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The Mathematical Society of Japan

2024 Annual Meeting

Titles and Short Summaries of the Talks

March, 2024

at Osaka Metropolitan University

2024 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 17th (Sun)–20th (Wed), 2024

Venue: Osaka Metropolitan University
3–3–138 Sugimoto, Sumiyoshi-ku
Osaka-shi, 558-8585, Japan

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The Mathematical Society of Japan

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	MSJ Prizes Presentation (Auditorium, 1F, Basic Experiment Edu. Bldg.) ····· (14:30–15:00) Plenary Talks (Auditorium, 1F, Basic Experiment Edu. Bldg.) Spring Prize Winner ····· (15:15–16:15) Ken-ichi Yoshikawa (Kyoto Univ.) ····· (16:30–17:30) Official Party (Nonohana House, 1F, Media Center) ····· (18:00–20:00)								
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Plenary Talks

March 18th (Mon) Auditorium, 1F, Basic Experiment Education Building

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

Ken-ichi Yoshikawa (Kyoto Univ.) Holomorphic analytic torsion for manifolds of Calabi–Yau type ..... (16:30–17:30)

Summary: Holomorphic analytic torsion is a spectral invariant of compact Kähler manifolds introduced by Ray–Singer in 1973. In the 1990s, as a consequence of mirror symmetry and string duality, two remarkable conjectures concerning the holomorphic analytic torsion of Calabi–Yau threefolds and Enriques surfaces were proposed by physicists. One is an equivalence of the analytic torsion of Calabi–Yau threefolds and certain curve counting invariants at genus-one of its mirror manifold (Bershadsky–Cecotti–Ooguri–Vafa), and the other is the coincidence of the analytic torsion of Enriques surfaces and the Borcherds Φ-function, the automorphic form on the moduli space characterizing the discriminant locus (Harvey–Moore). Following these conjectures, holomorphic torsion invariants of 2-elementary $K3$ surfaces and Calabi–Yau threefolds were introduced and studied by the speaker in the former case and by Fang, Lu and the speaker in the latter case. In the 2000s, those predictions by physicists concerning the analytic torsion of Enriques surfaces and quintic mirror threefolds were confirmed. In the late 2010s and beyond, there have been significant advances in the theory of holomorphic torsion invariants, such as the structure theorem of the invariant for 2-elementary $K3$ surfaces (S. Ma and the speaker), the construction of a holomorphic torsion invariant for Calabi–Yau manifolds (BCOV invariant) in higher dimensions and the proof of the genus-one mirror symmetry for Calabi–Yau hypersurfaces of the projective space of arbitrary dimension (Eriksson–Freixas i Montplet–Mourougane), and the birational invariance of the BCOV invariant (Fu-Zhang) etc. In the talk, I would like to give an overview of the developments of holomorphic torsion invariants mentioned above, focusing on 2-elementary $K3$ surfaces and possibly mirror symmetry at genus one. If time permits, I will also discuss some recent works in progress.

Featured Invited Talks

March 17th (Sun)

Conference Room I

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Hiroshi Sekigawa (Tokyo Univ. of Sci.) Symbolic-numeric computation ····· (13:00–14:00)

Summary: Symbolic-numeric computation is a computing methodology that combines ideas from symbolic and numeric computation. Symbolic computation (a.k.a. computer algebra) is very reliable, but it has the following issues: algorithms in symbolic computation demand significant resources, including time and memory; usual algorithms in symbolic computation break down when applied to inexact values. Symbolic-numeric computation addresses these issues by combining ideas from symbolic and numeric computation. In this talk, I will explain how to solve algebraic problems with inexact values by using symbolic-numeric computation through several examples.

Conference Room II

Akihiro Munemasa (Tohoku Univ.) Combinatorics of equiangular lines ····· (13:00–14:00)

Summary: The problem of equiangular lines asks how many lines through the origin can be placed in the Euclidean space while maintaining the pairwise angle of lines to be constant. This problem of metric geometry is seemingly easier than packing problems in the sphere or the Euclidean spaces, but it is in general open except for some small dimensions. By Lemmens and Seidel (1973), the problem can be reformulated as a purely combinatorial problem in terms of switching classes of graphs. In this talk, I will survey recent development on this problem in connection with root systems and integral lattices. I will also briefly touch on its complex analogue, where "lines" mean complex 1-dimensional subspaces, and "angles" mean the absolute values of the inner product of representing unit vectors. This analogue has been investigated by quantum physicists under the name SIC-POVM, yet its existence problem is unsolved in general.

Conference Room IV

Junguk Lee (Changwon National Univ.) Survey on a geography of Model Theory ····· (13:00–14:00)

Summary: In this survey talk, we will explore a geography of Model Theory under the guidance of Classification Theory. First, we review basic first-order logic and several dividing lines developed in Classification Theory. Second, we will focus on Classification Theory for fields and examine some interactions between Field Arithmetic and dividing lines.

March 19th (Tue)

Conference Room II

Takasi Senba (Fukuoka Univ.) Behavior of solutions to chemotaxis systems with logarithmic sensitivity functions ····· (13:00–14:00)

Summary: In this talk, we consider behavior of solutions to chemotaxis systems with logarithmic sensitivity functions. In particular, we will talk about blowup and global existence of those solutions. The behavior of solutions to classical chemotaxis systems is well known. The systems are chemotaxis systems with linear sensitivity function. The classical chemotaxis systems have Lyapunov functions, which are often used for the study of solutions to classical chemotaxis system. However, we do not still find Lyapunov functions of chemotaxis system with nonlinear sensitivity functions. This obstacles to the study of those systems. We will talk some results on blowup and global existence of those solutions.

Conference Room IV

Goo Ishikawa (Hokkaido Univ.*) Singular curves of sub-Riemannian spaces and related topics ..... (13:00–14:00)

Summary: A sub-Riemannian structure is given by a Riemannian metric on a vector subbundle of the tangent bundle (distribution) over a manifold. Then the notion of geodesics or length minimisers are naturally defined on sub-Riemannian spaces. Unlike Riemannian case, there appear *abnormal geodesics* or *singular curves*, as sub-Riemannian geodesics, in addition to normal geodesics. It turns out that *singular curves* are defined, depending just on the distribution, as critical points of end-point mapping in the context of control theory, and they are significant objects also in geometry and topology in their own right. In this talk, several topics and results on *singular curves* of distributions will be explained for specific cases, say, $(2,3,4)$-distributions (Engel), in terms of the growth of ranks by taking Lie brackets, $(2,3,5)$-distributions (Cartan), $(3,5)$-distributions, $(4,5)$-distributions, $(3,6)$-distributions, $(4,7)$-distributions and so on, with some perspectives.

March 20th (Wed)

Conference Room I

Masataka Chida (Tokyo Denki Univ.) On generalizations of p-adic Gross–Zagier formula ..... (13:00–14:00)

Summary: Gross and Zagier showed a remarkable formula which relates the first derivatives of L-functions for modular forms of weight two and heights of Heegner points on modular curves. Perrin-Riou proved a p-adic analogue of the Gross–Zagier formula. They have many important arithmetic applications including the conjecture of Birch and Swinnerton-Dyer (BSD conjecture). Subsequently, Gan–Gross–Prasad formulated a conjecture on a generalization of the Gross–Zagier formula to higher dimensional unitary and orthogonal Shimura varieties, which is known by the arithmetic Gan–Gross–Prasad conjecture. Wei Zhang proposed an approach to the arithmetic Gan–Gross–Prasad conjecture using relative trace formulas and he also formulated the arithmetic fundamental lemma (conjecture). Recently, Disegni–Zhang proved a p-adic analogue of arithmetic Gan–Gross–Prasad conjecture for unitary groups using this approach. On the other hand, Bertolini–Darmon–Prasanna introduced a slightly different kind of p-adic Gross–Zagier formula which is a special value formula for p-adic L-functions at a point outside of the interpolation range. It is known that this kind of formula has some interesting applications to BSD conjecture (more generally, Bloch–Kato conjecture). For example, Darmon–Rotger proved a BDP type formula for triple products of elliptic modular forms and it has an application to the equivariant BSD conjecture. In this talk, we will discuss some possible generalizations of these formulas to higher dimensional cases.

Conference Room IV

Kenji Kajiwara (Kyushu Univ.) Generation of aesthetic shape by integrable geometry ..... (13:00–14:00)

Summary: We consider log-aesthetic curves (LAC), a family of planar curves developed in industrial design, as curves that car designers regard as “aesthetic.” We present a new mathematical framework of LAC on the theory of integrable systems and similarity geometry. Using this framework, LAC is shown to be a similarity geometry analogue of Euler’s Elastica. Based on this mathematical setting, we present generalizations of LAC to discrete curves, space curves and surfaces, which may be useful for generating aesthetic shapes. The surfaces will be regarded as the similarity geometry analogue of the pseudospherical surfaces. We will mention on some interesting results in the formulation of the 3D space curve and surfaces, such as explicit formulas and symmetry structure. An interesting example of a classical truss structure called the Michell structure in architecture in which mechanical optimality, integrability, and aesthetic nature coexist will be discussed, together with the relationship with the discrete harmonic functions.

Foundation of Mathematics and History of Mathematics

March 17th (Sun) Conference Room VIII

9:30–11:30

1 Souji Shizuma (Osaka Pref. Univ.) General theorem for nonsimultaneous hat puzzles · · · · · · 15

Summary: The prisoner and hat puzzle, also known as the hat problem, is divided into two depending on whether the prisoners' statements are simultaneous or non-simultaneous. In this presentation, we will focus on puzzles with non-simultaneous type and introduce the general theorem.

2 Kenta Tsukuura (Hosei Univ.) On semiproperness of Namba forcings in Prikry extensions · · · · · · 15

Summary: It is known that many kinds of reflection principles fail in the extension by Prikry forcing. In particular, the semistationary reflection principle fails, which in turn implies non-semiproperness of some Namba forcings. We ask what cardinal such that Namba forcing over its is not semiproper in Prikry extension is. In this talk, we introduce $\mathcal{P}_\kappa\lambda$-variations of Namba forcings and show that every Namba forcing above the target of Prikry forcing is not semiproper in the extension.

3 Teruyuki Yorioka (Shizuoka Univ.) Some preservation theorems for forcing notions with models as side conditions · · · · · · 15

Summary: The side condition method is a general framework of constructions of proper forcing notions defined by Stevo Todorčević. These forcing notions equip with models as side conditions. In this talk, some preservation theorems for forcing notions with models as side conditions are introduced.

4 Toshimichi Usuba (Waseda Univ.) Uniform ultrafilters in a choiceless context · · · · · · 15

Summary: We study uniform ultrafilters in a choiceless context. We prove that $\aleph_{\omega+1}$ can be the least cardinal which carries a unirom ultrafilter. We also show that $\aleph_\omega$ can be the least cardinal which does not carry a uniform ultrafilter.

5 Yasuo Yoshinobu (Nagoya Univ.) Convex sets and the axiom of choice · · · · · · 15

Summary: For an $\mathbb{R}$-vector space V, let $\mathrm{MC}(V)$ denote the statement that every subset of V has a maximal convex subset and MC the statement that $\mathrm{MC}(V)$ holds for all V. Under ZF, we observe that MC is equivalent to the axiom of choice, and that $\mathrm{MC}(\mathbb{R}^3)$ is strictly stronger than $\mathrm{MC}(\mathbb{R}^2)$, which is equivalent to the axiom of countable choice for sets of reals.

6 Akito Tsuboi (Univ. of Tsukuba*) Dividing and forking in random structures · · · · · · 15

Summary: Dividing and forking are important concepts in model theory, both of which are related to abstract independence. Although these two concepts are not equivalent in general, in simple theories, they are equivalent. We demonstrate that these concepts differ in random hypergraphs omitting a certain kind of sub-hypergraphs. This work is a continuation of the study on which I presented at the 2022 fall meeting of the MSJ.

7 Hirotaka Kikyo (Kobe Univ.) On random hypergraphs and automorphisms with a single orbit · · · · · · 15
Akito Tsuboi (Univ. of Tsukuba*)

Summary: Let $\mathcal{H}(m,l,s)$ be the class of all finite m-hypergraphs A such that for any substructure X of A with $|X| = l$ has less than ${}_lC_m - s$ m-hyperedges. Suppose $0 \le s < {}_lC_m$. $\mathcal{H}(m,l,s)$ has the free amalgamation property if and only if $s < {}_{l-2}C_{m-2}$.
Let M be the random structure for $\mathcal{H}(m,l,s)$ (in the case that it exists). Then M has an automorphism with a single orbit.

11:45–12:00 Research Section Assembly

14:30–17:00

8 Koichiro Ikeda (Hosei Univ.) A note on ω-categorical stable theories ····· 15

Summary: We show that if α is in $(0,1)$ with $index(\alpha) = \infty$ and K_α is a class of finite graphs which is generated by an edge graph then a K_α-generic graph is ω-categorical and strictly stable.

9 Wataru Komine (Univ. of Tsukuba) On prime models of definably complete locally o-minimal theories ···· 15

Summary: Pillay and Steinhorn showed that every o-minimal theory has a prime model and it is unique up to isomorphism. We are interested in definably complete locally o-minimal theory which is generalization of o-minimal theory, and investigate existence and uniqueness of prime models in definably complete locally o-minimal theory. We give an counterexample to existence and some conditions for uniqueness.

10 Koki Okura (Univ. of Tsukuba) On rationality of Poincaré series in expansions of the p-adic fields ···· 15

Summary: We associate each subset of p-adic integers with a formal power series, which is called its Poincaré series. Denef showed that the Poincaré series of every set definable in the p-adic field structure is a rational function. In this talk, we examine the relationship between the rationality of Poincaré series in various expansions of the p-adic fields and their stability-theoritic properties. Especially, we will give an example of NIP expansions without such rationality.

11 Ikuo Yoneda (Tokuyama Coll. of Tech.) Weak one-basedness in the eq-structure and the existences of weak canonical bases in rosy theories ····· 15

Summary: Weak one-basedness is defined in the real sort by Berenstein and Vassiliev. We define weak one-basedness in the eq-structure, and we show that, in rosy theories, one-basedness is equivalent to weak one-basedness in the eq-structure with the existences of weak canonical bases.

12 Noriaki Kamiya (Univ. of Aizu*) On the title "Lie algebra" of books published in Japan ····· 15

Summary: In this talk, we exhibit the books of Lie algebra published in Japan, that is, about 1950 2023. It seems that the notation of Lie algebra is appeared from PRINCETON (USA) of 1934, and soon after, that came to JAPAN.

13 Koichi Hirata (Matsuyama Univ./Ehime Univ.*) Geometric foundations of inversive coordinates of circles ····· 15

Summary: The inversive coordinates of circles are defined as a coordinate system for studying problems where many circles touch each other. This coordinate system is suitable for application to Wasan problems, and we have introduced such applications so far. On the other hand, the geometric foundation of the coordinate system is also important. In this study, we present the results of the foundation for both $\sigma > 0$ and $\sigma < 0$ cases. We will also introduce the differences between the two cases.

14 Noriko Tanaka (Naragakuen Univ.)
Tsukane Ogawa (Yokkaichi Univ.) A study on the relationship of Takuma school's book Shouyaku-jutsu and a mathematical plate dedicated to the Zenkouji temple ····· 15

Summary: The Takuma school is a school in Osaka, and an important person in the Takuma school is Oka Shichibei-Yukitada (1791–). Oka left behind many documents. This paper discusses the solution to question 12 of Shouyaku-jutsu[Sinplifying method of equations] (14 questions total). It also investigates and analyzes the same figure drawn on the existing Takuma school's mathematical plate of the Zenkouji temple.

15 Tsukane Ogawa (Yokkaichi Univ.)
Noriko Tanaka (Naragakuen Univ.)
Treatment of polynomials in Oka Yukitada's "*Kijutsu Kairohou* (*A method to solve the path to create a formula*)" in the Takuma School (2) 15

Summary: The five (or six) volumes of *Kijutsu Kairoho* by Oka Yukitada of the Takuma School contain a variety of techniques for processing polynomials. We have already presented the "senshiki (transformation of polynomials)" and "ryakushiki (simplification of polynomials)." This presentation will discuss "shouyaku (removal of factors of polynomials)" in the *Art of shouyaku*. Since "shouyaku" is nothing more than the factorization of an equation from today's point of view, it has not received much attention so far. However, "shouyaku" shows a remarkable characteristic in the history of pre-modern Japanese mathematics in that it actively utilizes the separation of solutions to equations.

17:15–17:30 Mathematics History Team Meeting

March 18th (Mon) Conference Room VIII

9:15–12:00

16 Masaaki Kumazawa (Mino-Jiyu Gakuen High School)
On De Morgan algebras in BCK-algebras 15

Summary: We are well known that a bounded commutative BCK-algebra is a De Morgan algebra. In this presentation, we will define a new class in BCK-algebras: *Involutive bounded BCK-algebras with Condition* (I). This class is a proper large class than the class of bounded commutative BCK-algebras. Moreover, we would like to show that an algebra of this class is also a De Morgan algebra. We predict that this class is the largest class that is a De Morgan algebra in BCK-algebras.

17 Haruka Kogure (Kanazawa Univ.)
Taishi Kurahashi (Kobe Univ.)
On the conservation results for local reflection principles 15

Summary: For a class Γ of formulas, Γ local reflection principle $\mathrm{Rfn}_\Gamma(T)$ for a theory T of arithmetic is a scheme formalizing the Γ-soundness of T. Beklemishev proved that for every $\Gamma \in \{\Sigma_n, \Pi_{n+1} \mid n \geq 1\}$, the full local reflection principle $\mathrm{Rfn}(T)$ is Γ-conservative over $T + \mathrm{Rfn}_\Gamma(T)$. We firstly proved that the second condition **D2** of the derivability conditions is a sufficient condition for the conservation theorem to hold. We secondly investigate the conservation theorem in terms of Rosser provability predicates. We construct Rosser predicates for which the conservation theorem holds and Rosser predicates for which the theorem does not hold.

18 Yuta Sato (Kobe Univ.)
Taishi Kurahashi (Kobe Univ.)
The finite frame property of some extensions of the pure logic of necessitation 15

Summary: We study the finite frame property of some extensions of Fitting, Marek, and Truszczyński's pure logic of necessitation $\mathbf{N}$. For any natural numbers m, n, we introduce the logic $\mathbf{N}^+\mathbf{A}_{m,n}$ by adding the axiom scheme $\Box^n\varphi \to \Box^m\varphi$ and the rule $\dfrac{\neg\Box\varphi}{\neg\Box\Box\varphi}$ into $\mathbf{N}$. We proved the finite frame property of $\mathbf{N}^+\mathbf{A}_{m,n}$ with respect to Fitting, Marek, and Truszczyński's relational semantics. We also proved that the rule $\dfrac{\neg\Box\varphi}{\neg\Box\Box\varphi}$ is necessary for the completeness of $\mathbf{N}^+\mathbf{A}_{0,n}$ for $n \geq 2$.

Summary: So far, various kinds of models of set theory have been constructed, and recently many set theorists are interested in the structure of the *multiverse* consisting of these models. Modal logic is very useful to analyze this structure. Hamkins–Löwe studied the forcing accessibility relation on the multiverse. More precisely, they introduced *the modal logic of forcing* and proved that it corresponds to the modal logic S4.2. On the other hand, Solovay proved that *the modal logic of provability* corresponds to the modal logic GL. In this talk, we discuss the bimodal logic obtained by combining these two modal logics. We introduce a bimodal logic PF and prove that *the modal logic of provability and forcing* corresponds to PF.

Summary: We studied several notions related to incompleteness, undecidability and inseparability with the purpose of giving a clear overview of these notions. Firstly, we summarized the historical background of these notions. Secondly, we gave alternative proofs of known old results by Cobham, Vaught, and Pour-El. Finally, we proved that for any consistent RE theory, effective essential hereditary creativity and strong effective inseparability are equivalent.

Summary: We describe a constructive variation of the provability logic GL. The logic CGL is based on Mendler and de Paiva's constructive modal logic CK. The system CGL is obtained by adding Löb's axiom $\Box(\Box P \to P) \to \Box P$ to CK; the CGL models are obtained by adding a reverse well-foundedness condition to the CK models. We show that CGL is complete over CGL models via a canonical model construction. We also describe ongoing work on non-classical varieties of GL based on the intuitionistic modal logic IK and the Gödel modal logic GK.

Summary: Feedback Turing machines are Turing machines which can query a halting oracle $h :\subseteq \omega \times \omega \to \{\downarrow, \uparrow\}$, which has information on the convergence or divergence of *feedback* computations. To avoid a contradiction by diagonalization, feedback Turing machines have two ways of not halting: they can diverge as standard Turing machines, or they can freeze. A natural question to ask is: what if we iterate the feedback construction? We define αth order feedback Turing machines for each computable ordinal α and describe the semi-computable sets using inductive definitions and Gale–Stewart games. (Joint work with Juan P. Aguilera and Robert S. Lubarsky.)

Summary: The goal of this research is to show nontrivial equations and inequalities on equilibria of AND-OR trees without assumptions on tree shapes. In the previous meeting, we proved that two equilibria of randomized directional algorithms coincide. In the current talk, we discuss subsequent development. This work was done in collaboration with Fuki Ito.

Summary: A function is called *elementary* if it can be computed in time bounded by a tower of powers of constant height. A *trace function* for an irrational number α is a function that maps each rational number r to a rational number that is closer to α than r is. We show, as was conjectured by Kristiansen, that there exists an irrational number that has an elementary trace function but whose continued fraction expansion is not elementary. We also show that there exists an irrational number that has an elementary trace function but whose *sum approximation*, i.e., the function that maps each positive integer n to the index of the nth 1 in the binary expansion of the number, is not elementary.

Summary: The notion of probability plays a crucial role in quantum mechanics. It appears as the Born rule. In modern mathematics which describes quantum mechanics, however, probability theory means nothing other than measure theory, and therefore any operational characterization of the notion of probability is still missing in quantum mechanics. In our former works, based on the toolkit of algorithmic randomness, we presented an operational refinement of the Born rule, called the principle of typicality, for specifying the property of the results of quantum measurements in an operational way. In this talk, we refine and reformulate the security proof of the BB84 quantum key distribution protocol based on the principle of typicality, in order to demonstrate how properly our framework works in practical problems in quantum mechanics.

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

Hajime Ishihara (Toho Univ.) Reverse mathematics in constructive and predicative set theory

Summary: After quickly reviewing intuitionistic logic and classical Zermelo-Fraenkel set theory (**ZF**), we look into constructive Zermelo-Fraenkel set theory (**CZF**) and its subsystems **BCST** (Basic constructive set theory) and **ECST** (Elementary constructive set theory). Those constructive set theories are predicative without Powerset and with Separation being restricted, and we see that elementary constructions of sets can be performed in the theories. We introduce the notions of a set-generated class and NID (Non-deterministic Inductive Definition) principles. A class X of subsets of a set S is *set-generated* if there exists a *subset* G of X such that $\alpha = \bigcup\{\beta \in G \mid \beta \subseteq \alpha\}$ for all $\alpha \in X$. A *rule* on a set S is a pair (a, b) of subsets a and b of S; it is *nullary* if a is empty, *elementary* if a is a singleton and *finitary* if a is finitely enumerable. For a set R of rules on S, a subset α of S is *R-closed* if for each rule (a, b) in R, $a \subseteq \alpha$ implies $\exists x(x \in b \cap \alpha)$. The principle NID is that for each set S and each set R of rules on S,

the class of R-closed subsets of S is set-generated;

NID_0, NID_1 and $\mathrm{NID}_{<\omega}$ denote NID restricting R to a set of nullary, elementary and finitary rules, respectively. We first show (over **ECST**) that NID_0 is equivalent to Fullness, an axiom of **CZF**, and that NID_1 implies NID_0. Then we show (over **ECST**) that NID_1, "the category **Rel** of sets and relations has weak equalisers" and "the category **BP** of basic pairs and relation pairs has equalisers" are equivalent. Finally, we show (over **ECST**) that $\mathrm{NID}_{<\omega}$ is equivalent to "the class of models of a geometric theory is set-generated".

Algebra

March 17th (Sun) Conference Room I

9:00–10:30

Summary: An efficient method for computing the structure of Jordan chains of a matrix of integers or rational numbers by exact computation is proposed. We have given a method for computing Jordan chains of a matrix with exact computation. However, for deriving just the structure of Jordan chains, the algorithm can be reduced to increase its efficiency. We propose a modification of the algorithm for that purpose.

Summary: Two kinds of hyperplane arrangements can be obtained from a gain graph, a graph whose edges are labeled by elements in a group. Athanasiadis and Bailey have shown that freeness of these hyperplane arrangements sometimes coincide. In this talk, We will report what we know so far about when these coincidences occur.

Summary: The characteristic quasi-polynomial is the numbers of elements in the complement of hyperplane arrangements modulo positive integers which is introduced by Kamiya, Takemura, and Terao. In this talk, we compute the characteristic quasi-polynomials for arrangements which contain the Coxeter arrangement of types A, B, C, and D described by the orthonormal basis. In addition, by using this formulas, we also compute characteristic quasi-polynomials of arrangements obtained by deleting some hyperplanes from the Coxeter arrangements of types B, C, and D.

Summary: In this talk, we study genus-4 curves obtained as double covers of elliptic curves. Firstly we provide explicit defining equations of such curves with explicit criterion for whether it is nonsingular. We also show the irreducibility of the singular locus in any characteristic that is not 2 or 3. Secondly as an application we enumerate the isomorphism classes of superspecial genus-4 double covers of elliptic curves in small characteristic p (more precisely p is less than or equal to 23). We accomplish this by implementing our algorithm in the computer algebra system Magma and executing it. This work deals with a broader class of curves than the case of Howe curves studied by Kudo, Harashita and Howe in 2020.

5 Yuya Yamamoto (Yokohama Nat. Univ.)
Shushi Harashita (Yokohama Nat. Univ.)
The multiplicity-one theorem for the superspeciality of curves of genus two ····· 15

Summary: Igusa proved in 1958 that the polynomial determining the supersingularity of elliptic curves in Legendre form is separable. In this talk, we get an analogous result for curves of genus two in Rosenheim form. More precisely we show that the ideal determining the superspeciality of the curve has multiplicity one at every superspecial point. Igusa used a Picard–Fucks differential operator annihilating a Gauss hypergeometric series. We use Lauricella's system (of type D) of hypergeometric differential equations in three variables. We prove that each entry of the Cartier–Manin matrix satisfies the same partial differential equations and also various contiguity relations.

6 Ryo Ohashi (Univ. of Tokyo) On the Rosenhain forms of superspecial genus-2 curves ····· 15

Summary: In this talk, we examine superspecial genus-2 curves $C : y^2 = x(x-1)(x-\lambda)(x-\mu)(x-\nu)$ in characteristic $p \geq 3$. As a main result, we show that the difference between any two elements in $\{0, 1, \lambda, \mu, \nu\}$ is a square in $\mathbb{F}_{p^2}$. In addition, we show that C is maximal or minimal over $\mathbb{F}_{p^2}$ without taking its $\mathbb{F}_{p^2}$-form (we also give a criterion in terms of p that tells whether C is maximal or minimal). As these applications, we study the maximality of superspecial hyperelliptic curves of genus 3 and 4 whose automorphism groups contain $\mathbb{Z}/2\mathbb{Z} \times \mathbb{Z}/2\mathbb{Z}$.

10:45–11:45 Talk Invited by Algebra Section

Chikashi Miyazaki (Kumamoto Univ.) Castelnuovo–Mumford regularity of polynomial ideals and syzygy theoretic approach to vector bundles

Summary: The Castelnuovo–Mumford regularity introduced by Mumford generalizing an idea of Castelnuovo is one of the most important invariants measuring the complexity of the minimal free resolution of polynomial ideals. In 1980s, the Eisenbud–Goto conjecture, which says the Castelnuovo–Mumford regularity is bounded by degree and codimension of nondegenerate projective variety V, that is, $\operatorname{reg} V \leq \deg V - \operatorname{codim} V + 1$, as crossroads of algebraic geometry and commutative algebra, has interested mathmatician working in related fields.

My talk begins with regularity basics and surveys epoch-making results of 1980s and 1990s, especially works of Gruson–Lazarsfeld–Peskine, Lazarsfeld and Kwak, if possible, in some details of linear projections —secant lines, Mather's theory etc. Surprisingly, in 2018, McCullough–Peeva settled down to give counterexamples of the conjecture.

