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The Mathematical Society of Japan

2025 Annual Meeting

Titles and Short Summaries of the Talks

March, 2025

at Waseda University

2025 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 18th (Tue)–21st (Fri), 2025

Venue: Waseda Campus, Waseda University
1–6–1 Nishi-Waseda, Shinjuku-ku, 169-8050, Tokyo, Japan

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The Mathematical Society of Japan

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	MSJ Prizes Presentation (Big Auditorium, Okuma Auditorium) ····· (14:30–15:00) Plenary Talks (Big Auditorium, Okuma Auditorium) Spring Prize Winner ····· (15:15–16:15) Toru Ohmoto (Waseda Univ.) ····· (16:30–17:30) Official Party (Morinokaze, Okuma Memorial Tower) ····· (18:00–20:00)								
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Plenary Talks

March 19th (Wed) Big Auditorium, Okuma Auditorium

Award Lecture for the 2025 MSJ Spring Prize

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

Toru Ohmoto (Waseda Univ.) Thom polynomials —Singularity theory and enumerative geometry ..... (16:30–17:30)

Summary: *Thom polynomials* are a key component of a general enumerative theory for singularities of real and complex mappings — these are universal cohomological obstructions to the appearance of singular points of prescribed types in given mappings. The theory was originated by René Thom in the 1950s and has since been evolved in various aspects by many authors. I have been working on the theory over 30 years, indeed. In my viewpoint, it is about intersection theory on certain moduli spaces, "classifying stacks of local and semi-local singularities of maps", which provides consistent and deep insights into both classical and modern enumerative geometry with many potential applications. In particular, it would contribute to a satisfactory answer to (an advanced form of) Hilbert's 15th problem and connect such classics to recent new interests in enumerations inspired by mathematical physics and other fields. This talk is a gentle introduction to that theory.

Featured Invited Talks

March 18th (Tue)

Conference Room I

Tsukane Ogawa (Yokkaichi Univ.) The actual image of Seki Takakazu —His life, mathematics, and mathematical thought ····· (13:00–14:00)

Summary: Seki Takakazu (1645?–1708) founded traditional mathematics in Japan. Of course, other mathematicians wrote works before him. For example, Yoshida Mitsuyoshi wrote a mathematical book called the *Jinko-ki*, which raised the nations' interest in mathematics and the standard of everyday technology. Seki must have also studied these mathematical books. However, Seki encouraged the development of Japanese traditional mathematics, which is worthy of criticism even in today's mathematics. He was a unique figure in the 260-year history of mathematics in the Edo period. No other mathematician indeed inherited his achievements and mathematical thought. Even today, although many people know Seki's name, his mathematics and mathematical thought still need to be fully recognized.

I edited Seki Takakazu's work with three colleagues, published by Iwanami Shoten in 2023. This time, I would like to discuss Seki's life, mathematics, and mathematical thought, including the knowledge I gained during editing. I would particularly like to show the characteristics of his mathematical thought with specific examples and explain how he was ahead of his time. At the end of the lecture, I will introduce an overview of the edited collection.

1. Although only limited material is available regarding his life, we will briefly introduce his duties in the Kofu domain to the limited extent available.

2. Seki devised a method of writing formulae to solve the problems posed at the time and reduced them to higher-order simultaneous equations. The representation method he used extensively contributed to the development of traditional mathematics in Japan and was followed for a long time afterward. However, he was most interested in the elimination theory of higher-order simultaneous equations. Today's well-known resultant and expanded forms of determinants result from this process. He also solved problems such as approximate fractions of π, an arc length of a circle, and interpolation.

3. His essential attitude toward mathematics was to seek general principles behind problems. No one who truly understood and inherited this idea throughout the Edo period appeared. In that sense, he was far ahead of his time. On the other hand, his mathematics was strongly influenced by the tradition of Chinese mathematics. His goal is to present algorithms that are often based on inductive reasoning. Furthermore, society then did not need mathematics other than elementary mathematics. In this context, he extensively considered problems of interest in mathematics at the time, such as magic squares. In this sense, Seki was also a social being.

Conference Room II

Norio Iwase (Kyushu Univ.*) A_∞-structure and its applications to homotopy invariants, and to Differential Homotopy Theory ····· (13:00–14:00)

Summary: We start with some remarks and definitions related to higher homotopy associativity known as A_∞ structure introduced by Jim Stasheff. Then we observe how it relates to homotopy theoretical invariants such as Lusternik–Schnirelmann category (L-S cat), fibrewise L-S cat and Topological Complexity (TC). We see that TC can be determined by a hard calculation using a computer program, on a kind of algebraic resolution of a fibrewise space, which is derived from A_∞ view point. If we have enough strength, we shall discuss also about smooth A_∞ structures in terms of Differential Homotopy Theory based on Diffeology introduced by J.-M. Souriau, and/or Differentiable structure introduced by K.-T. Chen.

March 20th (Thu)

Conference Room V

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Ichiro Kataoka (Hitachi, Ltd.) Digitalized design support technology utilizing CAE and machine learning ····· (13:00–14:00)

Summary: In manufacturing, designers utilize Computer Aided Engineering (CAE) to conduct engineering tasks using computers during the preliminary examination of product and process design. It is necessary to verify the performance impact during design changes using CAE; however, reducing the labor involved in the iterative process of verification and modification remains a challenge. To address this, we have developed a technology that prepares a machine learning model trained on CAE results in advance, allowing for rapid evaluation of performance during design changes, thereby reducing labor. By presenting performance predictions and their rationale through machine learning to users, we anticipate a reduction in the labor required for evaluation.

Conference Room VI

Yoshinori Mishiba (Tohoku Univ.) Multiple zeta values over function fields ····· (13:00–14:00)

Summary: Let k be the rational function field in one variable over a finite field with q elements. Let ∞ denote a fixed infinite place of k of degree one, and let v be a finite place of k. In 2004, Thakur defined the ∞-adic multiple zeta values (MZVs) as function field analogues of real-valued MZVs. Like their classical counterparts, the ∞-adic MZVs exhibit many interesting properties. Subsequently, Chang and the speaker of this talk defined the v-adic MZVs, which serve as analogues of Furusho's p-adic MZVs.

In this talk, we introduce these objects and demonstrate the existence of a natural k-linear map from the k-vector space spanned by all ∞-adic MZVs to the k-vector space spanned by all v-adic MZVs. Furthermore, both spaces are closed under products, and this map is, in fact, a k-algebra homomorphism. This implies that the v-adic MZVs satisfy the same k-algebraic relations that their corresponding ∞-adic MZVs satisfy. The analogous statement between real-valued MZVs and p-adic MZVs was conjectured by Furusho but remains an open question.

The proof of this theorem relies on logarithmic interpretations for both ∞-adic MZVs and v-adic MZVs. By applying Yu's analytic sub-t-module theorem and carefully estimating division points of certain t-modules in both ∞-adic and v-adic settings, we establish the theorem. This is joint work with Chieh-Yu Chang and Yen-Tsung Chen.

Conference Room IX

Takuya Tsuchiya (Osaka Univ.) Mathematical theory of the finite element methods ····· (13:00–14:00)

Summary: The finite element methods (FEM) is one of the most powerful tools for numerical simulations of a many physical phenomena. An advantage of FEM is that it is compatible with the modern theory of differential equations based on functional analysis, and therefore it has a solid mathematical foundation. The aim of this lecture is to give an introduction of FEM to (pure and applied) mathematicians. To this end, I will explain (i) basic idea of FEM, (ii) brief explanation of the mathematical theory of FEM, (iii) some examples of FEM applied to mathematical problems, (iv) some open problems in the mathematical theory of FEM.

March 21st (Fri)

Conference Room I

Yousuke Ohyama (Tokushima Univ.) Algebraic analysis on the Painlevé equations ····· (13:00–14:00)

Summary: The Painlevé equations were obtained by classification of second-order ordinary differential equations without movable branch points, which cannot be solved by known functions. Some special solutions of the Painlevé equations, such as algebraic solutions and hypergeometric solutions, are known. But it is also known that general solutions cannot be expressed by combinations of solutions of linear differential equations and Abelian functions.
In this talk, we say "algebraic analysis of Painlevé equations" as searching guiding principles and procedures how to solve solving "non-solvable" equations. To solve non-solvable equations, it is necessary to reconsider the meaning of "solving equations". The Painlevé equations have two important properties. One is the Painlevé property, i.e. no movable branch points. The second is monodromy-preserving deformations. Monodromy-preserving deformation is closely related to the Riemann–Hilbert correspondence, which provides a one-to-one correspondence between ordinary differential equations and monodromy data. When we determine the monodromy data of an ordinary differential equation, it is useful and necessary to study monodromy-preserving deformations. We may consider the Painlevé; equations are "solved" by describing the Riemann–Hilbert correspondence. However, the level of "solving equations" varies. We will give an outline the algebraic analysis of the Painlevé equations in this stage. We particularly focus on the q-difference Painlevé equations.

Conference Room II

Tokio Matsuyama (Chuo Univ.) On the Kirchhoff equation ····· (13:00–14:00)

Summary: In his treatise of 1876 G. Kirchhoff proposed the integro-differential equation of hyperbolic type in order to describe small, transversal vibrations of an elastic string when the longitudinal motion can be considered negligible with respect to the transversal one. In 1940, S. Bernstein first studied the global existence for analytic data. Since then, it has been a long-standing open problem whether or not one can prove the existence of time global solutions in Sobolev spaces or Gevrey spaces without smallness conditions on the initial data. Moreover, the existence of local solutions in low regular Sobolev spaces is still not known. In this talk I will overview the known results on the global existence of the Cauchy problem to the Kirchhoff equation with small data in Sobolev spaces. After that, I will provide an idea of an alternative proof of Bernstein's theorem. Moreover, assuming that the lifespan of solutions is finite, I will review the blow-up phenomenon on the local solutions in Sobolev spaces.

Foundation of Mathematics and History of Mathematics

March 18th (Tue) Conference Room Ⅲ

9:00–10:45

Summary: We investigate the arithmetical completeness theorems of some extensions of Fitting, Marek, and Truszczyński's pure logic of necessitation **N**. For $m, n \in \omega$, let $\mathbf{N}^+\mathbf{A}_{m,n}$, which was introduced by Kurahashi and Sato, be the logic obtained from **N** by adding the axiom scheme $\Box^n A \to \Box^m A$ and the rule $\dfrac{\neg\Box A}{\neg\Box\Box A}$. In this paper, among other things, we prove that for each $m, n \geq 1$, the logic $\mathbf{N}^+\mathbf{A}_{m,n}$ becomes a provability logic.

Summary: In this study, we examine the interrelationships among the axioms associated with the principle of explosion and subminimal logics. We characterize the intersection between minimal logic and co-minimal logic. Additionally, we demonstrate that there are continua of logics situated between these logics and logics known to exist below intuitionistic logic, employing an enhanced version of Wronski's method.

Summary: We prove that the constructive and intuitionistic variants of the modal KB logic coincide. This result contrasts with a recent result by Das and Marin, who showed that the constructive and intuitionistic variants of K do not prove the same diamond-free formulas.

Summary: We study the Lyndon interpolation property (LIP) in modal logic and intermediate logic. We prove that among the 18 consistent normal modal logics of finite height extending S4 known to have CIP, 11 logics have LIP and 7 logics do not. We also prove that the intermediate propositional logic **LV** has LIP. This completes the study of LIP for intermediate propositional logics.

Summary: We revisit Smullyan's paper "Truth and Provability" for three purposes. First, we introduce the notion of Smullyan models to give a precise definition for Smullyan's framework discussed in that paper. Second, we clarify the relationship between Theorems F, T, and G proved by Smullyan and other newly introduced properties for Smullyan models in terms of both implications and non-implications. Third, we construct a Smullyan model based on the standard model of arithmetic and show the correspondence between the properties of this Smullyan model and those concerning truth and provability in arithmetic.

Summary: In this talk, we give a simple method for generating a Martin-Löf random infinite sequence with respect to an arbitrary computable Bernoulli measure, given a plain Martin-Löf random infinite sequence as an oracle.

11:00–12:00 Talk Invited by Section on Foundation and History of Mathematics

Tomoaki Kawano (Kanagawa Univ.) About quantum logic in mathematical logic

Summary: Quantum logic is a field that uses mathematical logic to analyze the special properties of observed propositions that appear in quantum mechanics. Quantum logic has two aspects: mathematical and physical analysis. In this lecture, mainly an overview of the characteristics of mathematical differences between other logics and quantum logic will be presented. Mathematical applications to quantum informatics will also be presented.

14:15–14:30 Research Section Assembly

14:45–17:00

7 Masahiro Kumabe (Open Univ. of Japan)
Toshio Suzuki (Tokyo Metro. Univ.)
Kenshi Miyabe (Meiji Univ.)
Quantifier variations in Solovay reducibility 15

Summary: Solovay reducibility is a fundamental concept in algorithmic randomness, used to compare the randomness of real numbers. In this work, we investigate how quantifier variations in the definitions and characterizations of Solovay reducibility affects its properties, specifically for left-c.e. reals and computably approximable (c.a.) reals. For left-c.e. reals, Solovay reducibility is relatively robust under quantifier variations; the different conditions remain equivalent. However, for c.a. reals, these conditions diverge, and we provide theorems and examples demonstrating these differences. Our findings connect to previous research where Solovay reducibility is characterized using partial Lipschitz functions.

8 Kenetsu Fujita (Gunma Univ.)
Toshihiko Kurata (Hosei Univ.)
On Reynolds–Hurkens–Coquand paradox 15

Summary: Hurkens provided a simplification of the so-called Girard's Paradox which originally appeared in Martin-Lof's type theory with axiom type:type (1971). Recently, Coquand presented a variant on the paradox, as a variation of Reynolds "paradox" in terms of T-algebras. We summarize an outline of Coquand's encoding and computational behavior of the paradox in lambdaU-, and give some remarks from the viewpoint of the powerful universe.

9 Katsushi Waki (Yamagata Univ.)
Progress report on the construction of the Sakuma collection database 15

Summary: We will report on the progress of the digitization and database construction of the Sakuma Collection, which began this year.

10 Koichi Hirata (Matsuyama Univ./Ehime Univ.*)
Casey's theorem: From the viewpoint of inversive coordinates of circles 15

Summary: In this study, we begin by expressing Casey's theorem in terms of inversive coordinates of circles, then present the theorem expressed using power of tangent. Finally, we show that the ordinary Casey's theorem can be derived by factorization when the power of tangent is nonnegative. In the process, we generalize Casey's theorem. We give a theorem expression that can be used even when straight lines are included or two circles do not have a common tangent. We also show that each factor in the factorized form of the theorem decomposes a circle into three circular arcs. As an application of these, we present a simple solution to Malfatti circles.

11 Noriko Tanaka (Naragakuen Univ.) Tsukane Ogawa (Yokkaichi Univ.) On the mathematics of the "Shikiki-jyutsu" written by Yukitada Oka 15

Summary: An important person in the Takuma school in the Kansai area is Yukitada Oka (1791–). We will discuss the mathematics of "Shikiki-jyutsu"written by Oka. In this book, the mathematical contents are sequences and approximations, even if the problems are geometry or the buying and selling of objects. Many of the problems use the method of finding n from an approximation by taking n-squared roots of nth-order expressions, which is interesting as a mathematical method. In the "History of Japanese Mathematics before Meiji Era", the five volumes of "Kijyutsu-Kairoho" and "Shikiki-jyutu" are referred to as "Kairoho" together, but a careful reading of the contents makes us hesitate to combine them with the five-volume set.

12 Makoto Tamura (Osaka Sangyo Univ.) Area and volume calculations in the Qin dynasty in the mathematical books of Qin bamboo slips housed at Peking University 15

Summary: The Mathematical Books of Qin Bamboo Slips housed at Peking University contain problems using the Pythagorean Theorem or the formula for the volume of a truncated quadrangular pyramid. In this talk, we will see some problems in them using the Gougu techniques described in Liu Hui's commentary on the "Nine Chapters", and discuss that these techniques were well known in the Qin dynasty. We will also discuss some applications of the volume formula of the truncated quadrangular pyramid and, if possible, another figure whose interpretation is suspect.

13 Hideyuki Majima (Ochanomizu Univ.*) On the number 3.16 as Pi in the 'Jinkok' by YOSHIDA Mitsuyoshi (continued) 15

Summary: We continue to disuss on the number 3.16 as Pi in the 'Jinkoki' by YOSHIDA Mitsuyoshi.

14 Michiyo Nakane The Hamilton principle derived by Jacobi 15

Summary: Both mathematicians and historians of mathematics might read the same mathematical paper, but their attitudes are completely different. This paper explains the difference by referring to a treatment of Jacobi about descriptions by Hamilton related to the Hamilton principle. He read a paper of Hamilton as a mathematician. However, we do not accept his perspective as a historian of mathematics because he added something new when he introduced the result of Hamilton.

17:15–17:30 Mathematics History Team Meeting

March 19th (Wed) Conference Room III

9:00–12:00

15 Takashi Yamazoe (Kobe Univ.) Cichoń's maximum with cardinals of the closed null ideal 15

Summary: Let $\mathcal{E}$ denote the σ-ideal generated by closed null sets on $\mathbb{R}$. We show that the uniformity and the covering of $\mathcal{E}$ can be added to Cichoń's maximum with distinct values, more specifically, it is consistent that $\aleph_1 < \mathrm{add}(\mathcal{N}) < \mathrm{cov}(\mathcal{N}) < \mathfrak{b} < \mathrm{non}(\mathcal{E}) < \mathrm{non}(\mathcal{M}) < \mathrm{cov}(\mathcal{M}) < \mathrm{cov}(\mathcal{E}) < \mathfrak{d} < \mathrm{non}(\mathcal{N}) < \mathrm{cof}(\mathcal{N}) < 2^{\aleph_0}$ holds.

16 Toshimasa Tanno (Kobe Univ.) Generalized Tukey relation in Solovay model 15

Summary: In considering cofinal types of directed sets, the Tukey relation (that is, the existence of Tukey maps) plays an important role in ZFC. However, in contexts without the axiom of choice, the Tukey relation is suitable for the comparison among cofinal types of directed sets. In this talk, we introduce a generalized version of the Tukey relation in ZF, called the pre-Tukey relation, and show that there is no pre-Tukey map among some directed sets corresponding to cardinal invariants in a certain type of Solovay model. Specifically, we investigate pre-Tukey relations among $(\omega^\omega, \leq^*), (\mathcal{M}, \subseteq)$ and $(\mathcal{N}, \subseteq)$. This is a joint work with Hiroshi Sakai.

Summary: We consider a statement that, for every edge coloring c of complete bipartite graph $G = A \cup B$, there is a complete bipartite subgraph $G' = A' \cup B'$ such that c is monochromatic on G', $|A'| = |A|$, and $|B'| = |B|$. We always assume that A and B are infinite. If $|A| \neq |B|$ then this statement is consistent with ZFC. However, if $|A| = |B|$ then there is a counterexample c anytime. The definition of this c is quite simple, and thus we believe that this coloring does not imply that the first statement is meaningless even if $|A| = |B|$. In this talk, we study variations of the first statement. In particular, we introduce that a statement that replaces "complete" with "connected", which is a theorem of ZFC.

Summary: An artinian tree is a tree as a partially ordered set. First we show that for a ZF-set x, i.e. epsilon-relation is well-founded, we have a rigid artinian tree T_x and for a given rigid artinian tree T we have a ZF-set x such that T is isomorphic to T_x as partially ordered sets. Without rigidity we have a correspondence between artinian trees and multisets in the sense of W, D. Blizard. We a;lso define addition and multiplication on sets and multisets which are extensions of those for ordinals.

Summary: The monotonicity theorem is one of the fundamental tools for the study of o-minimal structures. It says that for any unary definable function, its domain can be partitioned into a finite union of points and intervals so that the function is continuous and monotone on each of the intervals. Since this theorem is crucial, it is natural to attempt its generalization to wider situations. In particular, dp-minimal theories, which include o-minimal theories, are expected to have a property which should be called local monotonicity. However, there is an ordered structure which is suspected to be a negative answer to the conjecture. We studied this structure and found that it was not a counterexample, but that it nearly was.

Summary: An ultraproduct(-like) construction in the operator algebra context was introduced in the 1950s. In the same period, Łoś and Robinson discovered the application of (model-theoretic) ultraproducts to non-standard analysis. However, it does not seem that anyone at that time found any intrinsic connection between the two cases of ultraproducts. In recent years, a model-theoretic approach called continuous model theory, which is a generalization of classical model theory, has been found to be useful for the analysis of operator algebras. In this talk, we introduce the framework of continuous model theory (for operator algebras) and, as an application, discuss the isomorphism problem of ultraproducts in operator algebras.

Summary: We want to explain that there exit stable theories having a type of infinite weight in a finite language.

Summary: Evans and Wong proved that the theories of generic structures constructed by Hrushovski's method will be simple or have SOP3. But no examples for SOP3 are given. A conjecture that implies such theories have no SOP3 will be presented. We give some arguments towards the proof of the conjecture.

23 Koitaro Nakaura (Univ. of Tokyo) A simple construction of an indiscernible tree · 15
Akito Tsuboi (Univ. of Tsukuba*)

Summary: The notion of indiscernible sequences is a useful tool for simplifying complex arguments in model theory. The existence of an indiscernible sequence is demonstrated through a simple compactness argument using the finite version of Ramsey's theorem. Indiscernible trees are also significant in model theory; however, their existence is proved by a stronger set-theoretic theorem, such as the Erdös–Rado theorem. In this talk, we see a proof of the existence of an indiscernible tree using only the finite Ramsey theorem. This method can be applied to prove several results, including the fact that forking and dividing are equivalent over models in NTP_2 theories. This talk is based on joint work with Akito Tsuboi.

24 Akito Tsuboi (Univ. of Tsukuba*) On the spectrum of finite models · 10

Summary: This presentation reports on the interim results of our ongoing research into Lipkin's problem on finite models.

13:00–14:00 Talk Invited by Section on Foundation and History of Mathematics

Yoshihiro Maruyama (Nagoya Univ.) Universal topos theory and applications to quantum physics and machine learning

Summary: Categorical logic is the field of mathematical logic in which vast applications beyond foundations of mathematics have been developed successfully. In this talk we introduce universal topos theory, namely a universal algebraic extension of topos, tripos and hyperdoctrine theory, together with applications to quantum physics and machine learning in particular. We also briefly trace the recent history of categorical logic, clarifying, inter alia, that categorical quantum computing has been developed as an application of categorical substructural logics, which in turn gave rise to the recent trend of categorical machine learning (which Google's DeepMind has recently started working upon as well; the current research director of DeepMind actually comes from the categorical semantics community). Besides, we explain progress in our Moonshot project on categorical machine learning and its applications to AI-driven scientific discovery, with a focus upon how categorical logic can be applied beyond purely mathematical domains. No prior knowledge of advanced topics in any field is required; the talk will be made accessible to the general mathematical audience as far as possible. We hereby acknowledge that this work has been supported by the Moonshot Programme of the Cabinet Office of Japan.

Algebra

March 18th (Tue) Conference Room VI

9:00–12:00

Summary: S. Mukai settled $\mathbb{P}^{n,n}$ which describes degenerations of $\mathbb{P}^n \times \mathbb{P}^n$ via mainly followings (1), (2) ([S.Mukai,1997]): (1) incidence correspondeces of 2nd Veronese variety Ver_2 and Grassmann variety $\mathrm{Gr}_2 := \mathrm{Gr}(2, n+1)$, and (2) infinitely near singular poitns associated to the universal bundle. The author gives confluent variant $\mathbb{P}(^{n,n}_{p,q})$ of $\mathbb{P}^{n,n}$ totally over distinct primes p, q (and also to give $\mathbb{P}^{n,n,n}$ describing degenerations of $\mathbb{P}^n \times \mathbb{P}^n \times \mathbb{P}^n$ under addtional arguments) via or with followings (i)–(iii): (i) after describing (1) using valuations of associated differential operators ([I.2019 Sep, I.2022 Sep, I.2023 Mar]), to obtain such variant ones along "limit of ch.0 to ch.p" of [Deligne(1984), Krasner(1938)], (ii) for (2), based on [I.2019 Sep], to extend to Ver_α, Gr_α $(\alpha \geq 2)$, which gives an answer to speculations on higher rank case or c_i $(i \geq 2)$ ([Eisenbud-Harris(1988),p.153]). And, (iii) for del Pezzo fibration dP_6 of degree 6 with $\mathbb{P}^{n,n}$ ([S.Mukai,1997]), to describe degenerations of corresponding dP_6-fibrations in $\mathbb{P}(^{n,n}_{p,q})$ via several results on modular representaions, which are conducted to re-interpretation of [I.2022 Sep][I.2023 Mar].

Summary: Let X be a complex smooth Fano variety of dimension n. In this paper, we give a classification of such X when the pseudoindex is equal to $\dfrac{\dim X + 1}{2}$ and the Picard number greater than one.

Summary: A conjecture by Ishii states that for a finite subgroup G of $GL(2, \mathbb{C})$, a resolution Y of $\mathbb{C}^2/G$ is isomorphic to a moduli space $\mathcal{M}_\theta$ of G-constellations for some generic stability parameter θ if and only if Y is dominated by the maximal resolution. This paper affirms the conjecture in the case of dihedral groups as a class of complex reflection groups, and offers an extension of McKay correspondence.

Summary: The higher Chow group $\mathrm{CH}^p(X, q)$ is a generalization of the classical Chow group. It satisfies many interesting properties, but its structures are still mysterious for almost all varieties when $p > 1$. In this talk, I will explain an explicit construction of higher Chow cycles in $\mathrm{CH}^2(X, 1)$ on some $K3$ surfaces X with a non-symplectic automorphism of order 2, 3 or 4, respectively. By computing their images under the generalized Abel–Jacobi map, I show that for very general cases, these cycles are non-torsion in $\mathrm{CH}^2(X, 1)_{\mathrm{ind}}$, which is the quotient of $\mathrm{CH}^2(X, 1)$ by the image of the intersection product map. The key to the proof is to define a convenient variant of Jacobians by using automorphisms of $K3$ surfaces. Some of the theorems in this talk were obtained in joint work with Shohei Ma.

Summary: Let X be a nonsingular projective surface over the field of complex numbers $\mathbb{C}$ and L be a nef and big Cartier divisor on X. Then, a pare (X, L) is called a quasi-polarized surface. In my talk, I will explain the following results.
(1) Positivity of $h^0(aK_X + bL)$ for (X, L) with $\kappa(aK_X + bL) \geq 0$, where a, $b \in \mathbb{N}$,
(2) The classification of (X, L) with $h^0(aK_X + bL) = 1$.

Summary: In this talk, we discuss Fano manifolds whose Chern characters satisfy some positivity conditions. We show that such manifolds admit higher order minimal families of rational curves and are covered by high dimensional rational varieties.

Summary: When a tropical rational function φ on $\mathbb{R}^n$ is given, we can represent it as $\varphi = f \oslash g$ with tropical polynomials f and g. We develop the duality theorem for tropical rational functions to define the volume of the pair (f, g). We show that when $n = 1$, we can find a representation of $\varphi(x) \neq -\infty$ as $f(x) \oslash g(x)$ with the pair (f, g) of minimum volume. The dual subdivision of $f(x) \oplus (y \odot g(x))$ is unique up to translation, but when $n = 2$ this is not true.

Summary: For a projective variety $X \subset P^N$, we call the closure of the union of $(k-1)$-planes spanned by k points on X the k-secant of X and denote it by $\sigma_k(X)$. We study the singular locus of $\sigma_k(v_d(P^n))$ for the d-uple Veronese embedding v_d of P^n. By investigating geometry of moving tangents, the secant defectivity, and the identifiability of symmetric tensors, we determine the (non-)singularity of $\sigma_k(v_d(P^m))$ with any m-plane $P^m \subset P^n$. It shows an interesting trichotomy for singularity. We also study the defining equations of $\sigma_k(v_d(P^n))$ for exceptions of the trichotomy.

14:15–18:00

Summary: We describe irreducible components of the moduli spaces of rational curves on smooth coindex 3 Fano varieties. This is a higher-dimensional analog of the study of smooth Fano threefolds by Beheshti–Lehmann–Riedl–Tanimoto. In particular, we prove the moduli space of rational curves representing each numerical class is irreducible when the dimension is at least 5. This is joint work with Eric Jovinelly.

Summary: The minimal log discrepancy is an important invariant of singularities in birational geometry. The PIA (precise inversion of adjunction) conjecture states that we can precisely compare between the minimal log discrepancies of a variety and its Cartier divisor. In this talk, we give a counterexample to the PIA conjecture for minimal log discrepancies. We also give a counterexample to the LSC (lower semi-continuity) conjecture for families. This is joint work with Yusuke Nakamura.

Summary: We consider equivariant integrals on flag manifolds, especially Grassmannian manifolds. Using a computational method inspired by the theory of wall-crossing formulas by Takuro Mochizuki, we re-prove residue formulas for equivariant integrals given by Weber and Zielenkiewicz.

Summary: In heuristic terms, the Grothendieck period conjecture (GPC) posits that "polynomial relations with coefficients in $\overline{\mathbb{Q}}$ among the periods of a smooth projective variety X over $\overline{\mathbb{Q}}$ should be determined by the algebraic cycles on powers of X". The GPC has been proven only for CM elliptic curves by Chudnovsky, making it one of the most challenging longstanding conjectures on algebraic cycles. Thanks to two suggestions from the referees, we establish the GPC for Kummer surfaces associated to squares of CM elliptic curves. The key point is that the motive of this surface has a nontrivial transcendental part but belongs to the Tannakian category generated by the motive of a CM elliptic curve.

Summary: Normal log canonical del Pezzo surfaces of rank one with unique singular points defined over the complex number field $\mathbb{C}$ were classified. In addition, it is known that every such surface is affine ruled. In this talk, we classify normal log canonical del Pezzo surfaces of rank one with unique non-klt singular points defined over a field of characteristic zero. Moreover, we find several examples of these surfaces, which are not affine ruled.

Summary: Let k be an algebraically closed field of characteristic 2, X the singular surface of type D^0_{2n} and $m \in \mathbb{Z}_{\geq 0}$. There exists the jet scheme X_m of X and the truncation morphism π_m between X_m to X_0 ($\cong X$). We are interested in the fiber of the singular point by π_m, call it a singular fiber. For the case $n = 2^l (l \in \mathbb{Z}_{\geq 1})$, we give an irreducible decomposition of the singular fiber. Moreover, the defining ideals of these components can be given explicitly.

Summary: For an n-dimensional complex projective variety X and an ample line bundle L on X, the pair (X, L) is called an n-dimensional polarized variety. The sectional genus and the Δ-genus are the most basic invariants in the study of polarized varieties. As a generalization of them, Fukuma defined the ith sectional geometric genus and the ith Δ-genus. In this talk, we consider the case where X is a toric variety, and present formulae to determine the above invariants by using the h^*-vector of a lattice polytope associated with the line bundle L. In addition, we see that these formulae give various properties of ith sectional invariants of polarized toric varieties.

Summary: In this talk, we introduce the Goodwillie calculus of ∞-categories, which is a categorical analogue of Taylor expansion of functions. The approximation of ∞-categories of degree $n \geq 0$ is called n-excisive approximations. As a result of this work, we show that our definition of n-approximation of pointed ∞-categiories coincides with Heuts's work in the case of locally presentable ∞-catgoreis, and the n-excisive approximations have the universal property. As an application, in the case $n = 1$, we have that a cohomology theory on the category of non-unital algebras factors through the derived category of chain complexes along the cotangent complex functor.

Summary: Let E be an elliptic curve defined over $\mathbb{Q}$. We investigate how the Tate–Shafarevich group of E, which represents an obstruction to the local-global principle for E/K-torsors, behaves under quadratic number field extensions.

