$, which had not been unknown even in the good reduction case. I will also talk about a few applications of $\mathbb{Z}/p^n\mathbb{Z}(r)$ to the study of algebraic cycles on arithmetic schemes.

15:40–16:40 Award Lecture for the 2018 MSJ Algebra Prize

Satoshi Naito (Tokyo Tech) Representation theory of quantum affine algebras

Summary: In this talk, I will explain the following aspects of level-zero representations of quantum affine algebras:
1) explicit combinatorial realization, by semi-infinite Lakshmibai–Seshadri paths, of crystal bases of Demazure submodules of level-zero extremal weight modules over quantum affine algebras;
2) explicit relation of graded characters of level-zero Demazure submodules with the specializations of nonsymmetric Macdonald polynomials at $t = 0$ and $t = \infty$;
3) algebro-geometric interpretation of graded characters of level-zero Demazure submodules via Borel–Weil–Bott type theorem for semi-infinite flag manifolds.

16:50–17:50 Award Lecture for the 2018 MSJ Algebra Prize

Takayuki Hibi (Osaka Univ.) Monomial ideals and binomial ideals

Summary: Creating new trends of mutual development with combinatorics on convex polytopes, simplicial complexes, finite partially ordered sets and finite graphs and with statistics on contingency tables and experimental designs, commutative algebra on monomial ideals and binomial ideals is rapidly and dramatically growing by making the best use of modern techniques on, for example, Gröbner bases. In addition, plenty of fascinating problems remain unsolved. In the present draft, current streams of monomial ideals and binomial ideals will be surveyed quickly and their prospects will be predicted.

March 21st (Wed) Conference Room Ⅲ

9:15–12:00

55 Hirotaka Higashidaira (Meiji Univ.) On sequentially generalized Cohen–Macaulay bipartite graphs ····· 10

Summary: Let S be the polynomial ring in n variables over a field K and H a bipartite graph with n vertices. We denote by $I(H)$ the edge ideal of H. In 2003, N. T. Cuong and L. T. Nhan introduced the notion of sequentially generalized Cohen–Macaulay. H is called sequentially generalized Cohen–Macaulay when so is $S/I(H)$.
In this talk, we consider properties of sequentially generalized Cohen–Macaulay bipartite graphs. In particular, we investigate the behavior of edges of H when $\operatorname{depth}(S/I(H)) \leq 3$. Consequently, we give a characterization of sequentially generalized Cohen–Macaulay graphs of essential dimension 3.

56 Akiyoshi Tsuchiya (Osaka Univ.) Gorenstein Fano polytopes arising from perfect graphs ····· 10
Takayuki Hibi (Osaka Univ.)

Summary: Gorenstein Fano polytopes form one of the distinguished classes of lattice polytopes. Especially normal Gorenstein Fano polytopes are of interest. In this talk, we will give a new class of normal Gorenstein Fano polytopes arising from perfect graphs.

57 Akiyoshi Tsuchiya (Osaka Univ.) Normality and levelness of Cayley sums of lattice polytopes ····· 10

Summary: Normality or the integer decomposition property (IDP) is one of the most important properties on lattice polytopes. In fact, many authors have been studied the properties from view-points of combinatorics, commutative algebra and algebraic geometry. In this talk, we discuss when a Cayley sum is normal. Moreover, we consider when a Cayley sum is level.

58 Kazunori Matsuda (Osaka Univ.) Regularity and h-polynomials of monomial ideals ····· 10
Takayuki Hibi (Osaka Univ.)

Summary: Let $S = K[x_1, \ldots, x_n]$ denote the polynomial ring in n variables over a field K with each $\deg x_i = 1$ and $I \subset S$ a homogeneous ideal of S with $\dim S/I = d$. The Hilbert series of S/I is of the form $h_{S/I}(\lambda)/(1-\lambda)^d$, where $h_{S/I}(\lambda) = h_0 + h_1\lambda + h_2\lambda^2 + \cdots + h_s\lambda^s$ with $h_s \neq 0$ is the h-polynomial of S/I. It is known that, when S/I is Cohen–Macaulay, one has $\operatorname{reg}(S/I) = \deg h_{S/I}(\lambda)$, where $\operatorname{reg}(S/I)$ is the (Castelnuovo–Mumford) regularity of S/I. In this talk, given arbitrary integers r and s with $r \geq 1$ and $s \geq 1$, a monomial ideal I of $S = K[x_1, \ldots, x_n]$ with $n \gg 0$ for which $\operatorname{reg}(S/I) = r$ and $\deg h_{S/I}(\lambda) = s$ will be constructed.

59 Akihiro Higashitani (Kyoto Sangyo Univ.) On generalized F-signatures of Segre product of polynomial rings ···· 10
Yusuke Nakajima (Univ. of Tokyo)

Summary: Let K be an algebraically closed field of positive characteristic. We set $S(t) = K[x_1, y_1] \# \cdots \# K[x_t, y_t]$ and $R(r, s) = K[x_1, \ldots, x_{r+1}] \# K[y_1, \ldots, y_{s+1}]$. In this talk, we will compute generalized F-signatures of all modules belonging to the FFRT system of each of $S(t)$ and $R(r, s)$.

60 Takayuki Hibi (Osaka Univ.) Existence of regular unimodular triangulations of dilated empty simplices ····· 10
Akihiro Higashitani (Kyoto Sangyo Univ.)
Koutarou Yoshida (Osaka Univ.)

Summary: Given integers k and m with $k \geq 2$ and $m \geq 2$, let P be an empty simplex of dimension $(2k-1)$ whose δ-polynomial is of the form $1 + (m-1)t^k$. In this talk, the necessary and sufficient condition for the k-th dilation kP of P to have a regular unimodular triangulation will be presented.

Summary: Let R be a Hibi ring and ω the canonical ideal of R. We denote the n-th power of ω in $D(R)$, the group of divisorial ideals of R, by $\omega^{(n)}$ for any integer n. R is by definition, anticanonical level if all the generators of $\omega^{(-1)}$ have the same degree. In this talk, we analyze the structure of $\omega^{(n)}$ for any integer n and state a criterion of anticanonical level property of R.

Summary: The Mallows–Sloane bound is the inequality which estimates the minimum distance by the code length for a divisible self-dual code. Analogous inequalities for formal weight enumerators are completed.

Summary: An m-free hyperplane arrangement is a generalization of a free arrangement. There are rich researches for free arrangements, but the behavior of m-freeness has not been well analyzed yet when $m > 2$. Some basic questions remain open. In particular, Holm asked the following: (1) Does m-free imply $(m+1)$-free for any arrangement? (2) Are all arrangements m-free for m large enough? In this talk, we characterize m-freeness for product arrangements and show that all localizations of an m-free arrangement are m-free. From these results, we give counter examples to Holm's questions.

Summary: Hessenberg varieties are subvarieties of a flag variety. This subject makes connections with many research areas such as geometric representation theory, quantum cohomology of the flag variety, chromatic quasisymmetric functions of graph theory, and hyperplane arrangemants. In this talk, I will explain the connection between Hessenberg varieties and hyperplane arrangemants. More concretely, we show that a certain graded ring derived from the logarithmic derivation module of an ideal arrangement is isomorphic to the cohomology ring of a regular nilpotent Hessenberg variety, and the Weyl group invariant subring of the cohomology of a regular semisimple Hessenberg variety. This is joint work with Takuro Abe, Mikiya Masuda, Satoshi Murai, and Takashi Sato.

Summary: Let X be an affine G-variety, where G is a reductive algebraic group. The invariant Hilbert scheme parametrizes closed G-subschemes of X whose coordinate rings have a prescribed decomposition as G-modules. One of the main usage of the invariant Hilbert scheme, together with so-called the Hilbert–Chow morphism, is to study singularities of affine quotient varieties. In this talk, we study Popov's $SL(2)$-varieties by means of the invariant Hilbert scheme.

Summary: Spherical twists along spherical objects are autoequivalences of a triangulated category defined by Seidel and Thomas as a categorical analogue of Dehn twists along simple closed curves. Spherical twists share many properties with Dehn twists. On the other hand, there is a classical result by Humphries which states that if a collection of simple closed curves admits a "complete partition" and does not bound a disk then the group generated by the Dehn twists along them is isomorphic to the free product of free abelian groups. In this talk, we give a categorical analogue of Humphries' argument.

Summary: We define "non-commutative Kähler projective space". We describe fully the "infinitesimal deformation case" and discuss "finite (non-perturbative) deformation case". We then examine the cohomology in the "infinitesimal defomation case" from a view point of commutative algebraic geometry.

14:20–17:00

Summary: We give basic concepts of semialgebraic varieties. We will treat a semialgebraic subset of a real algebraic variety as a certain kind of abstract locally ringed space. We study a relation with semialgebraic varieties and complex algebraic varieties.

Summary: We will prove a theorem of Ax–Lindemann type for complex semi-abelian varieties as an application of a big Picard Theorem proved by the author in 1981, and then apply it to prove a theorem of the classical Manin–Mumford Conjecture for semi-abelian varieties, which was proved by M. Raynaud 1983, M. Hindry 1988, ..., and Pila–Zannier 2008 by a different method from others, which is most relevant to ours.

Summary: A curve is called superspecial if its Jacobian is isomorphic to a product of supersingular elliptic curves. The purpose of this study is to enumerate superspecial curves of genus g over $\mathbb{F}_q$ for a given g and for a given q. In 2016, the speakers gave an algorithm to enumerate superspecial curves of genus $g = 4$ over $\mathbb{F}_q$ with $q > 5$. By executing the algorithm on a computer algebra system Magma, they also enumerated superspecial curves of genus 4 over $\mathbb{F}_{25}$ and $\mathbb{F}_{49}$. In this talk, we present an improved algorithm, which works for any finite field $\mathbb{F}_q$ with $q \geq 5$, and classifies the isomorphism classes of superspecial curves of genus 4. By our implementation of the improved algorithm over Magma, we newly enumerate superspecial curves of genus 4 over prime fields $\mathbb{F}_p$ for $p \leq 11$.

Summary: A nonsingular projective curve C over a field K of positive characteristic is called superspecial if its Jacobian is isomorphic to a product of supersingular elliptic curves. In 2016 and 2017, Kudo and Harashita enumerated nonhyperelliptic superspecial curves of genus 4 over $\mathbb{F}_{25}$, $\mathbb{F}_{49}$ and $\mathbb{F}_{11}$. By implementing our algorithm over Magma, we determined the structure of the automorphism group of every nonhyperelliptic superspecial curve of genus 4 over $\mathbb{F}_{11}$.

Summary: We consider the embedded topology of plane curves in the complex projective plane, as in knot and link theory. In this talk, we introduce a new invariant, called the *splitting graph*, to distinguish the embedded topology of plane curves. This invariant is a generalization of the splitting number, which is an invariant not determined by the fundamental group of the complement of a plane curve. By using the splitting graph, we distinguish the embedded topology of plane curves consisting of one smooth curve and three lines.

Summary: In this talk we introduce some recent study of rational points of elliptic surfaces done from a geometric point of view, and apply it to construct interesting examples of plane curve arrangements of low degree which give rise to candidates for Zariski pairs. The constructed arrangements can be distinguished topologically by studying the arithmetic properties of the rational points used in the construction. Previously known examples of Zariski pairs consisting of cubic-line arrangements all involved flex tangent lines, but our new examples do not contain any flex tangents.

Summary: In the classification problem of Poisson structures, log symplectic structures which are generically symplectic Poisson structures with reduced degeneracy divisor is one of the most important class. Lima and Pereira studied log symplectic structures with simple normal crossing degeneracy divisor in the case that the variety is a Fano variety of Picard number 1 and they discovered a characterization of projective spaces. My research consider the case that the variety is a product of Fano varieties of Picard number 1. We will extend the result of Lima and Pereira and also give a bettter characterization of projective spaces.

Summary: Taku Suzuki (arXiv.16060.9350) gave some sufficient condition for a smooth Fano manifold to be covered by rational N-folds. Results of this sort might be useful for future investigation of "higher connectivity" properties in the Morel–Voevodsky Motivic homotopy theory. Motivated by this, I shall report that a slight relaxation of the condition in this Suzuki's theorem is possible.

Summary: The multiplicity of a point on a variety is a fundamental invariant to estimate how bad the singularity is. It is introduced in a purely algebraic context. On the other hand, we can also attach to the singularity the log canonical threshold, which is introduced in a birational theoretic context. In this talk, we show bounds of the multiplicity by functions of this birational invariant for a singularity of locally a complete intersection. As an application, we obtain the affirmative answer to Watanabe's conjecture on the multiplicity of canonical singularity of locally a complete intersection up to dimension 32.

Summary: The minimal model theory is a fundamental method to classify higher-dimensional algebraic varieties. Today the theory is not completed. It consists of the minimal model conjecture and the abundance conjecture. On the other hand, the non-vanishing conjecture is also an important open problem in the minimal model theory. In fact, the minimal model conjecture and the abundance conjecture implies the non-vanishing conjecture, and it is known by Birkar that the non-vanishing conjecture implies the minimal model conjecture. In this talk I focus on the minimal model conjecture and the simplest case of the non-vanishing conjecture, that is, the non-vanishing conjecture for smooth varieties. I explain that the non-vanishing conjecture for smooth varieties implies the minimal model conjecture.

Summary: Let X be a smooth complex projective variety of dimension n, and let L be an ample line bundle on X. Then the pair (X, L) is called a polarized manifold. In my short talk, I will talk about some problems related with the dimension of the global sections of adjoint bundles for polarized manifolds.

Summary: An ACM bundle on a polarized algebraic variety is defined as a vector bundle whose intermediate cohomology vanishes. We are interested in ACM bundles of rank one with respect to a very ample line bundle on a K3 surface. In this session, we give a necessary and sufficient condition for a non-trivial line bundle M on X with $|M| \neq \emptyset$ and $M^2 \geq L^2 - 6$ to be an ACM and initialized line bundle with respect to L, for a given K3 surface X and a very ample line bundle L on X.

Summary: Threefold semistable extremal neighborhoods, as of type (IIA), have important properties as rationality criterion of Q-conic bundles, or the existence of semistable flips by division algorithm by S. Mori. In this talk, the author reports his study about inducing an analogue of Miyaoka–Yau type inequality for threefold extremal contractions of type (IIA) with special regarding to the third Chern classes associated to the filtration of bi-anti-canonical divisors used in local-to-global deformation in the proof of [Mori1988], based on (non-)normal hyperplane section case of threefold extremal contractions of type (IIA) [Mori–Prokhorov 2016, 2017].

Geometry

March 18th (Sun) Conference Room I

9:15–11:35

1 Tetsuya Nagano (Univ. of Nagasaki) On the existence of the curve to give the inverse linear parallel displacement ····· 15

Summary: The existence of the curve to give the inverse linear parallel displacement is not known for a linear parallel displacement of Finsler space generally. A purpose of the study is to establish a mathematical method to find such a curve, but I don't have it, yet. Today, I report a necessary and sufficient condition for two curves that they are to be such curves to give other inverse linear parallel displacement each other.

2 Tsukasa Takeuchi (Keio Univ.)
Kiyonori Hosokawa
(ORCA Management Organization Co., Ltd.)
Construction of symplectic-Haantjes manifold of certain Hamiltonian systems ····· 10

Summary: Symplectic-Haantjes manifolds are constructed for several Hamiltonian systems following Tempesta–Tondo, which yields the complete integrability of systems.

3 Takayuki Moriyama (Mie Univ.)
Takashi Nitta (Mie Univ.)
Some examples of global Poisson structures on S^4 ····· 10

Summary: A Poisson structure is represented by a bivector whose Schouten bracket vanishes. We study a global Poisson structure on S^4 associated with a holomorphic Poisson structure on $\mathbb{CP}^3$. The space of the Poisson structures on S^4 is a real algebraic variety in the space of holomorphic Poisson structures on $\mathbb{CP}^3$. We generalize it to $\mathbb{HP}^n$ by using the twistor method. Furthermore, we provide examples of Poisson structures on S^4 associated with codimension one holomorphic foliations of degree 2 on $\mathbb{CP}^3$.

4 Takayuki Moriyama (Mie Univ.)
Takashi Nitta (Mie Univ.)
Splitting theorem for sheaves of holomorphic k-vectors on complex contact manifolds ····· 10

Summary: A complex contact structure γ is defined by a system of holomorphic local 1-forms satisfying the completely non-integrability condition. The contact structure induces a subbundle $\operatorname{Ker}\gamma$ of the tangent bundle and a line bundle L. In this paper, we prove that the sheaf of holomorphic k-vectors on a complex contact manifold splits into the sum of $\mathcal{O}(\bigwedge^k \operatorname{Ker}\gamma)$ and $\mathcal{O}(L \otimes \bigwedge^{k-1} \operatorname{Ker}\gamma)$ as sheaves of $\mathbb{C}$-*module*. The theorem induces the short exact sequence of cohomology of holomorphic k-vectors, and we obtain vanishing theorems for the cohomology of $\mathcal{O}(\bigwedge^k \operatorname{Ker}\gamma)$.

5 Hiroshi Sawai (Numazu Nat. Coll. of Tech.) Examples of solvmanifolds without LCK structures ····· 15

Summary: Belgun proved that Inoue surface has no Vaisman structures. In this talk, we generalize this result and construct solvmanifolds without LCK structures. Note that these solvmanifolds have LCS structures.

6 Masayuki Igarashi (Tokyo Univ. of Sci.) * On Hermite–Liouville structures constructed on the Hopf surface ····· 10

Summary: In the last 20 years, the Hermite–Liouville structures on compact complex manifolds have been studied. In these studies, almost all of the non-Kählerian structures were obtained by deforming from the Kähler–Liouville structure. In this presentation, the speaker will illustrate the construction of the examples of the Hermite–Liouville structure on the Hopf surface, which leads to the complete integrability of its geodesic flow.

Summary: Ricci Calabi functional is a functional on the space of Kähler metrics of a Fano manifold. Its critical points are called generalized Kähler Einstein metrics. In this talk, we show that the Hessian of the Ricci Calabi functional is non-negative at a generalized Kähler Einstein metric.

Summary: We give a characterization of relative Ding stable toric Fano manifolds in terms of the behavior of the modified Ding functional. We call the corresponding behavior of the modified Ding functional the *pseudo-boundedness from below*. We also discuss the pseudo-boundedness of the Ding / Mabuchi functional of general Fano manifolds.

Summary: In order to study the optimal degeneration of a Fano manifold, we introduce the Ding flow as the gradient flow of the Ding energy functional on the space of Kahler metrics.

14:15–16:35

Summary: I will talk about one of coarse geometric versions of the so-called Cartan–Hadamard theorem, that is, a coarse Cartan–Hadamard theorem on coarse convex spaces. Also I will deal with coarse homotopy, open cones and the coarse Baum–Connes conjecture. This talk is based on a joint-work with Tomohiro Fukaya (Tokyo Metropolitan University); 'Tomohiro Fukaya, Shin-ichi Oguni, A coarse Cartan–Hadamard theorem with application to the coarse Baum–Connes conjecture, preprint, 2017, arXiv:1705.05588'.

Summary: In the joint work with Shin-ichi Oguni, we introduced a new class of metric spaces which we call "coarsely convex spaces". This is a new formulation of "nonpositively curved spaces" from the view point of coarse geometry. This class includes Gromov hyperbolic spaces, CAT(0)-spaces, and systolic complexes. This class is closed under quasi-isometry, and direct product. The idea of the definition is "convexity of metric" and its coarsification. We also construct an ideal boundary for coarsely convex spaces. The construction is based on that of Gromov hyperbolic spaces. Due to time constraints, in this talk, we will not explain on an application to the coarse Baum–Connes conjecture, which is the original motivation of this work.

Summary: In this talk, we present the result that the $\mathrm{Cycl}_4(0)$ condition implies the $\mathrm{Cycl}_k(0)$ condition for any integer $k \geq 4$. We also present the result that a five-point metric space embeds isometrically into a CAT(0) space if and only if it satisfies the $\boxtimes$-inequalities.

Summary: Gigli, Mondino, and Savaré introduced the pmG-convergence on the space of pointed metric measure spaces and studied the stability of the curvature-dimension condition and the Mosco convergence of Cheeger energies under the pmG-convergence. We introduce a new condition generalizing the pmG-convergence and then prove similar results under this condition. Our study is also related to the study by García, Kell, Mondino, and Sosa for quotient spaces by actions of compact groups.

14 Hiroki Nakajima (Tohoku Univ.) Isoperimetric rigidity and distributions of 1-Lipschitz functions ····· 15
Takashi Shioya (Tohoku Univ.)

Summary: We prove that if a geodesic metric measure space satisfies a comparison condition for the isoperimetric profile and if the observable variance is maximal, then the space is foliated by minimal geodesics, where the observable variance is defined to be the supremum of the variance of 1-Lipschitz functions on the space. Our result can be considered as a variant of Cheeger–Gromall's splitting theorem and also of Cheng's maximal diameter theorem. As an application, we obtain an isometric splitting theorem for a complete weighted Riemannian manifold with positive Bakry–Émery Ricci curvature.

15 Hiroki Nakajima (Tohoku Univ.) Lipschitz order with an additive error and normal law à la Lévy on the Hamming cubes ····· 10

Summary: M. Gromov introduced the Lipschitz order relation on the set of metric measure spaces and developed a rich theory. For a metric measure space X, we consider the set of the distributions of 1-Lipschitz functions on X and we call it the 1-measurement of X. We also define Lipschitz order on the 1-measurement naturally. The existence of the maximum of 1-measurement is deeply related to the isoperimetric inequality of X. In fact if X is an n-dimensional sphere, we obtain the maximum of 1-measurement by the isoperimetric inequality. However, if X is a n-dimensional Hamming cube, the maximum of 1-measurement does not exist because of discreteness. We solve this problem by generalizing the definition of Lipschitz order with an error. On the spheres case, we have Normal law à la Lévy by considering the weak limit. We have the Hamming cubes version of it as an application of the main theorem.

16 Taiki Yamada (Tohoku Univ.) The Ricci curvature and the Laplacian on edges of graphs ····· 10
Jürgen Jost (Max Planck Inst.)

Summary: We define the distance between edges of graphs and study the coarse Ricci curvature on edges. We consider the Laplacian on edges based on the definition of the Laplacian on simplicial complexes. As one of our main results, we obtain an estimate of the first non-zero eigenvalue of the Laplacian by the Ricci curvature for a regular graph.

17 Ayato Mitsuishi (Fukuoka Univ.) Obtuse constant and volume of Alexandrov spaces ····· 15
Takao Yamaguchi (Kyoto Univ.)

Summary: We introduce a new geometric invariant called the obtuse constant of spaces with curvature bounded below, defined in terms of comparison angles. We first find relations between this invariant and volume. We discuss the case of maximal obtuse constant equal to $\pi/2$, where we prove some rigidity for spaces. Although we consider Alexandrov spaces with curvature bounded below, the results are new even in the Riemannian case.

16:45–17:45 Talk Invited by Geometry Section

Ryokichi Tanaka (Tohoku Univ.)[♭] Potential theory on discrete groups and metric embedding

Summary: We discuss countable groups, mainly focusing on problems related to existence of (bounded) harmonic functions. In particular we study questions such as which group does not admit any non-constant bounded harmonic function (Liouville property), and when it admits such a function, how all such functions are obtained (Poisson boundary). This problem often requires deep understanding on geometry of underlying groups as well as quantitative behavior of random walks. I will try to present this subject with several explicit key examples, emphasizing on importance of combining different ideas and techniques.

March 19th (Mon) Conference Room I

9:00–11:45

18 Hirotaka Ebisui (Geomathes Res. Center) Discovery of concurrent, collinear Theorems ····· 15

Summary: In the history, there are several elementary theorems by figure. We try to find such theorems, and found new 6 theorems. We show entire structures in figures of our text. We explain briefly them by naming as (1) star-star theorem (2) quadrangle Stainer theorem (3) 6 perpendicular-lines theorem (these 3 are concurrent theorems), (4) 10 lines theorem (5) 2 circles system theorem (6) Hexagon Theorem (these 3 are Collinear theorems). These are not proved. But, these theorems include important theoretical structures, and, it is interesting to follow the drawing orders and to consider on the compositions. Anyway, we show all figures of Theorems in our text. Please enjoy many strangeness of theorems. We will be able to speak some relations of theorems in later.

19 Jun O'Hara (Chiba Univ.) Residues and intrinsic volumes of submanifolds of $\mathbb{R}^n$ ····· 15

Summary: We show that the intrinsic volumes of compact bodies in the Euclidean spaces of dimension two and three can be obtained from the residues of the (relative) Brylinski beta functions.

20 Kaho Ohashi (Japan Women's Univ.) Construction of a metric on the moduli space of Delzant polytopes ····· 15

Summary: A. Pelayo–A. R. Pires–T. S. Ratiu–S. Sabatini defined a metric on the set of Delzant polytopes. They studied structures of the metric space and the moduli space with respect to the action of the integral affine transformations. The definition of the metric is natural, though, it does not induce a metric on the moduli space. In this talk we would like to try to define a metric on the moduli space. We can show that it actually defines a metric on the moduli space for 2-dimensional case.

21 Kenzi Satô (Tamagawa Univ.) The existence of orthocenters of simplices of hyperbolic spaces ····· 15

Summary: We consider orthocenters of simplices of hyperbolic spaces. Unlike the cases of Euclidean spaces or spheres, the similar condition does not always imply the existence of orthocenters. In this talk, we give characterizations of the existence of orthocenters.

22 Yuichiro Taketomi (Hiroshima Univ.) Singularities of the moduli space of left-invariant metrics and the properties of the corresponding metrics ····· 15

Summary: The moduli space of left-invariant metrics on a Lie group is defined as the orbit space of the action of the group of automorphisms and scalings on the space of left-invariant metrics, and has been studied actively. In this talk, we focus on some kinds of singular points which arise in the moduli space. We show that if an equivalent class of a left-invariant metric is the "most singular" point in the moduli space, then the left-invariant metric has nice properties.

23 Naohiko Kasuya (Kyoto Sangyo Univ.) Masamichi Takase (Seikei Univ.) Knots and links of complex tangents ····· 15

Summary: We show that a link in a closed orietable 3-manifold can be realized as the set of complex tangents of a smooth embedding of the 3-manifold into the complex 3-space if and only if it represents the trivial integral homology class in the 3-manifold.

24 Nobuhiro Innami (Niigata Univ.) The asymptotic behavior of geodesic circles in a 2-torus ····· 15

Summary: We prove that in any 2-torus T^2 for any point $p \in T^2$ and for any $\varepsilon > 0$ there exists a number $R > 0$ such that the geodesic circles with center p and radii t are ε-dense in T^2 for all $t > R$.

25 Kei Kondo (Yamaguchi Univ.) From Hopf's curvature pinching conjecture to a differentiable exotic sphere theorem 15

Summary: We prove that for an arbitrarily given compact Riemannian manifold M admitting a point $p \in M$ with a single cut point, every compact Riemannian manifold N admitting a point $q \in N$ with a single cut point is diffeomorphic to M if the radial curvature of N at q are sufficiently close in the sense of L^1-norm to that of M at p.

26 Toshihiro Shoda (Saga Univ.)
Shin Nayatani (Nagoya Univ.) Metrics on a closed surface of genus two which maximize the first eigenvalue of the Laplacian 15

Summary: We will consider the upper bound for the first eigenvalue of the Laplacian on a closed surface. For the genus two case, we obtain a singular metric which maximize the first eigenvalue. This result was conjectured by Jakobson–Levitin–Nadirashvili–Nigam–Polterovich. It is joint work with Shin Nayatani, Nagoya University.

13:15–14:15 Talk Invited by Geometry Section

Hirofumi Sasahira (Kyushu Univ.)* The Seiberg–Witten equations and applications

Summary: Since the Seiberg–Witten equations were introduced by Witten in 1994, the equations have produced many significant applications to 3 and 4 dimensional geometry. In this talk, we will discuss some of them and recent progress.

March 20th (Tue) Conference Room I

9:15–11:45

27 Jong Taek Cho (Chonnam Nat. Univ.)
Takahiro Hashinaga (Kitakyushu Nat. Coll. of Tech.)
Akira Kubo (Hiroshima Shudo Univ.)
Yuichiro Taketomi (Hiroshima Univ.)
Hiroshi Tamaru (Hiroshima Univ.) Realizations of some contact metric manifolds as Ricci soliton real hypersurfaces 15

Summary: Ghosh and Sharma have studied (κ, μ)-spaces, which are contact metric spaces with certain nullity conditions. Especially, they gave a necessary condition for (κ, μ)-spaces to be nongradient Ricci soliton manifolds. In this talk, we prove that in the connected, simply-connected and complete case such (κ, μ)-spaces can be realized as homogeneous real hypersurfaces in noncompact real two-plane Grassmannians. Consequently, we also prove that such spaces are actually Ricci soliton.