Focusing on the commutative algebra technique, I have been working from a joint paper with Hoa in 1995, $\operatorname{reg} R \leq a(R) + \dim R + 1$ for a Buchsbaum graded ring R, which had driven us to study the k-Buchsbaum property. The uniform position principle immediately implies $\operatorname{reg} V \leq \lceil (\deg V - 1)/\operatorname{codim} V \rceil + 1$ for a nondegenerate ACM variety. In order to extend our framework, I will explain the relationship between a-invariant and the Castelnuovo–Mumford regularity, and to get Castelnuovo-type bounds on the regularity even towards a classification of projective varieties —rarional normal scroll, del Pezzo variety.

Finally I am going to talk on the splitting of vector bundles closely related to the syzygy theory from my point of view. Several proofs are known for the Horrocks theorem, a vector bundle on the projectuve space having ACM property is isomorphic to a direct sum of line bundles. The one using the Castelnuovo–Mumford regularity is my favorite. Arising from this idea, we investigate the nonvanishing intermediate cohomologies and their relation with the regularity to get a characterization of some vector bundles.

14:15–18:00

7 Kenta Mori (Kwansei Gakuin Univ.) Toric rings of perfectly matchable subgraph polytopes ····· 10

Summary: The perfectly matchable subgraph polytope of a graph is a (0,1)-polytope associated with the vertex sets of matchings in the graph. We study algebraic properties (compressedness, Gorensteinness) of the toric rings of perfectly matchable subgraph polytopes. In particular, we give a complete characterization of a graph whose perfectly matchable subgraph polytope is compressed.

8 Sora Miyashita (Osaka Univ.) Comparing generalizations of Gorensteinness in semi-standard graded rings ····· 15

Summary: Semi-standard graded rings are a generalized notion of standard graded rings. In this talk, we compare generalized notions of the Gorenstein property in semi-standard graded rings. We discuss the commonalities between standard graded rings and semi-standard graded rings, as well as elucidate distinctive phenomena present in semi-standard graded rings that are absent in standard graded rings.

9 Koji Matsushita (Osaka Univ.)
Sora Miyashita (Osaka Univ.) Conditions for multiplicities and almost Gorensteinness ····· 15

Summary: Almost Gorenstein rings have been introduced as a generalization of Gorenstein rings and have been well studied. In this talk, we show that if Cohen–Macaulay graded rings R_1, R_2 and R satisfy appropriate conditions regarding multiplicity, then almost Gorenstein property of R implies Gorenstein properties for all of R_1, R_2 and R. Moreover, we provide its application to semi-standard graded rings.

10 Akihiro Higashitani (Osaka Univ.) Difference of Hilbert series of homogeneous affine semigroup ring and its normalization ····· 15

Summary: Let Q be an affine semigroup, $k[Q]$ the associated semigroup ring, and $k[\overline{Q}]$ its normalization, where k is a field. In this talk, in the case where $k[Q]$ is homogeneous, a difference of the Hilbert series of $k[Q]$ and $k[\overline{Q}]$ is discussed. More precisely, we prove that if $k[Q]$ satisfies Serre's condition (S_2), then the degree of the h-polynomial of $k[Q]$ is always greater than or equal to that of $k[\overline{Q}]$. Moreover, we also show counterexamples of this statement if we drop the assumption (S_2).

11 Kaito Kimura (Nagoya Univ.) Asymptotic behavior of Bass numbers of modules ····· 15

Summary: Let R be a commutative noetherian ring, I an ideal of R, and M a finitely generated R-module. The asymptotic behavior of the quotient modules M/I^nM of M for large integers n has been actively studied in commutative algebra. We consider the asymptotic Bass numbers of localizations of M/I^nM at prime ideals of R. The main result asserts that these have polynomial growth for large integers n that do not depend on the prime ideals when R is local.

12 Yuya Otake (Nagoya Univ.) Auslander–Bridger theory for complexes ····· 15

Summary: Let R be a two-sided noetherian ring. Auslander and Bridger developed the theory of the projective stabilization of the category of finitely generated R-modules, which is called the stable module theory. Recently, Yoshino established the stable "complex" theory, i.e., the theory of a certain stabilization of the homotopy category of complexes of finitely generated projective R-modules. We introduce higher versions of several notions introduced by Yoshino, such as the *torsionfreeness and the *reflexivity for complexes. Also, we prove the Auslander–Bridger approximation theorem for complexes.

13 Yuki Mifune (Nagoya Univ.) On the finiteness of resolving subcategories and the category of MCM modules ····· 15

Summary: Let R be a commutative noetherian ring. Denote by mod R the category of finitely generated R-modules. The concept of the radius of a full subcategory of mod R has been introduced by Dao and Takahashi in 2014. It has been linked to many well-studied notions such as the dimension of the stable category of maximal Cohen–Macaulay modules, finite/countable Cohen–Macaulay representation type and the uniform Auslander condition. This time we give a partial positive answer to a conjecture of Dao and Takahashi on the finiteness of radii of resolving subcategories.

14 Naoki Wakasugi (Nagoya Univ.)
Ryo Takahashi (Nagoya Univ.) On the category of cofinite modules and local cohomology modules ····· 15

Summary: Let R be a commutative noetherian ring and I be an ideal of R. In 2021, Bahmanpour proved if the local cohomology modules of any finitely generated R-modules are I-cofinite, then the subcategory of $\operatorname{Mod} R$ consisting of I-cofinite modules is an abelian subcategory when R is semi-local. We show the converse under certain assumptions.

15 Tokuji Araya (Okayama Univ. of Sci.)
Kei-ichiro Iima
(Nara Nat. Coll. of Tech.)
Ryo Takahashi (Nagoya Univ.) On the vanishing of DHKK complexities for singularity categories ···· 15

Summary: Let R be a commutative noetherian ring. In this talk, we study, for the singularity category of R, the vanishing of the complexity in the sense of Dimitrov, Haiden, Katzarkov and Kontsevich.

16 Naoki Endo (Meiji Univ.) Sally modules of extended canonical ideals and Goto rings ····· 15

Summary: The aim of this talk is, as part of stratification of Cohen–Macaulay rings, to introduce the notion of Goto rings, generalizing the notion of almost Gorenstein rings defined by Barucci and Fröberg for one-dimensional analytically unramified local rings; Goto, Matsuoka, and Phuong for one-dimensional Cohen–Macaulay local rings; and Goto, Takahashi, and the speaker of this talk for Cohen–Macaulay graded/local rings of arbitrary dimension. What has dominated the series of researches on almost Gorenstein rings is the fact that the reduction numbers of extended canonical ideals are at most 2; we define Goto rings as Cohen–Macaulay rings admitting such extended canonical ideals.

17 Ken-ichi Yoshida (Nihon Univ.)
Tomohiro Okuma (Yamagata Univ.)
Kei-ichi Watanabe
(Nihon Univ./Meiji Univ.) Normal tangent cone for the maximal ideal of a certain hypersurface ····· 15

Summary: In this talk, we prove that the normal tangent cone for the maximal ideal of a certain hypersurface is Cohen–Macaulay. Furthermore, we determine the normal reduction numbers and give a numerical criterion for Gorensteinness of such a normal tangent cone.

March 18th (Mon) Conference Room I

9:30–12:00

18 Shigeru Iitaka (Gakushuin Univ.*)
Yukimasa Saito
(Azabu Junior High School) Perfect numbers of new kind ····· 10

Summary: Let h denote a prime and m an integer.
If a positive integer α satisfies $X = \alpha - 2\phi(\alpha), \alpha = X(2hX + m - 1))X$, then α is said to be a perfect number of new type by Y.Saito.

Summary: 2-1 formula is an important family of relations between multiple zeta-star values(MZSVs) and half multiple zeta values(1/2-MZVs). In this talk, we introduce an analogue of 2-1 formula for MZSVs of 2-3-2-1 indices. We also give some special values of t-multiple zeta values of infinite depth.

Summary: In this talk, we define the periods obtained by iterated integrals on the Fermat curve of degree 2 and discuss their arithmetic properties. The definition is based on and extended from the iterated integral representation of multiple zeta values, and includes several other well-known periods. In particular, by using the theory of motivic iterated integrals given by Deligne, Goncharov et al., it is possible to give a motivic interpretation of our periods, and we can investigate the $\mathbb{Q}$-linear space spanned by our periods. I would like to explain this.

Summary: In this talk, we study the algebraic independence of the values of a certain family of power series including $\sum_{k=0}^{\infty} z^{d^k \pm k}$ and $\sum_{k=1}^{\infty} [k\omega] z^k$, where d is an integer greater than 1, ω is a real quadratic irrational number, and $[\cdot]$ denotes the integral part.

Summary: The Markov equation $x^2 + y^2 + z^2 = 3xyz$ has an open problem called the uniqueness conjecture, which was introduced by Frobenius in 1913. In this talk, we will introduce a similar conjecture considered in the generalized Markov equation $x^2 + y^2 + z^2 + k(yz + zx + xy) = (3 + 3k)xyz$ with nonnegative integer k as a parameter and discuss its partial solutions.

Summary: The notion of affine Deligne–Lusztig variety (ADLV) was first introduced by Rapoport, which has been applied to number theory such as the study of Shimura varieties and a realization of the local Langlands correspondence. Many of these applications make use of the special cases where the ADLV admits a simple description. One large class of such cases is the ADLV of Coxeter type, which has been already classified by Görtz–He–Nie. However, many people (Chan–Ivanov, Howard–Fox–Imai, Trentin,...) have found examples which are not of Coxeter type but admit a simple description. In this talk, I will explain about recent progress on this kind of new examples, including my recent work for GL_n.

Summary: In 2017, Garunkštis, Laurinčikas and Macaitienė proved the discrete universality theorem for the Riemann zeta-function sifted by imaginary part of nontrivial zeros of the Riemann zeta-function. This discrete universality has been extended in various zeta-functions and L-functions. In this talk, we generalize this discrete universality for Matsumoto zeta-functions.

Summary: We study the Hilbert space obtained by completing the space consisting of all smooth and compactly supported functions on the real line with respect to the Hermitian form attached to the Weil distribution. As a result, we obtain one novel equivalence condition for the Riemann hypothesis.

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

Teruhisa Koshikawa (Kyoto Univ.) ♭ Vanishing theorems for the cohomology of Shimura varieties

Summary: Shimura varieties are certain type of locally symmetric spaces, and have canonical structures of algebraic varieties. The cohomology of locally symmetric spaces are closely related to automorphic forms, and it has very rich structure and has been playing an important role for decades in the Langlands program, which connects automorphic forms and Galois representations. For such study, several types of vanishing theorems have been proved by several people with many different techniques form algebraic geometry, arithmetic geometry and the theory of automorphic representations, and these results are not just interesting, but also useful and often essential in the application. Some highlights in recent years are the proofs of the (potential) modularity and the Sato–Tate conjecture for elliptic curves over CM fields, and new cases of the generalized Ramanujan conjecture. These are generalizations of a lot of previous works starting with the proof of the last theorem of Fermat by Wiles and Taylor–Wiles. Such a generalization was first outlined by Calegari and Geraghty based on some new conjectures related to the cohomology of locally symmetric spaces. The progresses in recent years basically started by proving variants of their conjectures in several settings. A key ingredient is a certain vanishing theorem of torsion cohomology classes for Shimura varieties associated with quasi-split unitary groups. This was first proved by Caraiani and Scholze with several assumptions. I introduced a new technique based on the work of Fargues and Scholze on the geometrization of the local Langlands correspondence, and was able to drop many assumptions. These are now further generalized or enhanced by works of Santos, Hamann, Lee, and Zhang. People expect even more general forms of vanishing theorems, and their conjectural forms are related to the classification of automorphic representations and the categorical local Langlands conjecture. There are some works in progress in such directions. I will survey these results and ideas.

March 19th (Tue) Conference Room I

9:30–12:00

Summary: As a continuation of Part (I) (dimension 3 case), we state main theorems of [HY] which give a stably birational classification of algebraic k-tori of dimension 4.

Summary: The rationality problem of two-dimensional purely quasi-monomial actions was solved completely by Hoshi, Kang and Kitayama (2014, J. Algebra). As a generalization, we solve the rationality problem of two-dimensional quasi-monomial actions under the condition that the actions are defined within the base field. In order to prove the theorem, we give a brief review of the Severi-Brauer variety with some examples and rationality results. We also use a rationality criterion for conic bundles of $\mathbb{P}^1$ over non-closed fields.

Summary: We give a complete answer to the rationality problem (up to stable k-equivalence) for norm one tori $R^{(1)}_{K/k}(\mathbb{G}_m)$ of K/k whose Galois closures L/k are dihedral extensions with the aid of Endo and Miyata [EM75, Theorem 1.5, Theorem 2.3] and Endo [End11, Theorem 2.1]. By using a similar technique, we give refinements of the proof of stably rational cases of Endo and Miyata's theorems.

Summary: We give a complete answer to the rationality problem (up to stable k-equivalence) for norm one tori $T = R^{(1)}_{K/k}(\mathbb{G}_m)$ of K/k whose Galois closures L/k are $A_5 \simeq \mathrm{PSL}_2(\mathbb{F}_4)$ and $\mathrm{PSL}_2(\mathbb{F}_8)$ extensions. In particular, we prove that T is stably k-rational for $G = \mathrm{Gal}(L/k) \simeq \mathrm{PSL}_2(\mathbb{F}_8)$, $H = \mathrm{Gal}(L/K) \simeq (C_2)^3$ and $H \simeq (C_2)^3 \rtimes C_7$ where C_n is the cyclic group of order n. Based on the result, we conjecture that T is stably k-rational for $G \simeq \mathrm{PSL}_2(\mathbb{F}_{2^d})$, $H \simeq (C_2)^d$ and $H \simeq (C_2)^d \rtimes C_{2^d-1}$. Some other cases $G \simeq A_n$, S_n, $\mathrm{GL}_n(\mathbb{F}_{p^d})$, $\mathrm{SL}_n(\mathbb{F}_{p^d})$, $\mathrm{PGL}_n(\mathbb{F}_{p^d})$, $\mathrm{PSL}_n(\mathbb{F}_{p^d})$ and $H \lneq G$ are also investigated for small n and p^d.

Summary: Let A be a three-dimensional nonassociative division algebra over a finite field. Let A act on A^2 by left multiplication. One of our results states that there exist $v, v' \in A^2$ such that $Av \cap Av'$ is two-dimensional if and only if A is isotopic to a commutative algebra.

Summary: We compute the stable categories of graded maximal Cohen–Macaulay modules over R^1_ε and R^∞_ε, which are skew versions of $R^1 = k[x_1, \dots, x_n]/(x_1^2 + \cdots + x_n^2)$ with the standard grading and $R^\infty = k[x_1, \dots, x_n]/(x_1^2 + \cdots + x_{n-1}^2)$ with the standard grading, respectively. As a corollary we obtain that R^1_ε has finite Cohen–Macaulay representation type and R^∞_ε has countably infinite Cohen–Macaulay representation type.

Summary: In noncommutative algebraic geometry, classification of 4-dimensional Artin–Schelter regular (AS-regular) algebras is one of the main interests. It is known that a graded Ore extension of a 3-dimensional quadratic AS-regular algebra is a 4-dimensional quadratic AS-regular algebra. In this talk, we show that every graded Ore extension Λ of a 3-dimensional quadratic AS-regular algebra satisfies (G1) condition about the point scheme of Λ. In particular, for Type S, we give a list of geometric pairs of graded Ore extensions of 3-dimensional quadratic Calabi–Yau AS-regular algebras. Also, we investigate whether Λ is geometric or not.

Summary: Let A be a finite dimensional algebra over a field. Then, the real Grothendieck group $K_0(\mathrm{proj}A)_\mathbb{R}$ of the category of finitely generated projective A-modules is an Euclidean space whose canonical basis is given by the isoclasses of indecomposable projective modules. By using semistable torsion pairs defined by Baumann–Kamnitzer–Tingley, Asai introduced an equivalence relation on $K_0(\mathrm{proj}A)_\mathbb{R}$ called TF equivalence. For each finitely generated module $M \in \mathrm{mod}A$, we have found a method coarsening TF equivalence, and obtained a new equivalence relation on $K_0(\mathrm{proj}A)_\mathbb{R}$ called M-TF equivalence. We will talk about the definition and some important properties of M-TF equivalence.

14:15–14:30 Presentation Ceremony for the 2024 MSJ Algebra Prize

14:40–15:40 Award Lecture for the 2024 MSJ Algebra Prize

Hideto Asashiba (Shizuoka Univ.*/Kyoto Univ./Osaka Metro. Univ.) — Representation theory of finite-dimensional algebras and its applications (with a focus on coverings of derived equivalences and interval approximations)

Summary: In the first part of the lecture, as a topic of representation theory of finite-dimensional algebras, I will start with an overview of the derived equivalence classification of self-injective algebras, and then outline the 2-categorical covering theory and its applications to derived equivalences. In the second part, as an application of the representation theory to topological data analysis, the interval resolutions and interval replacements of persistence modules (modules over a finite poset) will be outlined.

16:00–17:00 Award Lecture for the 2024 MSJ Algebra Prize

Kentaro Nakamura (Saga Univ.) — Iwasawa theory for rank two p-adic Galois representations

Summary: In this talk, I will explain our main results on Kazuya Kato's conjectures on the local and the global Iwasawa main conjecture for rank two p-adic Galois representations. One result concerns with the existence of zeta elements for the universal deformations of rank two global p-adic Galois representations. The other one concerns with the existence of local zeta elements for the universal deformations of rank two local p-adic Galois representations. For both results, the theory of p-adic (local and global) Langlands correspondence for GL_2 is crucial. I'd like to explain that there exist deep relationships between p-adic Langlands correspondence and Kato's conjectures.

March 20th (Wed) Conference Room I

9:00–12:00

34 Masayuki Sukenaga (Hiroshima Univ.) — Smooth tropical complete intersection curves of genus 3 in $\mathbb{R}^3$ ····· 15

Summary: We develop a method for describing the tropical complete intersection of a tropical hypersurface and a tropical plane in $\mathbb{R}^3$. This involves a method for determining the topological type of a complete intersection by using a polyhedral complex. As an application, we show that there are no smooth tropical complete intersection curves in $\mathbb{R}^3$ whose skeletons are the lollipop graph of genus 3. This gives a partial answer to the open question of whether a lollipop graph of genus 3 appears in the skeleton of a tropical curve on a tropical plane in $\mathbb{R}^3$.

35 Masatomo Sawahara (Hirosaki Univ.) — Cylindricity of Du Val del Pezzo surfaces ····· 15

Summary: A cylinder in an algebraic variety means its open subset, which is isomorphic to the direct product of the affine line and an algebraic variety. In this talk, we will present the existing condition of polarized cylinders in Du Val del Pezzo surfaces of degree at least 2 defined over an algebraically closed field of characteristic 0. Moreover, we will also explain the existence criterion of cylinders in Du Val del Pezzo surfaces defined over an algebraically closed field of characteristic 2.

36 Kenta Watanabe (Nihon Univ.) — Donagi–Morrison conjecture concerning lifts of line bundles on curves contained in a K3 surface and its applications ····· 15

Summary: Let X be a K3 surface, and let L be a base point free and big line bundle of sectional genus g on X. Then the polarized K3 surface (X, L) is called Brill–Noether special if there exists a non-trivial line bundle M on X with $M \neq L$ such that $h^0(M)h^0(L \otimes M^\vee) \geq h^0(L) = g+1$. If (X, L) is Brill-Noether special, then any smooth curve $C \in |L|$ is Brill–Noether special. Because, the Brill–Noether number of $M \otimes \mathcal{O}_C$ is negative. However, the converse is still open. In this talk, I would like to focus on the Donagi–Morrison conjecture concerning the existence of lifts of line bundles on curves on a K3 surface and its applications.

Summary: Let X be a complex smooth Fano variety whose minimal anticanonical degree of non-free rational curves on X is at least $\dim X - 2$. We give a classification of extremal contractions of such varieties. As applications, we obtain a classification of Fano fourfolds whose pseudoindex and Picard number are greater than one and study the structure of Fano varieties with nef third exterior power of the tangent bundle.

Summary: I will talk about the classification of Fano 3-fold in Graded Ring Database with some examples.

Summary: We would like to discuss the space of rational curves on Fano threefolds with terminal factorial singularities. The project is motivated by the result of the paper by Roya Beheshti, Brian Lehmann, Eric Riedl, and Sho Tanimoto, regarding the Geometric Manin's conjecture (GMC) for smooth Fano threefolds. GMC predicts the asymptotic formula for the number of irreducible components of the Hom scheme $\mathrm{Hom}(\mathbb{P}^1, X, \alpha)$ as $\alpha \in \overline{\mathrm{Eff}}_1(X)$ grows positively. One of the main theorems is that GMC holds for terminal factorial del Pezzo threefolds of Picard rank 1 and $(-K_X)^3 \geq 24$.

Summary: Batyrev and Tschinkel's example is a Fermat cubic surface bundle X which is a Fano 5-fold. It is the first example for which Manin's conjecture can never hold for a proper closed exceptional set. Over a field F of characteristic 0, we give the minimal subset Z of $X(F)$ that contains every rational point coming from a thin map $f : Y \to X$ with equal or higher a- and b-values in lexicographical order, which is conjectured to be the correct exceptional set in Manin's conjecture. The set Z is a thin set defined by finitely many thin maps. Over a number field F, we show that every such thin map f factors through the finitely many ones.

Summary: The purpose of this paper is to prove the positivity of double point divisors of general inner projections for projective S_2-varieties with invertible dualizing sheaves, without assuming the smoothness or the normality of varieties. As applications, we characterize two types of projective varieties: varieties with trivial double point divisors and varieties with $d - e - 1 \leq n$ for dimension n, degree d and codimension e.

Summary: Based on our serial works ([I. 2018 Mar; 2020 Sep]) about three-dimensional Miyaoka–Yau type inequality with the associated third Chern classes (, abbreviated as $(\mathrm{MY})_{3,c_3}$), and its variant form with driven by symmetric 2-forms (, as $(\mathrm{MY})_{3,c_3,S^2}$), on an (extended) three-dimensional extremal neighborhood $(X, C) \subset \mathbb{C}^4$ ([Mori-Prokhorov 2021], [I. 2019 Sep]) with C reducible, in this talk, we mainly will give: i) to justify "Clemens–Griffiths–Kuznetsov (CGK) component" $\mathscr{C}_{CGK}$ corresponding to Artin–Mumford or Clemens–Griffiths properties related to (X, C) via several properties of $(\mathrm{MY})_{3,c_3}, (\mathrm{MY})_{3,c_3,S^2}$ ([I. 2019 Sep; 2020 Sep; 2021 Sep; 2022 Mar,Sep; 2023 Mar]), and ii) to give "canonical" embedding Φ of $\mathscr{C}_{CGK}$ by $(\mathrm{MY})_{3,c_3,S^2}$, which is an answer to the sect. (2.3) of [Li-Pertushi-Zhao, 2022], on which they mention to need three-dimesional Bogomolov type inequality with c_3 for embedding CGK component, and they use bounded derived category without it. Here, the word "canonical" means: other than categorical embedding, the target of Φ is not necessary bounded derived category, but occurs to be $n(\geq 3)$-angulated category with "selective" topologicality given by $(\mathrm{MY})_{3,c_3,S^2}$, which seem to be more flexible than [Li-Pertushi-Zhao,2022].

14:15–18:00

Summary: In this talk, we introduce a kind of factorization of finite groups called a uniform cyclic group factorization. It has an application to card-based cryptography, which is a research field that uses a deck of physical cards like playing cards to implement cryptographic techniques. If a group admits a uniform cyclic group factorization, then a card shuffle operation associated with the group can be implemented by random cyclic shifts. We believe that our research combines mathematical research on the factorization of finite groups with cryptographic research on card-based cryptography, providing a new perspective on both fields.

Summary: Harada conjectured that the product of the sizes of all conjugacy classes is divided by the product of the degrees of all irreducible characters for any finite group. When the group is the symmetric group Sn and the alternating group An, this conjecture is presented by the hook length properties of the Young diagram. We show the conjecture for the covering groups of symmetric groups and alternating groups.

Summary: Let V be a vertex algebra of countable dimension, G a subgroup of Aut$V$ of finite order, V^G the fixed point subalgebra of V under the action of G. We show a Schur–Weyl type duality for the actions of an associative algebra and V^G

Summary: The coset (commutant) construction is a fundamental tool to construct vertex operator algebras from known vertex operator algebras. The aim of this talk is to provide a fundamental example of the commutants of vertex algebras ouside vertex operator algebras. Namely, the commutant C of the *principal subalgebra* W of the A_1 lattice vertex operator algebra V_{A_1} is investigated. An explicit minimal set of generators of C, which consists of infinitely many elements and strongly generates C, is introduced. It implies that the algebra C is not finitely generated. Furthermore, Zhu's Poisson algebra of C is shown to be isomorphic to an infinite-dimensional algebra $\mathbb{C}[x_1, x_2, \ldots]/(x_i x_j | i, j = 1, 2, \ldots)$. In particular, the associated variety of C consists of a point. Moreover, W and C are verified to form a dual pair in V_{A_1}.

Summary: Let p be a prime. We consider finite groups G and G' having a common central p-subgroup. In 2018, Wang and Zhang introduced the notion of relative stable equivalence of Morita type for blocks of finite groups. In this talk, we give a method of constructing a Morita equivalence between the principal p-blocks of G and G' using this notion.

Summary: Let G be a finite group, N a normal subgroup and k an algebraically closed field of characteristic $p > 0$. Clifford's theorem states that the restricted module of arbitrary simple kG-module to kN is a semisimple module. In this talk, we introduce the brick version of Clifford's theorem.

Summary: Describing the homomorphism spaces between Specht modules of the symmetric groups in positive characteristic is an important open problem in representation theory. Carter and Payne gave a remarkable result describing homomorphisms between Specht modules whose associated partitions differ by a single row. We describe the use of techniques from quiver Hecke algebras to achieve a generalization of the Carter–Payne theorem.

Summary: Outside of type A, the cyclotomic KLR algebras are still quite mysterious, and have not been studied in great detail. They have been gaining attention in type C recently, and we now have several useful tools with which we may study their representation theory. These include a theory of Specht modules, underpinned by combinatorics of multipartitions and tableaux, analogous to the type A situation, and Evseev and Mathas's recent proof that these algebras are graded cellular. Building on these ideas, in joint work with Chris Chung and Andrew Mathas, we have calculated graded decomposition matrices in small ranks. We will explain the techniques used in this endeavour, and point to some interesting examples whose behaviour look very different to what we see in type A.

Summary: We give the Borel-type presentation of the equivariant quantum K-ring of the flag manifold in type C. The Borel-type presentation is an explicit quotient of a Laurent polynomial ring which is isomorphic to the equivariant quantum K-ring as rings. By specializing the Novikov variables in the Borel-type presentation of the equivariant quantum K-ring to 0, we can obtain the well-known Borel presentation of the equivariant K-ring of the flag manifold. In this sense, our presentation can be viewed as a quantum analogue of the classical Borel presentation.

Summary: Let K be a field and Q a finite acyclic quiver with n vertices. For an element λ of K^n, the deformed preprojective algebra $\Pi(Q,\lambda)$ was introduced and studied by Crawley-Boevey and Holland to study deformations of Kleinian singularities. If $\lambda = 0$, then $\Pi(Q,0)$ is the preprojective algebra introduced by Gelfand–Ponomarev, and appears in many areas of mathematics. Among interesting properties of $\Pi(Q,0)$, the classification of tilting ideals of $\Pi(Q,0)$ is fundamental and important. In this talk, we classify tilting ideals of $\Pi(Q,\lambda)$ by using a Coxeter group. This is joint work with William Crawley-Boevey.

Summary: Let G be a generator and a cogenerator in the category of finitely generated right A-modules for a finite-dimensional algebra A over a filed $\Bbbk$, and $\mathcal{I}$ the additive closure of G. We will define a $\mathcal{I}$-relative Koszul coresolution $\mathcal{K}^\bullet(V)$ of an indecomposable direct summand V of G, and show that for a finitely generated A-module M, the $\mathcal{I}$-relative i-th Betti number for M at V is given as the $\Bbbk$-dimension of the i-th homology of the $\mathcal{I}$-relative Koszul complex $\mathcal{K}^\bullet_V(M) := \mathrm{Hom}_A(\mathcal{K}^\bullet(V), M)$ of M at V for all $i \geq 0$. This is applied to investigate the minimal interval resolution/coresolution of a persistence module M, e.g., to check the interval decomposability of M, and to compute the interval replacement of M.