Summary: The Birch–Swinnerton-Dyer conjecture is a conjecture concerning elliptic curves and is widely considered one of the most important and challenging open problems in modern mathematics. Iwasawa theory is a powerful method for studying the "p-part" of the conjecture for each prime number p. However, due to significant technical difficulties, the classical theory can only handle odd prime numbers and cannot address the 2-part of the conjecture for any elliptic curve. In this talk, we will apply various techniques at the prime 2 to study the conjecture for a certain class of elliptic curves.

Summary: Montes and Nart gave a necessary and sufficient condition to calculate the index of orders by extending a result of Ore. However, they omitted the proof of the theorem, and the condition has a minor gap. In this talk, I will show the theorem in a precise form and report the proof.

Summary: The iterative composition of polynomials is a central topic in discrete dynamical systems and gives rise to many intriguing number-theoretic questions. In the study of polynomial dynamics, multipliers of periodic points play a fundamental role. A multiplier, defined as the value of the derivative of the map at a periodic point, determines the local behavior near that point. Periodic points with multipliers that are roots of unity are called parabolic. For a one-parameter family of polynomials, a parameter is said to be parabolic if the corresponding map has a parabolic periodic point. Parabolic parameters are closely related to bifurcation phenomena in dynamical systems and have been extensively studied from a dynamical perspective. In this talk, we will explore arithmetic properties of parabolic parameters, with a focus on upper bounds for their heights.

Summary: We classify all real quadratic fields such that the Galois groups of the maximal unramified pro-2-extensions over their cyclotomic $\mathbb{Z}_2$-extensions are metacyclic. Then all intermediate fields have metacyclic 2-class field towers. Moreover we give a general formula of the generator rank of the pro-2 Galois groups.

March 19th (Wed) Conference Room VI

9:00–12:00

Summary: I would like to talk about the relation between chiral categories (fusion categories) and factorizable sheaves. It is a trial to understand the works of Gaitsgory and Raskin in terms of the terminology of Beilinson and Drinfeld. I also would like to restate my previous works on the chiral algebra derivation of 2nd Chern character for all (complex) del Pezzo surfaces. To understand the factorizable sheaves, I will try to understand the work of Bezrukavnikov–Finkelberg–Schechtman by use of Ziv Ran space $\mathscr{R}(X)$ (ind-scheme) and sheaves on it. It is a close cousin of configuration space of a complex projective curve X. If time permits, I will also try to understand its relation to chiral homology of Beilinson and Drinfeld.

Summary: We prove $p_{n+1} - p_n = o(\sqrt{p_n}(\log\log\log p_n)^2)$ under the conjecture on the second Chebysev function by Montgomery.

Summary: Studying the Collatz Conjecture rules changes the perspective of the problem. The new perspective shows the rules organize all even positive integers into sub-sets; generate equalities with all odd positive integers; form a predictable pattern; and prevent the formation of loops other than the minor 4-2-1 loop and values continually increasing to infinity. The Collatz Conjecture is shown to be true for all positive integers.

Summary: For two kinds of polynomials $f_\pm(z) = \sum_{k=0}^{n} c_k^\pm z^k$ satisfying $f_\pm(1-z) = \pm f_\pm(z)$, we give formulas to rewrite $f_+(z)$ and $f_-(z)/(2z-1)$ in terms of polynomials in $s := z(1-z)$. This is a generalization and refinement of Faulhaber's formula (for Bernoulli polynomials) on the sums of powers.

Summary: One of the most fundamental facts of studying multiple zeta values is that multiple zeta values have an iterated integral representation. In response to this fact, Maesaka, Seki, and Watanabe gave a discretization of multiple zeta values. In this talk, we will introduce the overview of the study of discretization and give a q-analogue of discretization and one application.

Summary: The Barnes double zeta function $\zeta_2(s,\alpha;v,w) = \sum_{m=0}^{\infty}\sum_{n=0}^{\infty}(\alpha+vm+wn)^{-s}$ is known to has simple poles at $s=1$ and $s=2$. In this study, we calculated the Laurent series expansions at these poles. In particular, the constant term of the Laurent series expansion at $s=2$ took a form similar to the Euler constant γ. In this talk, we introduce these results.

Summary: In 2023, Laurinčikas questioned whether the universality theorem holds for the Riemann zeta-function shifted by an exponential function or not. In this talk, we give a positive answer of Laurinčikas's problem and generalize the Laurinčikas's problem to a joint universality theorem for the Riemann zeta-function.

Summary: In 1979, Gonek presented the hybrid joint universality theorem for Dirichlet L-functions and proved the universality theorem for Hurwitz zeta-functions with rational parameter as an application. The notion of the hybrid universality combines Voronin's universality theorem and Konecker approximation theorem. This is one of the developments of Voronin's universality theorem. For another development, a proof based on the probability theory has been developed by Bagchi and this method is often used for the proof of several types of the universality. However, no probabilistic proof based on Bagchi's approach has been formulated due to the complexities of adapting his method to the hybrid joint universality theorem. In this talk, we present a proof of the hybrid universality theorem based on the probability theory.

Summary: In this talk, we study the length spectra for maximal arithmetic Fuchsian groups associated with quaternion algebra over the field of rational numbers.

Summary: Recently, Bae–Lee–Lee–Sarkis (2021) gave many examples for classification of fermionic rational conformal field theory (which is one of vertex operator super algebras) by using 2nd-order super-MLDEs that is MLDEs on the theta group. In this talk, we give explicit forms of 2nd-order super-MLDEs and their solutions for fermionic log-conformal field theory.

32 Iwao Kimura (Univ. of Toyama) On a generalization of the Perrin sequence ····· 13

Summary: We generalize the Perrin sequence in a way and discuss a relation between a period of the sequence modulo a prime l and weight one cusp forms.

13:00–14:00 Talk Invited by Algebra Section

Yugen Takegahara (Muroran Inst. of Tech.) On the generalization of Burnside rings

Summary: Let G be a finite group. The isomorphism classes of finite G-sets form a half-ring with addition and multiplication induced by the disjoint union and the cartesian product, respectively. The Burnside ring of G is defined to be the associated Grothendieck ring. Given a contravariant functor F from the category of all finite G-sets to the category of abelian monoids, the F-Burnside ring of G-sets is introduced by E. T. Jacobson. Monomial Burnside rings, crossed Burnside rings, and lattice Burnside rings are known to be F-Burnside rings defined by the contravariant functors associated with 1-cocycles, finite monoids, and finite lattices, respectively. Concerning these rings, there are some results about primitive idempotents, units, tensor induction, characterization of solvable groups, and prime spectrum derived from the properties of the Burnside ring of G. Since lattice Burnside rings are abstract Burnside rings, the properties of lattice Burnside rings generalize those of the Burnside ring of G.

March 20th (Thu) Conference Room VI

9:00–12:00

33 Taro Sakurai (Chiba Univ.) Finite groups with very few character values ····· 10

Summary: Finite groups with very few character values are characterized. In particular, we show that a finite non-abelian group with exactly four character values is isomorphic to a generalized dihedral group

$$\operatorname{Dih} C_3^r = \langle\, a_1, \ldots, a_r, t \mid a_i^3 = [a_i, a_j] = t^2 = 1,\ a_i^t = a_i^{-1}\ (1 \le i, j \le r) \,\rangle$$

of order $2 \cdot 3^r$ for some $r \ge 1$.

34 Taro Sakurai (Chiba Univ.) Some recent progress on the modular isomorphism problem ····· 13

Summary: The modular isomorphism problem was a long-standing open problem on the group algebra $\mathbb{F}G$ of a finite p-group G over a field $\mathbb{F}$ of positive characteristic p. It asks whether $\mathbb{F}G \cong \mathbb{F}H$ implies $G \cong H$. We discuss some positive results and a characterization of counterexamples. This talk is based on joint works with Leo Margolis and Mima Stanojkovski.

35 Yuta Kozakai (Tokyo Univ. of Sci.), Yuta Kimura (Hiroshima Inst. of Tech.), Ryotaro Koshio (Tokyo Univ. of Sci.), Hiroyuki Minamoto (Osaka Metro. Univ.), Yuya Mizuno (Osaka Metro. Univ.) On induction/restriction of support τ-tilting modules over skew group algebras ····· 10

Summary: Let Λ be a finite dimensional algebra with an action by a finite group G and $A := \Lambda * G$ the skew group algebra. One of our main results asserts that the canonical restriction-induction adjoint pair of the skew group algebra extension $\Lambda \subset A$ induces a poset isomorphism between the poset of G-stable support τ-tilting modules over Λ and that of $(mod G)$-stable support τ-tilting modules over A.

36 Sin Yi Tsang (Ochanomizu Univ.) A generalization of Grün's lemma to skew braces · · · · · · 13

Summary: Skew brace is an algebraic structure introduced in the study of the set-theoretic solutions to the Yang–Baxter equation. It is known that skew braces share many similarities with groups. In this talk, we shall continue this line of research and investigate the analog of Grün's lemma in the setting of skew braces. Using the annihilator of a skew brace as an analog of the center of a group, we shall show that the analog of Grün's lemma holds for all two-sided perfect skew braces, and this yields a generalization of the usual Grün's lemma. We also note that the hypothesis that the skew brace is two-sided cannot be dropped.

37 Yuto Nogata (Hirosaki Univ.) Takara Kondo (Hirosaki Univ.) Simple 3-designs of $\mathrm{PSL}(2, 2^n)$ with block size 9 · · · · · · 10

Summary: Since $\mathrm{PSL}(2, 2^n)$ acts sharply 3-transitive on the projective line, we can construct 3-designs using the orbits of this group action on the projective line. Previous research has already determined the parameter λ and the Kramer–Mesner matrices for 3-designs with block sizes $k = 4, 5, 6$, and 7. The speaker determined the Kramer–Mesner matrix for a new case with block size $k = 9$. This presentation will introduce the method used to determine this matrix.

38 Takara Kondo (Hirosaki Univ.) Automorphism groups of orbifold VOAs arising from coinvariant lattices of the Leech lattice · · · · · · 13

Summary: Let Λ be the Leech lattice and $pX \in \{3C, 5C, 11A, 23A\}$. We determine the automorphism groups of the orbifold VOAs $V_{\Lambda_{pX}}^{\hat{g}}$ arising from the coinvariant lattices Λ_{pX}, where $g \in pX$ and $\hat{g}$ is a lift of g.

39 Masahiko Miyamoto (Univ. of Tsukuba⋆) 1-point functions on a VOA of moonshine type · · · · · · 10

Summary: As an application of Borcherds's Lie algebra and Dong–Masaon's paper in 2000, we prove that if V is a vertex operator algebra of moonshine type, then the space of 1-point functions associated with V is precisely the same as one associated with the moonshine vertex operator algebra $V^\natural$, where a vertex operator algebra is called to be moonshine type if it satisfies the following three conditions. (1) Its central charge is 24. (2) its character $\sum_{n\in\mathbb{Z}}(\mathrm{dim}V_n)q^{n-1}$ is $j(\tau) - 744 = q^{-1} + 196884q + \ldots$. (3) V has a nonsingular invariant bilinear form.

40 Mamoru Ueda (Univ. of Alberta) Affine Yangians and non-rectangular W-algebras · · · · · · 10

Summary: We will talk about how to construct a homomorphism from the affine Yangian of type A to the universal enveloping algebra of a non-rectangular W-algebra of type A. This homomorphism is an affine analogue of the one given by De Sole–Kac–Valeri and is surjective in the rectangular case. It is constructed by using the coproduct for the affine Yangian of type A and the Miura map for a W-algebra. As a consequence, we can obtain the compatibility between the coproduct for the affine Yangian and the parabolic induction for a non-rectangular W-algebra via this homomorphism. We expect that this homomorphism will contribute to the generalization of the AGT conjecture.

41 Kohei Yahiro (Kyoto Univ.) Yasuaki Hiraoka (Kyoto Univ.) A crystal structure on 2-parameter persistence modules · · · · · · 13

Summary: We show that the set of irreducible components of moduli space of 2D persistence module has a structure of the Kashiwara crystal. In the 2×2 case, we give an explicit description of the crystal structure.

Summary: We introduce prehomogeneous vector spaces (abbreviated PVs) associated with K-modulated quivers over the ground field K, which are a generalization of PVs associated with quivers. Here K is of characteristic zero, but it may not be algebraically closed. It is known that we can describe basic relative invariants of PVs associated with quivers by using Schofield semi-invariants. In this talk, we generalize the Schofield semi-invariants to the case of K-modulated quivers; that is, we introduce generalized Schofield semi-invariants. Furthermore, we describe basic relative invariants of PVs associated with K-modulated quivers having valued Dynkin graphs by using the generalized Schofield semi-invariants.

Summary: For a given linear action of a finite group on a lattice and a positive integer q, the mod q permutation representation is a quasi-polynomial in q. In this paper, we compute the multiplicity of each irreducible representation in the mod q permutation representation of a classical Weyl group on the two types of lattices, generated by the standard basis and by coroots. Additionally, in the case of the lattice generated by the standard basis, we give a representation of the multiplicity using integer partitions that characterize the irreducible character. In the case of the coroot lattice, we show that the multiplicity is closely related to the Ehrhart polynomial of the fundamental alcove.

Summary: The question of whether any unitary representation of braid groups can be constructed via the Long–Moody construction remains unresolved. In this talk, we first introduce the Katz–Long–Moody construction, an extension of the Long–Moody construction. Then, we demonstrate that middle convolution of the KZ-type equation is associated with the Katz–Long–Moody construction. We further show that the Katz–Long–Moody construction preserves the unitarity of representations and provide insights into the relationship between the Long–Moody construction and unitarity.

14:15–14:30 Presentation Ceremony for the 2025 MSJ Algebra Prize

14:40–15:40 Award Lecture for the 2025 MSJ Algebra Prize

Noriyuki Abe (Univ. of Tokyo)♭ On Hecke categories

Summary: We call a categorification of the Hecke algebra of a Coxeter system a Hecke category. It plays an important role in the representation theory of algebraic reductive groups over a field of positive characteristic. We discuss realizations of the Hecke category and their relations.

16:00–17:00 Award Lecture for the 2025 MSJ Algebra Prize

Hiromu Tanaka (Univ. of Tokyo)♭ On Fano threefolds in positive characteristic

Summary: In the 1980s, Mori and Mukai completed the classification of smooth Fano threefolds in characteristic zero, building on the work of Iskovskikh and Shokurov. I will explain an analogous result in positive characteristic. Additionally, we will discuss some differences between the situations in characteristic zero and positive characteristic.

March 21st (Fri) Conference Room VI

9:00–10:45

45 Momonari Kudo (Fukuoka Inst. of Tech.)
Kazuhiro Yokoyama (Rikkyo Univ.)
On maximal Gröbner basis degree for semi-regular sequences and a variant of Fröberg's conjecture ····· 13

Summary: In the study of Gröbner bases, it is important to find a feasible bound on the maximal Gröbner basis degree, both in theory and in practice. We focus on the case of a homogeneous ideal I of a polynomial ring R over a field, and consider a degree reverse lexicographic ordering. In this case, if the Krull dimension of I is ≤ 1, Lazard's bound is well-known, and similar bounds were obtained by Hashemi–Seiler. In this talk, we show an improvement of the above known bounds, assuming that the sequence of polynomials generating I is semi-regular (or weak semi-regular), or that the initial ideal of I is weakly reverse lexicographic. Moreover, we shall raise a variant of Fröberg conjecture, for homogeneous polynomial sequences $(f_1, \ldots, f_m)$ such that the Krull dimension of $R/\langle f_1, \ldots, f_m \rangle$ is ≤ 1.

46 Ryuji Tanimoto (Shizuoka Univ.)
Triangular involutions of the four-dimensional polynomial ring in characteristic two ····· 13

Summary: We are concerned with polynomial involutions in characteristic two. We look for involutions among triangular automorphisms of the four-dimensional polynomial ring in characteristic two and obtain three types of such involutions.

47 Akihiro Higashitani (Osaka Univ.)
On binomial edge rings of complete bipartite graphs ····· 13

Summary: We introduce a new class of algebras arising from graphs, called binomial edge rings. Given a graph G on d vertices with n edges, the binomial edge ring of G is defined to be the subalgebra of the polynomial ring with $2d$ variables generated by the binomials which correspond to n edges. In this talk, we calculate a SAGBI basis for this algebra and obtain an initial algebra associated with this SAGBI basis in the case of complete bipartite graphs. It turns out that such an initial algebra is isomorphic to the Hibi ring of a certain poset. Similar phenomenon also occurs in the context of Plücker algebras, so the framework of binomial edge rings can be interpreted as a kind of its generalization.

48 Akihiro Higashitani (Osaka Univ.)
Koji Matsushita (Osaka Univ.)
Koichiro Tani (Osaka Univ.)
SAGBI bases of algebras arising from finite distributive lattices ····· 13

Summary: In this talk, we consider the $\Bbbk$-subalgebra $\mathcal{R} := \Bbbk[f_{\alpha,\beta} := x_\alpha x_\beta - x_{\alpha\vee\beta}x_{\alpha\wedge\beta} : \alpha, \beta \in L]$ of the polynomial ring $S = \Bbbk[x_\alpha : \alpha \in L]$ where $\Bbbk$ is a field and L is a finite distributive lattice. We characterize when the set $\{f_{\alpha,\beta} : \alpha, \beta \in L\}$ is a SAGBI basis of $\mathcal{R}$ with respect to a monomial order $\preceq$ on S such that $\mathrm{in}_\preceq f_{\alpha,\beta} = x_\alpha x_\beta$ holds for which α and β belonging to L are incomparable.

49 Yuta Hatasa (Sci. Tokyo)
Nobukazu Kowaki (Osaka Univ.)
Koji Matsushita (Osaka Univ.)
Pseudo-Gorenstein edge rings ····· 13

Summary: In this talk, we study edge rings and their h-polynomials. we investigate when edge rings are pseudo-Gorenstein, which means that the leading coefficients of the h-polynomials of edge rings are equal to 1. We completely characterize when the edge rings of bipartite graphs are pseudo-Gorenstein. Moreover, we research the case of non-bipartite graphs.

50 Sora Miyashita (Osaka Univ.) Matteo Varbaro (Genova Univ.) The canonical trace of Stanley–Reisner rings that are Gorenstein on the punctured spectrum 13

Summary: It is known that a Cohen–Macaulay graded local ring is Gorenstein on the punctured spectrum if and only if the trace ideal of its canonical module contains a power of its irrelevant maximal ideal. In this talk, we show that for a Cohen–Macaulay Stanley–Reisner ring, it is Gorenstein on the punctured spectrum if and only if it is nearly Gorenstein or its canonical trace is the square of its irrelevant maximal ideal. Moreover, we provide a classification of Stanley–Reisner rings that are Gorenstein on the punctured spectrum.

11:00–12:00 Talk Invited by Algebra Section

Kenta Sato (Chiba Univ.) Singularities on hyperplane sections

Summary: Algebraic varieties often have singularities. Understanding how singularities behave under various geometric operations is a natural and important question both in algebraic geometry and commutative ring theory. In this talk, we will focus on the geometric operation of taking a "general hyperplane section".
According to the classical Bertini theorem, if the original variety X is non-singular, then a general hyperplane section H of X is also known to be non-singular. Many variants of this theorem have been established; for instance, it is known that if X is reduced (resp. normal, Cohen–Macaulay, Gorenstein), then so is H. Furthermore, in characteristic zero, the argument presented in Reid's paper implies that certain classes of singularities in the minimal model program possess a similar property. Specifically, if X has only log canonical (resp. klt, canonical, or terminal) singularities, then the same property holds for H.
In this talk, I will explain that a similar property holds for three-dimensional algebraic varieties defined over a field of positive characteristic. In the course of the proof, we provide a sufficient condition for log canonical (resp. klt) surface singularities to be geometrically log canonical (resp. geometrically klt) over a field. If time permits, I will also discuss the preservation of singularities under another geometric operation, namely "deformation".

14:15–18:00

51 Davide Dal Martello (Rikkyo Univ.) A cluster monodromic realization for Okamoto's symmetry of Painlevé VI 13

Summary: The Painlevé VI equation (PVI) admits a native $\mathfrak{sl}_2(\mathbb{C})$-Fuchsian isomonodromy representation. Taking the multiplicative middle convolution of a higher Teichmüller coordinatization for the corresponding Fuchsian monodromy group, we give Okamoto's birational transformation of PVI a monodromic realization in the language of cluster $\mathcal{X}$-mutations. The explicit mutation formula is given dual characterizations in geometric terms of both the colored associahedron and star-shaped fat graphs, expanding the cluster state of the art for PVI.

52 Toshiya Yurikusa (Tohoku Univ.) Dimension vectors of τ-rigid modules and intersection numbers on triangulated surfaces 13

Summary: To a triangulated surface, Labardini-Fragoso associated a finite dimensional Jacobian algebra J. We show that the dimension vectors of τ-rigid J-modules are given by the intersection numbers of tagged arcs introduced by Qiu and Zhou. Applying a study of the intersection numbers, we can give a characterization of the triangulated surface such that different τ-rigid J-modules have different dimension vectors. In particular, different basic support τ-tilting J-modules have different dimension vectors.

Summary: The algebraic extriangulated category was introduced by Xiaofa Chen as a counter part of the topological extriangulated category in the sense of Nakaoka–Palu. The localization theory for exatriangulated categories was developed by Nakaoka–Ogawa–Sakai, which provides a foundational machinery to construct an exact sequence $\mathscr{N} \to \mathscr{D} \to \mathscr{D}/\mathscr{N}$ in the category ET of extriangulated categories. In this talk, we will show several advantages of an extriangulated category $\mathscr{D}$ being algebraic: (1) Any extriangulated quotient $\mathscr{D}/\mathscr{N}$ can be realized as a quotient of an exact category $\mathscr{C}$ by its thick subcategory $\mathscr{M}$, namely, an exact equivalence $\mathscr{D}/\mathscr{N} \simeq \mathscr{C}/\mathscr{M}$ always exists; (2) We investigate an extriangulated analogue of Sarazola's K-theoretic localization, in which an associated long exact sequence of K-groups is established by passing to a certain enhancement.

Summary: The characteristic polynomial of a hyperplane arrangement plays a central roll to study it. As generalizations of the characteristic polynomial with special values, the coboundary polynomial and the characteristic quasi-polynomial can be mentioned. In this talk, I will introduce an invariant that can uniformly handle these polynomials for hyperplane arrangements defined over the ring of integers of an algebraic number field, and discuss its properties.

Summary: This is on "Modular representation theory of finite groups". In this area two of the most important and interesting conjectures are "Donovan's conjecture" and "Broue's abelian defect group conjecture". If these conjectures are for the principal p-blocks (where p is a prime), then the Scott module (after Leonard L. Scott) plays a very important role. More precisely speaking, it is quite useful to check Brauer indecomposability of the Scott module. In this talk we are going to discuss the Brauer indecomposability of the module for a finite group whose Sylow 2-subgrop is a wreath 2-group (here we are assuming that $p = 2$).

Summary: This is on "Modular representation theory of finite groups". In the area there are several exciting conjectures many researchers have been attacking. Donovan's conjecture and Broue's abelian defect group conjecture are two of them. In this talk, we are going to discuss both, when our p-blocks (p is a prime number) are the principal 2-blocks (we assume $p = 2$) and our finite groups have Sylow 2-subgroups that are isomorphic to the wreathed groups. Actually we have decided all the principal 2-blocks of the above groups up to "splendid Morita equivalence" (that is stronger than Morita equivalence). As a result we give a partial answer to Puig's finiteness conjecture, that is more precise than a relatively well-known conjecture called Donovan's conjecture.

Summary: Let A be a finite dimensional algebra over a field K. Many authors have described the triangulated structure of the stable category of Gorenstein-projective A-modules. For example, for monomial algebras A, Lu and Zhu proved that if A is 1-Iwanaga–Gorenstein, then the stable category of Gorenstein-projective A-modules is triangle equivalent to the stable module category of a self-injective Nakayama algebra. In this talk, we extend the above result to arbitrary monomial algebras A.

Summary: In algebraic geometry, smooth projective varieties with (anti-)ample canonical bundles are reconstructed from the bounded derived categories of coherent sheaves. This fact is called Bondal–Orlov's reconstructon theorem. In this talk, we explain Bondal–Orlov's reconstructon theorem in noncommutative projective geometry.

Summary: In 2015, Brandenburg, Chirvasitu, and Johnson–Freyd conjectured that every dualizable locally presentable linear category is strongly generated by compact projective objects. Although this conjecture was found to have a counterexample, we provide a complete answer to a modified version of the conjecture, using a result of Stefanich.

Summary: Auslander, in his seminal paper, proved that a Cohen–Macaulay complete local ring R has an isolated singularity if R has finite Cohen–Macaulay representation type. In this talk, we consider the finiteness of the dimension of the category of higher syzygy modules over an arbitrary noetherian local ring and provide some examples of noetherian rings of finite syzygy representation type.

Summary: Let R be a commutative noetherian local ring, and denote by mod R the category of finitely generated R-modules. The notions of dimension and radius for a subcategory of mod R have been introduced by Dao and Takahashi as an analogue of the Rouquier dimension of a triangulated category. When R is a Cohen–Macaulay local ring, it is known that the dimension of the subcategory $\mathrm{CM}(R)$, consisting of maximal Cohen–Macaulay R-modules, is typically finite, while subcategories strictly contained in $\mathrm{CM}(R)$ tend to be infinite-dimensional. The main results of this talk state that when R is not Cohen–Macaulay, some specific subcategories of mod R, which include a counterpart to $\mathrm{CM}(R)$, tend to be infinite-dimensional.

Summary: Akdenizli, Aytekin, Çetin, and Esentepe studied the Alexandrov space of the stable category of maximal Cohen–Macaulay modules. In this talk, we consider the quasi-compactness of the Alexandrov topology of some stable categories for certain singularities. We also explore the relationship between the Alexandrov topology, the cohomology annihilator, and the singular locus.

Summary: We generalize Auslander–Ding–Solberg's lifting theorem by using a "derived quotient" $A/^{L}(f_1, ..., f_r)$ in place of the usual quotient. The main theorem shows that if a finitely generated module M over $A/(f_1, ..., f_r)A$ satisfies $\mathrm{Ext}^2_{A/^{L}(f_1,...,f_r)}(M, M) = 0$, then M lifts to A. While this result was previously established using DG algebras and DG modules, this work provides an alternative proof using higher algebra theory (such as animated rings and its modules), taking a more diagram-chasing approach without explicit elements.

Summary: An almost Gorenstein ring is, one of the candidates for generalization of Gorenstein rings, defined by an existence of embedding of the rings into their canonical modules whose cokernel is an Ulrich module. The motivation of this generalization comes from the strong desire to stratify Cohen–Macaulay rings, finding new and interesting classes which naturally extend the Gorenstein rings. In this talk, we provide a characterization of the almost Gorenstein property of determinantal rings of a symmetric matrix of indeterminates over an infinite field. We also give an explicit formula for ranks of the last two modules in the resolution of determinantal rings using Schur functors. My talk is based on the work jointly with Ela Celikbas, Jai Laxmi, and Jerzy Weyman.

Geometry

March 18th (Tue) Conference Room I

9:30–11:45

1 Ryu Ueno (Hokkaido Univ.) Geodesic connectedness on statistical manifolds ····· 15

Summary: The Hopf–Rinow theorem in Riemannian geometry states that if the Levi-Civita connection on a connected Riemannian manifold is geodesically complete, then the connection must be geodesically connected. This property does not hold for general affine connections. On a certain class of statistical manifolds, the Hopf–Rinow theorem will be presented for the affine connections of the statistical manifold.

2 Yusei Aoki (Nagoya Inst. of Tech.)
Toshiaki Adachi (Nagoya Inst. of Tech.) Comparison theorem on string-elevations of trajectory-harps ····· 15

Summary: In order to study behaviors of trajectories for Kähler magnetic fields on a Kähler manifold, we consider trajectory-harps which are variations of geodesics associated with trajectories. For a trajectory γ, we take a geodesic joining $\gamma(0)$ and $\gamma(t)$ for each t, and study the string-elevation of the trajectory-harp which measures inner products of initial velocity vectors of joining geodesics and $\dot{\gamma}(0)$. Under an assumption on sectional curvatures from above, we estimate this string-elevation by using that for trajectory-harps on a complex space form.

3 Taika Okuda (Tokyo Univ. of Sci.) Deformation quantization of products for one-dimensional locally symmetric Kähler manifolds ····· 15

Summary: Deformation quantization with separation of variables of Kähler manifolds is one of the quantization methods studied by Karabegov which gives noncommutative Kähler manifolds. In particular, for locally symmetric Kähler manifolds, Sako–Suzuki–Umetsu and Hara–Sako studied the construction methods for their deformation quantization with separation of variables. From their construction methods, deformation quantizations with separation of variables were constructed for complex N-spaces $\mathbb{C}^N$, complex projective and hyperbolic spaces $\mathbb{C}P^N$, $\mathbb{C}H^N$, the complex Grassmannian $G_{2,4}(\mathbb{C})$, and arbitrary one- and two-dimensional ones. In this talk, we focus on N-fold products of one-dimensional locally symmetric Kähler manifolds and present an explicit formula for star products that give their deformation quantization with separation of variables.

4 Kazuhiro Ishige (Univ. of Tokyo) ♭
Asuka Takatsu (Tokyo Metro. Univ.)
Haruto Tokunaga
(KADOKAWA DWANGO Edu. Inst.) Non-preservation of concavity properties by the Dirichlet heat flow on Riemannian manifolds ····· 15

Summary: We prove that no concavity properties are preserved by the Dirichlet heat flow in a totally convex domain of a Riemannian manifold unless the sectional curvature vanishes everywhere on the domain.

5 Yasukatsu Tada
(Kanagawa Gakuen Junior & Senior Highschool) $\mathbb{Z}_2$ graded parity non-preserving Poisson brackets ····· 15

Summary: There exist $\mathbb{Z}_2$-graded parity non-preserving automorphisms of the Grassmann algebra and the Clifford algebra. These automorphisms do not preserve the bracket structure. We define the parity map and the parity term to quantify the odd difference between two odd generator systems. The infinitesimal odd deformation is computed using Hochschild cohomology. We explicitly derive the interrelation of the family of $\mathbb{Z}_2$-graded Poisson brackets through the Grassmann projection of automorphisms of the Clifford algebra. Furthermore, we show that this interrelation contains a Gerstenhaber algebra structure.

6 Shuhei Yonehara (Osaka Univ.) Godbillon–Vey classes of regular Jacobi manifolds ····· 15

Summary: The notion of a Jacobi manifold is a generalization of that of a Poisson manifold, and it has a foliation whose leaves have either a contact structure or a locally conformal symplectic structure. In this talk, for Jacobi manifolds with a regular foliation, we explicitly express the characteristic class called the Godbillon–Vey class, which is determined by the foliation, in terms of Jacobi structures.

7 Masaya Kawamura (Sugiyama Jogakuen Univ.) On a parabolic Monge Ampere type equation on compact almost Hermitian manifolds ····· 15

Summary: We investigate a parabolic Monge Ampere type equation on compact almost Hermitian manifolds and derive a priori gradient and second-order derivative estimates for solutions to this parabolic equation. These a priori estimates give us higher order estimates and a long-time solution. Then, we can observe its behavior as the time goes to infinity.

14:15–16:15

8 Ken Kuwata (Kagawa Nat. Coll. of Tech.)
Masao Jinzenji (Okayama Univ.) Weighted projective spaces and elliptic virtual structure constants ···· 15

Summary: We proposed the recipe for mirror symmetric computation of genus one Gromov–Witten invariants for non-singular degree k hypersurfaces on CP^{N-1} using elliptic virtual structure constants. we extend this approach to non-singular complete intersections in the weighted projective spaces. In this talk, we present the method and the results of numerical tests.