28 Kazushi Kobayashi (Chiba Univ.) Some remarks on the homological mirror symmetry for tori 15

Summary: Let us consider an n-dimensional complex torus whose period matrix is (I_n, T). Here, I_n is the identity matrix of order n and T is a complex matrix of order n whose imaginary part is positive definite. In particular, when we consider the case of $n = 1$, i.e., a one-dimensional complex torus, the corresponding complexified symplectic form of the mirror partner of the one-dimensional complex torus is defined by $-\frac{1}{T}$ or T. However, if we assume $n \geq 2$ and that T is a singular matrix, we can not define the mirror partner of the complex torus as the natural generalization of the case of $n = 1$ to the higher dimensional case. In this talk, we propose a way to avoid this problem, and discuss the homological mirror symmetry.

Summary: We define a class of harmonic Hadamard manifolds of hypergeometric type. This class of harmonic manifolds includes all Damek–Ricci spaces and also all rank one symmetric spaces of non-compact type as particular cases. Using a hypergeometric description of spherical functions on each harmonic Hadamard manifold X belonging to this class, we discuss harmonic analysis of radial functions on X. In this talk we would like to present the inversion formula, Plancherel theorem and Paley–Wiener type theorem for the spherical Fourier transform on a Hadamard harmonic manifold which is of hypergeometric type.

Summary: In this talk I consider a homogeneous holomorphic line bundle over a certain elliptic (adjoint) orbit, and set a representation of real semisimple Lie group on a complex vector subspace of the complex vector space of holomorphic cross-sections of the bundle. Then, I state that the representation is irreducible unitary.

Summary: Let X be a smooth compact manifold with corners which has two embedded boundary hypersurfaces $\partial_0 X, \partial_1 X$, and suppose a fiber bundle $\phi : \partial_0 X \to Y$ is given. We define a pseudodifferential calculus $\Psi^*_{\Phi,b}(X)$ generalizing the Φ-calculus of Mazzeo–Melrose and the b-calculus of Melrose. We investigate the Fredholm condition and the index of an operator $P \in \Psi^*_{\Phi,b}(X)$. And as its application, we prove the index theorem of "non-closed" $\mathbb{Z}/k$-manifolds.

Summary: A wave equation of motion of an elastic wire on a Riemannian manifold has a solution for any initial data.

Summary: We generalize several results for the Hamiltonian stability and the mean curvature flow of Lagrangian submanifolds in a Kähler–Einstein manifold to more general Kähler manifolds including a Fano manifold equipped with a Kähler form $\omega \in 2\pi c_1(M)$. Namely, we consider a variational problem for Lagrangian submanifolds in a Kähler manifold M w.r.t. a weighted volume functional. Moreover, we introduce the generalized Lagrangian mean curvature flow in a Fano manifold, and we show that if the initial Lagrangian is a small Hamiltonian deformation of a minimal and Hamiltonian stable Lagrangian w.r.t. the weighted volume functional, then the generalized MCF converges exponentially fast to a minimal Lagrangian submanifold.

Summary: An anisotropic surface energy is a generalizasion of the area of surfaces. It is the integral of an energy density function which depends on the surface normal over the considered surface, and it serves as a mathematical model of energy of crystals. The absolute minimizer of an anisotropic surface energy functional among all closed surfaces enclosing the same volume is unique and it is called the Wulff shape. In this talk, we show that, if the energy density function is not "convex", there exist closed equilibrium surfaces of the anisotropic surface energy for volume-preserving variations which are not the Wulff shape. By applying this result, it is shown that the uniqueness for closed self-similar solutions with genus zero for anisotropic mean curvature flow does not hold in general. These concepts and results are naturally generalized to higher dimensions.

35 Miyuki Koiso (Kyushu Univ.) Uniqueness of stable closed non-smooth hypersurfaces with constant anisotropic mean curvature ····· 10

Summary: An anisotropic surface energy is a generalizasion of the area of surfaces. It is the integral of an energy density function which depends on the surface normal over the considered surface, and it serves as a mathematical model of energy of crystals. The absolute minimizer of an anisotropic surface energy functional among all closed surfaces enclosing the same volume is unique and it is called the Wulff shape. In this talk, we show that, if the energy density function is of C^3 and "convex", then any stable closed equilibrium surface of the anisotropic surface energy for volume-preserving variations is (up to homothety and translation) the Wulff shape, here an equilibrium surface is said to be stable if the second variation of the energy for all admissible variations is nonnegative. The result holds also for hypersurfaces in any Euclidean space.

14:15–16:30

36 Makoto Sakaki (Hirosaki Univ.) * Transforms for minimal surfaces in 5-dimensional space forms ····· 10

Summary: We discuss transforms for minimal surfaces in 5-dimensional Riemannian space forms, and Lorentzian minimal surfaces in the 5-dimensional semi-Euclidean space of index 2.

37 Makoto Sakaki (Hirosaki Univ.) * Transforms and a representation formula for non-conformal harmonic surfaces in the Euclidean 3-space ····· 15

Summary: We give transforms and a representation formula for non-conformal harmonic surfaces in the Euclidean 3-space.

38 Kurando Baba (Tokyo Univ. of Sci.)
Osamu Ikawa (Kyoto Inst. Tech.)
Atsumu Sasaki (Tokai Univ.) Calibrated equalities and hyperpolar actions ····· 15

Summary: In this talk, we give a proof for calibrated equalities from the viewpoint of group actions. The essential part of our proof is to describe the orbit spaces for certain group actions on oriented Grassmann manifolds.

39 Kurando Baba (Tokyo Univ. of Sci.)
Osamu Ikawa (Kyoto Inst. Tech.)
Atsumu Sasaki (Tokai Univ.) Calibrated inequalities in pseudo-Riemannian geometry and a duality ····· 10

Summary: In this talk, we give a proof for Mealy's calibrated inequalities from the view point of group actions. As a typical example, we prove Wirtinger's inequality in terms of the duality which was introduced by the speakers.

40 Atsufumi Honda * (Yokohama Nat. Univ.) Isometric deformations of mixed type surfaces ····· 10

Summary: For a regular surface in Lorentz–Minkowski 3-space, a point is called a lightlike point if the first fundamental form is degenerate at the point. In this talk, we prove that any analytic surface admits non-trivial isometric deformations around a non-flat and non-degenerate lightlike point.

41 Taro Kimura (Nat. Inst. of Tech., Tsuruoka Coll.)
Katsuya Mashimo (Hosei Univ.) Classification of Cartan embeddings which are austere submanifolds ····· 15

Summary: In this talk, we will classify austere submanifolds in compact simple Lie groups. In particular, we proved that Cartan embeddings which defined by inner automorphisms of finite order $k > 2$ of compact simple Lie gruops are not austere.

42 Osamu Ikawa (Kyoto Inst. Tech.)
Hiroshi Iriyeh (Ibaraki Univ.)
Takayuki Okuda (Hiroshima Univ.)
Takashi Sakai (Tokyo Metro. Univ.)
Hiroyuki Tasaki (Univ. of Tsukuba)
Lagrangian Floer homology of two real forms in a complex flag manifold 15

Summary: An adjoint orbit M of a compact connected semisimple Lie group G is called a complex flag manifold. The intersection of two real forms L_0 and L_1 in a complex flag manifold M is an antipodal set of M. Applying the antipodal structure of the intersection $L_0 \cap L_1$, we calculate the Lagrangian Floer homology $HF(L_0, L_1 : \mathbb{Z}_2)$, when M has a G-invariant Kähler–Einstein metric and when two involutions of G defining L_0 and L_1 commute with each other.

43 Yohei Komori (Waseda Univ.)
Construction of pseudo-Anosov automorphisms whose dilatations are 2-Salem numbers 15

Summary: We construct a pseudo-Anosov automorphism whose dilatation is a 2-Salem number by means of the spectrum radius of the bicolored Coxeter element of a bipartite Coxeter system.

16:45–17:45 Talk Invited by Geometry Section

Hideki Miyachi (Osaka Univ.) Toward complex analysis on Teichmüller space

Summary: In this talk, I will overview the recent progress on my research on the complex analysis on Teichmüller space. The aim of this research is to give a unified treatment between the topological aspect and the complex analytical aspect in Teichmüller theory. I will discuss the infinitesimal deformation of singular Euclidean structures on a surface in aiming for developing the Teichmüller geometry (Extremal length geometry) on Teichmüller space. I also give a formula of the Levi form of the Teichmüller distance and the pluricomplex Green function on the Teichmüller space. If time permits, I will give an idea for unification and a conjecture on the pluricomplex Poisson kernel on the Bers slice.

Complex Analysis

March 18th (Sun) Conference Room VII

9:45–11:45

1 Shigeyoshi Owa (Yamato Univ.)* On univalences for Alexander type integrals ····· 15
Hitoshi Saitoh
(Gunma Nat. Coll. of Tech.)
Janusz Sokol (Univ. of Rzeszow)
Mamoru Nunokawa (Gunma Univ.*)

Summary: Let $\mathcal{H}$ be the class of functions $f(z)$ which are analytic in the open unit disk $\mathbb{U}$. Also let $\mathcal{A}$ be the subclass of functions $f(z)$ in $\mathcal{H}$ with $f(0) = 0$ and $f'(0) = 1$. The object of the present talk is to show some properties of functions $f(z)$ in $\mathcal{A}$ concerning with univalences for Alexander type integrals.

2 Kiyoki Tanaka (Daido Univ.)♭ Toeplitz operators on the polyharmonic Bergman space ····· 15

Summary: In this talk, we consider the polyharmonic Bergman spaces on the unit ball. As previous results, we obtain the estimates for the reproducing kernel of the polyharmonic Bergman space. By using the estimates for this kernel, we give a characterization of bouneded positive Toeplitz operators on the polyharmonic Bergman spaces.

3 Ryosuke Yamazaki The realization problem for Jørgensen numbers ····· 15
(Gakushuin Boys' Senior High School)
Yasushi Yamashita
(Nara Women's Univ.)

Summary: Hiroki Sato defined the Jørgensen number of a two-generator Kleinian group as a generalization of Jørgensen's inequality. Oichi–Sato asked the following natural problem: for any real number $r \geq 1$, when is there a Kleinian group whose Jørgensen number is equal to r? In this talk, we will give a complete solution for this realization problem.

4 Naotaka Kajino (Kobe Univ.) Weyl's eigenvalue asymptotics for the Laplacian on circle packing limit sets of certain Kleinian groups ····· 15

Summary: This talk will present the author's recent results on the construction of a "canonical" Laplacian on circle packing fractals invariant under the action of certain Kleinian groups and on the asymptotic behavior of its eigenvalues. In the simplest case of the *Apollonian gasket*, Teplyaev (2004) constructed a Laplacian *with respect to which the coordinate functions on the gasket are harmonic*, and the author has recently proved its uniqueness and discovered an explicit expression of it in terms of the circle packing structure of the gasket, which immediately extends to general circle packing fractals and defines (a candidate of) a "canonical" Laplacian on them. Then the author has further proved *Weyl's asymptotic formula* for the eigenvalues of this Laplacian, when the circle packing fractal is the limit set of certain Kleinian groups.

5 Tomoshige Yukita (Waseda Univ.) Construction of infinite series of ideal hyperbolic Coxeter 4-polytopes whose growth rates are Perron numbers. ····· 15

Summary: By glueing the ideal hyperbolic Coxeter 4-pyramids, we construct new infinite series of non-simple ideal hyperbolic Coxeter 4-polytopes. In this way, we provide a first example of such a non-compact infinite polyhedral series and prove that their growth rates are Perron numbers.

6 Masahiro Yanagishita (Yamaguchi Univ.) Construction of p-Weil–Petersson metric on p-integrable Teichmüller space ····· 15

Summary: If $p \geq 2$ and a Riemann surface R satisfies Lehner's condition, then the p-integrable Teichmüller space $T^p(R)$ has a complex Banach manifold structure modeled on p-integrable harmonic Beltrami differentials on R. When $p = 2$, then $T^2(R)$ has a complex Hermitian metric, which is called the Weil–Petersson metric. It was shown that this metric is Kähler and has the negative holomorphic sectional curvature and negative Ricci curvature.
In this talk, we construct the p-Weil–Petersson metric on $T^p(R)$ similarly to the Weil–Petersson metric on $T^2(R)$. In particular, we will say that this metric is smooth and strongly pseudoconvex when p is an even number.

7 Dounnu Sasaki (Waseda Univ.) The denseness probelm of geodesic currents and subset currents ····· 15

Summary: For a (Gromov) hyperbolic group G, which is a generalization of free groups (of finite rank) and surface groups, we can define the space $GC(G)$ of geodesic currents on G and the space $SC(G)$ of subset currents on G. The space $GC(G)$ is proved by Bonahon to be the completion of the set of conjugacy classes of cyclic subgroups of G with positive real weight. The space $SC(G)$ is expected to be the completion of the set of conjugacy classes of quasi-convex subgroups of G with positive real weight, which is still an open problem in general. In the case that G is a free group, Kapovich–Nagnibeda solved the problem. We solve the problem in the case of a surface group.

14:15–15:15 Talk Invited by Complex Analysis Section

Hiroki Sumi (Kyoto Univ.) Randomness-induced phenomena in random holomorphic dynamical systems and their applications

Summary: We consider random holomorphic dynamical systems. There are many new phenomena caused by the effect of randomness in random dynamical systems which cannot hold in deterministic dynamical systems. Such phenomena are called randomness-induced phenomena (or noise-induced phenomena). In this talk, we see some randomness-induced phenomena in random holomorphic dynamical systems and some applications of such phenomena to random relaxed Newton's methods.

March 19th (Mon) Conference Room VII

10:00–11:40

8 Takahiro Inayama (Univ. of Tokyo) L^2 estimates and vanishing theorems for holomorphic vector bundles equipped with singular Hermitian metrics ····· 15

Summary: We investigate singular Hermitian metrics on vector bundles, especially strictly Griffiths positive ones. L^2 esitimates and vanishing theorems usually require an assumption that vector bundles are Nakano positive, however there is no general definition of the Nakano positivity in the singular settings. In this talk, we show some L^2 estimates and vanishing theromes by assuming that the vector bundle is strictly Griffiths positive and the base manifold is projective.

9 Genki Hosono (Univ. of Tokyo) On recent topics on L^2 extension theorems ····· 15

Summary: We give a L^2-extension theorem of jets with a sharp constant using the method of Berndtsson–Lempert. We explain the result of a jet L^2-extension theorem obtained by McNeal–Varolin. We also present a method for sharper estimates.

10 Sachiko Hamano (Osaka City Univ.)
Masakazu Shiba (Hiroshima Univ.*)
Hiroshi Yamaguchi (Shiga Univ.*)
Variation of the **a**-span of an open Riemann surface and pseudoconvexity 15

Summary: Let R be a marked open Riemann surface of finite genus. If there exists a conformal embedding of R into a closed Riemann surface $\widetilde{R}$ of the same genus with prescribed homological types of surfaces, $\widetilde{R}$ is called a closing of R. A closing of R induces the Riemann's period matrix T of $\widetilde{R}$. Shiba–Yamaguchi investigated the set of all closings of R, and showed that each diagonal element of T is a closed disk $\mathfrak{M}$ in the upper half plane.
We shall study variation of the period matrices $T(t)$ of the closings of an open Riemann surface $R(t)$ with complex parameter t, and show the rigidity of hyperbolic diameter of $\mathfrak{M}(t)$ under the pseudoconvex variation of $R(t)$.

11 Akio Kodama (Kanazawa Univ.*)♭
A localization principle for biholomorphic mapppings between the Fock–Bargmann–Hartogs domains 15

Summary: In this talk, we announce that a localization principle for biholomorphic mappings between equidimensional Fock–Bargmann–Hartogs domains holds. As an application of this, we can show that any proper holomorphic mapping between two equidimensional Fock–Bargmann–Hartogs domains satisfying some condition is necessarily a biholomorphic mapping.

12 Masataka Tomari (Nihon Univ.)*
Tadashi Tomaru (Gunma Univ.*)
maximal ideal cycle and fundamental cycle of normal two dimensional double points 15

Summary: Let Z be the Artin fundamental cycle of a resolution of normal complex singularity of the form $z^2 - f(x, y) = 0$. Once studied by Laufer around 1980's, $z^2 = y(x^4 + y^6)$ is famous as the example of the case $Z^2 = -1$ where the maximal ideal cycle M does not equals Z in all the resolution of singularities. We characterize the condition $Z^2 = -1$ completely by means of equisingular class of $f(x, y) = 0$ the numerical characters including a Puiseux pairs and other invariants. For the equality $Z = M$ problem, we can extend Dixon's theorems to the complete criterion about $Z = M$ in terms of numerical characters of $f(x, y) = 0$.

13 Katsusuke Nabeshima (Tokushima Univ.)
Shinichi Tajima (Univ. of Tsukuba)
An algorithm for computing integral numbers in a ring of convergent power series II 10

Summary: The notion of integral closure of an ideal is a key concept in commutative algebra and in singularity theory. Integral numbers, the degrees of integral dependence relations, are also of considerable importance. Effective methods for computing integral numbers w.r.t. an ideal are required. In this talk, first we give an algorithm for computing integral numbers w.r.t. an ideal in a ring of convergent power series. Second, we report some integral numbers of Malgrange's singularities and Skoda–Briançon's singularities.

13:15–14:15 Talk Invited by Complex Analysis Section

Takayuki Koike (Osaka City Univ.)
Hermitian metrics on numerically effective line bundles and neighborhoods of complex submanifolds

Summary: Let X be a complex manifold and $Y \subset X$ be a compact complex submanifold of X. Our main interest is in the complex analytical structure of a tubular neighborhood of Y. A motivation comes from a study of Hermitian metrics on a holomorphic line bundle L on X, especially when L has a semi-positivity property in numerical (i.e. intersection-theoretical) sense, called "numerically effective (nef)". We will explain the relationship between the study of neighborhoods of complex submanifolds and of numerically effective line bundles. We will also talk on other applications of the study of neighborhoods of complex submanifolds.

Functional Equations

March 18th (Sun) Conference Room IX

9:15–12:00

Summary: In this study, we investigate a mathematical model of hematopoietic stem cells. The model is described by a system of partial differential equations, which depend on space and age. By applying the method of characteristics, we reformulate the model into a reaction-diffusion equation with a nonlocal spatial term and time delay. We prove the existence, uniqueness and positivity of the solution, and obtain a threshold condition for the global asymptotic stability of the trivial equilibrium. In addition, we obtain sufficient conditions for the existence of nontrivial equilibrium and the uniform persistence of the system.

Summary: In this talk, we introduce the notion of dimensioned numbers and extended dimensioned numbers. The notion of dimensioned numbers originates in geometric measurements, and they can be used to describe iterated exponential functions of a single variable. We apply the theory of dimensioned numbers to solving some functional equations of a single variable.

Summary: The oscillation problem of a nonlinear delay difference equation is studied. Sufficient conditions for all solutions of the equation to be oscillatory and for the existence of a nonoscillatory solution are established. Our main results are proved by use of the phase plane analysis which is developed in a similar way to Sugie and Ono [4] in 2004.

Summary: We consider a Hamilton–Jacobi flow staring from a pathological function. Here, a function on $\mathbf{R}$ is said to be pathological, if it is everywhere continuous but nowhere differentiable.

Summary: Generalized trigonometric functions (GTFs) are simple generalization of the classical trigonometric functions. GTFs are deeply related to the p-Laplacian, which is known as a typical nonlinear differential operator, and there are a lot of works on GTFs concerning the p-Laplacian. However, few applications to differential equations unrelated to the p-Laplacian are known. We will apply GTFs with two parameters to a nonlinear nonlocal boundary value problem without p-Laplacian.

Summary: We consider the oscillation problem for nonlinear differential equation $(|x'|^{p(t)-2}x')' + (\lambda/t^{p(t)})|x|^{p(t)-2}x = 0$, where λ is a positive constant and $p(t) > 1$ is a nondecreasing and smooth function. Using Riccati technique and function sequence technique, we obtain sufficient conditions for this equation to be (non)oscillatory. The obtained results show that there exists a critical value for this problem.

Summary: We study the bifurcation of positive solutions for the one-dimensional (p, q)-Laplace equation with nonlinear term u^{r-1}. There are five types of order relations for (p, q, r). We study the exact shape of the bifurcation curve in each type of the order relation. Furthermore, we investigate the asymptotic profile of the normalized solution $u(x)/\|u\|_\infty$ as $\|u\|_\infty \to 0$ or $\|u\|_\infty \to \infty$, where $\|u\|_\infty$ denotes the L^∞-norm of u.

Summary: This talk deals with the two-dimensional linear differential system

$$x' = y, \quad y' = -x - h(t)y$$

on $[t_0, \infty)$, where $h \in C^1[t_0, \infty)$ and $h(t) > 0$ for $t \geq t_0$. Criteria to obtain the box dimension of graphs of solution curves are established.

Summary: The autonomous planar half-linear differential system is considered, which is a generalization of the autonomous planar linear system. It is well-known that the autonomous planar linear system can be solved by eigenvalues, that is, roots of the characteristic equation. In this talk, the characteristic equation for the autonomous planar half-linear differential system is introduced, and the asymptotic behavior of its solutions is established by roots of the characteristic equation.

Summary: A *global attractor* is a notion for a topological semi-dynamical system whose phase space is a metric space. In particular, this notion is important when the phase space is an infinite-dimensional Banach space by the finiteness of its fractal dimension. However, it should be noticed that the notion of a global attractor depends on the specific choice of a metric. In this talk, we "define" global attractors in the context of the "non-existence of natural metrics" of the phase space and study those properties. This includes a case where the phase space is a Fréchet space, which is motivated by differential equations with unbounded delay. We obtain sufficient conditions for the existence, which will be applied to such equations.

Summary: Voros coefficients are important objects in exact WKB analysis to study global behavior of solutions of differential equations. In this talk I will report that the Voros coefficients for hypergeometric differential equations with two variables are given by the generating functions of free energies defined in terms of Eynard and Orantin's topological recursion.

12 Saburou Saitoh * (Gunma Univ.*/Inst. of Reproducing Kernels)
Haydar Akca (Abu Dhabi Uni.)
Sandra Pinelas (Military Acad. Portugal)
Incompleteness of the theory of differential equations and open problems 10

Summary: From the viewpoint of the division by zero ($0/0 = 1/0 = z/0 = 0$) and the division by zero calculus ($\tan(\pi/2) = 0$), we will show some incompleteness of the theory of differential equations in an undergraduate level and we will propose fundamental open problems as the results.
Other topics in this talk: Differential equations with singularities; Continuation of solution; Singular solutions; Solutions with singularities; Solutions with an analytic parameter; Special reductions by division by zero of solutions; Partial differential equations; Introduction of $\log 0 = \log \infty = 0$; and Applications of $\log 0 = 0$; $e^0 = 1, 0$.

13 Saburou Saitoh * (Gunma Univ.*/Inst. of Reproducing Kernels)
Tsutomu Matsuura (Gunma Univ.)
Division by zero calculus and singular integrals 10

Summary: Here, we will give the interpretation for the Hadamard finite part of singular integrals by means of the division by zero calculus - $\log 0 = \log \infty = 0$ (not as limiting values) in the meaning of the one point compactification of Aleksandrov.

14:15–16:15

14 Takanobu Hara (Hokkaido Univ. / Tokyo Metro. Univ.)
A Carleson-type estimate for p-superharmonic functions 10

Summary: Let Ω be a domain in $\mathbb{R}^n$ with $n \geq 2$, and let u be a nonnegative p-superharmonic function in Ω. Kilpeläinen and Malý proved that there exists a constant $C > 0$ such that

$$u(x) \leq C \left(\inf_{B(x,R)} u + \mathbf{W}_p^{\mu}(x, 2R) \right)$$

whenever $B(x, 2R) \subset \Omega$, where μ is the Riesz measure of u and $\mathbf{W}_p^{\mu}(x, 2R)$ is the Wolff potential of μ. In this paper, we extend this inequality to near the boundary of Ω. More precisely, we give a pointwise estimate for p-superharmonic functions which vanish on the boundary and a global integrability estimate of p-superharmonic functions. Combining the two estimates, we give an analog of the Carleson estimate.

15 Xiaojing Liu (Ibaraki Univ.)
Toshio Horiuchi (Ibaraki Univ.)
The equivalences among p-capacity, p-Laplace-capacities and Hausdorff measure 10

Summary: Let Ω be a smooth bounded domain of $\mathbf{R}^N$. In this paper, we study the equivalences among p-capacity, p-Laplace-capacities and Hausdorff measure. Firstly we present the equivalence between p-capacity $C_p(K)$ and p-Laplace-capacitiy $C_{\Delta_p}(K)$ relative to Ω for a given compact set $K \subset \Omega$. Secondly we establish the equivalence between p-Laplace capacity $C_p(K, \partial\Omega)$ relative to $\partial\Omega$ and Hausdorff measure $\mathcal{H}^{N-1}(K)$ on $\partial\Omega$ for a given compact set $K \subset \partial\Omega$.

16 Albert Rodríguez Mulet (Hokkaido Univ.)
Eigenfrequencies of a thin straight elastic body 10

Summary: The Lamé operator is a 2nd order linear elliptic differential operator frequently used to describe the oscillations that take place in a uniform isotropic elastic body. When the oscillations are time-periodic, the differential equation can be simplified to the spectral analysis of the Lamé operator. In our case, we study the case of a thin straight elastic body such that it has its ends fixed. In particular we provide results about the asymptotic behaviour of the eigenvalues and eigenfunctions as the domain gets thinner.

17 Takashi Furuya (Nagoya Univ.) An application of the factorization method for some inverse acoustic scattering problems ····· 10

Summary: We consider the inverse scattering problem of time-harmonic acoustic plane waves by multiple impenetrable obstacles. For the purpose, we derive the factorization method of Kirsch, which is a sampling method for solving certain kinds of inverse problems where the shape and location of a domain have to be reconstructed. We introduce new results to reconstruct the unknown obstacles by the factorization method. The main idea is to modify the original factorization method by using a priori known outer and inner estimations for a part of unknown obstacles. By our work, we can expand the application of the factorization method for some inverse acoustic scattering problems.

18 Kimie Nakashima (Tokyo Univ. of Marine Sci. and Tech.) Multiple existence of indefinite nonlinear diffusion problem in population genetics ····· 10

Summary: We consider Lou–Nagylaki conjecture (2002) on a stationary problem of some reaction diffusion equation in population genetics. We deal with the case where spatial dimension is 1. In this case a stationary problem of the equation satisfies $du'' + g(x)u^2(1-u) = 0$ with Neumann zero boundary condition.
Under the condition $\int_\Omega g(x)\,dx \geq 0$ and some additional condition on $g(x)$, uniqueness of a nontrivial solution has been already shown. In this talk we construct many nontrivial solutions for some $g(x)$ satisfying $\int_\Omega g(x)\,dx < 0$.

19 Kazuhiro Oeda (Waseda Univ.)
Kousuke Kuto (Univ. of Electro-Comm.) Classification of steady states to a prey-predator model with population flux by attractive transition ····· 10

Summary: This talk is concerned with the stationary problem of a diffusive Lotka–Volterra prey-predator model with population flux by attractive transition. We analyze two limiting systems as the nonlinear diffusion coefficient approaches infinity. A main result reveals the global bifurcation structure of positive solutions of one of the limiting systems.

20 Yasuhito Miyamoto (Univ. of Tokyo) A limit equation and bifurcation diagrams of semilinear elliptic equations with general supercritical growth ····· 10

Summary: We study radial solutions of the semilinear elliptic equation $\Delta u + f(u) = 0$ under rather general growth conditions on f. We construct a radial singular solution and study the intersection number between the singular solution and a regular solution. An application to bifurcation problems of elliptic Dirichlet problems is given. To this end, we derive a certain limit equation from the original equation at infinity, using a generalized similarity transformation. Through a certain transformation, all the limit equations can be reduced into two canonical cases, i.e., $\Delta u + u^p = 0$ and $\Delta u + e^u = 0$.

21 Yasuhito Miyamoto (Univ. of Tokyo)
Tohru Wakasa (Kyushu Inst. of Tech.) Exact eigenvalues and eigenfunctinos for a one-dimensional Gel'fand problem ····· 10

Summary: It is known that every positive solution of a one-dimensional Gel'fand problem can be written explicitly. In this talk we give exact expressions of all the eigenvalues and eigenfunctions of the linearized eigenvalue problem at each solution. We study asymptotic behaviors of eigenvalues and eigenfunctions as the L^∞-norm of the solution goes to the infinity. We also study the problem $u'' + \lambda e^{-u} = 0$ and the associated linearized problem.

22 Kenichiro Umezu (Ibaraki Univ.)
Uriel Kaufmann (Univ. Nacional de Córdoba)
Humberto Ramos Quoirin (Univ. de Santiago de Chile)
Loop components of nontrivial nonnegative solutions for indefinite concave-convex problems 10

Summary: In this talk, we discuss the existence of a loop component of nontrivial nonnegative solutions for a concave-convex elliptic problem with the Neumann boundary condition. Positivity for solutions on the loop is also discussed. Our approach relies on bifurcation analysis.