Summary: Let k be an algebraically closed field of positive characteristic p and let $\mathbb{G}_a$ denote the additive group of k. A representation $u : \mathbb{G}_a \to \mathrm{SL}(n,k)$ is said to be fundamental if u factors through a representation of $\mathrm{SL}(2,k)$. In the case where $p \geq 3$, Fauntleroy (1977) gave a representation $u : \mathbb{G}_a \to \mathrm{SL}(3,k)$ so that u is not fundamental. In this talk, we classify fundamental representations of $\mathbb{G}_a$ into $\mathrm{SL}(3,k)$ in positive characteristic.

Geometry

March 17th (Sun) Conference Room IV

9:30–11:45

1 Ryu Ueno (Hokkaido Univ.) Statistical biharmonic map 15
Hitoshi Furuhata (Hokkaido Univ.)

Summary: We present statistical biharmonic maps, a new class of mappings between statistical manifolds derived from a natural variation problem. We give the Euler–Lagrange equation of this problem, and prove that improper affine spheres induce examples of such maps.

2 Atsufumi Honda (Yokohama Nat. Univ.) The total absolute curvature of closed curves with singularities 15
Chisa Tanaka (NTT DATA Frontier Corp.)
Yuta Yamauchi (Yokohama Nat. Univ.)

Summary: In this talk, we give a generalization of Fenchel's theorem for wave fronts in the n-dimensional Euclidean space R^n. We prove that, for a closed non-co-orientable 1-dimensional frontal in R^n, its total absolute curvature is greater than or equal to π. The equality holds if and only if the frontal is a planar L-convex closed frontal whose rotation index is $\frac{1}{2}$ or $-\frac{1}{2}$. Furthermore we show that, if the total absolute curvature is π and if the frontal admits at most cusps, the number N of cusps is an odd integer greater than or equal to 3, and $N = 3$ holds if and only if the wave front is a simple closed curve.

3 Isami Koga (Math. Res. Inst. Calc for Industry/Hiroshima Univ.) Harmonic totally real maps of the 3-sphere into the complex projective spaces 15
Yasuyuki Nagatomo (Meiji Univ.)

Summary: I would like to introduce a classification result of harmonic totally real maps with constant energy density of the 3-sphere into the complex projective spaces.

4 Riku Kishida (Tokyo Tech) The volume of conformally flat manifolds as hypersurfaces in the light-cone 15

Summary: In this talk, we focus on a conformally flat Riemannian manifold (M^n, g) isometrically immersed into the light-cone Λ^{n+1} as a hypersurface. We compute the first and the second variational formulas on the volume of such hypersurfaces. Such a hypersurface M^n is not only immersed in Λ^{n+1} but also isometrically realized as a hypersurface of a certain null hypersurface N^{n+1} in the Minkowski spacetime, which is different from Λ^{n+1}. Moreover, M^n has a volume-maximizing property in N^{n+1}.

5 Yuuki Sasaki (Utsunomiya Univ.) Orbits of the isotropy group action on quaternionic symmetric spaces 15

Summary: A symmetric space which is a quaternionic Kahler manifold is called a quaternionic symmetric space. We study some properties of orbits of the isotropy group action on a compact quaternionic symmetric space with respect to the quaternionic structure. In particular, an orbit is a totally complex submanifold or a quaternionic submanifold if and only if the orbit is a polar. Moreover, many orbits containing principal orbits satisfy some property which is an analogy of a totally complex submanifolds.

6 Toru Kajigaya (Tokyo Univ. of Sci.) Nonexistence of stable discrete maps into some homogeneous spaces of nonnegative curvature 15

Summary: We consider stabilities for the weighted length or energy functional of a discrete map from a finite weighted graph (X, m_E) into a smooth Riemannian manifold (M, g). We prove the non-existence of a stable discrete minimal immersion or a non-constant stable discrete harmonic map from a finite weighted graph into certain homogeneous spaces, such as Kähler C-spaces of positive holomorphic sectional curvature and some simply-connected compact Riemannian symmetric spaces.

Summary: We determine all the homogeneous structure tensors on $\mathbb{S}^2 \times \mathbb{R}$ and $\mathbb{H}^2 \times \mathbb{R}$. This work together with previous articles yields a complete classification of all the homogeneous structure tensors on three-dimensional homogeneous Riemannian manifolds.

14:15–16:10

Summary: We propose a Hamiltonian Lie algebroid and a momentum section over a Dirac structure as a generalization of a Hamiltonian Lie algebroid over a pre-symplectic manifold and one over a Poisson manifold. A Hamiltonian Lie algebroid and a momentum section are generalizations of a Hamiltonian G-space and a momentum map over a symplectic manifold.

Summary: We expand the notion of homotopy momentum sections in multisymplectic geometry to the one for bundle-valued multisymplectic manifolds with Lie algebroids. We focus on the momentum map for quaternionic Kähler manifolds introduced by K. Galicki and H. B. Lawson, and describe the condition for it to be the expanded homotopy momentum section.

Summary: We discuss homological mirror symmetry for weighted projective spaces (WPS) based on SYZ construction. We consider WPS with a moment map on the complex side and the open dense torus as the torus fibration over the interior of the moment polytope. On the mirror symplectic side, we consider the dual torus fibration with the same base and a generalization of Fukaya–Oh category of Morse homotopy of the polytope on it.

Summary: We study the closure of a complex subtorus in a toric manifold. If the closure of the complex subtorus is a smooth complex submanifold in the toric manifold, then the subtorus action on such submanifold is Hamiltonian. In this case, we may think of the embedding of the submanifold as a torus-equivalent embedding. We show that the image of the moment map for the Hamiltonian subtorus action on our submanifold coincides with the image of the Delzant polytope of the ambient toric manifold under the pullback of the inclusion of the tori. The submanifolds constructed in our talk are called torus-equivalently embedded toric manifolds with respect to the subtorus action.

Summary: We study homological mirror symmetry for Hirzebruch surface $\mathbb{F}_k$ as a complex manifold by using the Strominger–Yau–Zaslow construction of mirror pair and Morse homotopy. For the Hirzebruch surface $\mathbb{F}_1$, Futaki–Kajiura proved homological mirror symmetry by using SYZ construction and Morse homotopy. We extend Futaki–Kajiura's result of Hirzebruch surface $\mathbb{F}_1$ to $\mathbb{F}_k$. In this talk, we construct a quasi-isomorphism from the category of Morse homotopy to the DG category of the complex side and discuss the minimality of the category of Morse homotopy.

Summary: The notion of cosymplectic manifolds is an odd-dimensional analogue of symplectic manifolds. Albert introduced the concept of Hamiltonian actions on cosymplectic manifolds and proved a reduction theorem. In this talk, we refine this theorem in the case of coKähler manifolds, that is, normal almost contact metric manifolds which have a compatible cosymplectic structure.

16:25–17:25 Talk Invited by Geometry Section

Kazushi Ueda (Univ. of Tokyo) Mirror symmetry and degeneration

Summary: Mirror symmetry is a mysterious relationship between complex geometry and symplectic geometry, which is inspired by string theory. It suggests that strings perceive the world fundamentally differently from particles. Since every compact symplectic manifold comes in a family with varying volumes, a mirror of a compact symplectic manifold is not a single complex manifold but a degenerating family of complex manifolds. Studying the limits of degenerating families in various contexts is one of the central problems in geometry, related to compactifications of moduli spaces and localization (or concentration) of information near singular points. In the talk, I will discuss degenerations from the perspective of mirror symmetry.

March 18th (Mon) Conference Room IV

10:10–10:25 Presentation Ceremony for the 2023 MSJ Geometry Prize

10:30–11:30 Award Lecture for the 2023 MSJ Geometry Prize

Kento Fujita (Osaka Univ.)♭ On criteria for the K-stability of Fano varieties

Summary: We survey recent progress on K-stability of Fano varieties.

13:00–14:00

14 Yusei Aoki (Nagoya Inst. of Tech.) Estimates on characteristic magnetic focal value on Käher manifold
Toshiaki Adachi (Nagoya Inst. of Tech.) 15

Summary: A Käher magnetic fields on a Kähler manifold is a constant multiple of the Kähler form. We study magnetic Jacobi fields which are obtained as derivatives of variations of trajectories for Kähler magnetic fields. In this talk, we concider a "special" magnetic Jacobi field along tarajectory. Since velocity vecor and accelaration vector span a complex line, we study "special" magnetic Jacobi fields which are related with such directions. We take auxiliary magnetic Jacobi field to estimete. We get estimates of "special" magnetic Jacobi field by comparing magnetic Jacobi field on complex space forms.

15 Kenzi Satô (Tamagawa Univ.) Two kinds of new centroids of spherical and hyperbolic triangles 15

Summary: The centroid of a planar triangle satisfies many properties, but the points with each property are different for a spherical or hyperbolic triangle. In this talk, the point trisecting the area and the concurrent point of 3 arcs bisecting the area are considered.

16 Víctor Pérez-Valdés (Univ. of Tokyo) Differential symmetry breaking operators for principal series representations of the pair (SO(4,1), SO(3,1)) 15

Summary: In this talk, we discuss about the problem of constructing and classifying all differential symmetry breaking operators for principal series representations of the pair (SO(4,1), SO(3,1))

March 19th (Tue) Conference Room IV

9:30–11:45

17 Shota Hamanaka (Mitsubishi Electric Corp. Adv. Tech. R&D Center) Limit theorems for the total scalar curvature 15

Summary: In this talk, we give some $W^{1,p}$ limit theorems for total scalar curvatures. More precisely, we show that the lower bound of the total scalar curvatures on a closed n-manifold is preserved under the $W^{1,p}$ convergence of the Riemannian metrics for $p > n$ provided that each scalar curvature is nonnegative. We also give an example which suggests that the $W^{1,p}$ $(p > n)$ convergence is almost optimal.

Summary: We prove that the integral of scalar curvature over a Riemannian manifold is uniformly bounded below in terms of its dimension, upper bounds on sectional curvature and volume, and a lower bound on injectivity radius. This is an analogue of an earlier result of Petrunin for Riemannian manifolds with sectional curvature bounded below. Both proofs rely on the convergence theory of Riemannian manifolds with one-sided curvature bounds. The parallel structure comes from that of the limit spaces, i.e., Alexandrov spaces and GCBA spaces.

Summary: Stimulated by improved oscillation estimates of the potential function and the scalar curvature on compact gradient Ricci solitons introduced in a recent work by X. Cheng, E. Ribeiro Jr., and D. Zhou (Proc. Amer. Math. Soc. Ser. B **10** (2023), 33–45), we give several new sufficient conditions for compact four-dimensional normalized shrinking Ricci solitons to satisfy the Hitchin–Thorpe inequality. Our new conditions refine the validity of the Hitchin–Thorpe inequality obtained by the author (J. Math. Phys. **58** (2017), 023503 & J. Math. Phys. **59** (2018), 043507 & Differential Geom. Appl. **66** (2019), 231–241).

Summary: We derive some new local gradient estimates of Li–Yau, Hamilton, Li–Xu types for positive solutions to porous medium and fast diffusion equations associated with the Witten Laplacian on a complete Riemannian manifold via m-Bakry–Émery Ricci curvature with ε-range. As applications, we give some Harnack inequalities for positive solutions to porous medium and fast diffusion equations associated with the Witten Laplacian on a complete non-compact Riemannian manifold via m-Bakry–Émery Ricci curvature with ε-range.

Summary: We study the space of non-extendable invariant quasimorphisms.

Summary: We initiate coarse group theoretic study of scl (stable commutator length).

Summary: A metric measure space is a metric space with a Borel measure. This concept was defined when considering the limit of a sequence of Riemannian manifolds. Currently, there are several definitions of metric measure spaces, and one of them is a metric measure space with a probability measure considered by Gromov. In the theory of this metric measure space, the invariants called the partial diameter and the observable diameter are often used. We obtained the result that the partial diameter or the observable diameter equals zero if and only if there exist points that have positive measures (called the atoms).

14:15–17:10

Summary: A metric space is said to be strongly rigid if no positive distance is taken twice by the metric. In 1972, Janos proved that a separable metrizable space has a strongly rigid metric if and only if it is zero-dimensional. As a development of this result, for a zero-dimensional metrizable space, we prove that the set of all strongly rigid metrics is dense in the space of metics. Moreover, if the space is the union of countably many compact subspaces, then that set is comeager. As a consequence, we show that for a strongly zero-dimensional metrizable space, the set of all metrics possessing no nontrivial (bijective) self-isometry is comeager in the space of metrics.

Summary: A Gaussian random variable is characterised in terms of a differentiable real-valued function. The characterisation is referred to as Stein identity. Stein identity implies Poincaré inequality in terms of a random variable. We observe the implication from the point of view of a discrete distribution via quantification. This observation enables us to show Stein identity and Poincaré inequality in terms of the quantification. We also argue them to obtain their results on geometric analysis.

Summary: We consider the problem whether sub-Finsler manifolds satisfy the measure contraction property $MCP(K,N)$, and if so, what is the optimal K and N. It has been considered for sub-Riemannian Heisenberg groups (and its generalizations), and the optimal N was relevant to the geodesic dimension. We consider the ℓ^p-Heisenberg group. We show that for $1 < p < 2$, it satisfies $MCP(K,N)$ with non-positive K and some N which is strictly greater than the geodesic dimension. On the other hand, for $2 < p \leq \infty$, it has finite geodesic dimension, but it does not satisfies $MCP(K,N)$ for any numbers.

Summary: We show that Sobolev curves in a dual Banach space can be characterized in terms of weak derivatives in a weak* sense. Since every metric space embeds isometrically into a dual Banach space, this implies a characterization of metric space valued Sobolev curves in terms of such derivatives. Furthermore, we investigate for which target spaces Sobolev curves are weak* differentiable almost everywhere.

Summary: On Euclidean spaces, the squared distance function $|\cdot|^2$ is a convex function as well as a semiconcave function. When it comes to Heisenberg group, due to the appearance of the cut locus and the abnormal set, the squared sub-Riemannian distance cannot be locally semiconcave nor locally semiconvex. However, if we consider the correponding weaker horizontal convexity (or h-convexity in short) on Heisenberg group instead, the h-semiconcavity holds for the squared sub-Riemannian distance on Heisenberg group. This result can be generalized to the case of so-called ideal Carnot groups.

Summary: We study an eigenvalue problem for the Laplacian on a compact Kähler manifold. Considering the k-th eigenvalue λ_k as a functional on the space of Kähler metrics with fixed volume on a compact complex manifold, we introduce the notion of λ_k-extremal Kähler metric. We deduce a condition for a Kähler metric to be λ_k-extremal. As examples, we consider product Kähler manifolds and flat complex tori. The condition for the flat metric on a complex torus to be λ_k-extremal is also a necessary condition for the flat complex torus to admit an isometric minimal immersion into a Euclidean sphere by first eigenfunctions.

30 Yuya Takahashi (Nagoya Univ.) Operad structures in geometric quantization of the moduli space of flat $SU(2)$-connections on a Riemann surface · · · · · 15

Summary: The moduli space of flat $SU(2)$-connections on a Riemann surface is known to contain an open dense subset which is a symplectic manifold equipped with both Kähler and real polarizations. In this talk, we will construct morphisms of modular operads $\mathsf{f}_{Käh}$ and f_{re} by using the quantum spaces $\mathcal{H}_{Käh}$ and $\mathcal{H}_{re}$ associated to the Kähler and real polarizations respectively. Moreover, we will relate the two morphisms $\mathsf{f}_{Käh}$ and f_{re}, and prove the equality $\dim \mathcal{H}_{Käh} = \dim \mathcal{H}_{re}$, which is known as the result of Jeffrey and Weitsman (1992). This operadic structures are similar to those obtained by Takahashi (2023) in the case of the moduli space of spatial polygons.

31 Tatsuki Seto (Meiji Pharm. Univ.)
Takashi Maruyama (NEC Laboratories Europe)
A Fredholm module on self-similar sets built on n-cubes · · · · · 15

Summary: We construct a Fredholm module on self-similar sets such as the Cantor dust, the Sierpinski carpet and the Menger sponge. Our construction is a higher dimensional analogue of Connes' combinatorial construction of the Fredholm module on the Cantor set. We also calculate the Dixmier trace of operators induced by the Fredholm module.

32 Taika Okuda (Tokyo Univ. of Sci.)
Akifumi Sako (Tokyo Univ. of Sci.)
Star product with separation of variables on $G_{2,4}(\mathbb{C})$ · · · · · 15

Summary: Deformation quantization with separation of variables for Kähler manifolds has been proposed by Karabegov. Especially, locally symmetric cases have also been studied by Sako–Suzuki–Umetsu or Hara–Sako. On the other hand, deformation quantization with separation of variables for complex Grassmannians has not been explicitly constructed so far, except for $\mathbb{C}P^N$. In this work, we explicitly determined the star product with separation of variables on $G_{2,4}(\mathbb{C})$ by using the solution of the recurrence relations given by Hara–Sako.

March 20th (Wed) Conference Room IV

9:20–10:15

33 Joonhyung Kim (Chungnam Nat. Univ.)
Ioannis D. Platis (Univ. of Crete)
Li-Jie Sun (Yamaguchi Univ.)
On the Kähler cone of the Heisenberg group · · · · · 15

Summary: Starting from the Sasakian structure of the Heisenberg group we construct a Kähler structure of the Siegel domain. We also show other Kähler structures of the Siegel domain and all these are PCR-Kähler equivalent, that is, essentially the same when restricted to the CR structure.

34 Yuya Takeuchi (Univ. of Tsukuba) Kohn–Rossi cohomology of spherical CR manifolds · · · · · 15

Summary: The Kohn–Rossi cohomology is a CR analog of the Dolbeault cohomology and is one of fundamental invariants in CR geometry. In this talk, we prove some vanishing theorems for the Kohn–Rossi cohomology of some spherical CR manifolds. To this end, we use a canonical contact form defined via the Patterson–Sullivan measure and Weitzenböck-type formulae.

35 Natsuo Miyatake (Tohoku Univ.) Extended Hitchin equation for cyclic Higgs bundles associated with a quasi-subharmonic function, and its Dirichlet problem · · · · · 15

Summary: We demonstrate the existence and uniqueness of the solution to the Dirichlet problem for a generalization of Hitchin's equation for diagonal harmonic metrics on cyclic Higgs bundles. The generalized equations are formulated using subharmonic functions. In this generalization, the coefficient exhibits worse regularity than that in the original equation.

10:30–11:30 Talk Invited by Geometry Section

Hisashi Kasuya (Osaka Univ.) Vector bundles and Higgs bundles over Sasakian manifolds, present and future

Summary: The speaker and his collaborators develop the theory of Higgs bundles over compact Sasakian manifolds as an odd-dimensional analogue of the great works of Corlette, Hitchin and Simpson on Higgs bundles over compact Kähler manifolds. Sasakian geometry is often qualified as an odd-dimensional analogy of Kähler geometry. An important theme on Sasakian geometry is to show that Sasakian geometry is not just an analogue. The purpose of this talk to give an overview of recent results on Higgs bundles over compact Sasakian manifolds and suggest future programs for going beyond an analogy of Kähler case.

Complex Analysis

March 17th (Sun) Conference Room VI

9:50–11:20

1 Kiyoki Tanaka (Meijo Univ.) Little Hankel operators on Bloch type spaces 15
Satoshi Yamaji (Kobe City Coll. of Tech.)

Summary: Axler gave a characterization for bounded or compact Hankel operators with anti holomorphic symbols on Bergman spaces. Based on Axler's results, Bonami–Luo gave a characterization for bounded little Hankel operators with anti holomorphic symbols from Bergman spaces to another Bergman spaces. In this talk, we announce a result of characterization for bounded little Hankel operator with anti holomorphic symbols on Bloch type spaces.

2 Toshiyuki Sugawa (Tohoku Univ.) On universal convexity of shifted hypergeometric functions 15
Li-Mei Wang (Univ. of Int. Business and Econ.)
Chengfa Wu (Shenzhen Univ.)

Summary: In this talk, we consider mainly the shifted hypergeometric function $f(z) = z_2F_1(a, b; c; z)$ for real parameters with $0 < a \le b \le c$. Ruscheweyh, Salinas and Sugawa developed in their 2009 paper the theory of universal prestarlike functions on the slit domain $\mathbb{C} \setminus [1, +\infty)$ and showed universal starlikeness of f under some assumptions on the parameters. We will give conditions on the parameters which lead to universal convexity of f.

3 Yohei Komori (Waseda Univ.) On the convergence of Thurston's hyperbolic circle packing algorithm 15

Summary: In this talk we will show the convergence of Thurston's iterated algorithm for hyperbolic circle packing. Colin de Verdière proved the convergence for Euclidean case. We will also consider circle pattern case.

4 Katsuhiko Matsuzaki (Waseda Univ.) On the real-analytic structure of integrable Teichmüller spaces 15

Summary: For the p-integrable Teichmüller space T_p $(p \ge 1)$, which is given by p-integrable Beltrami coefficients with respect to the hyperbolic metric, we describe its real-analytic structure by using Besov spaces.

5 Hiroaki Aikawa (Chubu Univ.) Intrinsic ultracontractivity for planar domains with wide access property 15

Summary: Utilizing capacitary width and the parabolic box argument, we unveil analytic notions behind geometric characterizations of wide accessible planar domains, those are IU or have finite lifetime.

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

Takao Ohno (Oita Univ.) Boundedness of maximal operators and Sobolev-type inequalities for Riesz potentials

Summary: The maximal operator is a classical tool in harmonic analysis and studying Sobolev functions and partial differential equations and plays a central role in the study of differentiation, singular integrals, smoothness of functions and so on. It is well known that the maximal operator is bounded on the Lebesgue space if $p > 1$. One of important applications of the boundedness of the maximal operator is Sobolev's inequality for Riesz potentials of functions in the Lebesgue space. My aim in this talk is to talk about the boundedness of the maximal operator on variable exponent Lebesgue spaces, variable exponent Morrey spaces, Musielak–Orlicz spaces, Musielak–Orlicz–Morrey spaces and so on. As an application of the boundedness of the maximal operator, we establish a generalization of Sobolev's inequality for Riesz potentials of functions in the above spaces.

15:35–16:30

6 Hidetaka Hamada (Kyushu Sangyo Univ.)
Shaolin Chen (Hengyang Normal Univ.)
Riesz type inequalities and a Hardy–Littlewood type theorem on bounded symmetric domains · · · · · 15

Summary: The aim of this talk is to establish some Riesz type inequalities of pluriharmonic functions on bounded symmetric domains, which extend a theorem due to Kalaj. Also, we observe that similar Riesz type inequalities do not hold for the pluriharmonic Hardy space $\mathscr{PH}^p(\Omega)$ in the cases $p = 1, \infty$. We obtain a Hardy and Littlewood type theorem in the case $p = 1$.

7 Hidetaka Hamada (Kyushu Sangyo Univ.)
Shaolin Chen (Hengyang Normal Univ.)
Harmonic functions with smooth moduli · · · · · 10

Summary: Pavlović studied Lipschitz conditions with respect to $\psi_\alpha(t) = t^\alpha$, $0 < \alpha < 1$ on the modulus of real-valued harmonic functions on the Euclidean unit ball of $\mathbb{R}^n$ with $n \geq 2$. The aim of this talk is to improve and extend a Pavlović's result to a general fast majorant ψ and to real-valued harmonic functions on an $\mathscr{L}_\psi$-extension domain of $\mathbb{R}^n$.

8 Hidetaka Hamada (Kyushu Sangyo Univ.)
Shaolin Chen (Hengyang Normal Univ.)
Holomorphic and pluriharmonic functions with smooth moduli and Hardy–Littlewood type theorems · · · · · 10

Summary: In this talk, we discuss the Hardy–Littlewood type theorems and smooth moduli of holomorphic and pluriharmonic functions. Our result improves and extends the corresponding results due to Dyakonov in 2004 and Hardy and Littlewood in 1932.

9 Hidetaka Hamada (Kyushu Sangyo Univ.)
Shaolin Chen (Hengyang Normal Univ.)
Pluriharmonic Lipschitz type spaces and composition operators · · · · · 15

Summary: The main purpose of this talk is to develop some methods to study the composition operators between pluriharmonic Lipschitz type spaces. Some characterizations of boundedness and w-compactness of composition operators between the pluriharmonic Lipschitz type spaces will be given. The obtained results improve and extend some corresponding known results by Madigan in 1993 and Pavlović in 2008.

March 18th (Mon) Conference Room VI

9:50–11:20

10 Takanori Ayano (Osaka Metro. Univ.)
An improvement on the power series expansion of the sigma function associated with the telescopic curves · · · · · 15

Summary: The sigma function is obtained by modifying the Riemann's theta function. The sigma function has some remarkable algebraic properties that it is directly related with the defining equations of an algebraic curve. Namely, the coefficients of the power series expansion of the sigma function around the origin become polynomials of the coefficients of the defining equations of the algebraic curve. It is an important problem to determine the coefficients of the power series expansion of the sigma function. In The Mathematical Society of Japan Autumn Meeting 2022, I made a presentation on the result of the power series expansion of the sigma function associated with the telescopic curves. In this talk, I will give an improvement of this result.

11 Li-Jie Sun (Yamaguchi Univ.)
Geometric structures on the quaternionic Heisenberg group · · · · · 15

Summary: Analogous to the pseudohermitian manifold in CR geometry, there exists a quaternionic counterpart known as the quaternionic contact manifold. A well-known example is the quaternionic Heisenberg group. Our main focus is to explore the Sasakian 3-structure on the quaternionic Heisenberg group, which is important to investigate the geometry on its Riemannian cone.

12 Tadashi Tomaru (Gunma Univ.*) Arnold's 14 exceptional singularities and families of elliptic curves with complex multiplications ····· 15

Summary: In my paper in 2013, I introduced the notion of C*-pencil of curves, From the point of view, I will explain some relations between Arnold's 14 exceptional singularities and families of elliptic curves with complex multiplications.

13 Takayuki Koike (Osaka Metro. Univ.) $\overline{\partial}$ cohomology of the complement of a semi-positive anticanonical divisor of a compact surface ····· 15

Summary: Let X be a non-singular compact complex surface such that the anticanonical line bundle admits a smooth Hermitian metric with semi-positive curvature. For a non-singular hypersurface Y which defines an anticanonical divisor, we investigate the $\overline{\partial}$ cohomology group $H^1(M, \mathcal{O}_M)$ of the complement $M = X \setminus Y$.

14 Takeo Ohsawa (Nagoya Univ.)♭ On the Levi problem for locally pseudoconvex bounded domains of regular type with a curvature negativity on the boundary ····· 15

Summary: Given a bounded locally pseudoconvex domain Ω in a complex manifold M with a complete Kähler metric and a positive line bundle, it is proved that Ω is holomorphically convex if the canonical bundle of M is negative on $\partial\Omega$, under a regularity condition on $\partial\Omega$ wich is satisfied if $\partial\Omega$ is a C^2-smooth hypersurface.

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

Tomoyuki Hisamoto (Tokyo Metro. Univ.) Optimal degeneration for a Fano manifold

Summary: The existence problem of the Kähler–Einstein metric for Fano manifolds was solved by Chen–Donaldson–Sun and by many contributions of other people in the 2010s. In the proof, the uniform lower bound estimate of the Bergman kernel played a crucial role. While a general Fano manifold does not admits a Kähler–Einstein metric, its parabolic version, known as the Kähler–Ricci flow, has the long-time solution and converges to the Kähler–Einstein metric if it exists. In terms of the algebraic geometry the Kähler–Ricci flow corresponds to the optimal degeneration of the Fano manifold, which is characterized as the degeneration with minimal (non-Archimedean) entropy. In this talk I will explain the asymptotic construction of optimal degeneration using multiplier ideal sheaves. I would also like to touch upon the quantization of the Kähler–Ricci flow, in connection with the above construction.

Functional Equations

March 17th (Sun) Conference Room II

9:30–12:00

Summary: The q-Painlevé equation of type $E_6^{(1)}$ is given as a q-difference system with an affine Weyl group symmetry of type $E_6^{(1)}$. We obtained a 3×3 Lax formalism for the equation as a new one. Our goal is to understand a birational representation of an affine Weyl group symmetry of type $E_6^{(1)}$ as actions on the 3×3 Lax formalism. In this talk, we talk about a relation between it and known birational actions of 3 kinds of affine Weyl group of type $A_2^{(1)}$ as a partial result.