9 Kentaro Yamaguchi (Tokyo Metro. Univ.) Delzant type theorem for torus-equivariant hypersurfaces in symplectic toric manifolds ····· 15

Summary: We investigate the conditions when the closure of a complex subtorus is a smooth complex submanifold in a symplectic toric manifold. In this talk, when codimension of the complex subtorus is one, we provide a characterization of these conditions in terms of the condition of a pair of a Delzant polytope and the pullback of the inclusion of tori. Our main result can be seen as a generalization of the Delzant correspondence to the case of the closures in symplectic toric manifolds.

10 Masakazu Takakura (Tokyo Metro. Univ.) Division theorem with sharp L^2 estimate and characterization of plurisubharmonic functions ····· 15

Summary: In this talk, I will discuss the results of the division theorem with the sharp L^2-estimates and use these to characterize pluriharmonic functions.

11 Masakazu Takakura (Tokyo Metro. Univ.) L^2 division theorem on the Hilbert bundles ····· 15

Summary: In this talk, I will present the results of the L^2 division theorem for infinite-dimensional holomorphic vector bundles whose fibers are Bergman spaces. Additionaly, I will explain characterristic approximation method used to prove this result, which is based on the L^2 existence theorem.

12 Shunsuke Saito (Tokyo Univ. of Sci.) K-instability of hyperplane sections of Segre varieties ····· 15

Summary: In the early 1980s, Sakane and Hano proved that the automorphism group of a smooth hyperplane section of the Segre variety $\Sigma_{m,n}$ is nonreductive when $m \neq n$, and consequently revealed that it does not admit a constant scalar curvature Kähler metric in any Kähler class. According to the famous Yau–Tian–Donaldson conjecture, which is now a central topic in Kähler geometry, "existence of constant scalar curvature Kähler metrics" should be equivalent to an algebro-geometric condition "K-polystability". Therefore, such hyperplane sections are expected not to be K-polystable. In this talk, I will explain the following statement, which is an algebro-geometric counterpart of Sakane and Hano's results: a normal hyperplane section of the Segre variety $\Sigma_{m,n}$ are K-unstable for any polarization either when $m \neq n$ or when it is singular.

13 Tomoyuki Hisamoto (Tokyo Metro. Univ.) Satoshi Nakamura (Sci. Tokyo) — Continuity method for the Mabuchi soliton on the extremal Fano manifolds · · · · · 15

Summary: We run the continuity method for Mabuchi's generalization of Kähler–Einstein metrics, assuming the existence of an extremal Kähler metric. It gives an analytic proof (without minimal model program) of the recent existence result obtained by Apostolov, Lahdili and Nitta. Our key observation is the boundedness of the energy functionals along the continuity method.

16:30–17:30 Talk Invited by Geometry Section

Eiji Inoue (Kyoto Univ.) — On Perelman entropy in Kähler geometry

Summary: In these five years, a new feature of Perelman entropy was explored in Kähler geometry. Not only it is related to Kähler–Ricci flow and Kähler–Ricci soliton, it is also related to extremal Kähler metric and K-stability. Recently, it turns out that a certain "spacetime" structure in non-archimedean pluri-potential theory is behind this entropy, by which optimal destabilization conjecture on Perelman entropy was solved. I will survey these developments and propose future direction.

March 19th (Wed) Conference Room I

9:30–11:45

14 Homare Tadano (Yamaguchi Univ.) — An improvement of the Myers theorem via m-Bakry–Émery Ricci curvature with ε-range · · · · · 15

Summary: By using conjugate and disconjugate theorems for second-order linear differential equations, we establish an improvement of the Myers theorem for complete Riemannian manifolds via m-Bakry–Émery Ricci curvature with ε-range. In contrast to the classical theorem of S. B. Myers (Duke Math. J. **8** (1941), 401–404), our result does not always require non-negativity of the m-Bakry–Émery Ricci curvature on the whole manifold and is new even the m-Bakry–Émery Ricci curvature is reduced to the Ricci curvature.

15 Homare Tadano (Yamaguchi Univ.) — A Calabi-type theorem via m-Bakry–Émery Ricci curvature with ε-range · · · · · 15

Summary: By using conjugate and disconjugate theorems for second-order linear differential equations, we establish a Calabi-type compactness criterion for complete Riemannian manifolds via m-Bakry–Émery Ricci curvature with ε-range. In contrast to the classical theorem of E. Calabi (Duke Math. J. **34** (1967), 667–676), our result does not require non-negativity of the m-Bakry–Émery Ricci curvature and is new even the m-Bakry–Émery Ricci curvature is reduced to the Ricci curvature.

16 Naoya Ando (Kumamoto Univ.) — The topological holonomy groups in vector bundles on tori · · · · · 15

Summary: The topological holonomy group of a metric connection of an oriented metric vector bundle of rank 4 on a 2-torus is an at most countable subgroup of SO(4) and given by fixed two circles which generate the fundamental group of the torus. This is closely related to the topological holonomy groups of the connections given in the two orientable subbundles of rank 3 of the 2-fold exterior power of the original vector bundle and they are at most countable subgroups of SO(3). In this talk, denseness theorems with respect to these topological holonomy groups are stated. Moreover, analogous results are stated in relation to the topological holonomy groups of metric connections of Hermitian vector bundles of complex rank 2.

17 Masataka Shibata (Meijo Univ.) Hiroshi Iriyeh (Ibaraki Univ.) — Minimizing problem of the volume product of D_2 or S_4-invariant three dimensional convex bodies · · · · · 15

Summary: There is a version of the Mahler conjecture for asymmetric convex bodies in $\mathbb{R}^n$. It is still open if $n \geq 3$. In this talk, we give partial results for the asymmetric version of the Mahler conjecture for the case $n = 3$.

18 Hidemasa Suzuki (Chiba Univ.) Explicit correspondences between gradient trees in $\mathbb{R}$ and pseudo-holomorphic disks in $T^*\mathbb{R}$ ····· 10

Summary: Fukaya and Oh studied the correspondence between pseudo-holomorphic disks in T^*M which are bounded by Lagrangian sections $\{L_i^\epsilon\}$ and gradient trees in M which consist of gradient curves of $\{f_i - f_j\}$. Here, L_i^ϵ is defined by $L_i^\epsilon = \mathrm{graph}(\epsilon df_i)$. They constructed approximate pseudo-holomorphic disks in the case $\epsilon > 0$ is sufficiently small. When $M = \mathbb{R}$ and Lagrangian sections are affine, pseudo-holomorphic disks w_ϵ can be constructed explicitly. In this talk, we show that pseudo-holomorphic disks w_ϵ converges to the gradient tree in the limit $\epsilon \downarrow 0$.

19 Tomoya Nakatani (Chiba Univ.) The category of graded matrix factorizations for a deformation of A_μ-sin-gularities associated to universal unfolding ····· 10

Summary: The triangulated categories of (ungraded) matrix factorizations were introduced by Eisenbud and Knorrer in the study of the maximal Cohen–Macaulay modules. Kajiura–Saito–Takahashi proved that the category of graded matrix factorizations for a polynomial of type ADE is triangulated equivalent to the derived category of finitely generated right modules over the path algebra of a Dynkin quiver of the corresponding type. For each polynomial of type ADE, we obtain the family of polynomials parametrized by the base space of universal unfolding and can consider the category of graded matrix factorizations of a deformed polynomial on a generic point of the base space. In this talk, I would like to explain the triangulated structure and existence of full exceptional collections for this category.

20 Tadashi Udagawa (Waseda Univ.) Solutions of the tt*-equation constructed from the SU(2)k-fusion ring and its DPW description ····· 15

Summary: The tt*-equation was introduced by S. Cecotti and C. Vafa in the literature of conformal field theory. In this talk, we give a solution to the tt*-equation for the SU(2)k-fusion ring consisting of a finite solutions to the sinh-Gordon equation. The construction is due to the idea of Cecotti and Vafa. Our first result is a precise mathematical formulation of the construction. Our second result is a "DPW description" of the tt*-equation for the SU(2)k-fusion ring. We apply the DPW method, and we describe the solution by the corresponding holomorphic data. Our third result makes explicit use of representations for SU(2). We give a correspondence between solutions and representations.

13:00–14:00 Talk Invited by Geometry Section

Kenji Fukaya (Tsinghua Univ.)♭ A infinity functor and its geometric application

Summary: I will report several geometric application of the notion of A infinity functor

March 20th (Thu) Conference Room I

9:30–11:30

21 Fumika Mizoguchi (Osaka Metro. Univ.) Two-step nilpotent Lie algebras obtained by quivers and geometric structures ····· 15

Summary: In the study of geometric structures on nilmanifolds, two-step nilpotent Lie algebras obtained by graphs play an important role. Recently, additional examples of nilpotent Lie algebras have been constructed from finite quivers without cycles. These latter examples can have arbitrarily high degrees of nilpotency, and admit Riemannian Ricci soliton metrics. In this talk, we study nilpotent Lie algebras obtained by finite quivers without cycles that are two-step nilpotent, and we prove that they can also be obtained by graphs. Using this relationship, we demonstrate that every two-step nilpotent Lie algebra obtained by a finite quiver without cycles admits a pseudo-Riemannian Ricci-flat metric.Additionally, we also classify these nilpotent Lie algebras that admit symplectic structures.

Summary: We show all of polars of Pin^c groups and related compact Lie groups,which are not necessarily connected.

Summary: A Lie group is almost abelian if it has a commutative normal subgroup of codimension one. In this talk, we show a classification theorem for Ricci-flat left-invariant Lorentzian metrics on almost abelian Lie groups. As an application, we introduce the vacuum solution corresponding to a higher dimensional version of the Petrov solution, which is one of the classical solutions in relativity. The Petrov solution is the only vacuum solution of Einstein equations admitting a simply-transitive four-dimensional maximal group of isometry. This talk is based on joint work with Takanao Tsuyuki (Hokkaido Information University).

Summary: For an n-dimensional immersed compact submanifold in Euclidean space $\mathbb{R}^{n+r}$, it is known that the total absolute curvature is greater than or equal to the sum of the Betti numbers. Moreover, the total absolute curvature is equal to 2 if and only if the submanifold is a convex hypersurface embedded in an affine $(n+1)$-subspace of $\mathbb{R}^{n+r}$ (the Chern–Lashof theorem). In this talk, we show a Chern–Lashof type theorem for submanifolds with singularities (called frontals) in Euclidean space. The total absolute curvature is greater than or equal to the sum of the Betti numbers. Furthermore, if the total absolute curvature is equal to 2 and all singularities are of the first kind, then the image of the frontal coincides with a closed convex body of an affine n-subspace of $\mathbb{R}^{n+r}$.

Summary: In this talk, we study symmetric triads with multiplicities constructed from commutative compact symmetric triads. Although our results were presented at the MSJ Autumn Meeting 2019, we will further explore the double Satake diagrams from the perspective of Vogan diagrams. This approach demonstrates that the isomorphism classes of symmetric triads with multiplicities can be determined more directly from the double Satake diagrams.

Summary: As a generalization of Einstein metrics, A. Gray introduced a notion of Einstein-like metrics in 1978. A reimannian metric g is said to be Einstein-like metrics of type $\mathscr{B}$, if Ricci tensor r of the metric g is a Codazzi tensor. We consider invariant metrics on compact homogeneous spaces. It is not difficult to see that, for generalized flag manifolds G/K with second Betti number $b_2(G/K) = 1$, invariant Einstein-like metrics of type $\mathscr{B}$ are Einstein. We show that, for generalized flag manifolds G/K with second Betti number $b_2(G/K) = 2$ and isotropy summands $\nu \leq 10$, the same holds.

14:15–17:15

Summary: I will report that two geometric optimization problems which are Lagrange dual to each other can be solved for the Berger spheres.

Summary: Given an edge-length parameter on a finite graph, we construct a vertex-weight and an edge-weight from it and define the corresponding graph Laplacian. We consider a maximization of the first nonzero eigenvalue of the graph Laplacian over all edge-length parameters subject to a normalization. We prove that the supremum of the first nonzero eigenvalue diverges for an arbitrary graph containing a cycle as a subgraph.

Summary: Given a Riemannian submersion $(M, g) \to (B, j)$ each of whose fiber is connected and totally geodesic, we consider a certain 1-parameter family of Riemannian metrics $(g_t)_{t>0}$ on M, which is called the canonical deformation. We prove that if each fiber is Einstein and (M, g) satisfies a certain condition about its Ricci curvature, then the scale-invariant quantity $\lambda_1(g_t)\mathrm{Vol}(M, g_t)^{2/\dim M}$ goes to ∞ with t. As examples, we consider Riemannian submersions from compact rank one symmetric spaces and the twistor fibration of a quaternionic Kähler manifold of positive scalar curvature.

Summary: The spheres S^{2m+1} and S^{4m+3} can be represented as homogeneous spaces $\mathrm{SU}(m+1)/\mathrm{SU(m)}$ and $\mathrm{Sp}(m+1)/\mathrm{Sp(m)}$, respectively. We classify $\mathrm{SU}(m+1)$ or $\mathrm{Sp}(m+1)$-equivariant harmonic maps of spheres to spheres. Though we can explicitly describe the moduli spaces of those maps, the dimension of them will be given in this talk. As a result, "identity theorem" emerges in both cases.

Summary: This paper investigates the evolution of space curves governed by the Pohlmeyer–Lund–Regge (PLR) equation, an integrable system that generalizes the sine-Gordon equation with applications in geometry and field theory. Using the Frenet frame and its associated differential equations, we derive the evolution equations for the curvature and torsion of space curves under PLR evolution. We then reformulate these equations in terms of a 2×2 matrix representation, establishing a correspondence between the evolution of the Frenet frame and the Lax system of the PLR equation. This formulation introduces a complex function analogous to the Hasimoto transformation used in the nonlinear Schrödinger equation. Finally, we present explicit N-soliton solutions and illustrate the geometric evolution of the curves and the surfaces they generate.

Summary: We show that the Morse index of an unstable closed minimal hypersurface Σ in a compact semi-simple Riemannian symmetric space $M = G/K$ is bounded from below by constant times the first Betti number of Σ.

Summary: The relationship between Lie–Poisson algebras and deformation quantization has been known for a long time. It turns out that there has been very little research on this in the context of fuzzy spaces or matrix regularization. In this paper, we consider quantization in a broad sense to include matrix regularization, and we construct a general theory of Lie–Poisson algebra quantization. As a concrete example, we deal with cases that have not been known before, such as the case of su(3) with Lie–Poisson structure.

Summary: In this talk, we consider graphical translators and graphical rotating solitons for the mean curvature flow. First, we classify the shapes of translators given by the graphs of functions on the rank one symmetric space which are invariant under the isotropy action. Next, in the case where the symmetric space is of higher rank, we investigate translators given by the graphs of functions on the symmetric space which are invariant under the Hermann action of cohomogeneity two. Finally, we state rotating solitons given by graphs of functions on the symmetric space which are invariant under the cohomogeneity one action.

Summary: We study the curve shortening flow on surfaces with warped product metrics. Specifically, we consider a warped product of a unit circle and an open interval with a strictly increasing warping function. In this setting, a graph property can be defined for curves within these warped products. It is known that this graph property is preserved under the curve shortening flow. In this talk, we will explain that, under the curve shortening flow, the curve becomes a graph in finite time.

March 21st (Fri) Conference Room I

9:30–11:45

Summary: We seek the compactness theorem of the Rellich–Kondrachov type for mappings between metric spaces. The Rellich–Kondrachov theorem asserts that if we impost additional regularity on a sequence of mapping bounded in Lebesgue space, then a converging subsequence exists. In the classical situation, the regularity refers to integrable weak derivatives. Weak derivatives are not available for metric spaces, so a notion of metric gradient is involved. We aim to make our formulation abstract but, at the same time, include classical results. The last might help understand the geometrical background of the Rellich–Kondrachov theorem.

Summary: In this talk, for a metrizable space Z, we consider the space of metrics that generate the same topology of Z, and that space of metrics is equipped with the supremum metrics. For a metrizable space X and a closed subset A of it, we construct a map E from the space of metrics on A into the space of metrics on X such that E is an extensor of metrics and preserves the supremum metrics between metrics.

Summary: Given a metrizable space X, let $\mathrm{Met}(X)$ be the space of admissible metrics on X with the sup-metric, and $\mathrm{BMet}(X)$ be the subspace consisting of bounded metrics. In this talk, we shall investigate the isometric universality of $\mathrm{Met}(X)$ and $\mathrm{BMet}(X)$. If there exists a continuous surjection from X to the Hilbert cube, then $\mathrm{BMet}(X)$ is isometrically universal for the class of totally bounded metric spaces. For every infinite cardinal κ, $\mathrm{Met}(\kappa)$ is isometrically universal for metric spaces of weight κ. On the other hand, if X is countable and compact, then $\mathrm{Met}(X)$ is not isometrically universal for the class of compact metric spaces.

Summary: We show that the "higher dimensional version" of Thompson group V has a linear divergence function. Roughly speaking, the divergence function of a finitely generated group is the function that is the length of the path connecting two points at the same distance from the origin while avoiding a small ball with the center at the origin in its Cayley graph. This function represents a "degree of connectedness at the infinity" of Cayley graphs.

Summary: A coarsely convex space is a class of metric space of non-positive curvature that includes Busemann spaces. Hosaka in 2002 introduced geometrically finite groups acting on Busemann spaces and studied their properties. Based on this work, we define geometrically finite groups acting on coarsely convex spaces and study their properties.

Summary: In sub-Riemannian geometry, it has been actively studied whether a Carnot group satisfies the Measure Contraction Property $MCP(0,N)$, and what the optimal value N is. In this context, we consider this problem for sub-Finsler Heisenberg groups. First, we observe the conditions under which the MCP holds, focusing on the smoothness and convexity of the sub-Finsler norm. Next, we show that for any $N \geq 5$, there exists a sub-Finsler structure on the Heisenberg group that satisfies $MCP(0,N)$, and that the equality $N = 5$ is achieved if and only if the metric is sub-Riemannian.

Summary: A horoboundary is one of the attempts to compactify metric spaces, and is constructed using continuous functions on metric spaces. It is a concept that include global information of metric spaces, and its correspondence with an ideal boundary constructed using geodesics has been studied in nonpositive curvature spaces such as CAT(0) spaces and geodesic Gromov hyperbolic spaces. In this talk, I will introduce a certain correspondence between the horoboundary and the ideal boundary of "coarsely convex spaces", which can be regarded as a generalization of nonpositive curvature spaces.

14:15–15:15

Summary: Siegel demonstrated that the $(2, 3, 7)$-triangle group is the orientable 2-dimensional hyperbolic orbifold group with the smallest covolume. He also posed the problem of determining the hyperbolic orbifold group with the smallest covolume in each dimension, known as Siegel's problem. In this talk, we consider Siegel's problem for the growth rate instead of the covolume and present the 10-dimensional hyperbolic Coxeter group with the smallest growth rate.

Summary: We prove that a crossed product associated with an action of a totally disconnected locally compact group on a compact space is simple if the action is minimal, topologically free, and free when it is restricted to some compact open subgroup. We also prove a partial converse of this result.

Summary: We establish a family of inequalities that hold true on any 6 points in any CAT(0) space. We prove that the validity of these inequalities does not follow from any properties of 5-point subsets of CAT(0) spaces. In particular, the validity of these inequalities does not follow from the CAT(0) 4-point condition.

15:30–16:30 Talk Invited by Geometry Section

Summary: I will summarize recent developments in the theory of invariant quasimorphisms, including applications to coarse geometry and symplectic geometry.

Complex Analysis

March 18th (Tue) Conference Room IV

9:30–11:40

1 Toshiyuki Sugawa (Tohoku Univ.)
Li-Mei Wang
(Univ. of Int. Business and Econ.)
Hypergeometric functions and Hausdorff moment sequences ····· 15

Summary: Pólya showed in 1926 that the hypergeometric function $F(z) = F(a, b; c; z)$ has a totally monotone sequence as its coefficients; that is, F is the generating function of a Hausdorff moment sequence, when $0 \le a \le 1$ and $0 \le b \le c$. In this paper, we give a complete characterization of such hypergeometric functions F in terms of complex parameters a, b, c. As an application, we give also a necessary and sufficient condition for a hypergeometric function to be universally starlike.

2 Keisuke Soma (Waseda Univ.)
Yohei Komori (Waseda Univ.)
On the Dirichlet fundamental domains for n-gon groups ····· 15

Summary: We will characterize the number of sides of the Dirichlet fundamental domain for n-gon group in terms of the position of the base point.

3 Ryo Matsuda (Kyoto Univ.) ♭
David maps and Teichmüller theory ····· 15

Summary: One way to define Teichmüller space is to use quasiconformal maps. By the measurable Riemannian mapping theorem, quasiconformal maps can be obtained as a solution to the partial differential equation $f_z = \mu f_{\bar{z}}$, where the Beltrami coefficient μ is a measurable function satisfying $\|\mu\|_{L^\infty} < 1$. Even in the degenerate case where $\|\mu\|_{L^\infty} = 1$, it is known that $f_z = \mu f_{\bar{z}}$ has a solution. Therefore, I would like to talk about some results that aim to construct "slightly bigger Teichmüller spaces" than before, including such degenerate phenomena.

4 Hideki Miyachi (Kanazawa Univ.)
Boounded pluriharmonic functions and holomorphic functions on Teichmüller space and non-ergodicity of the action of the torelli group on the space of projective measured laminations ····· 15

Summary: In this talk, I will give versions of the Fatou theorem and F. and M. Riesz theorem for bounded pluriharmonic functions and holomorphic functions on Teichmüller space. Applying these theorems, we will show that the action of the Torelli group on the space of projective measured laminations is not ergodic.

5 Hideki Miyachi (Kanazawa Univ.)
Second order infinitesimal spaces on Teichmüller space and duality between the Teichmüller metric and the L^1-norm for holomorphic quadratic differentials ····· 15

Summary: In this talk, I will introduce the second order infinitesimal spaces on the Teichmüller space of closed Riemann surfaces of genus $g \ge 2$, and give their basic properties. I will also discuss the duality between the Teichmüller metric and the L^1-norm functions on the holomorphic vector bundle of holomorphic quadratic differentials over the Teichmüller space.

6 Katsuhiko Matsuzaki (Waseda Univ.)
Teichmüller space of diffeomorphisms on the real line with bi-Lipschitz continuity ····· 15

Summary: The Teichmüller spaces of orientation-preserving diffeomorphisms of the unit circle with Hölder continuous derivatives, as well as those of diffeomorphisms with continuous derivatives satisfying the Zygmund condition, have been previously studied. In this talk, we discuss the challenges in defining analogous Teichmüller spaces for diffeomorphisms of the real line, propose solutions to these challenges, and explore their applications to the Teichmüller space in the case of Zygmund continuous derivatives.

7 Hiroshige Shiga (Kyoto Sangyo Univ. / Sci. Tokyo*) — On moduli spaces of Cantor sets 10

Summary: Let $\omega = (q_n)_{n=1}^{\infty}$ be an element of $(0,1)^{\mathbb{N}}$. Then, we can define a generalized Cantor set $E(\omega)$ on the unit interval $[0,1]$ of $\mathbb{R}$. In this talk, we consider the moduli space $M(\omega)$ of ω and show some properties of the space.

8 Yoshihiko Mitsumatsu (Chuo Univ.), Teruaki Kitano (Soka Univ.), Shigeyuki Morita (Univ. of Tokyo*/Sci. Tokyo*) — On the structure around fixed points of one dimensional real analytic diffeomorphisms 15

Summary: For a real analytic diffeomorphism f of a neighborhood of the origin of the real line $\mathbb{R}$ satisfying $f(0) = 0$ and $f'(0) > 0$, there exists a unique one to one correspondence of points in the region $x < 0$ and those in $x > 0$. This fact is shown by applying the parabolic linearization of the dynamics in one complex variable.

14:20–15:20 Talk Invited by Complex Analysis Section

Shun Kumagai (Hachinohe Inst. of Tech.) — Galois action on Teichmüller curves and related combinatorial objects

Summary: In 2005, Möller pointed out that the embedding of the family of affine deformations of an origami (square-tiled surface) into the moduli space is arithmetic. He presented the Galois–Teichmüller theory on a particular origami and showed another proof of the $\widehat{GT}$-relation of the absolute Galois group $G_{\mathbb{Q}}$. The embedded curve (Teichmüller curve) admits a Fuchsian model of the group of affine self-symmetry called the Veech group. In this talk, we present an overview of Möller's theory and discuss the Veech groups in this context using combinatorial objects such as dessins, origamis, and tile structures. We study covering relations of origamis and their Teichmüller curves by introducing tile structures.

15:40–16:30

9 Takanori Ayano (Osaka Metro. Univ.), Victor M. Buchstaber (Steklov Math. Inst.) — A solution of the KP equation in terms of the abelian function of a real hyperelliptic curve 15

Summary: A hyperelliptic curve with an even degree polynomial is called a real hyperelliptic curve. A hyperelliptic curve with an odd degree polynomial is called an imaginary hyperelliptic curve. It is well known that the abelian functions of imaginary hyperelliptic curves satisfy the KdV equation and the KP equation. Baker defined the fundamental abelian functions of real hyperelliptic curves and gave differential relations of these functions explicitly for genus 3. By using this result, for genus 3, Matsutani proved that the abelian function of a real hyperelliptic curve satisfies the KP equation. In this talk, for any genus, we will give differential relations of the abelian functions of real hyperelliptic curves explicitly and prove that the abelian function of a real hyperelliptic curve satisfies the KP equation.

10 Tomoki Kawahira (Hitotsubashi Univ.) — Zalcman's lemma in higher dimensions and applications in two-dimensional complex dynamics 15

Summary: In this talk, we present a formalization of a higher dimensional version of Zalcman's rescaling principle for non-normal families of holomorphic functions. We then apply this framework to the dynamics of holomorphic diffeomorphisms of $\mathbb{C}^2$, constructing hyperbolic 3-dimensional laminations inspired by the work of Lyubich and Minsky. This provides a new insight to the notion of quasi-expansion, as introduced by Bedford and Smillie.

11 Tatsuhiro Honda (Senshu Univ.)
Hidetaka Hamada (Kyushu Sangyo Univ.)
Bohr's phenomena in several complex variables 15

Summary: In this talk, we will discuss about several Bohr radii for holomorphic mappings with values in the unit polydisc $\mathbb{U}^N$ in $\mathbb{C}^N$. In particular, we obtain the new Bohr radius for a holomorphic mapping F with $F(z) = P_m(z) + \sum_{s=p}^{\infty} P_s(z)$, for $z \in \mathbb{U}^N$, where $P_s(z) = \frac{1}{s!} D^s F(0)(z^s)$. When $m \geq 1$, the Bohr radius is asymptotically sharp as $N \to \infty$. Note that when $m \geq 1$, the Bohr radius is completely different from the cases with values in the unit disc $\mathbb{U}$ and in the complex Hilbert balls with higher dimensions.

March 19th (Wed) Conference Room IV

9:30–11:40

12 Shaolin Chen (Hengyang Normal Univ.)
Hidetaka Hamada (Kyushu Sangyo Univ.)
Dou Xie (Hengyang Normal Univ.)
Hardy–Littlewood type theorems for the Dirichlet solution of a differential operator 15

Summary: The main aim of this talk is to investigate Hardy–Littlewood type theorems on functions induced by a differential operator. We first prove more general Hardy–Littlewood type theorems for the Dirichlet solution of a differential operator which depends on $\alpha \in (-1, \infty)$ over the unit ball $\mathbb{B}^n$ of $\mathbb{R}^n$ with $n \geq 2$, related to the Lipschitz type space defined by a majorant which satisfies some assumption. We find that the case $\alpha \in (0, \infty)$ is completely different from the case $\alpha = 0$ due to Dyakonov (Adv. Math. 187 (2004), 146–172).

13 Shaolin Chen (Hengyang Normal Univ.)
Hidetaka Hamada (Kyushu Sangyo Univ.)
Dou Xie (Hengyang Normal Univ.)
A Hopf type lemma for the Dirichlet solution of a differential operator 10

Summary: The main aim of this talk is to investigate a Hopf type lemma on functions induced by a differential operator. A general Hopf type lemma for the Dirichlet solution of a differential operator which depends on $\alpha \in (-1, \infty)$ over the unit ball $\mathbb{B}^n$ of $\mathbb{R}^n$ will be established in the case $\alpha > n - 2$.

14 Shaolin Chen (Hengyang Normal Univ.)
Hidetaka Hamada (Kyushu Sangyo Univ.)
Characterizations of pluriharmonic Bloch functions in bounded symmetric domains 15

Summary: Let $\mathbb{B}_X$ be a bounded symmetric domain realized as the open unit ball of a JB*-triple X. The aim of this talk is to give several characterizations of pluriharmonic Bloch functions on $\mathbb{B}_X$ and give an application to composition operators between pluriharmonic Bloch spaces.

15 Ian Graham (Univ. of Toronto)
Hidetaka Hamada (Kyushu Sangyo Univ.)
Gabriela Kohr (Babeş-Bolyai Univ.)
Mirela Kohr (Babeş-Bolyai Univ.)
Subordination chains in infinite dimensions 15

Summary: In 2013, Graham, Hamada, Kohr and Kohr studied A-normalized univalent subordination chains and the Loewner PDE on a reflexive complex Banach space. They also gave some conjectures and questions on A-normalized univalent subordination chains. In this talk, we give some positive answers to the above conjectures and questions in separable reflexive complex Banach spaces.

16 Shota Kikuchi (Suzuka Nat. Coll. of Tech.) On the Ohsawa–Takegoshi L^2-extension theorem by using Azukawa pseudometrics 15

Summary: The Azukawa pseudometric is a function defined from the pluricomplex Green function with a pole at a point, and it generalized the Robin constant defined from the classical Green function. In this talk, I explain about the Azukawa pseudometric defined from the pluricomplex Green function with poles along subvarieties, and its application to the Ohsawa–Takegoshi L^2-extension theorem.

17 Shun Sugiyama (Nat. Inst. of Tech., Kitakyushu Coll.) q-complete with corners open sets and vanishing cohomology groups 15

Summary: Let X be a reduced Stein space of pure dimension n, D an open set in X, and q an integer such that $1 \leq q \leq n$. Assume that $H^{n-1}(D, \mathcal{O}) \to H^{n-1}(D, \mathcal{M})$ is injective and $H^k(D, \mathcal{O}) = 0$ for every $k = q, \ldots, n-2$. Then we prove that D is locally q-complete with corners at every point $x \in \partial D \setminus \mathrm{Sing}(X)$. As a corollary, we obtain Eastwood–Vigna Suria's theorem and a new characterization theorem of Steinness.

18 Takeo Ohsawa (Nagoya Univ.)♭ Hyperconvex submanifolds have hyperconvex neighborhoods 15

Summary: It will be reported that a method of constructing a locally hyperconvex neighborhood of a very special nonhyperconvex domain works of constructing a locally hyperconvex neighborhood of a very special nonhyperconvex

19 Takeo Ohsawa (Nagoya Univ.)♭ Solving a generalized Levi problem on weakly 1-complete manifolds 15

Summary: By extending the solutions of the Levi problem by Oka and Grauert, a generalized Levi problem suggested by Grauert will be solved by the L^2 method of Andreotti–Vesentini and Hörmander.

13:00–14:00 Talk Invited by Complex Analysis Section

Masataka Iwai (Osaka Univ.)♭ On the inequalities of Chern classes and the structure theorem

Summary: It has been shown by Miyaoka and Yau that, for any n-dimensional complex projective manifold X with a positive canonical bundle, the Miyaoka–Yau inequality $2(n+1)c_2(X)c_1(X)^{n-2} \geq nc_1(X)^n$ holds. Moreover, if the equality holds in the Miyaoka–Yau inequality, the universal cover of X is a unit ball in $\mathbb{C}^n$. In this talk, I will present some inequalities of Chern classes and the structure theorem in the case of equality. This talk is based on a joint work with Shin-ichi Matsumura (Tohoku University) and Niklas Muller (Essen University).