16:30–17:30 Award Lecture for the 2017 MSJ Analysis Prize

Yoshitsugu Takei (Doshisha Univ.)
On the instanton-type expansions of elliptic functions and Painlevé transcendents —The final stage of the exact WKB analysis for Painlevé equations

Summary: The exact WKB analysis is based on the Borel resummation method (or the Borel–Laplace method) and, as its consequence, the instanton-type expansions of Painlevé transcendents play an important role in the exact WKB analysis of Painlevé equations. However, such instanton-type expansions are very wild objects and we cannot expect their convergence in general. In this talk, I would like to propose a new approach to handle the instanton-type expansions of Painlevé transcendents. A key idea of this approach is to use the instanton-type expansions of elliptic functions. The structure of instanton-type expansions of elliptic functions will be also discussed in the talk.

March 19th (Mon) Conference Room IX

9:15–12:00

23 Yohei Toyota (Osaka Univ.)
Takashi Suzuki (Osaka Univ.)
The behavior of blow-up solutions for mean filed equation with multi-intensities 10

Summary: In this talk we consider the minimizing sequence for some energy functional of an elliptic equation associated with the mean field limit of the point vortex distribution one-sided Borel probability measure. If such a sequence blows up, we derive some estimate which is related to the behavior of solution near the blow-up point. Moreover, we study the two-intensities case to derive the sufficient condition for this estimate.

24 Daisuke Naimen (Muroran Inst. of Tech.)
Massimo Grossi (Sapienza Univ. of Roma)
Blow-up analysis for sign-changing radial solutions in Trudinger–Moser critical equations in $\mathbb{R}^2$ 10

Summary: In this talk we consider low energy sign-changing radial solutions to a elliptic problem related to the Trudinger–Moser inequality. We study the asymptotic behaviour of them. As a result, we show that when the solution has k interior zeros, it exhibits a multiple blow-up behaviour in the first k nodal sets while it converges to the least energy solution of a critical problem in the $(k+1)$-th one. We also prove that in each concentration set, with an appropriate scaling, the solution converges to the solution of the classical Liouville problem in $\mathbb{R}^2$.

25 Aya Ishizeki (Chiba Univ.)
Takeyuki Nagasawa (Saitama Univ.)
Decomposition of generalized O'Hara's energies 10

Summary: O'Hara defined some knot energies for finding canonical configuration of a knot in a given knot type. One of them is known as the Möbius energy. The authors showed that the Möbius energy can be decomposed into three parts; the first one measures how the curve is bent, the second one does how the curve is twisted, and the third one is an absolute constant. The authors define generalized O'Hara's energies, and announce that they can be decomposed in a similar way under suitable assumptions including the case of O'Hara's $(\alpha, 1)$ energies with $\alpha \in [2, 3)$, which are self-repulsive and bounded for any smooth curves without self-intersections.

26 Yohei Sato (Saitama Univ.)
Shibata Masataka (Tokyo Tech)
Infinitely many solutions for a nonlinear Schrödinger equation with general nonlinearity 10

Summary: We prove the existence of infinitely many solutions for $-\Delta u + V(x)u = f(u)$ in $\mathbb{R}^N$, $u \in H^1(\mathbb{R}^N)$, where $V(x)$ satisfies $\lim_{|x|\to\infty} V(x) = V_\infty > 0$ and some conditions. We require conditions of $f(u)$ only around 0 and at ∞.

27 Shota Tateyama (Tohoku Univ.)
Shigeaki Koike (Tohoku Univ.)
Andrzej Święch (Georgia Tech)
Fully nonlinear parabolic equations with unbounded ingredients 10

Summary: The weak Harnack inequality for L^p-viscosity supersolutions of fully nonlinear second-order uniformly parabolic partial differential equations with unbounded coefficients and inhomogeneous terms is established. It is shown that Hölder continuity of L^p-viscosity solutions is derived from the weak Harnack inequality for L^p-viscosity supersolutions. Furthermore, the local maximum principle for L^p-viscosity subsolutions is shown. By these properties, the Harnack inequality for L^p-viscosity solutions is obtained. Several further remarks are presented.

28 Shota Tateyama (Tohoku Univ.)
The Phragmén–Lindelöf theorem for fully nonlinear parabolic equations with unbounded ingredients 10

Summary: In 1957, A. Friedman proved the Phragmén–Lindelöf theorem for classical solutions of linear parabolic equations in cones, whose axis is the positive t-axis and whose vertex is the origin of $\mathbb{R}^{n+1}$. We establish the Phragmén–Lindelöf theorem for fully nonlinear uniformly parabolic equations with unbounded coefficients in same domains.

29 Naoto Kajiwara (Univ. of Tokyo)
Matthias Hieber (TU Darmstadt)
Klaus Kress (TU Darmstadt)
Patrick Tolksdorf (TU Darmstadt)
Time periodic solutions on real interpolation spaces and its applications to some electrophysiological models 10

Summary: We consider the time periodic abstract linear parabolic evolution equation $\partial_t u + Au = f, t \in \mathbb{R}, u(t+T) = u(t)$. We construct the general theory on a real interpolation spaces $D_A(\theta, p)$. It corresponds to time periodic version of the DaPrato–Grisvard maximal $L^p - D_A(\theta, p)$ regularity theorem. Moreover as its application we prove that the nonlinear bidomain equations which is the electrophysiological model have unique time periodic solution near the stable solution by fixed point theorem if the periodic data is sufficiently small.

30 Naoto Kajiwara (Univ. of Tokyo)
Yoshikazu Giga (Univ. of Tokyo)
Klaus Kress (TU Darmstadt)
Time periodic solutions to the bidomain equations subject to arbitrary large force 10

Summary: We consider the bidomain equations with Fitzhugh–Nagumo type nonlinear term. We prove that there exists a periodic solution if the data is periodic. Here we do not assume the smallness of the data and the nonlinear term is super-linear. The proof is based on a weak-strong uniqueness argument. To construct the weak periodic solution, we use the Brouwer's fixed point theorem for the Poincaré map.

Summary: The subject of this work is to construct a new approach to a parabolic-elliptic Keller–Segel system from its parabolic-parabolic case, and to use the parabolic-parabolic case as a step to establish new results in the parabolic-elliptic case. Our aim is, by considering that the parabolic-elliptic case is as a limit of its parabolic-parabolic system, to establish a result such that, only dealing with the parabolic-parabolic Keller–Segel system is enough to obtain the new properties for solutions of its parabolic-elliptic case. In this talk we consider fast signal diffusion limit in a Keller–Segel system, which namely is convergence of a solution for the parabolic-parabolic Keller–Segel system to that for its parabolic-elliptic version.

Summary: This talk deals with a 3D two-species Keller–Segel–Stokes system with competitive kinetics. Recently, in a 3D two-species chemotaxis-Stokes system Cao–K.–Mizukami proved global existence and asymptotic behaviour of classical solutions under some conditions. However, the same argument as in the previous work could not be applied to the present problem. The present work asserts global existence and asymptotic behaviour of classical solutions for the Keller–Segel setting.

Summary: In this talk we will consider the initial boundary problem for degenerate Keller–Segel systems. For the non-degenerate systems, it is known that $q = m + \frac{2}{N}$ (m denotes the intensity of diffusion, q denotes a nonlinearity and N is the space dimension) is the critical condition for boundedness and blow-up. It is expected that the case of degenerate diffusion has the same critical condition. However, for the blow-up results, the previous paper gave only the existence of unbounded solutions, which includes the blow-up in infinite time. This talk hence gives finite-time blow-up of energy solutions from the initial data with a large negative energy.

Summary: We show unboundedness of solutions to a degenerate drift-diffusion equation with the mass critical exponent and estimates of the concentration quantity of radially symmetric solutions. When a given initial datum has finite second moment and the energy functional of it is initially negative, it is known that the corresponding solution blows up in finite time. We prove that solutions to our problem do not remain bounded in the energy space even if we do not impose such a weight condition under the negative energy condition. In particular, if the solution is radially symmetric and the energy functional of the initial datum is negative, then we can eliminate the possibility of growing up. Moreover, we give lower estimates of the mass for radially symmetric blow-up solutions.

13:15–14:15 Award Lecture for the 2017 MSJ Analysis Prize

Tetsutaro Shibata (Hiroshima Univ.) Asymptotic analysis of eigenvalue problems for nonlinear elliptic equations and analysis of inverse bifurcation problems

Summary: We first study the global and local behavior of bifurcation curves for elliptic nonlinear eigenvalue problems in L^q-framework ($q > 1$). We consider the case where λ is parameterized by the L^q-norm $\alpha = \|u_\lambda\|_q$ of the solution u_λ corresponding to λ and is represented as a continuous function $\lambda = \lambda(\alpha)$. Especially, we restrict our attention to the asymptotic behavior of $\lambda(\alpha)$ as $\alpha \to \infty$ and $\alpha \to 0$. We establish several precise asymptotic expansion formulas for $\lambda(\alpha)$ as $\alpha \to \infty$ and $\alpha \to 0$ to understand well the total structures of the bifurcation curves. We next consider the inverse bifurcation problems. Especially, we will show some results for inverse problems by using a variational method and asymptotic expansion formulas for $\lambda(\alpha)$ for $\alpha \gg 1$.

March 20th (Tue) Conference Room IX

9:15–12:00

35 Kenta Nakamura (Kyushu Univ.) The existence and properties of a solution to the p-Sobolev flow ····· 10
Masashi Misawa (Kumamoto Univ.)

Summary: In this talk, we study a doubly nonlinear parabolic equation, called the p-Sobolev flow, which is the classical Yamabe flow on a bounded domain in Euclidean space. We show the existence of a weak solution to the p-Sobolev flow without geometrical assumption and present properties of its solution.

36 Lorenzo Cavallina (Tohoku Univ.) On the shape of a two-phase heat conductor with a surface of the constant flow property ····· 10
Rolando Magnanini (Univ. of Florence)
Shigeru Sakaguchi (Tohoku Univ.)

Summary: We study how the presence of a surface of the constant flow property influences the shape of a two-phase heat conductor. The existence of a surface that satisfies the constant flow property at every moment in time is a very strong requirement: we show that this condition implies the radial symmetry of our heat conductor. In addition, we study the difference behaviour of two-phase heat conductors satisfying an analogous overdetermined elliptic problem. In this case we are able to construct a family of non radially symmetric solutions.

37 Takashi Kagaya (Kyushu Univ.) A singular limit problem of Allen–Cahn equation with Neumann boundary condition on non-convex domains ····· 10

Summary: We study a singular limit problem of the Allen–Cahn equation with the homogeneous Neumann boundary condition on non-convex domains with smooth boundaries under suitable assumptions for initial data. The main result is the convergence of the time parametrized family of the diffused surface energy to Brakke's mean curvature flow with a generalized right angle condition on the boundary of the domain.

38 Nao Hamamuki (Hokkaido Univ.) On a dynamic boundary condition for singular degenerate parabolic equations in a half space ····· 10
Yoshikazu Giga (Univ. of Tokyo)

Summary: We consider a dynamic boundary value problem for singular degenerate parabolic equations in a half space. In the context of viscosity solutions, we establish a comparison principle and prove existence of solutions together with Lipschitz regularity of the unique solution. A relationship with a Dirichlet or Neumann condition is also studied.

39 Yukihiro Seki (Kyushu Univ.) On blow-up of solutions for harminic map heat flow with values in a sphere ····· 10
Paweł Biernat (Bonn Univ.)

Summary: In this talk we will discuss blow-up of a harmonic map heat flow from R^d to S^d, where S^d denotes a unit sphere in R^d. Our main result yields a constructive examples of Type II blow-up solutions for $d \geq 7$. These blow-up solutions satisfy various point-wise estimates in some space-time regions.

Summary: In this talk, we consider a free boundary problem of Fisher-KPP equation $u_t = u_{xx} + u(1-u)$, $t > 0$, $ct < x < h(t)$. The number $c > 0$ is a given constant, $h(t)$ is a free boundary which is determined by the Stefan-like condition. This model may be used to describe the spreading of a non-native species over a one dimensional habitat. The free boundary $x = h(t)$ represents the spreading front. In this model, we impose zero Dirichlet condition at left moving boundary $x = ct$. This means that the left boundary of the habitat is a very hostile environment and that the habitat is eroded away by the left moving boundary at constant speed c. In this talk, I will give a trichotomy result, that is, for any initial data, exactly one of the three behaviours, vanishing, spreading and transition, happens.

Summary: We consider the Cauchy problem for semilinear heat equation in R^N. We study the case where initial data have polynomial decay rate at the spatial infinity, and investigate the convergence property of the global solutions to the forward self-similar solutions.

Summary: For repulsive Hamiltonians we obtained Rellich's theorem, the radiation condition and the limiting absorption principle. Our setting include the case of the inverted harmonic oscillator. In the proofs, we mainly use a commutator argument. This argument simple and elementary, and does not employ energy cut-offs or the microlocal analysis.

Summary: My talk is concerning on the the mathematical theory of quantum measurements. Especially, we will consider the continuous quantum measurements of the position of particles during a finite time. The probability amplitude of particles just after the measurement is given in the form of the weighted Feynman path integrals, WFPI, or the restricted Feynman path integrals, according to Feynman and Mensky's theory of quantum measurements. We will show that WFPI for it are defined mathematically in L^2 and the weighted Sobolev spaces, and satisfy the non-self-adjoint Schrödinger equations.

Summary: We obtain higher order expansions of evolution operators corresponding to the Cauchy problem of the linear damped wave equation in $\mathbf{R}^n$. Established hyperbolic part of expansion seems to be new in the sense that the order of the expansion of the hyperbolic part depends on the spatial dimension.

Summary: We consider the new structural conditions to show the decay property of the linear symmetric hyperbolic systems from the viewpoint of the dissipative structure. Especially, we are concerned with the model systems which have a non-symmetric relaxation and therefore their decay estimate is of regularity-loss. Recently, since the Shizuta–Kawashima stability theory cannot be applicable to such a system, the structural conditions to show the decay property of regularity-loss have been investigated. However, we have the last question that the structural condition which can be applied to the Timoshenko–Cattaneo system has not been developed yet. In this talk, we introduce the new structural condition which will be the first condition applicable to the Timoshenko–Cattaneo system and the other systems of the same weakest dissipative mechanism.

46 Kenta Nakamura (Kyushu Univ.)
Tohru Nakamura (Kumamoto Univ.)
Shuichi Kawashima (Kyushu Univ.)
Asymptotic stability of rarefaction waves for a model system of hyperbolic balance laws 10

Summary: In this talk, we addressed with rarefaction waves for a hyperbolic system of balance laws in the whole space or half space. We shall prove a priori estimate of a solution and the asymptotic stability of rarefaction waves by using L^2-energy method and standard calculus.

47 Motohiro Sobajima (Tokyo Univ. of Sci.)
Masahiro Ikeda (RIKEN/Keio Univ.)
Life-span of blowup solutions to semilinear wave equation with space-dependent critical damping 10

Summary: We consider the semilinear wave equation with space-dependent critical damping term in $\mathbb{R}^N (N \geq 3)$. The equation is of the form $\partial_t^2 u - \Delta u + V_0 |x|^{-1} \partial_t u = |u|^p$. If $V_0 = 0$, then small data blowup for $p \leq p_0(N)$ and small data global existence for $p > p_0(N)$ are proved with well-known Strauss exponent $p_0(N)$. In this talk we will show that a similar blowup phenomenon occurs for $\frac{N}{N-1} < p < p_0(N + V_0)$.

14:15–16:15

48 Takayuki Niimura (Hokkaido Univ.)
Attractors and their stability with respect to rotational inertia for a nonlocal extensible beam equation 10

Summary: We will study the initial-boundary value problem for the Kirchhoff type plate equation with rotational inertia. In particular, we consider the long-time behavior of the solution of the equation and show the existence of attractors and clarify their properties. Furthermore, we will also cover the influences of the rotational inertia on the long-time dynamics.

49 Masahiro Ikeda (RIKEN/Keio Univ.)
Yuta Wakasugi (Ehime Univ.)
Inui Takahisa (Tokyo Univ. of Sci.)
Mamoru Okamoto (Shinshu Univ.)
Time decay estimates for the linear damped wave equation and the critical exponent for the semilinear problem with slowly decaying data 10

Summary: We study the Cauchy problem of the damped wave equation

$$\partial_t^2 u - \Delta u + \partial_t u = 0$$

and give L^p-L^q estimates of the solution for $1 \leq q \leq p < \infty$ $(p \neq 1)$ with derivative loss. We apply this estimate to the nonlinear problem

50 Masahiro Ikeda (RIKEN/Keio Univ.)
Motohiro Sobajima (Tokyo Univ. of Sci.)
Life-span of solutions to semilinear wave equation with time-dependent critical damping 10

Summary: We consider the Cauchy problem of the nonlinear wave equation with a scaling critical time-dependent damping $\mu(1+t)^{-1} u_t$. Here μ is non-zero constant. When $\mu = 0$, the equation becomes the usual wave equation and the critical power dividing small data global existence and blow-up is given by Strauss exponent Strauss exponent $p_0(N)$ (N means spatial dimension). We give a small data blow-up result in the case $1 + 2/N < p \leq p_0(N + \mu)$ if μ is near 0.

51 Natsumi Yoshida (Ritsumeikan Univ.)
Large time behavior of solutions toward a multiwave pattern to the Cauchy problem for the dissipative wave equation with partially linearly degenerate flux 10

Summary: We study the large time asymptotics of solutions to the Cauchy problem for the one-dimensional dissipative wave equation where the far field states are prescribed. Especially, we deal with the case when the flux function is convex or concave but linearly degenerate on some interval. Then the Cauchy problem has a unique global in time solution which tends toward a multiwave pattern consists of rarefaction and viscous contact waves as time goes to infinity. The proof is given by a technical energy method and the careful estimates for the interactions between the nonlinear waves.

Summary: We study the large time asymptotics of solutions to the Cauchy problem for a one-dimensional scalar conservation law with nonlinear viscositywhere the far field states are prescribed. Especially, we deal with the case when the flux function is fully convex, and also the viscosity is a nonlinearly degenerate one. Then the Cauchy problem has a unique global in time solution which tends toward a rarefaction wave as time goes to infinity. The proof is given by a technical energy method, and a Sobolev type inequality motivated by an idea of Kanel'.

Summary: We consider the fourth order nonlinear Schrödinger equation

$$i\partial_t u - \frac{1}{4}\partial_x^4 u = f(u), \quad (t,x) \in \mathbf{R} \times \mathbf{R},$$

where $f(u)$ is the power nonlinearity of order $p > 5$. We show scattering operators are well defined in the neighborhood of the origin of a suitable weighted Sobolev space.

Summary: We consider initial data problem for 1d cubic nonlinear Schrödinger equation with repulsive delta potential. We will show that if a data belongs to a weighted Sobolev space and is sufficiently small then solution decays in time in the same order as a free equation and asymptotically behaves like free solution with a logarithmic phase correction. Recently, long range scattering for nonlinear Schrödinger equation with a potential is extensively studied. In the previous results, a class of smooth and decaying potential is considered. In our case, we fully use explicit formulas which are available in the delta potential case.

Summary: We consider large time behavior of solutions to the nonlinear Schrödinger equation with a homogeneous nonlinearity of the critical order which is not necessarily a polynomial. We handle the case in which the nonlinearity contains non-oscillating factor $|u|^{1+2/d}$. It turns out that there is no solution which behaves like a free solution with or without any logarithmic phase corrections. We also prove nonexistence of an asymptotic free solution in the case that the gauge invariant nonlinearity is dominant, and give a small data finite time blow-up result.

Summary: In this talk we shall treat the Strichartz estimates for magnetic Schrödinger equations and its application to global existence of the solutions and scattering theory with power type nonlinear term in an exterior domain. The proof relies on similar argument to the case of whole space.

16:30–17:30 Talk Invited by Functional Equations Section

Hirokazu Ninomiya (Meiji Univ.) Traveling wave solutions and entire solutions of reaction-diffusion equations

Summary: When several stable states coexist, propagation phenomena are often observed in many fields including dissipative situations. To characterize the universal profiles of these phenomena, traveling wave solutions and entire solutions play important roles. Here traveling wave solution is meant by a solution of a partial differential equation that propagates with a constant speed, while it maintains its shape in space, and an entire solution is a solution defined for all space and time variables. In this talk we focus on the Allen–Cahn–Nagumo equation, which is a single reaction diffusion equation with bistable nonlinearity and explain how to construct entire solutions and the relation between traveling wave solutions and entire solutions.

March 21st (Wed) Conference Room IX

9:15–12:00

57 Ikkei Shimizu (Kyoto Univ.) Remarks on local well-posedness of Schrödinger map equation ····· 10

Summary: We consider the initial value problem for Schrödinger map equation. We provide some supplemental arguments for the work by Gustafson et al. (Duke Math. J. 145(3), 537–583, 2008), in which local well-posedness near the family of harmonic maps is asserted.

58 Mamoru Okamoto (Shinshu Univ.) Ill-posedness of the Cauchy problem for the fractional Schrödinger equation ····· 10

Summary: We consider ill-posedness of the Cauchy problem for the fractional Schrödinger equation. More precisely, we prove norm inflation with general initial data. This argument with minor modifications also shows the ill-posedness for the generalized Boussinesq equations.

59 Daisuke Sakoda (Osaka Univ.) Hideaki Sunagawa (Osaka Univ.) Small data global existence for a quadratic derivative nonlinear Schrödinger system in two space dimensions ····· 10

Summary: We consider the initial value problem for a system of quadratic derivative nonlinear Schrödinger equations in two space dimensions with the masses satisfying a suitable resonance relation. We give a structural condition on the nonlinearity under which small data global existence holds. This is an extension of previous results by Hayashi–Li–Naumkin and Ikeda–Katayama–Sunagawa.

60 Hiroyuki Hirayama (Univ. of Miyazaki) Well-posedness for the Zakharov–Kuznetsov–Burgers equation in two space dimensions ····· 10

Summary: We consider the Cauchy problem of the Zakharov–Kuznetsov–Burgers equation (ZKB for short) in two space dimensions. By using the Fourier restriction norm with the effect of the dissipative term, we prove the well-posedness in the Sobolev space H^s for $s > -1/2$. It is interesting that ZKB has dissipative effect only x-direction, but the result for the regularity is better than the well-posedness of the Zakharov–Kuznetsov equation for both x and y-directions.

61 Ikki Fukuda (Hokkaido Univ.) Second asymptotic profile for the generalized KdV-Burgers equation ····· 10

Summary: We study the asymptotic behavior of global solutions to the initial value problem for the generalized KdV-Burgers equation. One can expect that the solution to this equation converges to a self-similar solution to the Burgers equation, due to earlier works related to this problem. Actually, we obtain the optimal asymptotic rate similar to those results and the second asymptotic profile for the generalized KdV-Burgers equation.

Summary: We study the Boltzmann equation near global Maxwellians in the d-dimensional whole space. A unique global-in-time mild solution to the Cauchy problem of the equation is established in a Chemin–Lerner type space with respect to the phase variable (x, v). Both hard and soft potentials with angular cutoff are considered. The new function space for global well-posedness is introduced to essentially treat the case of soft potentials, and the key point is that the velocity variable is taken in the weighted supremum norm, and the space variable is in the s-order Besov space with $s \geq d/2$ including the spatially critical regularity.

Summary: Axisymmetric solutions to the Einstein equations with the energy-momentum tensor of barotropic perfect fluid can be constructed mathematically as a post Newtonian approximation to slowly rotating axisymmetric solutions to the Euler–Poisson equation of gaseous stars, provided that the adiabatic exponent near the vacuum belongs to the interval $]6/5, 3/2[$.

Summary: We concern with the asymptotic behaviors of radially symmetric solutions for multi-dimensional Burgers equation on the exterior domain in $\mathbb{R}^n$, where the boundary and far field conditions are prescribed. In a case where the corresponding 1-D Riemann problem for the non-viscous part admits a shock wave, we show the solution tends toward a superposition of stationary wave and rarefaction wave as time goes to infinity. We also show the decay rate estimate. Furthermore, for $n = 3$, we give the complete classification of the asymptotic states, which includes even a superposition of stationary wave and viscous shock wave.

Summary: A system of equations for compressible viscoelastic fluid is considered in an infinite layer. When the external force has a suitable form, the system has a solution of parallel flow type. It is shown that the solution of the system exists globally in time if the initial data is sufficiently close to the one of the parallel flow, provided that the initial data for the parallel flow is sufficiently small and the viscosity coefficient and the shear wave speed are sufficiently large.

Summary: In this talk, we consider the free boundary problem for compressible-incompressible two-phase flows with phase transitions in isothermal case. Two fluids are separated by a sharp interface and a surface tension is taken into account. We use the Navier–Stokes–Korteweg equations for the compressible fluid and the Navier–Stokes equations for the incompressible fluid, whose model is thermodynamically correct. We show the maximal L_p-L_q regularity theorem with the help of the $\mathcal{R}$-bounded solution operators of the corresponding generalized resolvent problem and Weis's operator-valued Fourier multiplier theorem.

Summary: It is presented the local well-posedness of free boundary problem for the Navier–Stokes equations with surface tension without any restriction of the size of initial data. Hanzawa transform is used to represent the free surface. Since the standard linearized procedure requires a smallness restriction for the initial data, to avoid such smallness assumption, I used a modified linearized problem, which was first proposed by V. A. Solonnikov.

68 Yoshihiro Shibata (Waseda Univ.) Global well-posedness for a $\mathbb{Q}$ tensor model of Incompressible Nematic Liquid Crystals in $\mathbb{R}^N$ 10

Summary: I will talk about the global well-posedness for the Cauchy problem of a $\mathbb{Q}$ tensor model of Incompressible Nematic Liquid Crystals in the N-dimensional Euclidean space. This is a joint work with Maria Schonbeck (Univ. California Santa Cruz). The proof is done by combination of L_p-L_q decay estimations and L_p-L_q maximal regularity for the heat equations and Stokes equations.

69 Kazuyuki Tsuda (Osaka Univ.) Takayuki Kobayashi (Osaka Univ.) Time decay estimate with diffusive property and smoothing effect for solution to the compressible Navier–Stokes–Korteweg system 10

Summary: Time decay estimate of a solution to the compressible Navier–Stokes–Korteweg system is studied. Concerning the linearized problem, the decay estimates with diffusive property for initial date are derived. As an application, the time decay estimates of a solution to the nonlinear problem are given. In contrast to the compressible Navier–Stokes system, for linear system regularities of initial dates are lower and independent of the order of derivative of the solution owing to smoothing effect from the Korteweg tensor. Furthermore, for the nonlinear system diffusive properties are obtained with initial dates having lower regularity than that of studies of the compressible Navier–Stokes system.

14:15–16:15

70 Nobu Kishimoto (Kyoto Univ.) Yoshitaka Saiki (Hitotsubashi Univ.) Kengo Nakai (Univ. of Tokyo) Yoneda Tsuyoshi (Univ. of Tokyo) Global mild solution to Navier–Stokes equations with partial hyperviscosity 10

Summary: Our purpose is to clarify the energy cascade mechanism for the incompressible Navier–Stokes equations. For the first step, we study the NS equations with partial hyperviscosity (dissipation is removed from some of the low Fourier modes) with DNS. This study direction is highly related to the previous result by T. Elgindi, W. Hu, V. Šverák (2017). This is a joint work with Professors Kishimoto, Saiki and Yoneda.

71 Tatsu-Hiko Miura (Univ. of Tokyo) On singular limit equations for the Navier–Stokes equations in moving thin domains 10

Summary: We consider the incompressible Navier–Stokes equations in a three-dimensional moving thin domain. Under the assumption that the moving thin domain degenerates into a two-dimensional closed evolving surface as the width of the thin domain tends to zero, we give a formal derivation of limit equations on the degenerate evolving surface of the Navier–Stokes equations. We also compare our limit system with the Navier–Stokes equations on a stationary manifold, which is described in terms of the Levi–Civita connection.

72 Yasunori Maekawa (Kyoto Univ.) On stability of physically reasonable solutions to the two-dimensional Navier–Stokes equations 10

Summary: The flow past an obstacle is a fundamental object in fluid mechanics. In 1967 R. Finn and D. R. Smith proved the unique existence of stationary solutions, called the physically reasonable solutions, to the Navier–Stokes equations in a two-dimensional exterior domain modeling this type of flows when the Reynolds number is sufficiently small. In this talk we prove that the physically reasonable solutions constructed by Finn and Smith are asymptotically stable with respect to small and well-localized initial perturbations.

Summary: We shall establish a Beale–Kato–Majda type extension criterion of smooth solutions to the Navier–Stokes equations. It is known that if a smooth solution u to the Navier–Stokes equations on $(0,T)$ satisfies $\int_0^T \|\mathrm{rot}\, u(\tau)\|_{L^\infty} d\tau < \infty$, then u can be continued to the smooth solution on $(0,T')$ for some $T' > T$. In this talk, we shall slightly relax this condition for extension of smooth solutions to the 3D Navier–Stokes equations in not only the whole space but also the half space, bounded domains and exterior domains with smooth boundary.