Summary: We consider the nonlinear differential equation $(a(t)|x'|^{p(t)-2}x')' = b(t)|x|^{q(t)-2}x$, where $a(t)$, $b(t)$, and $q(t) > 1$ are positive continuous, and $p(t) > 1$ is continuously differentiable. Nonoscillatory proper solutions of this equations are categorized into four classes, characterized by specific integral conditions. By leveraging these classes, we introduce a minimal set for solutions of this equation, thereby extending the concept of principal solutions of linear equations. This talk is based on a joint work with Professor Zuzana Došlá (Masaryk University, Czech Republic).

Summary: Mathematical Analysis for target shooting problems is given. We consider the differential systems describing the motion of an objective thrown at the target. We assume that the air resistance is proportional to the square of the magnitude of its velocity. We can determine whether or not the objective hits the target in some cases.

Summary: We consider the one-dimensional nonlinear eigenvalue problem of Kirchhoff type. We obtain the first eigenvalue μ_1 of this problem explicitly by using a simple time map method. We also obtain the first eigenfunction associated with μ_1.

Summary: The delay differential equations (DDEs), in which the time derivative of the unknown function also depends on the past information determine infinite-dimensional dynamical systems as the time evolution of the history segments of solutions, even when the independent variables of the unknown function are only time variable. While this infinite-dimensionality can cause complicated behavior of solutions to DDEs, the actual complexity of the dynamics depends on the "size of the time-lag." To facilitate such an understanding, it is necessary to develop a treatment of DDEs. In this talk, for retarded functional differential equations (RFDEs), which give a mathematical formulation of DDEs, we introduce a notion of "mild solutions" to linear RFDEs for a purpose of dealing with "discontinuous history functions", which is a barrier to the study of RFDEs.

6 Junya Nishiguchi (Tohoku Univ.) Fundamental systems of solutions and fundamental matrix solutions to linear delay differential equations ····· 15

Summary: For a non-homogeneous linear RFDE, we consider how the solutions are expressed by using the solutions to the homogeneous equation and the forcing term. By an analogy to non-homogeneous linear ODEs, we call such a formula the *variation of constants formula* and ask "What is the *fundamental matrix solutions* to the linear RFDE?" This is of course a fundamental question, and there is a long history of over fifty years. However, it is known that there is a conceptual difficulty which is peculiar to RFDEs. In this talk, we resolve the difficulty by defining fundamental matrix solutions to the linear RFDE as matrix-valued milds solutions having discontinuous matrix-valued functions in their initial histories.

7 Naoki Hamamoto (Osaka Metro. Univ.) The Hardy's constant for curl-free vector fields on the half-plane ····· 12

Summary: The N-dimensional Hardy's inequality $\int_{\mathbb{R}^N} |\nabla \boldsymbol{u}|^2 dx \geq C \int_{\mathbb{R}^N} \frac{|\boldsymbol{u}|^2}{|\boldsymbol{x}|^2} dx$ with the best constant $C = (N-2)^2/4$ is well known when the test vector field $\boldsymbol{u} : \mathbb{R}^N \to \mathbb{R}^N$ is in $C_c^\infty(\mathbb{R}^N)$ and unconstrained. We are interested in how C can be improved when $\boldsymbol{u}$ is constrained by the curl-free condition $\mathrm{curl}\boldsymbol{u} \equiv \boldsymbol{0}$; however, when $N = 2$ such an improvement cannot be obtained. On the other hand, when the support of $\boldsymbol{u}$ is contained in the half space $\mathbb{R}^N_+$ the best constant is known to be $N^2/4$ for unconstrained fields. In this situation we treat the problem how C can be improved when $\boldsymbol{u}$ is a two-dimensional curl-free field whose support is contained in the half-plane $\mathbb{R}^2_+$.

8 Takeshi Suguro (Kumamoto Univ.) ♭ Stability estimates for the logarithmic Sobolev inequality for a generalized entropy and an application to the uncertainty relation inequality ····· 15

Summary: We consider the logarithmic Sobolev inequality for the Tsallis entropy, which is a generalization of the Boltzmann–Shannon entropy. We show the stability estimate for the logarithmic Sobolev inequality via the Gagliardo–Nirenberg inequality. Moreover, we derive an extension of the uncertainty relation inequality.

14:15–16:15

9 Yukihide Tadano (Tokyo Univ. of Sci.)
Shu Nakamura (Gakushuin Univ.)
Keita Mikami (RIKEN)
Continuum limit for discretized elliptic operators on square lattice ··· 15

Summary: In this talk, we consider the discretization of elliptic operators $P = -\sum_{j,k} \partial_{x_j} a_{j,k}(x) \partial_{x_k} + V(x)$ on $\mathbb{R}^d$ onto the square lattice $h\mathbb{Z}^d$ with mesh size h. We show that under the strictly ellipticity of $a_{j,k}$ and a certain assumption where V is not necessarily bounded, the above discretized operators converge to P in the continuum limit. We also show that as an application the spectra and eigenfunctions of P can be approximated by those of its discretization.

10 Takashi Suzuki (Osaka Univ.)
Kazuo Watanabe (Kitasato Univ.)
Interface vanishing of differential forms ····· 5

Summary: We introduce $d - \delta$ systems on differential forms in Euclidean spaces and show the interface vanishing of the solution. This result generalizes the previous theorems on stationary and non-stationary Maxwell's equation.

11 Shimpei Makida (Hokkaido Univ.)
Atsushi Nakayasu (Kyoto Univ.)
Stability of metric viscosity solutions under Hausdorff convergence ··· 15

Summary: Recently, the domain perturbation problem for the Hamilton–Jacobi equation has been studied. In this talk we investigate the stability of viscosity solutions of the Hamilton–Jacobi equations for a sequence of domains that are not necessarily monotone. The proof is based on the relaxed half semilimit and a characterization of the metric viscosity solutions in terms of squared distance functions.

12 Tatsuya Ueno (Kanagawa Univ.) Existence of positive ground state solution of coupled nonlinear Kirchhoff–Schrödinger system for a subcritical and critical case 10

Summary: In this talk, we prove the existence of positive ground state solution of a nonlinear Kirchhoff–Schrödinger system with constant potentials for a subcritical case and critical case. We use a variational technique, in particular, we consider a minimization problem on the Nehari–Pohozaev manifold corresponding to the problem.

13 Yasuhito Miyamoto (Univ. of Tokyo) Exact Morse index of radial solutions for semilinear elliptic equations with critical exponent on annuli 10

Summary: We consider a Dirichlet problem of the Henon equation with a critical exponent on annuli. This problem has exactly two radial solutions with n nodal domains. When the domain is a ball, the problem has no positive solution due to Pohozaev identity. Therefore, it is interesting to study the case where the inner radius goes to zero. In this talk we study the Morse index of radial solutions. In particular, an exact Morse index can be determined when the inner radius is small. Several estimates of the Morse index are also obtained.

14 Haruki Takemura (Univ. of Tokyo)
Yasuhito Miyamoto (Univ. of Tokyo)
Tohru Wakasa (Kyushu Inst. of Tech.) Asymptotic formulas of the eigenvalues for the linearization of the scalar field equation 15

Summary: We give asymptotic formulas for all the eigenvalues of the linearization problem of the Neumann problem for the scalar field equation $\varepsilon^2 u_{xx} - u + u^3 = 0$. The eigenvalues are classified into three categories. The eigenvalues in the three categories respectively converge to -3, 0 and 1 as $\varepsilon \to 1$. The number of the eigenvalues which converge to -3 is equal to the number of the interior and boundary peaks of the solution of Neumann problem u. The number of the eigenvalues which converge to 0 is equal to the number of the interior peaks of u. In this study, complete elliptic integrals and Jacobi's elliptic functions play an important role.

15 Kenta Nakamura (Kumamoto Univ.) Local properties of fractional parabolic De Giorgi classes 10

Summary: This talk studies fractional parabolic De Giorgi classes of order s, p and renders the local boundedness and the nonlocal weak Harnack estimate. I will present a brief sketch of the proof of my results as long as time permits.

16 Kotaro Sato (Tohoku Univ.) Long-time behavior of solutions to some quasistatic evolution equation 15

Summary: We investigate long-time dynamics of strong solutions of the initial-boundary value problem for differential equations of doubly-nonlinear type in this talk. More precisely, we characterize the stationary limits of the global-in-time L^2-solutions as a solution to the corresponding stationary problem. Here, the layer structure (or so-called comparison principle) of the equations plays an important role in the proof of the characterization of the limit.

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

Yoshiaki Goto (Otaru Univ. of Commerce) Hypergeometric integrals —homology and cohomology

Summary: Hypergeometric integrals are defined as integrals of the product of complex powers of polynomials. We study hypergeometric integrals by using homology and cohomology groups with local coefficients, so-called twisted homology and cohomology groups. Many types of relations between hypergeometric functions can be regarded as relations in (co)homology groups. Further, the intersection forms on (co)homology groups are also useful tools. In this talk, I would like to show some examples that hypergeometric integrals are studied by using twisted (co)homology groups and intersection forms.

March 18th (Mon) Conference Room II

9:30–12:00

17 Ryunosuke Kusaba (Waseda Univ.)
Tohru Ozawa (Waseda Univ.)
Higher order asymptotic expansions for the complex Ginzburg–Landau type equation in the supercritical case ····· 15

Summary: We present explicit asymptotic profiles with parabolic self-similarity of global solutions to the Cauchy problem for the complex Ginzburg–Landau type equation in the super Fujita-critical case. Our approach is based on the integral representation of the CGL semigroup and Taylor expansions with respect to the both space and time variables. We also discuss the optimal decay rate in time of the remainder for the asymptotic expansion.

18 Shohei Kohatsu (Tokyo Univ. of Sci.)
Immediate smoothing of measure-valued population densities in a Keller–Segel system with flux limitation ····· 15

Summary: We deal with a Keller–Segel system with flux limitation. For the one-dimensional Keller–Segel system, it is known that given any nonnegative measure-valued initial data, the system admits a global classical solution which is continuous at $t = 0$. The purpose is to show this immediate smoothing in the system for any dimension with the aid of effect of flux limitation.

19 Sachiko Ishida (Chiba Univ.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Global solvability for N-dimensional tumor invasion models via the maximum Sobolev regularity ····· 10

Summary: We consider the initial-boundary value problem for a degenerate chemotaxis model arising from tumor invasion, in which the first equation is $u_t = \nabla \cdot (f(u,w)\nabla u - g(u)\nabla v)$. The diffusivity and the sensitivity are assumed to fulfill $f(u,w) \geq u^{m-1}$ $(m > 1)$, $0 \leq g(u) \leq u(u+1)^{\alpha-1}$ $(\alpha \in \mathbb{R})$. It is shown that if $\alpha + 1 = m + \frac{4}{N}$ $(N \geq 3)$, then for any initial data with small mass, the system possesses a global bounded weak solution.

20 Tatsuya Hosono (Tohoku Univ.)♭
Philippe Laurençot (CNRS / Univ. Savoie Mont Blanc)
Global existence and boundedness of solutions to the 4D fully parabolic chemotaxis system with indirect signal production ····· 15

Summary: We consider the Cauchy problem for the 4 dimensional fully parabolic chemotaxis system with indirect signal production. In this talk, we show that the solution exists globally in time provided that the initial mass is less than the value $(8\pi)^2$, known as the 4 dimensional threshold value whether the blow-up of solutions occurs or not. Furthermore some condition on the initial mass ensuring the boundedness of solutions is also obtained. This talk is based on a joint work with Philippe Laurençot (CNRS & Université Savoie Mont Blanc).

21 Masahiko Shimojo (Tokyo Metro. Univ.)
Jong-Shenq Guo (Tamkang Univ.)
Convergence to traveling waves of predator-prey type reaction-diffusion systems with equal diffusivity by utilizing a relative entropy ····· 15

Summary: Our aim is to construct a general framework to derive the asymptotic stability of traveling waves. This method is universal in the sense that it works well for waves in many reaction-diffusion systems with equal diffusivities.

22 Masahiko Shimojo (Tokyo Metro. Univ.)
Jong-Shenq Guo (Tamkang Univ.)
Karen Guo (Providence Univ.)
Stability of monostable traveling waves in diffusive three-species competition systems ····· 15

Summary: We discuss the asymptotic stability of traveling waves of diffusive three-species competition systems under certain perturbations of initial data.

23 Masaharu Taniguchi (Okayama Univ.)
Hirokazu Ninomiya (Meiji Univ.)
Traveling front solutions of dimension n generate entire solutions of dimension $(n-1)$ in reaction-diffusion equations 15

Summary: Multidimensional traveling front solutions and entire solutions of reaction-diffusion equations have been studied intensively. To study the relationship between multidimensional traveling front solutions and entire solutions, we study the reaction-diffusion equation with a bistable nonlinear term. It is well known that there exist multidimensional traveling front solutions with every speed that is greater than the speed of a one-dimensional traveling front solution connecting two stable equilibria. In this paper, we show that the limit of the n-dimensional multidimensional traveling front solutions as the speeds go to infinity generates an entire solution of the same reaction-diffusion equation in the $(n-1)$-dimensional space.

24 Masaharu Taniguchi (Okayama Univ.)
Entire solutions with and without radial symmetry in balanced bistable reaction-diffusion equations 15

Summary: Let $n \geq 2$ be a given integer. In this paper, we assert that an n-dimensional traveling front converges to an $(n-1)$-dimensional entire solution as the speed goes to infinity in a balanced bistable reaction-diffusion equation. As the speed of an n-dimensional axially symmetric or asymmetric traveling front goes to infinity, it converges to an $(n-1)$-dimensional radially symmetric or asymmetric entire solution in a balanced bistable reaction-diffusion equation, respectively. We conjecture that the radially asymmetric entire solutions obtained in this paper are associated with the ancient solutions called the Angenent ovals in the mean curvature flows.

13:00–14:00 Talk Invited by Functional Equations Section

Qing Liu
(Okinawa Inst. of Sci. and Tech. Grad. Univ.)
Monge solutions of eikonal equations in metric spaces

Summary: In recent years, there has been rapid progress in the study of nonlinear partial differential equations in general metric spaces, driven by applications in optimal transport, traffic flows, control theory, data sciences and many others. This talk provides a summary of recent results on the first order Hamilton–Jacobi equations in metric spaces, with emphasis on a special case of the eikonal equation.

We begin with a brief review of the theory of viscosity solutions, a well-established powerful tool for fully nonlinear partial differential equations in the Euclidean space. We next discuss several recently developed approaches to tackle the well-posedness of Hamilton–Jacobi equations in metric spaces. Our focus will be placed on the notion of so-called Monge solutions to the eikonal equation, which was originally introduced by Newcomb–Su (1995) as an equivalent alternative of viscosity solutions in the Euclidean case. We extend their idea to metric spaces. Compared to other known notions of metric viscosity solutions, its advantage lies in the convenience that it does not require any smooth test functions, whose existence is a significant obstacle in general metric spaces.

It is possible to adapt this method to further study eikonal equation with a discontinuous or even only integrable inhomogeneous term. In the last part of the talk, we present our recent results concerning this problem in metric measure spaces.

March 19th (Tue) Conference Room II

9:45–12:00

25 Kaito Kokubu (Tokyo Univ. of Sci.)
On solitary wave solutions to dispersive equations with double power nonlinearities 10

Summary: We study semilinear elliptic equations with the fractional Laplacian in dimension 1. The equations with single power nonlinearities have been observed by Weinstein (1987), Frank–Lenzmann (2013), and so on. We focus on the equations with double power nonlinearities and consider the existence of ground states.

Summary: We consider non-smoothness of the fundamental solution for the Schrödinger equation with a spherically symmetric and super-quadratic potential in the sense that $V(x) \geq C|x|^{2+\varepsilon}$ at infinity with constants $C > 0$ and $\varepsilon > 0$. Yajima(1996) has shown that if V is super-quadratic and the spatial dimension is one, then the fundamental solution $E(t, x, y)$ is not smooth anywhere with respect to (t, x, y). In this talk, we show that the fundamental solution $E(t, x, y)$ does not belong to C^1 as a function of (t, x, y) if V is a spherically symmetric and super-quadratic potential, the spatial dimension is larger than or equals to 4.

Summary: We consider short-time asymptotic behaviors of the fundamental solutions for Schrödinger equations with potentials which are time-dependent and at most quadratic growth. Fujiwara (1980) has studied asymptotic behaviors of the fundamental solutions in the case where potentials are smooth. The purpose of this talk is to show in the case where potentials are non-smooth.

Summary: This talk focuses on the Cauchy problem of the Hartree equation for infinite quantum systems. The Strichartz estimates for orthonormal systems play an essential role in this problem. The initial data is given in the Schatten classes, and the orthonormal Strichartz estimates determine the optimal Schatten exponents α. Consequently, when relying solely on deterministic estimates to manage the initial data terms, we cannot construct any solutions for initial data in Schatten classes with exponents greater than α. However, we can go beyond this limitation by introducing a randomization of initial data. In this talk, we will first establish probabilistic Strichartz estimates and then apply them to the Hartree equation. Finally, we obtain local solutions for initial data in bigger Schatten classes than the deterministic Strichartz estimates allow.

Summary: Kato–Yajima smoothing estimates are one of the fundamental results in study of dispersive equations such as Schrödinger equations and Dirac equations. For $d(\geq 2)$-dimensional free Schrödinger equations, optimal constants of smoothing estimates were given by Bez–Saito–Sugimoto (2015). In contrast, optimal constants for free Dirac equations are known only in the 2-dimensional case (Ikoma, 2022). In this talk, we give optimal constants for the 3-dimensional free Dirac equation.

Summary: We consider the Cauchy problem for one-dimensional dispersive equations of KdV type on the torus. Our main new ingredient is the replacement of improved Strichartz estimates with improved bilinear estimates so as to treat the worst resonant interactions. As a result, we obtain the unconditional well-posedness for the generalized KdV equation in $H^s(\mathbb{T})$ for $s > 1/2$. Our result also holds for more general equations whose dispersive operator behaves for high frequencies as a Fourier multiplier with the symbol $i|\xi|^\alpha\xi$ for $1 \leq \alpha \leq 2$. We remark that our methods work for the real line case as well.

Summary: We consider the Cauchy problem of one dimensional dissipative nonlinear Schrödinger equations with a critical power nonlinearity. In this talk, we show that L^2-decay rate obtained in the previous work is optimal in the analytic class.

14:15–16:00

Summary: We consider a 3-dimensional nonlinear Schrödinger equation with average nonlinearity. This is a generalized model of the resonant system of an NLS with a partial harmonic oscillator in terms of nonlinear power. We provide a new proof for the conservation law of kinetic energy and remove the restriction on nonlinearity. Moreover, in the focusing, super-quintic, and sub-nonic cases, we construct a ground-state solution and classify the behavior of the solutions below the ground state. We demonstrate a sharp threshold for scattering and blow-up.

Summary: We consider nonlinear Schrödinger equations with a time-decaying harmonic potential. The nonlinearity is gauge-invariant of the long-range critical order. Kawamoto and Muramatsu show that the equation admits a nontrivial solution that behaves like a free solution with a logarithmic phase correction in the frameworks of both the final state problem and the initial value problem. Also, in the equation without the potential, Hayashi and Naumkin establish the existence of a modified scattering operator. In this talk, we construct a modified scattering operator for our equation by utilizing a generator of the Galilean transformation.

Summary: In this talk,I will report on the lifespan estimates of time-local classical solutions of semilinear wave equations with spatial weights and non-compactly supported data in one space dimension. Lifespan means the maximum existence time of solutions. There are cases where no time-local solution exists due to the spatial weight of the nonlinear term and the decay of the initial data.

Summary: This talk is concerned with global existence of small solutions to a two-speed and three-component system with quadratic nonlinear terms in 3D that so far has fallen beyond the capability of existing techniques. At the price of assuming radial symmetry, we resort to a point-wise estimation approach. The proof of global existence is based on the iteration argument using only weighted sup norms. Our weight functions are useful in observing that gain of time decay occurs in the product of derivatives of two components with different propagation speeds. This gain compensates for a small loss of decay of a certain component. Gain of time decay is observed also for "the tangential derivatives", and we thereby allow for some null forms in the nonlinear terms.

Summary: We consider the Cauchy problem for the viscous nonlinear wave equation. We show the ill-posedness in negative Sobolev spaces of the Cauchy problem for polynomial nonlinearity. In particular, we prove a norm inflation result above the scaling critical regularity in some cases.

37 Mohamed Ali Hamza (Imam Abdulrahman Bin Faisal Univ.)
Yuta Wakasugi (Hiroshima Univ.)
Shuji Yoshikawa (Oita Univ.)
Asymptotic profiles for the Cauchy problem of damped beam equation with two variable coefficients and derivative nonlinearity 10

Summary: We study the asymptotic behavior of solutions to the Cauchy problem of nonlinear damped beam equation with time-dependent coefficients. We give a conjecture of the classification of the asymptotic behavior of solutions depending on the coefficients, and show a partial answer for the case of parabolic-type behavior.

16:15–17:15 Award Lecture for the 2023 MSJ Analysis Prize

Masahito Ohta (Tokyo Univ. of Sci.) ♭ Strong instability analysis of standing waves for nonlinear Schrödinger equations

Summary: A typical equation considered in this talk is the following nonlinear Schrödinger equation (NLS):

$$i\partial_t u = -\Delta u + |x|^2 u - |u|^2 u, \quad (t,x) \in \mathbb{R} \times \mathbb{R}^3.$$

It is known that for any $\omega \in (-3, \infty)$ there exists a unique positive solution (ground state) $\phi_\omega(x)$ of the stationary problem $-\Delta\phi + |x|^2\phi + \omega\phi - |\phi|^2\phi = 0$ in the energy space $X := \{v \in H^1(\mathbb{R}^3) : |x|v \in L^2(\mathbb{R}^3)\}$. A standing wave solution $e^{i\omega t}\phi_\omega(x)$ of (NLS) is said to be stable if for any $\varepsilon > 0$ there exists $\delta > 0$ such that if $\|u_0 - \phi_\omega\|_X < \delta$ then the solution $u(t)$ of (NLS) with $u(0) = u_0$ exists globally and satisfies $\inf\{\|u(t) - e^{i\theta}\phi_\omega\|_X : \theta \in \mathbb{R}\} < \varepsilon$ for all $t \in [0, \infty)$. Otherwise, $e^{i\omega t}\phi_\omega(x)$ is said to be unstable. On the other hand, $e^{i\omega t}\phi_\omega(x)$ is said to be strongly unstable if for any $\varepsilon > 0$ there exists $u_0 \in X$ such that $\|u_0 - \phi_\omega\|_X < \varepsilon$ and the solution $u(t)$ of (NLS) with $u(0) = u_0$ blows up in finite time. In this talk, we will review the strong instability of standing wave solutions for some nonlinear Schrödinger equations.

March 20th (Wed) Conference Room II

10:00–12:00

38 Masahiro Takayama (Keio Univ.)
Tatsuo Iguchi (Keio Univ.)
A priori estimates for solutions to the motion of an inextensible hanging string 15

Summary: We consider the initial boundary value problem to the motion of an inextensible hanging string of finite length under the action of the gravity. In this problem, the tension of the string is also an unknown quantity. It is determined as a unique solution to a two-point boundary value problem, which is derived from the inextensibility of the string together with the equation of motion, and degenerates linearly at the free end. We derive a priori estimates for solutions to the initial boundary value problem in weighted Sobolev spaces under a natural stability condition. The necessity for the weights results from the degeneracy of the tension. Uniqueness of solution is also proved.

39 Taichi Eguchi (Waseda Univ.)
The energy equality of the magnetohydrodynamic system in the framework of Lorentz–Besov spaces 15

Summary: We find a new criterion of the Lorentz–Besov spaces to establish the energy equality of the incompressible magnetohydrodynamic (MHD) system in $\mathbb{R}^3$. In the Navier–Stokes equations, Cheskidov–Luo (2020) obtained the energy equality if the weak solution belongs to the class of the Lorentz–Besov spaces that are not contained in the classical Onsager space $L^3(0,T;B^{1/3}_{3,\infty})$. Motivated by Cheskidov–Luo (2020), we obtain a new criterion of the Lorentz–Besov spaces to establish the energy equality of the MHD system. We may regard our criterion on the MHD system as a generalization of the criterion of Cheskidov–Luo (2020).

40 Tim Binz (TU Darmstadt)
Yoshiki Iida (Waseda Univ.)
Uniqueness of weak solutions to the primitive equations in some anisotropic spaces 15

Summary: We consider the three dimensional primitive equations for large scale oceanic and atmospheric dynamics. The uniqueness of weak solutions to the system is still open. In this talk, based on regularity in terms of Besov spaces, we give a new class in which the uniqueness holds, and compare with the known result by Tachim Medjo (2010). The proof of our result is basically relied on Littlewood–Paley theory argument.

41 Zhongyang Gu (Univ. of Tokyo)
Xin Hu (Univ. of Tokyo)
Tsuyoshi Yoneda (Hitotsubashi Univ.)
Anomalous smoothing effect on the incompressible Navier–Stokes–Fourier limit from Boltzmann with periodic velocity 10

Summary: Adding a nontrivial term composed from a microstructure, we prove the existence of a global-in-time weak solution, whose enstrophy is bounded for all the time, to an incompressible 3D Navier–Stokes–Fourier system for arbitrary initial data. It cannot be expected to directly derive the energy inequality for this new system of equations. The main idea is to employ the hydrodynamic limit from the Boltzmann equation with periodic velocity and a specially designed collision operator.

42 Yuta Koizumi (Waseda Univ.)
Convergence of approximating solutions of the Navier–Stokes equations in higher ordered Sobolev norms 15

Summary: We show that the approximating solutions $\{u_j\}_{j=0}^{\infty}$ of the Navier–Stokes equations constructed by Kato (1984) with the initial data $u(0) \in L^n_\sigma(\mathbb{R}^n)$ converge to the local strong solution u in the topology of $W^{k,q}(\mathbb{R}^n)$ for all $k \in \mathbb{N}$ provided the convergence in the scaling invariant norm in $L^q(\mathbb{R}^n)$ with the time weight holds. As an application of our convergence, it is clarified that the approximation of the pressure is established in $W^{k+1,q}(\mathbb{R}^n)$.

43 Tomoyuki Nakatsuka (Matsuyama Univ.)
Existence of time-periodic strong solutions to the Navier–Stokes equation in the whole space 15

Summary: In this talk, the existence of time-periodic strong solutions to the Navier–Stokes equation in $\mathbb{R}^n$ is established under a suitable smallness condition on the external force. Our analysis is based on splitting periodic solutions into steady and purely periodic parts. One advantage of this decomposition is the availability of slightly more regularity in time of the purely periodic part. We apply this property to construct time-periodic solutions of the Navier–Stokes equation with information on the classes of their steady and purely periodic parts.

14:15–15:15

44 Erika Ushikoshi (Yokohama Nat. Univ. / Osaka Univ.)
Takahiro Okabe (Osaka Univ.)
Haru Kanno (Yokohama Nat. Univ.)
Helmholtz–Weyl decomposition on a time dependent domain for time periodic Navier–Stokes flow 12

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

45 Yoshiaki Teramoto
Takaaki Nishida (Kyoto Univ.)
Decay of solutions to the initial boundary value problem of the Stokes system in the halfspace 15

Summary: The initial boundary value problem of the Stokes system in the 3D halfspace is considered. The boundary condition subject on $x_3 = 0$ is the balance of stress. Under certain conditions on the initial value we derive the rate of decay in time of L^2 norm of solutions to this problem. The solutions to an auxiliary boundary value are estimated by residue analysis.

46 Jou-chun Kuo (Waseda Univ.)
Yoshihiro Shibata (Waseda Univ.*)
L_1 approach to the compressible viscous fluid flows in the half-space 15

Summary: This talk is devoted to proving the local well-posedness for the Navier–Stokes equations describing the isotropic motion of the compressible viscous fluid flows in the half-space with non-slip boundary conditions. We construct a unique strong solution in the L_1 in time and $B^{s+1}_{q,1} \times B^s_{q,1}$ in space maximal regularity class. Here, $1 < q < \infty$ and $-1 + N/q \leq s < 1/q$, where $N \geq 2$ is the space dimension. The approach is by means of the analytic semigroup theory and we use Lagrange transformation in order to eliminate the convection term $\mathbf{v} \cdot \nabla \rho$.

15:30–16:30 Talk Invited by Functional Equations Section

Itsuko Hashimoto
(Kanazawa Univ./Osaka Metro. Univ.)
Inflow and outflow problem on radially symmetric solution for fluid equation

Summary: We consider the boundary value problem of radially symmetric solutions for the multi-dimensional Burgers equation and compressible Navier–Stokes equation on the exterior domain, where the boundary and far field conditions are prescribed. In this talk, we first consider the existence of radially symmetric stationary solutions for both inflow and outflow problems. We also comment for the asymptotic stability of the obtained stationary solutions for both Burgers equation and compressible Navier–Stokes equation. Next we consider the inviscid limit problem of the radially symmetric stationary solutions to compressible Navier–Stokes equation. In this consideration, we investigate the corresponding Euler equation and boundary layer equation and their relations. Finally we clear the difference of the inviscid limit state between Inflow and outflow problem.