Functional Equations

March 18th (Tue) Conference Room V

9:00–12:00

1 Hiroshi Ogawara (Josai Univ.) Differential transcendence of general solutions to Mahler-type difference Riccati equations ····· 12

Summary: Nishioka constructed a criterion for differential transcendence of general solutions to difference Riccati equations over difference fields. In this talk, we simplify Nishioka's criterion concerning Mahler-type transforming operators.

2 Toshio Oshima (Josai Univ.) Resolution of singularities and middle convolutions of KZ-type equations ····· 12

Summary: We introduce an extension of the generalized Riemann scheme of Fuchsian ordinary differential equations in the case of KZ-type equations. It describes the local structure of the equations obtained by resolution of singularities of KZ-type equations. We give the transformation of the extension under middle convolutions. Then we get the corresponding transformation of the eigenvalues and their multiplicities of the residue matrices of KZ-type equations under the middle convolution. The result is interpreted by combinatorics of single-eliminated tournaments.

3 Kosuke Shibuya (Tohoku Univ.)♭ Brezis–Van Schaftingen–Yung formula on balls and its applications ··· 12

Summary: Brezis–Van Schaftingen–Yung characterized the Sobolev semi-norm in a whole new way, replacing the L^p norm of the Gagliardo–Slobodeckij semi-norm with the weak L^p norm. In this talk we extend the formula to open balls in $\mathbb{R}^N$ and as a corollary, establish the same formula for some function classes, the Morrey space and the uniformly local Lebesgue space.

4 Takashi Suzuki (Osaka Univ.) Hodge decomposition on bounded domains in Euclidean space ····· 5

Summary: We show the Hodge decomposition on bounded domains in Euclidean space in any space dimension. Relations between the classical results on closed manifold and recent study on three space dimension is also discussed. l

5 Ryuji Kajikiya (Osaka Electro-Comm. Univ.) Sobolev compact embeddings in unbounded domains ····· 12

Summary: We study the compact embedding of the Sobolev space $W_0^{m,p}(\Omega)$ in $L^q(\Omega)$ or in $BC^{k,\theta}(\Omega)$ for unbounded domains Ω. If Ω is bounded, these embeddings are compact. However, if Ω is unbounded, it is not necessarily compact. We give a necessary and sufficient condition of the compact embedding for unbounded domains Ω.

6 Ryuji Kajikiya (Osaka Electro-Comm. Univ.) The Poincaré inequality and its applications. ····· 12

Summary: The aim of this lecture is to construct examples of unbounded domains Ω for which the Sobolev space $W_0^{m,p}(\Omega)$ is compactly embedded in $L^q(\Omega)$ or in $BC^{k,\theta}(\Omega)$. Another purpose is to study an elliptic equation in an unbounded domain and to prove the existence of a positive solution and infinitely many solutions.

Summary: The Möbius energies for knots and 2-component links are considered. It is known that these energies have the Möbius-invariant decomposition. There are many expressions of decomposed energies. Among of them, the second decomposed energy can be expressed via the Gauss map directly or in directly. Conventionally, the expression via Gauss map on the original energy and the first decomposed energy was known only the indirect one. In this talk, a direct expression of the first decomposed energy and the original energy are demonstrated.

Summary: In the previous talk, the Möbius energies for knots and 2-component were considered, and energy expressions via Gauss map are demonstrated. The existence of minimizers of these energies depends on the topology of knot classes or link classes. This suggests that the Euler–Lagrange equation contains terms of coefficients including information of topology. In case of links, the mapping degree of Gauss map is the linking number. In this sense, the Gauss map contains information of topology.
As an application of direct expressions, we derive the first variational formulas making use of the Gauss map. The formulas are already known, however, they have easier viewing than already-known expressions by use of the Gauss map.

Summary: We consider the equation $\Delta_{\mathbb{S}^n} U - \lambda U + U^p = 0$, $U > 0$ in $\mathbb{S}^n$, where $\Delta_{\mathbb{S}^n}$ is the Laplace–Beltrami operator on $\mathbb{S}^n$, $n \geq 3$, $\lambda > 0$, and $p > 1$. We prove the existence of a sequence $\{\lambda_m\}$ that m positive entire solutions of the equation exist if $\lambda > \lambda_m$.

Summary: We consider the problem $\Delta_{\mathbb{S}^N} u + u^p = 0$ in $\Omega_{\theta_1,\theta_2}$, $u = 0$ on $\partial\Omega_{\theta_1,\theta_2}$, where $\mathbb{S}^N$ is the Laplace–Beltrami operator on $\mathbb{S}^N$, $N \geq 3$, $p > 1$, and $\Omega_{\theta_1,\theta_2}$ is a spherical band. We establish sufficient conditions for the uniqueness and nonuniqueness of positive solutions only depending on the geodesic distance.

Summary: We consider the problem $-\Delta u = |g|^{\alpha-1} g u^p$, $u > 0$, in Ω; $u = 0$ on $\partial\Omega$, where $N \geq 1$, $\Omega \subset \mathbb{R}^N$ is a bounded domain with piecewise smooth boundary $\partial\Omega$, $g \in L^\infty(\Omega)$ and $|\{x \in \Omega \mid g(x) > 0\}| > 0$, Ω and g are reflectionally symmetric with respect to the hyperplane $x_1 = 0$, $\alpha \geq 1$, $1 < p < \infty$ when $N = 1, 2$, $1 < p < (N+2)/(N-2)$ when $N \geq 3$. We estimate the energy of least energy solutions and show that the solution is asymmetric for α large enough.

Summary: We get the rigidity results for a class quasilinear p-Laplace type equation on the sphere. Rigidity means that the elliptic equation has no other solution than some constants at least when a parameter is in a certain range. This p-Laplace type equation arises from the study of asymptotic behavior near the origin for the semilinear p-Laplace equation on the punctured ball. Our result gives a positive answer to L. Veron's question in a paper 1992 and his book 2017 at page 440.

14:15–16:45

Summary: We deal with a four-component reaction-diffusion system with mass conservation in a bounded domain with the Neumann boundary condition. This system serves as a model describing the segregation pattern which emerges during the maintenance phase of asymmetric cell devision. By utilizing the mass conservation, the stationary problem of the system is reduced to a two-component elliptic system with nonlocal terms, formulated as the Euler–Lagrange equation of an energy functional. We first establish the spectral comparison theorem, relating the stability/instability of equilibrium solutions to the four-component system to that of the two-component system. Subsequently, with an appropriate scaling, we prove a Γ-convergence of the energy functional. Furthermore, in a cylindrical domain, we prove the existence of equilibrium solutions with monotone profile representing a segregation pattern.

Summary: For bifurcation analysis, we study the positive solution set for a semilinear elliptic equation of the logistic type, equipped with a sublinear boundary condition modeling coastal fishery harvesting. Non resonant and resonant cases are considered, where we investigate the existence, uniqueness, multiplicity of positive solutions, and their asymptotic profiles as a parameter varying.

Summary: We study the existence of ground states without restricting ourselves to the space of radial functions for a class of fourth order nonlinear elliptic systems. Although neither the maximum principle nor the Schwarz symmetric rearrangement can be applied to our problem, as usually performed for second order problems, we remove the radial symmetry by applying the Fourier rearrangement. A classification whether the ground states are semi-trivial or fully-nontrivial is also presented. Our results complement those given by Alvarez-Caudevilla, Colorado and Galaktionov(2015).

Summary: We study the nonlocal nonlinear elliptic problem with a doping profile. We are interested in the existence of ground state solutions by considering the minimization problem on a Nehari–Pohozaev set. The presence of a doping profile causes several difficulties, especially in the proof of the uniqueness of a maximum point of a fibering map. When the doping profile is a characteristic function supported on a bounded smooth domain, some geometric quantities related to the domain, such as the mean curvature, are responsible for the existence of ground state solutions.

Summary: We study the nonlinear scalar field equation with a point interaction at the origin in dimensions two and three. By applying the mountain pass theorem and the technique of adding one dimensional space, we prove the existence of a nontrivial singular solution for a wide class of nonlinearities. We also establish the Pohozaev identity by proving a pointwise estimate of the gradient near the origin. Some qualitative properties of nontrivial solutions are also given.

Summary: In this talk, we study the multiplicity of solutions for a nonlinear Schrödinger system with three wave interaction for sufficiently large coupling parameter under the space of radially symmetric functions. In addition, we also study the property of critical values.

Summary: In this talk, I will discuss the linear stability of defect solution, one of modulated traveling wave solutions of the reaction-diffusion system. The solution is a spatio-temporal pattern, and by considering the solution in a appropriate moving frame system, it becomes a time periodic solution. Moreover, the defect is a solution that asymptotically approaches wave trains, which is a periodic solution at plus-minus infinity, and its stability problem is important. In this study, we construct the Evans function and report its relation to the eigenvalues of the periodic map.

Summary: We consider a modulated traveling wave called a defect in a reaction-diffusion system. Such a solution is a modulated wave that asymptotically approaches a wave train at infinity. Therefore, it can be discussed in the same way as traveling pulse, which is composed by connecting two front type traveling waves. The problem is that the phase space becomes an infinite dimensional space when the problem is reduced to the existence of heteroclinic solutions of vector fields. In this talk, I will report the results obtained for the existence problem of a certain type of defect and the analytical method used.

Summary: We are interested in the Neumann problem of a 1D stationary Allen–Cahn equation with a nonlocal term. We obtained the global bifurcation diagram of stationary solutions, which includes the secondary bifurcation from the odd-symmetric solution due to the symmetric breaking effect. Moreover, we derived the stability and instability of all symmetric solutions. However, stability and instability of asymmetric solutions is not clarified. In this talk, we investigate the stability of asymmetric solutions near the secondary bifurcation point by solving the nonlocal linearized eigenvalue problem improving and developing methods in Miyamoto–Mori–Tsujikawa–Yotsutani (JDE, 2021), and Miyamoto–Mori–Tasaki–Tsujikawa–Yotsutani (preprint).

Summary: We study polyhedral entire solutions to a bistable reaction-diffusion equation in $\mathbb{R}^n$. We consider a pyramidal traveling front solution to the same equation in $\mathbb{R}^{n+1}$. As the speed goes to infinity, its projection converges to an n-dimensional polyhedral entire solution. Conversely, as the time goes to $-\infty$, an n-dimensional polyhedral entire solution gives n-dimensional pyramidal traveling front solutions. This result suggests a correlation between traveling front solutions and entire solutions in general reaction-diffusion equations or systems.

17:00–18:00 Talk Invited by Functional Equations Section

Michiaki Inaba (Nara Women's Univ.) Moduli space of rational connections and the geometry of Painlevé equations

Summary: It is known that the sixth Painlevé equations are obtained as the isomonodromic deformation of second order linear ordinary differential equations with 4 simple poles on the complex projective line. In the framework of Jimbo–Miwa–Ueno, the isomonodromic deformation is extended to the irregular singular cases, from which the other types of Painlevé equations of the first to fifth types can be obtained.
In this talk, we consider the moduli theoretic construction of this isomonodromic deformation. In the joint work with Iwasaki and Saito, we constructed the moduli space of logarithmic parabolic connections on the projective line and derived the Painlevé equations as the isomonodromic deformation in a special case. This procedure can be extended to irregular singular cases, but we needed to overcome the difficulty of formulating the moduli problem in the ramified irregular singular case. We will briefly see its idea.
In the framework of Sakai, the Painlevé equations are derived from the classification of a certain kind of algebraic rational surfaces. In the case of the sixth Painlevé equations, the corresponding rational surface is a compactification of the Okamoto's space of initial conditions of the sixth Painlevé equations. In the joint work with Iwasaki and Saito, we constructed this compactification as a moduli space of ϕ-connections in the logarithmic case. In ongoing collaboration with Komyo, the speaker is trying to extend this procedure to the irregular singular cases. We will also look at its partial idea.

March 19th (Wed) Conference Room V

9:00–12:00

23 Shingo Takeuchi (Shibaura Inst. of Tech.)
Nagi Suzuki (Shibaura Inst. of Tech.)
Generalization of the complete elliptic integrals and the Legendre relation by the eigenfunctions of p-Laplacian ····· 12

Summary: The complete elliptic integrals, together with Jacobi elliptic functions, are effective integral quantities in expressing exact solutions of nonlinear differential equations. In this talk, we report a generalization of the complete elliptic integrals and the Legendre relation by the eigenfunctions of p-Laplacian.

24 Hiroshi Wakui (Univ. of Fukui)
Tetsuya Yamada (Fukui Nat. Coll. of Tech.)
Stability of constant steady states of a drift-diffusion equation with an attraction-repulsion drift term ····· 12

Summary: In this talk, we consider stability of constant steady states of a drift-diffusion equation with an attraction-repulsion drift term. Our problem has infinitely many constant steady states. When the problem has an attraction type drift term, the constant steady states is stable for suitable constant range. On the other hand, stability of arbitrary constant steady states is induced by a repulsion type drift term. We will show that an attraction-repulsion type drift term leads to an abundant structure of constant steady states.

25 Shohei Kohatsu (Tokyo Univ. of Sci.)
Takasi Senba (Fukuoka Univ.)
Forward self-similar solutions and stationary solutions to flux-limited Keller–Segel systems ····· 12

Summary: We consider radial forward self-similar solutions to flux-limited Keller–Segel systems, and establish global existence of solutions from measure-valued initial data, such as the Dirac measure. We also apply the method for construction of forward self-similar solutions to the stationary problem.

26 Shohei Kohatsu (Tokyo Univ. of Sci.)
Takasi Senba (Fukuoka Univ.)
Critical mass and stability of stationary solutions to flux-limited Keller–Segel systems ····· 12

Summary: We first determine critical mass of initial data in flux-limited Keller–Segel systems with critical blow-up exponent. We then consider the system with initial data having that critical mass, and establish stability of stationary solutions. These results generalize the 8π-problem in the classical Keller–Segel system.

27 Masahiko Shimojo (Tokyo Metro. Univ.)
Jong-Shenq Guo (Tamkang Univ.)
Karen Guo (Providence Univ.)
Convergence to forced waves for the Fisher-KPP equation in a shifting environment · · · · · 12

Summary: This talk aims to investigate the stability of forced waves for the Fisher-KPP equation in a shifting environment, without imposing the monotonicity condition on the shifting intrinsic growth term. A new method is introduced to derive the stability of forced waves under certain perturbations of a class of initial data.

28 Mario Fuest (Leibniz Univ. Hannover)
Yuya Tanaka (Kwansei Gakuin Univ.)
Finite-time blow-up for a three-dimensional chemotaxis-May–Nowak model in the supercritical case · · · · · 12

Summary: A chemotaxis-May–Nowak model was proposed by Stancevic–Angstmann–Murray–Henry in 2013, and for the model, results on boundedness and finite-time blow-up of solutions were obtained by Bellomo–Painter–Tao–Winkler (2019), Winkler (2019) and Tao–Winkler (2021). Moreover, Fuest (2019) introduced a modified model and proved global existence and boundedness of solutions. The purpose of this talk is to show finite-time blow-up in the modified model in the three-dimensional case.

29 Hayato Nakamura (Univ. of Tokyo)
Keisuke Nishigaki (EY Japan)
Yasuhito Miyamoto (Univ. of Tokyo)
Exact periods and exact critical values for Hopf bifurcations from multi-peak solutions of the shadow Gierer–Meinhardt model · · · · · 10

Summary: We consider the shadow Gierer–Meinhardt model. Wei and Winter showed that if $(p, r) = (3, 2)$ or $(2, 2)$, then as τ increases, a stable stationary monotone solution is destabilized by Hopf bifurcation, and hence periodic solutions appear. In this paper we consider two cases $(p, r) = (3, 1)$ and $(3, 3)$. We show that a Hopf bifurcation occurs for n-mode stationary solutions, $n \geq 1$, in a rigorous way, studying eigenvalues in detail. Exact periods and exact critical values of τ can be written by using complete elliptic integrals. A relationship between a period and a shape of a stationary solution is also studied. In particular, a maximum point of the period is studied.

30 Kazuya Hirose (Hokkaido Univ.)
Lower gradient estimates for viscosity solutions to first-order Hamilton–Jacobi equations depending on the unknown function · · · · · 10

Summary: In this talk, we derive the lower bounds for gradients of viscosity solutions to Hamilton–Jacobi equations, where the convex Hamiltonian depends on the unknown function. We obtain several gradient estimates using different methods. First, we utilize the equivalence between viscosity solutions and Barron–Jensen solutions and study the properties of the inf-convolution. Second, we examine the Lie equation to understand how initial gradients propagate along its solutions.

31 Tapio Kurkinen (Okinawa Inst. of Sci. and Tech. Grad. Univ.)
Harnack's inequalities for a nonlinear parabolic equation in non-divergence form · · · · · 10

Summary: We will discuss Harnack-type results for a general form of parabolic equation that generalizes both the standard parabolic p-Laplace equation and the normalized version arising from stochastic game theory. We get Harnack's inequality in both intrinsic and elliptic forms depending on the singularity of the equation and will discuss the optimality of these results.
Based on joint work with Mikko Parviainen and Jarkko Siltakoski.

32 Junichi Harada (Akita Univ.)
Dynamics near the ground states for the Sobolev critical Fujita type heat equation in 6D · · · · · 8

Summary: We will discuss the dynamics near the ground states for the Sobolev critical Fujita type heat equation in 6D. This result gives a 6D version of classification results for a higher dimensional case obtained by Professor Collot–Merle–Raphael. In contrast to their results, our result requires the additional integrability conditions on the initial data.

33 Marius Ghergu (UCD)
Yasuhito Miyamoto (Univ. of Tokyo)
The Gel'fand problem on expanding tubular domains in $\mathbb{R}^2$: Existence and the Morse index of solutions 10

Summary: We discuss the existence and the Morse index of solutions to the Gel'fand problem on $\Omega_R \subset \mathbb{R}^2$, where Ω_R, $R >> 1$, are expanding tubular domains with fixed width. We obtain the existence of an increasing divergent sequence R_k and a corresponding sequence of solutions U_{R_k}. We investigate the energy of such solutions and obtain the asymptotic formula of the Morse index as $k \to \infty$.

13:00–14:00 Award Lecture for the 2024 MSJ Analysis Prize

Yūki Naito (Hiroshima Univ.) Structure of radially symmetric solutions to nonlinear elliptic equations

Summary: We study the structure of radially symmetric solutions to the semilinear elliptic equation $\Delta u + \lambda f(u) = 0$ under general supercritical growth conditions on $f(u)$. First we provide the existence and uniqueness of the singular solution, and show the convergence of regular solutions to the singular solution. Using this results, we next study the global bifurcation diagram of positive solutions to this problem. We show that, under some growth conditions on $f(u)$, an unbounded bifurcation curve has no turning point, which indicates the existence of the singular extremal solution. We also present some other relevant results. Main technical tools are intrinsic transformations for semilinear elliptic equations and ODE techniques, and our theory can be applied for a wide class of nonlinearities in a unified way.

March 20th (Thu) Conference Room V

9:30–12:00

34 Shota Fukushima (Chiba Inst. of Tech.)
Yong-Gwan Ji (Korea Inst. for Adv. Stud.)
Hyeonbae Kang (Inha Univ.)
Xiaofei Li (Zhejiang Univ. of Tech.)
Estimate of electric field around perfect conductors with interface resistance 12

Summary: We place two disk-shaped perfect conductors in a uniform electric field which is parallel to the segment connecting their centers. Then the electric field is perturbed by these conductors. This situation is formulated by the Laplace equation with suitable interface conditions. It is known that the electric field blows up as the conductors approach each other if we pose the continuity of the potential and its flux across the interface. This condition corresponds to the zero interface resistance. If the interface resistance is not zero, then the potential is no longer continuous across the boundary. Our main result is that the electric field remains finite if the conductor has same radii and same non-zero interface resistance.

35 Naoto Kajiwara (Gifu Univ.)
Ken Furukawa (Univ. of Toyama)
Yoshikazu Giga (Univ. of Tokyo)
No formulation of a new phase for a free boundary problem in combustion theory 10

Summary: We consider a free boundary problem for the heat equation with a given non-negative external heat source. On the free boundary, we impose the zero Dirichlet condition and the fixed normal derivative so that heat escapes from the boundary. In various settings, we show that there exist no solutions when the initial temperature equals the fixed temperature no matter where the initial location of the free boundary is given provided that the external heat source is bounded from above. We also note that there is a chance to have a solution when the external temperature is unbounded as time tends to zero by giving a self-similar solution.

Summary: We consider the Cauchy problem for the heat diffusion equation in the whole Euclidean space consisting of two media locally with different constant conductivities, where initially one medium has temperature 0 and the other has temperature 1. Suppose that the interface S is of class C^2 in a neighborhood of a point $x \in S$. Then the mean curvature of S at x can be extracted from the initial behavior of temperature at x. This result is purely local in space. As a corollary, it is shown that if the interface S is stationary isothermic, then the mean curvature of S must be constant.

Summary: We consider the Cauchy problem of the system of derivative nonlinear Schrödinger equations. For non-periodic case, there are some results for the well-posedness of this system. In this talk, we prove the well-posedness of this system for periodic initial data in the Sobolev spaces. The results in this talk contain the well-posedness for the scaling critical initial data. The bilinear Strichartz estimate plays an important role in the scaling critical case. To obtain the bilinear Strichartz estimate, we use the Strichartz estimate on strip domain in frequency space. We also give the convolution estimate which is used in the case that resonance occurs.

Summary: We consider the Cauchy problem of the system of derivative nonlinear Schrödinger equations. In this talk, we prove the ill-posedness of this system for periodic initial data in the Sobolev spaces. When the resonance occurs in High-Low→High interaction, it is difficult to control the singularity in the nonlinear terms. In particular, the singularity for periodic case is stronger than non-periodic case. To obtain the ill-posedness, we consider the solutions to the system which cause the resonance in High-Low→High interaction. We reveal the behavior of such solutions by using the Hamiltonian structure of the system, and obtain the norm inflation or lack of continuity of the flow map.

Summary: We prove several scattering results for dispersion-managed nonlinear Schrödinger equations. In particular, we establish small-data scattering for both 'intercritical' and 'mass-subcritical' powers by suitable modifications of the standard approach via Strichartz estimates. In addition, we prove scattering for arbitrary data in a weighted Sobolev space for intercritical powers by establishing a pseudoconformal energy estimate.

Summary: We consider the initial-boundary value problem of the nonlinear Schrödinger equation on the half spaces with a nonlinear Neumann boundary condition. We show that the local well-posedness for the problem based on the boundary Strichartz estimate for the spatial anisotropic Bochner space. Our results includes not only the case of one and two dimensional case but also the case of three dimensional case.

Summary: We show the discrete version of the Brezis–Gallouet inequality and introduce its application to a structure-preserving finite difference scheme for the cubic nonlinear Schrödinger equation in two-space dimension.

42 Ryo Muramatsu (Tokyo Univ. of Sci.) Well-posedness on modulation spaces for Schrödinger equation with rough magnetic fields ····· 12

Summary: In this talk, we consider the initial value problem of the Schrödinger equation in a magnetic field in the modulation space. E. Cordero, F. Nicola and L. Rodino, in 2015, have shown that the generalized Schrödinger equation containing the equation with a scalar potential is well-posed in the modulation space. In this presentation, we show the well-posedness of the Schrödinger equation in a magnetic field in the cases of non-smooth and decaying magnetic field.

43 Ryo Muramatsu (Tokyo Univ. of Sci.)
Fumihito Abe (J Institute Co., Ltd.) Characterization of the wave front set for the solutions of the Schrödinger equations with magnetic fields ····· 12

Summary: In this talk, we consider the initial value problem of the Schrödinger equation in a magnetic field. We characterized the wave front set for the solutions of the Schrödinger equations with magnetic fields in the case of decaying magnetic fields. Kato, Kobayashi, and Ito have investigated the wave front set for the Schrödinger equation of free particle or with the harmonic oscillator by using their former results about the representation of the solutions for Schrödinger equations. S. Mao has characterized the wave front set for the solutions of the Schrödinger equations with constant or perturbed constant magnetic fields. Our results are some extension of the above results.

14:15–16:45

44 Shunya Hashimoto (Saitama Univ.)
Masaru Hamano (Waseda Univ.)
Shuji Machihara (Saitama Univ.) Global solution for the stochastic nonlinear Schrödinger system in four dimensions ····· 10

Summary: We discuss the global existence of solutions to a system of stochastic Schrödinger equations with multiplicative noise. Our setting of the quadratic nonlinear terms in dimension 4 is L^2-critical. We treat the solutions under the ground state. We estimate the time derivative of the quantity of energy by using the cancellation of the cubic terms in the spatial derivative of the solution.

45 Mamoru Okamoto (Osaka Univ.)
Toshiki Kondo (Osaka Univ.) Ill-posedness for a higher-order nonlinear Schrödinger equation with a derivative on the circle ····· 12

Summary: We consider a periodic higher-order nonlinear Schrödinger equation with the nonlinearity $u^k\partial_x u$, where k is a natural number. We prove the ill-posedness of the Cauchy problem in the Sobolev space $H^s(\mathbb{T})$ for any $s \in \mathbb{R}$.

46 Koichi Komada (Ritsumeikan Univ.) Scattering problem for group-symmetric solutions of the nonlinear fourth-order Schrödinger equation ····· 12

Summary: We consider the focusing, L^2-supercritical and $\dot{H}^2$-subcritical nonlinear fourth-order Schrödinger equation. Guo (2016) and Dinh (2021) obtained the scattering of radially symmetric solutions below the ground state threshold in $d \geq 2$. In this work, we extend the scattering results to group-symmetric solutions. In Komada and Masaki (2024), the scattering of group-invariant solutions below the ground state was proved under a certain hypothesis. To remove the hypothesis, we establish the nonoptimal scattering result for general solutions, where the threshold is less than certain fraction of the ground state level.

47 Haruya Mizutani (Osaka Univ.)
Luca Fanelli (UPV/EHU)
Luz Roncal (BCAM)
Nico Michele Schiavone (TU of Madrid) Local smoothing effects for the Schrödinger equation with the Heisenberg sub-Laplacian ····· 12

Summary: We consider the free Schrödinger equation associated with the sub-Laplacian on the Heisenberg group. In contrast to the Euclidean case, the equation becomes a transport equation in one specific direction for a class of initial data due to its anisotropic structure. In particular, there are neither dispersive estimates nor (global-in-time) Strichartz estimates in this setting. Nevertheless, we show the solution satisfies Kato-type local smoothing effects similar to the Euclidean case at least for the cylindrical solutions.

48 Ikki Fukuda (Shinshu Univ.) Optimal decay estimate and asymptotic profile for solutions to the generalized KP equation with an anisotropic dissipation term ····· 12

Summary: In this talk, we consider the Cauchy problem for the generalized KP equation with the dissipation term $-\nu u_{xx}$. This is one of the nonlinear dispersive-dissipative type equations, which has a spatial anisotropy. In this study, we consider the large time behavior of the solution to this problem. In particular, we derive the decay estimates of the solution when $u_0 \in L^1(\mathbb{R}^2)$ and show that the optimal decay rate for the L^∞-norm is given by $t^{-\frac{5}{4}}$. Moreover, under the additional weight assumption on the initial data, we also establish the asymptotic formula for the solution in the L^∞-sense.

49 Kenjiro Ishizuka (Kyoto Univ.) 2-solitary waves of the complex-valued nonlinear damped Klein–Gordon equation ····· 10

Summary: In this talk, we consider the complex-valued nonlinear damped Klein–Gordon equation. In the real-valued case, Cote, Martel, Yuan, and Zhao (2021) proved that 2-solitary waves with the same sign do not exist. Furthermore, they constructed a Lipschitz manifold in the energy space with codimension 2 of 2-solitary waves with opposite signs. On the other hand, we need the rotation of a solitary wave in the complex-valued case. We give the asymptotic behavior of 2-solitary waves and analyze the set of 2-solitary waves.

50 Shun Takizawa (Tokyo Univ. of Sci.) Boundedness of propagators for Dirac equations with potentials on Wiener amalgam spaces ····· 12

Summary: We consider boundedness of propagators for Dirac equations on Wiener amalgam spaces. In the case where bounded potentials, Trapasso (2020) has studied boundedness of propagators. The purpose of this talk is to prove boundedness of propagators for Dirac equations with unbounded time-dependent potentials. In particular we deal with class of potentials such as including Stark and harmonic potentials.

51 Yuki Kurokawa (Hokkaido Univ. of Edu.) The effects of two nonlinearities on the critical decay for systems of wave equations ····· 10

Summary: In this talk, we consider the Cauchy problem for systems of wave equations with the combined nonlinearities such as $|u|^\alpha + |v|^\beta$. For the slowly decaying data, we show the effects of this type of nonlinearities on the critical decay.

52 Kimitoshi Tsutaya (Hirosaki Univ.)
Yuta Wakasugi (Hiroshima Univ.) Global existence and blow up of solutions of time derivative nonlinear wave equations ····· 12

Summary: We consider the Cauchy problem for time derivative nonlinear wave equations with time-dependent propagation speed and damping. In this talk we show global existence and blow up in a finite time of solutions of the problem by focusing on conditions on the propagation speed and damping.

53 Motohiro Sobajima (Tokyo Univ. of Sci.)
Kimitoshi Tsutaya (Hirosaki Univ.)
Yuta Wakasugi (Hiroshima Univ.) Appearance of Strauss-type exponent in semilinear wave equations with time-dependent speed of propagation ····· 12

Summary: In this talk, we consider semilinear wave equations with time-dependent speed of propagation and scattering damping under a smallness condition on the initial data. In particular, we discuss blowup phenomena corresponds to the case of sub-Strauss case for the usual semilinear wave equation.

17:00–18:00 Talk Invited by Functional Equations Section

Tatsuya Miura (Kyoto Univ.) Escher–Ito's problem for area-preserving curvature flows

Summary: For a class of area-preserving curvature flows of closed planar curves, we prove that every immortal solution becomes asymptotically circular without any additional assumptions on initial data. As a particular corollary, every solution of zero enclosed area blows up in finite time. This settles an open problem posed by Escher and Ito in 2005 for Gage's area-preserving curve shortening flow, and moreover extends it to the surface diffusion flow of arbitrary order.

March 21st (Fri) Conference Room V

9:30–12:00

54 Masahiro Takayama (Keio Univ.)
Tatsuo Iguchi (Keio Univ.)
Well-posedness of the initial boundary value problem for the motion of an inextensible hanging string 12

Summary: We consider the motion of an inextensible hanging string of finite length under the action of the gravity. The motion is governed by nonlinear and nonlocal hyperbolic equations, which is degenerate at the free end of the string. We show that the initial boundary value problem to the equations of motion is well-posed locally in time in weighted Sobolev spaces at the quasilinear regularity threshold under a stability condition.

55 Yoshihiro Ueda (Kobe Univ.)
Linear stability for the scalar viscous conservation laws with delay effect 12

Summary: In this talk, we consider the stability of the non-zero equilibrium state for the scalar viscous conservation laws with a delay effect. The linear stability is analyzed by using the characteristic equation of the corresponding eigenvalue problem. If our equation does not have a delay effect, the characteristic equation is given by a polynomial equation. On the other hand, if our equation has a delay effect, the characteristic equation becomes a transcendental equation, and it is difficult to analyze it. In this situation, we apply the useful known result concerned with the characteristic equation for the ordinary delay differential equations and try to get the sharp stability condition for our equation.