Summary: We consider the initial-boundary value problem for the Navier–Stokes equations in two dimensional domains. Under a certain condition on the asymptotic behavior of the vorticity at infinity, we prove that the vorticity and its gradient of solutions are both globally square integrable. As their applications, Loiuville-type theorems are obtained.

Summary: There are mild solutions to the Navier–Stokes equtations in Serrin class with initial data in scale invariant homogeneous Besov spaces. We show the solution is uniformly analytic in $x \in \mathbb{R}^n$ whose convegence radius is in proportion to $\sqrt{t}$.

Summary: We consider incompressible Navier–Stokes equations in the whole space $\mathbb{R}^n$ under the non-trivial faces. In particular, we construct a strong solution to the Naiver–Stokes equations in weak Lebesgue space. Firstly we introduce a maximal subspace where the Stokes semigroup is strongly continuous. Then we construct a local in time weak mild solution of the Naiver–Stokes equations in $L^{n,\infty}$. Then uniqueness criterion is discussed.

Summary: We consider the stationary Navier–Stokes equations in $\mathbb{R}^n$ for $n \geq 3$. We show the existence and uniqueness of solutions in the homogeneous Triebel–Lizorkin space $\dot{F}^{-1+\frac{n}{p}}_{p.q}$ with $p \leq n$ for small external forces in $\dot{F}^{-3+\frac{n}{p}}_{p.q}$. These are shown by the boundedness of the Riesz transform, the para-product formula, and the embedding theorem in homogeneous Triebel–Lizorkin spaces. Moreover, it is proved that under some additional assumption on external forces, our solutions have more regularity.

Summary: The solutions of the stationary Navier–Stokes equations in $\mathbb{R}^n$ for $n \geq 3$ in the scaling invariant Besov spaces are investigated. It is proved that bounded smooth external forces whose $\dot{B}^{-3}_{\infty,1}$ norms are arbitrary small can produce bounded smooth solutions whose $\dot{B}^{-1}_{\infty,\infty}$ norms are arbitrary large. Such norm inflation phenomena are shown by constructing the sequence of external forces, as similar to those of initial data proposed by Bourgain–Pavlović in the non-stationary problem.

16:30–17:30 Talk Invited by Functional Equations Section

Tsukasa Iwabuchi (Tohoku Univ.)♭ On the ill-posedness for the compressible Navier–Stokes equations

Summary: We consider the ill-posedness problem for the compressible Navier–Stokes system under the barotropic condition in the critical Besov spaces. It is known that the existence and the uniqueness of the solution hold in the homogeneous Besov spaces $\dot{B}^{\frac{n}{p}}_{p,1} \times \dot{B}^{\frac{n}{p}-1}_{p,1}$ with $1 \leq p < 2n$, where the density and the velocity belong to $\dot{B}^{\frac{n}{p}}_{p,1}$ and $\dot{B}^{\frac{n}{p}-1}_{p,1}$, respectively. On the other hand, if $p > 2n$, the solution does not depend on initial data continuously in general. In this talk, we show that for the critical case $p = 2n$ the system is ill-posed by showing the norm inflation.

Real Analysis

March 20th (Tue) Conference Room VII

9:00–12:00

1 Toshiharu Kawasaki (Nihon Univ. / Tamagawa Univ.) On the principal value of Henstock–Kurzweil integral ····· 15

Summary: There are the wide Denjoy integral, the approximately continuous Perron integral, the approximately continuous Henstock integral, the approximately continuous Denjoy integral and the distributional denjoy integral as the wider integrals than Denjoy–Perron–Henstock–Kurzweil integral. These integrals are defined by replacing derivative with approximately derivative and distributuinal derivative. In this talk, we extend an integral by the Cauchy's principal value and show the obtained results.

2 Aoi Honda (Kyushu Inst. of Tech.) Yoshiaki Okazaki (Fuzzy Logic Systems Inst.) Weak L_p space $L^{p,\infty}$ for quasi-subadditive monotone measure ····· 15

Summary: The weak L_p space $L^{p,\infty}(\mu)$ is introduced for the quasi-subadditive monotone measure μ. If μ is continuous from below, them $L^{p,\infty}(\mu)$ is a quasi-Banach space. As an application it is shown that there exists a real number $\alpha \in (0,1]$ such that the power transformatin μ^α is uniformly quasi-subadditive. Furthermore there exists a subadditive monotone measure λ satisfying $\lambda \leq \mu^\alpha \leq 2\lambda$.

3 Toshiaki Murofushi (Tokyo Tech) Naoki Enomoto (Tokyo Tech) Conditions for the strong form of the Egorov theorem in non-additive measure theory ····· 15

Summary: The consequent of the strong form of the Egorov theorem in non-additive measure theory is that strong almost everywhere convergence implies strong almost uniform convergence. This paper shows that the conjunction of the uniform subadditive continuity and the order continuity of the non-additive measure is a sufficient condition for the consequent of the strong form of the Egorov theorem, and that the monotone continuity is a necessary condition.

4 Fumiaki Kohsaka (Tokai Univ.) The proximal point algorithm for convex functions in complete CAT(1) spaces ····· 15

Summary: Using the recently introduced resolvent of a convex function in a complete CAT(1) space, we obtain existence and convergence theorems for the proximal point algorithm in such a space.

5 Shin-ya Matsushita (Akita Pref. Univ.) On the convergence of an operator splitting method ····· 15

Summary: Let H be a real Hilbert space and let $f : H \to (-\infty, \infty]$ and $g : H \to (-\infty, \infty]$ be proper, lower semicontinuous and convex functions. This talk considers a problem of finding the resolvent $J_{\partial(f+g)}$ of the subdifferential $\partial(f+g)$. It is assumed that both the resolvents $J_{\partial f}$ and $J_{\partial g}$ of ∂f and ∂g can be easily computed. This enables us to consider the case in which a solution to the problem cannot be computed easily.

6 Koji Aoyama (Chiba Univ.) Strongly quasi-nonexpansive mappings, II ····· 15

Summary: In this talk, we introduce and study a quasi-nonexpansive mapping, a strictly quasi-nonexpansive mapping, and a strongly quasi-nonexpansive mapping in an abstract space. In particular, we give some basic properties of such mappings.

7 Sachiko Atsushiba (Univ. of Yamanashi) — Weak and strong convergence theorems for a sequence of nonlinear operators ····· 15

Summary: In this talk, we study the relations among k-acute points, attractive points and fixed points. Further, we apply these to rearrange proofs of some known convergence theorems and to prove new convergence theorems for nonlinear mappings in Hilbert spaces. Using the ideas of attractive points, acute points and fixed points, we also prove convergence theorems for nonlinear mappings in Banach spaces.

8 Tomonari Suzuki (Kyushu Inst. of Tech.) — Two topologies on ν-generalized metric spaces ····· 15

Summary: We will talk about two topologies on ν-generalized metric spaces.

9 Yukino Tomizawa (Niigata Inst. of Tech.) — Geometric constants of $\pi/2$-rotation invariant norms ····· 15

Summary: In this talk, we study the von Neumann–Jordan constant of $\pi/2$-rotation invariant norms on R^2. We know that any $\pi/2$-rotation invariant normed space is isometrically isomorphic to some Day–James space. Since the von Neumann–Jordan constant is invariant under isometrically isomorphic, for characterization of the constant, it is enough to consider the Day–James space. From this fact, we can give some estimations of the constant.

10 Ryoichi Kunisada (Waseda Univ.)[♭] — Summability methods and Fourier analysis on $\mathbb{R}^\times$ ····· 15

Summary: We introduce a certain class of summability methods which are defined by the convolution operation in the group algebra $L^1(\mathbb{R}^\times)$ and study b-strongness and b-equivalence between them. In particular, this class contains an integral version of Cesàro summability method and we give a necessary and sufficient condition for a summability method in the class to equivalent to this one.

11 Takeshi Iida (Fukushima Nat. Coll. of Tech.) — The dual inequality of the boundedness fot the Hardy–Littlewood maximal operator and the fractional integrals ····· 15

Summary: In this talk, we consider the dual inequality for the Hardy–Littlewood maximal operator M and the fractional integral operator I_α. Since the fractional integral operator I_α has the property $\int I_\alpha f g dx = \int f I_\alpha g dx$ for $f \geq 0$ and $g \geq 0$, the weight norm inequality $I_\alpha : L^p(v^p) \to L^q(u^q)$ is equivalent to $I_\alpha : L^{q'}(u^{-q'}) \to L^{p'}(v^{-p'})$, where $\frac{1}{p} + \frac{1}{p'} = \frac{1}{q} + \frac{1}{q'} = 1$ $(1 < p < \infty,\ 1 < q < \infty)$ and let u and v be weights. Analogously, we consider whether the dual inequality for the Hardy–Littlewood maximal operator holds on weighted Lebesgue spaces. In particular, we verify the dual inequalities of $M : L^p(w) \to L^p(w)$ and $M : L^p(Mw) \to L^p(w)$.

14:15–16:15

12 Ryutaro Arai (Ibaraki Univ.), Eiichi Nakai (Ibaraki Univ.) — Compact commutators of Calderón–Zygmund and generalized fractional integral operators with a function in Campanato spaces on generalized Morrey spaces ····· 15

Summary: We discuss the compactness of the commutators $[b, T]$ and $[b, I_\rho]$ on generalized Morrey spaces with variable growth condition, where T is a Calderón–Zygmund operator, I_ρ is a generalized fractional integral operator and b is a function in generalized Campanato spaces with variable growth condition.

Summary: Let $\mathbb{R}^n$ be the n-dimensional Euclidean space. Let $b \in \mathrm{BMO}(\mathbb{R}^n)$ and T be a Calderón–Zygmund singular integral operator. In 1976 Coifman, Rochberg and Weiss proved that the commutator $[b,T] = bT - Tb$ is bounded on $L^p(\mathbb{R}^n)$ $(1 < p < \infty)$, that is,

$$\|[b,T]f\|_{L^p} = \|bTf - T(bf)\|_{L^p} \le C\|b\|_{\mathrm{BMO}}\|f\|_{L^p},$$

where C is a positive constant independent of b and f. For the fractional integral operator I_α, Chanillo proved the boundedness of $[b, I_\alpha]$ in 1982. These results were extended to Orlicz spaces by Fu, Yang and Yuan (2012, 2014). In this talk we discuss the boundedness of the commutator $[b, I_\rho]$ on Orlicz spaces, where I_ρ is a generalized fractional integral operator.

Summary: We study the boundedness of the commutator of fractional indegrals on martingale Morrey spaces. We give a necessary and sufficient condition on the boundedness in terms of martingale Campanato spaces.

Summary: We define the Besov spaces on an arbitrary open set of $\mathbb{R}^d$. Based on the spectral theorem for the Dirichlet Laplacian, we introduce test function spaces and distributions to define the Besov spaces analogously to Peetre's idea for the whole space case, which is by the dyadic decomposition of the spectrum. We will define the Besov spaces of the inhomogeneous type and the homogeneous type, and also show fundamental properties such as completeness, embedding, etc.

Summary: The purpose of this talk is to establish bilinear estimates in Besov spaces generated by the Dirichlet Laplacian on a domain of Euclidian spaces. These estimates are proved by using the gradient estimates for heat semigroup together with the Bony paraproduct formula and the boundedness of spectral multipliers.

Summary: We define the Besov spaces on an arbitrary open set of $\mathbb{R}^d$, based on the spectral theorem for Schrödinger operators with potential of which negative part is of the Kato class. The purpose of this talk is to show the isomorphism relations among the Besov spaces generated by the Dirichlet Laplacian and the Schrödinger operators.

Summary: In this talk, we study the boundedness of the Schrödinger operator $e^{i\Delta}$ on Wiener amalgam spaces and determine its optimal condition.

16:30–17:30 Talk Invited by Real Analysis Section

Ryotaro Tanaka (Kyushu Univ.) Geometric techniques in Banach space theory: Challenges to Tingley's problem

Summary: Mathematical developments are always based on problems. Challenges to difficulties generate new ideas. In this talk, we focus on a 30 years old open problem in Banach space theory, so-called Tingley's problem, and present new geometric techniques (and results) derived from our challenges.

March 21st (Wed) Conference Room VII

9:15–12:00

19 Masaaki Mizukami (Tokyo Univ. of Sci.) The parabolic-elliptic chemotaxis case as a limit of the fully parabolic chemotaxis system with signal-dependent sensitivity ····· 15

Summary: This paper gives a first insight into making a mathematical bridge between the parabolic-parabolic signal-dependent chemotaxis system and its parabolic-elliptic version. To be more precise, this talk deals with convergence of a solution for the parabolic-parabolic chemotaxis system with strong signal sensitivity to that for the parabolic-elliptic chemotaxis system.

20 Shunsuke Kurima (Tokyo Univ. of Sci.) Vanishing viscosity for a Cahn–Hilliard type system on unbounded domains ····· 15

Summary: This talk deals with vanishing viscosity for a Cahn–Hilliard type system on an unbounded domain with smooth bounded boundary. Colli–Gilardi–Rocca–Sprekels (2017) studied it in the case of a bounded domain using Aubin–Lions lemma. However, this lemma dose not work well in the case of unbounded domains. The present work asserts that we can discuss vanishing viscosity for the above system in an unbounded domain.

21 Kosuke Kita (Waseda Univ.)
Mitsuharu Ôtani (Waseda Univ.)
Hiroki Sakamoto (Hitachi-GE Nuclear Energy, Ltd.) Some threshold property for a reaction diffusion system arising from a nuclear reactor model ····· 15

Summary: We study an initial-boundary value problem for a reaction diffusion system, which consists of two real-valued unknown functions. This system describes diffusion phenomena of neutrons and heat in nuclear reactors, introduced by Kastenberg and Chambré. In this model, the unknwon functions represent the neutron density and the temperature in nuclear reactors. We proved that this equation has at least one positive stationary solution in last MSJ Autumn Meeting 2017. In this talk, we show that the positive stationary solution plays a role of threshold to classify initial data into two groups; corresponding solutions of the equation blow up in finite time and exist globally.

22 Yutaka Tsuzuki (Hiroshima Shudo Univ.) Existence for Vlasov–Poisson equations with angle error in magnetic field in a half-space ····· 15

Summary: We deal with initial-boundary problems for Vlasov–Poisson equations in a half-space with external magnetic force horizontal to a wall. In 2013, Skubachevskii gives local-in-time solvability to the system. Moreover, in 2017, global-in-time solutions were obtained by effectively using the magnetic force whose direction is horizontal to the wall. This talk provides an existence result for the system where the magnetic force has angle error in the vertical direction.

23 Taishi Motoda (Kyoto Univ. of Edu.) Time periodic solutions of Cahn–Hilliard system with dynamic boundary conditions ····· 15

Summary: The existence problem for Cahn–Hilliard system with dynamic boundary conditions and time periodic conditions is discussed. We apply the abstract theory of evolution equations by using viscosity approach and the Schauder fixed point theorem in the level of approximate problem. One of the key point is the assumption for maximal monotone graphs with respect to their domains. Thanks to this, we obtain the existence result of the weak solution by using the passage to the limit.

24 Ryota Nakayashiki (Chiba Univ.) Kobayashi–Warren–Carter system subject to quasi-linear diffusions and dynamic boundary conditions ····· 15

Summary: In this talk, we consider a coupled system of two parabolic type initial-boundary value problems, called the Kobayashi–Warren–Carter model of grain boundary motion in a polycrystal. The systems are denoted by $(\mathrm{S})_\varepsilon$ with arguments $\varepsilon \geq 0$. The characteristic point of our systems is to assume the dynamic boundary conditions in one problem. Now, the focus of this talk is to address the three assignment concerned with the qualitative results of the systems. The first is the existence of solutions to the systems, including the representation of solutions. The second is the continuous dependence of the systems to $(\mathrm{S})_\varepsilon$ for the variations of $\varepsilon \geq 0$. The third is the large-time behavior of solutions.

25 Hiroshi Watanabe (Oita Univ.) Solvability of degenerate parabolic-parabolic systems ····· 15

Summary: We consider the initial value problem (CP) for degenerate parabolic-parabolic systems with variable coefficients. The systems are coupled with strongly degenerate parabolic equations and nonhomogeneous heat equations. Strongly degenerate parabolic equations are regarded as a linear combination of the time-dependent conservation laws (quasilinear hyperbolic equations) and the porous medium type equations (nonlinear degenerate parabolic equations). Thus, the equation has both properties of hyperbolic equations and those of parabolic equations. In this talk, we discuss the solvability for (CP).

26 Makoto Nakamura (Yamagata Univ.)
Yuya Sato (Yamagata Univ.) On the Cauchy problem of a semilinear diffusion equation in an expanding space ····· 10

Summary: We consider the Cauchy problem for a semilinear diffusion equation in an expanding space, and we show global solutions for small initial data.

27 Makoto Nakamura (Yamagata Univ.) Remarks on the derivation of Navier–Stokes equations and elastic wave equations in uniform and isotropic spacetimes ····· 10

Summary: We consider the extension of the Navier–Stokes equations and the elastic wave equations in the Minkowski spacetime to the equations in uniform and isotropic spacetimes.

28 Yoshikazu Giga (Univ. of Tokyo)
Martin Bolkart (TU Darmstadt)
Takuya Suzuki
(Adv. Simulation Tech. of Mechanics R&D, Co., Ltd.) Analyticity of the Stokes semigroup in BMO ····· 10

Summary: We consider the Stokes semigroup in a large class of domains including bounded domains, the half-space and exterior domains. We will prove that the Stokes semigroup is analytic in a certain type of solenoidal subspaces of BMO.

14:15–16:00

29 Takeshi Fukao (Kyoto Univ. of Edu.) A strict separation property from pure phases for GMS model with logarithmic potential ····· 15

Summary: The equation and dynamic boundary condition of Cahn–Hilliard type was introduced by Goldstein–Miranville–Schimperna (2011), this problem is called GMS model and it is similar to the general Cahn–Hilliard system. In this talk, the double well potential of logarithmic type is employed. A strict separation property from pure phases is considered.

30 Noriaki Yamazaki (Kanagawa Univ.)
Nobuyuki Kenmochi (Univ. of Warsaw)
Ken Shirakawa (Chiba Univ.)
Quasi-variational evolution equations governed by double time-dependent subdifferentials 15

Summary: In this talk we introduce a new class of doubly nonlinear quasi-variational evolution equation governed by double time-dependent subdifferentials. The main aim of this talk is to show the existence of a solution to our equations.

31 Akio Ito
Evolution inclusion on a real Hilbert space with quasi-variational structure for inner product —Time-dependent convex functions— 15

Summary: Throughout our recent researches, we showed that the tumor invasion model with quasi-variational structure can be rewritten into an evolution inclusion on a suitable Hilbert space. Moreover, its norms has a quasi-variational structure in general. That is, they depend upon an unknown function, which is one of the functions (components) of a unique solution to the tumor invasion model. In this talk, an evolution inclusion on a real Hilbert space with quasi-variational structure for inner products is considered. And a main purpose is to give the continuity property of proper l.s.c. convex functions with quasi-variational structure which appear as subdifferentials operators in the evolution inclusions.

32 Ken Shirakawa (Chiba Univ.)
A gradient system based on an anisotropic image processing 15

Summary: In this talk, we consider a gradient flow of a non-convex functional, which was proposed by [Berkels et -al, pp. 293–301, Vision Modeling and Visualization 2006 (2006)] as a possible governing energy for an anisotropic image processing on a bounded spatial domain $\Omega \subset \mathbb{R}^2$. Our gradient flow is descried in a nonstandard form of *partial differential inclusions*, which contains a composition $\partial\gamma \circ R$ of: a (possibly) set-valued subdifferential $\partial\gamma$ of an anisotropic metrix $\gamma \in W^{1,\infty}(\mathbb{R}^2)$; and a rotation matric $R \in C^\infty(\mathbb{R}; \mathbb{R}^{2\times 2})$. Under appropriate settings, some mathematical observations for the gradient system will be provided on the basis of the time-discretization approach.

33 Kota Kumazaki
(Tomakomai Nat. Coll. of Tech.)
Solvability of a free boundary problem describing moisture swelling process in porous materials 15

Summary: In this talk, we propose a mathematical model for moisture swelling process in concrete materials. Moisture swelling process appear in, for instance, frost damage in concrete materials which is a nonlinear phenomenon to give rise to crack inside of concrete. Our model consists of a diffusion equation for moisture in a one microscopic hole of concrete and a free boundary problem for the front of the moisture region. In this talk, we discuss the existence and uniqueness of a time global solution for this problem, and moreover, some results of the behavior of the free boundary as time goes to infinity.

34 Toyohiko Aiki (Japan Women's Univ.)
Existence of a weak solution to a free boundary problem describing adsorption process 15

Summary: Recently, we investigated a free boundary problem describing a adsorption process in a porous media. In the global existence result to this model we require the smallness condition $h < 1$ for the boundary function h to prevent that the free boundary touches the fixed boundary. This is a big obstacle to consider a multi-scale model consisting of nonlinear diffusion equation and the free boundary problem. To overcome this difficulty, we propose a new weak formulation to the free boundary problem. Also, we show existence of a weak solution without the smallness condition to the boundary data.

16:15–17:15 Talk Invited by Real Analysis Section

Shun Uchida (Waseda Univ.) Solvability of a system describing double-diffusive convection phenomena in some porous medium

Summary: We consider some equations describing double-diffusive convection phenomena of incompressible viscous fluid in a porous medium. Roughly speaking, this system consists of the Stokes equation and two advection-diffusion equations. Although the fluid equation in our model is linearized, the others still possess convection terms as non-monotone perturbations, which make it difficult to deal with this system.

Main topic of this talk is to show the global solvability of this double-diffusive convection system. In particular, we focus on the existence of time periodic solutions to the system in the whole space domain for large data, i.e., without any smallness conditions for given external forces. In previous results for periodic problems of parabolic type equations with non-monotone perturbation terms (e.g., incompressible Navier–Stokes equations and Boussinesq system), it seems that either of the smallness of given data or the boundedness of space domain is essential. However, in spite of the presence of non-monotone terms, the solvability of our problem in the whole space is shown for large external forces via the convergence of solutions to approximate equations in bounded domains.

Functional Analysis

March 18th (Sun) Conference Room IV

14:15–16:15

1 Saburou Saitoh * (Gunma Univ.*/Inst. of Reproducing Kernels)
Tsutomu Matsuura (Gunma Univ.)
Yosihiro Sawano (Tokyo Metro. Univ.)
What are reproducing kernels? 15

Summary: Here, we will state simply a general meaning for reproducing kernels. We would like to answer for the general and essential question that: what are reproducing kernels? By considering the basic problem, we were able to obtain a general concept of the generalized delta function as a generalized reproducing kernel and, as a general reproducing kernel Hilbert space, we can consider all separable Hilbert spaces comprising functions.

2 Saburou Saitoh * (Gunma Univ.*/Inst. of Reproducing Kernels)
Tsutomu Matsuura (Gunma Univ.)
Yoshihiro Sawano (Tokyo Metro. Univ.)
General integral transforms by the concept of generalized reproducing kernels 15

Summary: The general integral transforms in the framework of Hilbert spaces were combined with the general theory of reproducing kernels and many applications were developped. The basic assumption here that the integral kernels belong to some Hilbert spaces. However, as a very typical integral transform, in the case of Fourier integral transform, the integral kernel does not belong to $L_2(\mathbf{R})$, however, we can establish the isometric identity and inversion formula.
On the above situations, we will develop some general integral transform theory containing the Fourier integral transform case that the integral kernel does not belong to any Hilbert space, based on the general concept of generalized reproducing kernels.

3 Takashi Aoki (Kindai Univ.)
Ryuichi Ishimura (Chiba Univ.)
Daniele C. Struppa (Chapman Univ.)
Shofu Uchida (Kindai Univ.)
Linear continuous operators acting on the space of entire functions of a given order 15

Summary: We consider the relationship between linear continuous operators acting on the space of entire functions of one variable of a given order and linear differential operators of infinite order satisfying certain growth conditions for the coefficients. We found that these two classes of operators are equivalent. Our results can be extended to the case of several variables.

4 Yoritaka Iwata (Tokyo Tech)
Module over the Banach algebra defined by the logarithmic representation of infinitesimal generators 15

Summary: The operator algebra is introduced based on the framework of logarithmic representation of infinitesimal generators. In conclusion a set of generally-unbounded infinitesimal generators is characterized as a module over the Banach algebra.

5 Fumio Hiroshima (Kyushu Univ.) Mass renormalization in the Nelson model ····· 12
Susumu Osawa (Kyushu Univ.)

Summary: The asymptotic behavior of the effective mass $m_{\rm eff}(\Lambda)$ of the so-called Nelson model in quantum field theory is considered, where Λ is an ultraviolet cutoff parameter of the model. Let m be the bare mass of the model. It is shown that for sufficiently small coupling constant $|\alpha|$ of the model, $m_{\rm eff}(\Lambda)/m$ can be expanded as $m_{\rm eff}(\Lambda)/m = 1 + \sum_{n=1}^{\infty} a_n(\Lambda)\alpha^{2n}$. A physical folklore is that $a_n(\Lambda) = O([\log\Lambda]^{(n-1)})(\Lambda \to \infty)$. It is rigorously shown that

$$0 < \lim_{\Lambda\to\infty} a_1(\Lambda) < C, \quad C_1 \le \lim_{\Lambda\to\infty} a_2(\Lambda)/\log\Lambda \le C_2$$

with some constants C, C_1 and C_2.

6 Fumio Hiroshima (Kyushu Univ.) Renormalized Gibbs measures associated with the Nelson model ····· 15

Summary: We can construct the Gibbs measure associated with the renormalized Nelson model in scalar quantum field theory. By using this Gibbs measure we investigate properties of the ground state of the Nelson Hamiltonian.

7 Kiyoomi Kataoka (Univ. of Tokyo) On generalized eigenvalues of an operator related to Kuramoto conjecture ····· 15
Yu Mada (Univ. of Tokyo)

Summary: Kuramoto's famous conjecture is that there is a positive constant K_c such that the system of oscillators becomes synchronized only when the coupling constant $K > K_c$. H. Chiba proved this conjecture for the continuous version of Kuramoto model in 2015. His proof covers the cases that the initial distributions $g(\omega)$ of frequencies of oscillators are Gaussian or Cauchy. His key tool is the precise analysis of the generalized eigenvalues of some unbounded linear operator T related to $g(\omega)$ on some Hilbert space. We extended his method to the analytic distributions of form $g = e^{-P(\omega)}/M$, where $P(\omega)$ is an even polynomial which increases in $\omega > 0$, and M is a positive constant.

16:30–17:30 Talk Invited by Functional Analysis Section

Nobuaki Obata (Tohoku Univ.) Quantum probabilistic methods for spectral analysis of graphs

Summary: Quantum (non-commutative) probability, tracing back to von Neumann who originally aimed at statistical study of quantum mechanics, has been penetrated into other branches of mathematics. In this lecture we focus on the interaction with spectral analysis of (growing) graphs developed during the last decade and mention some current topics.

In general, quantum probability is discussed in terms of an algebraic probability space $(\mathcal{A}, \varphi)$, where $\mathcal{A}$ is a unital $*$-algebra and $\varphi : \mathcal{A} \to \mathbb{C}$ is a state. Given a graph we consider the adjacency matrix (or other matrices such as Laplacian matrix, distance matrix, etc.) as a real random variable of an algebraic probability space, typically the adjacency algebra equipped with a state.

The first method is quantum decomposition. If the adjacency matrix A is decomposed into a sum of three operators $A = A^+ + A^- + A^\circ$, where A^+, A^-, A° are the creation, annihilation and preservation operators in an interacting Fock space, then the spectral distribution of A is obtained as the vacuum distribution of the canonical field operator of the interacting Fock space, where the theory of orthogonal polynomials is applied. This method is useful also for asymptotic spectral distributions of growing graphs.

The second method is based on various concepts of independence arising from non-commutative nature. If the adjacency matrix is expressible as a sum of independent random variables, typically when a graph admits a product structure, the spectral distribution is given by convolution of probability distributions. Hence for a growing graph, the asymptotic spectral distribution is obtained from the associated central limit theorem. The Cartesian, comb, star, free, Kronecker, lexicographic products of graphs are discussed along with quantum probability.

March 19th (Mon) Conference Room IV

9:30–12:00

8 Junsei Watanabe (Tokyo Gakugei Univ.) * Functional analytic viewpoints in computational linguistics of translated literary works ····· 15

Summary: Statistical analysis of styles of translated versions of literary works is more difficult than that of the originals, because most of the variables used in the latter case indicate only characteristics of the authors, not of the translators. We replace probability measures related with the text of a literary work by conditional expectations related with the text of the original and translated versions of the work, and compare the numerical values of these condional expectations. Results obtained by applying our framework to Mancu books on natural sciences, Neo-Confucianism or Catholicism published in the 17th and the 18th centuries are given.