Real Analysis

March 19th (Tue) Conference Room VI

9:30–12:00

1 Yoshifumi Ito — Definition and existence theorem of the axiomatic set theory I ····· 15

Summary: In this lecture, we give the complete system of axioms of the set theory I.
This is the combined system of axioms ZFC and the axiom of the ordinal numbers and the axiom of the transcendental construction. Here the system of axioms of the set theory I is given in the new formulation.
We prove the existence theorem of the set theory I by constructing its model.
This is the final and complete solution of the problem of the axiomatic set theory.

2 Yoshifumi Ito — Definition and existence theorem of Euclidean geometry ····· 10

Summary: In this lecture, we define Euclidean geometry and prove its existence theorem by using the axiomatic method.
In the present time, we know the complete set theory.
Thereby we can define the plane in the exact sense. Thus we use the notion of the point, the straight line in the plane.
Thereby we give the complete solution of the problem of the foundation of Euclidean geometry.

3 Toshiharu Kawasaki (Tamagawa Univ./Chiba Univ./Chiba Univ.) — On the structure of space of all extended integrable functions, II ····· 15

Summary: In this talk, we expand the concept of integration and further discuss the structure of space of extended integrable functions.

4 Ryoji Fukuda (Oita Univ.)
Aoi Honda (Kyushu Inst. of Tech.)
Yoshiaki Okazaki (Fuzzy Logic Systems Inst.) — Uniform topogies on $\mathcal{L}_0$ with respect to a non-additive measure ····· 15

Summary: Let $\mathcal{L}_0$ be a space of all measurable functions defined on a non-additive measure space (Ω, μ). We discuss the uniform topology on $\mathcal{L}_0$, which is given by entourages $V_\varepsilon = \{(f, g) \mid \mu(|f - g| > \varepsilon) \leq \varepsilon\}$ $(\varepsilon > 0)$. We give some equivalent conditions for this uniformness and these also equivalent conditions for the uniformness of the measure algebra, which is naturally included in $\mathcal{L}_0$.

5 Satoshi Yamaguchi (Ibaraki Univ.) — Bi-preduals of generalized Morrey spaces with variable growth condition ····· 15

Summary: Let $L_{p,\lambda}(\mathbb{R}^d)$ be the Morrey space. In 2015 Rosenthal and Triebel gave the proof that

$$\left(\overline{C^\infty_{\mathrm{comp}}(\mathbb{R}^d)}^{L_{p,\lambda}(\mathbb{R}^d)}\right)'' = L_{p,\lambda}(\mathbb{R}^d).$$

We consider generalized Morrey spaces $L_{p,\phi}(\mathbb{R}^d)$ with variable growth function $\phi : \mathbb{R}^d \times (0, \infty) \to (0, \infty)$. In this talk we extend the duality to $L_{p,\phi}(\mathbb{R}^d)$. Moreover, we characterize $\overline{C^\infty_{\mathrm{comp}}(\mathbb{R}^d)}^{L_{p,\phi}(\mathbb{R}^d)}$ by the mean value of functions in $L_{p,\phi}(\mathbb{R}^d)$.

6 Ryota Kawasumi
Masahiro Ikeda (RIKEN)
Isao Ishikawa (Ehime Univ.)
A characterization of boundedness of composition operators on Orlicz–Morrey spaces 15

Summary: In this talk, we introduce our recent result about the necessary condition on boundedness of composition operators to the Orlicz–Morrey space, which extends the result about the Morrey space by Hatano, Ikeda, Ishikawa and Sawano in 2021. The composition operator is also called the Koopman operator and has been applied to data science and dynamical system extensively. To show the necessary condition we prove the boundedness of the composition operator from a Orlicz–Morrey space to itself, which was introduced in MSJ Autumn Meeting 2023 at Tohoku University. Next, we show that the product of the singular values of a Jacobi matrix is a positive constant. Finally, we find a function in Orlicz–Morrey space satisfying the previous step.

7 Hiroyasu Mizuguchi (Kansai Univ.)
generalized relation of Pythagorean orthogonality by two-dimensional norms 15

Summary: The orthogonality relation in inner product spaces is simple, fruitful and interesting. When moving to normed spaces, we have many possibilities to extend this notion. Pythagorean orthogonality is one of them. The condition of Pythagorean orthogonality can be expressed by usual ℓ_2-norm $\|\cdot\|_2$ on $\mathbb{R}^2$. So we consider the generalized relation of Pythagorean orthogonality by two-dimensional norms. Similar to Pythagorean orthogonality or other orthogonalities, we obtain three existence theorems on this generalized relation.

8 Sachiko Atsushiba
(Tokyo Woman's Christian Univ.)
Approximation of fixed points of monotone nonexpansive-type mappings 15

Summary: In this talk, we prove weak and strong convergence theorems for monotone nonexpansive-type mappings. We also study the asymptotic behavior of orbits of some nonlinear mappings.

14:15–16:15

9 Tsuyoshi Yoneda (Hitotsubashi Univ.)
Fourier uncertainty principle and mathemetial analysis on machine learning 15

Summary: Reservoir Computing (RC) is a type of recursive neural network (RNN), and there can be no doubt that the RC will be more and more widely used for building future prediction models for time-series data, with low training cost, high speed and high computational power. In this talk, we clarify hidden structures of input and recurrent weight matrices in RC neural networks, and show that such structures are closely related to the Fourier uncertainty principle.

10 Emu Kondo (Nara Women's Univ.)
Shinya Moritoh (Nara Women's Univ.)
Weighted Hardy's inequality for nonincreasing functions and the doubling condition for weights 15

Summary: The aims of my talk are to state a limiting case of weighted Hardy's inequality and to give a simple proof of it by using the doubling condition for weights.

11 Mai Harada (Kanagawa Univ.)
Noriaki Yamazaki (Kanagawa Univ.)
On the existence of time periodic solutions for the SIRS model with the seasonally-dependent transmission rate 15

Summary: We consider periodic problems for SIRS models with the seasonally-dependent transmission rate. Then, we prove the existence of time-periodic solutions to our problems.

12 Naotaka Ukai (Chiba Univ.)
Daiki Mizuno (Chiba Univ.)
Ken Shirakawa (Chiba Univ.)
Harbir Antil (George Mason Univ.)
Anisotropic energy gradient system associated with image denoising process with orientation adjustment 15

Summary: In this talk, we consider a gradient system of a non-convex functional, based on a governing energy for anisotropic image denoising, as developed in [Berkels et al., SFB 611, 2006]. A characteristic of our gradient system lies in the nonstandard part $\partial\gamma \circ R$, which consists of the (set-valued) subdifferential $\partial\gamma$ of an anisotropic metric $\gamma \in W^{1,\infty}(\mathbb{R}^2)$, and a rotation matrix $R \in C^\infty(\mathbb{R}; \mathbb{R}^{2\times 2})$. This part plays a key role in the orientation adjustment within the image denoising process. Under appropriate settings, we will provide some mathematical observations for the gradient system using the time-discretization approach.

13 Daiki Mizuno (Chiba Univ.)
Ken Shirakawa (Chiba Univ.)
Pseudo-parabolic phase-field model of grain boundary motion with solidification effect 15

Summary: In this talk, we deal with a coupling system consisting of Allen–Cahn equation with singular type diffusion and Kobayashi–Warren–Carter type system with pseudo-parabolicity. This system is based on the ϕ-η-θ model, which is proposed by [Kobayashi, RIMS Kokyuroku, 1210, 68–77 (2001)] as a mathematical model of grain boundary motion with solidification. In this system, the main characteristics are the strong singularity in the diffusions and variable-dependent mobilities, and these characteristics make it difficult to guarantee important mathematical properties, including the uniqueness of solutions. To address these problems, we consider a system modified by introducing pseudo-parabolic structure, which delivers better smoothness to the solution. Based on the above, we set our goal to discuss solvability, uniqueness, and regularity results of the system.

14 Noriaki Yamazaki (Kanagawa Univ.)
Pierluigi Colli (Univ. of Pavia)
M. Hassan Farshbaf-Shaker (WIAS)
Ken Shirakawa (Chiba Univ.)
Approximate methods for optimal control problems of the Frémond model for shape memory alloys 15

Summary: In this talk, we consider optimal control problems for the one-dimensional Frémond model for shape memory alloys. This model is constructed in terms of basic functionals like free energy and pseudo-potential of dissipation. The state problem is expressed by a system of partial differential equations involving the balance equations for energy and momentum. We prove the existence of an optimal control that minimizes the cost functional for a nonlinear and nonsmooth state problem. Moreover, we show the necessary condition of the optimal pair by using optimal control problems for approximating systems.

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

Shin-ya Matsushita (Akita Pref. Univ.) Fixed point algorithms and their applications

Summary: The main purpose of this talk is to present some current progress about the fixed point algorithms. This talk consists of two parts. The first part deals with the theory of nonexpansive mapping in Hilbert spaces and some fixed point algorithms. The second part focuses on the many different interpretations of nonexpansve mappings and algorithms, and describes their connections to many other topics in optimization and applied mathematics.

March 20th (Wed) Conference Room VI

9:30–12:00

15 Yoshiho Akagawa (Gifu Nat. Coll. of Tech.)
Kazunori Matsui (Seikei Univ.)
Nonnegativity of the threshold function in an elastoplasticity model based on quasi-variational inequality 10

Summary: This paper discusses the nonnegativity of the threshold function in the elastoplasticity model based on quasi-variational inequality. In the previous work, the existence of a solution is proved under the assumption that the threshold function is strictly positive. In physical terms, it is natural that the threshold function is nonnegative. Therefore, it is meaningful to discuss the well-posedness under the weaker assumption. To prove the existence of a solution to the elastoplasticity model, we construct the concrete projection of the constraint set.

16 Hana Kakiuchi (Japan Women's Univ.)
Toyohiko Aiki (Japan Women's Univ.)
Solvability of free boundary problems for the parabolic equation system 15

Summary: We consider a free boundary problem for a system of two parabolic equations on the one-dimensional space interval. The problem has been proposed as a mathematical model for a baking bread process in a hot oven. In the modeling we assume that the region consists of crumb, crust, and the evaporation front. The unknown functions of the problems are the position of the evaporation front which is regarded as the free boundary, the temperature field, and the mass distribution. Here, the temperature field and the mass distribution satisfy the standard parabolic equations in the crumb and crust regions, which are separated by the free boundary. We discuss about solvability of the approximation problem in the present talk.

17 Akiko Morimura (Japan Women's Univ.)
Toyohiko Aiki (Japan Women's Univ.)
Convergence of approximation solutions obtained by the finite volume method in moisture transport model 15

Summary: We consider the initial boundary value problem for nonlinear parabolic equations with non-monotone boundary conditions. The problem was already investigated as a mathematical model for moisture transport phenomena in porous materials. In our recent work, we have established existence and uniqueness of weak solutions by the Schauder fixed point theorem and the dual equation method, respectively. Since the proof for the existence is not constructive, it is important to show convergence of numerical solutions. In the present result, by applying the finite volume method, we approximate the partial differential equations and prove that the sequence of approximation solutions converges to the weak solution. The key to the proof is a compact theorem for discretized functions.

18 Chiharu Kosugi (Yamaguchi Univ.)
Toyohiko Aiki (Japan Women's Univ.)
Existence of strong solutions for the energy conservation system representing motions of incompressible elastic curve on the plane 15

Summary: In this talk, we consider the energy conservation system for the beam equation with the nonlinear stress function having singularity. In the previous meeting, we established existence and uniqueness of the weak solution to this problem. Also, existence and uniqueness of the solution for the energy dissipative system were already obtained. We note that the dissipative property is characterized by the viscosity coefficient. In this talk by showing that the sequence of the strong solution of the conservation system as the viscosity coefficient tends to 0, we prove the existence of the solution to the conservation system. In our proof the well-known compact theorem plays an important role.

Summary: This talk deals with a parabolic–parabolic Keller–Segel system with density-dependent sensitivity. In a Keller–Segel system with logistic source, Lankeit (2021) constructed global classical solutions for initial data in $L^1 \times W^{1,2}$. The purpose of this talk is to show existence of global classical solutions for initial data in $L^2 \times (W^{2,q} \cap W^{1,2})$ with some $q > 1$ in a parabolic–parabolic Keller–Segel system with density-dependent sensitivity.

Summary: We consider boundedness and finite-time blow-up in a chemotaxis system with flux limitation. When there is no logistic term, Tello (Comm. Partial Differential Equations; 2022; 47; 307–345) obtained a condition such that finite-time blow-up occurs, however, the condition could still be improved. We improved the condition for finite-time blow-up in the system within the framework of weak solutions. Also, we established boundedness and finite-time blow-up of weak solutions to a chemotaxis system with flux limitation and logistic source.

Summary: This talk deals with a fully parabolic chemotaxis system with nonlocal source. In the case that the second equation is simplified by the elliptic one, global existence and boundedness have already been obtained by Bian, Chen and Latos (Nonlinear Anal.; 2018; 176; 178–191). The purpose of this talk is to derive global existence and boundedness in the case that the second equation is parabolic.

Summary: There are some studies on nonlocal-to-local convergence of evolution equations. For example, Davoli–Scarpa–Trussardi (2021) and Abels–Terasawa (2022) have studied nonlocal-to-local convergence of Cahn–Hilliard equations. On the other hand, regarding phase field systems, in the case of a conserved phase field system related to entropy balance, nonlocal-to-local convergence has already been confirmed (K. (2022)). In this talk, we focus on convergence of a nonlocal phase field system with inertial term to a parabolic-hyperbolic phase field system.

Summary: We consider a Cauchy problem of a quasi-variational structural evolution inclusion on an abstract real Hilbert space. The main purpose of this talk is to establish the abstract perturbation theory for evolution inclusions on real Hilbert spaces with quasi-variational structures by showing the existence of strong solutions on any finite interval, not strong global-in-time solutions. Moreover, it is applicable to the tumor invasion system with quasi-variational degenarate diffusion for the movement of tumor cells, which is treated in the paper, Quasi-variational Structure Approach to Systems with Degenerate Diffusions, Rendiconti del Seminario Matematico della Universita di Padova, 147 (2022), 169–235.

14:15–15:40

24 Ken Shirakawa (Chiba Univ.)
Daiki Mizuno (Chiba Univ.)
Harbir Antil (George Mason Univ.)
Optimal control problems governed by pseudo-parabolic gradient systems for KWC type energies · · · · · 15

Summary: In this talk, we consider a class of optimal control problems governed by KWC type systems with pseudo-parabolicity. Here, KWC type system means a gradient system associated with KWC energy, which was a free-energy of grain boundary motion proposed by [Kobayashi–Warren–Carter, Physica D, 140 (2000)]. In this study, we should be note that our state system admits a unique solution, even under unknown-dependent mobilities. Indeed, in previous works, unknown-dependent mobilities brought significant difficulties in the observations of uniqueness and linearization for the KWC type system. In view of this, we set the objective of this talk to establish a mathematical theory for optimization problems governed by the KWC type system. The main focuses of this talk will be on the existence of the optimal control, and the necessary conditions for the optimal control.

25 Masahiro Ikeda (RIKEN/Keio Univ.)
Shun Uchida (Oita Univ.)
Takeshi Fukao (Ryukoku Univ.)
An approximation of evolution equation with clique expansion of hypergraph Laplacian · · · · · 15

Summary: Hypergraph G is the triplet consisting of a finite set V, a family $E \subset 2^V$, and $w : E \to (0, \infty)$. We are concerned with an ODE governed by some nonlinear set-valued operator defined on $\mathbb{R}^V$, which is called "hypergraph Laplacian". This ODE can be interpreted as a model of "heat" diffusion in the network represented by hypergraph. In this talk, we consider the case where the heat at some vertices of the hypergraph is given, and discuss the existence of solution and the continuous dependence of solution on given data.

26 Takanori Ebata (Niigata Univ.)
Hiroki Ohwa (Niigata Univ.)
Continuous dependence on the initial and flux functions for entropy solutions of general balance laws · · · · · 15

Summary: We consider the continuous dependence on the initial and flux functions for the entropy solutions to the Cauchy problem of general balance laws. In general, for the proof, it is necessary to assume that the flux and source functions are continuously differentiable. However, without the assumption that the functions are continuously differentiable, under only the assumption that the functions are locally Lipschitz continuous, we prove the continuous dependence on the initial and flux functions for the entropy solutions.

27 Kota Kumazaki (Kyoto Univ. of Edu.)
Adrian Muntean (Karlstad Univ.)
Large-time behavior of a solution to a multiscale model · · · · · 15

Summary: In this talk, we consider a multiscale model describing nonlinear phenomena in porous materials. This model consists of a diffusion equation for the relative humidity distributed in materials and a free boundary problem describing the water-filling process in microscopic pockets. We consider each microscopic pocket as a one-dimensional interval and correspond the interval to each point of materials. In the previous result, we have proved the existence and uniqueness of a globally-in-time solution to the model. In this talk, we discuss the large-time behavior of a solution and investigate the steady state in each pocket.

28 Takeshi Fukao (Ryukoku Univ.)
Pierluigi Colli (Univ. of Pavia)
Allen–Cahn equations with dynamic boundary conditions of fourth-order · · · · · 15

Summary: In this study, we consider the initial and boundary value problem of the second-order parabolic Allen–Cahn equation with the dynamic boundary condition of fourth-order Cahn–Hilliard type. As an approximation problem, we consider an evolution equation governed by a subdifferential and discuss the limiting procedure approaching the target problem.

15:45–16:45 Award Lecture for the 2023 MSJ Analysis Prize

Naoki Tanaka (Shizuoka Univ.) Abstract theory for evolution equations

Summary: This presentation provides an overview of recent advances in abstract theory for evolution equations, with a focus on topics related to the abstract quasi-linear theory pioneered by Kato. The significant theme is to explore strategies for weakening or eliminating stability, continuity with respect to the time variable, and denseness of domains of operators imposed in Kato's theory.

The discussion will begin by relaxing the strong continuity condition on the time variable, and our result obtained under Carathéodory's condition will be explained. Subsequently, a new concept of stability will be proposed, and Kōmura's conjecture regarding the well-posedness of an abstract degenerate wave equation will be discussed.

Future topics, such as the well-posedness of an abstract quasi-linear evolution equation governed by a family of non-densely defined operators in a reflexive Banach space and the approximate solvability of differential equations in a complete metric space, will be outlined. The former necessitates investigating a family of operators that do not satisfy the known stability conditions. The latter is related not only to mutational analysis but also to QDE theory, which is associated with product formulas for semigroups of operators.

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

Hirotoshi Kuroda (Hokkaido Univ.) On the behaviour of solutions to the fourth order total variation flow equation

Summary: We consider the fourth order total variation flow equation. In the case of the second order, many results are known. Typical results are presented for comparison with the case of the fourth order. We characterize the solution in terms of what is called the Cahn–Hoffman vector field for the fourth order case. Next, we introduce a notion of calibrability of a set in our fourth order setting to explain the behaviour of solutions. This notion is related to whether a characteristic function preserves its form throughout the evolution. These concepts are used to discuss the relationship between the behaviour of solutions and spatial dimensions and boundary conditions.

Functional Analysis

March 17th (Sun) Conference Room VII

9:30–11:00

1 Shuji Watanabe (Gunma Univ.) The Bogoliubov transformation and the gap equation in the BCS model of superconductivity with external magnetic field 15

Summary: Under a simple condition, we derive the Bogoliubov transformation and the gap equation in the BCS model of superconductivity with external magnetic field.

2 Itaru Sasaki (Shinshu Univ.)
Yasumichi Matsuzawa (Shinshu Univ.)
Shinnosuke Izumi (Shinshu Univ.)
Kouta Imura
(Nagano Pref. Fujimi High School)
On the radius of convergence of the ground state in a pair interaction model 15

Summary: A year ago at the Mathematical Society of Japan we reported that the ground state and ground state energy of a pair interaction model are analytic with respect to the coupling constant. However, it was not enough to estimate the coupling constants such that the Maclaurin series converges. We have improved the proof and extended it to what we consider to be the best possible value.

3 Yukihide Tadano (Tokyo Univ. of Sci.)
Shu Nakamura (Gakushuin Univ.)
Keita Mikami (RIKEN)
Continuum limit for Laplace operators on lattices 15

Summary: We consider Laplace operators defined on lattices with mesh size h and those operators with perturbations of potentials. We prove that the above operators converge to certain elliptic operators in the continuum limit from the view point of spectral theory. We obtain as an application the asymptotic behavior of the spectra and eigenfunctions of the above operators.

4 Fumio Hiroshima (Kyushu Univ.) Positivity improving for the Nelson model with nonzero total momenta 15

Summary: It is shown that the strongly continuous semigroup generated by the Nelson Hamiltonian with zero total momentum zero is positivity improving. It is also shown that the strongly continuous semigroup generated by the Nelson Hamiltonian with nonzero total momentum zero is also positivity improving. Moreover the similar results are obtained for the relativistic Nelson Hamiltonian.

5 Kazuyuki Wada (Hokkaido Univ. of Edu.) Exponential decay for eigenfunctions associated with discrete spectra of quantum walks 15

Summary: In this talks, we show that eigenfunctions associated with discrete spectra of quantum walks posesses exponential decay property. First, we estabsish the abstract theorem for unitary operators whose eigenvector associated with discrete spectra has exponential decay property. We consider the d-dimensional 2d-state quantum walks as an application.

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

Artbazar Galtbayar (National Univ. of Mongolia) The L^p-boundedness of the wave operators for bi-Schrödinger operators on $\mathbb{R}^4$

Summary: We prove that the wave operators for the fourth order Schrödinger operator $\Delta^2 + V(x)$ in $\mathbb{R}^4$ are bounded in $L^p(\mathbb{R}^4)$ for the set of p's of $(1, \infty)$ depending on the kind of spectral singularities of H at zero which can be described by the space of bounded solutions of $(\Delta^2 + V(x))u(x) = 0$.

March 18th (Mon) Conference Room VII

9:30–11:00

6 Temma Aoyama (Univ. of Tokyo) Deformation of heat kernels and Wiener measures from the viewpoint of BenSaïd–Kobayashi–Ørsted's Laguerre semigroup theory ····· 15

Summary: The BenSaïd–Kobayashi–Ørsted theory gives a generalization of the theory of metaplectic representations, and metaplectic representations relate to a classical harmonic analysis including heat flow. From this perspective, we may consider a deformation of classical heat theory. In this talk, we examine which basic properties of the classical heat theory can be generalized and, by using these properties, we discuss a construction of a deformed Wiener measure.

7 Toshihisa Kubo (Ryukoku Univ.) Bent Ørsted (Aarhus Univ.) The classification and construction of projectively covariant differential operators on $\mathbb{RP}^2$ ····· 15

Summary: In contrast to conformal geometry, in which there are a large number of works on conformally covariant differential operators, only a few results are known for projectively covariant differential operators. For instance, the classification of such differential operators for $\mathbb{RP}^2$ seems not in the literature, although the case for $\mathbb{RP}^1$ was done by G. Bol in 1949. In this talk, we shall discuss the classification and explicit construction of projectively covariant differential operators on $\mathbb{RP}^2$.

8 Kazuki Kannaka (RIKEN) Proper actions of semisimple Lie groups and the Hurwitz–Radon number I ····· 15

Summary: Let G/H be a homogeneous space of reductive type and L a reductive Lie subgroup of G. We consider the natural left action of L on G/H. When H is non-compact, the properness of this action often imposes serious constraints on L.
In this talk, we introduce a certain condition for classical G/H (of possibly higher corank). Then I would like to discuss a type of theorem stating that there are almost no semisimple Lie subgroups L that act properly on G/H satisfying this condition. This talk is based on a joint work with Koichi Tojo (RIKEN).

9 Koichi Tojo (RIKEN) Proper actions of semisimple Lie groups and the Hurwitz–Radon number II ····· 15

Summary: Let $G \subset GL(N, \mathbb{C})$ be a classical Lie group and G/H a homogeneous space satisfying "very even condition". We show that for fixed $n \in \mathbb{N}$, the condition that G/H admits a $Spin(n, 1)$ proper action can be described by the Hurwitz–Radon number (or its analogues) of the size N. This talk is based on a joint work with Kazuki Kannaka (RIKEN).

10 Atsumu Sasaki (Tokai Univ.) Weyl group of pseudo-Riemannian symmetric space ····· 15

Summary: It is well-known that the Weyl group of a non-compact real semisimple Lie group coincides with the Weyl group of the restricted root system of its Lie algebra. This talk considers the Weyl group $W(G/H)$ of pseudo-Riemannian symmetric space G/H. We show that $W(G/H)$ is the same as the Weyl group of the Lie group associated to G/H.

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

Taito Tauchi (Aoyama Gakuin Univ.) Relationship between multiplicities of induced representations and orbit decomposition on real and complex flag varieties

Summary: Let G be a real reductive algebraic group and H its real reductive algebraic subgroup. It was proved by T. Kobayashi and T. Oshima that the finiteness of the multiplicities of irreducible G-representations in $C^\infty(G/H)$ is equivalent to the real sphericity of G/H. Moreover, they also proved that the uniform boundedness of the multiplicities in $C^\infty(G/H)$ is equivalent to the sphericity of $G_{\mathbb{C}}/H_{\mathbb{C}}$, where $G_{\mathbb{C}}$ and $H_{\mathbb{C}}$ are complexifications of G and H, respectively. These theorems indicate a relationship between the multiplicities in $C^\infty(G/H)$ and the orbit decomposition of the real and complex full flag varieties with respect to the action of H and $H_{\mathbb{C}}$, respectively. In this talk, a variant of this relationship will be discussed by replacing the full flag varieties with partial flag varieties.

March 19th (Tue) Conference Room VII

9:30–11:30

11 Keiichi Watanabe (Niigata Univ.) On gyro operations in open balls of complex inner product spaces · · · · 15

Summary: We present some results on structures which should be called as Moebius or Einstein gyrovector spaces. They are introduced into an open balls centered at the origin of complex inner product spaces.

12 Osamu Hatori (Niigata Univ.*)
Toshikazu Abe (Ibaraki Univ.) A Mazur–Ulam theorem on a GGV and its application · · · · · · · · · · · · 15

Summary: We show a Mazur–Ulam theorem on a GGV and a revised proof. As an application, we show a rather short proof of a known result about a characterization of the Thompson isometry on the positive cone of the positive invertible elements in a unital C^*-algebra.

13 Michiya Mori (Univ. of Tokyo) On the Scottish Book Problem 155 by Mazur and Sternbach · · · · · · · · · 15

Summary: Problem 155 of the Scottish Book asks whether every bijection $U\colon X \to Y$ between two Banach spaces X, Y with the property that, each point of X has a neighborhood on which U is isometric, is globally isometric on X. We prove that this is true under the additional assumption that X is separable and the weaker assumption of surjectivity instead of bijectivity.

14 Yuki Seo (Osaka Kyoiku Univ.) On numerical radius inequalities related to geometric means · · · · · · · · · 15

Summary: In this talk, we show numerical radius inequalities releted to geometric means of real power for positive invertible operators, which estimates the upper and lower bounds of the α-geometric means in terms of the generalized Kantorovich constant.

15 Masatoshi Ito (Maebashi Inst. of Tech.) Inequalities among the weighted Heinz mean and related ones · · · · · · · 15

Summary: Recently Furuichi, Minculete and Moradi got an improvement of the weighted arithmetic-logarithmic-geometric mean inequality. In this talk, as an extension of their result, we obtain inequalities among the weighted Heinz mean and related ones. Our approach is to consider the notion of a transpose symmetric path of weighted means.

16 Hiroyuki Osaka (Ritsumeikan Univ.)
Mohsen Kian (Univ. of Bojnord)
Mohammad Sal Moslehian (Ferdowsi Univ. of Mashhad) On characterization of matrix monotone decreasing functions · · · · · · · · 15

Summary: Relating to finding possible upper bounds for the probability of error for discriminating between two quantum states, it is well-known that
$\mathrm{tr}(A+B) - \mathrm{tr}|A-B| \le 2\mathrm{tr}(f(A)g(B))$
holds for every positive-valued matrix monotone function f, where $g(x) = x/f(x)$, and all positive definite matrices A and B. In this talk, we present a characterization of matrix monotone decreasing functions based on a matrix version of the above inequality.