56 Yoshihiro Ueda (Kobe Univ.)
Nonlinear stability for the scalar viscous conservation laws with delay effect 12

Summary: In this talk, we consider the nonlinear stability of the non-zero equilibrium state for the viscous Burgers equation with a delay effect in the one-dimensional whole space. The necessary and sufficient conditions for linear stability are obtained in Ueda (2024), and the situation strongly depends on equilibrium states. Our purpose is to derive the condition for nonlinear stability from the result of linear stability. The method for deriving linear stability is analyzing the corresponding eigenvalue problem, but it does not apply to the derivation of nonlinear stability. Thus, we apply the energy method to construct the a priori estimate and prove the existence of the global-in-time solution.

57 Ken Furukawa (Univ. of Toyama)
Well-posedness for drift-diffusion equations under the dynamic boundary condition describing filtration 10

Summary: In this talk, we will discuss the well-posedness of PDEs for describing filtration. Filtration can be described by combining dynamic boundary conditions with certain minor boundary conditions. The previous result has been based on the L^2-framework, but we will introduce results on the well-posedness of the L^p-L^q-framework.

58 Ken Furukawa (Univ. of Toyama)
Data assimilation to the primitive equations in H^2 10

Summary: We develop a mathematical theory of data assimilation (DA) for the primitive equations (PE). In this talk, we show a convergence result of the solution of the DA equations of the PE to the true solution of the PE in H^2-class.

59 Morimichi Umehara (Univ. of Miyazaki)
A steady and spherically symmetric flow of the viscous heat-conducting and self-gravitating gas 12

Summary: We consider a system of equations describing a spherically symmetric flow of gas, which is viscous, heat-conducting, self-gravitating, bounded by the free-surface and moving around a central spherical body. We analyze its stationary flow in the Lagrangian-mass framework. We see that there uniquely exists a non-trivial and physically meaningful solution to the corresponding stationary problem under a certain restricted situation.

Summary: In this talk, we consider the large time behavior of solutions to the system of equations describing motion of compressible viscoelastic fluids. We focus on the linearized system around a motionless state in a three-dimensional exterior domain and derive the local energy decay estimates of its solutions to give the diffusion wave phenomena caused by sound wave, viscous diffusion and elastic shear wave.

Summary: For the incompressible Navier–Stokes flow in n-dimensional whole space, the asymptotic expansion up to n-th order is well-known. The terms on this expansion have parabolic-scalings which yield large-time behavior of the velocity. The parabolic-scalings also guarantee uniqueness of the expansion. The preceding works suggested that the velocity contains some logarithmic evolution in time. In this talk, asymptotic expansion up to $2n$-th order is derived. Moreover, the logarithmic evolution is concreted.

Summary: Consider the Cauchy problem of the Navier–Stokes equations in $\mathbb{R}^n (n \geq 2)$ with the initial data $a \in \dot{B}^{-1+n/p}_{p,\infty}$ for $n < p < \infty$. We establish the Gevrey type estimates for the error between the successive approximations $\{u_j\}_{j=0}^{\infty}$ and the strong solution u provided the convergence in the scaling invariant norm in $L^q(\mathbb{R}^n)$ with the time weight holds. It is also clarified that the convergence rate of the higher order approximation is at least the same as that of the lower order approximation. In addition, the approximation for the pressure is also established.

14:15–16:30

Summary: We consider the solvability of the 2D stationary Navier–Stokes system on the whole plane. It is well-known that the well-posedness problem of this system around zero is very hard because of the Stokes' paradox. In contrast, considering solutions around the non-zero constant flow, the perturbed system has a better regularity in the linear part. This enables us to prove the uniquely existence of solutions in the scaling critical spaces of the Besov type. In order to this purpose, we should define such spaces anisotropically by taking into account the direction and absolute value of uniform flows.

Summary: We consider the low Mach number limit of the compressible Navier–Stokes equations in the scaling critical Besov space. It was Danchin (2002) who firstly proved that the compressile Navier–Stokes flow weakly converges to the incompressible Navier–Stokes flow as the Mach number goes to 0 in the critical framework. We focus on the strong convergence of the low Mach number limit in the critical setting.

65 Zhongyang Gu (Univ. of Tokyo)
Xin Hu (Wuhan Univ.)
Pritpal Matharu (KTH Royal Inst. of Tech.)
Bartosz Protas (McMaster Univ.)
Makiko Sasada (Univ. of Tokyo)
Tsuyoshi Yoneda (Hitotsubashi Univ.)
The incompressible Navier–Stokes limit from the lattice BGK Boltzmann equation 10

Summary: In this research, we prove that a local weak solution to the d-dimensional incompressible Navier–Stokes equations ($d \geq 2$) can be constructed by taking the hydrodynamic limit of a velocity-discretized Boltzmann equation with a simplified BGK collision operator. Moreover, in the case when the dimension is $d = 2, 3$, we characterize the combinations of finitely many particle velocities and probabilities that lead to the incompressible Navier–Stokes equations in the hydrodynamic limit. Numerical computations conducted in 2D provide information about the rate with which this hydrodynamic limit is achieved when the Knudsen number tends to zero.

66 Taichi Eguchi (Waseda Univ.)
Energy equality and inviscid limit of the fractional Navier–Stokes equations 12

Summary: We find a new criterion for the validity of the energy equality of the 3D fractional Navier–Stokes equations in the framework of the Lorentz–Besov spaces. Note that our sufficient condition is strictly weaker than that of Cheskidov et.al. (2008) related to the largest class $L^3(0,T;B^{1/3}_{3,\infty})$ for the validity of the energy conservation law of the Euler equations. Moreover, taking the inviscid limit of the fractional Navier–Stokes equations, we obtain the energy conservation law of the Euler equations in the framework of the same Lorentz–Besov spaces. Furthermore, we mention the relation between our new criterion and the Onsager conjecture.

67 Mitsuo Higaki (Kobe Univ.)
Yulong Lu (Univ. of Minnesota)
Jinping Zhuge (Morningside Center of Math.)
Wall laws for viscous flows in 3D randomly rough pipes 10

Summary: We consider effective approximations and wall laws of viscous laminar flows in 3D pipes with randomly rough boundaries. The random roughness is characterized by the boundary oscillation scale $\varepsilon \ll 1$ and a probability space with ergodicity quantified by functional inequalities. The results in this talk generalize the previous work by Basson–Gérard-Varet (2008) and Gérard-Varet (2009) for 2D channel flows with random Lipschitz boundaries to 3D pipe flows with random boundaries of John type.

68 Mikihiro Fujii (Nagoya City Univ.)
Stationary Navier–Stokes equations on the half space in the scaling critical framework 12

Summary: In this talk, we consider the inhomogeneous Dirichlet boundary value problem for the stationary Navier–Stokes equations in n-dimensional half spaces $\mathbb{R}^n_+ = \{x = (x', x_n)\ ;\ x' \in \mathbb{R}^{n-1}, x_n > 0\}$ with $n \geqslant 3$ and prove the well-posedness in the scaling critical Besov spaces. Our approach is to regard the system as an evolution equation for the normal variable x_n and reformulate it as an integral equation. Then, we achieve the goal by making use of the maximal regularity method that has developed in the context of nonstationary analysis in critical Besov spaces. Furthermore, for the case of $n \geqslant 4$, we find that the asymptotic profile of the solution as $x_n \to \infty$ is given by the $(n-1)$-dimensional stationary Navier–Stokes flow.

69 Jou-chun Kuo (Waseda Univ.) L_1 approach to the compressible viscous fluid flows in general domains
Yoshihiro Shibata (Waseda Univ.*) 12

Summary: This talk is devoted to proving the L_1 in time and $B^s_{q,1}$ in space maximal regularity for the Stokes equations obtained by linearized procedure of the Navier–Stokes equations describing the compressible viscous fluid motion. Here, $1 < q < \infty$ and $-1 + N/q \leq s < 1/q$, where N is the space dimension. The approach is by means of the spectral analysis of Lamé equations based on the real interpolation arguments. An application of our theorem is to prove the local well-posedness of the Navier–Stokes equations with non-slip boundary conditions in uniform C^3 domains, whose boundary is compact.

70 Yuko Enomoto (Shibaura Inst. of Tech.) About Stokes equation with free boundary condition 12
Yoshihiro Shibata (Waseda Univ.*)

Summary: We consider the Stokes equations with non-homogeneous free boundary conditions, which is obtained by the linearization procedure of the free boundary problem of the Navier–Stokes equations describing the viscous compressible fluid flows. We prove the L_1 maximal regularity of solutions to this Stokes equations. This is an extension result of L_p-L_q maximal regularity result obtained by D. Gotz and Y. Shibata to the L_1 in time maximal regularity case.

71 Yoshihiro Shibata (Waseda Univ.*) Free boundary problem in the half-space 12

Summary: In this talk, I will talk about the global wellposedness of free boundary problem for the incompressible Navier–Stokes equations in the L_p in time and L_q in space framework in the half space. The main tools are L_p-L_q maximal regularity and weighted estimate for solutions to the Stokes equations in the half space. Then, the standard fixed point argument yields the global well-posedness for small initial data.

16:45–17:45 Talk Invited by Functional Equations Section

Erika Ushikoshi (Yokohama Nat. Univ.) Helmholtz–Weyl decomposition on a time dependent domain with an application to time periodic Navier–Stokes flows with large flux

Summary: In this talk, we investigate the Helmholtz–Weyl decomposition on a time dependent bounded domain $\Omega(t)$ in $\mathbb{R}^3$. In particular, we consider the domain dependence of each component in the decomposition, i.e., the harmonic vector fields, vector potentials, and scalar potentials equipped with suitable boundary conditions. As an application, we construct a time periodic solution of the incompressible Navier–Stokes equations for some boundary data with non-zero fluxes.

Real Analysis

March 20th (Thu) Conference Room IV

9:00–12:00

1 Takeshi Iida (Fukushima Nat. Coll. of Tech.) On commutators generated by BMO-function and the fractional integral operator in Orlicz–Morrey spaces ····· 15

Summary: This talk builds upon existing research concerning commutators and Morrey spaces by delving into the theory of commutators generated by BMO functions and fractional integral operators in the broader context of Orlicz–Morrey spaces. Examples triplet of Young functions will be provided, along with the demonstration of the boundedness of the respective operators. Furthermore, an Olsen-type inequality pertinent to these commutators will be derived. These findings not only expand the comprehension of harmonic analysis, but also lay the groundwork for prospective studies on commutators in relation to more general operators and function spaces.

2 Kotaro Inami (Nagoya Univ.) Randomized Strichartz estimates in modulation spaces ····· 15

Summary: It is known that randomized functions enjoy improved Strichartz estimates in terms of integrability (Benyi–Oh–Pocovnicu (2015)). In this talk, we will propose randomized Strichartz estimates in modulation spaces. Using random effects and the orthogonal Strichartz estimate, we obtain a refined Strichartz estimate in modulation space settings.

3 Naoya Hatano (Chuo Univ.) Characterization for BMO norm via quasi-Banach lattices ····· 15

Summary: It is well known that BMO norm can be characterized by using the L^p-average. After that these characterizations are generalized to average via some kinds of function spaces. Especially, the generalizations by using (ball) Banach function spaces are given by Ho, Izuki and Sawano. Thus, in this talk, we introduce the generalizations for these characterizations with respect to some quasi-Banach lattices which is more generalization for (ball) Banach function spaces.

4 Satoshi Yamaguchi (Ibaraki Univ.), Eiichi Nakai (Ibaraki Univ.), Katsunori Shimomura (Ibaraki Univ.) Generalized Campanato spaces with $p = 1$ and the duals of atomic Hardy spaces ····· 15

Summary: It is known that the Campanato space is a subspace of the dual of some atomic Hardy space. We give relations between these spaces.

5 Motofumi Aoki (Kyoto Univ.), Tsukasa Iwabuchi (Tohoku Univ.) On the fractional Leibnitz rule in bounded domains ····· 15

Summary: In this talk, we consider the fractional Leibniz rule on bounded domains. The study of the fractional Leibniz rule is known in the whole space. Kenig–Ponce–Vega (1993) considered the estimates when the differential exponent is less than 1 in Sobolev space. Fujiwara–Georgiev–Ozawa (2018) derived an estimate corresponding to the Leibniz rule in Sobolev space when the differential exponent is less than 2. We study the fractional Leibniz rule corresponding to Kenig–Ponce–Vega (1993) in the Besov space.

6 Koji Aoyama (Chiba Univ.), Shigeru Iemoto (Chuo Univ.) Parallel methods for strongly quasinonexpansive mappings in a Hilbert space ····· 15

Summary: This talk deals with a common fixed point problem for strongly quasinonexpansive mappings defined on a Hilbert space. To approximate the solution to this problem, we present an iterative process using the parallel method based on Anh and Chung (2014) and Aoyama (2018).

7 Sachiko Atsushiba (Tokyo Woman's Christian Univ.) — Weak and strong convergence theorems for monotone nonexpansive mappings and α-nonexpansive mappings ····· 15

Summary: In this talk, we prove weak and strong convergence theorems for monotone nonexpansive mappings. We prove a theorem giving a necessary and sufficient condition for the strong convergence of the iterations for monotone nonexpansive mappings. Further, we prove weak convergence theorems for monotone α-nonexpansive mappings.

8 Takashi Honda (Iwate Univ.) — Convergence theorems of conditional expectations by using contractive projections on a Banach space ····· 15

Summary: In this talk, we show the equivalent condition of sub-algebras such that the sequence of conditional expectations converges strongly. It is an application of linear contractive projection theory on a Banach space by using nonlinear analytic methods.

9 Hiroko Manaka (Nihon Univ.) — Relation between an averaged mapping in a Hilbert space and a nonlinear mapping in Banach spaces ····· 15

Summary: In this talk we treat with an averaged mapping defined in a Hilbert space at first. Some properties of this mapping give many convergence theorems with iterative methods. In a Hilbert space this mapping makes a lot of useful tools, because it is passible to obtain many good equations and inequalities with properties of a norm in a Hilbert space. However, in Banach spaces we sometimes have difficulties in order to make algorithm with respect to convergence theorems for a fixed point. We introduce a nonlinear mapping defined in Banach spaces and show the relation between the averaged mapping in Hilbert space and this nonlinear mapping in Banach spaces.

10 Shin-ya Matsushita (Akita Pref. Univ.) — On fixed point algorithms using metric projections ····· 15

Summary: In this talk, we investigate fixed point algorithms using metric projections onto the intersection of two halfspaces.

11 Aqib Saghir (Saitama Univ.), Shunya Hashimoto (Saitama Univ.) — A fixed point result of Kannan-type for multi-valued mapping on fuzzy metric spaces ····· 10

Summary: We prove a Kannan-type fixed point theorem for multi-valued mappings on G-complete fuzzy metric spaces. The proof uses the Hausdorff fuzzy metric space which was introduced by Rodriguez-Lopez and Romaguera.

14:15–15:30

12 Yukino Tomizawa (Niigata Inst. of Tech.) — A geometric constant of complete Busemann spaces ····· 15

Summary: We consider a geometric constant of complete Busemann spaces from the perspective of characterizing the convexity of the space. This is a generalization of the von Neumann–Jordan constant in Banach spaces.

13 Toshiharu Kawasaki (Tamagawa Univ.) — Some properties of the extended integral, II ····· 15

Summary: We would like to consider a case where the indefinite integral takes an infinite value. For that reason, we extend the concept of integrals. In this talk, we discuss some properties of the extended integral.

14 Fukuda Ryoji (Oita Univ.), Honda Aoi (Kyushu Inst. of Tech.), Yoshiaki Okazaki (Fuzzy Logic Systems Inst.) — Linear topological structure of a function space determined by a non-additive measure ····· 15

Summary: The uniform structure of a function space determined by a non-additive measure is discussed. The function space of our concern is the $L1$ space with respect to non-linear integral given by a non-additive measure, such as the Sugeno integral, Choquet integral, Shilkret integral, pan integral, SD integral, concave integral, convex integral, and so on.

15 Jun Kawabe (Shinshu Univ.) Generalized monotone convergence theorems for nonlinear integrals · · 15

Summary: This presentation aims to establish monotone convergence theorems for the Choquet, Shilkret and Sugeno integrals. These are among the most significant nonlinear integrals defined as integration concepts by nonadditive measures. Our formulation features three notable attributes:

1. It allows the convergence of not only a sequence but also a net of functions.
2. It does not require the domain of nonadditive measures to be a lattice, a ring or a field.
3. It does not assume any additive-like properties for nonadditive measures.

15:45–16:45 Award Lecture for the 2024 MSJ Analysis Prize

Hitoshi Tanaka (Tsukuba Univ. of Tech.) Rectangular fractional integral operator, Carleson-type embedding theorems, Fefferman–Phong-type condition

Summary: With rectangular doubling weight, a generalized Hardy–Littlewood–Sobolev inequality for rectangular fractional integral operators is verified. The result is a nice application of M-linear embedding theorem for dyadic ractangles. An interesting relation between Carleson-type embedding theorems and Fefferman–Phong-type condition is also verified.

17:00–18:00 Talk Invited by Real Analysis Section

Yoshihiro Sawano (Tokyo Metro. Univ.) Morrey spaces

Summary: The goal of this talk is to survey some recent studies on Morrey spaces. First, as a model case, I will review Lebesgue spaces. I take up some problems in Lebesgue spaces to make a natural introduction of Morrey spaces as a next step. I collect some elementary properties of Morrey spaces. This aspect concerns the functional analysis. After this, I will introduce a fundamental result about the boundedness of the Hardy–Littlewood maximal operator. This is a typical technique of dealing with how to handle the operators acting on Morrey spaces. I would like to introduce a couple of examples why Morrey spaces are effective. I will take up the boundedness properties of the fractional integral operators. After explaining some fundamental facts, I would like to introduce some problems left open. About these open problems, I will offer some words to what is known.

March 21st (Fri) Conference Room IV

9:00–12:00

16 Naotaka Ukai (Chiba Univ.) Coupling system of elliptic and pseudo-parabolic PDEs arising from
Daiki Mizuno (Chiba Univ.) anisotropic image-denoising · 14
Ken Shirakawa (Chiba Univ.)
Harbir Antil (George Mason Univ.)

Summary: In this talk, we consider a coupled system of nonlinear elliptic and pseudo-parabolic PDEs. This system is based on governing energy for anisotropic image denoising with the optimization of orientation data, developed in [Berkels et al., SFB 611, 2006]. Our previous research focused on the well-posedness of pseudo-parabolic system. However, it is practically difficult to set the initial value of orientation. The reason is that it is unclear how the initial value of orientation should be extracted from the image. The aim of this study is to achieve the automatic computation of optimal orientation data. Specifically, the elliptic PDE component of our system functions as part of the automatic optimization process, without relying on initial data. Under suitable assumptions, an optimization scheme based on our system will be established through the main results presented in this talk.

17 Makoto Okumura (Konan Univ.) A linear structure-preserving scheme for the two-dimensional Cahn–Hilliard equation with a dynamic boundary condition ····· 14

Summary: The Cahn–Hilliard equation with the dynamic boundary condition proposed by Goldstein–Miranville–Schimperna (GMS) has characteristic conservation and dissipation laws. Focusing on these structures, we have designed a structure-preserving scheme for the two-dimensional Cahn–Hilliard equation that maintains the conservation and dissipation laws in a discrete sense. However, the scheme is nonlinear, and in numerical calculations, it is necessary to solve nonlinear simultaneous equations at each time step, which is computationally expensive. Therefore, in this study, we propose a new linear structure-preserving scheme based on a multi-step linearization technique of the scheme. In this presentation, we will discuss the properties and numerical results.

18 Yutaro Chiyo (Tokyo Univ. of Sci.)
Hisashi Terasaki (Tokyo Univ. of Sci.)
Yutaka Tsuzuki (Hiroshima Shudo Univ.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Solvability in a special case of a moisture transport model for porous materials ····· 14

Summary: This talk deals with solvability in a moisture transport model for porous materials in some restricted case. In this talk, by assuming additional condition on known functions, we derive solvability in this model.

19 Akiko Morimura (Japan Women's Univ.)
Toyohiko Aiki (Japan Women's Univ.)
Error estimates of approximate solutions for a nonlinear parabolic equation with a non-monotone boundary condition by the finite volume method ····· 14

Summary: We consider the initial boundary value problem for a nonlinear parabolic equation with a non-monotone boundary condition. This problem was introduced as a mathematical model of moisture transport phenomena in porous materials. In our previous work, we showed the existence and uniqueness of weak solutions to our problem and the convergence of approximate solutions, constructed by the finite volume method, to the weak solution. In this presentation, we establish the existence of strong solutions and obtain error estimates on the convergence of the approximate solutions. In particular, the lemma on a discrete-continuous mixed version of the Gagliardo–Nirenberg inequality is a key to the proof.

20 Yusuke Murase (Meijo Univ.) Numerical simulations for moisture transport model in 1-dimensional spacial domain ····· 14

Summary: We discuss the numerical simulations for moisture transport model. This model is a multi scale free boundary problem described by partial differential equations, and this model contains a mathematical model of adsorption phenomena as subsystem. The subsystem was simulated numerically with using experimentally way, and FEM with adaptive moving mesh method in known results, but there are some undesirable properties for numerical simulations of moisture transport model. In this talk, I'll show you our economic numerical scheme and some numerical simulations for moisture transport model in 1-dimensional spacial domain.

21 Shohei Kohatsu (Tokyo Univ. of Sci.) Global smooth solutions for measure-valued initial data in a Keller–Segel system with nonlinear diffusion and flux limitation ····· 14

Summary: We deal with a Keller–Segel system with nonlinear diffusion and flux limitation. In the previous study, we considered the system in the case with linear diffusion, and showed that given any nonnegative initial data belonging to the space of Radon measures for the population density and to a suitable first-order Sobolev space for the signal density, the system admits a global smooth solution which is continuous at $t = 0$ in an appropriate sense. The purpose is to show this immediate smoothing in the system for any dimension with the aid of combined effect of nonlinear diffusion and flux limitation.

Summary: This talk deals with a chemotaxis system involving gradient-dependent source. For this system with Neumann boundary condition, Ishida–Lankeit–Viglialoro (2024) proved global existence and boundedness of solutions. The purpose of this talk is to show boundedness of solutions in the system with Robin boundary condition.

Summary: This talk deals with a nonlinear system of partial differential equations modelling the formation of granuloma during tuberculosis infections, which was proposed by Feng in 2024. The main result asserts global solvability of this model in the classical and weak sense in the two- and three-dimensional setting, respectively.

Summary: In this talk we establish uniqueness of solutions to the one-dimensional free boundary problem describing a baking process of bread. For the problem we assume that a region occupied by the breads consists of crumb, crust and the evaporation front, and unknown functions are the position of the front, the temperature field, and the water mass distribution. Since the boundary condition for the mass distribution contains the temperature field, we do not expect existence of strong solutions for the distribution. Hence, we define a solution by applying the weak formulation to the mass distribution. Now, we aim to show uniqueness of solutions to our problem by the standard method.

Summary: In this talk, we consider a one-dimensional free boundary problem. This problem is a model describing micro-swelling in pores of porous materials. Here, let the porous materials and each pore be the macro domain and the micro domain, respectively, and we assume that each pore exists at the point of the materials. Under this assumption, we define a model describing micro-swelling at each pore. For this problem, we have already proved the existence and uniqueness of a solution to the model. In this talk, as a new property of the solution to the model, we show the result on the differentiabilty of the solution with respect to macro variables and its maximum estimate.

Summary: There are some studies on phase field systems with inertial term. For example, parabolic hyperbolic phase field systems have been studied (see e.g., Grasselli–Pata (2003, 2004), Grasselli–Petzeltová–Schimperna (2006), Wu–Grasselli–Zheng (2007), K. (2020)). Caginalp (1986, 1988) proposed phase field systems in the case that the equation regarding the order parameter is a parabolic Allen–Cahn equation or a parabolic Cahn–Hilliard equation. Phase field systems with inertial term consider that there are rapid phase transformation processes in nonequilibrium dynamics. In this talk we consider a phase field system in the case that the equation regarding the order parameter is a hyperbolic Cahn–Hilliard equation.

27 Takeshi Fukao (Ryukoku Univ.)
Pierluigi Colli (Univ. of Pavia)
Second order parabolic equations with higher order dynamic boundary conditions · · · · · 14

Summary: The problem with the dynamic boundary condition is a sort of transmission problem between the bulk and its boundary. The various kinds of problems with the dynamic boundary condition are studied for the heat equation, or the Allen–Cahn equation. Moreover, in the case of the Cahn–Hilliard equation, there are several models in which the position of the normal derivative in the equation is different. Recently, these several models have studied the subjects of vanishing surface diffusion. In all of them, the bulk equation is the Cahn–Hilliard equation, and the boundary equation is a kind of forward-backward equation. In this paper, to clarify the essence of their well-posedness, we start from the Allen–Cahn equation with the dynamic boundary condition of Cahn–Hilliard type. The asymptotics, more precisely the well-posedness and error estimates from the starting problem to three kinds of systems are discussed.

14:15–16:45

28 Takuma Yoshizumi (Osaka Univ.)
Makoto Nakamura (Osaka Univ.)
Blowing-up solutions for semi-linear Klein–Gordon equations with the blowing-up space in FLRW spacetimes · · · · · 14

Summary: We consider the Cauchy problem of semi-linear Klein–Gordon equations in Friedmann–Lemaítre–Robertson–Walker spacetimes. We consider the concrete scale-function $a(\cdot)$, which describes various types of spaces. In this talk, we remark the blowing-up space (the "Big-Rip" in cosmology). In this space, we have proved the blowing-up solutions for the gauge variant semi-linear terms. This work is based on a joint work with M. Nakamura.

29 Sho Watabe (Niigata Univ.)
Hiroki Ohwa (Niigata Univ.)
L^1 contractive solutions to the Cauchy problem of conservation laws with a discontinuous flux · · · · · 14

Summary: We consider the Cauchy problem of conservation laws with a discontinuous flux. The purpose of this talk is to prove the existence of L^1 contractive solutions to the Cauchy problem.

30 Takanori Ebata (Niigata Univ.)
Hiroki Ohwa (Niigata Univ.)
A uniqueness condition for weak solutions of conservation laws · · · · · 14

Summary: We consider the uniqueness of weak solutions to the Cauchy problem of conservation laws. The purpose of this talk is to prove the uniqueness of the solutions under some condition.

31 Hiroyoshi Mitake (Univ. of Tokyo)
Hiroshi Watanabe (Oita Univ.)
Equivalence of entropy solutions and viscosity solutions to degenerate parabolic equations and its applications · · · · · 14

Summary: We consider anisotropic degenerate parabolic-hyperbolic equations and degenerate viscous Hamilton–Jacobi equations. We prove the equivalence of two notions of entropy solutions and viscosity solutions of two equations, and apply it to obtain a large-time behavior of viscosity solutions to quasilinear Hamilton–Jacobi equations, and entropy solutions to degenerate parabolic-hyperbolic equations in a periodic setting.

32 Daiki Mizuno (Chiba Univ.)
Ken Shirakawa (Chiba Univ.)
A constrained optimal control problem associated with a parabolic KWC system with a relaxation term · · · · · 14

Summary: In this talk, we deal with a constrained optimal control problem of a relaxed parabolic KWC system. KWC-type system is based on a mathematical model of grain boundary motion, which is proposed by [Kobayashi et al., Physica D, 140, 141–150](2000). A key aspect of this talk is in the unknown-dependent mobility, which has been a big obstacle for the uniqueness question to KWC-type systems. Against this difficulty, we build on the uniqueness result without change to the mobility, reported in the previous MSJ meeting, and we consider a KWC-type system with a smoothness condition for initial data. Specifically, we focus on an optimal control problem with a certain constraint and discuss the existence of optimal control and the necessary conditions for the optimality.

Summary: We show the existence of a measure-valued optimal control which maximizes a profit from harvesting in agriculture or aquaculture, where the population is governed by age-structured population models with spatial diffusion.

Summary: In this talk, we consider a coupled system of a nonlinear parabolic equation, and a regularized harmonic type flow. Our system is is derived as a gradient system of the following energy-functional, which is based on the free-energy associated with 3D-grain boundary motion. The focus of this talk is on the uniqueness of the variational solution to (P). The main results are outlined as follows: (i) a sufficient condition for the uniqueness of the system (P); (ii) the uniqueness of the one-dimensional solution to the system (P) including the non-smooth case; (iii) the uniqueness of a time-local solution to the system (P) in higher spatial dimensions under the smooth setting.

Summary: This talk is concerned with the solvability of nonlinear evolution equations involving time-fractional derivatives and applications to PDEs. We present an existence result of strong solutions to time-fractional evolution equations governed by time-dependent subdifferential operators in Hilbert spaces. The abstract result is also applied to the Cauchy–Dirichlet problem for some p-Laplace subdiffusion equations posed in time-dependent smooth domains.

Summary: We study a time-periodicity problem for a class of abstract nonlinear quasi-variational evolution equations associated with subdifferential operators depending on both time and the unknown. Assuming time-periodicity for the subdifferential operator, we prove the existence of a periodic solution using the abstract theory of time-dependent subdifferential evolution equations and its generalization.

Summary: We consider an initial-boundary value problem of a tumor invasion of indirect chemotaxis effect whose total mass of tumor cells is conservative in time. Moreover, our model has two quasi-variational structures. One is that the coefficient of random motility of tumor cells depends on not only the total mass of chemoattractant substance but also the extracellular matrix. The other is that the diffusion flux of tumor cells is degenerate in general and depends upon the extracellular matrix. These structures makes it more difficult and complicate to analyze this model mathematically. The aim of this talk, we give the global existence of strong solutions by using the general theory, which was established in the paper, A mass-conserved tumor invasion system with quasi-variational degenerate diffusion, Analysis ans Applications, 20 (2022), No. 4, 615–680.

17:00–18:00 Talk Invited by Real Analysis Section

Chiharu Kosugi (Yamaguchi Univ.) Mathematical analysis of models representing motions for the elastic curve with the compressible stress function

Summary: In this talk, we consider initial and boundary value problems of the beam equation as the dynamical model for the elastic curves on the plane. In our model, from the difference of dimensions between the domain and the range, the unknown function is representing the position. The one of features of our model is to assume that the stress function has a singular point. Thanks to this, we can treat the nonlinear strain and large movements of the elastic curve, mathematically. Moreover, we can obtain the lower bounded for the strain. The purpose of this talk is to prove the solvability of the problem for the extended class of stress functions having the singularity that we have dealt with so far.

Functional Analysis

March 18th (Tue) Conference Room VII

9:30–10:55

1 Hisashi Morioka (Ehime Univ.)
Kazunori Ando (Ehime Univ.)
Hiroshi Isozaki (Univ. of Tsukuba*)
Unique continuation theorem for discrete Schrödinger operators on lattices ····· 15

Summary: We derive a Rellich–Vekua type uniqueness theorem for discrete Schrödinger operators with exponentially decreasing potentials on a class of lattices containing square, triangular, hexagonal lattices and their ladders. We also discuss the unique continuation theorem and the non-existence of eigenvalues embedded in the continuous spectrum.

2 Hiroki Sako (Niigata Univ.)
existence of a continuous time quantum walk which realizes a given discrete time quantum walk ····· 15

Summary: A quantum walk (QW) is a unitary operator on a Hilbert space, which represents a kind of quantum dynamics. In many cases, a QW gives a sequence of probability measures on a space. Some quantum walks have discrete parameters, others have continuous parameters. By the spectral decomposition theorem for unitary operators, for every discrete time QW, there exists a one parameter unitary group whose restriction is the given QW. However, in many cases, such a unitary group has no physical counterpart. In this talk, we start with a definition of QWs and their realizability by continuous time QWs. we also look at several theorems on this topic.