9 Shizuo Miyajima (Tokyo Univ. of Sci.)
Isao Saito (Tokyo Univ. of Sci.)
Characterization of closed balls via metric projections ····· 10

Summary: Consider the following property (P) for a bounded closed convex set C in a Banach space X: (P) For every $x \in X$, a positive-scalar multiple of x gives a nearest point in C to x. Then it is clear that a closed ball with its center at the origin has this property. The converse to this assertion is the subject of this talk, and it is proved that a bounded closed convex set $C \subset X$ with $0 \in \operatorname{Int} C$ possessing property (P) is a closed ball with center 0, provided X is smooth and $\dim X > 1$. It is also proved that if a closed convex set $C \subset X$ with $0 \in \operatorname{Int} C$ satisfies (P), then X is smooth, provided the boundary of C is smooth in a weak sense.

10 Sin-Ei Takahasi (Yamagata Univ.*)
Hiroyuki Takagi (Shinshu Univ.)
Takeshi Miura (Niigata Univ.)
Hirokazu Oka (Ibaraki Univ.)
Semigroup operations distributed by the ordinary multiplication or addition on the real numbers ····· 15

Summary: Our motivation of this research is based on a certain refinement of an inequality that is induced by an abstract Jensen's inequality and on a characterization of a semigroup operations that is distributed by a vector addition in a plane. We determine cancellative, continuous operations on $\mathbb{R}$ with the usual topology that is distributed by the usual multiplication and addition.

11 Osamu Hatori (Niigata Univ.) Surjective isometries on Banach algebras of Lipschitz maps ····· 15

Summary: We show that a surjective isometry with respect to the sum norm between the Banach algebras of Lipschitz maps with the values in unital commutative C^*-algebras is canonical. When the unital commutative C^*-algebra is the complex plane, the result confirms the statement of Example 8 of the paper by Jarosz and Pathak.

12 Nobukazu Shimeno (Kwansei Gakuin Univ.)
Yuichi Tamaoka (Kwansei Gakuin Univ.)
The hypergeometric function of type A and the Lauricella hypergeometric series ····· 15

Summary: Heckman–Opdam hypergeometric function for the root system of type A_{n-1} with a certain degenerate parameter can be expressed by the Lauricella hypergeometric function F_D.

Summary: For a real split Lie group $G = KAN$, Vogan introduced the notion of *fine* K-types. We define a similar class of K-types for general connected real semisimple Lie groups. For a K-type in this class, we study matrix-valued elementary spherical functions. If there exists an invariant differential operator of the first order acting on the spherical functions, we can explicitly write the elementary spherical functions using Opdam's non-symmetric hypergeometric functions.

Summary: In this talk, we announce the result on a generalization of Cartan decomposition for symmetric spaces to spherical homogeneous spaces of reductive type. Moreover, we deal with some examples concerning to our result and explain how to find abelian subgroups.

Summary: Let X be a homogeneous space of a real reductive Lie group G. Then it is proved by T. Kobayashi and T. Oshima that the regular representation $C^\infty(X)$ contains each irreducible representation of G at most finitely many times if a minimal parabolic subgroup P of G has an open orbit on X, or equivalently, if the number of P-orbits on X is finite. Moreover, Kobayashi proved that for a general parabolic subgroup Q of G, there is a degenerate principal series representation induced from Q contained in $C^\infty(X)$ with infinite multiplicity if Q has no open orbit on X. In this article, we prove that there is a degenerate principal series representation induced from Q contained in $C^\infty(X)$ with infinite multiplicity if the number of orientable (or transverse orientable) Q-orbits on X is infinite even when there exists an open Q-orbit on X.

Summary: We introduce the notion of wreath algebra with trace. This can be regarded as an abstraction of the wreath product of an algebra with trace and the infinite symmetric group. Using this notion, we describe an invariant theory simply.

13:15–14:15 Talk Invited by Functional Analysis Section

Hideyuki Ishi (Nagoya Univ. / JST PRESTO) — Gamma-type integrals over convex cones

Summary: The Laplace transform of a power function on the positive half line is equal to a power function again up to a constant multiple, where the Gamma function appears as the coefficient. Replacing the half line by a homogeneous convex cone, Gindikin showed that the Laplace transform of a relatively invariant function over the homogeneous cone equals a relatively invariant function on the dual cone with an explicit Gamma factor. On the other hand, it is known in mathematical statistics that the Laplace transform of a power of the determinant function over the cone of positive definite real symmetric matrices with prescribed zero components equals a product of powers of minors with an explicit Gamma factor provided that the zero pattern is associated to a chordal graph. Although such a cone is not necessarily homogeneous, the integral formula is quite similar to Gindikin's formula eventually.
In this talk, we introduce a new cone consisting of positive definite real symmetric matrices with a specific block decompositions satisfying certain axioms. The class of this new cone contains all the homogeneous cones and the cones associated to chordal graphs. We establish Gamma-type integral formulas concerning the Laplace transform of a product of powers of minors over the new cones, so that the formulas mentioned above are obtained as special cases. Furthermore, considering the analytic continuation of the Gamma integral formula, we define the Riesz distribution whose Laplace transform equals a product of powers of minors of symmetric matrices, which gives a fundamental solution of a certain differential operator in a special case.

March 20th (Tue) Conference Room IV

9:30–12:00

17 Yasuo Watatani (Kyushu Univ.) * / Tsuyoshi Kajiwara (Okayama Univ.) — A computation of the dimension group for the self-similar map given by the tent map 15

Summary: We introduce a dimension group for a self-similar map as the K_0-group of the core of the C^*-algebra associated with the self-similar map together with the canonical endomorphism. The key step for the computation is an explicit description of the core as the inductive limit using their matrix representations over the coefficient algebra, which can be described explicitly by the singularity structure of branched points. We compute that the dimension group for the tent map is the countably generated free abelian group together with the unilatral shift.

18 Kengo Matsumoto * (Joetsu Univ. of Edu.) — Ruelle C^*-algebras associated with Smale spaces and bilateral Cuntz–Krieger algebras 15

Summary: We will characterize topologically conjugate two-sided topological Markov shifts $(\bar{X}_A, \bar{\sigma}_A)$ in terms of the associated asymptotic Ruelle C^*-algebras $\mathcal{R}_A$ with its commutative C^*-subalgebras $C(\bar{X}_A)$ and the canonical circle actions. We will also show that extended Ruelle algebras $\tilde{\mathcal{R}}_A$, which are purely infinite version of the asymptotic Ruelle algebras, with its C^*-subalgebras $C(\bar{X}_A)$ and the canonical torus actions γ^A are complete invariants for topological conjugacy of two-sided topological Markov shifts.

19 Hiroyuki Osaka (Ritsumeikan Univ.) — Stable rank for crossed products by actions of finite groups on C*-algebras 15

Summary: Let G be a finite group, A a unital separable finite simple nuclear C*-algebra, and α an action of G on A. Assume that A absorbs the Jiang–Su algebra $\mathcal{Z}$, the extremal boundary of the trace space of A is compact and finite dimensional and that α fixes any tracial state of A. Then $\mathrm{tsr}(A \rtimes_\alpha G) = 1$. In particular, when A has a unique tracial state, we conclude $\mathrm{tsr}(A \rtimes_\alpha G) = 1$ without above conditions on a tracial state space of A.

20 Kei Hasegawa (Kyushu Univ.) Boundary rigidity for free product C*-algebras · 15

Summary: We prove a boundary rigidity result for the embedding of a reduced free product C*-algebra into its associated "crossed product" C*-algebra. This provides new examples of rigid embeddings of exact C*-algebras into purely infinite simple nuclear C*-algebras.

21 Yusuke Sawada (Nagoya Univ.) The affine property of quasi-free states on self-dual CAR algebras · · · · 15

Summary: There is a one-to-one correspondence between quasi-free states on a self-dual CAR algebra and covariance operators. The problem of when the correspondence preserve convex combinations is solved in the case when the Hilbert space which we treat has a finite dimansion and covariance operators commutes.

22 Takuya Takeishi (Kyoto Univ.) Reconstructing the Bost–Connes semigroup actions from K-theory · · · 15

Summary: We discuss on the classification of Bost–Connes systems. We present that two Bost–Connes C*-algebras for number fields are isomorphic if and only if the original semigroups actions are conjugate. Together with recent reconstruction results in number theory by Cornelissen–de Smit–Li–Marcolli–Smit, we conclude that two Bost–Connes C*-algebras are isomorphic if and only if the original number fields are isomorphic. This is a joint work with Y. Kubota.

23 Toshihiko Masuda (Kyushu Univ.) Tannaka–Kreĭn–Woronowicz duality from the viewpoint of Q-systems · 15

Summary: We discuss the Tannaka–Kreĭn duality theorem of Woronowicz from the viewpoint of Q-systems in the sense of Fidaleo–Isola.

24 Yusuke Isono (Kyoto Univ.) Unique prime factorization for infinite tensor product factors · · · · · · · · 15

Summary: In this talk, we study a unique prime factorization property for tensor product factors with infinitely many tensor components. We provide several examples of type II and III factors which satisfy this property, including all free product factors with diffuse free product components. Our proof is based on Popa's intertwining techniques and the study of relative amenability on the continuous cores.

25 Narutaka Ozawa (Kyoto Univ.) Finite-dimensional representations constructed from random walks · · · 15

Summary: Let a finitely generated amenable group G and a probability measure μ on it (that is finitely-supported, symmetric, and non-degenerate) be given. I will present a construction, via the μ-random walk on G, of a harmonic cocycle and the associated orthogonal representation of G. Then I describe when the constructed orthogonal representation contains a non-trivial finite-dimensional subrepresentation (and hence an infinite virtually abelian quotient), and some sufficient conditions for G to satisfy Shalom's property H_{FD}. (joint work with A. Erschler, arXiv:1609.08585)

14:15–16:00

26 Masaru Nagisa (Chiba Univ.) Some operator norm inequalities · 15

Summary: We prove some formulas for operator norm inequalities related to operator means. As an example, we can get the following inequality (proved by H. Kosaki in 2014): For any positive integer $n \geq m$, it holds

$$\frac{1}{2^n}|||\sum_{i=0}^{n} {}_nC_i H^{i/n} X K^{(n-i)/n}||| \leq \frac{1}{2^m}|||\sum_{j=0}^{m} {}_mC_j H^{j/m} X K^{(m-j)/m}|||,$$

where $|||\cdot|||$ is an arbitrary unitarily invariant norm on $\mathbb{M}_N(\mathbb{C})$, $H, K, X \in \mathbb{M}_N(\mathbb{C})$ and $H, K \geq 0$.

27 Junichi Fujii (Osaka Kyoiku Univ.) Graphical approach to Hopf algebras · 15

Summary: Hopf algebra is one of a important structure to consider objects in the quantum information theory. But the Sweedler's convention, which is a basic tool of the calculation, is a little complicated for beginners. So, as another tool, we observe the graphical calculus of Hopf algebras. Though it is often used partially, we extend it for instance to the quantum double or universal R-matrix.

28 Masayuki Fujimoto (Osaka Kyoiku Univ.)
Yuki Seo (Osaka Kyoiku Univ.)
Mixed Schwarz inequalities via the matrix geometric mean ····· 10

Summary: Furuta showed a weighted version of a mixed Schwarz inequality for any square matrices. In this talk, we show the following matrix version based on the Cauchy–Schwarz inequality for matrices: Let A, X and Y be matrices in $\mathbb{M}_n$ and $U \in \mathbb{M}_n$ a unitary matrix in a polar decomposition of $Y^*AX = U|Y^*AX|$. Then

$$|Y^*AX| \le X^*|A|^{2\alpha}X\#U^*Y^*|A^*|^{2\beta}YU$$

holds for all $\alpha, \beta \in [0,1]$ with $\alpha + \beta = 1$.

29 Yuki Seo (Osaka Kyoiku Univ.)
Masayuki Fujimoto (Osaka Kyoiku Univ.)
A weighted mixed Schwarz operator inequality via the geometric operator mean ····· 10

Summary: In this talk, by virtue of the Cauchy–Schwarz operator inequality due to J. I. Fujii, we show a weighted mixed Schwarz operator inequality in terms of the geometric operator mean. As applications, we show Wielandt type operator inequalities via the geometric operator mean.

30 Takeaki Yamazaki (Toyo Univ.)
The Karcher equation, relative operator entropy and the Ando–Hiai inequality ····· 15

Summary: Pálfia has been obtained that the Generalized Karcher Equation (GKE) has a unique positive solution, and he obtained a lot of nice properties of it as an operator mean. In this talk, we shall introduce relations among a solution of the Generalized Karcher Equation (GKE), representing function of an operator mean and relative operator entropy, firstly. Next, we shall introduce further extensions of the Ando–Hiai inequality.

31 Shuhei Wada (Nat. Inst. of Tech., Kisarazu Coll.)
When does Ando–Hiai inequality hold? ····· 10

Summary: Let α be in $(0,1)$ and $r > 0$ and $\#_\alpha$ stand for the weighted operator geometric mean. We consider the following statement:

$$A, B > 0, \quad A\#_\alpha B \ge I \Rightarrow A^r\#_\alpha B^r \ge I.$$

Ando and Hiai show that if $r \ge 1$, then this holds. In the present paper, we prove that the above statement holds only if $r \ge 1$. We try to find a characterization of the indices $p, q \in (0,1)$ and $\mu, \lambda > 0$ satisfying

$$A, B > 0, \quad A\#_p B \ge I \Rightarrow A^\mu\#_q B^\lambda \ge I.$$

32 Hiroaki Tohyama (Maebashi Inst. of Tech.)
Hiroshi Isa (Maebashi Inst. of Tech.)
Eizaburou Kamei
Masayuki Watanabe (Maebashi Inst. of Tech.)
Some relations among the n-th relative operator entropies and the n-th operator divergences ····· 15

Summary: Let A and B be bounded positive invertible operators on a Hilbert space $\mathcal{H}$. For each $n \in \mathbb{N}$, let $\Psi^{[1]}_{A,B}(x,y) \equiv \frac{\Psi_{A,B}(x)-\Psi_{A,B}(y)}{x-y}$ and $\Psi^{[n]}_{A,B}(x,y) \equiv \frac{\Psi^{[n-1]}_{A,B}(x,y)-\Psi^{[n-1]}_{A,B}(y,y)}{x-y}$ $(n \ge 2)$, where $\Psi_{A,B}(t) \equiv A^{\frac{1}{2}}(A^{-\frac{1}{2}}BA^{-\frac{1}{2}})^tA^{\frac{1}{2}}$. So far, we have introduced the notions of the n-th operator divergences $D^{[n]}_{FK}(A|B)$ and $\Delta^{[n]}_1(x)$ which are generalizations of the Petz–Bregman divergence $D_{FK}(A|B) \equiv B - A - S(A|B)$ and $\Delta_1 \equiv T_x(A|B) - S(A|B)$, respectively. In this talk, we introduce the notions of the n-th relative operator entropies $T^{[n]}_x(A|B) \equiv \Psi^{[n]}_{A,B}(x,0)$ and $S^{[n]}(A|B) \equiv \Psi^{[n]}_{A,B}(0,0)$, and show some relations among the n-th relative operator entropies and the n-th operator divergences.

16:15–17:15 Talk Invited by Functional Analysis Section

Fumio Hiai (Tohoku Univ.) Multivariate matrix/operator means

Summary: The notion of (two-variable) operator means was introduced in an axiomatic way by Kubo and Ando (1980). A long-standing problem since then had been to generalize it to more than two variables. A breakthrough happened when the definitions of multivariate geometric means of positive definite matrices were found by the iteration method of Ando, Li and Mathias (2004) and in the Riemannian geometry approach by Moakher (2005) and by Bhatia and Holbrook (2006). In this talk I survey recent developments on multivariate means of positive definite matrices/operators in the Riemannian geometry approach, mainly on the multivariate version of the weighted geometric and power means. A significant feature of the multivariate geometric mean is that it is understood as the Cartan barycenter in the Riemannian trace metric, so it is also characterized by the Karcher equation (the gradient zero equation). This approach using Karcher type equations can be extended to an even more general setting of probability measures on the positive definite matrices (also operators), where the Wasserstein distance plays a crucial role. I furthermore explain log-majorization for the geometric mean in the setting of probability measures and a recent result on deformation of multivariate operator means by a fixed point method.

Statistics and Probability

March 18th (Sun) Conference Room VIII

9:15–12:00

1 Kazutoshi Yamazaki (Kansai Univ.)
Irmina Czarna (Univ. of Wrocław)
Jose-Luis Perez (Centro de Investigación en Matemáticas)
Tomasz Rolski (Univ. of Wrocław)
Fluctuation theory for level-dependent Lévy processes ····· 15

Summary: We consider a level-dependent Lévy process that changes its drift depending on the position of the process. We first generalize the refracted Lévy process of Kyprianou and Loeffen (2010), which changes its drift above a given threshold, to the multi-refracted case. We then extend the results for more general level-dependent Lévy processes. We show how fluctuation identities of these processes can be expressed via scale functions.

2 Kei Noba (Kyoto Univ.)
José-Luis Pérez (CIMAT)
Kazutoshi Yamazaki (Kansai Univ.)
Kouji Yano (Kyoto Univ.)
On optimal periodic dividend strategies for Lévy risk processes ····· 15

Summary: We study the optimal periodic dividend problem where dividend payments can only be made at the jump times of an independent Poisson process.

3 Yuichi Shiozawa (Osaka Univ.)
Jian Wang (Fujian Normal Univ.)
Upper rate functions of Brownian motion type for symmetric jump processes ····· 15

Summary: We are concerned with upper rate functions for a symmetric jump process on the Euclidean space generated by a regular Dirichlet form. We give a condition on the jumping function for the process to enjoy upper rate functions of Brownian motion type. Our condition implies that the second moment of the jumping function is finite.

4 Takahiro Hasebe (Hokkaido Univ.)
Noriyoshi Sakuma (Aichi Univ. of Edu.)
Steen Thorbjørnsen (Aarhus Univ.)
Freely selfdecomposability of the normal distributions ····· 10

Summary: We prove that the (classical) normal distributions are freely selfdecomposable. More generally it is established that the Askey–Wimp–Kerov distributions are freely self-decomposable. The main ingredient in the proof is a general characterization of the freely selfdecomposable distributions in terms of the derivative of their free cumulant transform.

5 Toshio Nakata (Fukuoka Univ. of Edu.)
The maxima for the generalized St. Petersburg game ····· 10

Summary: In this talk, we consider the maxima of payoffs for the generalized St. Petersburg game. The maxima for the original St. Petersburg game cannot be normalized to converge to a nondegenerate limit distribution. However, tuning the parameters appearing in the generalization, we show the normalized maxima converge to the Fréchet distribution.

6 Yong Moo Chung (Hiroshima Univ.)
Hiroki Takahasi (Keio Univ.)
Large deviaition principle for unimodal maps with flat critical point ····· 15

Summary: We study a smooth unimodal map whose critical point is non-recurrent and flat. Assuming the critical order is either polynomial or logarithmic, we establish the large deviation principle and give a partial description of the zeroes of the corresponding rate function.

7 Jin Hatomoto (Tokyo Nat. Coll. of Tech.) Relation between mixing properties and chaos in the sense of Devaney 10

Summary: In this talk, we consider continuous maps of a metric space and introduce relations between mixing properties such as decay of correlations and topologically mixing and Devaney's chaos.

8 Hisatoshi Yuasa (Osaka Kyoiku Univ.)* A relative, strictly ergodic model theorem for infinite measure-preserving systems 15

Summary: Every factor map between given ergodic, measure-preserving transformations on infinite Lebesgue spaces can be realized as a proper, factor map between strictly ergodic, locally compact Cantor systems. A locally compact Cantor system is a topological dynamical system of a homeomorphism on a locally compact (non-compact) metric space, whose one-point compactification is a Cantor set. Such a system, or a homeomorphism, is said to be strictly ergodic if the homeomorphism has a unique, up to scaling, invariant Radon measure and every orbit of it is dense in the metric space.

9 Haruyoshi Tanaka (Wakayama Med. Univ.) On convergence of the Gibbs measures of perturbed graph iterated function systems with degeneration 15

Summary: We study a perturbation of graph iterated function systems (graph IFS). In this study, we consider a family of graph IFSs with small parameter $\epsilon > 0$ such that some functions which compose this IFS converge to constant values as $\epsilon \to 0$. Therefore, the limit graph IFS (unperturbed system) may have several Gibbs measures associated with the dimension of the limit set even if the parametrized graph IFS (perturbed system) possess a unique Gibbs measure $\mu(\epsilon, \cdot)$ for each $\epsilon > 0$. In this situation, we give a necessary and sufficient condition for convergence of $\mu(\epsilon, \cdot)$ in the case when the limit graph IFS has 2 or 3 Gibbs measures. In particular, this condition is composed of Perron eigenvalues of Ruelle operators.

10 Masatake Hirao (Aichi Pref. Univ.) On p-frame potential of random point configurations on the sphere ... 15

Summary: In this talk we deal with two types of random point configurations, spherical ensemble and the jittered sampling on the sphere. The former is a well-studied determinantal point process on the sphere, and the latter is one of the famous random sampling method. We compare these random point configurations with spherical designs, which are one of the non-random "good" point configurations on the sphere in the viewpoint of p-frame potential. We also discuss other random point configurations on the sphere if possible.

14:15–15:00

11 Nariyuki Minami (Keio Univ.) One-dimensional Schrödinger operator with decaying white noise potential 15

Summary: We consider the Schrödinger operator whose potential consists of the white noise multiplied by a decaying factor. This model can be defined as a symmetric operator for any realization of white noise, and it is almost surely self-adjoint under some mild conditions. The nature of the positive part of this operator is similar to the model considered by Kotani and Ushiroya (CMP vol. 115 (1988)).

12 Yuki Suzuki (Keio Univ.) Diffusion processes with random potentials consisting of specially contracted self-similar processes 15

Summary: Limiting behaviors of one-dimensional diffusion processes with random potentials are studied. The potentials consist of specially contracted self-similar processes. The minimum processes and the maximum processes of the processes are also investigated.

13 Kiyoiki Hoshino (Osaka Pref. Univ.) On the reconstruction formulas in the wide sense of Wiener functionals from the SFCs 10

Summary: We discuss whether a random function (or a stochastic differential as an extension) is identified and how it is reconstructed from the stochastic Fourier coefficients (SFCs). In this talk, we focus on Skorokhod type SFC and give simple reconstruction formulas using Wiener chaos decomposition from SFCs of Wiener functionals on a space with Haar measure.

15:15–16:15 Award Lecture for the 2017 MSJ Analysis Prize

Masayoshi Takeda (Tohoku Univ.) Properties of symmetric Markov processes with tightness property

Summary: We consider irreducible, strong Feller, symmetric Markov processes with tightness property, and call the class of symmetric Markov processes having such properties Class (T). If a symmetric Markov process in Class (T) is conservative, then it has a very strong recurrence property, and if not, then it explodes very fast. Using this fact, we can derive some spectral properties, for example, p-independence of the growth bound of its semi-group, compactness of semi-group, bounded continuity of eigenfunctions. As an application of these properties, we can prove the existence and uniqueness of quasi-stationary distribution. By checking time-changed processes to be in Class (T), we give an analytic characterization of the criticality (or subcriticality) for Schroedinger forms. Moreover, we show that Green function for Schroedinger-type operator satisfies some principles in potential theory (eg. Ugaheri's maximum principle, the continuity principle) if the principal eigenvalue of the time-changed process is greater than one.

16:30–17:30 Talk Invited by Statistics and Probability Section

Koichiro Takaoka (Hitotsubashi Univ.) The first fundamental theorem of asset pricing: stochastic integrals and martingale measures

Summary: The first fundamental theorem of asset pricing roughly states that a stochastic process satisfies a property concerning the Itô integrals with respect to it, called the no-arbitrage property, if and only if the process has an equivalent martingale measure. The theorem for discrete-time finite-dimensional processes on finite probability spaces, which goes back to Harrison and Kreps (1979), is a restatement of Stiemke's lemma of finite-dimensional linear algebra. The theorem in the general setting can thus be viewed as an infinite-dimensional extension of Stiemke's lemma. In the continuous-time setting, there is more than one way to formulate the "no-arbitrage property." In this presentation, an emphasis will be put on the L^0 space of random variables and the technique of numeraire change.

March 19th (Mon) Conference Room VIII

9:30–11:30

Summary: In this talk, we study quasiconvex programming with a reverse quasiconvex constraint. We introduce affine and quasiaffine characterizations of a reverse quasiconvex constraint. By using these characterizations, we show necessary optimality conditions for the problem in terms of Greenberg–Pierskalla subdifferential. Additionally, we investigate surrogate duality for quasiconvex programming with a reverse quasiconvex constraint.

Summary: In this talk, we consider an adaptive control approach in Markov decision process in order to solve a problem of multivariate Bayesian control chart. We show that there exist an average optimal adaptive and asymptotically discounted optimal policies.

Summary: In this study, we consider a decision process model with a converging branch system which is one of the nonserial transition systems. The model is treated by three approaches. Thus we introduce three types of recursive equations by using dynamic programming technique.

17 Shuhei Mano (Inst. of Stat. Math.) A direct sampler for A-hypergeometric distributions and its application to random Young taubleaux 15

Summary: A distribution whose normalization constant is an A-hypergeometric polynomial is called an A-hypergeometric distribution. Such a distribution is in turn a generalization of the generalized hypergeometric distribution on the contingency tables with fixed marginal sums. For sampling from an A-hypergeometric distribution, the first choice may be use of Markov chain Monte Carlo (MCMC) with moves generated by a Markov basis. In this talk, as an alternative to MCMC methods, a direct sampling algorithm for general A-hypergeometric distribution will be presented. As an application of the exact sampler, sampling from random Young tableaux will be discussed. The Ferguson's Dirichlet process is an example of such random Young tableaux. A popular direct sampler, such as the Blackwell–MacQueen's urn scheme, does not work for random Young tableaux without infinite exchangeability. In contrast to the urn schemes, our direct sampler still works without exchangeability.

18 Hideyasu Yamashita (Aichi Gakuin Univ.) Probabilistic loop path integral for spins 15

Summary: Let $\mathrm{Spin}(2\ell+1)$ denote the spin group, represented as a subgroup of $\mathrm{SU}(2^\ell)$ (spin representation). Let G be $\mathrm{SU}(\ell)$ or $\mathrm{Spin}(2\ell+1)$, and V be $\mathbb{C}^\ell$ or $\mathbb{C}^{2^\ell}$, respectively. Fix $T>0$ and S^1 denote the loop, viewed as the interval $[0,2T]\subset\mathbb{R}$ where the endpoints identified. Let H be a self-adjoint operator on V. For any operator A on V, let $A(t):=e^{-itH}Ae^{itH},\ t\in\mathbb{R}$. We show some formulas which give the value of

$$\mathrm{Tr}A_n(t_n)\cdots A_0(t_0)B_1(t'_1)\cdots B_m(t'_m),\ 0=t_0<\cdots<t_n=T,\ 0<t'_1<\cdots<t'_m<T,$$

which can be interpreted as a quantum expectation value, by a limit of probability measures on $C^\infty\left(S^1,G\right)$.

19 Shigeyoshi Ogawa (Ritsumeikan Univ.)
Gerard Kerkyacharian (LPMA, Univ. Paris-Diderot)
Pencho Petrushev (Univ. South Carolina)
Dominique Picard (Univ. Paris-Diderot)
On the regularity of Gaussian processes indexed by Dirichlet spaces 10

Summary: We are concerned with the regularity of centered Gaussian processes $(Z_x(\omega))_{x\in M}$ indexed by compact metric spaces (M,ρ). We are to show as our main result that the almost everywhere Besov space regularity of such a process is (almost) equivalent to the Besov regularity of the covariance $K(x,y)=E(Z_xZ_y)$ under the assumption that (i) there is an underlying Dirichlet structure on M which determines the Besov space regularity, and (ii) the operator K with kernel $K(x,y)$ and the underlying operator A of the Dirichlet structure commute.
As an application of this result we investigate the case of compact homogeneous spaces and, in particular, the case where M is the sphere.

20 Tomoko Takemura (Nara Women's Univ.) Convergence of diffusion processes in a tube 15

Summary: Diffusion processes in a tube are direct product diffusion processes $\mathbb{Y}$ of one dimensional diffusion processes $X^{(1)}$ and skew product diffusions Ξ, or the time changed process $\mathbb{X}$ which is based on a positive continuous additive functional $\Phi(t)$. The skew product Ξ are given by one dimensional diffusion processes R and a spherical Brownian motion Θ by means of positive continuous additive functional $\mathbf{f}(t)$. We show a limit theorem for a sequence of time changed process $\mathbb{X}_n$ under some assumptions for R_n, ν_n (Revuz measure of $\mathbf{f}_n(t)$), and underlying measure.

11:30–12:00 Research Section Assembly

March 20th (Tue) Conference Room VIII

10:00–11:40

21 Hiromu Yumiba (Int. Inst. for Nat. Sci.)
Yoshifumi Hyodo (Okayama Univ. of Sci./Int. Inst. for Nat. Sci.)
Masahide Kuwada (Int. Inst. for Nat. Sci.)