17 Takeaki Yamazaki (Toyo Univ.)
Hiroyuki Osaka (Ritsumeikan Univ.) The induced Aluthge sequence of compact operators · · · · · · · · · · · · · · · 15

Summary: We shall introduce convergence properties of iteration of the induced Aluthge transforms. In this talk, we shall consider compact, AN and AM operators.

14:15–15:45

Summary: In 1988, Haagerup and Størmer conjectured that any pointwise inner automorphism of a type III_1 factor is a composition of an inner and a modular automorphism. We study this conjecture and prove that any type III_1 factor with trivial bicentralizer indeed satisfies this condition. In particular, this shows that Haagerup and Størmer's conjecture holds in full generality if Connes' bicentralizer problem has an affirmative answer. Our proof is based on Popa's intertwining theory and Marrakchi's recent work on relative bicentralizers.

Summary: We generalize Ocneanu's ADE inter-Dynkin connection systems to the case of an arbitrary finite depth subfactor with its maximal atlas. We also discuss how to determine the intermediate subfactor lattice of an irreducible subfactor arising from an irreducible bimodule in the maximal atlas. Kawahigashi's "Quantum Galois correspondence" and "a characterization of a finite-dimensional commuting square producing a subfactor of finite depth" play a key role in this generalization.

Summary: KK-theory gives a tool to understand the morphisms of operator algebras and if the K-groups of the operator algebras are finitely generated one has a duality for the KK-groups which is called the Spanier–Whitehead K-duality. Many variants of this duality are studied in the context of the Poincare duality, Paschuke's duality and the dual algebras due to N. Higson. In this talk, I would like to talk about some categorical description of this duality and its application to the theory of extensions of C*-algebras. I will explain how to understand a duality of extensions of C*-algebras introduced by K. Matsumoto from the viewpoint of the Spanier–Whitehead K-duality.

Summary: The Razak–Jacelon algebra $\mathcal{W}$ is the simple separable nuclear monotracial $\mathcal{Z}$-stable C*-algebra which is KK-equivalent to $\{0\}$. We say that an action γ of a finite group on $\mathcal{W}$ is $\mathcal{W}$-absorbing if there exist a simple separable nuclear monotracial C*-algebra A and an action α on A such that γ is conjugate to $\alpha \otimes \mathrm{id}_{\mathcal{W}}$. In this talk, we shall show a classification theorem for certain outer $\mathcal{W}$-absorbing actions of finite abelian groups.

Summary: This talk is about an operator theoretic aspect of Coarse Geometry. Every operator on (the ℓ_2 space on) a uniformly locally finite metric space X that is approximable by finite-propagation operators is quasi-local. Since introduced by J. Roe in 90s, it has been questioned whether the converse also holds true. It is indeed the case, by Spakula and Zhang's theorem (2018), if the metric space X is sufficiently nice (namely, satisfying Yu's property A). In this talk, I will report that the converse does not hold if the metric space X contains a sequence of expanders.

16:00–17:00 Talk Invited by Functional Analysis Section

Takuya Takeishi (Kyoto Inst. Tech.) C*-algebras constructed from number fields and related complete invariants of number fields

Summary: The study of C*-algebras from number theory originates from the work of Bost and Connes, but today there are several other known constructions. The interesting point is that for certain classes of C*-algebras from number theory, it is possible to show that those C*-algebras are isomorphic if and only if original fields are isomorphic. In this talk, we summarize those kind of rigidity results. As a consequence of rigidity results, we can see that the topological full groups of several groupoids from number theory are complete invariants of number fields. We summarize recent developments on the homology of the topological full group for a certain class.

Statistics and Probability

March 17th (Sun) Conference Room Ⅲ

9:30–11:40

1 Kiyoiki Hoshino (Osaka Metro. Univ.) Characterization of the stochastic integral by the Riemann sum ····· 15

Summary: We consider the Riemann sum of the same type we introduced at the MSJ autumn meeting in 2020 and discuss approximation and characterization of the stochastic integral with respect to a local martingale by the Riemann sum. We extend the preceding result given at the meeting mentioned above mainly in the following respect: (1) on the weight measures defining the Riemann sum, (2) on the continuity of the integrator and (3) on the uniform Riemann approximation of the stochastic integral.

2 Kosuke Yamato (Univ. of Tsukuba), Kei Noba (Inst. of Stat. Math.) Existence of quasi-stationary distributions of standard processes with no negative jumps ····· 15

Summary: I will talk about the existence of quasi-stationary distributions for standard processes with no negative jumps killed at the boundaries. Quasi-stationary distributions are a kind of equilibrium state for Markov processes with killing. For standard processes with no negative jumps, we can define a function called the scale function, which provides a simple representation of the exit times and the potential density. Using the scale function, we can generalize the methods that have been used for one-dimensional diffusions and Lévy processes and provide necessary and sufficient conditions for the existence of quasi-stationary distributions.

3 Hirotaka Kai (Kyoto Univ.) Long time behavior of Lévy processes on manifolds ····· 15

Summary: Applebaum constructs a Lévy process on Riemannian manifolds by projecting the solution to the Marcus type stochastic differential equation on the orthonormal frame bundle, so called Elles–Elworthy–Malliavin construction. In this talk, we will show that how the curvature of a Riemnnain manifold affects the properties of aLévy process. We reveal these effects by introducing some estimates for the radial part of a Lévy process.

4 Yasuhito Nishimori (Nat. Inst. of Tech., Anan Coll.) Limiting distributions for particles near the frontier of spatially inhomogeneous branching symmetric stable processes ····· 15

Summary: We discuss on the maximal displacement of the branching symmetric α-stable processes. Here, we assume the branching rate measure is in the Kato class and it has a compact support on d-dimensional Euclidean space. We show that the maximal displacement exponentially grows and its order is determined by the index α and the spectral bottom of the corresponding Schrödinger-type operator. Then, we consider the evolution of particles near the frontier and determine the limiting distribution of these particles.

5 Yuji Hamana (Univ. of Tsukuba) Asymptotic expansion for the tail probability of the hitting time and site of Brownian motion ····· 10

Summary: We consider the large time asymptotics for the tail probabitity of the first hitting time of Brownian motion with the fixed arrival site. We give the first three terms in the three dimensional cases. In the two dimensional case, we show that the tail probability admits an asymptotic expanson in powers of $1/\log t$.

6 Shun Yanashima (Tokyo Metro. Univ.), Kensuke Ishitani (Tokyo Metro. Univ.) An invariance principle for random walk bridges conditioned to stay between two curves ····· 15

Summary: Brownian house-moving is a stochastic process that plays an important role in computing higher-order Greeks for barrier options. It was introduced by Ishitani, Hatakenaka, and Suzuki (2020). In this presentation, we construct Brownian house-moving in a different way from their previous work. Specifically, we construct Brownian house-moving as the weak limit of Gaussian random walk bridges conditioned to stay between two curves.

7 Soma Nishino (Tokyo Metro. Univ.) Kensuke Ishitani (Tokyo Metro. Univ.) Higher order integration by parts formulae for Wiener measures on a path space between two curves · · · · · 15

Summary: The first order integration by parts formulae for Wiener measures on a path space between two curves are already known. In this talk, we extend this result to the higher order integration by parts. In the case of higher order, non-trivial boundary terms, which are absent in the conventional first order case, appear additionally. Furthermore, in the proof of this result, a construction method using random walk approximation of stochastic processes called Brownian excursion and Brownian house-moving becomes necessary. In the proof, we introduce the notion of first-order and second-order infinitesimal probabilities. We will explain that this concept is useful in organizing the integration by parts formulae.

8 Masato Hoshino (Osaka Univ.) Ismaël Bailleul (Univ. Bretagne Occidentale) Random models on regularity-integrability structures · · · · · 15

Summary: In the study of singular SPDEs, it has been a challenging problem to obtain a simple proof of a general probabilistic convergence result (BPHZ theorem). Differently from Chandra and Hairer's Feynman diagram approach, Linares, Otto, Tempelmayr, and Tsatsoulis recently proposed an inductive proof based on the spectral gap inequality by using their multiindex language. Inspired by their approach, Hairer and Steele also obtained an inductive proof by using the regularity structure language. In this talk, we introduce an extension of the regularity structure including integrability exponents and provide a simpler proof of BPHZ theorem. This talk is based on a joint work with Ismael Bailleul (Univ Brest).

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

Yushi Hamaguchi (Osaka Univ.) Infinite dimensional Markovian lifts of stochastic Volterra equations

Summary: Stochastic Volterra equations (SVEs for short) are useful to model dynamics with hereditary properties, memory effects and roughness of the path, which cannot be described by standard SDEs. However, the analysis of SVEs is much more difficult than the SDEs case since the solutions are no longer Markovian or semimartingales in general. In this talk, we introduce an infinite dimensional framework which captures Markov and semimartingale structures behind SVEs. We show that an SVE can be "lifted" to an infinite dimensional stochastic evolution equation (SEE for short) and that the solution of the SEE becomes a Markov process on a Hilbert space. Furthermore, we establish asymptotic properties and well-posedness results for lifted SEEs, and then apply them to the original SVEs.

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

Nobuaki Naganuma (Kumamoto Univ.) Approximation theory of SDEs driven by fractional Brownian motion

Summary: In this talk, we will consider approximation of solutions to stochastic differential equations (SDEs) driven by fractional Brownian motions. In particular we focus on asymptotic error distributions. In preceding results, several schemes (e.g. Euler–Maruyama scheme, Milstein scheme, Crank–Nicolson scheme and so on) to approximate the solutions were proposed and studied in several situations, which are classified by continuity and dimensions of the driving processes. To obtain such results, we use rough path theory to formulate SDEs and use the fourth moment theorem to identify limit distributions of error distributions. We will give an overview of them and introduce preceding results and recent developments.

March 18th (Mon) Conference Room III

9:30–11:40

9 Misaki Tabata (Ritsumeikan Univ.) An infinite-dimensional Hawkes process · 15

Summary: We construct an infinite-dimensional stochastic process using the Hawkes process, specifically by establishing a compound Hawkes process. In this construction, we introduce a Poisson random measure to the process, thereby creating an infinite-dimensional stochastic process from a measure-theoretic perspective. For the constructed process, we derive sufficient conditions for the existence of $\mathcal{L}_1, \mathcal{L}_2$ moments and the Laplace transform. In particular, for $\mathcal{L}_2$ moment and the Laplace transform, we use a compensated Poisson measure to derive these conditions for the infinite-dimensional stochastic process we have constructed.

10 Makoto Nakashima (Nagoya Univ.) Feynman–Kac representation for three-dimensional heat equation with one-center point interaction · 15

Summary: In this talk, we consider the heat equation associated with the Schrödinger operator with one-center point interaction $H_\lambda := -\Delta + \lambda\delta_0$, where δ_0 is a Dirac measure at 0. This expression of the operator is the formal one but H_λ is mathematically defined via the norm-resolvent convergence of the Schrödinger operators with short-range interaction. We give a kind of Feynman–Kac representation of the heat equation associated with H_λ.

11 Makoto Nakashima (Nagoya Univ.)
Seiichiro Kusuoka (Kyoto Univ.)
Song Liang (Waseda Univ.)
Sergio Albeverio (Univ. of Bonn)
Stochastic quantization of the three-dimensional Edwards measure · · · 15

Summary: In this talk, we focus on the Edwards model formally given by

$$\nu_\lambda(d\omega) = \frac{1}{Z_\lambda} \exp\left(-\lambda \int_0^1 \int_0^t \delta_0(\omega_t - \omega_s)dsdt\right) \nu_0(d\omega)$$

for $\lambda \geq 0$, where Z_λ is a normalizing constant. The formal random variable $J(\omega) = \int_0^1 \int_0^t \delta_0(\omega_t - \omega_s)dsdt$ is called a self-intersection local time, that measures a random set $T(\omega) = \{(s,t) : \omega_s = \omega_t\}$. We will talk about the stochastic quantization of ν_λ via the Dirichlet form.

12 Naomasa Ueki (Kyoto Univ.) Positivity of small ball probabilities of a Gaussian random field, and its applications to random Schrödinger operators · 15

Summary: The spectrum of a Schrödinger operator with a Gaussian random potential is $\mathbb{R}$. This is a theorem appeared in a book by Pastur and Figotin, and is proven by the theory on small ball probabilities, which had been extensively developed for Gaussian random fields. In this talk, some remarks are given on the proof, and similar facts are proven for a Schrödinger operator with a Gaussian random magnetic field.

13 Haruyoshi Tanaka (Naruto Univ. of Edu.) Higher-order asymptotic behaviours of pressure functionals and statistical representations of the coefficients · 15

Summary: We study the higher-order asymptotic behaviour of the pressure functional $\epsilon \mapsto P(\varphi + \epsilon\psi)$ with potentials φ and ψ on a countable Markov shift X, where $P(f)$ means the topological pressure of f. In this talk, we give a condition for obtaining the n-order asymptotic expansion of $\epsilon \mapsto P(\varphi + \epsilon\psi)$. Moreover, we have an explicit formula for the behaviour of $\mu((\sum_{i=0}^{m-1}(\psi - \int_X \psi\, d\mu) \circ \sigma^i)^k)$ as $m \to \infty$ with the Gibbs measure μ of φ and the shift σ. As a corollary, it turns out that the 3-th coefficient of the expansion has a limit representation that looks like the asymptotic variance well.

14 Takumu Ooi (Kyoto Univ.)
Toshihiro Uemura (Kansai Univ.)
Dynkin games for Markov processes 15

Summary: We consider Dynkin games for Markov processes associated with semi-Dirichlet forms. Dynkin games are the optimal stopping games introduced as the models of zero-sum games by two players. We prove that the solution to the certain variational inequality with two obstacles is the equilibrium price of the Dynkin game. Moreover, we obtain the saddle point of the game.

15 Yuji Shinozaki (Bank of Japan / Tokyo Tech)
Syoiti Ninomiya (Tokyo Tech)
Error estimation of high-order recombination and its application 15

Summary: Those algorithms to perform the patch dividing which are necessary when weakly approximating SDEs using the recombination method developed in [C. Litterer T. Lyons, 2012] are proposed. Refining Litterer–Lyon's error estimation provides the patch radius criteria on which these algorithms are based. Numerical examples of the calculation of option prices under the Heston model are also presented.

16 Yuki Ueda (Hokkaido Univ. of Edu.)
Uniform convergence towards extreme value distributions in free probability 15

Summary: In probability theory, there had been an interest in the uniform convergence to an extreme value distribution. Extreme value distributions are classified into three types: Fréchet, Weibull, and Gumbel types, and the uniform convergence rate for Fréchet type was obtained by Smith and Omey. Later, Bartholmé and Swan obtained a new convergence rate from Stein's method in the Fréchet case. In 2020, Kusumoto and Takeuchi similarly used the Stein method to obtain an estimate of the Gumbel case. In this talk, we will report the results obtained on the uniform convergence to the free extreme value distribution using the Stein method as in the classical case. In free case, we will point out that information on the left tail of the distribution, which does not appear in the classical case, becomes important.

11:40–12:10 Research Section Assembly

March 19th (Tue) Conference Room III

10:00–11:10

17 Teruo Tanaka (Hiroshima City Univ.)
Certain fractional optimal stopping problems —continuous time case— 10

Summary: We give the formulation of optimal stopping problems which combined a continuous time stochastic process and the criterion of a fractional reward. Using standard arguments in the theory of mathematical programming, we prove the existence of optimal stopping times under certain assumptions on the regularity of the stochastic processes.

18 Toshiharu Fujita (Kyushu Inst. of Tech.)
Stochastic decision process with feedforward loop system —Minimum reward system— 15

Summary: We consider minimum reward system on a stochastic decision process model with a feedforward loop system, which is one of the nonserial branch systems. We apply invariant imbedding approach to our model and introduce recursive equations by dynamic programming technique.

Summary: In this talk we give an upper bound for the degree of a certain type of B_d-invariant weighted spherical designs, as a generalization of Bajnok (2007), Heo–Xu (2001) and Sawa–Xu (2014). To achive this goal, we focus on the equivalence of designs on the simplex and on the sphere. In addition to this, we also pay attention to the equivalence between the design on sphere and a certain type of Hilbert's identity. In particular, the former allows us to evaluate the upper bound of the design, and this is precisely our main result. We also discuss the best possibility of our bound in low dimensions.

Summary: We consider multi-way contingency tables with the same ordered classifications and propose an asymmetry model based on f-divergence, which extends a previous model. In this talk, we show the asymptotic properties of test statistics. Additionally, we also offer insights into the previous model from the perspective of the proposed model. Finally, we present numerical experiments as a validation of the obtained results.

March 20th (Wed) Conference Room Ⅲ

10:00–11:40

Summary: In this talk, we consider a test statistic for Mardia's multivariate skewness related to the test for multivariate normality. Mardia (1970) gave the definitions of the multivariate skewness and the sample measure of multivariate skewness, and the test statistic was given by using the expectation and variance of asymptotic approximate statistic for the multivariate sample skewness. In this talk, we consider an improvement on Mardia's result. In particular, we derive exact results, instead of asymptotic Mardia's results for the expectation and variance. From the exact results, we propose a new test statistic with a good chi-squared approximation. Finally, we compare our result with that of Mardia (1970) and investigate the accuracy of chi-squared approximation by a Monte Carlo simulation.

Summary: The multivariate allometric regression model is a multivariate multiple regression model which imposes that the difference of mean vectors of two observations is always parallel to the leading eigenvector of the covariance matrix of observations. For this model, we consider the estimation problem for the leading eigenvector. Considering a class of estimators which includes conventional estimators, we evaluate estimation accuracies of the estimators contained in this class. Moreover, some estimators based on a preliminary test are proposed.

Summary: We consider the estimation problems for conditionally heteroskedastic ergodic time series models with high-dimensional and sparse parameters and possibly infinite- dimensional nuisance parameters. We first establish the asymptotic behavior of the Dantzig selector based on the least squares method to estimate the unknown parameter of interest. Then, using the Dantzig selector and a consistent estimator for the nuisance parameter, we propose the asymptotically normal estimator for the non-zero components of the parameter of interest. Applications to the integer-valued autoregressive models are also presented in this talk.

Summary: Substantial works about clustering on high-dimension, low-sample-size (HDLSS) data have been performed. Particularly, asymptotic behaviors of hierarchical clustering are investigated without assuming normality. On the other hand, asymptotic properties of k-means on behalf of partitional clustering in the HDLSS settings seem to have not been studied sufficiently. Especially, while the kernel method with some methodologies is investigated, a theoretical result of kernel k-means is not obtained. In this talk, we show the asymptotic properties of k-means for HDLSS data. Then, we introduce kernel k-means and show its effectiveness. At last, we present numerical simulation studies that demonstrate the performance of k-means and kernel k-means for high dimensional data, discussing the achieved results.

Summary: In this talk, we consider the problem of recovering a signal (low-rank) matrix in high-dimensional settings. We first consider the conventional PCA to recover the signal matrix and show that the estimation of the signal matrix holds consistency properties under severe conditions. The conventional PCA is heavily subjected to a noise. In order to remove the noise, we apply the cross-data-matrix (CDM) methodology and propose a new estimation of the signal matrix. We show that the proposed estimation by the CDM method holds the consistency properties under mild conditions and improves the error rate of the conventional PCA effectively.

Summary: For the data supported on $[0, \infty)$ or $[0, 1]$, the so-called boundary bias problem is one of the interests. Instead of the location-scale kernel $k((x - \cdot)/h)/h$, we have recently developed asymmetric kernel method to solve the boundary bias problem. In this talk, we consider the problem of estimating the density for cylinder data, using the asymmetric kernel and von Mises kernel. This is a first step, so that some related works in this direction will be expected by combining the circular distribution theory with the nonparametric method.

14:15–15:15 Award Lecture for the 2023 MSJ Analysis Prize

Yasunori Fujikoshi (Hiroshima Univ.*) Model selection based on information criteria in high-dimensional statistical analysis

Summary: In this talk we consider model selection methods based on information criteria such as AIC, BIC and Cp in high-dimensional statistical analysis. First we point in multivariate regression (Fujikoshi, Sakurai and Yanagihara (2014), Yanagihara, Wakaki and Fujikoshi (2015), Bai, Choi, Fujikoshi and Hu (2022)) that within the framework of large-sample and high-dimension data AIC and Cp are asymptotically consistent, but there exists a case that BIC is not asymptotically consistent. This is a remarkable result, since it was known that AIC and Cp are not asymptotically consistent under the large sample case. Existence of the case that BIC is not asymptotically consistent but AIC is asymptotically consistent can be seen for the other situation as in estimating the dimensionality in principal component analysis, multivariate regression analysis and discriminant analysis. There is a faulty in the use of AIC and the like in a variable selection problem, since the amount of computation becomes numerous as the number of variables to choose is large. In order to avoid this difficulty, we discuss KOO (kick-one-out) methods. As a result, it is shown that the methods have asymptotic high-dimensional consistency in multivariate regression and discriminant analysis models under certain conditions (Fujikoshi (2022)).

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

Tomoyuki Nakagawa (Meisei Univ.) Robust Bayesian inference using the divergences and its applications

Summary: In Bayesian statistics, the robustness against outliers is one of important issues. It is well known that an ordinary Bayesian inference is strongly influenced by outliers. As one of the solutions to this problem, Bayesian inference using heavy-tailed distributions has been used for a long time and has been studied extensively in recent years. However, the heavy-tailed distributions require a model to be constructed for each problem, and it is often difficult to deal with complex models. On the other hand, Bayesian inference using the divergence has the advantage of being flexible applied to a variety of models, and has been developed by numerous studies in recent years. In this presentation, we consider that the robustness of Bayesian inference using the density power and gamma divergences. In addition, we show the performance of these Bayesian inferences which applied to several models in simulation studies.

Applied Mathematics

March 17th (Sun) Conference Room IX

9:00–12:00

1 Jiro Akahori (Ritsumeikan Univ.)
Norio Konno (Ritsumeikan Univ.*)
Rikuki Okamoto (Ritsumeikan Univ.)
Iwao Sato (Oyama Nat. Coll. of Tech.)
Yuma Tamura (Ritsumeikan Univ.)
Absolute zeta functions and periodicity of quantum walks on cycles 15

Summary: The absolute zeta function can be considered as a zeta function over $\mathbb{F}_1$ and the quantum walk is a quantum counterpart of the classical random walk. We showed a connection between the quantum walk and the absolute zeta function. Then we focused Grover walks and Hadamard walks on cycle graphs, which are typical models of quantum walks, and using cyclotomic polynomials, we calculated the periods and absolute zeta functions of such quantum walks. Especially, our result includes other proofs of some known results which showed such periods in some cases.

2 Rikuki Okamoto (Ritsumeikan Univ.)
Konno Norio (Ritsumeikan Univ.*)
Sato Iwao (Oyama Nat. Coll. of Tech.)
Akahori Jiro (Ritsumeikan Univ.)
Absolute zeta functions of zeta functions of quantum walks 15

Summary: We consider the absolute zeta function of zeta functions of quantum walks. First, we define the matrix zeta function for square matrix. The zeta function of quantum walk is a matrix zeta function for the Grover matrix that determines quantum walk on a graph. The zeta function of quantum walk has an absolute automorphic form of weight depending on the number of edges of the graph. We can consider the absolute zeta function of zeta function of quantum walk by this absolute automorphy. Especially, we calculate the absolute zeta function of zeta functions of quantum walks on a complete graph.

3 Taisuke Hosaka (Yokohama Nat. Univ.)
Etsuo Segawa (Yokohama Nat. Univ.)
Norio Konno (Ritsumeikan Univ.*)
QW-search/Zeta correspondence 10

Summary: In this talk, we introduce the zeta function for the search model based on quantum walk. For the cycle, we give an expression of the zeta function in the case where the position and number of the marked vertices are general. Moreover we deal with the d-dimensional torus in the two special case of the position of the marked vertices, fixing the number of marked vertices is half.

4 Iwao Sato (Oyama Nat. Coll. of Tech.)
Takako Endo (Tohoku Univ.)
Takashi Komatsu (Univ. of Yamanashi)
Norio Konno (Ritsumeikan Univ.*)
Weighted alternating Walk/Zeta correspondence 15

Summary: We define a generalized second weighted alternating zeta function of a graph, and express the generalized second weighted alternating zeta function of a vertex-transitive regular graph by spectra of the transition probability matrix of the symmetric simple random walk on it and its Laplacian. Furthermore, we present an integral expression for the limit of the generalized second weighted alternating zeta functions of a series of vertex-transitive regular graphs. As an example, we treat the generalized second weighted alternating zeta functions of a finite torus.

Summary: Let p be a positive real number. We determine the best constants of two types of discrete ℓ^p Sobolev inequalities on a complete graph K_N. The discrete ℓ^p Sobolev inequality shows that the maximum of $|u(i)|^p$ is estimated from above by constant multiples of the potential energy for vector $\boldsymbol{u} = {}^t(u(0), \cdots, u(N-1)) \in \mathbb{C}^N$. The potential energy is the ℓ^p norm of $\boldsymbol{u}$ with dumping coefficicent a. In addition, we also have the best constant of the discrete ℓ^p Sobolev inequality in the case of $a = 0$.

Summary: Fujimura and Shiraishi showed that all Euler trails of G are obtained in parallel for any Eulerian graph with 2^n edges. In this paper, we generalize this result for an arbitrary Eulerian graph G by an idea of adding a dummy padding path to G.

Summary: A tree T is said to be *even* if all pairs of vertices of degree one in T are joined by a path of even length. We conjecture that every r-regular non-bipartite connected graph G has a spanning even tree and verify this conjecture when G has a 2-factor. Well-known results of Petersen and Hanson et al. imply that the only remaining unsolved case is when r is odd and G has at least r bridges. We investigate this case further and propose some related conjectures.

Summary: A subgraph H of an edge-colored graph G is rainbow if all the edges of H receive different colors. If G does not contain a rainbow subgraph isomorphic to H, we say that G is rainbow H-free. For connected graphs H_1 and H_2, if every rainbow H_1-free complete graph edge-colored in sufficiently many colors is rainbow H_2-free, we write $H_1 \leq H_2$. The binary relation $\leq$ is a preorder. Cui et al. (2021) characterized the pairs (H_1, H_2) with $H_1 \leq H_2$ when either H_1 or H_2 is a subgraph of the other. Motivated by their result, we are currently searching for such pairs under the condition that neither H_1 nor H_2 is a subgraph of the other. In this talk, We give a progress report of this study.

Summary: A simplicial complex is said to be *critical* for the 3-sphere S^3 if it cannot be embedded in S^3 but after removing any one point, it can be embedded. We show the following theorem:
Let $X = (G \times S^1) \cup H$ be a critical complex, where G and H are graphs. Then $(G \times \{0\}) \cup H$ has a minor $G' \cup H'$ which is one of the following.
(1) $G' \cup H'$ is K_5, where $H' = K_{1,4}$.
(2) $G' \cup H'$ is K_5, where $H' = K_3$.
(3) $G' \cup H'$ is $K_{3,3}$, where $H' = K_{1,3}$.

Summary: A simplicial complex is said to be *critical* for the 3-sphere S^3 if it cannot be embedded in S^3 but after removing any one point, it can be embedded. There exist complexes which cannot be embedded in S^3, but they do not contain any critical complexes. From the property of those examples, we define an equivalence relation on all simplicial complexes $\mathcal{C}$ and a partially ordered set of complexes $(\mathcal{C}/\sim;\subseteqq)$, and refine the definition of critical. According to the refined definition of critical, we show that if a complex X cannot be embedded in S^3, then there exists $[X'] \subseteqq [X]$ such that $[X']$ is critical for $[S^3]$.

Summary: The topological complexity of a space is a numerical homotopy invariant closely related to the robot motion planning problem. If robot motions are required to go along with certain direction, the directed topological complexity plays an important role to control directed algorisms. This talk will focus on the directed topological complexity of a space decomposed by a poset.

Summary: The symmetric edge polytope (SEP) of a graph is a centrally symmetric reflexive polytope whose vertices are defined by the edges of the graph. SEPs have been studied extensively in the past twenty years. Recently, a generalized version of SEPs has been introduced from graphs (i.e. graphic matroids) to regular matroids, which is characterized by totally unimodular matrices. Generalized SEPs are known to have palindromic Ehrhart h^*-polynomials. On the other hand, it is conjectured that (ordinary) SEPs have nonnegative γ-vectors. In this talk, we show that the conjecture on the nonnegativity of γ-vectors of SEPs does not hold for generalized SEPs.