3 Itaru Sasaki (Shinshu Univ.)
Yasumichi Matsuzawa (Shinshu Univ.)
Shinnosuke Izumi (Shinshu Univ.)
Kouta Imura
(Nagano Pref. Fujimi High School)
On the holomorphy of the ground state of the Pauli–Fierz model in the dipole approximation ····· 15

Summary: We consider a system where an electron, connected to the origin by a spring, interacts with light. It is proven that the ground state of this quantum system and its ground state energy are holomorphic with respect to the parameter corresponding to the charge within a strip-shaped region of finite width containing the real axis. Consequently, the radius of convergence of the perturbation expansion around the origin is evaluated as half the width of this strip. When the wavelength of the interacting light is cut off at the Compton wavelength, and mass renormalization is also taken into account, it is shown that the width of this strip is approximately 17.94 times the elementary charge. Therefore, in particular, the Maclaurin series in terms of the elementary charge converges.

4 Fumio Hiroshima (Kyushu Univ.)
Analysis of ground state and renormalized spectral zeta function of Rabi model ····· 15

Summary: We show that a renormalized spectral zeta function of the quantum Rabi model converges to the Riemann zeta function as the coupling constant goes to infinity. We also construct a ground state measure for the quantum Rabi model and we discuss the expectation values of observables with respect to the ground state.

11:00–12:00 Talk Invited by Functional Analysis Section

Yukihide Tadano (Univ. of Hyogo) Long-range scattering theory of discrete quantum systems

Summary: Scattering theory of the Schrödinger operators has been extensively studied since the beginning of research of the Schrödinger equations. It is known that a short-range/long-range perturbation is classified according to its decay rate at infinity, and that for long-range perturbations modified wave operators are needed to define by the associated classical mechanics. On the other hand, it is not clear at first glance whether discrete quantum systems, e.g. discrete Schrödinger operators on a periodic graph, have the corresponding "classical" mechanics and modified wave operators can be defined in a reasonable way. In this talk, I will give a long-range scattering theory of discrete quantum systems by constructing Isozaki–Kitada modifiers from the associated Hamiltonian mechanics on a torus.

March 19th (Wed) Conference Room VII

9:30–10:50

Summary: We write $Y(p_1, p_2; G)$ for the optimal constant (the optimal ratio of both sides) of Young's convolution inequality on a locally compact group G. The main result of this talk is that $Y(p_1, p_2; G) \leq Y(p_1, p_2; H)$ for any closed subgroup $H \subset G$. It follows from this inequality that $Y(p_1, p_2; G) \leq Y(p_1, p_2; \mathbb{R})^{\dim G - r(G)}$ for any connected Lie group G such that the center of the semisimple part is a finite group such as connected linear Lie groups and connected solvable Lie groups, where $r(G)$ is the dimension of the maximal compact subgroups of G. This result contains several known results that Beckner, Fournier, Klein–Russo, and Nielsen proved.

Summary: We consider a tensor product of two representations of $Sp(n, \mathbb{R})$ realized as the spaces of holomorphic functions on the bounded symmetric domain. Then this is decomposed into a discrete direct sum of irreducible representations. In this talk, we construct the intertwining operator (holographic operator) from each irreducible summand to the tensor product as an integral operator.

Summary: Let $\mathfrak{g} = \mathfrak{sl}(n+1, \mathbb{C})$ for $n \geq 2$. We write $\mathfrak{p} = \mathfrak{p}_{1,n}$ for the maximal parabolic subalgebra of $\mathfrak{g}$ corresponding to the partition $(1, n)$ of $n+1$. We write $M_{\mathfrak{p}}^{\mathfrak{g}}(\xi, s)$ for the generalized Verma module for $(\mathfrak{g}, \mathfrak{p})$ induced from the simple $\mathfrak{p}$-module $(\xi, s) \in \mathrm{Irr}(\mathfrak{p})_{\mathrm{fin}} \simeq \mathrm{Irr}(\mathfrak{sl}(n, \mathbb{C}))_{\mathrm{fin}} \times \mathbb{C}$. Let $\mathfrak{g}'$ be a subalgebra of $\mathfrak{g}$ such that $\mathfrak{g}' = \{\mathrm{diag}(X', 0) : X' \in \mathfrak{sl}(n, \mathbb{C})\} \simeq \mathfrak{sl}(n, \mathbb{C})$ and put $\mathfrak{p}' := \mathfrak{p} \cap \mathfrak{g}'$. We define a generalized Verma module $M_{\mathfrak{p}'}^{\mathfrak{g}'}(\sigma, r)$ for $(\mathfrak{g}', \mathfrak{p}')$ similarly.
In this talk we shall determine the branching laws of $M_{\mathfrak{p}}^{\mathfrak{g}}(\mathrm{triv}, s)|_{\mathfrak{g}'}$ and $\mathrm{Im}(\varphi)|_{\mathfrak{g}'}$ for a $\mathfrak{g}$-homomorphism $\varphi \in \mathrm{Hom}_{\mathfrak{g}}(M_{\mathfrak{p}}^{\mathfrak{g}}(\tau, u), M_{\mathfrak{p}}^{\mathfrak{g}}(\mathrm{triv}, s))$. In relation to these branching laws, the factorization identities of a $\mathfrak{g}'$-homomorphism $\Phi \in \mathrm{Hom}_{\mathfrak{g}'}(M_{\mathfrak{p}'}^{\mathfrak{g}'}(\sigma, r), M_{\mathfrak{p}}^{\mathfrak{g}}(\mathrm{triv}, s))$ will be also discussed.

Summary: In this talk, we consider differential symmetry breaking operators $\mathbb{D}_{\lambda,\nu}^{N,m}$ between principal series representations of the groups $SO_0(4,1)$ and $SO_0(3,1)$, realized as vector bundles over the 3-sphere and the 2-sphere respectively, $\mathbb{D}_{\lambda,\nu}^{N,m} : C^\infty(S^3, \mathcal{V}_\lambda^{2N+1}) \to C^\infty(S^2, \mathcal{L}_{m,\nu})$. In particular, we construct and classify all of them when $|m| > N$. Moreover, in this case, one can show that any symmetry breaking operator is given by one of these differential operators $\mathbb{D}_{\lambda,\nu}^{N,m}$.

11:00–12:00 Talk Invited by Functional Analysis Section

Takuma Hayashi (Osaka Metro. Univ.) Rationality problems in representation theory

Summary: A rationality problem is to find smaller fields of definition of a given object over a large field. The key to rationality problems for irreducible representations is to describe the classification of irreducible representations over the given field and the algebras of their endomorphisms. This goes back to a work of Loewy in 1903 for irreducible finite dimensional representations of groups over the real numbers in terms of those over the complex numbers and their complex conjugation. Its generalization for reductive groups over fields of characteristic zero was established by Borel–Tits (1965) and Tits (1966). Their arguments should be applied to various settings in representation theory since their main tool is the Galois descent.
Another direction in rationality problems of representations is to compare irreducible representations for an extension of algebraically closed fields (the absolute irreducibility). The basic tool for this is Jaconson's density theorem in 1945.
In this talk, I review the works of Loewy, Borel–Tits, and Tits. Then I report my recent work in progress on application of their ideas to equivariant holonomic D-modules. I will also explain a consequence of Jacobson's density theorem in the theory of equivariant holonomic D-modules.

March 20th (Thu) Conference Room VII

9:30–10:55

9 Yuki Seo (Osaka Kyoiku Univ.) Estimates of the operator geometric mean by the Hadamard product 15

Summary: We estimated the difference between the Hadamard product and the Karcher mean of n positive invertible operators on the Hilbert space in terms of the Specht ratio and the Kantorovich constant. In this talk, we improve the obtained inequalities in the case of $n = 2$ in terms of the generalized Kantorovich constants.

10 Kenta Kojin (Nagoya Univ.) Some relations between Schwarz–Pick inequality and von Neumann's inequality 15

Summary: We will study a relation between two important inequalities in complex analysis and operator theory. Moreover, we will use this observation to prove a new dilation theorem.

11 Hikaru Awazu (Univ. of Tokyo) Amenability of group actions and Banach algebras 15

Summary: The amenability of group actions on topological spaces generalizes amenability of groups and has applications in group theory, such as characterizing C^*-exact groups. For a topological group G , group amenability can be characterized through the amenability of the convolution Banach algebra $L^1(G)$. Here a Banach algebra A is called amenable if all derivations from A to any dual-type A-A-Banach bimodule are inner. We extend this result to discrete group actions on compact Hausdorff spaces, using certain Banach algebra arising from the action and a weakened amenability condition of Banach algebras. We also proved a fixed-point characterization of amenable actions, which improves the result by Dong and Wang (2015).

12 Boo Rim Choe (Korea Univ.)♭ Hilbert–Schmidt double differences of composition operators 15
Xin Guo
(Zhongnan Univ. of Econ. and Law)
Takuya Hosokawa (Ibaraki Univ.)
Hyungwoon Koo (Korea Univ.)
Shûichi Ohno
Maofa Wang (Wuhan Univ.)

Summary: In the setting of the standard weighted Bergman spaces over the unit disk, compactness characterizations for linear combinations of composition operators have been known. We here investigate into similar properties for Hilbert–Schmidtness with main focus on double differences and obtain a complete characterization for Hilbert–Schmidt double differences of composition operators.

13 Takeshi Miura (Niigata Univ.)
M. G. Cabrera-Padilla (Almería Univ.)
Antonio Jimenéz-Vargas (Almería Univ.)
Moisés Villegas-Vallecillos (Cádiz Univ.)
Function spaces formed by differentiable functions and surjective isometries on them ····· 15

Summary: We give a general framework for elucidating the structure of surjective isometries on function spaces with differential structure. This theorem allows us to unify several existing results.

11:00–12:00 Talk Invited by Functional Analysis Section

Kouhei Izuchi (Yamaguchi Univ.) Invariant subspaces in Hardy space on the bidisk

Summary: We consider invariant subspaces in Hilbert spaces of analytic functions. In classical work, Beurling has given the complete characterization of invariant subspaces in the Hardy space $H^2(\mathbb{D})$ on the open unit disk $\mathbb{D}$. After that, invariant subspaces in various analytic function spaces have been studied so far. A typical example on $\mathbb{D}$ is the Bergman space $L^2_a(\mathbb{D})$. It is well known that $H^2(\mathbb{D})$ and $L^2_a(\mathbb{D})$ have the Beurling property, that is, it holds that for an invariant subspace M the smallest invariant subspace containing the wandering subspace $M \ominus zM$ is M. But for the case of the Hardy space $H^2(\mathbb{D}^2)$ on the bidisk $\mathbb{D}^2$, the situation is quite different. In this talk, we will discuss the Beurling property and the rank of some invariant subspaces in $H^2(\mathbb{D}^2)$.

14:30–17:00

14 Takehiko Mori (Chiba Univ.) Application of operator theory for the Collatz conjecture ····· 15

Summary: The Collatz conjecture (or the $3n+1$-problem) is a longstanding open problem for positive integers. In this study, we present new relationship between dynamical systems and C^*-algebras. Namely, we will formulate the Collatz conjecture in terms of C^*-algebras. We discuss formulations of the Collatz conjecture by C^*-algebras in the following three ways: (1) single operator, (2) two operators, and (3) Cuntz algebra. For the C^*-algebra generated by each of these, we consider the condition that it has no non-trivial reducing subspaces. For (1), we prove that the condition implies the Collatz conjecture. In the cases (2) and (3), we prove that the condition is equivalent to the Collatz conjecture.

15 Hyuga Ito (Nagoya Univ.) B-valued semi-circular system and free Poincaré inequality ····· 15

Summary: We will characterize a B-valued semi-circular system by a natural B-valued free Poincaré inequality. This is a non-commutative analogue of that of Gaussian distribution by Poincaré inequality, and is also a B-valued generalization of that of a scalar-valued semi-circular system due to Biane. To establish this, we will introduce and essentially use a B-valued generalization of Chebyshev polynomials of the second kind, which has nice properties similarly to the scalar-valued case. Our result states that to be a B-valued semi-circular system is equivalent to that our natural free Poincaré inequality holds for only a "certain class" of non-commutative polynomials. This implies that B-valued free Poincaré inequality is quite non-trivial. Finally, we will give a simple counterexample to Voiculescu's conjecture on B-valued free Poincaré inequality.

16 Hajime Moriya (Kanazawa Univ.) Thermal area law for infinite quantum systems ····· 10

Summary: Thermal area law is a property of general thermal equilbrium states given in terms of the mutual entropy. Its proof for finite-dimensional systems was provided by Wolf–Verstraete–Hastings–Cirac in 2007. We establish thermal area law for infinitely extended quantum systems making use of our formalism of equilibrium in quantum systems.

Summary: By combining Rordam's construction and author's previous construction, we provide the first examples of amenable actions on simple separable nuclear C*-algebras that are neither stable finite nor purely infinite. For free groups, we also provide unital examples. We arrange the actions so that the crossed products are still simple with both a finite and an infinite projection.

Summary: This is a joint work with Kengo Matsumoto. We would like to explain a construction of the reciprocal Kirchberg algebra of a Cuntz–Krieger algebras. Starting from a given Cuntz–Krieger algebra, there is a unique unital Kirchberg algebra, called reciprocal algebra, whose automorphism group is very similar to that of the original algebra from the viewpoint of homotopy, and we previously observed that the reciprocal algebra of a Cuntz–Krieger algebra is not realized as a Cuntz–Krieger algebra. We will show you how to construct this algebra using the generators and relations. We will also compare the canonical gauge actions for both of Cuntz–Krieger and its reciprocal algebras.

Summary: It is known that, for a minimal action of a compact group on a factor, there is a natural bijective correspondence between the set of all subfactors containing the fixed point subfactor and the set of closed subgroups of the group. This is a famous result by Izumi–Longo–Popa, and the correspondence is called the Galois correspondence. In this talk, I will discuss the Galois correspondence for minimal actions on simple C*-algebras.

Summary: Gelaki–Naidu–Nikshych, and Turaev–Virelizier showed the existence of G-braiding on the relative Drinfeld center of a G-graded fusion category. We will explain this fact from a point of view of Longo–Rehren inclusions.

Summary: In the theory of C*-algebras, the Weyl groups were defined for the Cuntz algebras and graph algebras by Cuntz and Conti et al. respectively. In this paper, we introduce and investigate the Weyl groups of groupoid C*-algebras as a natural generalization of the existing Weyl groups. Then we analyse several groups of automorphisms on groupoid C*-algebras. Finally, we apply our results to Cuntz algebras, graph algebras and C*-algebras associated with Deaconu–Renault systems.

Summary: Let $A \subset M$ be an inclusion of von Neumann algebras with an operator valued weight $E\colon M \to A$. We show that every positive element $x \in M$ with $E(x) < \infty$ satisfies the weak Dixmier property for the inclusion $A \subset M$. This generalizes Marrakchi's result for conditional expactaions and has several applications to type III factors in the framework of Popa's deformation/rigidity theory. For example, we generalize Ozawa's relative solidity theorem and construct some new examples of prime type III factors.

Statistics and Probability

March 18th (Tue) Conference Room VIII

9:30–11:20

1 Yuuya Yoshida (Nagoya Inst. of Tech.) A simple proof of the formula of Solov'ev–Nielsen–Blom for the expected waiting time ····· 15

Summary: Solov'ev (1966), Nielsen (1973), and Blom (1982) independently showed a formula for the expected waiting time until a given finite pattern first occurs in random data. In this paper, we give a simple and combinatorial proof of the formula.

2 Katsunori Fujie (Kyoto Univ.)
Octavio Arizmendi (CIMAT)
Daniel Perales (Texas A&M)
Yuki Ueda (Hokkaido Univ. of Edu.) S-transform in finite free probability ····· 15

Summary: We present a simplified explanation of why free fractional convolution corresponds to the differentiation of polynomials, by finding how the finite free cumulants of a polynomial behave under differentiation. This approach allows us to understand the limiting behaviour of the coefficients $\widetilde{\mathsf{e}}_k(p_d)$ of p_d when the degree d tends to infinity and the empirical root distribution of p_d has a limiting distribution μ on $[0,\infty)$. Specifically, we relate the asymptotic behaviour of the ratio of consecutive coefficients to Voiculescu's S-transform of μ. This prompts us to define a new notion of finite S-transform, which converges to Voiculescu's S-transform in the large d limit. It also satisfies several analogous properties to those of the S-transform in free probability, including multiplicativity and monotonicity.

3 Noriyoshi Sakuma (Osaka Univ.)
Yuki Ueda (Hokkaido Univ. of Edu.) On generalized Meixner-type free gamma distributions ····· 10

Summary: We introduce and study a class of generalized Meixner-type free gamma distributions, which includes the free gamma distributions introduced by Bryc and Bozejko and certain scaled free beta prime distributions introduced by Yoshida. We investigate basic properties and mixture structures of these distributions. From the perspectives of both free and boolean probability theories, we observe notable relationships between generalized Meixner-type free gamma distributions and Marchenko–Pastur distributions via the Belinschi–Nica semigroups.

4 Masanori Hino (Kyoto Univ.)
Ryuya Namba (Kyoto Sangyo Univ.) Fractional order binomial distributions and their properties ····· 15

Summary: We introduce a new class of probability distributions and linear operators, fractional order binomial distributions and fractional order Bernstein operators. These are defined on the basis of the generalized binomial theorem originating from the proof of the neo-classical inequality in the rough path theory. We discuss explicit expressions and quantitative estimates of the moments and characteristic functions of such distributions, and some limit theorems.

5 Ryoji Takano (Osaka Univ.)
Masato Hoshino (Osaka Univ.) A semigroup approach to the reconstruction theorem for singular modelled distributions and its applications ····· 15

Summary: We will present an extension of the semigroup approach used in Otto and Weber'19 and Hoshino'23 to provide a shorter proof of the reconstruction theorem for singular modelled distributions which is a main analytic theorem in the theory of regularity structures. By applying our approach, one can construct the local-in-time solution to the space inhomogeneous stochastic partial differencial equations. For example, the parabolic Anderson model such that the variable coefficient in the differential operator is Hölder continuous is one example.

6 Hirotatsu Nagoji (Kyoto Univ.) Singularity of solutions to singular SPDEs ····· 15
Seiichiro Kusuoka (Kyoto Univ.)
Martin Hairer (EPFL)

Summary: We give a sufficient condition for the marginal distribution of the solution of singular SPDEs on the d-dimensional torus to be singular with respect to the law of the Gaussian measure induced by the linearised equation. As applications we obtain the singularity of the ϕ^4_3-measure with respect to the Gaussian free field measure and the border of parameters for the fractional ϕ^4-measure to be singular with respect to the base Gaussian measure. Our approach is applicable to quite a large class of singular SPDEs.

7 Seiichiro Kusuoka (Kyoto Univ.) Berry–Esseen bounds for large-time asymptotics of one-dimensional
Yuichi Shiozawa (Doshisha Univ.) diffusion processes via Malliavin–Stein method ····· 15

Summary: In this talk we consider solutions of stochastic differential equations which diverge to infinity as the time parameter goes to infinity. If the coefficients converge as the spacial variable goes to infinity, then the solutions will get close to some Gaussian processes with positive drifts as the time parameter goes to infinity. We prove Berry–Esseen type bounds for the solutions in this setting. In particular, we obtain bounds of the total variation distance between the law of the centered and scaled solutions of the stochastic differential equations and the standard normal distribution with an optimal rate of convergence in the time parameter. In the proof we apply the Malliavin–Stein method to estimate the total variation distance.

14:15–15:15 Award Lecture for the 2024 MSJ Analysis Prize

Ryoki Fukushima (Univ. of Tsukuba) Random walk among random obstacles

Summary: In this talk, I will present some recent results about the random walk conditioned to avoid randomly located obstacles. This may be considered as the random walk conditioned to stay on the percolation cluster. The model exhibits interesting localization phenomena both under the annealed law and the quenched law. Traditionally, this model was studied by analytical methods but recent progress relies more on combinatorial methods. Based on joint works with Jian Ding, Rongfeng Sun and Changji Xu.

15:30–16:30 Talk Invited by Statistics and Probability Section

Takahiro Mori (Kyoto Inst. Tech.) L^p-extension of Kato class measures and its application to the analysis of multiple points of the trajectories of Markov processes

Summary: The Kato class was introduced by Tosio Kato in the 1970s as a condition for the essentially self-adjointness of Schrödinger operators and was subsequently given a probabilistic interpretation by Aizenman and Simon. In this talk, we discuss the properties of the L^p-Kato class, which is the L^p-extension of such classes. In particular, We will show that the range of p such that the measure associated with a space belongs to L^p-Kato class is given by the Hausdorff dimension of the space and the walk dimension of the stochastic process when the heat kernel estimate of the stochastic process is given using these dimensions. We also show that such a range of p is given by the Sobolev embedding theorem of the Dirichlet space corresponding to the stochastic process into L^{2p}-Lebesgue space. As an application, some results obtained on the existence of p-multiple points of the trajectories of stochastic processes and on the properties of (mutual-/self-)intersection measures or local times measuring the amount of p-multiple points are presented.

March 19th (Wed) Conference Room VIII

9:30–11:20

8 Toru Sera (Osaka Univ.) Higher order approximations in arcsine laws for subordinators ····· 15

Summary: We discuss higher order approximations in Dynkin–Lamperti theorem, a limit theorem for the distribution of a subordinator immediately before its first passage time over a fixed level.

Summary: The purpose of our talk is to introduce the construction of a stochastic process called "diffusion house-moving" and its properties. We study the weak convergence of diffusion bridge conditioned to stay between two curves, and we refer to this limit as diffusion house-moving. Applying this weak convergence result, we give the sample path properties of diffusion house-moving.

Summary: We consider the first hitting time to a sphere of an Ornstein–Uhlenbeck process and give an explicit form of the joint density of the hitting time and the hitting site by means of Gegenbauer polynomials and density functions of hitting times of radial Ornstein–Uhlenbeck processes.

Summary: Schumacher(1985) and Brox(1986) introduced a diffusion process with a Brownian potential. In this talk, we introduce diffusion processes with random potentials. The random potentials consist of three selfsimilar processes with different exponents. We study the long-time behavior of our processes.

Summary: The reflection principle of Brownian motion was established by Lévy. P . As generalization of its property, Carr. P and Nadtochiy. S constructed the transformation that generates the reflection principle for the multi-demensional diffusion process. On the other hand, the quantum walk is a quantum counterpart of the classical random walks. Quantum walks are studied for properties similar to random walks, for example, derivation of the probability distribution and the limiting distribution. In this presentation, we introduce the counterpart of the reflection principle in the sense of Carr–Nadtochiy's transformation.

Summary: We derive a Clark–Ocone–Haussmann (COH) type formula under a change of measure for L^1-canonical additive processes, providing a tool for representing financial derivatives under a risk-neutral probability measure. COH formulas are explicit martingale representations of random variables in terms of their Malliavin derivatives. In mathematical finance, the COH formula under a change of measure is crucial for representing financial derivatives under a risk-neutral probability measure. An application of our results is solving the local risk minimization (LRM) problem in financial markets driven by pure jump additive processes. LRM, a prominent hedging approach in incomplete markets, seeks strategies that minimize the conditional variance of the hedging error.

14 Yuji Shinozaki (Musashino Univ.)
Kohei Hayashi (RIKEN)
Numerical methods for the rough volatility model: High-order discretization using Markovian approximation and KLNV scheme ····· 15

Summary: This study introduces an accelerated computational method for the rough volatility model using Markovian approximation and the KLNV scheme. The rough volatility model, widely studied in finance, enables consistent representation of historical and implied volatility. A key feature is its use of a stochastic Volterra integral equation with a Riemann–Liouville integral for modeling volatility. Focusing on the rough Heston model, we employ Markov approximation to discretize the integral kernel, approximating it as a Markovian SDE. Applying the KLNV scheme for high-order time discretization further enhances computational efficiency. We present the algorithm and numerical examples demonstrating its practical advantages.

11:20–11:50 Research Section Assembly

March 20th (Thu) Conference Room VIII

9:30–11:30

15 Teruo Tanaka (Hiroshima City Univ.)
Bellman equations associated with optimal stopping problems for discrete time N-parameter Markov processes ····· 10

Summary: We consider optimal stopping problems for discrete time N-parameter Markov processes and Bellman equations that optimal value functions satisfy.

16 Hayato Takahashi (Random Data Lab.)
Exact distributions of p-values of Kolmogorov–Smirnov tests and tests of random numbers ····· 15

Summary: In MSJ2024 Osaka, we demonstrated tests of random number generators (RNG) by Kolmogorov–Smirnov goodness of fits tests of exact distributions of runs (H. Takahashi arXiv:2302.14356) and their empirical distributions generated by RNG. We also showed Kolmogorov-Smirnov goodness of fits tests of p-values with uniformly continuous null hypothesis. However p-values are discretely distributed. In this talk, we present exact discrete distributions of p-values (random null hypothesis) and tests of RNGs with random null hypothesis.

17 Masatake Hirao (Aichi Pref. Univ.)
On Sobolev statistics from the perspective of the quasi-Monte Carlo method on the sphere ····· 15

Summary: One of the tests in directional statistics is the "test of uniformity", which is a way to test the null hypothesis H_0 : $X_1, \ldots, X_n$ are uniformly distributed on the sphere when random vectors $X_1, \ldots, X_n$ on the sphere are mutually independent. Many tests of uniformity have been proposed, many of which can be unified within the framework of the Sobolev test. Sobolev statistics are related to well-known concepts in QMC theory, such as worst-case error and generalized discrepancy. In this talk, we present a generalization of the Riesz test proposed by Bakshaev (2010), and also introduce related topics and open problems.

18 Tomoki Tamaru (Kobe Univ.)
Kenji Tanino (Kobe Univ.)
Masatake Hirao (Aichi Pref. Univ.)
Masanori Sawa (Kobe Univ.)
More on the corner-vector construction for spherical designs ····· 15

Summary: Spherical design was first introduced by Delsarte, Goethals and Seidel(1977). One of the most fundamental problems in the study of spherical designs is the existence as well as construction. The corner-vector method is a traditional way of constructing designs with only corner vectors. This method can respond to the preference for simplicity of construction. However by Bajnok it has the drawback that the generated designs have degree at most 7. Therefore, we construct designs with generalized corner vector which have degree larger than 8. In this talk, we show a uniform upper bound for designs generated by generalized corner vectors and show some examples of designs.

19 Ayaka Yagi (Tokyo Univ. of Sci.)
Hiroto Kozawa (Tokyo Univ. of Sci.)
Takashi Seo (Tokyo Univ. of Sci.)
The null distribution of simplified T^2-type test statistic for two-sample problem with two-step monotone missing data ····· 15

Summary: We consider the null distribution of the simplified T^2-type test statistic for two-sample problem with two-step monotone missing data. The simplified T^2-type test statistic for two-sample problem is used as a test statistic for testing the equality of two mean vectors with monotone missing data. An asymptotic expansion for its null distribution using decomposition of the simplified T^2-type test statistic is derived. Note that the correlation of each decomposed statistic is considered in the derivation. Further, we present an improved test statistic based on the Bartlett adjustment for chi-squared approximation. Finally, we investigate the asymptotic behavior of the null distributions of the simplified T^2-type test statistic and the improved test statistic using Monte Carlo simulation.

20 Hitoshi Motoyama (Aoyama Gakuin Univ.)
A simple derivation of the asymptotic normality of quantile estimators in unequal probability sampling ····· 15

Summary: In this study, we establish a simple derivation of the asymptotic normality of quantile estimators based on the Hajek estimators for the population distribution function in unequal probability sampling designs.

21 Ken-ichi Koike (Nihon Univ.)
Soshi Banno (Dai-ichi Life Techno Cross Co., Ltd.)
Attainment conditions of the Bayesian information inequalities for the escort distribution ····· 10

Summary: Some attainment conditions for attaining for Bayesian information inequalities such as the van Trees and the Borovkov–Sakhanenko inequalities regard to the order of the escort distribution when the probability distribution of the data is modeled using an escort distribution, which is a generalized probability distribution constructed from an exponential family, and the prior distribution is either conjugate or Jeffreys, and the parameter of interest is a function of the order of the escort distribution. Some examples are also considered.

22 Hirai Mukasa (Kyushu Univ.)
Research on Bayes linear estimators in a general linear model ····· 15

Summary: Bayes linear estimators are derived by minimizing the average total mean squared error in a general linear model. In this presentation, we prove that Bayes linear estimators are linearly sufficient, but not necessarily linearly complete. Moreover, we derive necessary and sufficient conditions under which two Bayes linear estimators coincide. In this proof, two approaches are considered, both of which yield the same result.

March 21st (Fri) Conference Room VIII

9:30–11:30

23 Rinka Sagawa (Waseda Univ.)
Kazuki Koizumi (Waseda Univ.)
Yan Liu (Waseda Univ.)
Asymptptic theory for exponential smoothings ····· 10

Summary: We consider the asymptotic theory for the simple and double exponential smoothing. The simple exponential smoothing is a forecasting method for time series data without a trend or seasonal pattern, while the double exponential smoothing accounts for trends in the time series as an extension of the simple exponential smoothing. We establish the asymptotic normality for both methods, which potentially contributes to the selection criteria for smoothing coefficients. Numerical simulations are provided to visualize their asymptotic normality through cross-validation. In real data analysis, the prediction accuracies of the simple and double exponential smoothing are compared under conditions of asymptotic normality for the monthly number of foreign visitors to Japan from United states, United Kingdom, Australia, and China.

Summary: One purpose of regression analysis in time series analysis is to predict future values based on past data. Various methods have been proposed for parameter estimation in the harmonic regression model, such as the least square estimator, maximum likelihood estimator, and shrinkage estimator. When constructing a regression mode for prediction, a model is selected by minimizing prediction error. In this study, we focus on the prediction error resulting from misspecification in multivariate harmonic time series regression model. Using the least square regression estimator, we demonstrate that this prediction error can be decomposed into the prediction error from autoregression model, and a periodic component based on the spectral density matrix of the stationary time series. Through simulations, we confirm the effectiveness of our proposal.

Summary: We consider the problem of testing for homoscedasticity in high-dimensional time series, under the assumption that the sample size n and the dimension p satisfy $p/n \to c \in (0, \infty)$ as $n, p \to \infty$. The homoscedasticity refers to the case where the covariance matrix of the time series is equal to the identity. The test statistic is so-called the V-statistic in the multivariate statistics. The asymptotic null distribution of the V-statistic is shown to be asymptotically normal. The simulation study illustrates the finite sample properties of the V-statistic.

Summary: We study the second-order asymptotics of the maximum likelihood estimator (MLE) and the Whittle estimator for the Gaussian stationary processes with ε-contaminated spectral densities. The second-order asymptotic efficiency of the Gaussian MLE has been established so far. We extend this result to the ARMA models with an ε-contamination. The second-order Edgeworth expansions for the MLE and Whittle estimator with an ε-disturbance in spectral density are derived for robustness evaluation. As an illustration, we investigate the measure of second-order robustness of MLE and Whittle estimator for AR(1) models with a graphical demonstration.

Summary: The long memory phenomena frequently occur in the empirical studies of various fields. The fractionally integrated process is the one of the suitable candidate which appropriately represents the long memory property. There are two recursive algorithms for determining the one-step predictors of time series, that is, the Durbin–Levinson algorithm and the innovation algorithm. The Durbin–Levinson algorithm for the fractionally integrated process is well-known and widely used, which naturally derives the Cholesky factorization of the inverse matrix of the covariance matrix of the process. In this talk, we derive the innovation algorithm for the fractionally integrated process. The result is also applied to the derivation of the Cholesky factorization of the covariance matrix of the process in the explicit form. Moreover, the asymptotic theory of Gaussian maximum likelihood estimator (GMLE) is derived in terms of the innovation algorithm.

Summary: We present the asymptotic mixed normality of the least absolute deviation (LAD) estimator for a class of non-Gaussian locally stable stochastic differential equation (SDE) observed at high frequency over a fixed period.

Summary: This presentation focuses on hypothesis testing for Principal Component Regression (PCR) coefficients in high-dimensional settings. We first derive asymptotic distributions of the sample PCR coefficients under a strongly spiked eigenvalue model. By using the asymptotic distributions, we propose a new hypothesis testing procedure for PCR coefficients in high-dimensional settings. Through numerical simulations, we examine the method's performance.