GA*-optimal balanced third-order designs of resolution R*({10, 01}) with $N < \nu(m)$ for 3^m factorials 15

Summary: We consider the third-order linear model for 3^m factorials. In previous talk (MSJ Autumn Meeting 2017), we gave the A*-optimal 3^m-BTO designs of resolution R*({10, 01}) derived from SA's with the number of assemblies (= N) is less than the number of non-negligible factorial effects (= $\nu(m)$) and $m \geq 6$.

Let T be a 3^m-BTO design of resolution R*({10, 01}) derived from an SA with N assemblies, and further let $\sigma^2 S_T(\alpha)$ ($\alpha = 0, 1, 2$) be the trace of the variance-covariance matrix of the estimators based on T. If $S_T(\alpha) \leq S_{T^*}(\alpha)$ for any T^*, then T is said to be GA^*_α-optimal, where T^* is a 3^m-BTO design of resolution R*({10, 01}) derived from an SA with N assemblies. In this talk, we present GA^*_α-optima 3^m-BTO designs of resolution R*({10, 01}) derived from SA's for $m = 6, 7, 8$, where $N < \nu(m)$.

22 Mitsuhiro Takami (Tokyo Univ. of Sci.)
Yusuke Saigusa (Yokohama City Univ.)
Aki Ishii (Tokyo Univ. of Sci.)
Sadao Tomizawa (Tokyo Univ. of Sci.)

Measure of departure from local symmetry for square contingency tables 10

Summary: In this talk, we propose a new measure for square contingency tables. We construct the measure on the basis of the weighted harmonic mean of the diversity index. We derive properties of the measure and introduce a new model, local symmetry model.

23 Nobuhiro Taneichi (Hokkaido Univ. of Edu.)
Yuri Sekiya (Hokkaido Univ. of Edu.)
Jun Toyama (Inst. for the Practical Application of Math.)

Improvement of test of complete independence in multi-dimensional contingency tables. 15

Summary: We consider a test of complete independence in multi-dimensional contingency tables. We derive an expression for approximation of the null distribution of the test statistic based on asymptotic expansion. By using the continuous term of the expansion, we consider transformed statistics that increase the speed of convergence to a chi-square limiting distribution.

24 Tomoya Ikezawa (Tokyo Univ. of Sci.)
Kiyotaka Iki (Tokyo Univ. of Sci.)
Kouji Yamamoto (Osaka City Univ.)
Sadao Tomizawa (Tokyo Univ. of Sci.)

Measure of departure from point-symmetry for the collapsed square contingency tables 10

Summary: For square contingency tables with ordered categories, there may be some cases that one wants to analyze them by considering collapsed tables with some adjacent categories combined in the original table. This presentation considers the point-symmetry model for collapsed square contingency tables and proposes a measure to represent the degree of departure from point-symmetry. Also this presentation gives approximate confidence interval for proposed measure.

25 Takuya Yoshimoto (Tokyo Univ. of Sci./Chugai Pharmaceutical Co., Ltd.)
Kouji Tahata (Tokyo Univ. of Sci.)
Kiyotaka Iki (Tokyo Univ. of Sci.)
Sadao Tomizawa (Tokyo Univ. of Sci.)
Covariance symmetry model and decomposition of symmetry model for square contingency table 15

Summary: For the analysis of square contingency table, Caussinus (1965) pointed out that the symmetry model holds if and only if both the quasi-symmetry model and the marginal homogeneity model hold. This presentation proposes the covariance symmetry model and the decomposition theorem of the symmetry model into the covariance symmetry model and the marginal homogeneity model, which are different from Causinnus's.

26 Jo Suzuki (Osaka Univ.)
Estimation of conditional mutual information for discrete and continuous variables 15

Summary: This paper considers to estimate conditional mutual information given three sequences each of which is either continuous of discrete. The estimation generates a sequence of quantizations, estimate conditional mutual information of quantized values, and choose the maximum estimation value. It estimates continuous and discrete variables alike in a seemless manner. In particular, we prove two important properties. First, with probability one as the sample size goes to infinity, the obtained estimation is zero if and only if they are conditionally independent. Secondly, the estimation asymptotically converges to the true value. The procedure has been implemented in the CRAN package BNSL developed by J. Suzuki and J. Kawahara.

14:15–15:05

27 Kazuyoshi Yata (Univ. of Tsukuba)
Makoto Aoshima (Univ. of Tsukuba)
Bias-corrected estimation of eigenvalues in high-dimensional settings 15

Summary: In this talk, we consider estimation of eigenvalues in high-dimensional settings. First, we show that the sample eigenvalue is not a consistent estimator of the true eigenvalue for high-dimensional settings. Yata and Aoshima (2012, JMVA) proposed a new PCA method called the noise reduction (NR) methodology. The estimation of the eigenvalue by the NR method has a first-order consistency. We investigate more deeply the asymptotic behavior of the NR method. We give a new eigenvalue estimation and show that it holds the second-order consistency.

28 Aki Ishii (Tokyo Univ. of Sci.)
Kazuyoshi Yata (Univ. of Tsukuba)
Makoto Aoshima (Univ. of Tsukuba)
Equality tests of high-dimensional covariance matrices by using the noise-reduction methodology 15

Summary: In this talk, we consider the equality tests of covariance matrices for high-dimensional data. Aoshima and Yata (2017) proposed two eigenvalue models for high-dimensional data and constructed two-sample test procedures. One is called strongly spiked eigenvalue (SSE) model and the other one is called non-SSE (NSSE) model. Ishii et al. (2016) proposed an equality test of two covariance matrices under the SSE model. Li and Chen (2012) proposed a test procedure under the NSSE model. We evaluate the test statistic of Li and Chen (2012) under the SSE model and give new test procedures by using the noise-reduction method given by Yata and Aoshima (2012). We also compare our new test procedures with that given by Ishii et al. (2016).

29 Yoshihiko Maesono (Kyushu Univ.)
Taku Moriyama (Kyushu Univ.)
Smoothed two-sample nonparametric tests and their asymptotic properties 10

Summary: In this paper we discuss smoothed rank statistics for testing a location shift parameter of the two-sample problem. They are based on the discrete test statistics —the median and Wilcoxon's rank sum tests. For the one-sample problem, Maesono et al. (2017) reported that some nonparametric discrete tests have a problem with their p-values because of their discreteness. The p-values of the Wilcoxon's test are frequently smaller than those of the median test in tail area. This causes an arbitrary choice of the median and Wilcoxon's rank sum tests. In order to conquer this problem, we propose smoothed versions of those tests. The smoothed tests inherit good properties of the original tests, and asymptotically equivalent to the original test statistics. We study significance probabilities and local asymptotic powers of the proposed tests.

15:20–16:20 Talk Invited by Statistics and Probability Section

Kazuki Matsubara (ChuoGakuin Univ.) Pairwise additivity of BIB designs and related combinatorial structures

Summary: A set of ℓ balanced incomplete block (BIB) designs with common parameters having pairwise additivity is called an ℓ-pairwise additive BIB design. The ℓ-pairwise additivity of BIB designs can be regarded as a decomposition of a BIB design and/or a composition of several BIB designs, and further yields BIB designs with ℓ distinct block sizes. In this talk, we discuss comprehensively the existence of ℓ-pairwise additive BIB designs through the relationship with other combinatorial structures. Especially, as related combinatorial structures, we focus on nested BIB designs, orthogonal arrays (mutually orthogonal latin squares), perpendicular arrays, difference matrices and finite geometries. Furthermore, we present some results on splitting-balanced block designs named newly. The pairwise additivity also relates to the splitting-balanced property. The splitting-balanced block design (also called a splitting BIB design in literature) was introduced for applications to authentication codes by Ogata et al. in 2004. Finally, the bound of the number of blocks and some existence of splitting-balanced block designs are provided.

16:40–17:40 Talk Invited by Statistics and Probability Section

Koji Tsukuda (Univ. of Tokyo) Studies on the theory of weak convergences in Hilbert spaces and its applications

Summary: In this presentation, weak convergences of random processes taking values in a separable Hilbert space are discussed. Especially, by using a common approach based on the limit theory in L^2 spaces, we study partial sum processes of dependent random variables which appear in the following two topics: (i) statistical change point testing; (ii) functional central limit theorem for logarithmic combinatorial assemblies. (i) Statistical change point testing. When there exist chronologically obtained data, it is in interest to determine whether there are structural changes or not. In the domain of statistics, tests for such hypothesis is considered in the so-called change point testing. For parametric change point problems, several works have proposed test procedures based on score functions. Following these works, we propose a procedure based on the functional of a weighted random process whose weak convergence is discussed in $L^2(0,1)$, which is a modification of test statistics in previous works. (ii) Functional central limit theorem for logarithmic combinatorial assemblies. Assemblies are a class of random combinatorial structures which includes random permutations, random mappings, random forests of labeled trees, and so on. The law of component counts of assemblies is provided from independent Poisson variables combined with the conditioning relation. In previous works, the weak convergence of the partial sum process of component counts of logarithmic assemblies, which are assemblies satisfying the logarithmic condition, has been considered in the Skorokhod space. On the other hand, we consider the partial sum process involving a weight function, which makes the limit different, and derive its weak convergence in $L^2(0,1)$.

March 21st (Wed) Conference Room VIII

10:00–12:00

30 Nakahiro Yoshida (Univ. of Tokyo) Martingale expansion and power variation · · · · · 15

Summary: Inference for volatility under finite time horizon becomes non-ergodic statistics. The quasi-maximum likelihood estimator and the Bayesian type estimator of the volatility parameter are asymptotically mixed normal in general. Asymptotic expansion in non-ergodic systems is then indispensable to develop the higher-order inferential theory for volatility. We present asymptotic expansion of a martingale having a mixed normal limit. The expansion formula is expressed by the adjoint of a random symbol with coefficients described by the Malliavin calculus, differently from the standard invariance principle. We discuss its application to the power variation of a diffusion process. Identification of the random symbols is an issue.

31 Nakahiro Yoshida (Univ. of Tokyo) Asymptotic expansion of Skorohod integrals · · · · · 15

Summary: Asymptotic expansion of the distribution of the Skorohod integral jointly with a reference variable is derived. We introduce a second-order interpolation formula in frequency domain to expand a characteristic functional and combine it with the scheme developed in the martingale expansion. Random symbols are used for expressing the asymptotic expansion formula. Quasi tangent, quasi torsion and modified quasi torsion are introduced in this paper. This is a joint work with D. Nualart.

32 Yoshiyuki Tanida (Waseda Univ.)
Fumiya Akashi (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
Asymptotic theory and numerical studies of Whittle estimation for high-dimensional time series · · · · · 10

Summary: In this presentation, we develop the estimation theory for Whittle functional of high-dimensional non-Gaussian dependent processes. Using a sample version based on a thresholded periodogram matrix, we introduce a thresholded Whittle estimator of unknown parameter, and elucidate its asymptotics. It is shown that the thresholded Whittle estimator is a $\sqrt{n}$-consistent estimator of the unknown parameter, and that the standardized version has the asymptotic normality. Some numerical studies illuminate an interesting feature of the results. Concretely, for high-dimensional AR(2), we compared the difference of RMSE between the usual Whittle estimator $\hat{\theta}_w$ and the thresholded estimator $\hat{\theta}_{w,th}$, leading to a conclusion that $\hat{\theta}_{w,th}$ is better than $\hat{\theta}_w$.

33 Yujie Xue (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
LASSO estimators for high-dimensional time series with long-memory disturbances · · · · · 10

Summary: Consider a linear regression model: $Y_t = z_t'\beta + \varepsilon_t$ where $\{\varepsilon_t\}$ is a stationary process with mean zero and spectral density $f(\lambda)$, and z_t is a known nonrandom function vector of t. In this talk, it is desired to discuss the LASSO estimator of β when $\{\varepsilon_t\}$ is a long-memory strictly stationary process (i.e. $f(\lambda)$ is unbounded at the origin) all of whose moments exist and has the infinite moving average representation, and when the dimension of β defined as p increases with sample size n. An interesting property of the LASSO estimators is shown.

34 Kou Fujimori (Waseda Univ.) Cox's proportional hazards model with a high-dimensional and sparse regression parameter · · · · · 15

Summary: This talk deals with the proportional hazards model proposed by D. R. Cox in a high-dimensional and sparse setting for a regression parameter. To estimate the regression parameter, the Dantzig selector is applied. The variable selection consistency of the Dantzig selector for the model will be proved. This property enables us to reduce the dimension of the parameter and to construct asymptotically normal estimators for the regression parameter and the cumulative baseline hazard function.

Summary: Recently, we often observe the heavy-tailed time series data in variety of fields, and it is unfeasible to apply the classical likelihood ratio-based method to such data directly. To overcome the difficulty, this talk constructs the self-weighted generalized empirical likelihood (SW-GEL) statistic for possibly infinite variance processes, and elucidates the local asymptotic power of the SW-GEL statistic. The self-weighting method proposed by Ling (2005, JRSS) enables us to control effects brought by the infinite variance of underlying time series models. By the self-weighting method, the proposed statistic converges to the non-central chi-square distribution under the local alternatives. This talk also introduces the selection procedure of tuning parameters in self-weights based on the local asymptotic power.

Summary: It is well known that the property of local asymptotic normality (LAN) allows us to discuss the asymptotic efficiency of estimation via minimax theorems. We proved LAN property for symmetric stable processes and one-sided stable processes under high-frequency observations using non-diagonal rate matrices depending on the parameter to be estimated. In contrast to the classical LAN families in the literature, non-diagonal rate matrices are inevitable.

Applied Mathematics

March 18th (Sun) Conference Room VI

9:30–11:45

1 Tomoko Adachi (Toho Univ.) A labeling of a cyclic bipartite graph and its application to RAID · · · · 10

Summary: A cluttered ordering is a kind of cyclic orderings, and can be used to minimize the number of disk operations in RAID system. Mueller et al. (2005) decomposed the complete bipartite graph into isomorphic copies of the special bipartite graph $H(h;t)$, where h and t are positive integers. The special bipartite graph $H(h;t)$ has each $h(t+1)$ vertices as upper vertex set and lower vertex set. In this talk, we define the special bipartite graph $H(h,k;t)$, where h, $k(h \neq k)$ and t are positive integers. The special bipartite graph $H(h,k;t)$ has $h(t+1)$ vertices as upper vertex set and $k(t+1)$ vertices as lower vertex set. We present some edge labeling of the infinite families of $H(1,2;t)$.

2 Mickaël Buchet (Tohoku Univ./TU Graz) Vietoris–Rips realization of indecomposable persistence modules of arbitrarily large dimension · · · · 15
Emerson Gaw Escolar (Tohoku Univ.)

Summary: In this work we construct an infinite family, parametrized by dimension order d, of non-isomorphic indecomposable persistence modules over the commutative ladder of length 5. We provide a family of bifiltrations of topological spaces whose H_1 persistent homologies is the infinite family of persistence modules. Moreover, we provide Vietoris–Rips constructions of the family of bifiltrations. Our construction provides an elementary proof of the fact that the commutative ladders with length greater than or equal to 5 is representation-infinite. Furthermore, we aim by this example to illustrate that indecomposable persistence modules of high dimension as a representation may encode some interesting and easy to visualize phenomenon.

3 Michio Seto (Nat. Defense Acad. of Japan) Application of the theory of quasi-orthogonal integrals to graph theory · · · · 10
Sho Suda (Aichi Univ. of Edu.)

Summary: In this talk, we give two inequalities concerning increasing families of finite graphs. Those inequalities are derived from the theory of quasi-orthogonal integrals developed by de Branges–Rovnyak and Vasyunin–Nikol'skii.

4 Shohei Satake (Kobe Univ.) Remark on two typical properties of random graphs · · · · 15

Summary: There are some well known properties which random graphs satisfy with probability 1. Here we deal with two such typical properties of random graphs, namely, the n-existentially closed (n-e.c.) property and the pseudo-random property. Cameron and Stark remarked that the pseudo-random property does not necessarily imply the n-e.c. property for large n. However there seems no results about the inverse relationship.
In this talk, we give the first construction of n-e.c. graphs without the pseudo-random property, which means that the n-e.c. property also does not necessarily imply the pseudo-random property for every n.

Summary: We study the homological properties of random simplicial complexes, which have received a lot of attention over the past several years. In particular, we obtain asymptotic behavior of lifetime sums of persistent homology for a class of increasing random simplicial complexes, which is a higher-dimensional counterpart of Frieze's zeta function theorem for the Erdős–Rényi graph process. Main results include solutions to the questions on the Linial–Meshulam complex process and the clique complex process that were posed in the preceding study by Hiraoka and Shirai. One of the key ingredients of the arguments is a new upper bound of Betti numbers of general simplicial complexes in terms of the number of small eigenvalues of Laplacians on links, which is regarded as a quantitative version of the cohomology vanishing theorem.

Summary: For a positive integer d, the d-dimensional Chebyshev–Frolov lattice is the $\mathbb{Z}$-lattice in $\mathbb{R}^d$ generated by the Vandermonde matrix associated to the roots of the d-dimensional Chebyshev polynomial. It is important to enumerate the points from the Chebyshev–Frolov lattices in axis-parallel boxes when $d = 2^n$ for a non-negative integer n, since the points are used for the nodes of Frolov's cubature formula, which achieves the optimal rate of convergence for many spaces of functions with bounded mixed derivatives and compact support. The existing enumeration algorithm for such points by Kacwin, Oettershagen and Ullrich is efficient up to dimension $d = 16$. In this paper we suggest a new enumeration algorithm of such points for $d = 2^n$, efficient up to $d = 32$.

Summary: A continuous lattice is a semantic domain of a computation such as a lambda calculous. Our motivation comes from a development of a formal theory of semantic domains. We first talk about a theory of relational T-algebra, an extension of a T-algebra. Michael Barr proved the category of relational T-algebra defined by the ultra-filter monad is isomorphic to the category of topological spaces. We review their theory and reformulate it using our simple flamework of a relational calculus.

Summary: We show that the Smith normal form of a skew-symmetric D-optimal design of order $n \equiv 2 \pmod 4$ is determined by its order. We apply our result to show that certain D-optimal designs of order $n \equiv 2 \pmod 4$ are not equivalent to any skew-symmetric D-optimal design.

Summary: Let $v(k, \lambda)$ be the maximum order of connected bipartite k-regular graphs whose second-largest eigenvalues are at most λ. We show an upper bound for $v(k, \lambda)$, which is based on the linear programming bound. If a graph attains the bound, then it is a distance-regular graph that satisfies $g \geq 2d - 2$, where g is the girth and d is the diameter of the graph. There are infinitely many bipartite distance-regular graphs that satisfy $g \geq 2d - 2$. We can prove the non-existence of bipartite distance-regular graphs with $g \geq 2d - 2$ for $d > 26$ by the manner of Fuglister (1987). This is a joint work with Sebastian Cioabă and Jack Koolen.

14:20–16:30

Summary: A subdigraph H of an arc-colored digraph D is *properly colored* if any two consecutive arcs of H receive distinct colors. A *kernel by properly colored paths* of an arc-colored digraph D is a set S of vertices of D such that (i) no two vertices of S are connected by a properly colored directed path in D, and (ii) every vertex outside S can reach S by a properly colored directed path in D. We conjecture that every arc-colored digraph with all cycles properly colored has such a kernel and verify the conjecture for unicyclic digraphs, semi-complete digraphs and bipartite tournaments, respectively.

Summary: A matching M of a graph G is said to be extendable if M is a subset of a perfect matching of G, and M is said to be distance d matching if the edges of M lie pair-wise distance at least d. If every distance d matching of G is extendable, then we say that G is distance d matchable. In this talk we introduce the following results: 1) Let G be a 3-connected cubic bipartite graph. If there exist two cycles C_1, C_2 of length at most d such that $E(C_1) \cap E(C_2) = \{e\}$ for every $e \in E(G)$, then G is distance d matchable. 2) Let G be a 3-connected cubic bipartite planar graph. If there exist two cycles C_1, C_2 of length at most 6 such that $e \in E(C_i)$ $(i = 1, 2)$ for every $e \in E(G)$, then G is distance 6 matchable.

Summary: A *triangulation* on a closed surface is a graph embedded on the surface each of whose face is triangular. Let G be a triangulation on a closed surface and $n \geq 3$ be a natural number. A coloring $c : V(G) \to \mathbb{Z}_n$ is called an *n-triad coloring* if $\{c(u), c(v), c(w)\}$ belongs to $\{\{i, i+1, i+2\} \mid i \in \mathbb{Z}_n\}$ for any face uvw of G.
We would like to determine the set of numbers n such that G has n-triad colorings. The set can be determined completely by the chromatic number of G if G is embedded on the sphere or the projective plane. In this talk, we shall focus on G which is embedded on the torus and investigate the above set of G.

Summary: An *r-dynamic k-coloring* of a graph G is a proper k-coloring such that any vertex v has at least $\min\{r, \deg_G(v)\}$ distinct colors in $N_G(v)$. The *r-dynamic chromatic number* $\chi_r^d(G)$ of a graph G is the least k such that there exists an r-dynamic k-coloring of G. Loeb and et al, proved that $\chi_3^d \leq 10$ if G is a planar graph, however this result is not considered not to be sharp. Thus finding an optimal upper bound on $\chi_3^d(G)$ for a planar graph G is a natural interesting problem. We will show some upper bounds on $\chi_3^d(G)$ for triangulations on the plane, the projective plane and the torus.

14 Kengo Enami (Yokohama Nat. Univ.) 3-connected 3-regular planar graphs embedded on non-spherical surfaces 15

Summary: It is well-known that every 3-connected planar graph is uniquely embeddable on the sphere but it is not uniquely embeddable on any surface other than the sphere. We shall focus on a 3-connected 3-regular planar graph and classify structures of its embeddings on the torus, the projective plane and the Klein bottle.

15 Kenta Ozeki (Yokohama Nat. Univ.) The signature of edge colorings on the projective plane 15
Toshiki Abe (Yokohama Nat. Univ.)

Summary: Let G be a k-regular k-edge colorable graph. Moreover, let φ be a k-edge coloring of G. Let v be a vertex of $V(G)$ and $E(v)$ denotes the set of all edges incident with v. Let ρ_v be a bijective map $E(v) \to \{1, 2, ..., k\}$ and we call the set $\rho = \{\rho_v : v \in V(G)\}$ basis. Now we obtain the correspondence $\pi_v = \varphi \circ \rho_v^{-1}$ for every v. The signature of φ is defined as $\prod_{v \in V(G)} \mathrm{sign}(\pi_v)$.
In this talk, we obtain the signatures of k-edge-colorings in k-regular graphs on the projective plane for a certain basis ρ. Moreover, this has an application to the list coloring conjecture for certain graph class by using former result.

16 Kenta Noguchi (Tokyo Denki Univ.) Spanning bipartite subgraphs having large size of even triangulations 15

Summary: We consider a spanning bipartite subgraph of an even (i.e. Eulerian) triangulation G on a surface. If G has a spanning bipartite quadrangulation, then its size is two-thirds of $E(G)$. In this talk, we discuss the condition of G having a spanning bipartite quadrangulation Q. We also discuss the maximum size of a spanning bipartite subgraph of G when G does not have Q.

17 Yusuke Suzuki (Niigata Univ.) Exceptional balanced triangulations on closed surfaces 15
Satoshi Murai (Osaka Univ.)

Summary: In our recent research, we proved that two balanced (or 3-colorable) triangulations of a closed surface are not necessary connected by a sequence of balanced stellar subdivisions and welds. This answers a question posed by Izmestiev, Klee and Novik. In this talk, we especially discuss two local operations called a pentagon contraction and a pentagon splitting, which are also defined for balanced triangulations of closed surfaces. We show that most two balanced triangulations of a closed surface are transformed into each other by a sequence of the above two operations. Furthermore, we introduce such exceptional balanced triangulations of closed surfaces with low genera.

16:45–17:45 Talk Invited by Applied Mathematics Section

Masashi Shinohara (Shiga Univ.) Classification problems and extremal problems on distance sets

Summary: We consider good configurations from the point of view of the theory of distance sets. A subset X of a Euclidean space is called a k-distance set if there exists exactly k values of distances between two distinct points in X. The study of distance sets was initiated by Erdös (1946). One of the major problems in the theory of k-distance sets in the d-dimensional Euclidean space is to determine the largest possible cardinality $g_d(k)$ of k-distance sets and classify the distance sets X satisfying $|X| = g_d(k)$. Such k-distance sets are said to be optimal. Furthermore, we are also interested in characterization of k-distance sets with large points relative to k. In this talk, we introduce some results for optimal k-distance sets and extremal problems on distance sets.

March 19th (Mon) Conference Room VI

9:30–11:45

18 Iwao Sato (Oyama Nat. Coll. of Tech.)
Hideo Mitsuhashi (Hosei Univ.)
Hideaki Morita (Muroran Inst. of Tech.)
A weighted generalized Bartholdi zeta function of a digraph ····· 15

Summary: We define a weighted generalized Bartholdi zeta function and a weighted generalized Bartholdi L-function of a digraph, and present their determinant expressions. Furthermore, we give express the weighted generalized Bartholdi zeta function of a group covering of a digraph by a product of its weighted generalized Bartholdi L-functions.

19 Yusuke Ide (Kanagawa Univ.)
Norio Konno (Yokohama Nat. Univ.)
Daichi Nakayama (Yokohama Nat. Univ.)
Two-state space-inhomogeneous coined quantum walk ····· 10

Summary: We consider the two-state space-inhomogeneous coined quantum walk (QW) in one dimension. We obtain the uniform measure as the stationary measure by solving the eigenvalue problem. This approach is based on the method giving by Kawai, Komatsu and Konno. (2017).

20 Takashi Komatsu (Yokohama Nat. Univ.)
Norio Konno (Yokohama Nat. Univ.)
Akihiro Narimatsu (Yokohama Nat. Univ.)
The Quantum walk on the 2-dimensional torus ····· 10

Summary: We analyze two types of the Quantum walk on the 2-dimensional torus, the Grover walk and the Fourier walk, and obtain provability amplitude and the search algorithm using the Fourier walk.

21 Daiju Funakawa (Hokkaido Univ.)
Toru Fuda (Hokkaido Univ.)
Satoshi Sasayama (Hokkaido Univ.)
Akito Suzuki (Shinshu Univ.)
Eigenvalue analysis of a 2-dimensional quantum walk ····· 15

Summary: We consider the 2-dimensional 4-states quantum walk. This quantum walk is an extension of the 1-dimensional split-step quantum walk. By the earlier study, it is known that if a particular function f has zero points, then time evolution operator U has eigenvalues. In such a case, localization occurs. In this talk, we introduce the necessary and sufficient condition of f has zero points. This research is a joint work with T. Fuda, S. Sasayama and A. Suzuki.

22 Tomoyuki Terada (Kanazawa Inst. of Tech.)
Takashi Komatsu (Yokohama Nat. Univ.)
Norio Konno (Yokohama Nat. Univ.)
Kei Saito (Yokohama Nat. Univ.)
Study on the one-dimensional lazy Fourier walk ····· 10

Summary: We consider the property of lazy Fourier walk in one dimension. For example, stationary measure, time-averaged limit measure, and periodicity.

23 Hiromichi Ohno (Shinshu Univ.)
Unitary equivalence classes of one-dimensional quantum walks ····· 15

Summary: This study investigates the unitary equivalence classes of one-dimensional quantum walks. We determine the unitary equivalence classes of one-dimensional quantum walks, two-phase quantum walks with one defect, complete two-phase quantum walks, one-dimensional quantum walks with one defect and translation-invariant quantum walks.

24 Takashi Komatsu (Yokohama Nat. Univ.)
Norio Konno (Yokohama Nat. Univ.)
Stationary measures of quantum walks on the higher-dimensional integer lattice 15

Summary: Stationary measures of quantum walks on the one-dimensional integer lattice are well studied. However, the stationary measure for the higher dimensional case has not been clarified. In this talk, we give the stationary amplitude for quantum walks on the higher-dimensional integer lattice with a finite support by solving the corresponding eigenvalue problem. As a corollary, we can obtain the stationary measures of the Grover walks.

25 Takashi Komatsu (Yokohama Nat. Univ.)
Hikari Kawai (Yokohama Nat. Univ.)
Norio Konno (Yokohama Nat. Univ.)
Stationary measures of space-inhomogeneous quantum walks 10

Summary: We consider the two-state space-inhomogeneous coined quantum walk in one dimension. For a general setting, we obtain the stationary measures of the quantum walks by solving the eigenvalue problem. As a corollary, stationary measures of the multi-defect model and space-homogeneous quantum walks are derived.

26 Yusuke Yoshie (Tohoku Univ.) Periodicity of the Grover walk on joint of graphs 15

Summary: The Grover walk is a kind of quantum walks on graphs, and it is applied to various study fields. The Grover walk is determined by a unitary time evolution operator given by the underlying graph. So we can say that the Grover walk is induced by the graph. We focus on characterizations of graphs inducing periodic Grover walks, that is, there exists a integer k such that k-th iteration of the time evolution operator becomes identity operator. In previous walk, such graphs have been found, e.g. cycle graphs, path graphs, complete bipartite graphs. In this talk, we construct new graphs with these graphs, and consider the periodicity of the Grover walk on these graphs.