14:15–16:50

Summary: A facial 3-complete k-coloring of a triangulation G on a surface is a vertex k-coloring such that every triple of the colors appears on the boundary of some face of G. The facial 3-achromatic number $\psi_3(G)$ of G is the maximum integer k such that G has a facial 3-complete k-coloring. We show an upper bound for difference of facial 3-achromatic numbers between two triangular embeddings of the same graph on a surface.

Summary: Given an n-sided polygon P on the plane with $n \geq 4$, we consider a problem whether P is quadrangulatable or not by adding straight segments into the interior. We can easily find a non-quadrangulatable polygon P and hence we introduce Steiner points, which are auxiliary points which can be put in any position in the interior or exterior of P. In our talk, we estimate the number of Steiner points for quadrangulating P using the notion "spirality" of P which measures how far P is from being convex polygon in a sense.

Summary: In 2022, Bokal, Brinkmann, and Zamfirescu considered the problem of the connectivity of the dual and they defined a function $\delta_k(c)$ as the smallest genus s which allows a simple c-connected graph G embedded in an orientable surface $\mathbb{S}_s$ with a simple dual G^* with a k-cut. This function is well-defined for $c \geq k \geq 1$ and they determined the exact value when $k \geq 3$ or $c \leq 6$. In this talk, we determine the exact value of $\delta_2(c)$ for all c and give an upper bound for $\delta_1(c)$, which is one apart from the best, for infinitely many c.

Summary: A quadrature formula is a formula computing a definite integration by evaluation at a set of finitely many points (design). Examining the existence of certain rational quadrature formulas leads to applications to interesting problems such as Waring's problem and spherical designs. A central symmetric quadrature is a central research object in the real case. Sawa and Uchida proved the existence and the non-existence of central symmetric rational quadrature formulas for Hermite polynomials. In this talk, we consider an extension of the above results to Bessel polynomials and discuss complex analogues of central symmetry with examples. This is a joint work with Masanori Sawa.

Summary: In this talk we consider the existence of rational quadrature for Hermite polynomials and Chebyshev polynomials of the first kind, which originally goes back to a work by Hausdorff (1909) concerning Waring problem in number theory. We show some nonexistence theorems for quadrature with small number of points and then provide existence results, together with explicit constructions and individual curious examples. Our proof is based on elementary number-theoretic techniques and elementary geometric considerations.

Summary: The classification problem of P- and Q-polynomial association schemes has been one of the central problems in algebraic combinatorics. The definition of the multivariate version of P- and/or Q-polynomial association schemes was reported at the last meeting. In this talk, we show that the non-binary Johnson scheme and the association scheme obtained from attenuated spaces are bivariate Q-polynomial association schemes.

Summary: The transitivity argument shows that shells of the extended quadratic residue codes of length $p+1$ over $\mathbb{F}_q$, $(\widetilde{Q}_{q,p+1})_\ell$, support combinational 2-designs. In the present talk, by computing Jacobi polynomials and harmonic weight enumerators, we show that $(\widetilde{Q}_{q,p+1})_\ell \cup ((\widetilde{Q}_{q,p+1})^\perp)_\ell$ $(\neq \emptyset)$ is a 3-design. In addition, we introduce the way to construct infinite series of 3-designs in $\widetilde{Q}_{r^2,p+1}$, which does not follow from the transitivity argument.

20 Reina Ishikawa (Waseda Univ.) Exceptional designs in some extended quadratic residue codes ····· 15

Summary: In general, a non-empty set of all codewords with a weight of ℓ in extended quadratic residue codes has a combinatorial 2-design. Bonnecaze–Sóle (2021) demonstrated that extended binary quadratic residue codes of length 42 has a 3-design. However, this result was obtained only through electronic calculations. The goal of this presentation is to provide additional examples in the extended ternary and quaternary quadratic residue codes with logical proofs. We compute Jacobi polynomials and harmonic weight enumerators for the extended ternary quadratic residue code of length 14 and the extended quaternary quadratic residue code of length 18. By using these results, we prove our examples through logical reasoning.

21 Hiroaki Taniguchi (Yamato Univ./Kagawa Nat. Coll. of Tech.*) On quadratic APN functions $F(x)+Tr(x)L(x)$ ····· 15

Summary: We first characterize how two $(n-1,m)$ functions f and g can be combined into an APN (n,m)-function F of the form $F(x)=f(x)$ and $F(x+e_0)=g(x)$ for $x\in\mathbf{F}_2^{n-1}$ with $e_0\in\mathbf{F}_2^n\backslash\mathbf{F}_2^{n-1}$. Next we specialize this characterization to the case when f is quadratic and $g(x)=f(x)+L(x)$ for some linearized polynomial L. Lastly for a quadratic APN (n,n)-function F and a linearized polynomial L, we give a characterization of APN-ness for (n,n)-function $F(x)+Tr(x)L(x)$. With some computational experiments, we see that CCZ-inequivalent APN functions $F(x)+Tr(x)L(x)$ can be obtained from F using this construction.

17:00–18:00 Talk Invited by Applied Mathematics Section

Xiao-Nan Lu (Gifu Univ.) Combinatorial structures for group testing and combinatorial testing

Summary: *Group testing* (GT) is a method for identifying defective items within a large population by pooling samples together for joint testing. Combinatorial structures in GT, commonly represented by binary matrices like *separable matrices* and *disjunct matrices*, serve as crucial mathematical frameworks for formulating efficient testing strategies. *Combinatorial testing* (CT) focuses on the identification and location of faults arising from interactions among a small number of factors, not just independent items. Test case designs in CT employ combinatorial structures, such as *covering arrays*, *locating arrays*, and *detecting arrays*. Remarkably, GT can be viewed as specialized CT models under particular conditions.
In both GT and CT, constructions and characterizations of combinatorial structures are closely related to extremal combinatorics, combinatorial designs, and coding theory. The practical applications of GT and CT have also impacted the advancements in combinatorial design theory. This talk aims to introduce the fundamental mathematical frameworks through key combinatorial structures for GT and CT. Moreover, recent research focusing on variations and extensions of classical GT and CT using novel combinatorial structures will be discussed.

March 18th (Mon) Conference Room IX

9:00–12:00

22 Jun Sato (Tokyo Polytechnic Univ.) Exact stationary state of the inhomogeneous ASEP ····· 15
Yuki Ishiguro (Univ. of Tokyo)
Katsuhiro Nishinari (Univ. of Tokyo)

Summary: We find the exact stationary state of the asymmetric simple exclusion process, where the hopping rates are dependent on the position of the lattice site.

23 Shuhei Kamioka (Osaka Seikei Univ.) An integrable algorithm for randomly sampling plane partitions ····· 15

Summary: An algorithm for random sampling of plane partitions is proposed. The algorithm is based on an integrable system, called the discrete two-dimensional Toda equation. The complexity of the algorithm is about the same as a conventional fast method. In addition, the probability distribution for sampling is determined by a solution to the integrable system. For this property, we can perform the sampling from a nontrivial distribution in the same manner as the uniform one.

Summary: In topological data analysis, persistent homology provides a compact descriptor of the birth and death scales of the topological features of data. In particular, the descriptor, the persistence diagram, can be algebraically understood using interval decompositions of persistence modules. In a previous work, we characterized all posets whose persistence modules are guaranteed to be interval decomposable. In addition to the classical setting of zigzag persistence, this includes what we call the bipath poset and bipath persistence, as a generalization of the persistent homology of filtrations. In this work, we provide algorithms to compute the interval decompositions and thus construct persistence diagrams for bipath persistence.

Summary: We consider the regular covering of a finite digraph which allows multi-arcs ans multi-loops. We define the notion "inverse arcs" for such a digraph. In addition, we will see that the regular covering of the digraph can be constructed as the induced digraph with respect to the ordinary voltage assignment corresponding to the group action, including the behaviors of those inverse arcs of them. This enables one to consider the problem which describes decomposition of the generalized weighted zeta function for the regular covering of a digraph.

Summary: In general, a graph zeta function is defined for ordinary paths. On the other hand, there also exists a graph zeta function defined for alternating paths. These can be expressed in the Ihara representation, similar to the case of ordinary paths. In this talk, we will define more general paths and present the Ihara expression of the graph zeta function.

Summary: In our previous paper [1], we have shown that Grover walk on complete graphs with n vertices and a self-loop at each vertex has period $2n$. The method of the proof is focus on the eigenvalues of the evolution matrix U. In this talk, we show another proof of the above problem by focusing on group structures obtained from the evolution matrix U.

Summary: Quantum walks are mathematical models that are said to be quantum version of random walks and are applied to topological insulators. In recent years, open quantum walks, in which the flow of particles are controlled, have been studied actively. For closed systems, topological invariants are described using the dimension of the eigenspace of the time evolution operator. For this reason, the analysis of the eigenvalues of the time evolution operator is important in the study of quantum walks. In this talk, we will analyze the birth eigenvalues of the Mochizuki–Kim–Obuse model, which is an example of an open quantum system.

29 Masahiro Sanka (Keio Univ.)
Katsuhiro Ota (Keio Univ.)
Toughness, forbidden induced paths and hamiltonicity of graphs ····· 15

Summary: For a real number $t > 0$, we say that a graph G is t-tough if for any set S with $G - S$ disconnected, the number of components of $G - S$ is at most $|S|/t$. In 1973, Chvátal conjectured that there exists a constant t_0 such that every t_0-tough graph is hamiltonian. In this talk, the result on 2-tough $2K_2$-free graphs provided by Ota and the presenter is introduced. To show the result, the theorem saying that every 2-tough graph has a 2-factor is useful. On the other hand, it is also known that every 3/2-tough $2K_2$-free graph has a 2-factor. In this talk, the result on forbidden induced paths for a 3/2-tough graph to have a 2-factor is also introduced.

30 Kuniharu Yokomura (Tokai Univ.)
On degree conditions of balanced 3-partite Hamiltonian-connected graphs ····· 15

Summary: For a graph G and $u, v \in V(G)$, a path in G from u to v is called a (u, v)-*path*, and if (u, v)-path is a Hamiltonian path from u to v, then (u, v)-path is called a (u, v)-*Hamiltonian path*. A graph G is said to be *Hamiltonian-connected* if there exists a (u, v)-Hamiltonian path between any two vertices u, v. 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 Hamiltonian-connected.

31 Shinya Fujita (Yokohama City Univ.)
On monochromatic connectivity in edge-colored graphs ····· 10

Summary: We consider edge-colored graphs. Let G be an edge-colored graph. If, for any two vertices in G, there exists a monochromatic path connecting them, then we say that G is monochromatic connected. Some recent results on monochromatic connectivity in edge-colored graphs will be reviewed.

32 Kiyoshi Ando (Nat. Inst. of Informatics)
A constructive characterization of 5-edge-connected 5-regular multi-graphs ····· 15

Summary: We deal with multi-graphs with no self-loops. By introducing a new operation "quasi- edge-binding", we give a generating theorem for 5-edge-connected 5-regular multi-graphs. This is a 5-edge-connected analogue of Korzig–Simmons result on $2k$-edge-connected $2k$-regular multi-graphs.

13:00–14:00

33 Satoru Fukasawa (Yamagata Univ.)
Tsuyoshi Miezaki (Waseda Univ.)
Galois points for a graph ····· 15

Summary: In this talk, we introduce the notion of a Galois point for a finite graph, using the theory of linear systems of divisors for graphs discovered by Baker and Norine. We present a new characterization of complete graphs in terms of Galois points.

34 Tsuyoshi Miezaki (Waseda Univ.)
Yuusaku Nishimura (Waseda Univ.)
Akihiro Munemasa (Tohoku Univ.)
Tadashi Sakuma (Yamagata Univ.)
Shuhei Tsujie (Hokkaido Univ. of Edu.)
A generalization of the chromatic symmetric function ····· 15

Summary: The present talk aims to give a generalization of the chromatic symmetric function. We call this the Kneser chromatic function and show that the set of Kneser chromatic functions is a complete invariant for graphs. Further, we give three graph invariants and discuss some of their properties.

35 Yusaku Nishimura (Waseda Univ.) A simple random walk and equitable partition ····· 15

Summary: It is known that the average hitting times of simple random walks from any vertex to any other vertex in distance-regular graphs are determined by their intersection array. In this paper, we introduce a new graph classification called f-equitable, utilizing both the equitable partition and the function f, which represents one of the generalizations of distance-regular graphs. We determine the average hitting times from any vertex to any other vertex in f-equitable graphs by using their parameter, referred to as the quotient matrix. Furthermore, we establish the existence of a function (f_1, f_2) such that the Cartesian product of two strongly regular graphs is (f_1, f_2)-equitable. We then calculate the quotient matrix for these graphs and determine the average hitting times from any vertex to any other vertex in these graphs.

36 Yuho Tanaka (Waseda Univ.) On the average hitting times of directed Cayley graphs ····· 15

Summary: The exact formula for the average hitting time of simple random walks from one vertex to any other vertex on $\mathrm{Cay}(\mathbb{Z}_N, \{\pm 1, \pm 2\})$ was given by Y. Doi et al. [*Discrete Applied Mathematics*, **313** (2022) 18-28]. Y. Doi et al. give a simple formula for the average hitting times of simple random walks on $\mathrm{Cay}(\mathbb{Z}_N, \{\pm 1, \pm 2\})$ by using an elementary method. In this talk, using an elementary method also used by Y. Doi et al. [*Discrete Applied Mathematics*, **313** (2022) 18-28], we give a simple formula for average hitting times of simple random walks on $\mathrm{Cay}(\mathbb{Z}_N, \{+1, +2\})$. Furthermore, we also give the exact formula for the average hitting times of random walks on the weighted Cayley graph $\mathrm{Cay}(\mathbb{Z}_N, \{+1, +2\})$.

March 19th (Tue) Conference Room IX

9:50–12:00

37 Koji Nuida (Kyushu Univ.) A proof of Zorn's Lemma from elementary properties of partially ordered sets ····· 10

Summary: Zorn's Lemma is stated purely in terminology of posets (partially ordered sets), but its standard proof relies on transfinite recursion, which is a non-elementary set-theoretic machinery. In this talk, we show a new simple proof of Zorn's Lemma that only uses (besides Axiom of Choice) basic properties of posets. In contrast to the existing similar proofs, our proof is more elementary in the sense that it even does not use the notion of well-ordered sets.

38 Tetsuya Nagano (Univ. of Nagasaki) Finsler encryption ····· 15

Summary: Inspired by previous work with the first example proposed at SecITC 2020, we give a general description of Finsler encryption that is based on a Finsler space, which uses a kind of a differentiable geometry on a smooth manifold, with appropriate quantization as the security parameter. Key generation, encryption and decryption algorithms are introduced in outline, and a further example is presented. Then we analyse security properties of Finsler encryption. First, as the dimension (as another security parameter) increases, the length of the secret key also increases, and hence the computational hardness becomes stronger. Second, we prove indistinguishability against chosen-plaintext attacks.

39 Ryoko Tomiyasu (Kyushu Univ.) Packing theory derived from phyllotaxis and products of linear forms ····· 15

Summary: Parastichies are spiral patterns observed in plants and numerical patterns generated using golden angle method. We generalize this method by using Markoff theory and the theory of product of linear forms, to obtain packings on Riemannian manifolds with a locally diagonalizable metric. Using this method, we prove that it is possible to generate packings on any real analytic Riemannian surfaces with the packing density bounded below by approximately 0.7. For 3-manifolds, the lower bound for the packing density is approximately 0.38.

40 Tomoharu Suda (RIKEN) A categorical perspective on the relationship between discrete and continuous time dynamical systems 15

Summary: Dynamical systems are broadly categorized into two types: discrete and continuous time systems. While it is commonly acknowledged that analogies exist between these two types, formalizing and proving this correspondence in a mathematically rigorous manner poses a challenge. This study aims to explore the relationship between these categories in the light of category theory. The main result of this research establishes a connection between discrete and continuous dynamical systems via classical constructs, namely the Poincaré map and suspension flow. This result not only elucidates the relationship between the two types of systems but also validates the natural relevance of these constructs in the study of dynamical systems.

41 Tomoyuki Miyaji (Kyoto Univ.)
Kazuya Okamoto (Waseda Univ.)
Akiyasu Tomoeda (Kansai Univ.)
Neimark–Sacker bifurcation with discrete rotational symmetry and traveling waves 15

Summary: The Neimark–Sacker bifurcation, a codimension-one bifurcation for a fixed point of a map with a pair of complex eigenvalues on the unit circle, leads to the appearance of an invariant closed curve. We show that a branch of traveling waves, which form invariant closed curves, bifurcates by the Neimark–Sacker bifurcation of a homogeneous fixed point provided that the map commutes with the action of the cyclic group. In addition, we discuss a method of numerical continuation of the bifurcating traveling waves and application to a system of delay difference equations proposed by the present authors as a traffic flow model.

42 Mikio Murata (Tokyo Univ. of Agri. and Tech.) Turing patterns appearing in Gray–Scott cellular automaton 15

Summary: A cellular automaton constructed by positive value differentiation and ultradiscretization of the Gray–Scott model generates various non-uniform spatiotemporal patterns through numerical simulation. This spatiotemporal pattern can be considered a Turing pattern in a broad sense. In this presentation, we will report the results of numerical simulations of a two-dimensional Gray–Scott cellular automaton by replacing diffusion parameters, initial concentration, and neighborhoods and grids.

43 Itsuki Watanabe (Waseda Univ.) High density limit for nonlocal cross-diffusion model with self-diffusion 15

Summary: The deterministic limit of a stochastic model of nonlocal cross-diffusion with self-diffusion is considered. The stochastic model is given by two types particle system where the diffusion rate depends on the density of both particle types. In this talk, we reveal its deterministic limit, and show the existence of solution of nonlocal cross-diffusion equation by Markov chain approximation method.

44 Ken Furukawa (RIKEN)
Hiroyuki Kitahata (Chiba Univ.)
Drift-diffusion equations under dynamic boundary conditions for filtration phenomena 15

Summary: We introduce a mathematical model describing the microbial ecosystem in an aquarium. We present a mathematical analysis of the model and numerical simulation results. The model is based on a one-dimensional advection-diffusion equation, a predator-prey model, and dynamic boundary conditions. Dynamic boundary conditions are a type of boundary conditions that include time derivatives in the boundary conditions, unlike the Dirichlet, the Neumann, and the Robin boundary conditions. In this model, the dynamic boundary condition with the fourth boundary condition is considered. This study is based on joint research with Professor Hiroyuki Kitahata of Chiba University.

14:15–14:40 Presentation Ceremony for the 2023 Applied Mathematics Prize

14:50–16:30

45 Yoshihisa Morita (Ryukoku Univ.*)
Shuichi Jimbo (Hokkaido Univ.)
Front propagation and blocking for the bistable reaction-diffusion equation on tree-like metric graphs 15

Summary: We deal with the bistable reaction-diffusion equation on an unbounded metric graph, comprising half-lines and triple junctions, referred to as a tree-like metric graph. Our analysis focuses on the behavior of the entire solution displaying front propagation from the infinity end of a primary branch (half-line). We establish conditions for the existence of standing front solutions that block the front propagation. This blocking depends on not only conditions at the junctions but also the length between neighboring junctions. Additionally, we prove the stability/instability of the standing fronts.

46 Koichi Anada
(Waseda Univ. Senior High School)
Tetsuya Ishiwata
(Shibaura Inst. of Tech.)
Takeo Ushijima (Tokyo Univ. of Sci.)
A Remark on the blow-up rates of curvatures in the area-preserving curvature flow in the plane 15

Summary: We deal with the area-preserving curvature flow in the plane, particularly the blow-up phenomena of curvatures on cusp singularities in contractions of convex immersed curves with self-crossing points. For Abresch–Langer type curves with highly symmetric properties, it has been known that the maximum of curvatures blows up at a finite time under some assumptions. In this talk, we consider the blow-up rates in this case.

47 Masato Kimura (Kanazawa Univ.)
Jingtong Li (Kanazawa Univ.)
Yikan Liu (Kyoto Univ.)
Gen Nakamura
(Hokkaido Univ./Hokkaido Univ.)
Hirofumi Notsu (Kanazawa Univ.)
Yoshihiro Ueda (Kobe Univ.)
Unique existence of weak solution and asymptotic behavior of Zener-type viscoelastic wave equation 15

Summary: We consider a Zener-type viscoelastic wave equation in a bounded domain, which consists of n Maxwell-type viscoelastic components connected in parallel and a dumping term. Based on a physically natural energy dissipation identity, we establish the unique existence of a weak solution and a stability estimate. The proof of the existence of the solution is performed by a compactness argument for the time-discretized solution as the time increment tends to zero. Furthermore, we prove an exponential decay property of the energy as time tends to infinity even for the case without the dumping term.

48 Kota Ohno (Chuo Univ.)
Toshiyuki Ogawa (Meiji Univ.)
Process to reach consensus in Deffuant model 15

Summary: Opinion dynamics, one of the fields of social science, is a multidisciplinary field and has been studied using the mathematical model. Among them, the Deffuant model is widely known, which simply models changes in the opinions of multiple agents. Both consensus and split states are seen as locally stable equilibriums. In this study, we introduce the "non-consensus ratio" to describe the behavior near the critical point through variations of this ratio. Furthermore, we also discuss the process to reach consensus in the modified Deffuant model where distance is introduced for the agent placement.

49 Keiichiro Kagawa (Hokkaido Univ.)
Makoto Okumura (Konan Univ.)
Yasuaki Kobayashi (Hokkaido Univ.)
Duligengaowa Wuergezhen (RIKEN)
Ritsuko Morita (Osaka Univ.)
Hironobu Fujiwara (RIKEN)
Masaharu Nagayama (Hokkaido Univ.)
Numerical simulation to reproduce morphogenesis of hair follicles ···· 15

Summary: In this study, we focus on the morphogenesis of hair follicles, one of the appendages of the skin, in which a two-dimensional placode is transformed into a cylindrical structure. We use a mathematical model incorporating signal diffusion from fibroblasts and plastic deformation of the basement membrane to investigate how the signal affects the mechanical properties of the basement cells and membrane to reproduce the phenomenon of invagination. We hypothesize that only in regions where the signal is strong, basal cells deform vertically and that the basement membrane and dermis are more easily deformed, successfully reproducing the sinking phenomenon. This model will be the basis for future studies on avian hair follicles with projecting geometry and other skin appendages such as the mammary gland.

50 Sungrim Seirin Lee (Kyoto Univ./Kyoto Univ.)
Mathematical dermatology linking eruption morphology and in vivo pathology ····· 15

Summary: Chronic spontaneous urticaria (CSU) is one of the most intractable human-specific skin diseases. However, as no experimental animal model exists, the mechanism underlying disease pathogenesis in vivo remains unclear, making the establishment of a curative treatment challenging. Here, using a novel approach combining mathematical modeling, *in vitro* experiments and clinical data analysis, we demonstrate that the pathological state of CSU patients can be inferred by geometric features of the skin eruptions. Our study not only demonstrates that pathological states of diseases can be defined by geometric features but will also facilitate more accurate decision-making to manage CSU in the clinical setting.

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

Yoshitaro Tanaka (Future Univ.-Hakodate)
Nonlocal evolution equations and approximations by system of partial differential equations

Summary: Many evolutional equations with spatial convolution using suitable integral kernel have been proposed. This type of equation is called the nonlocal evolution equation. Nonlocal evolution equations are analyzed for dispersion of animals and plants, pigmentation patterns in the animal epidermis, and cell migration, and so on. To reveal the relationship between the nonlocal evolution equations and local systems, we approximate the nonlocal evolution equations by systems of partial differential equations. We show that the nonlocal evolution equations with two types of convolution can be approximated by a multi-component reaction-diffusion system and Keller–Segel system, respectively. From this theory, we explain that dealing with a nonlocal interaction is in a sense equivalent to dealing with local dynamical system.

March 20th (Wed) Conference Room IX

9:50–12:00

51 Takashi Furuya (Shimane Univ.) Globally injective and bijective neural operators ····· 10

Summary: Recently, there has been great interest in neural operators, which learn operators between infinite-dimensional function spaces. Given their discretization-invariance property, neural operators have been remarkably successful, especially in learning solution operators for partial differential equations (PDEs). In this talk, we show that injective neural operators are universal approximators of continuous operators. This holds substantial relevance to inverse problems in PDEs, as injective neural operators can serve invertible surrogate models for solution operators, which, in general, is not injective due to ill-posnedss of inverse problems. This is joint work with Michael Puthawala (South Dakota State University), Matti Lassas (University of Helsinki), and Maarten V. de Hoop (Rice University).

52 Jumpei Nagase (Univ. of Electro-Comm.) ReLU function representability by piecewise nonlinear functions ····· 15

Summary: As a discussion on the representability of deep neural network models, we discuss the condition that the ReLU function can be represented by a composition of non-linear functions and affine functions. If the activation function is representable of the ReLU function, then the deep neural network model is possible to transform any linear connection into a multilayer perceptron model. And since it is possible to express the design of that model architecture down as a parameter constraint, representability of the ReLU function is an important concept in the systematic discussion of deep neural network models. Specific conditions are the case by linear combination of functions and the case by composition of functions.

53 Takeshi Gotoda (Tokyo Tech) Numerical study of enstrophy variation on filtered-Euler flows ····· 15

Summary: We investigate enstrophy variation in an incompressible and inviscid flow through point-vortex solutions of the 2D filtered Euler equations, which are a regularized 2D Euler equations. The preceding results have shown that there exist three point-vortex solutions converging to self-similar collapsing solutions of the point-vortex system and dissipate the enstrophy in the zero limit of a filter scale. In this study, we numerically show that the enstrophy dissipation could occur for certain four and five point-vortex solutions in that limit.

54 Yuuki Shimizu (Univ. of Tokyo) Impact of curvature on a point vortex ····· 15

Summary: Towards quantifying the impact of curvature variations on a point vortex, we discuss some dynamical properties of the point vortex on continuously differentiable surfaces obtained by gluing two different constant-curvature surfaces.

55 Takehiko Kinoshita (Saga Univ.)
Yoshitaka Watanabe (Kyushu Univ.)
Mitsuhiro T. Nakao (Waseda Univ.)
Regarding the matrix 2-norm of real 2×2 matrices and improved convergence order of norm for approximate inverse operetors ····· 15

Summary: We report that we have improved the convergence order of norm for approximate inverse operetors reported in [1].

56 Takeshi Terao (Kyushu Univ.)
Yoshitaka Watanabe (Kyushu Univ.)
Katsuhisa Ozaki (Shibaura Inst. of Tech.)
Numerical verification method of the approximate inverse operator norm for infinite-dimensional linear operators ····· 15

Summary: In this talk, we present a verified singular value estimation, especially an enclosure of the spectral norm for the approximate inverse operator norm for infinite-dimensional linear operators. Enclosures of the spectral norm give important information in the computation of rigorous error bounds for the solution of ordinary and partial differential equations.

57 Makoto Okumura (Konan Univ.) On the regularity of a matrix appearing in the proof of the solvability of a structure-preserving scheme under dynamic boundary conditions 15

Summary: Recently, the Cahn–Hilliard equation with dynamic boundary conditions that consider the Cahn–Hilliard equation even on the boundary has been proposed by Goldstein–Miranville–Schimperna (GMS). This model has characteristic conservation and dissipation laws. In the previous study, we proposed a structure-preserving scheme for the two-dimensional GMS model that retained the above laws in a discrete sense and proved its solvability. In the proof, it is necessary to show the regularity of a certain matrix, which was derived conditionally. Concretely, we clarified at least how small the time mesh size should be according to the space mesh sizes to make the mapping well-defined. In this study, we have unconditionally proved the regularity of the matrix in a particular case. In this talk, we talk about the result.

58 Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Daisuke Ito (Shibaura Inst. of Tech.)
Taichi Shiga
Monotonicity-preserving numerical scheme for fractional advection equation 15

Summary: The fractional advection equation is a time nonlocal equation that refers to the solution history; that is, it is a delay partial differential equation. In this talk, we propose a finite difference scheme that reproduces the monotonicity of the solution to the fractional advection equation and show theoretical results and some numerical demonstrations.

14:15–15:25

59 Fumio Kikuchi (Univ. of Tokyo*)
Xuefeng Liu
(Tokyo Woman's Christian Univ.)
Techniques for hypercircle-based error estimation of finite element solutions 15

Summary: Kikuchi and H.Saito once proposed an a priori error estimation method for finite element solutions using $P_1$and Raviart–Thomas $H(div)$ triangular elements. Recently, we have found that improved results can be obtained and simplified technique introduced there is justified. We explain outline of the theory with its analysis and give numerical results for a few sample problems. Reasonable coincidence between theory and numerical results is observed, so that the proposed method and techniques are really effective. Our methodology is applicable to higher degree triangular and rectangular elements and also a posteriori estimation.