Summary: This talk examines change-point detection methods for high-dimensional, low-sample-size data. While change-point detection methods using principal component analysis and factor analysis have been proposed, their theoretical properties often assume sparsity in data structure. Although many methods for change-point detection have been developed, we introduce a method based on differences in distances between data points and derive its asymptotic properties. Through numerical simulations, we examine the method's performance and extend it to detect multiple change-points, offering further theoretical insights.

14:15–15:15 Talk Invited by Statistics and Probability Section

Summary: We treat the variable selection problem for selecting effective variables in high-dimensional multivariate models. When the number of candidate variables is large, calculating variable selection criteria for all the possible subsets becomes computationally expensive. To address this problem, the KOO method using a variable selection criterion, has recently been noted to be useful. In this study, we focus on the variable selection problem for selecting explanatory variables in high-dimensional multivariate linear models. We examine the selection consistency of the KOO method using each the Cp-type criterion and the AIC-type criterion is examined under a high-dimensional and large-sample theory, where the number of variables may approach infinity as the sample size increases.

15:30–16:30 Talk Invited by Statistics and Probability Section

Sumito Kurata (Kyushu Univ.) Model evaluation criteria with robustness in selection based on statistical divergence measures

Summary: In this presentation, I describe the application of statistical divergence measures with robustness against outliers to model selection problems. In real data, there frequently exist outliers that are markedly different in value from others. Since it is difficult to provide a clear threshold of such outliers, robust methods that reduce the influence of the outliers have a great importance. I introduce the quasi-likelihood built upon statistical divergence, and derive model evaluation criteria from it. Especially, I focus on BHHJ divergence family and its related classes: BHHJ divergence is a representative robust divergence in parametric estimation. The proposed model evaluation criteria possess a characteristic of reducing the negative influence of the outliers by down-weighting for them. We can measure the robustness against outliers of a criterion via the difference of values of the criterion between the population with outliers and the non-contaminated population. Noting that, robustness in model selection does not necessarily correspond to robustness in estimation. The conditions for robust selection differ depending on the divergence families: some classes of divergence can not guarantee robustness in model selection and some classes require quite strict conditions for robust selection, despite the fact that these divergence have robustness in parametric estimation. Moreover, I introduce criteria for the determination of the regularization parameter, that achieve two properties: robustness against outliers and selection consistency under the high-dimensional assumptions.

Applied Mathematics

March 18th (Tue) Conference Room IX

9:30–11:50

1 Yusaku Nishimura (Waseda Univ.) Kneser chromatic function and complete invariants for trees ····· 15

Summary: R. P. Stanley defined an invariant for graphs called the chromatic symmetric function and conjectured it is complete invariant for trees. Miezaki et al. generalised the chromatic symmetric function and defined the Kneser chromatic functions denoted by $\{X_{K_{\mathbb{N},k}}\}_{k\in\mathbb{N}}$, and rephrase Stanley's conjecture that $X_{K_{\mathbb{N},1}}$ is a complete invariant for trees. Then, a natural question regarding this conjecture is that is there a upper bound of k such that $X_{K_{\mathbb{N},k}}$ is a complete invariant for trees. In this presentation, we show that $X_{K_{\mathbb{N},2}}$ is a complete invariant for trees.

2 Yuta Watanabe (Aichi Univ. of Edu.) Representations of ordered Hamming schemes ····· 15

Summary: The ordered Hamming scheme is an extension of the wreath product of one-class association schemes and is a type of generalized Hamming scheme introduced by Delsarte. It is known that the eigenmatrices of the ordinary Hamming scheme can be described using the Krawtchouk polynomials, and the Terwilliger algebra of the ordinary Hamming scheme is the symmetric tensor algebra of the Terwilliger algebra of a one-class association scheme. In this talk, I will discuss how these results can be extended to the ordered Hamming scheme.

3 Hirotake Kurihara (Yamaguchi Univ.) Wirtinger inequalities and the Euclidean distortions for association schemes ····· 15

Summary: In this abstract, we introduce the results obtained in joint work with Takfumi Kondo (Kagoshima University) that are related to association schemes. In the study of the measure concentration phenomenon in CAT(0) spaces, the Wirtinger inequality plays an important role. To give a rough explanation of the Wirtinger inequality, it is an inequality that shows a certain kind of optimality for the embedding of a finite set with a geometric structure or group structure into an Euclidean space. In this study, we gave the Wirtinger inequality for symmetric association schemes. As a corollary of this result, we obtained some evaluation of the Euclidean distortion of a graph obtained from an association scheme.

4 Tomohiro Kamiyoshi (Matsue Coll. of Tech.)
Makoto Nagura (Osaka Electro-Comm. Univ.)
Shin-ichi Otani (Kanto Gakuin Univ.) On the principal part of production matricies for the exponential recursive matrix of unified Stirling numbers ····· 15

Summary: This presentation examines the exponential recursive matrix of unified Stirling numbers introduced by Hsu and Shiue and explores the properties of its corresponding production matrix. The production matrix, as defined here, extends earlier definitions by incorporating Roman factorials to include the negative domain. For convenience, it is also shifted by one column without altering its essence. Using the production matrix, various equations can be derived. This talk highlights the properties and relationships of the production matrix in the context of unified Stirling numbers.

5 Diogo Kendy Matsumoto (Teikyo Univ. of Sci.) 3-self-centered unique eccentric point graphs ····· 15

Summary: A graph is called self-centered if all of its vertices have the same radius and diameter. Especially, we call a self-centered graph having diameter r simply r-self-centered graph. In this talk, we show some results of a 3-self-centered graph satisfying the unique eccentric point property from the viewpoint of girth.

6 Akihiro Higashitani (Osaka Univ.)
Kenta Ueyama (Shinshu Univ.)
Switching equivalence classes of skew-symmetric matrices and modular Eulerian matrices 15

Summary: In this talk, we introduce an operation on skew-symmetric matrices over $\mathbb{Z}/\ell\mathbb{Z}$ called switching. This notion is derived from the notion of switching in graph theory. It is known that the switching equivalence classes of graphs are deeply related to the isomorphism classes of Eulerian graphs. In this talk, we define a class of skew-symmetric matrices over $\mathbb{Z}/\ell\mathbb{Z}$ referred to as modular Eulerian matrices, and prove the coincidence of the numbers of switching equivalence classes of skew-symmetric matrices and equivalence classes of modular Eulerian matrices for some cases.

7 Yuho Tanaka (Waseda Univ.)
The directed spanning trees of the directed square cycles 15

Summary: In 1975, D. J. Kleitman and B. Golden used topological properties of a planar embedding of C_n^2, where C_n^2 is the square cycle on n vertices, to derive a formula for the number of spanning trees, when n is even. They mentioned that a similar method could be used to derive the same formula for odd n, without giving details. In 2024, A. Munemasa and Y. Tanaka classified connected spanning convex subgraphs of C_n^2, the square of the n-vertex cycle and showed that every spanning tree of C_n^2 is contained in a unique non-trivial connected spanning convex subgraph of C_n^2. They obtained a purely combinatorial derivation of the formula for the number of spanning trees of C_n^2. In this talk, we extend this result so that we count the number of the directed spanning trees of the directed square of the n-vertex cycle.

8 Xiao-Nan Lu (Gifu Univ.)
Existentially closed critical Cayley graphs 15

Summary: A graph is called *t-existentially closed* (t-e.c.) if, for every t-element subset A of vertices and every subset $B \subseteq A$, there is a vertex outside A adjacent to all vertices in B and to none in $A \setminus B$. A t-e.c. graph is *critical* if removing any vertex makes it no longer t-e.c. This talk focuses on 2-e.c. critical Cayley graphs. By providing explicit constructions and verifying non-existence results by computers, we show that a 2-e.c. critical Cayley graph of order n exists if and only if $n \geq 9$ and $n \notin \{10, 11, 14\}$.

14:15–15:55

9 Hirotake Yaguchi (Mie Univ.*)
Generation of nonrecursive n-bit pseudorandom numbers based on β-transformation on $[1, 2)$ $(n = 64, 128, 192, ..., 8192)$ 15

Summary: We show that we can generate nonrecursive n-bit pseudorandom numbers using a simple algorithm which we call **xMM** (**e**x**t**ract **M**iddle and **M**ultiply). The algorithm consists of five times repetition of (i) multiplication of two n-bit integers and (ii) taking out n bits from the result of (i). The algorithm can be described using the β-transformation on $[1, 2)$ defined by $T_{2^k B}(X) = (2^k B)X - \lfloor (2^k B)X \rfloor + 1,\ \ X,\ B \in [1, 2)$. We also consider the mathematical condition of generating random numbers.

10 Yoshinori Kametaka (Osaka Univ.*)
Kohtaro Watanabe (Nat. Defense Acad. of Japan)
Atsushi Nagai (Tsuda Coll.)
Kazuo Takemura (Nihon Univ.)
Hiroyuki Yamagishi (Tokyo Metropolitan Coll. of Indus. Tech.)
Hiroto Sekido (Osaka Seikei Univ.)
The best constant of discrete Sobolev inequality on $C_{20} \sim C_{60}$ fullerene 15

Summary: We consider a classical mechanical model of carbon molecular C_N fullerenes. $N = 20, 24, 26, 28, \cdots, 58, 60$ are the numbers of atoms of C_N fullerenes. The discrete Sobolev inequality on C_N fullerenes show that the square of the maximum of the deviation is estimated from above by constant multiples of the potential energy. Among such the constant, the smallest constant is the best constant. Hence, it is considered that the best constant represents the rigidity of the mechanical model. We calculate all the best constants of the discrete Sobolev inequalities corresponding to C_N fullerenes isomers and rank the rigid among all isomers of C_N fullerenes.

Summary: We consider a free action of a finite group G on a finite digraph D. A finite digraph in this talk allows multi-arcs and multi-loops. Since the action is free, the digraph D is the lift of the quotient digraph D/G via an ordinary voltage assignment (OVA) m for D/G. Let H be a subgroup of G. We also have a free action of H on D. Thus D is also the lift of D/H via an OVA n for D/H. Negami and Sato provide in their remarkable paper published in 2010 a relation for two OVA's m and n for the symmetric digraph for a finite simple graph, which we call Nagami–Sato's lemma. In this talk, we show Negami–Sato's lemma for a general digraph which allows multi-arcs and multi-loops.

Summary: We present an expression of Konno–Sato Theorem by the Euler product, and we give its applications by using the determinant expressions of the edge zeta function and the Bartholdi zeta function. Furthermore, we generalize them to the generalized Grover matrix of a regular graph.

Summary: We consider a zeta function of the time evolution matrix of a bipartite walk on a bipartite graph, and present a formula for the absolute zeta function of the zeta function of the time evolution matrix of a bipartite walk on a semiregular bipartite graph. Furthermore, we give formulas for the absolute zeta functions of the zeta functions of the time evolution matrices of bipartite walks on the complete bipartite graph and an even cycle graph. As an application, we obtain formulas for the absolute zeta functions of the zeta functions of the Grover matrices of the complete bipartite graph and an even cycle graph.

Summary: We define a zeta function with respect to the twisted Grover matrix of a mixed digraph, and present an exponential expression and a determinant expression of this zeta function. As an application, we give a trace formula with respect to the twisted Grover matrix of a mixed digraph.

16:10–17:10 Talk Invited by Applied Mathematics Section

Summary: The Ihara expression is a determinant expression which describes the structure of a graph. Recently, it has been shown that the Ihara expression is connected to quantum walks, knot invariants, and other areas. This has led to increased research interest in the Ihara expression from various fields. However, the conditions for constructing the Ihara expression, such as the required graph or weight properties, remain unclear. The definition of the Ihara expression has also not yet been provided. In this talk, I provide an overview of research on expressions of the graph zeta function. I will discuss recent results toward defining the Ihara expression.

March 19th (Wed) Conference Room IX

10:00–11:50

15 Toranosuke Omura (Hokkaido Univ.) Constructing an $m \times (n+1)$ trianguloid from an $m \times n$ trianguloid ····· 15

Summary: Triangulations of a product $\Delta^{m-1} \times \Delta^{n-1}$ have been studied for several years. Pavel Galashin, Gleb Nenashev, and Alexander Postnikov defined trianguloids as edge-colored Graphs satisfying some axims. They constructed bijection between triangulations of $\Delta^{m-1} \times \Delta^{n-1}$ and $m \times n$ trianguloids. I constructed a method of constructing an $m \times (n+1)$ trianguloid from an $m \times n$ trianguloid.

16 Aki Mori (Setsunan Univ.) Triangular faces of the order and chain polytope of a maximal ranked poset ····· 15

Summary: In this talk, we study the number of triangular 2-faces of the order polytope and the chain polytope associated with a maximal ranked poset. We show the following result: if P is a maximal ranked poset, then the number of triangular 2-faces of the order polytope of P is less than or equal to that of the chain polytope of P, with equality holding if and only if P does not contain an X-poset as a subposet. This result contributes to the advancement of Hibi and Li's conjecture.

17 Masahiro Hachimori (Univ. of Tsukuba) Partitionability of nonpure simplicial complexes and h-triangles ····· 15

Summary: A simplicial complex is partitionable if its face lattice can be partitioned into boolean intervals whose tops are facets. For pure simplicial complexes, partitionability implies the nonnegativity of h-vectors, but for nonpure simplicial complexes, the situation is complicated. To study the partitionability of nonpure cases, the speaker has previously introduced several strengthened notions of partitionability. In this presentation, we discuss the hierarchy of these strengthened partitionabilities of nonpure simplicial complexes along with the properties of their h-triangles related to nonnegativity.

18 Shinya Fujita (Yokohama City Univ.) The domination number of a central graph and the vertex cover of a graph ····· 10

Summary: For a simple undirected graph G with complement $\overline{G}$, the central graph $C(G)$ is constructed by adding a path of length two edges between all pairs of non-adjacent vertices in $\overline{G}$. In this work, utilizing the notion of central graphs, we provide a novel classification scheme for all simple undirected graphs based upon the existence of a minimum cardinality vertex cover that concomitantly serves as a dominating set in the complement.

19 Tomoki Yamashita (Kindai Univ.), Katsuhiro Ota (Keio Univ.) An Ore-type condition for 2-edge-connected $[2,k]$-factors in 2-connected graphs ····· 15

Summary: A $[2,k]$-factor of a graph G is a spanning subgraph F of G with $2 \leq d_F(v) \leq k$ for each $v \in V(F)$, where $d_F(v)$ is the degree of a vertex v in F. Since a connected $[2,2]$-factor is a Hamilton cycle, a 2-edge-connected $[2,k]$-factor is a generalization of a Hamilton cycle. Many degree conditions for the existence of a Hamilton cycle are known. In this talk, we introduce several conjectures and theorems on degree conditions for the existence of a 2-edge-connected $[2,k]$-factor, and we give a positive answer to one conjecture of them.

20 Kuniharu Yokomura (Tokai Univ.) On degree conditions of balanced 3-partite panconnected graphs ····· 15

Summary: For a graph G and two vertices u and v of G, a path in G from u to v is called a (u,v)-*path*, and the distance between u and v is the length of shortest (u,v)-path, denoted as $d(u,v)$. A graph G is said to be *panconnected* if for any two distinct vertices u and v of G and for each integer l with $d(u,v) \leq l \leq |V|-1$, there is a (u,v)-path of length l in G. A k-partite graph is said to be a *balanced k-partite graph* if each partite set has the same number of vertices. We give some conditions for balanced 3-partite graphs to be panconnected.

21 Kazunori Matsuda (Kitami Inst. of Tech.)
Yuichi Yoshida (City Office of Kitami)
The minimum value of vertices and edges of connected simple graphs with three invariants associated with the matching having specific values 15

Summary: Let p, q and r be integers with $1 \leq p \leq q \leq r \leq 2q$. We will talk about the minimum value of vertices and edges of connected simple graphs its induced matching number, minimum matching number and matching number is equal to p, q, and r, respectively.

13:15–14:00

22 Kohei Tanaka (Shinshu Univ.) Lefschetz calculus in finite spaces and its applications 15

Summary: We develop an integration theory on finite topological spaces (partially ordered sets) with the Lefschetz number as a measure and introduce its application to fixed point enumeration.

23 Kengo Enami (Tsuda Coll.)
Shun-ichi Maezawa (Nihon Univ.)
Yusuke Suzuki (Niigata Univ.)
3-Linkedness of optimal 1-planar graphs 15

Summary: Let $Z = (s_1, s_2, \ldots, s_k, t_1, t_2, \ldots, t_k)$ be an ordered set of distinct vertices of a graph G. A Z-linkage of G is a set of k pairwise disjoint paths $P_1, P_2, \ldots, P_k$ such that P_i connects s_i and t_i for $i = 1, 2, \ldots, k$. A graph G is k-linked if G has at least $2k$ vertices and, for any ordered set Z of $2k$ vertices, G has a Z-linkage. A graph G is 1-planar if G can be drawn on the plane so that each of its edges crosses at most once other edge at a point. A 1-planar graph G is optimal if $|E(G)| = 4|V(G)| - 8$. We characterize 3-linked optimal 1-planar graphs.

24 Kenta Noguchi (Tokyo Univ. of Sci.) Embedding of complete graphs so that the dual has a 1-cut II 15

Summary: We find embeddings of complete graphs where the dual is simple, has a 1-cut, and the genus equals the minimum genus of the original graph plus 2.

March 20th (Thu) Conference Room IX

9:25–12:00

25 Yoshihito Ogasawara (Waseda Univ./Shibaura Inst. of Tech./Miyoshigokinkogyo Co. Ltd.)
Epistemology as applied topology 15

Summary: Topology is used not only as a language to describe the concept of form, but also as a language to describe our "way of seeing things" itself (i.e., not only as a language to describe the concept of form, but also as a language to describe the form of a concept [the concept of a concept]). We also use a concept called "Primitive Chaos" as a model of the world depicted by this language. Primitive Chaos represents a worldview in which determinism and non-determinism are inseparably intertwined. Applying topology under this model provides an interesting insight into our perception of the world.

26 Yuuya Yoshida (Nagoya Inst. of Tech.) Mathematical comparison of classical and quantum mechanisms in optimization under local differential privacy 15

Summary: Differential privacy (DP) is an influential method of protecting private data, and is a condition for a conditional probability distribution. Since we can regard DP as a condition for a tuple of probability vectors, it is natural to consider a similar condition for a tuple of density matrices as a quantum version of DP. This condition is called classical-quantum DP (CQ-DP) because it is considered in converting classical data to quantum states. In the study of DP (including CQ-DP), a positive parameter ε represents the privacy level to be guaranteed. In this talk, we show that CQ-DP has a quantum advantage in certain optimization problems. Moreover, we compare classical DP and CQ-DP mathematically to clarify a relation between privacy level and quantum advantage.

Summary: In this talk, we introduce a numerical method for validating solutions to boundary value problems for semilinear elliptic partial differential equations with homogeneous Dirichlet boundary conditions on a disk. This approach is based on Zernike polynomials, which are defined using Jacobi polynomials, a class of orthogonal polynomial systems. The main result of this talk is that the weighted sequence space for the coefficients of the Zernike series forms a Banach algebra under a discrete convolution that corresponds to the product of functions and a certain weighted ell-one norm.

Summary: This study focuses on linear partial differential equation (PDE) systems that arise in topology optimization where the thickness of a structure is constrained. The thickness derived from the PDE is a fictitious one, and the key challenge of this work is to verify its equivalence to the intuitive, geometrically defined thickness. In this talk, we demonstrate that the thickness of an infinite, straight film with constant thickness as a simple shape is equivalent within a general domain. The proof involves constructing a reference solution within a special domain and evaluating the difference using the maximum principle and an interior H^1 estimate.

Summary: Scalar variables that fluctuate irregularly due to random firing and decay have been observed in a wide range of fields, including financial engineering, physics, and biology. As a model of gene expression in which transcription depends on a complex promoter state, we formulate a Markov jump process $Y(t)$ coupled with an n-state categorical process $X(t)$ consisting of $n-1$-off and 1-on states. We prove that the stationary probability density function of Y can be concisely expressed by the inverse Laplace transform of a generalized hypergeometric series. We also validate the scalability and reducibility of our model, which is critical for real data analysis.

Summary: In this talk, I survey median-based quasi-Monte Carlo (QMC) integration over the multi-dimensional unit cube. This method approximates the integral of a function by taking the median of several integral estimates obtained from independent and random choices of the underlying QMC point sets. I present results on the universality of median-based QMC rules, in the sense that, without any prior knowledge of the target function space, an almost optimal rate of convergence for the worst-case error can be achieved. Additionally, I share numerical results illustrating the effectiveness of median-based QMC rules.

Summary: We consider the bistable reaction-diffusion equation on metric graphs, specifically, star graphs and graphs formed by gluing star graphs with the Neumann boundary conditions at the endpoints. The purpose of the study is to provide stable/unstable equilibrium solutions with their precise profiles for sufficiently long edges. To this end, we derive a reduced energy for approximate solutions on the star graphs and obtain the solutions as critical points the energy. The comparison principle is also applied to show the stability of the solutions on the graphs formed by the star graphs.

Summary: In general, skin diseases manifest as "visible information" in the form of skin eruptions over the body, while the underlying processes within the body that cause these phenomena are often only captured as fragmented information at a single point in time through skin biopsies. Additionally, diseases such as urticaria, which are unique to humans, cannot be analyzed using animal models, necessitating the inference of pathophysiology based on in vitro experiments and limited clinical data. In this presentation, I propose a new approach that bridges "the visible shapes of skin eruptions with the invisible world of molecular and cellular dynamics within the body", thereby overcoming existing limitations through the integration of mathematical science, data analysis, and clinical dermatology. Furthermore, I will introduce a novel method that integrates mathematical modeling with topological data analysis, enabling the estimation of patient-specific parameters based on the shape of their skin eruptions.

Summary: We formulate a body circulation mathematical model which represents the dynamic of blood concentration levels of glucose and insulin in each organs. From Oral Glucose Tolerance Test (OGTT) data of healthy subjects, we conduct parameter estimation of the mathematical model and testify the validity of our model based on the medical facts. Next, we conduct parameter estimations to fit Intra Venous Glucose Tolerance Test (IVGTT) data from healthy subjects with different fasting hours. By investigating glucose metabolism change in each organ with different fasting, it turns out that the numerical result from estimated parameters coincides with the experimental result. At last, we conduct parameter estimations to fit OGTT data from mice and clustering analysis to extract important metabolism indexes which describe the difference of mice ages and mice diet.

14:15–14:40 Presentation Ceremony for the 2024 Applied Mathematics Prize

14:50–16:30

Summary: In this talk we discuss the Kuramoto model (KM) having natural frequencies and defined on a uniform graph. The natural frequencies are assumed to be deterministic and equally placed, or uniformly randomly distributed, and the graph is assumed to be complete simple, random dense or random sparse. We completely obtain equilibria and determine their stability and bifurcations in the KM when the natural frequencies are deterministic and equally placed and the graph is complete simple. We also describe the stationary solutions and their stability in the corresponding continuum limit (CL). Moreover, using the result for the CL, we discuss the dynamics of the KM when the natural frequencies are uniformly randomly distributed and the graph is complete simple, random dense or random sparse. We also give numerical simulation results for the KM when the natural frequencies are random.

Summary: We study feedback control of the Kuramoto model (KM) with natural frequencies on a uniform graph which may be complete simple, random dense or random sparse. We choose as the target orbit the synchronized state in which all oscillators rotate with the same rotational speed, and design the controller using the continuum limit (CL). When the graph is complete simple, we prove that if the feedback gain is larger than a critical value, then there exists an asymptotically stable synchronized solution that tends to the target orbit as the feedback gain goes to infinity, and that the CL has an asymptotically stable continuous solution which corresponds to the asymptotically stable solution to the KM. When the graph is random, we show that the continuous solution to the same CL as in the above case behaves as an asymptotically stable one in the KM. We demonstrate the theoretical results by numerical simulations for the KM on the three types of graphs.

Summary: When a large force is applied to metallic materials, plastic deformation occurs, remaining even after the force is removed. In materials subjected to cyclic loading, strain hardening is observed. One effective description of this hardening behavior is the kinematic hardening rule, which accounts for the shift of the constraint set in stress space as plastic deformation develops. In this study, we propose a new numerical scheme for an elastoplastic model with kinematic hardening. We prove that the solution is stable under appropriate norms when the operator relating strain to the center of the constraint set is Lipschitz continuous. Furthermore, this stability leads to the existence of a solution to the original problem.

Summary: We describe mathematical methods on mixed therapy using radiation and drug by the methods of systems biology and molecular dynamics. Several medical insights are also presented.

Summary: A mathematical model describing dynamics of particle-fluid two-phase fluids with low particle volume fractions flowing down the slope with low inclination angles and non-flat bottoms is constructed. The proposed model is based on the dilution approximation system derived by Murisic et al. (2013) corresponding to the experiment by Zhou et al. (2005) in which a suspension of glass beads and silicone oil was poured onto an acrylic slope with a fixed angle. In addition to the complete model, we have derived a simplified model as systems of conservation laws / balance laws taking non-flat bottoms and dilution approximation into account. In this talk, we provide the derivation details and sample numerical simulations of fluid morphology.

Summary: Self-propelled systems are composed of particles or droplets that can move spontaneously by consuming free energy. Their motion can be distinguished between those that change their shape and those that do not. In this study, using the Allen–Cahn equation, we formulated a self-propelled system that doesn't change shape and is driven by the difference in surface tension. In this presentation, I'll present the derivation of our model, the numerical results, and the stability of the motion of elliptical and dumbbell-shaped objects obtained from the numerical calculations.

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

Kazuyuki Yagasaki (Kyoto Univ.) On the development of the theory of nonintegrability of dynamical systems after Poincaré

Summary: As well known, Henri Poincaré won a prize competition celebrating the 60th birthday of King Oscar II for his work on the restricted three-body problem around the end of the 19th century. After his work, the problem of nonintegrability of dynamical systems has been studied extensively, and it is now one of the most important topics in the field of dynamical systems. In this talk, I review the development of the theory of nonintegrability of dynamical systems after Poincaré and present some recent results. In the first half, we mainly follow the work of Kozlov, Ziglin, Morales-Ruiz and Ramis in the development of the theory after glancing at Poinacaé's result: Kozlov sophisticated Poincaré's approach, and Ziglin, Morales-Ruiz and Ramis established new theories of nonintegrability. In the second half, we will see recent results on nearly integrable systems, one-dimensional nonautonomous systems and Poincaré–Dulac normal forms.

March 21st (Fri) Conference Room IX

9:25–12:00

40 Ken Nakashima (Shimane Univ.), Ippei Obayashi (Okayama Univ. / Tohoku Univ.) On fast algorithm for connected persistence diagrams · · · 15

Summary: We have developed and released a program for calculating the connected persistence diagrams, named "RuCPD". The connected persistence diagrams is an extension of the conventional general persistence diagram to ladder-type filtration. In this talk, we will explain the techniques for calculating the connected persistence diagrams at high speed, mainly from the perspective of algorithms. We will also report that we have achieved performance sufficient for practical use.

41 Ippei Obayashi (Okayama Univ. / Tohoku Univ.), Ken Nakashima (Shimane Univ.) RuCPD: Software for connected persistence diagrams · · · 15

Summary: Persistence diagrams (PD) enable us to characterize the shape of data using the idea of topology. A Connected Persistence diagram (cPD) is an extension of a PD and can describe the relationship between two PDs when two input data have an inclusion relationship. Nakashima and Obayashi have developed cPD computing software, RuCPD. In this presentation, we will introduce the implementation and usage of the software.

42 Takehiko Kinoshita (Saga Univ.), Yoshitaka Watanabe (Kyushu Univ.), Mitsuhiro T. Nakao (Waseda Univ.) Some quantitative lower bound estimates for the norm of resolvent and its applications · · · 15

Summary: We introduce a method to obtain the quantitative values L_h satisfying $\left\|(zI-A)^{-1}\right\| \geq L_h$.

43 Shinya Uchiumi (Hokkaido Univ.) A mixed Galerkin method for the Stokes problem using higher order approximation spaces on coarse meshes for the pressure · · · 15

Summary: The motion of incompressible fluids is modeled by the Navier–Stokes equations which have unknowns of the velocity and pressure. The Stokes problem is a simple model focusing on this point, which still has discussions on choices of the approximation space for the unknowns. Here, we develop a mixed Galerkin approximation for the Stokes problem, where we use the finite element space with a dense mesh for the velocity, and a higher order polynomial space with a coarse mesh for the pressure. We perform experiments showing accuracy and efficiency in solving the resultant linear system using the Krylov subspace method, and compare with the standard approximation by the Taylor–Hood element pair.

Summary: It has been experimentally confirmed that nanoscale particles formed by block copolymers show a variety of three-dimensional morphologies depending on the shape and internal microphase separation. Furthermore, a coupled Cahn–Hilliard system has been derived as a free energy gradient system that can be defined for this experimental system, yielding various minimizer depending on the parameters. However, the details of this free energy landscape remain unclear. In this talk, we investigate the dynamics of the solution by numerical simulations based on a structure preserving scheme for one-dimensional coupled Cahn–Hilliard system. We show that (1) a global saddle point network is revealed, and (2) the parameter dependence of the trajectory and the minimizer as the final destination can be classified.

Summary: We present numerical results on the convergence, stability, and accuracy of solutions for the semi-linear Klein–Gordon equation with a power law nonlinear term in the de Sitter spacetime. This presentation is a continuation of the MSJ Autumn Meeting 2024 at Osaka University. We report the changes of the convergence and the behavior of the solutions when the initial amplitude, mass, the magnitude of the Hubble constant, and the numbers of grid are changed.

Summary: We propose an algorithm for evolving spiral curves on a planar domain by normal velocities depending on the so-called crystalline curvatures and driving forces. The algorithm uses a minimizing movement approach and relies on a special level set method for embedding the spirals. Our approach enables us to handle the situations not only several centers of spirals are in the domain, but also some centers have several spirals. We present numerical simulations and comparisons demonstrating the efficacy of the proposed numerical algorithm.

Summary: The collective dynamics of oscillating pulses arising in a three-component FitzHugh–Nagumo system is considered. It is numerically found that clustered pulses exhibits several types of collective oscillatory behavior, including in-phase synchronization and irregular motions of pulse interfaces. Among these dynamics, we focus on in-phase synchronizations of oscillating pulses that are observed for a wide range of parameters. To investigate the mechanism for the synchronization, the reaction-diffusion equations are first reduced to finite dimensional ODEs for the motion of pulse interfaces, and by center manifold reduction, Stuart–Landau equations coupled with equations for pulse positions are derived near the onset of Hopf bifurcation. Phase reduction is further applied to the Stuart–Landau equations, yielding a system of ODEs for the positions and the phases of the oscillatory pulses. The reduced equations of point-mass and phase of oscillation capture essential features of the collective dynamics observed for the original PDEs, and yet make the problem analytically more tractable. In the talk, we will mainly deal with the cases of 2-pulse and 3 -pulse synchronization, and discuss their stability as well as the possibility for other types of synchronized states.

Summary: We consider the correspondence between dynamics at infinity and asymptotic expansion of finite-time blow-up solutions in nonautonomous systems of ordinary differential equations. A simple criterion of the existence of blow-ups is provided through the correspondence between "equilibria at infinity" and coefficients of the leading terms, as well as eigenpairs among associated linearized matrices. While the corresponding results in autonomous systems are already obtained by the speaker and his collaborators, the counterpart in nonautonomous setting is also obtained in the similar way with partial modifications.