14:00–14:20 Presentation Ceremony for the 2017 MSJ Prize for Excellent Young Applied Mathematicians

March 20th (Tue) Conference Room VI

9:15–11:50

27 Genki Kusano (Tohoku Univ.) The bootstrap method by the Persistence weighted Gaussian kernel 15

Summary: In topological data analysis, the topological structures in data are transformed into a persistence diagram, and its statistical method is proposed by the Persistence weighted Gaussian kernel (PWGK). Here, let us consider the expectation of persistence diagrams by the PWGK. While it is difficult to calculate the expectation in general, the confidence set which contains the true expectation can be constructed by the bootstrap method. In this talk, we will discuss the bootstrap method by the PWGK and its asymptotic consistency.

28 Hiroshi Takeuchi (Tohoku Univ.)
Yasuaki Hiraoka (Tohoku Univ.)
The persistent homology of a correspondence: A viewpoint from quiver representations 15

Summary: The theory of homology induced maps of correspondences proposed by Shaun Harker et al. is a powerful tool which allows the retrieval of underlying homological information from sampling data with noise or defects. In this study, we redefine induced maps of correspondences within the framework of quiver representations, and provide more concise proofs of the main theorems in the original paper. With this point of view, we easily extend these ideas to filtration analysis, which provides a new method for analyzing dynamical systems.

29 Ippei Obayashi (Tohoku Univ.) Volume optimal cycles for persistent homology · 15

Summary: Persistent homology (PH) is a significant tool for topological data analysis, which analyzes shape of data efficiently and quantitatively. A persistence diagram (PD) is a visualization tool of PH, which is a multiset on $\mathbb{R} \times (\mathbb{R} \cup \infty)$. Each point on a PD (called a birth-death pair) corresponds a homological structure such as a ring, cavity, etc. appearing in the data. For a practical application of PH, we want to identify such a homological structure for a selected birth-death pair. The idea of a volume optimal cycle and the computation algorithm are proposed in this talk.

30 Takashi Teramoto (Asahikawa Medical Univ.) Akihiro Takiyama (Hokkaido Bunkyo Univ.) The case studies of using computational homology in medical science · 10

Summary: We present a methodlogy using computation homology for quantitatve measurements in medical science, in collaboration with diagnostic doctors. Our talk will consits of two folds: cubical homology index for bone morphometry in three-dimension, and immunohistochemical scoring based on persistent homology.

31 Hiroe Oka (Ryukoku Univ.) Sota Koyama (Ryukoku Univ.) The Conley index over base · 15

Summary: The Conley index over a base [Mrozek Reineck, Srzednicki 1997] is a generalization of the Conley index for flows [Conley 1972]. In the case when the base is the circle, it is naturally related to the discrete type of Conley index of a Poincare section of the flow. We will consider the homology version of the Conley index over a base, and discuss the relation between them.

32 Shunji Horiguchi On convergences and distributions of roots of extended complex Newton's method · 15

Summary: We extend the complex Newton's method. We give the followings for the extended complex Newton's method. Relationship between extended complex Newton's method and Riemann surface. Conditional expression of initial values for convergence of extended complex Newton's method. Speeds of convergences of extended complex Newton's method. The distributions of roots of extended complex Newton's Method.

33 Fuminori Sakaguchi (Univ. of Fukui) 'Decipherment' of integer sequences corresponding to extra solutions in an integer-type algorithm for ODEs · 15

Summary: An integer-type algorithm for solving ODEs was proposed by the author and M. Hayashi. This algorithm is based on the expansion of solution functions by rational-function-type basis functions, and it is based on the 'exact' kernel vectors of non-square matrices. In this algorithm, we can read and 'decipher' integer coefficient sequences directly, and hence we can analyze behavior of numerical solutions exactly and pure-mathematically. In this study, the author gives further numerical examples where it is clearly shown that many hyperfunction components are contained in extra solutions mixed in numerical solutions obtained by this algorithm, by a direct 'decipherment' of integer coefficient sequences contained in numerical results by this algorithm, than the examples already presented.

34 Tomooki Yuasa (Ritsumeikan Univ.)
Tatsuki Akiyama (Ritsumeikan Univ.)
Arturo Kohatsu-Higa (Ritsumeikan Univ.)
Second order unbiased simulation method for reflected stochastic differential equations 15

Summary: In this talk, we consider unbiased simulation methods functionals of solutions of one-dimensional reflected stochastic differential equations. Alfonsi–Hayashi–Kohatsu propose an unbiased simulation method for the present problem based on the parametrix method. However, the variance of this method is not finite in general unless one uses an importance sampling method. We propose a different way of obtaining what we call a second order parametrix method which leads to an alternative unbiased random variable with finite moments. We call this method "Second order unbiased simulation method for reflected stochastic differential equations".

35 Takehiko Kinoshita
Yoshitaka Watanabe (Kyushu Univ.)
Mitsuhiro T. Nakao (Waseda Univ.)
An invertibility verifications for linear elliptic operators mapping to dual space 15

Summary: This talk presents an computer-assisted procedure for verifying the invertibility of second-order linear elliptic operators and for computing a bound on the norm of its inverse. This approach is an improvement of a theorem (Nakao, et al. 2015, Jpn. J. Ind. Appl. Math. 32, 19–32) that uses projection and constructive a priori error estimates. Several examples which confirm the actual effectiveness of the procedure are reported on.

36 Tomoyuki Miyaji (Meiji Univ.)
Hisahi Okamoto (Gakushuin Univ.)
Computer-assisted proof of the existence of a unimodal solution to the Proudman–Johnson equation 15

Summary: We study the existence of unimodal stationary solutions to the Proudman–Johnson equation with an external force. In particular, we are interested in the case of a high Reynolds number. In order to prove the existence and unimodality of a solution, we resort to interval arithmetic. We formulate the stationary problem for the Proudman–Johnson equation as a system of first order ordinary differential equations, and we apply the shooting method and the interval Newton method for proving the existence of a solution. As the shooting method is numerically unstable, we encounter some difficulties especially when the Reynolds number is high. For solving this problem, we apply the multiple shooting method and the multiple-precision floating-point arithmetic.

14:15–16:40

37 Yuuki Ueda (Univ. of Tokyo)
Norikazu Saito (Univ. of Tokyo)
The inf-sup condition and error estimate of the Nitsche's method for the parabolic problems 15

Summary: We study the application of the Nitsche's method to the parabolic problems. Under some assumptions, the parabolic initial-boundary value problem has a unique weak solution. The problem is discretized in space by the Galerkin method and the Dirichlet boundary condition is enforced weakly by the Nitsche's method. It is well known that the bilinear form satisfies the Galerkin orthogonality. In this presentation, we will prove that the bilinear form also satisfies the inf-sup condition. This condition implies that the resulting semi-discretized problem has a unique solution. Moreover, the error estimate follows directly from the inf-sup condition and the Galerkin orthogonality.

38 Daisuke Koyama ♭ (Univ. of Electro-Comm.)
An application of the interior penalty method to a mixed nonconforming finite element method for biharmonic problems 15

Summary: We introduce a numerical method for biharmonic problems which is obtained by applying the interior penalty method to a mixed nonconforming finite element method which is called the Hermann–Johnson (HJ) method. We show that a priori error estimates of our method can be the same as those of the HJ method by appropriately choosing a penalty parameter in our method.

Summary: For the Stokes equation defined in 3D domain with a general shape, the Scott–Vogelius finite elements are used to obtain strictly divergence-free approximation solution. Then, by using the hypercircle equation method, a quantitative a priori error estimation is obtained for the FEM solution. Such an a priori error estimation can be used in solution existence verification of nolinear Navier–Stokes equation defined in 3D domain with general shapes. The convergence rate is confirmed by numerical results.

Summary: The discontinuous Galerkin (DG) time-stepping method applied to abstract evolution equation of parabolic type is studied using a variational approach. We establish the inf-sup condition for the DG bilinear form. Then, the optimal order error estimates under appropriate regularity assumption on the solution are derived as direct applications of the standard interpolation error estimates. Our method of analysis is new. It differs from previous works on the DG time-stepping method by which the method is formulated as the one-step method.

Summary: The discontinuous Galerkin time-stepping method (DG time-stepping method) is a time-discretization method based on the discontinuous Galerkin finite element method. In contrast to one-step methods, the approximated solution is well-defined at each time in the DG time-stepping method. Therefore, it gives an efficient numerical algorithm with space-time methods for moving boundary problems such as fluid structure interaction. However, there are few studies on theoretical analysis for the behavior of approximated solutions at each time. In this talk, we address the DG time-stepping method for parabolic problems in the framework of analytic semigroup theory. We present optimal order error estimates for the homogeneous heat equation. The key point is rigorous estimates for rational functions that express the approximated solutions.

Summary: We previously reported examples of convergence of unstable finite difference schemes applied to quasilinear partial differential equations of the normal form with analytic initial data. This time we report that convergence also holds for initial value problems for the heat equation with initial data in a certain class of analytic functions and also for the sideways heat equation with initial data in a Gevrey class.

Summary: We investigate the numerical stability for semi-linear Klein–Gordon equations in de Sitter spacetime. We show the differences of the numerical stability between some positive nonlinear terms and the negative one. In addition, the numerical stability in the four dimension and more is shown.

44 Ai Ishikawa (Kobe Univ.)
Takaharu Yaguchi (Kobe Univ.)
The extension of the energy-preserving method based on the variational principle to the Lie group 15

Summary: The energy-preserving method based on the variational principle and the discrete gradient method are methods for designing a scheme for the Hamilton equations that preserves the energy conservation law exactly. In the discrete gradient method, the various extensions, e.g. the extension to the equations on a manifold have been proposed. Although the method based on the variational principle has an advantage in the view of the computational cost, this method has not been applied to the equations on the manifold yet. In this talk, we extend the energy-preserving method based on the variational principle to equations on the Lie group and show a numerical test for the heavy top problem.

45 Makoto Okumura (Osaka Univ.)
Nonlinear and linear DVDM scheme for the conservative non-local Allen–Cahn equation 15

Summary: We propose nonlinear and linear finite difference scheme for the conservative non-local Allen–Cahn equation. Both proposed schemes inherit characteristic properties, the conservation of mass and the decrease of the global energy from the equation. We show that the schemes are stable in the sense that the numerical solution is bounded concerning max-norm, and have a unique solution. Since the nonlinear scheme is the system of equations concerning the new time step, it takes time to compute. Numerical examples demonstrate the effectiveness of the proposed scheme and that the computational time of the linear scheme is shorter than one of the nonlinear scheme. In this talk, we mainly introduce the linear scheme.

16:50–17:50 Talk Invited by Applied Mathematics Section

Shuji Yoshikawa (Oita Univ.)
Energy method for structure-preserving finite difference schemes

Summary: We introduce the energy method for structure-preserving finite difference schemes which inherit the physical structures such as energy conservation or dissipative laws. Another aim is to give some useful properties for difference quotient which is compatible with the structure-preserving finite difference schemes. The method and properties enable us not only to take the problem with more general nonlinearity but also to improve proofs of error estimate between the numerical and exact solutions. In this talk, after explaining our procedure by using a simple example, several our recent results are introduced.

March 21st (Wed) Conference Room VI

9:15–11:55

46 Masaji Watanabe (Okayama Univ.)
Fusako Kawai (Kyoto Inst. Tech.)
Inverse analysis for microbial population in biodegradation process of xenobiotic polymer 15

Summary: This study shows that monomer consumption and viability loss are the primary factors for microbial growth in exogenous type depolymerization processes. A mathematical model for the weight distribution and microbial population is described. Inverse problems for a time factor and a molecular factor of degradation rate are illustrated.

47 Yoichi Enatsu (Tokyo Univ. of Sci.)
Emiko Ishiwata (Tokyo Univ. of Sci.)
Takeo Ushijima (Tokyo Univ. of Sci.)
On an SIR model with free boundary 15

Summary: Free boundary problems are recently used to model phenomena of biological invasion for species such as migration into a new habitat (e.g., Du & Lin (2010) and references therein). These ideas are also applied to epidemic models. In this talk, we extend the result in Kaellen (2017) to the simple diffusive epidemic model with free boundary, namely we prove the existence of a semi wave solution. We numerically observe the semi wave and the front motion of this model with free boundary.

Summary: Many researchers have studied the self-driven particles. In one example, there is camphor atop water channel. It is now said that the motion of camphor is caused by differences in surface tension. The gradient of surface tension is induced by a camphor molecular layer development atop the surface. Mathematical models for the camphor motion have been constructed used the above mechanisms, and the models reproduce many characteristic motion. Although Marangoni Convection seems to influence the self-motion of the camphor, there are only a few reports discussing mathematical models that include convection explicitly. We have constructed a mathematical model for the self-motion of camphor including influence of convection, and now are calculating some cases to compare with some experiments.

Summary: We propose a mechanism of stable formation of the granular layer in the epidermis. In our mathematical model of the epidermis, we assume that a stimulant, which promotes the differentiation process of epidermal cells, is released when cells undergo cornification. We demonstrate that our model forms the granular layer and confirm that its layer structure is maintained stably by using some cost functions. We are also working on formation of tight junctions, which exit in the granular layer and play an important role in skin barrier function, and we introduce our trial models for them.

Summary: Recently, it has been attended the relation between the elongation phenomena and rotational migration of cell group since they are observed in three-dimensional morphogenesis such as fruiting body formation of Dictyostelium Discoideum and somite formation of zebra fish. In particular, although it is known that the somite is covered by basement membrane, it is not clear the reason why rotational migration occurs. In order to understand cellular mechanism for rotational migration of cell groups covered by basement membrane, we propose a mathematical model which consists of a self-propelled particle model representing cellular migration and a phase-field model representing basement membrane. Moreover, we will show phase diagram of parameters for migration modes and give a theoretical suggestion for biological experiments.

Summary: In this talk, we deal with the initial value problem of evolutionary differential equations with a mixed derivative on the periodic domain. Here, "mixed derivative" indicates the case where a spatial differential operator is operating on the time derivative, obscuring the vector field describing the flow. Therefore, some reformulation to reveal it is the first step of PDE-theoretical and numerical studies. However, it is nontrivial because the spatial differential operator is not invertible and cannot be easily eliminated. Though this issue was already settled for linear cases, general theory has been undeveloped. In this talk, we propose a novel procedure for wider class of equations. Moreover, as an application, we establish the global well-posedness of the sine-Gordon equation in characteristic coordinates.

Summary: Uniform flow is one of fundamental steady solutions of Euler equation on a plane. A generalization of the flow on curved surfaces is a Killing vector field, which is also a steady solutions of Euler equation on Riemannian manifolds. In this talk, we introduce how surfaces has a no-normal regular Killing vector field and as its application, construction of an analytic formula of Green's function on the surface.

Summary: We propose a one-dimensional hydrodynamic partial differential equation. This model is based on a Constantin–Lax–Majda–De Gregorio model generalized by Okamoto, Sakajo and Wunsch. The equation admits an inviscid invariant quantity. In the presence of the viscosity and a large-scale random forcing, the solution gives rise to a turbulent state with cascade of the inviscid invariant. We will give how those phenomenon is understood from the view point dynamical system.

Summary: Based on the Linear-Quasi-Gaussian compensator, we design a linear feedback system stabilizing point vortex equilibria near an aerodynamic wing with two auxiliary flaps known as a Kasper Wing in the presence of a uniform flow. This is modeled by a two-dimensional incompressible an inviscid flow. The actuation mechanism is blowing and suction localized on the main plate represented as a sink- source singularity, whereas we measure pressure across the plate as system output. We show that the linearised system around these equilibria are both controllable and observable for almost all actuator and sensor locations. Numerical computations illustrate that Kasper Wing configurations are in general not only more controllable than their single plate counterparts, but also acquire larger basins of attraction owing to the feedback control.

Summary: Generalized J-integral is the tool which is effective to study the shape optimization of singular points (containing boundary) with respect to various cost functions, energy, mean compliance, least square errors, in boundary value problems for partial differential equations. I will talk an application of Generalized J-integral method to shape sensitivity of eigenvalue problems.

14:15–16:40

56 Keiichi Ueda (Univ. of Toyama) — Synchronization of two interacting populations of oscillators by autonomous parameter control · · · · · 15

Summary: We study synchronization of two interacting populations of oscillators. We assume that the sign and the strength of the interactions are taken as system variables, and that the variables are determined by a function of the oscillator variables. Under an appropriate choice of the function, we can observe spontaneous intra- and inter-group phase synchronization.

57 Takeshi Watanabe (Univ. of Tokyo), Zhijun Gao (Tohoku Univ.), Yasumasa Nishiura (Tohoku Univ.) — Global bifurcation structure governing interaction between bump heterogeneity and pulse with oscillatory tail · · · · · 15

Summary: Three-component FitzHugh–Nagumo equation is investigated. This equation has a parameter region in which traveling pulse with oscillatory tail appears. When such moving pulse interacts with heterogeneity of the media, the interaction between tail and heterogeneity is important. We consider a bump-type heterogeneity and investigate the asymptotic behavior of the pulse motion when a pulse collides with the bump. When the width of the bump is fixed and the height of that is changed, three different asymptotic behaviors arise sequentially: Oscillatory pinning (OSC), stationary pinning (STA), and rebound (REB). In these asymptotic states, it is conjectured that all asymptotic states are contained in the set of bifurcation branches which is generated from the trivial branch.

58 Kei Nishi (Kyoto Sangyo Univ.), Masaharu Nagayama (Hokkaido Univ.), Satoshi Nakata (Hiroshima Univ.) — Bifurcation analysis of the motion of two self-propelled camphor disks on an annular field · · · · · 15

Summary: The dynamics of two self-propelled camphor disks on an annular field is explored both numerically and analytically. In our previous study, it was already found by the direct numerical simulation of a model equation that the two camphor disks exhibited a variety of behavior, and underwent transition between the behavior as the length of the annular field was varied. In order to analytically elucidate the mechanism for the transition in behavior, we reduced the model equation which consisted of two ODEs and one PDE into three ODEs for the motion of the two camphor disks. In this talk, the bifurcation structure that causes the transition will be revealed, based on the reduced ODEs.

59 Shogo Yamanaka (Kyoto Univ.), Kazuyuki Yagasaki (Kyoto Univ.) — Existence of transverse heteroclinic orbits and nonintegrability in two-degree-of-freedom Hamiltonian systems with saddle-centers · · · · · 15

Summary: We consider a class of two-degree-of-freedom Hamiltonian systems with saddle-centers connected by heteroclinic orbits. We show that if the sufficient conditions for real-meromorphic nonintegrability hold, then the stable and unstable manifolds of the periodic orbits intersect transversely, are quadratically tangent or do not intersect in general, and they do not intersect when the Hessian matrix of the Hamiltonian has a different number of positive eigenvalues at the associated saddle-centers. Our theory is illustrated for a system with quartic single-well potential.

60 Naoto Nakano (Kyoto Univ. / JST PRESTO) — Characteristics of derivative embedded surfaces and predictability of timeseries · · · · · 15

Summary: Here, we consider the derivative embedding of a scalar function. Since the embedded surface can hold some characteristics of the original time-series, one can derive some predictability result from characteristics of the embedded surface.

61 Takiko Sasaki (Meiji Univ.)
Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Numerical and mathematical analysis for the blow-up curve of solutions to 1-dimensional nonlinear wave equations 15

Summary: We study a blow-up curve for the one dimensional wave equation $\partial_t^2 u - \partial_x^2 u = 2^p |\partial_t u|^p$ with the Dirichlet boundary condition. The purpose of this talk is to show that the blow-up curve T satisfies that $T'(x) \to -1$ as $x \to 0 + 0$ (1) under the suitable initial conditions. To prove the result, we convert the equation into a first order system, and then present some numerical investigations of the blow-up curves. From the numerical results, we were able to confirm (1) holds numerically. Moreover, under some assumptions, we were also able to confirm (1) holds mathematically.

62 Koichi Anada (Waseda Univ. Senior High School)
Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Takeo Ushijima (Tokyo Univ. of Sci.)
A study for backward self similar solutions of a quasi-linear parabolic equation 15

Summary: In this talk, we consider properties of backward self similar solutions for a quasi-linear parabolic equation $v_t = v^\delta(v_{xx} + v)$. Their properties are very important to investigate asymptotic behavior of solutions to this parabolic equation, especially, the blow-up sets and rates.

63 Kaname Matsue (Kyushu Univ./Kyushu Univ.)
Blow-up rates of blow-up solutions determined by dynamics at infinity 15

Summary: Geometric treatments of blow-up solutions for autonomous ordinary differential equations and their blow-up rates are concerned. Our approach focuses on the type of invariant sets at infinity via compactifications of phase spaces, and dynamics on their center-stable manifolds. In particular, we show that dynamics on center-stable manifolds of invariant sets at infinity with appropriate time-scale desingularizations as well as blowing-up of singularities characterize dynamics of blow-up solutions as well as their rigorous blow-up rates not only of so-called "type-I" but also other types.

64 Kaname Matsue (Kyushu Univ./Kyushu Univ.)
Oscillatory blow-up solutions with fast blow-up rates and oscillatory grow-up solutions 15

Summary: Geometric treatments of oscillatory blow-up solutions for autonomous ordinary differential equations and their blow-up rates are concerned. As in the preceding talk, we apply compactification of phase spaces and time-scale desingularization to characterization of blow-up solutions. In particular, when divergent solutions are characterized by trajectories on center manifolds of non-hyperbolic periodic orbits on the horizon for desingularized vector fields, they blow up in finite time with infinitely fast oscillation and faster blow-up rate than type-I rates in typical cases, while they can also grow up in infinite time in some cases. We see such behavior in a certain system known as Liénard equation.

16:50–17:50 Talk Invited by Applied Mathematics Section

Akitoshi Takayasu (Univ. of Tsukuba)
Verified computations for solutions of evolution equations with semigroup theory

Summary: In this talk, we provide a methodology of verified computing for solutions to evolution equations (nonlinear heat equations, 1-dimensional advection equations with variable coefficients, and the complex Ginzburg–Landau equations). Our methodology is based on semigroup theory, which is widely used in analytical studies and originated from pioneering works by Hille and Yosida. The main contribution of this study is to combine a "classical analysis" with "computer-assisted methods" to provide a numerical method of enclosing a solution for evolution equations. The combination of quantitative estimates arising from verified numerical computations and qualitative results obtained by classical analysis is expected to open the access to many unsolved problems by purely analytical means.

Topology

March 18th (Sun) Conference Room II

9:40–12:00

1 Eiko Iwayama — The simplex of n-dim. and New Euler–Poincaré Expanded characteristic and the relation of combination numbers ····· 5

Summary: I have constructed the simplex MS_n of n-dim. The alternative sum of numbers of k-dim-sub-simplexes MS_n^k of n-simplex MS_n are New Euler–Poincaré Expanded characteristic "NEPE". I have had NEPE $= 1$ for all dim. n. I have obtained the table like "Pascal's triangle" for M_n^k $(k = 0, 1, \cdots, n)$ and we also have $\mathrm{M}_n^k = {}_{n+1}C_{k+1}$ ($_{n+1}C_{k+1}$: combinatorial numbers).

2 Eiko Iwayama — The triangle of the cuboids of n-dimension and New Euler–Poincaré Expanded characteristic ····· 5

Summary: I have constructed the cuboid M_n of n-dim. The alternative sum of numbers of k-dim. sub-cuboids M_n^k are "New Euler–Poincaré Expanded characteristic NEPE". I have had NEPE $= 1$ for all dim. n. We can connect 4 dim. cuboid with hyper planes. If the complex of cubes has 2-holes, then NEPE $= -1$.

3 Yoshihito Ogasawara (Waseda Univ.) — On an applicability of topology ····· 10

Summary: New possibility of topological application is explored. In this study, topology is not only regarded as a system of morphological concepts, but also tried to be interpreted as the discussion of conceptual morphology. This means that our concepts themselves are tried to be described by the topology which is a system of our concepts, as mathematical system itself is described by mathematics in the field of foundations of mathematics.
Then, new picture of the world is tried to be drawn by such a sense of topology. The world is not regarded as a priori existence, but tried to be described as the emergence from our recognition.

4 Hironobu Naoe (Tohoku Univ.) — Infinitely many corks having large shadow-complexities ····· 15

Summary: Any exotic pair of simply connected closed 4-manifolds are related by a cork twist. Every 4-manifold can be represented by a simple polyhedron with a coloring on each region, called a shadow. Using shadows of 4-manifolds, Costantino defined a complexity of a 4-manifold, which is the minimum number of true vertices of its shadow. We have known many examples of corks having low complexities. In this talk, we will show that there also exist infinitely many corks with large complexity.

5 Akira Miyamura (Tokyo Tech) — A note on signature of Lefschetz fibrations with planar fiber ····· 10

Summary: In this talk, we present a signature formula for allowable Lefschetz fibrations over D^2 with planar fiber by computing Maslov index appearing in Wall's non-additivity formula.

6 Yusuke Inagaki (Osaka Univ.) — On Fuchsian loci of Hitchin components of a pair of pants ····· 15

Summary: Hitchin components are the connected components of character varieties of surface groups containing Teichmüller spaces, and the subsets of Hitchin components which correspond to Teichmüller spaces are called Fuchsian loci. Recently Bonahon–Dreyer constructed a parameterization of $\mathrm{PSL}_n(\mathbb{R})$-Hitchin components by using the Anosov property of elements of $\mathrm{PSL}_n(\mathbb{R})$-Hitchin components and invariants of flags introduced by Fock–Goncharov, which is a parameterization by Euclidian convex polytopes. In this talk, we give an explicit description of Fuchsian loci of a pair of pants by using the Bonahon–Dreyer parameterization.

7 Yuuki Tadokoro (Nat. Inst. of Tech., Kisarazu Coll.) — Pointed harmonic volume and its relation to extended Johnson homomorphism · · · · · 15

Summary: As a natural extension of the period, the pointed harmonic volume for a compact Riemann surface is defined using Chen's iterated integrals. It captures more detailed information of the complex structure. It is also one of a few explicitly computable examples of complex analytic invariants. We obtain its new value for a certain pointed hyperelliptic curve. An application of the pointed harmonic volume is presented. We explain the relationship between the pointed harmonic volume and first extended Johnson homomorphism on the mapping class group of a pointed oriented closed surface.

8 Takahiro Yamamoto (Tokyo Gakugei Univ.) — Cobordism groups of Morse functions on manifolds with boundary · · · 15

Summary: In this talk, we discuss whether cobordism groups of Morse functions on manifolds with boundary are trivial or not.

9 Asahi Tsuchida (Hokkaido Univ.), Kentaro Saji (Kobe Univ.) — Singularities of bundle homomorphism between a distribution and a vector bundle · · · · · 15

Summary: We consider singularities of bundle homomorphisms from a tangent distribution and a vector bundle of the same rank. Generic classification of the singularities for low dimensional cases are studied. We also consider a bundle homomorphism which is induced from a Morin map. In the case a distribution is a contact structure, we give a characterization of singularities of the bundle homomorphisms by using the contact Hamiltonian vector field.

10 Kentaro Saji (Kobe Univ.) — $SO(3)$-normal form of swallowtail and geometric patterns · · · · · 10

Summary: We construct a form of swallowtail singularity in $\boldsymbol{R}^3$ which uses coordinate transformations on the source and isometries on the target. As an application, we classify configurations of asymptotic curves and characteristic curves near swallowtail.

14:15–15:15 Talk Invited by Topology Section

Daisuke Kishimoto (Kyoto Univ.) — Homotopy theory of polyhedral products

Summary: A polyhedral product is a space constructed combinatorially from a given abstract simplicial complex. Its homotopy invariants like cohomology give important combinatorially defined algebras such as Stanley–Reisner rings, and it is also important in toric topology. So there have been considerable efforts to develop the homotopy theory of polyhedral products in view of both combinatorics and topology. But there is no general technique to develop the homotopy theory of polyhedral products until the fat wedge filtration has been introduced. I will present a survey of the recent development of the homotopy theory of polyhedral products based on the fat wedge filtration and its applications. This talk is based on the joint work of Kouyemon Iriye (Osaka Prefecture University).

15:30–18:00

11 Masayuki Yamasaki (Okayama Univ. of Sci.) — On rotation numbers of regular closed curves on aspherical surfaces · · · · · 15

Summary: I define a rotation number of a regular closed curve on a complete euclidean/hyperbolic syrface, which, together with the free homotopy class, determines a regular homotopy class. I also give a Whitney-type formula for this rotation number.

Summary: Stratifolds are considered from a categorical point of view. We show among others that the category of stratifolds fully faithfully embeds into the category of $\mathbb{R}$-algebras as does the category of smooth manifolds. We prove that a variant of the Serre–Swan theorem holds for stratifolds. In particular, the category of vector bundles over a stratifold is shown to be equivalent to the category of vector bundles over an associated affine scheme although the latter is in general larger than the stratifold itself.