60 Aufa Numan Fadhilah Rudiawan (Kanazawa Univ.)
Alexandr Žák (Czech Tech. Univ. in Prague)
Michal Beneš (Czech Tech. Univ. in Prague)
Masato Kimura (Kanazawa Univ.)
Hirofumi Notsu (Kanazawa Univ.)
A finite element scheme for a multiphase flow model 15

Summary: A numerical scheme for a multi-phase flow model describing sedimentation phenomena is presented. The unknown functions of the model are the velocities and the volume fractions of the N-phases and the common pressure, where N is the number of fluid phases. After introducing an energy estimate of the model, a stability result of the scheme and two-dimensional numerical results are also presented.

61 Tokuhiro Eto (Univ. of Tokyo)
Harald Garcke (Univ. of Regensburg)
Robert Nürnberg (Univ. of Trento)
A structure-preserving parametric finite element method for the multi-phase Mullins–Sekerka problem with triple junctions · · · · · · · · · · · · · · · · 15

Summary: We consider a sharp interface formulation for the multi-phase Mullins–Sekerka flow. Making use of a variational formulation, we introduce a fully discrete finite element method. Our discretization features a parametric approximation of the moving interfaces that is independent of the discretization used for the equations in the bulk. The scheme can be shown to be unconditionally stable and to satisfy an exact volume conservation property. Moreover, an inherent tangential velocity for the vertices on the discrete curves leads to asymptotically equidistributed vertices, meaning no remeshing is necessary in practice. Several numerical examples, including a convergence experiment for the three-phase Mullins–Sekerka flow, demonstrate the capabilities of the introduced method.

62 Karel Svadlenka (Tokyo Metro. Univ.)
On an approximation scheme for anisotropic interfacial motion on obstacle · 15

Summary: We consider L^2 gradient flow of anisotropic surface energy in the presence of an obstacle and possibly a volume constraint. With the twofold purpose of existence proof and numerical implementation, we introduce a thresholding approximation scheme employing anisotropic kernels, and investigate its properties, such as stability, convergence and Gamma-convergence of the corresponding approximate energies. We also show numerical simulations of motions involving topology changes.

15:40–16:40 Talk Invited by Applied Mathematics Section

Yikan Liu (Kyoto Univ.)
On solution dynamics of coupled systems and semilinear problems of time-fractional diffusion equations

Summary: The last decade has witnessed explosive developments and gradual saturation of nonlocal models from various practical backgrounds. As a popular representative, partial differential equations with fractional derivatives in time have gathered considerable attentions among applied mathematicians. Recently, linear theory for fractional diffusion equations with time derivatives in $(0, 1)$ has been well established, followed by extensive researches on related numerical methods and inverse problems. This motivates the generalizations of studies from single equations to coupled systems and from linear to nonlinear problems.
Started with a brief survey on existing results on time-fractional partial differential equations, this talk is concerned with the solution dynamics of their coupled and semilinear counterparts. For coupled time-fractional diffusion systems, we obtain a sharp estimate for the long-time asymptotic behavior of solutions by the Laplace transform. Further, we discover a new decay pattern by the coupling of non-fractional and fractional diffusion equations. For time-fractional diffusion equation with superlinear convex semilinear terms including Fujita type nonlinearity u^p, we show the blow-up of solutions and provide upper estimates of the blow-up times by a comparison principle.

Topology

March 17th (Sun) Conference Room V

9:30–11:10

1 Takahiro Oba (Osaka Univ.) Symplectic fillings of unit cotangent bundles of spheres ····· 15
Myeonggi Kwon (Jeonbuk National Univ.)

Summary: This talk is concerned with symplectic fillings of contact manifolds. After briefly giving an overview of results on the topology of symplectic fillings, I will present joint work with Myeonggi Kwon, in which we give some topological restrictions on symplectic fillings of unit cotangent bundles of spheres S^n and show the uniqueness of diffeomorphism types of them, under some condition, for the case $n = 3$. Also, I will explain an application of our result to exact symplectic cobordisms.

2 Naoyuki Monden (Okayama Univ.) Geography of symplectic 4-manifolds admitting Lefschetz fibrations ·· 15
Anar Akhmedov (Univ. of Minnesota)

Summary: Ruled surfaces play an important role in the theory of Lefschetz fibrations. In fact, Lefschetz fibrations on blow-ups of ruled surfaces have given many interesting examples. In this talk, using them, we give Lefschetz fibrations on minimal symplectic 4-manifolds with arbitrary finitely presented fundamental groups that violate the Noether inequality.

3 Naoyuki Monden (Okayama Univ.) Ruled surfaces and indecomposable Lefschetz fibrations ····· 15
Anar Akhmedov (Univ. of Minnesota)

Summary: In this talk, we give a relation among the genus of the base space of blow-ups of a ruled surface admitting a Lefschetz fibration, the number of blow-ups and the genus of the Lefschetz fibration. Using this relation, we obtain a condition for a Lefschetz fibration to be fiber sum indecomposable. Moreover, we give fiber sum indecomposable Lefschetz fibrations on minimal total spaces.

4 Tatsumasa Suzuki (Tokyo Tech) $P_{a,b}$-surgery on 4-manifolds ····· 15
Motoo Tange (Univ. of Tsukuba)

Summary: In 2004, Iwase and Matsumoto introduced pochette surgery. In 2018, Nakamura introduced a generalization of pochette surgery called $P_{a,b}$-surgery. A $P_{a,b}$-surgery on a 4-manifold X is an operation of removing the interior of the boundary sum $P_{a,b} = \natural^a S^2 \times D^2 \natural^b S^1 \times D^3$ of a $S^2 \times D^2$ and b $S^1 \times D^3$ embedded in X from X and gluing $P_{a,b}$ to $X - \operatorname{int} P_{a,b}$ by a diffeomorphism of $\partial P_{a,b}$. $P_{1,1}$-surgery is nothing but pochette surgery. In this talk, we introduce identification factors of the diffeomorphism type of any $P_{a,b}$-surgery on any 4-manifold by Nakamura. Furthermore, we compute the homology groups of any $P_{a,b}$-surgery of the 4-sphere with a trivial embedding. We also show that any finitely generated group is isomorphic to the fundamental group of a $P_{a,b}$-surgery on a simply connected 4-manifold.

5 Tsukasa Isoshima (Tokyo Tech) Trisections of the doubles of some Mazur type 4-manifolds ····· 15

Summary: A trisection is roughly a decomposition of a closed, oriented, smooth 4-manifold into three 4-dimensional 1-handlebodies. A trisected 4-manifold can be described by a trisection diagram that consists of a closed, oriented surface and certain three kinds of cut systems on the surface. A Mazur type 4-manifold is a compact, contractible, smooth 4-manifold admits a handle decomposition that consists of only single 0-, 1-, and 2-handle. It is known that the double of each Mazur type is diffeomorphic to S^4. In this talk, we show that certain trisection diagrams of the doubles of the Mazur types introduced by Akbulut and Kirby are standard.

6 Masaki Ogawa (Tohoku Univ.) Weinstein trisections of trivial surface bundles 10

Summary: Trisection is a decomposition of a closed, oriented 4-manifold. Recently, a trisection which has a symplectic property is introduced by Lambert-Cole, Meier and Starkston. This trisection is called a Weinstein trisection. They showed that any closed 4-manifold with symplectic structure admits a Weinstein trisection. But there only a few example of Weinstein trisection. In this talk, I introduce Weinstein trisections of product of two closed surfaces.

11:20–12:00 Research Section Assembly

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

Masaaki Ue (Kyoto Univ.*) Constraints on intersection forms of 4-manifolds with given boundary in terms of Gauge theoretical invariants

Summary: For any closed 3-manifold Y, there exists a compact 4-manifold X bounded by Y. We discuss constraints on the intersection form of X (in particular when X is spin) in terms of several invariants of Y derived from Gauge theory, including Seiberg–Witten and Heegaard Floer theories. We mainly focus on Manolescu's κ-invariant of Y.

15:40–17:30

7 Atsuhide Mori (Osaka Dent. Univ.) A model of linguistic minimalism 15

Summary: In this presentation, I will propose an easy topological model of what the external and internal merges in the generative linguistics are doing in the real brain and examine the need for formal techniques in a recent development of linguistic minimalism.

8 Teruaki Kitano (Soka Univ.) On linear representations of a surface group of genus 2 into $SL(2;\mathbb{Z}[1/2])$
Marina Shibata (Soka Univ.) with a nontrivial real Euler class 10

Summary: Milnor proved that there exists a flat real $\mathbb{R}^2$-vector bundle over a closed orientable surface of genus $g > 1$ with non-trivial Euler number in 1958. This was proved by giving a representation from the fundamental group of a surface in $SL(2;\mathbb{R})$. Here $SL(2;\mathbb{R})$ acts on the plane linearly and then does on the unit circle. Hence the above result implies that the real Euler class is nontrivial on $SL(2;\mathbb{R})$, which is defined originally in the homeomorphism group of the circle. Further as Sullivan mentioned in 1975, Milnor's construction was done implicitly on $SL(2;\mathbb{Z}[1/2])$. In this talk, we give concrete examples of representations in $SL(2;\mathbb{Z}[1/2])$ with nontrivial Euler number. This is a joint work with Marina Shibata(Soka univ.).

9 Ryoma Kobayashi (Ishikawa Nat. Coll. of Tech.) Generating sets for the level d mapping class group of a compact non-orientable surface 15

Summary: The level d mapping class group $\mathcal{M}_d(S)$ of a surface S is the subgroup of the mapping class group of S consisting of mapping classes acting trivially on $H_1(S;\mathbb{Z}_d)$. In this work, we gave a normal generating set of $\mathcal{M}_d(N_{g,n})$ for a genus $g \geq 4$ compact non-orientable surface $N_{g,n}$ with $n \geq 0$ boundaries. In addition, we can construct a finite generating set of $\mathcal{M}_d(N_{g,n})$ for $n \geq 1$, from a finite generating set of $\mathcal{M}_d(N_{g,0})$ by induction on n.

10 So Yamagata (Fukuoka Univ.) Presentation of the pure braid group and section of the braid arrangement ····· 15

Summary: In1891, Hurwitz introduced the (pure) braid group as the fundamental group of the configuration space of points in the complex plane.
Later, in 1925, Artin studied the algebraic and geometric perspectives of braids. In particular, he gave a presentation of the braid group, which is now recognized as a standard one. He also studied the pure braid group and gave its presentation. However, it is much more complicated than the one of the braid group. Thus, there is nothing better than to have a simple to look and intuitive presentation of the pure braid group.
In my talk, even though there is no new presentation, we connect two different approaches to the pure group: from group theory and from hyperplane arrangement.

11 Xiaobing Sheng (Okinawa Inst. of Sci. and Tech. Grad. Univ.) Some experimental results on knots and links constructed from Thompson's group F a la Jones ····· 15

Summary: Vaughan Jones motivated by an attempt to develop new conformal field theory, obtained a sequence of results related to Thompson's groups F. One of the results is the concrete construction of knots and links from Thompson's group F and the oriented Thompson's group as an analogue of the results on braid groups. Aiello and Baader investigated knots and links constructed from certain positive words in F and they proved that the so-called positive oriented Thompson links are arborescent.
We present a sequence of computational results on certain sequences of knots from certain sequences of words and we also provide a way of estimating the number of crossings from the group theoretic property.

12 Haru Negami (Chiba Univ.) Generalization of the twisted Long–Moody construction ····· 15

Summary: The Long–Moody construction is a method for obtaining a representation of the braid group from a given representation of the semidirect product of the free group and the braid group defined by Artin representation. Artin representation has a geometric realization such as the transformation of the loops on a closed disk with n points. Wada generalized the Artin representation, which is called Wada-type representation, and obtained the group invariants of links.
We extended the Long–Moody construction to obtain an infinite series of representations of the braid groups and named it as twisted Long–Moody construction. In this talk, we further extend the method to some of the Wada-type representations. We then discuss the connection between this construction and the unitarity of the representation.

March 18th (Mon) Conference Room V

9:30–10:00

13 Toshiyuki Akita (Hokkaido Univ.), Sota Takase (Hokkaido Univ.) Groups having Wirtinger presentations and the second group homology ····· 10

Summary: Kuz'min (1996) characterized groups having Wirtinger presentations in relation to their second group homology. We further refine the connections between these groups and their second group homology.

14 Masahiko Yoshinaga (Osaka Univ.), Yu Tajima (Hokkaido Univ.) Causal order complex and magnitude homotopy type ····· 15

Summary: The magnitude homology group of a metric space was introduced by Hepworth, Willerton, Leinster and Shulman. In this talk, for a given metric space, we construct a pair of simplicial complexes whose homology group is isomorphic to the magnitude homology group. The construction is based on the causal order on the metric space-time and its order complex.

March 18th (Mon) Conference Room IV

10:10–10:25 Presentation Ceremony for the 2023 MSJ Geometry Prize

10:30–11:30 Award Lecture for the 2023 MSJ Geometry Prize

Kento Fujita (Osaka Univ.) ♭ On criteria for the K-stability of Fano varieties

Summary: We survey recent progress on K-stability of Fano varieties.

March 18th (Mon) Conference Room V

13:00–14:00

15 Naotsugu Chinen (Nat. Defense Acad. of Japan)
Takamitsu Yamauchi (Ehime Univ.)
Equivariant asymptotic dimension, asymptotic dimension and covering dimension ····· 15

Summary: We consider the following question. For a free action $\Gamma \curvearrowright X$ of a discrete group Γ on a normal space X with $\mathrm{ead}(\Gamma \curvearrowright X) < \infty$, does the inequality $\mathrm{ead}(\Gamma \curvearrowright X) \leq \mathrm{asdim}\,\Gamma + \dim X$ hold? We give the following positive partial answer. If Γ is locally finite, then $\mathrm{ead}(\Gamma \curvearrowright X) \leq \dim X$ (without the assumption $\mathrm{ead}(\Gamma \curvearrowright X) < \infty$). In particular, if X is the n-dimensional sphere, then $\mathrm{ead}(\Gamma \curvearrowright X) = n$.

16 Yasushi Hirata (Kanagawa Univ.)
Yukinobu Yajima (Kanagawa Univ.*)
Weak D-space properties on products with metric spaces ····· 15

Summary: In this talk, we discuss weak D-space properties on products with metric spaces. We obtain the result that for each normal product space $X \times Y$ with a metric space Y, (1) if X is a collectionwise Hausdorff aD-space, then $X \times Y$ is an aD-space, (2) if X is an irreducible space, then $X \times Y$ is irreducible.

17 Yasushi Hirata (Kanagawa Univ.)
Yukinobu Yajima (Kanagawa Univ.*)
Weak D-space properties on infinite products ····· 15

Summary: In this talk, we discuss weak D-space properties on infinite products. We obtain the result that (1) the Σ-product of arbitrary many copies of $\mathbb{I}$ is dually discrete, where $\mathbb{I} = [0, 1]$ is the closed interval in the real line, (2) if κ is an infinite cardinal such that there is no weakly inaccessible cardinal $\leq \kappa$, then $\mathbb{N}^\kappa$ is irreducible, where $\mathbb{N} = \{0, 1, 2, \cdots\}$ is the countable discrete space.

March 19th (Tue) Conference Room V

9:30–12:00

18 Katsumi Ishikawa (Kyoto Univ.)
Takayuki Morifuji (Keio Univ.)
Masaaki Suzuki (Meiji Univ.)
Twisted Alexander vanishing order of knots ····· 10

Summary: We define the twisted Alexander vanishing order of a knot to be the order of the smallest finite group such that the corresponding twisted Alexander polynomial is zero. In this talk, we show its basic properties.

19 Hiroshi Goda (Tokyo Univ. of Agri. and Tech.)
Takayuki Morifuji (Keio Univ.)
Chirality of hyperbolic knots and twisted Alexander polynomials ····· 10

Summary: In this talk, we report a relationship between the chirality of knots and higher-dimensional twisted Alexander polynomials associated with holonomy representations of hyperbolic 3-cone-manifolds. In particular, we provide a new necessary condition for a knot, that appears in a hyperbolic 3-cone-manifold of finite volume as a singular set, to be amphicheiral. Moreover, we can detect the chirality of hyperbolic twist knots, according to our criterion, using low-dimensional irreducible representations.

Summary: An annihilating polynomial of the colored Jones polynomial for a knot is conjectured to produce the A-polynomial when made into a commutative polynomial by putting $q = 1$ (AJ conjecture). In this talk, we give an annihilating polynomial of the colored Jones polynomial for the Whitehead link. We observe that a kind of A-polynomial appears when we make the annihilating polynomial into a commutative polynomial as in the AJ conjecture. We also give another annihilating polynomial for the Whitehead link that is alternating under the transposition of colors.

Summary: The knot quandle is known to be a complete invariant for oriented classical knots up to orientation. Eisermann computed the second quandle homology group of the knot quandle and showed that it characterizes the unknot. In this talk, we compute the second quandle homology group of the knot n-quandle for each integer $n > 1$, where the knot n-quandle is a certain quotient of the knot quandle. Although the knot n-quandle is weaker than the knot quandle, the second homology group of the former is found to have more information than that of the latter.

Summary: Two (full) knot Floer complexes are called stably equivalent if they can be made to become filtered chain homotopy equivalent by adding an acyclic complex to each complex. Hom showed that if two knots are concordant, then their knot Floer complexes are stably equivalent. In this talk, we construct infinitely many mutually non-concordant hyperbolic knots whose knot Floer complex is stably equivalent to that of a $(3, q)$-torus knot. In particular, the upsilon invariant of such knots is convex. This gives a new answer to Borodzik and Hedden's question of for which knots is the upsilon invariant a convex function.

Summary: For a non-arithmetic Kleinian group $\Gamma < \mathrm{Isom}(\mathbb{H}^3)$, the commensurator $C(\Gamma) < \mathrm{Isom}(\mathbb{H}^3)$ is the (unique) maximal group commensurable with Γ. Few examples of computation of commensurators of cocompact Kleinian groups are known. Let L_n be the Löbell polyhedron, which is a compact polyhedron with $2n + 2$ faces, and $\Gamma(L_n)$ the subgroup of $\mathrm{Isom}(\mathbb{H}^3)$, generated by the reflections in the faces of L_n. In this talk, I will show the calculation of the commensurators $C(\Gamma(L_n))$ for $n \geq 61$.

Summary: Ahara and Suzuki proved that an integral region choice problem for a knot projection is solvable. This result does not hold for replacing "knot projection" with "link projection". In this talk, we introduce a diagrammatic characterization to solve an integral region choice problem for a link projection.

Summary: For a closed piecewise linear (PL) curve in $\mathbf{R}^2$, a geometric transformation called a panorama view is applied to show two basic formulae on the shape of the curve by Crofton and by Banchoff. We note that for a simple PL curve, a sequence of polygons can be obtained by which one can describe the organizations of so called hollows of the curve.

Summary: We consider a strongly mixed weighted homogeneous polynomial $f := f_{2,2,1,2,1,4}$ $(k = 3) = z_2^2\bar{z}_2 - 6z_1^2z_2\bar{z}_2 + 11z_1^2\bar{z}_1^2z_2 - 6z_1^4\bar{z}_1^2$ of type J_{10}^-. We first show that $f := f_{2,2,1,2,1,4}$ $(k = 3)$ is strongly Newton non-degenerate. We next consider the toric modification $\hat{\pi} : X \to \mathbb{C}^2$ associated with the regular simplicial cone subdivision Σ^* which is admissible for the dual Newton diagram $\Gamma^*(f)$ of f. Then it is concluded that the strict transform $\tilde{V}$ via the toric modification $\hat{\pi}$ of the mixed hypersurface singularity $V := f^{-1}(0)$ is not only a real analytic manifold outside of $\tilde{V} \cap \hat{\pi}^{-1}(\mathbf{0})$ but also a real analytic manifold as a germ at $\tilde{V} \cap \hat{\pi}^{-1}(\mathbf{0})$.

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

Mayuko Yamashita (Kyoto Univ.)♭ Topological Modular Forms and supersymmetric quantum field theories

Summary: In this talk I will explain my works with Y. Tachikawa and T. Johnson-Freyd to give a bridge between physics and homotopy theory, especially the theory of Topological Modular Forms (TMF). TMF is an E_∞ ring spectrum which has deep and rich structure from homotopy-theoretical viewpoints. On the other hand, TMF is relevant in physics because it is conjectured by Stolz and Teichner to classify two-dimensional supersymmetric quantum field theories (SQFTs). We originally started from applying TMF to a problem in superstring theory, but investigating it further, we have found many interesting mathematical results on TMF out of physical motivations.

In the first work (https://arxiv.org/abs/2108.13542) with Tachikawa we used TMF to prove the vanishing of anomalies in heterotic string theory. After that, N. Kawazumi suggested considering a secondary transformation of spectra arising from the vanishing result. This idea turns out to be crucial; we found that the secondary transformation coincides the Anderson duality of TMF. This result allows us to detect subtle torsion phenomena in TMF by differential-geometric ways, and leads us to new conjectures on the relation between VOAs and TMF (https://arxiv.org/abs/2305.06196). Moreover, in the work-in-progress with T. Johnson-Freyd, we found a new explanation of the mysterious 576-periodicity in TMF and SQFTs. In the talk, I explain this exciting interplay between physics and mathematics.

Infinite Analysis

March 19th (Tue) Conference Room VIII

9:30–11:30

1 Mizuki Mori (Ochanomizu Univ.)
Kouichi Takemura (Ochanomizu Univ.)
Three-term recurrence relations and Heun equations · · · · · 15

Summary: Heun's differential equation is a standard form of the second order Fuchsian differential equation with four singularity, and it has an accessory parameter. We investigate the coefficients of the local holomorphic solution to Heun's differential equation around the origin. We use the facts that the coefficients are polynomials on the accessory parameter and they satisfy a three-term recurrence relation.

2 Yumi Arai (Ochanomizu Univ.)
Solutions to q-hypergeometric equations associated with q-middle convolution · · · · · 15

Summary: We investigate the integral representations of solutions to q-hypergeometric equation and its variant obtained through q-middle convolution by using transformation formulas for q-hypergeometric series. We show the correspondence between these integral solutions and solutions obtained through other methods. We also show the linear relationships among the integral solutions.

3 Takahiko Nobukawa (Kobe Univ.)
Taikei Fujii (Kobe Univ.)
Connection problem for the variant of q-hypergeometric equation of degree three · · · · · 15

Summary: The variant of q-hypergeometric equation of degree three is introduced by Hatano–Matsunawa–Sato–Takemura (Funkcial. Ekvac., 2022) from the viewpoint of quantum integrable systems. Euler-type integral solutions and hypergeometric series solutions are obtained by Fujii–Nobukawa (arXiv:2207.12777). The main purpose of this talk is to give linear relations for the integral solutions. As an application, we get a three term relation for the very-well-poised q-hypergeometric function ${}_8W_7$.

4 Sanefumi Moriyama (Osaka Metro. Univ.)
ABJM matrix models and q-Painlevé equations · · · · · 15

Summary: It was known that sometimes Painlevé equations have solutions of matrix models. We conjecture that a certain matrix model solves the sixth q-Painlevé equation. This matrix model originates from a three-dimensional superconformal Chern–Simons theory which describes multiple M2-branes in M-theory. The partition function of this theory reduces to a matrix model using the localization theorem. After moving to the grand canonical ensemble by introducing the fugacity dual to the overall rank, we find the grand canonical partition function serves as the tau function and solves the 40 bilinear relations of qPVI. This talk is based on works with Tomoki Nosaka, JHEP08(2023)191.

5 Yousuke Ohyama (Tokushima Univ.)
Mano's decomposition and q-Painlevé equations · · · · · 15

Summary: We study connection formula of several types of q-Painlevé equations. Mano's decomposition, which is a q-analogue of Jimbo's decomposition theorem, is a powerful tool to study global theory on q-Painlevé equations. We show existence of solutions given by formal double power series for the q-Painlevé equations. In degenerated cases, some confluent basic hypergeometric functions appear after decomposing the Lax pairs.

6 Tetsu Masuda (Aoyama Gakuin Univ.)
An explicit formula for the discriminants of the Umemura polynomials of the Painlevé V equation · · · · · 15

Summary: We present a combinatorial formula for the discriminants of the Umemura polynomials associated with a family of rational solutions to the Painlevé V equation.

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

Ryo Okawa (Osaka Metro. Univ./Kyoto Univ.) Non-stationary difference equation and affine Laumon space

Summary: In the first half of the talk, we will introduce the joint work with Awata, Hasegawa, Kanno, Shakirov, Shiraishi, and Yamada. We explain the theorem that the affine Laumon partition function is a solution of the Shakirov equation. The Shakirov equation is gauge equivalent to the quantized q-difference Painlevé VI equation proposed by Hasegawa. It is also identified with the quantum Knizhnik–Zamolodchikov(q-KZ) equation for $U_q(A_1^{(1)})$. In the latter half of the talk, we would like to introduce the joint work with Shiraishi, and point out the similarity between the Shakirov equation and the wall-crossing formula.

March 20th (Wed) Conference Room VIII

9:30–11:30

7 Masahiko Yoshinaga (Osaka Univ.), Misha Feigin (Univ. of Glasgow), Zixuan Wang (Hokkaido Univ.) Integral expressions of logarithmic vector fields for multiarrangements 15

Summary: The explicit construction of the logarithmic vector fields for hyperplane arrangements with multiplicity is a hard problem in general. In this talk, we will discuss integral expression of them.

8 Saburo Kakei (Rikkyo Univ.) Solutions to the KP hierarchy with an elliptic background 15

Summary: A class of "elliptic soliton" solutions of the Kadomtsev–Petviashvili hierarchy, which includes a determinantal solution of Li and Zhang, is described in terms of pseudo-differential operator formulation. Real-valued solutions are discussed and various examples that display web-like patterns are presented.

9 Genki Shibukawa (Kobe Univ.), Masatoshi Noumi (Rikkyo Univ.) Ruijsenaars-type identities and their applications 15

Summary: We prove some identities, which we call *Ruijsenaars-type identities*, and show their applications such as 1) commutativity of some difference operators and 2) Weyl group symmetry of the Tableau representation of interpolation polynomials.

10 Ryo Takenaka (Osaka Metro. Univ.) On exponents associated with Y-systems 15

Summary: Let $\mathfrak{g}$ be a finite dimensional simple Lie algebra and X be its Dynkin diagram. Associated with X and a positive integer ℓ such that $\ell \geq 2$, Kuniba and Nakanishi introduced a system of algebraic relations called Y-system. It has been proved that solutions of the Y-system have periodicity. Based on this result, Mizuno introduced a notion of exponent and gave a conjectual formula expressing the exponents for any (X, ℓ). He also gave a proof for (A_1, ℓ) and $(A_r, 2)$. In this talk, we show results for some other Dynkin types and level $\ell = 2$.

11 Ryota Akagi (Nagoya Univ.) Ordered product expressions of rank 2 cluster scattering diagrams 15

Summary: We focus on cluster scattering diagrams, which were introduced in recent years. They are closely related to cluster algebras. By Nakanishi's study, it was clarified that dilogarithm elements play an important role in cluster scattering diagrams. In particular, for rank 2 cases, every cluster scattering diagram is recovered by a (possibly infinite) product of dilogarithm elements, which is called ordered product of dilogarithm elements. In this talk, we show some result for these ordered products.

Summary: We construct new solutions to the tetrahedron equation and the 3D reflection equation, by developing the recent study by Sun and Yagi on the tetrahedron equation applying quantum cluster algebras.

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

Katsushi Ito (Tokyo Tech) ODE/IM correspondence and exact WKB analysis in quantum mechanics

Summary: The ODE/IM correspondence, which was found by P. Dorey and R. Tateo in 1998, provides a non-trivial relation between the spectral problem of ordinary differential equations and the functional relation approach in the quantum integrable system. This relation clarifies also the relation between the exact WKB analysis of one-dimensional quantum mechanics and the Thermodynamic Bethe Ansatz (TBA) equation in two-dimensional quantum integrable theory. The Voros symbols in the exact WKB analysis correspond to the Y-functions. In this talk, we review the ODE/IM correspondence for the Schrödinger equation with polynomial potential. The associated TBA equations show the wall-crossing phenomena under the deformation of the potential, which describes a detailed structure of the correspondence. We also discuss a generalization to higher-order ODE.