14:15–15:15

Summary: I have devised a new digital signature system using the Finsler encryption that I introduced last year. Finsler encryption is a public-key cryptosystem that uses linear parallel displacement as a one-way function. Today, I will talk about the digital signature system and the features within it that ensure security. The security-assuring feature relies on the LPD assumption, which is established in Finsler encryption. Althouth I will not go into detail this time, the computational difficulty is the same as in Finsler encryption.

Summary: In this talk, I will present a reservoir computing study using Nino 3.4 time series data that accurately represents El Nino events. Hassanibesheli–Kurths–Boers (2022) constructed a reservoir machine learning model by using a conventional bandpass filter. Although this is the best prediction result so far, the model cannot be used directly for future El Nino predictions because their filter incorporates future data. Therefore, we have developed a new bandpass filter method that does NOT incorporate any future data. Then we have succeeded in creating a reservoir machine learning model (with reasonable filtered data) that exceed the previous forecast skill score.

Summary: We consider arbitrary bounded discrete time series originating from dynamical system with recursivity. More precisely, we provide an explicit construction of recurrent neural networks which effectively approximate the corresponding discrete dynamical systems.

Summary: In recent years, Physics-informed Neural Networks (PINNs) have been actively studied as a powerful method for solving partial differential equations(PDEs) that describe various physical phenomena. We focus on applying PINNs to the Navier–Stokes equations, which are fundamental equations in fluid dynamics. In this talk, we show an estimate of the numerical error of learned numerical solutions when using PINNs to approximate solutions of the Navier–Stokes equations with external force terms.

15:30–16:30 Talk Invited by Applied Mathematics Section

Takaharu Yaguchi (Kobe Univ.) Geometric deep scientific computing

Summary: Recently, Scientific Machine Learning (SciML), which is a combination of machine learning and scientific computing, has attracted much attention. SciML has the potential to achieve many improvements that have been difficult to realize with traditional techniques. For example, operator learning makes physical simulations much faster by learning solution operators of partial differential equations. Also, physics-informed neural networks enable parallelization in the time. In this talk, I will discuss recent topics in this field from both theoretical and practical perspectives, focusing on machine learning methods that preserve physical or geometric properties.

Topology

March 18th (Tue) Conference Room II

9:30–11:40

1 Dror Bar-Natan (Univ. of Toronto) Emergent version of Drinfeld's associator equations · · · · · · · · · · · · · · · · · 15
Yusuke Kuno (Tsuda Coll.)

Summary: We introduce the concept of emergent braids. Then we define a variant of the Grothendieck–Teichmüller Lie algebra and show its relationship with the Kashiwara–Vergne Lie algebra.

2 Sonia Mahmoudi (Tohoku Univ.) From toroidal pseudo links to pseudo DP tangles · · · · · · · · · · · · · · · · · · · 15

Summary: In this talk, we present the theory of pseudo DP tangles, which incorporate undetermined crossings inspired by the theory of pseudo knots. Pseudo DP tangles are defined as liftings in the universal cover of spatial pseudo links in the thickened torus, called pseudo motifs. They are analyzed through diagrammatic methods that account for both local and global isotopies. We emphasize on pseudo scale equivalence, a concept defining equivalence between finite covers of pseudo motif diagrams. We investigate the notion of equivalence for these structures, leading to an analogue of the Reidemeister theorem for pseudo DP tangles. Furthermore, we address the complexities introduced by pseudo scale equivalence in defining minimal pseudo motif diagrams.

3 Sonia Mahmoudi (Tohoku Univ.) On invariants of pseudo DP tangles · 15

Summary: A pseudo DP tangle in the thickened plane is the lifting of a toroidal pseudo link embedded in the thickened torus to the universal cover. Following our first talk on equivalence, we now extend the concept of invariants for pseudo DP tangles by introducing the notion of WeRe set, a generalization of the resolution sets for pseudo knots. The WeRe set is defined as the set of all classical DP tangles that can be obtained from a given pseudo DP tangle by resolving each precrossing into a classical crossing. This set is shown to be invariant under the combinatorial moves defined earlier, providing an interesting tool for classifying pseudo DP tangles.

4 Noboru Ito (Shinshu Univ.) Commutator and higher Arnold strangeness · 15

Summary: We formulate a relationship between higher Arnold strangeness, i.e. Tabachnikov, plane curve invariants and the lower central series of a subgroup of the pure twins group. We use this to show that there exist infinite families of prime plane curves whose invariants match those of a given plane curve up to a given order.

5 Kazuhiro Ichihara (Nihon Univ.) On two-bridge ribbon knots · 10
Sayo Horigome
(Caritas Girls' Junior & Senior High School)

Summary: We show that a two-bridge ribbon knot $K(m^2, mk \pm 1)$ with $m > k > 0$ and $(m, k) = 1$ admits a symmetric union presentation with partial knot which is a two-bridge knot $K(m, k)$. Similar descriptions for all the other two-bridge ribbon knots are also given.

6 Jun Murakami (Waseda Univ.) On the colored Jones polynomial of double twist knots · · · · · · · · · · · · · · · · 10

Summary: The volume conjecture is related to the colored Jones polynomial corresponding to the N dimensional representation of $\mathcal{U}_q(sl_2)$ where q is the $2N$-th root of unity. New expression of such colored Jones polynomial of the double twist knots is obtained by using the ADO invariant. This expression is useful for proving the volume conjecture for double twist knots.

7 Atsuhiko Mizusawa (Waseda Univ.)
Yuka Kotorii
(Hiroshima Univ./Hiroshima Univ./RIKEN)
A classification of link-homotopy classes with vanishing short Milnor invariants ····· 15

Summary: In this talk, we consider the link-homotopy classes with vanishing short Milnor invariants. It is known that the link-homotopy classes of links are obtained from those of string links modulo the actions of partial conjugations. We give new generators of the partial conjugations and classify the link-homotopy classes with vanishing short Milnor invariants by using the new actions.

8 Jun Ueki
(Ochanomizu Univ./Ochanomizu Univ.)
Honami Sakamoto (Ochanomizu Univ.)
Ryoto Tange (Waseda Univ.)
Liminal $\mathrm{SL}_2\mathbb{Z}_p$-representations and cyclic covers of twist knots ····· 15

Summary: Let p be a prime number and let $\mathbb{Z}_p$ denote the ring of p-adic integers. We consider SL_2 representations of knot groups. A liminal $\mathrm{SL}_2\mathbb{Z}_p$ representation is a reducible representation such that other representations in its neighborhood is irreducible. If the intersection of the varieties of reducible and irreducible characters over $\mathbb{F}_p$ satisfies the assumption of Hensel's lemma, then we obtain a liminal representation. In the case of twist knot $K = J(2, 2m)$, the condition for the existence of such a representation is given by the quadratic reciprocity law. For instance, if $K = J(2, -2)$, then it becomes $p \equiv \pm 1 \bmod 5$. On the other hand, the size r_n of H_1 of the branched $\mathbb{Z}/n\mathbb{Z}$-cover of $J(2, 2m)$ is given by a Lucas-type sequence. For instance, if $K = K(2, -2) = 4_1$, then we have $p \mid r_{2k-1}$ implies $p \equiv \pm 1 \bmod 5$, so it has a liminal representation. We assert that such implication holds true for every $J(2, 2m)$.

14:20–15:20 Talk Invited by Topology Section

Kokoro Tanaka (Tokyo Gakugei Univ.) Surface knot theory and quandle theory

Summary: A surface knot is an embedded connected closed surface in the four-dimensional Euclidean space, and a quandle is an algebraic structure whose axioms encode the movements of classical knots through their diagrams. In this talk, we study oriented surface knots by using quandle theory. In particular, we discuss algebraic properties of the knot quandles and the fudamental classes of oriented surface knots.

15:40–17:30

9 Jumpei Yasuda (Osaka Univ.) A formula for Alexander polynomials of 2-plat 2-knots ····· 15

Summary: A 2-knot is a smmothly embedded 2-sphere in the 4-space. A 2-dimensional braid was introduced by Viro as a higher dimensional analogue of an braid. We can construct a 2-knot from a 2-dimensional braid of degree $2m$ by taking the plat closure, which is called an m-plat 2-knot. Every 1-plat 2-knot is known to be trivial. In this talk, we focus on 2-plat 2-knots. We will introduce a normal form for these 2-knots and provide a formula for their Alexander polynomials.

10 Mizuki Fukuda (AIST–Tohoku Univ.)
Masaharu Ishikawa (Keio Univ.)
Twist spun knots of twist spun knots ····· 10

Summary: An n-knot is a smoothly embedded n-sphere in the $n+2$-sphere. The construction, called twist-spinning, of an $n+1$-knot from an n-knot is introduced by Zeeman. We can repeat this construction finitely many times. In this talk, we focus on 3-knots obtained from a 1-knot by applying twist-spinning twice and give a sufficient condition to detect triviality and non-triviality of the 3-knot. We use fiberedness of 3-knots obtained by twist-spinning to show the triviality, and use 3-orbifold fundamental groups to show the non-triviality.

Summary: When a binary operation is defined on a set, one can consider invariant orders associated with it. For example, it is known that an order on the fundamental group of a manifold induces a certain co-dimension one R-covered foliation on the manifold. While orders are traditionally studied on groups, recent research has extended this framework to quandles, motivated by perspectives such as knot theory. In this talk, I will propose a dynamical approach to studying quandle orders. Specifically, I will explain what quandle orders and quandle actions are, introduce the theorem of dynamical realization that connects these two concepts, and discuss some of its applications.

Summary: A spatial surface is a compact surface embedded in the 3-sphere S^3. It is presented by a diagram of a spatial trivalent graph, which we call a diagram of a spatial surface. A multiple group rack is an algebraic structure corresponding to two of the three Reidemeister moves for diagrams of spatial surfaces. In this talk, we introduce a method for constructing multiple group racks and its applications.

Summary: Alexander polynomial can be generalized to an invariant of a pair of a link and its quandle representation, which we call an Alexander-type invariant, with a weight corresponding to an extension of the quandle. In this talk, we introduce a determinant state sum formula for an Alexander-type invariant satisfying certain condition and discuss the invariance and properties of the invariant.

Summary: S. Kim and O. Manturov attempted to define invariants of special configurations and movements of points and lines on a plane by using spaces of triangulations of surfaces. They defined a sequence of groups by explicit finite presentations as places where these invariants take their values. In this talk, we will report the results of our investigation into structures of these groups.

Summary: Clasper surgery induces the Y-filtration $\{Y_n\mathcal{IC}\}_n$ over the monoid of homology cylinders, which serves as a 3-dimensional analogue of the lower central series of the Torelli group of a surface. In this talk, we investigate the torsion submodules of the associated graded modules of these filtrations. To detect torsion elements, we introduce a homomorphism on $Y_n\mathcal{IC}/Y_{n+1}$ induced by the degree $n+2$ part of the LMO functor. Additionally, we provide a formula of this homomorphism for clasper surgery, and use it to demonstrate that every non-trivial torsion element in $Y_6\mathcal{IC}/Y_7$ has order 3.

March 19th (Wed) Conference Room II

9:30–11:35

16 Ryuichi Nakahara (Okayama Univ.)
Naoyuki Monden (Okayama Univ.)
An attempt and report on the collaboration of medical, mathematical and engineering sciences ····· 10

Summary: With advancements in AI technology, sophisticated mathematical knowledge, such as topology has become essential for AI development, particularly in handling high-dimensional feature spaces like those used in large language models (e.g., ChatGPT). To address this need, we initiated a multidisciplinary study group, "Medical-Mathematical-Engineering Collaboration," involving medicine, engineering, and mathematics. Unlike traditional med-engineering collaborations that allow task division, this new approach required all members to learn mathematics, posing unique challenges. From 2021 to 2024, we conducted 43 sessions to create and deliver AI-focused math teaching materials for academia and industry. Key findings include the need for mutual understanding, minimizing workload on mathematicians, and designing cost-efficient, targeted educational materials.

17 Teruaki Kitano (Soka Univ.)
Yuta Nozaki (Yokohama Nat. Univ.)
Michel Boileau (Aix-Marseille Univ.)
An order on the set of prime knots via π-orbifold groups ····· 10

Summary: For a knot in the 3-sphere, the π-orbifold group is defined as a quotient of the knot group. When there exists an epimorphism between π-orbifold groups, we define a relation $K \succeq K'$ between two knots K, K'. When a knots is sufficiently complicated, it gives a partial order. We talk about this order $K \succeq K'$ for a Montesinos knot K. Further we show that if K is a small knot, then there are only finitely many knots K' satisfying $K \succeq K'$.

18 Yuichi Yamada (Univ. of Electro-Comm.)
Motoo Tange (Univ. of Tsukuba)
Seifert manifolds that have two Dehn surgery descriptions along torus knots ····· 10

Summary: We study pairs of integer and rational positive Dehn surgeries along torus knots whose results are orientation-reversing homeomorphic Seifert manifolds. Such pairs consist of some sequences, but have a simple summarized presentation, under symmetries on torus knots. Our purpose is an extension of Greene's changemaker method on L-spaces in negative definite 4-manifolds, used in the lens space realization problem.

19 Motoo Tange (Univ. of Tsukuba)
Yuichi Yamada (Univ. of Electro-Comm.)
L-space embedding in negative definite closed 4-manifold constructed by a pair of Dehn surgeries along knots ····· 15

Summary: Our purpose is to extend Greene's changemaker method on L-spaces in negative definite 4-manifolds, which was utilized in his resolution of lens space realization problem. We establish an equality between the torsion coefficients of two L-space knots and characteristic elements in $-\mathbb{Z}^{n+1}$. We address the deficiency in Greene's inequality for non-sharp bound using our equality.

20 Tatsumasa Suzuki (Meiji Univ.)
On the d-invariants of Brieskorn homology 3-spheres with almost simple linear graphs ····· 15

Summary: In 2003, Ozsváth and Szabó introduced an invariant of rational homology spin^c cobordisms called a d-invariant. It is not clear how to calculate the d-invariant for the Brieskorn homology 3-sphere $\Sigma(p,q,r)$ uniformly and concretely. In 2020, Karakurt and Şavk investigated the d-invariant of $\Sigma(p,q,r)$ with $pq+pr-qr=1$, a class of Brieskorn homology 3-spheres with almost simple linear graphs. They derived concrete calculation results with p even and a formula with p odd. In this talk, we find concrete methods for calculating new infinite examples of the d-invariant for $\Sigma(p,q,r)$ with p odd and $pq+pr-qr=1$. Furthermore, we see an infinite number of examples for $\Sigma(p,q,r)$ with p odd and $pq+pr-qr=1$ showing phenomena that cannot occur when p is even.

21 Keisuke Teramoto (Yamaguchi Univ.) Height functions on generalized cuspidal edges ····· 15

Summary: A generalized cuspidal edge is a surface with certain singular points, and it admits a well-defined smooth unit normal vector field even at singular points. By this property, we can define the height function on a generalized cuspidal edge in the normal direction. In this talk, we explain characterizations of singularities of the function in terms of geometrical properties for a given generalized cuspidal edge.

22 Koki Iwakura (Kyushu Univ.) Non-singular extensions of horizontal stable fold maps from surfaces into the plane ····· 15

Summary: In this talk, we consider the non-singular extension problem of horizontal stable fold maps from closed oriented surfaces into $\mathbb{R}^2$. Specifically, given a closed oriented surface M and a submersion $g\colon M \times [0,1] \to \mathbb{R}^2$ that is a horizontal stable fold map on the boundary, we seek conditions under which there exist a compact oriented 3-dimensional manifold N with $\partial N = M$ and a submersion $F\colon N \to \mathbb{R}^2$ such that F agrees with g on a collar neighborhood of ∂N. As our main theorem, we provide a necessary and sufficient condition for the existence of a non-singular extension with certain properties of a horizontal stable fold map.

23 Kentaro Saji (Kobe Univ.) Geometry on D_4 singularities of fronts ····· 15

Summary: A form of the $D_4^{\pm}$-singularities of fronts in $\mathbb{R}^3$ which uses coordinate transformation on the source and isometry on the target will be presented. As an application, we calculate differential geometric invariants near the $D_4^{\pm}$-singularities, and give a Gauss–Bonnet type formula for fronts having generic rank one singularities and $D_4^{\pm}$-singularities.

March 20th (Thu) Conference Room II

9:30–11:55

24 Haruka Takeuchi (Nara Women's Univ.) Minimal self-intersections of filling curve on surfaces ····· 15

Summary: Let S be a connected orientable surface. A closed curve $\gamma \subset S$ in minimal position is said to be filling if γ intersects every simple closed curve on S. In 1981, Kra showed that a filling curve on S determines a pseudo-Anosov element of the mapping class group. Recently, some mathematical algorithms were proposed to determine whether any curve in minimal position on S is filling, but it is not realistic to decide by hand in complex cases. Following the results of Aretiness, We prove that for every $i \geq 3$, a filling curve exists on $S_{2,1}$ and S_2 whose number of intersections is i. In this talk, we will present the algorithm of Aretiness for determining whether any curve on a closed surface S_g of genus $g \geq 2$ is filling and the results of our computer experiments.

25 Takuya Katayama (Osaka Metro. Univ.)
Erika Kuno (Osaka Univ.) Hempel–Lickorish theorem and its applications ····· 10

Summary: The Hempel–Lickorish theorem gives a universal upper bound for the distance of the curve graphs of surfaces. This is a classical result on the curve graphs. Using bicorn curves, we give a new upper bound for the distance of the curve graphs of closed surfaces. In addition, we prove that the curve graph of any closed surface is 14-hyperbolic with one exception. By combining improved Hempel–Lickorish theorem and results on bicorn curves, we also give an effective bound on the bounded geodesic image theorem.

Summary: Tsuboi proved that the Calabi invariant transgresses to the Euler class of foliated circle bundles. McDuff defined secondary classes on the classifying space of certain foliated products, which is a higher-dimensional analog of the Calabi invariant. In this talk, I will explain that McDuff's secondary class transgresses to the Euler class of foliated sphere bundles, which provides a higher-dimensional analog of Tsuboi's theorem.

Summary: In this talk we consider boundedness of the bundle diffeomorphism group $\mathrm{Diff}_\pi(M)_0$ of a fiber bundle $\pi : M \to S^1$ with fiber N and structure group $\Gamma < \mathrm{Diff}(N)$. We distinguish an integer $k = k(\pi) \in \mathbb{Z}_{\geq 0}$ and construct a function $\widehat{\nu} : \mathrm{Diff}_\pi(M)_0 \to \mathbb{R}/k\mathbb{Z}$. When $k \geq 1$, the group $\mathrm{Diff}_\pi(M)_0$ is bounded and $cld\,\mathrm{Diff}_\pi(M)_0 \leq k+3$, if $\mathrm{Diff}_{\eta,c}(E)_0$ is perfect for the trivial (N,Γ) bundle $\eta : E \to \mathbb{R}$. On the other hand, when $k = 0$, the map $\widehat{\nu}$ is a unbounded quasimorphism, so that $\mathrm{Diff}_\pi(M)_0$ is unbounded and not uniformly perfect. We also describe the integer k in term of the attaching map of the bundle π as the mapping torus and give some explicit examples of (un)bounded groups.

Summary: Based on an analysis of the semi-local structure of 1-dimensional real analytic diffeomorphisms with a fixed point, we show that the Mather–Thurston map $\mathcal{MT} : B\widetilde{Diff^{\omega}_{+}(S^1)}^{\delta} \to \Lambda B\overline{\Gamma}^{\omega}_{1}$ for real analytic oriented flat circle bundles and its S^1-Borel quotient, both of them admit homotopy left inverses.

Summary: The farthest point map on the (boundary of) 4-cube is a piecewise rational map. It is related to its intrinsic radius and diameter, and its star and source unfolding. The limit set is the union of the diagonals of its eight facets(3-cubes). The limit point(s) of a point in the relative interior of a facet are also in the relative interior of a facet.

Summary: We introduce Markov set-valued functions on one-dimensional continua. Also, we give the notion of the same pattern between two Markov set-valued functions. Then, we get a theorem that the same pattern induces homeomorphic generalized inverse limits, as a generalization of a result of Imamura, Matsuhashi, and the speaker.

Summary: Stein's groups, generalizing the well-known Higman–Thompson groups, are defined as groups of piecewise linear bijections of an interval with finitely many breakpoints and slopes belonging to specified additive and multiplicative subgroups of the real numbers. Our main result establishes a classification theorem for these groups under the assumptions that the slope group is finitely generated and the additive group has rank at least 2. We achieve this by interpreting Stein's groups as topological full groups of ample groupoids. A central concept in our analysis is the notion of H^1-rigidity in the cohomology of groupoids.

32 Kodai Yamamoto (Kyushu Univ.) Homoclinic tangency of the largest codimension and statistical irregularity 15

Summary: Given a continuous dynamical systems on a metric space, a point is called (statistically) irregular if the time average of a continuous function along its orbit does not exist. Takens posed the question of whether there exist persistence classes of dynamical systems for which the set of irregular points has positive Lebesgue measure. In this talk, I present a model of diffeomorphisms with homoclinic tangency of the largest codimension such that every C^r neighborhood of the model contains diffeomorphisms which has a contracting wandering domain that consist of irregular point.

14:20–15:20 Talk Invited by Topology Section

Yuji Terashima (Tohoku Univ.) Quiver mutation and topology

Summary: Quiver mutations are ubiquitous in many branches of mathematics with cluster algebras. This talk will explain how quiver mutations appear and what role they play in topology.

15:40–17:35

33 Kanon Yashiro (Niigata Univ.) Morse bipersistence modules and rectangle barcodes 15
Kanta Koeda
Ryuma Orita (Niigata Univ.)

Summary: One-parameter persistent homology is well established, while concrete models for multi-parameter persistent homology remain relatively underexplored. In this talk, we present a construction of two-parameter persistent homology based on Morse theory and discuss its invariants.

34 Tomoki Uda (Univ. of Toyama) Ellipse tangency analysis for anisotropic persistent homology 15

Summary: Persistent Homology (PH) is a key tool in Topological Data Analysis (TDA), commonly used for capturing the shape of data. Standard PH analysis puts disks at each point, assuming isotropic local geometry. However, real-world data often lacks such isotropy. We propose a novel approach using ellipses instead of disks for Vietoris–Rips filtrations, incorporating anisotropy into PH. This model calculates the pairwise contact time of growing ellipses, interpreted as a distance value. We present an exact and efficient numerical method for finding the contact time and points, enabling anisotropic PH.

35 So Yamagata (Fukuoka Univ.) On mapping fiber graphs in discrete homotopy theory 10

Summary: In recent years, it has become fashionable to import ideas from homotopy theory into combinatorial contexts. Discrete homotopy theory, or A-homotopy theory, is a "combinatorial" homotopy theory defined for graphs, simplicial complexes, and metric spaces, and has been rapidly developed by Carranza–Kapulkin and others in recent years. Discrete homotopy theory also has applications in the topology of subspace arrangements, TDA, network analysis, and other areas. In this talk, we will survey recent developments in the field and give some recent results obtained by the speaker.

36 Soichiro Fujii (Masaryk Univ.)
Yuni Iwamasa (Kyoto Univ.)
Kei Kimura (Kyushu Univ.)
Yuta Nozaki (Yokohama Nat. Univ.)
Akira Suzuki (Tohoku Univ.)
Homotopy types of Hom complexes of graph homomorphisms whose codomains are cycles 10

Summary: For simple graphs G and H, the Hom complex $\mathrm{Hom}(G, H)$ is a polyhedral complex whose vertices are the graph homomorphisms $G \to H$. It is known that $\mathrm{Hom}(G, H)$ is homotopy equivalent to a disjoint union of points and circles when both G and H are cycles. We generalize this known result by showing that $\mathrm{Hom}(G, H)$ is homotopy equivalent to a disjoint union of points and circles whenever G is connected and H is a cycle.

Summary: Splitting invariants are effective for distinguishing the embedded topology of plane curves. Splitting invariants encode how a plane curve $\mathcal{C}$ is "entangled" with the other curve $\mathcal{B}$, and they do not depend on the fundamental group. In this talk, we introduce a generalization of splitting invariants, called the *G-combinatorial type*, for plane curves by using the modified plumbing graph defined by Hironaka in 2000. Based on the arguments for graph manifolds of Waldhausen in 1967 and for plumbing graphs of Neumann in 1981, it can be proved that the G-combinatorial type is invariant under certain homeomorphisms.

Summary: In the mid-20th century, economist Kenneth Arrow introduced the concept of social welfare function and established what is now known as Arrow's Impossibility Theorem. In Terao Hiroaki's work, 'Chambers of arrangements of hyperplanes and Arrow's impossibility theorem (2007)' he defined and studied the concept of 'admissible map,' which is a generalization of the social welfare function within the framework of hyperplane arrangements. In this broader setting, he proved a generalized form of Arrow's Impossibility Theorem using combinatorial methods. This presentation offers an alternative proof of this generalized theorem, drawing on techniques from algebraic topology.

Summary: Motivated by the Atiyah–Hirzebruch, Totaro counter-examples to the integral Hodge conjecture, we endow algebro-geometric invariant interpreration to the cokernel of the purely topologically defined Thom reduction from the complex cobordism to the integral cohomology. For the traditionally considered topological codimension 4 case, we find it to be a birational invariant.

Infinite Analysis

March 20th (Thu) Conference Room Ⅲ

10:00–11:40

1 Nobutaka Nakazono (Tokyo Univ. of Agri. and Tech.) Higher-order Painlevé-type difference equations obtained from a system of partial difference equations having the CAC property ····· 15

Summary: The consistency around a cube (CAC) property is known as integrability for two-dimensional partial difference equations. In this talk, we demonstrate that higher-order Painlevé-type difference equations, along with their Lax pairs and affine Weyl group symmetries, can be obtained by imposing periodic conditions on systems of two-dimensional partial difference equations with the CAC property.

2 Chihiro Sato (Ochanomizu Univ.), Kouichi Takemura (Ochanomizu Univ.) Degeneration of q-Heun equations ····· 15

Summary: For more discovery of series solutions of the Heun equation and its degeneration, we investigate degeneration of the q-Heun equation which is a q-difference equation of the Heun equation.

3 Yumi Arai (Ochanomizu Univ.), Kouichi Takemura (Ochanomizu Univ.) On q-convolution and convergence ····· 15

Summary: Sakai and Yamaguchi introduced the q-convolution and the q-middle convolution as q-deformations of the convolution and the middle convolution by Dettweiler and Reiter. Arai and Takemura reformulated the q-convolution and the q-middle convolution, which was announced in the 2024 MSJ Autumn Meeting. In this talk, we obtain sufficient conditions that the Jackson integrals associated with the q-convolution converge and satisfy the q-difference equation associated with the q-convolution.

4 Takahiko Nobukawa (Kobe Univ.) Jackson integral representation for Kajihara's q-hypergeometric series $W^{M,2}$ and related q-difference system ····· 15

Summary: Kajihara's q-hypergeometric series $W^{M,N}$ is a multivariable extension of the very-well-poised q-hypergeometric series ${}_{2r}W_{2r-1}$. In this talk, we present a Jackson integral representation for $W^{M,2}$. We also construct a q-difference system associated with this integral. This system is an extension of the variant of q-hypergeometric equation of degree three, defined by Hatano–Matsunawa–Sato–Takemura. We show this system includes the q-Appell–Lauricella system φ_D as a degeneration.

5 Satoshi Tsuchimi (Kobe Univ.), Genki Shibukawa (Kobe Univ.) A multivariate analogue of the generalized μ-function ····· 15

Summary: In this talk, we introduce a multivariate analogue of the generalized μ-function in view of the q-difference equation. We also show that it satisfies some properties, such as pseudo-periodicity and symmetries.

6 Kazuya Matsugashita (Kindai Univ.), Takao Suzuki (Kindai Univ.) A continuous limit of the q-Garnier system ····· 15

Summary: In a recent work, the q-Garnier system, which is a system with multi discrete time evolutions, was formulated as a birational representation of an extended affine Weyl group. Our aim is to derive the higher order Painlevé system and its symmetry, which was proposed by K. Fuji, T. Suzuki and T. Tsuda, by taking a continuous limit for a discrete time evolution of the q-Garnier system.

14:15–15:15 Talk Invited by Infinite Analysis Special Session

Hiroshi Kawakami (Aoyama Gakuin Univ.) Toward a comprehensive theory of Painlevé-type equations with a focus on spectral types

Summary: The Painlevé equations are second-order non-linear ordinary differential equations discovered by Painlevé. Recently, research on higher-dimensional Painlevé-type differential equations has progressed, and particularly in the case where the phase space is four-dimensional, it can be said that we have obtained a comprehensive understanding of Painlevé-type differential equations. On the other hand, in the two-dimensional case, there exists a framework based on discrete Painlevé equations, within which the Painlevé equations are naturally positioned (Sakai's theory). Similarly, we aim to construct a framework based on discrete equations for higher-dimensional cases as well. Although this talk does not achieve that goal, I would like to present my computational results regarding higher-dimensional Painlevé-type difference and q-difference equations from the viewpoint of deformation theory of linear equations.

March 21st (Fri) Conference Room III

9:30–10:35

7 Yosuke Kawamoto (Okayama Univ.) Genki Shibukawa (Kobe Univ.) Integral operators for Jack polynomials and the intertwining property for the β-Laguerre processes 15

Summary: It is known that the β-Laguerre processes satisfy an intertwining relation with respect to a conventional Markov kernel. We find a different kind of intertwining property with respect to a new Markov kernel. The proof is demonstrated via the Jack symmetric polynomials. To carry out this approach, we show that the Jack polynomials are eigenfunctions of the new Markov kernel.

8 Ryota Akagi (Nagoya Univ.) Cluster-cyclicity of skew-symmetrizable matrices of rank 3 15

Summary: The main objects in this talk are skew-symmetrizable matrices and their mutations in cluster-algebras. It is known that each skew-symmetrizable matrix corresponds to a valued quiver, and my study is to obtain the condition when this quiver is always cyclic after applying mutations. For this purpus, we introduce the Markov constant of a skew-symmetrizable matrix, which has appeared in the previous works for skew-symmetric matrices.

9 Yusuke Ohkubo (Setsunan Univ.) The quantum toroidal $\mathfrak{gl}_2$ algebra and the $N = 1$ superconformal algebra 15

Summary: It is known that the q-deformed Virasoro algebra can be obtained from the free field representation of the quantum toroidal $\mathfrak{gl}_1$ algebra. In this talk, by applying the same method to the quantum toroidal $\mathfrak{gl}_2$ algebra, we show that the $N = 1$ superconformal algebra arises from the degenerate limit of a certain generator. From that generator, we expect to be able to construct a q-deformed version of the $N = 1$ superconformal algebra.

10 Taichiro Takagi (Nat. Defense Acad. of Japan) A bosonic formula for one-dimensional configuration sums and the minimal excludant in integer partitions 15

Summary: Motivated by the study of the minimal excludant in integer partitions by G. E. Andrews and D. Newman, we introduce a pair of new partition statistics that can be derived from generating functions containing a bosonic formula for one-dimensional configuration sums of a box-ball system. These statistics can be calculated by a combinatorial way, and are equinumerous with the number of integer partitions that are characterized by the smallest odd/even non-negative integer that is not a part of them.

10:50–11:50 Talk Invited by Infinite Analysis Special Session

Masato Okado (Osaka Metro. Univ.) On the fermionic formula conjecture for branching functions of affine Lie algebras

Summary: Around 2000, with Hatayama, Kuniba, Takagi, Tsuboi and Yamada, we formulated the X=M conjecture which equates the one dimensional sum for the tensor product of Kirillov–Reshetikhin crystals and a fermionic formula originating from Bethe Ansatz. In 2017, with Schilling and Scrimshaw, we solved it for all nonexceptional affine types. It enables us to obtain the fermionic formula for branching functions of highest weight modules over affine Lie algebras with respect to underlying finite-dimensional simple Lie algebras. However, this conjecture is still open for exceptional types. In this talk, I will explain my recent trial to attack this problem.