Summary: Discovery or recognition of the right kind of *algebraic structure* is often important in the development of mathematical subjects. In situations where various complex kinds of algebraic structure can arise, special technology for systematically finding and treating algebraic structures would be desirable. In particular, such technology would be necessary for broad application of *higher category theory*, since algebraic structures of high categorical dimension are varied and can be complicated. We shall describe how concrete understanding of higher categorical *coherence* leads to a systematic view on some (quite general) kinds of algebraic structure. A consequently found new phenomenon concerning *topological field theories* is interesting in its contrast to the *cobordism hypothesis*.

Summary: We show that the bulk-edge correspondence for two-dimensional type A topological insulators follows directly from the cobordism invariance of the index.

Summary: We consider a translation invariant bounded linear self-adjoint operator (model of a Hamiltonian) on a three-dimensional lattice (bulk) and its restrictions onto two subsemigroups (edges) and their intersection (corner). We first show that, if our bulk and edges Hamiltonians have a common spectral gap, we can define a topological invariant for the gapped bulk and edges. We next show a relation between this invariant and another invariant defined for the corner.

Summary: For closed simply connected manifold M of dimension ≥ 4, we introduce a new spectral sequence converging to the space of knots in M.

Summary: We prove the odd dimensional framed little disks operads is not formal as a non-symmetric operad.

Summary: A complete nonsingular toric variety (called a toric manifold) is over P if its quotient by the compact torus is homeomorphic to P as a manifold with corners. Bott manifolds are toric manifolds over an n-cube I^n and blowing them up at a fixed point produces toric manifolds over $\mathrm{vc}(I^n)$ an n-cube with one vertex cut. They are all projective. On the other hand, Oda's 3-fold, the simplest non-projective toric manifold, is over $\mathrm{vc}(I^3)$. In this paper, we classify toric manifolds over $\mathrm{vc}(I^n)$ $(n \geq 3)$ as varieties and as smooth manifolds. It consequently turns out that there are many non-projective toric manifolds over $\mathrm{vc}(I^n)$ but they are all diffeomorphic, and toric manifolds over $\mathrm{vc}(I^n)$ in some class are determined by their cohomology rings as varieties.

19 Hiraku Abe (Osaka City Univ.)
Tatsuya Horiguchi (Osaka Univ./Osaka City Univ.)
Mikiya Masuda (Osaka City Univ.)
On the cohomology rings of regular semisimple Hessenberg varieties 10

Summary: We investigate the cohomology rings of regular semisimple Hessenberg varieties whose Hessenberg functions are of the form $h = (h(1), n \cdots, n)$ in Lie type A_{n-1}. The main result gives an explicit presentation of the cohomology rings in terms of generators and their relations. Our presentation naturally specializes to Borel's presentation of the cohomology ring of the flag variety, and it is compatible with the representation of the symmetric group on the cohomology constructed by J. Tymoczko.

March 19th (Mon) Conference Room II

9:30–10:30

20 Atsuhide Mori (Osaka Dental Univ.)
Symplectic/contact geometry of t-distributions 15

Summary: In the previous work, the speaker studied the positive and negative symplectic structures on the space of the pairs of normal distributions and found a Lagrangian submanifold with nice properties. In this talk, we extend this result to the space of the pairs of t-distributions and propose an application concerning the smoothness of the movement of a parameter.

21 Takuya Katayama (Hiroshima Univ.)
Embeddability of the right-angled Artin groups on the complement graphs of linear forests 15

Summary: In 2011, Sang-hyun Kim and Thomas Koberda proved that, for any finite graphs Λ and Γ, a full embedding of Λ into the extension graph Γ^e of Γ gives rise to an embedding between the corresponding right-angled Artin groups, $A(\Lambda) \hookrightarrow A(\Gamma)$. Then the following natural question arises: for which graphs Λ and Γ, can we reduce an embedding $A(\Lambda) \hookrightarrow A(\Gamma)$ into a full embedding $\Lambda \to \Gamma^e$? Recently, several authors proved that the reduction is impossible for some Λ and Γ. In this talk, we give a positive answer when Λ is the complement graph of a linear forest. In addition, we can further reduce an embedding $A(\Lambda) \hookrightarrow A(\Gamma)$ into a full embedding between the defining graphs, $\Lambda \to \Gamma$, if Λ is the complement graph of a linear forest.

22 Motoko Kato (Univ. of Tokyo)
On the isomorphism problem of signed Thompson groups 10

Summary: Higman–Thompson groups are groups of homeomorphisms of the Cantor space which are locally orientation preserving. They are examples of finitely presented virtually simple groups. Generalizing these groups, Funar and Neretin defined signed Higman–Thompson groups. Signed Higman–Thompson groups are groups of homeomorphisms of the Cantor space which are locally orientation preserving or orientation reversing. In this talk, we give a necessary and sufficient condition for a signed Higman–Thompson group to be isomorphic to one of Higman–Thompson groups. This is based on a joint work with Javier Aramayona and Julio Aroca (Autonomous University of Madrid).

23 Narutaka Ozawa (Kyoto Univ.)
Kazhdan's property (T) and semidefinite programming 15

Summary: It has been known that Kazhdan's property (T) is semi-decidable and an algorithm to detect property (T) has been proposed. In this talk, I will describe an improved algorithm that exploits the symmetry on the given test group G. The improved algorithm makes computer verification of property (T) for certain groups possible otherwise impossible. I will report the result of a large-scale calculation. This talk is based on a joint work with M. Kaluba and P. Nowak.

10:45–11:45 Talk Invited by Topology Section

Masayuki Asaoka (Kyoto Univ.) Growth rate of the number of periodic points for smooth dynamical systems

Summary: The exponential rate of the growth rate of the number of periodic points is an important invariant of a dynamical sytems. For example, it determines the convergence radius of the dynamical zeta function of the system and, for hyperbolic dynamics, it determines the topological entropy. It is natural to ask whether 'most' of smooth dynamical systems exhibit at most exponential growth of the number of periodic points or not. Some classical results showed that systems in a dense subset of the set of smooth maps in general dimensions and all real-analytic one-dimensional systems exhibit such tame growth. However, in 2000, Kaloshin proved that super-exponential growth is 'abundant' in smooth dynamics, and recently, the author found 'abundant' examples in real-analytic dynamics. In the first part of the talk, we survey classical results on at most exponential growth for tame cases, including hyperbolic systems. In the second part, we discuss contemporary results for wild cases.

13:00–14:20

24 Noriaki Kawaguchi (Univ. of Tokyo)$^\flat$ On the shadowing and limit shadowing properties ··· 15

Summary: In this talk, we consider the relation between the shadowing property and the limit shadowing property of topological dynamical systems. We show that for any continuous self-map f of a compact metric space, if f has the limit shadowing property, then the restriction of f to the non-wandering set satisfies the shadowing property. As an application, we prove the equivalence of the two shadowing properties for equicontinuous maps.

25 Shinobu Hashimoto (Tokyo Metro. Univ.) Moduli of two-dimensional diffeomorphisms with cubic tangencies ··· 15

Summary: We study conjugacy invariants for 2-dimensional diffeomorphisms with homoclinic cubic tangencies (two-sided tangencies of the lowest order) under certain open conditions. Ordinary arguments used in past studies of conjugacy invariants associated with one-sided tangencies do not work in the two-sided case. In this talk, we will present a new method which is applicable to the two-sided case.

26 Koichi Hiraide (Ehime Univ.)$^\flat$, Chihiro Matsuoka (Osaka City Univ.) Relationship between topological entropy and Lyapunov exponents ··· 15

Summary: In this talk we discuss the relationship between topological entropy and Lyapunov exponents, provided that the Pesin entropy formula holds, and mention some results by experimental mathematics.

27 Kaori Yamazaki (Takasaki City Univ. of Econ.) Questions on monotone operators for vector-valued maps ··· 15

Summary: Answering a question of Yang, we show that, for an ordered topological vector space Y with positive interior points, if each non-zero positive element is an order unit, then Y is isomorphic to the real line. We also provide a technique which reduces some vector-valued results to the original real-valued ones by using some Minkowski functionals.

28 Yukinobu Yajima (Kanagawa Univ.), Yasushi Hirata (Kanagawa Univ.) Three embeddings and their implications in products of generalized metric spaces ··· 15

Summary: We discuss when C^*-embedding or C-embedding implies P-embedding in products of generalized metric spaces, such as M-spaces, Σ-spaces and semi-stratifiable spaces.

March 20th (Tue) Conference Room II

9:20–12:00

29 In Dae Jong (Kindai Univ.)
Kazuhiro Ichihara (Nihon Univ.)
Kouki Taniyama (Waseda Univ.)
Achiral 1-cusped hyperbolic 3-manifolds not coming from amphicheiral null-homologous knot complements ····· 15

Summary: It is experimentally known that achiral hyperbolic 3-manifolds are quite sporadic at least among those with small volume, while we can find plenty of them as amphicheiral knot complements in the 3-sphere. In this talk, we show that there exist infinitely many achiral 1-cusped hyperbolic 3-manifolds not homeomorphic to any amphicheiral null-homologous knot complement in any closed achiral 3-manifold.

30 Kazuhiro Ichihara (Nihon Univ.)
Tetsuya Itoh (Osaka Univ.)
Toshio Saito (Joetsu Univ. of Edu.)
Chirally cosmetic surgeries and Casson invariants ····· 15

Summary: I will report on our recent study of chirally cosmetic surgery, that is, a pair of Dehn surgeries on a knot producing homeomorphic 3-manifolds with opposite orientations. Several constraints on knots and surgery slopes to admit such surgeries are given. Our main ingredients are the original and the $SL(2,C)$ version of Casson invariants. As an application, we give a complete classification of chirally cosmetic surgeries on two bridge knots of genus one.

31 Naoki Sakata (Hiroshima Univ.)
Veering structures of the canonical decompositions of hyperbolic fibered two-bridge link complements ····· 10

Summary: Epstein–Penner has proved that each finite-volume cusped complete hyperbolic manifold admits a canonical decomposition into ideal polyhedra. I proved that the canonical decompositions of hyperbolic fibered two-bridge link complements are layered with respect to the fiber structures. On the other hand, Agol has shown that every pseudo-Anosov mapping torus of a surface, punctured along the singular points of the stable and unstable foliations, admits a canonical "veering" layered triangulation. In this talk, we completely determine, for each hyperbolic fibered two-bridge link, whether the canonical decomposition of its complement is veering with respect to the fiber structure.

32 Ken'ichi Yoshida (Kyoto Univ.)
Hyperbolicity on tangle gluings ····· 15

Summary: Let us glue a 3-manifold and the complement of a trivial tangle along bounding 4-punctured spheres. We propose that this construction can be regarded as an analogue of a Dehn filling. We will show an analogous result for Thurston's hyperbolic Dehn surgery theorem.

33 Ryan Blair (California State Univ.)
Makoto Ozawa (Komazawa Univ.)
Height, trunk and representativity of knots ····· 15

Summary: In this talk, we investigate three geometrical invariants of knots, the height, the trunk and the representativity. First, we give a counterexample for the conjecture which states that the height is additive under connected sum of knots. Next, we show that the representativity is bounded above by a half of the trunk. We also define the trunk of a tangle and show that if a knot has an essential tangle decomposition, then the representativity is bounded above by half of the trunk of either of the two tangles. Finally, we remark on the difference among Gabai's thin position, ordered thin position and minimal critical position. We also give an example of a knot which bounds an essential non-orientable spanning surface, but has arbitrarily large representativity.

Summary: We define and compare several natural ways to compute the bridge number of a knot diagram. We study bridge numbers of crossing number minimizing diagrams, as well as the behavior of diagrammatic bridge numbers under the connected sum operation. For each notion of diagrammatic bridge number considered, we find crossing number minimizing knot diagrams which fail to minimize bridge number. Furthermore, we construct a family of minimal crossing diagrams for which the difference between diagrammatic bridge number and the actual bridge number of the knot grows to infinity.

Summary: Murakami introduced the Gordian distance as the least crossing-changes to transform one knot into another. Based on a matrix operation analogous to the crossing-change, he also introduced the algebraic Gordian distance between Seifert matrices. We consider the restrictions when the algebraic Gordian distance is one and improve a result of Kawauchi that if two matrices have algebraic Gordian distance one, then their Alexander polynomials have a certain relation. We give new answers to a question of Jong, showing that some Alexander polynomials cannot be realized by distance one matrices if a corresponding quadratic equation does not have an integer solution.

Summary: Let $M = \Sigma(a_1, a_2, a_3)$ be a Brieskorn homology 3-sphere. Here $2 \leq a_1 < a_2 < a_3$ are pairwise coprime integers. Further we suppose that $a_1 = 2$, or a_1, a_2, a_3 are odd integers. We write $\tau_\rho(M)$ to Reidemeister torsion of M for an irreducible representation $\rho : \pi_1(M) \to SL(2;\mathbb{C})$. Now we consider the set $RT(M) = \{\tau_\rho(M)\} \subset \mathbb{R}$ of all values, which is a finite set of real numbers.
In this talk, we would like to discuss the problem that how strong $RT(M)$ is as an invariant for Brieskorn homology 3-spheres and show $RT(M)$ determines M.

Summary: Recently, J. Greene and J. Howie gave intrinsic characterizations of alternating links in terns of a pair of definite spanning surfaces. These answer the Fox problem which asked what non-diagrammatic properties characterize alternating links. In this talk, we give a characterization of alternating link exteriors in terms of cubed complexes.

Summary: We call the link obtained from a ball of sepaktakraw by replacing each annulus piece with a circle the sepatakraw link. The sepaktakraw link is an alternating link with rich symmetry. In this talk, we introduce sevearl properties of the sepaktakraw link.

14:20–15:20 Talk Invited by Topology Section

Takefumi Nosaka (Tokyo Tech) Nilpotent studies in 3-dimensional topology

Summary: The purpose of this talk is to explain nilpotent studies in low-dimensional topology, and to introduce my resent results on this topic. In particular, we focus on the topic of Milnor–Orr invariants, higher Massey products, and tree part of the Kontsevich invariant of links. The main result is that I gave diagrammatic computation of these invariants (of appropriate degree), and computed some examples. In the nilpotent work, the nilpotent quotient of the free group plays key role. So, in this talk, I start by reviewing properties and homology of the quotient group. After that, I briefly explain the above invariants with properties, and introduce the diagrammatic computations. Here we consider a comparison with known results concerning the mapping class group. Finally, I roughly show a future plan.

15:35–17:45

39 Noboru Ito (Univ. of Tokyo) On equivalence classes of spherical curves by deformations of types RI and RIII 15
Megumi Hashizume (Meiji Univ.)

Summary: Let P, P' be spherical curves. Suppose that P, P' are reduced spherical curves. Then the following conditions are piarwise equivalent.
(A) P' is obtained from P by applying a sequence of deformations of RI, RIII and ambient isotopy.
(B) P' is obtained from P by applying a sequence deformations of RIII, α, β and ambient isotopy.

40 Noboru Ito (Univ. of Tokyo) Finite type invariants and n-similarity of virtual knots by forbidden moves 10
Migiwa Sakurai (Ibaraki Nat. Coll. of Tech.)

Summary: Vassiliev introduced filtered invariants of knots using crossing changes (1990), called finite type invariants. For the finite type invariants, Ohyama introduced a notion of n-triviality (1990) and Taniyama generalized it to obtain a notion of n-similarity (1992). Goussarov, Polyak, and Viro introduced universal finite type invariants of virtual knots using virtualization (2000). We mimicked their ideas, and defined finite type invariants of virtual knots and introduced a notion that corresponds to n-similarity, using forbidden moves (J. Math. Soc. Japan). In this talk, we give infinitely many examples of n-similar pairs of virtual knots by forbidden moves and show that every invariant of Goussarov, Polyak, and Viro is an invariant of us.

41 Yuka Kotorii (RIKEN) C_n-move on long virtual knot and Goussarov–Polyak–Viro's finite type invariant 10

Summary: A C_n-move is a family of local moves on knots and links, which gives a topological characterization of finite type invariants of knots. We extend the C_n-move to (long) virtual knots by using the lower central series of the pure virtual braid, and call it a virtual C_n-move. We then prove that for long virtual knots a virtual C_n-equivalence generated by virtual C_n-moves is equal to n-equivalence, which is an equivalence relation on (long) virtual knots defined by Goussarov–Polyak–Viro. Moreover we directly prove that two long virtual knots are not distinguished by any finite type invariants of degree $n-1$ if they are virtual C_n-equivalent, for any positive integer n.

42 Atsuhiko Mizusawa On HL-homotopy classes for 3-component handlebody-links 15

Summary: Two handlebody-links are HL-homotopic if they are transformed from one to the other by a sequence of self-crossing changes of their handles. For 3-component handlebody-links, we construct a bijection between the set of the HL-homotopy classes and the set of the equivalence classes of the set of tuples of one 3-dimensional matrix and three matrices with respect to some relations.

Summary: The Dijkgraaf–Witten invariant is a topological invariant for compact oriented 3-manifolds in terms of a finite group and its 3-cocycle. The invariant is a state sum invariant constructed by using a triangulation, likewise the Turaev–Viro invariant. In this talk, we discuss an extention of the Dijkgraaf–Witten invariants to cusped 3-manifolds. We show that the Dijkgraaf–Witten invariants distinguish some pairs of orientable cusped hyperbolic 3-manifolds with the same hyperbolic volumes and Turaev–Viro invariants. We also give an example of a pair of cusped hyperbolic 3-manifolds with the same hyperbolic volumes and homology groups, meanwhile with the distinct Dijkgraaf–Witten invariants.

Summary: The colored Jones polynomial is a q-polynomial invariant of links colored by irreducible representations of a simple Lie algebra. A q-series called the tail of a knot K is obtained as the limit of the $\mathfrak{sl}_2$ colored Jones polynomials $\{J_n(K;q)\}_n$ $(n \to \infty)$. We give two explicit formulae of the tail of the $\mathfrak{sl}_3$ colored Jones polynomials colored by $(n, 0)$ for the $(2, 2m)$-torus link. These two expressions of the tail derive Andrews–Gordon identities for the $\mathfrak{sl}_3$ false theta function.

Summary: Kuperberg introduced web spaces for some Lie algebras which are generalizations of the Kauffman bracket skein module on a disk. We derive some formulas for A_1 and A_2 clasped web spaces by graphical calculus using skein theory. These formulae are colored version of the skein relation, a twist formula, and a bubble skein expansion formula. We calculate the $\mathfrak{sl}_2$ and $\mathfrak{sl}_3$ colored Jones polynomials of 2-bridge knots and links explicitly using the twist formula.

Summary: We define a functor $\mathcal{Q}$ from the category of multiple conjugation biquandles to that of multiple conjugation quandles. We show that for any multiple conjugation biquandle X, there is a one-to-one correspondence between the set of X-colorings and that of $\mathcal{Q}(X)$-colorings diagrammatically for any handlebody-link and spatial trivalent graph.

Summary: The minimal coloring number of a $\mathbb{Z}$-colorable link is the minimal number of colors for non-trivial $\mathbb{Z}$-colorings on diagrams of the link. We determine the minimal coloring number for any $\mathbb{Z}$-colorable links.

Summary: We calculate the twisted Alexander polynomials of $(-2, 3, 2n+1)$-pretzel knots associated to their holonomy representations.

Infinite Analysis

March 20th (Tue) Conference Room V

10:00–11:30

1 Kentaro Kojima (Chuo Univ.)
Tsukasa Sato (Chuo Univ.)
Kouichi Takemura (Chuo Univ.)
Polynomial solutions of q-Heun equation 15

Summary: We study polynomial solutions of q-Heun equation. In particular we investigate the condition for the accessory parameter E of q-Heun equation which admits a non-zero polynomial solution.

2 Zhijie Chen (Yau Math. Sci. Center)
Ting-Jung Kuo (Nat. Taiwan Normal Univ.)
Chang-Shou Lin (Nat. Taiwan Univ.)
Kouichi Takemura (Chuo Univ.)
Real-root property of the spectral polynomial of the Treibich–Verdier potential and related problems 15

Summary: We study the spectral polynomial of the Treibich–Verdier potential. Such spectral polynomial, which is a generalization of the classical Lame polynomial, plays fundamental roles in both the finite-gap theory and the ODE theory of Heun's equation. In this talk, we prove that all the roots of such spectral polynomial are real and distinct under some assumptions. The proof uses the classical concept of Sturm sequence and isomonodromic theories. We also prove an analogous result for a polynomial associated with a generalized Lame equation. Differently, our new approach is based on the viewpoint of the monodromy data.

3 Ayumu Hoshino (Hiroshima Inst. of Tech.)
Jun'ichi Shiraishi (Univ. of Tokyo)
Explicit formulas for one-column Macdonald polynomials of types C_n and D_n 15

Summary: We present explicit formulas for the Macdonald polynomials of types C_n and D_n in the one-column case.

4 Masahiko Ito (Univ. of Ryukyus)
Aiko Miyanaga (Kobe Univ.)
Masatoshi Noumi (Kobe Univ.)
Determinant formulas for the q-hypergeometric integrals associated with the root system of type G_2 15

Summary: We present some determinant formulas for the q-hypergeometric integrals associated with the root system of type G_2, which generalize Macdonald's constant term formula. We introduce a method of deriving the q-difference equation satisfied by the determinant and finding its special value.

5 Kôki Itô (Toyohashi Univ. of Tech.)
Homology of q-cycles 15

Summary: We introduce homology to be dual of the q-de Rham cohomology. Conventional q-cycles correspond to q-analogues of (noncompact) locally finite chains. We need regularize Jackson integrals over such q-cycles. Essentially, a regularization of such a q-cycle has been introduced. Nevertheless, such a regularization has not been understood as a compact chain. Thus, we introduce q-cycles including compact ones in the case of dimension 1.

6 Kanam Park (Kobe Univ.)
An extension of q-hypergeometric series and a monodromy preserving deformation 15

Summary: Tsuda obtained a monodromy preserving deformation which has a special solution represented by a generalization of Gauss hypergeometric function. Our purpose is to obtain its q-analog. We define a series $\mathcal{F}_{M,N}$ as an extension of a q-hypergeometric series. In this talk, we give such a monodromy preserving deformation when $N = 1$.

14:00–15:30

7 Yousuke Ohyama (Tokushima Univ.) A connection problem for basic hypergeometric series ${}_r\phi_{r-1}(\mathbf{0};\boldsymbol{b};q,x)$ ····· 15

Summary: We show a connection formula of a linear q-differential equation satisfied by ${}_r\phi_{r-1}(\mathbf{0};\boldsymbol{b};q,x)$. We use a q-Laplace transformation to obtain an integral representation of solutions of the q-differential equation.

8 Yousuke Ohyama (Tokushima Univ.) q-Stokes coefficients of a difference equation satisfied by basic Hypergeometric Series ${}_3\phi_2(a_1,a_2,a_3;b_1,0;q,x)$ ····· 15

Summary: We study a resummation of a divergent solution of a q-difference equation satisfied by ${}_3\phi_2(a_1,a_2,a_3;b_1,0;q,x)$. For the divergent series which is not hypergeometric type, we determine the q-Stokes coefficients.

9 Hokuto Kanbara
Yuto Takeda
Kimio Ueno (Waseda Univ.) Expansion of solutions for KZ-theoretical monodromy preserving deformation in terms of multiple polylogarithms ····· 15

Summary: We introduce a system of nonlinear differential equations which is the integrable condition of deformation of the KZ equation of two variables (z,w). We denote this system by 1DE which is equations in the variable w. We consider solutions holomorphic at the origin $w=0$ of 1DE. In this talk, we will show that these solutions are expanded in terms of multiple polylogarithms.

10 Kimio Ueno (Waseda Univ.) KZ-theoretical approach to monodromy preserving deformation and its relation to Schlesinger equations ····· 10

Summary: We consider the relation between 1DE and the Schlesinger equation of one variable, 1SE. Particularly, we show that from constant solutions to 1DE, one can construct solutions to 1SE. Moreover an example related to Appell $F_1(\alpha,\beta,\beta',\gamma;\, z,zw)$ are discussed.

11 Masato Okado (Osaka City Univ.)
Anne Schilling (UC Davis)
Travis Scrimshaw (Univ. of Queensland) Bijection between paths and rigged configurations of nonexceptional affine types ····· 15

Summary: We establish a bijection between rigged configurations and highest weight elements of a tensor product of Kirillov–Reshetikhin crystals for all nonexceptional types. A key idea for the proof is to embed both objects into bigger sets for simply-laced types $A_n^{(1)}$ or $D_n^{(1)}$, whose bijections have already been established. As a consequence we settle the $X=M$ conjecture in full generality for nonexceptional types.

12 Kanehisa Takasaki (Kindai Univ.) Topological vertex and integrable hierarchies of Volterra type ····· 15

Summary: A generating function of the two-partition topological vertex $W_{\lambda\mu}(r)$ with positive integral parameter r is known to become a tau function of the 2D Toda hierarchy. We reconsider this special solution of the 2D Toda hierarchy in the Lax formalism, and show that this solution is related to an integrable hierarchy of the Volterra type. The case where $r=1$ amounts to the ordinary Volterra hierarchy. This observation seems to show an interpretation of recent work of Dubrovin, Liu, Yang and Zhang on integrable structures of cubic Hodge integrals.

15:45–16:45 Talk Invited by Infinite Analysis Special Session

Taro Kimura (Keio Univ.) Quiver gauge theory and quiver W-algebra

Summary: Quiver W-algebra is a gauge theory construction of (q-deformed) W-algebra associated with a quiver. In this formalism, the generating current of the W-algebra is obtained through double quantization of Seiberg–Witten geometry, describing the moduli space of supersymmetric vacua, and the gauge theory partition function, known as the Nekrasov function, is explicitly given by a correlator of the screening charge. The formalism of quiver W-algebra naturally reproduces the construction of $\mathrm{W}_{q,t}(g)$ by Frenkel–Reshetikhin, and also gives rise to several generalized situations for W-algebra and gauge theory: (1) affine quiver W-algebra (2) elliptic deformation of W-algebra (3) non-simply-laced (fractional) quiver variety.

March 21st (Wed) Conference Room V

9:30–10:30

13 Kohei Motegi (Tokyo Univ. of Marine Sci. and Tech.) ♭ Elliptic Felderhof model and elliptic Schur functions ····· 15

Summary: We apply the recently developed Izergin–Korepin analysis on the wavefunctions of integrable lattice models to the elliptic Felderhof model. We prove that the wavefunctions are expressed as the product of a deformed elliptic Vandermonde determinant and elliptic Schur functions. As an application of the correspondence between the wavefunctions and the elliptic Schur functions, we derive dual Cauchy formula for the elliptic Schur functions.

14 Hiroyuki Yamane (Univ. of Toyama), Iván Angiono (Nat. Univ. of Córdoba) Bruhat order of Weyl groupoids ····· 15

Summary: We introduce Bruhat order of Weyl groupoids. We use nil-Hecke algebras of Weyl groupoids.

15 Yoshitake Hashimoto (Tokyo City Univ.), Takuya Matsumoto (Nagoya Univ.), Akihiro Tsuchiya (Kavli IPMU) Screening operators and $\mathfrak{sl}_2$ action on the lattice vertex operator algebras of type A_1 ····· 15

Summary: In this talk, we shall consider the marginal deformations of the Belavin–Polyakov–Zamolodchikov (BPZ) minimal models, which are the fundamental models of the two-dimensional conformal field theory. These deformations preserve the Virasoro symmetries and parametrized by the formal deformation parameter ϵ. In particular, by formulating the deformed theories over the pair $(\mathcal{K}, \mathcal{O})$ of the ring of formal power series $\mathcal{O} = \mathbb{C}[[\epsilon]]$ and the quotient field $\mathcal{K} = \mathbb{C}((\epsilon))$, we discuss the characteristic features of the BPZ minimal models and their extensions.

16 Ryo Sato (Univ. of Tokyo) Modular transformation properties and the Verlinde formula ····· 15

Summary: The classification of simple modules over the $\mathcal{N} = 2$ vertex operator superalgebra (VOSA) of central charge $3(1 - \frac{2p'}{p})$ is obtained by D. Adamović via the Kazama–Suzuki coset construction. When $p' = 1$, the simple modules coincide with the $\mathcal{N} = 2$ unitary minimal series. On the other hand, when $p' > 1$, there are uncountably many simple modules and they are non-unitary. In this talk we give the modular transformation law of the characters of the simple non-unitary modules. As an application, we propose a conjectural Verlinde formula for the non-unitary $\mathcal{N} = 2$ VOSA. Note that this result is an analogue to the conjectural Verlinde formula for the admissible affine $\mathfrak{sl}(2)$ VOA proposed by T. Creutzig and D. Ridout.

10:45–11:45 Talk Invited by Infinite Analysis Special Session

Hiroshi Naruse (Univ. of Yamanashi) Generalization of Hall–Littlewood function from the view point of Schubert calculus, generationg function and application

Summary: We generalize Hall–Littlewood function in the framework of generalized cohomology theory. We get a generating function expression for the generalized Hall–Littlewood functions. For the case of connective K-theory we recover determinantal or Pfaffian formula for K-theoretic Schur or Schur Q-function.