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The Mathematical Society of Japan

2022 Annual Meeting

Titles and Short Summaries of the Talks

March, 2022

at Saitama University

2022 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 28th (Mon)–31st (Thu), 2022

Supported by: Saitama University

Venue: Saitama University
Shimo-Okubo 255, Sakura-ku, Saitama-shi

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The Mathematical Society of Japan

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Plenary Talks

March 29th (Tue) 1-301, 3F, 1st Lecture Hall

Award Lecture for the 2022 MSJ Spring Prize

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

Yoshiko Ogata (Univ. of Tokyo) Classification of gapped ground state phases in quantum spin systems ..... (16:45–17:45)

Summary: Recently, classification problems of gapped ground state phases attract a lot of attention in quantum statistical mechanics. We explain about our operator algebraic approach to these problems.

Featured Invited Talks

March 28th (Mon)

Conference Room II

Yuichi Yoshida (Nat. Inst. of Informatics) Spectral theory for directed graphs and hypergraphs ····· (13:00–14:00)

Summary: The usual spectral graph theory is a theory for undirected graphs that considers a matrix called the Laplacian and uses its eigenvalues and eigenvectors to reveal the properties of the graph. In practical applications, however, directed graphs, which have orientated edges, and hypergraphs, which can contain more than three vertices in a single edge, are also very important objects. To fill this gap, spectral theory for directed graphs and hypergraphs has recently been developed, and various results such as clustering and sparsification were obtained. Laplacians for directed graphs and hypergraphs are not matrices (i.e., linear operators), but nonlinear (multivalued) operators, and key mathematical tools that help us to analyze those Laplacians are the theories of submodular functions and monotone operators. In this talk, I will review these progresses and discuss future outlook.

Conference Room III

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Taiji Suzuki (Univ. of Tokyo) Mathematical theories of deep learning ····· (13:00–14:00)

Summary: In this talk, I present mathematical theories of deep learning, especially, I discuss how deep learning can outperform shallow learning methods such as kernel methods and show its connection to classic statistics/machine-learning theories such as "sparseness." First, I will introduce some examples in which deep learning can outperform the shallow methods, in which sparsity and non-convex geometry of the target function space play the essential role. Next, I present a deep learning optimization theory based on a noisy gradient descent, and show how it can achieve the global optimal solution. Theoretical tools from the probability theory such as stochastic differential equations and Wasserstein geometry play the key role. Throughout the talk, I also discuss the limitation of the current theory to explain the behavior of deep learning.

Conference Room IV

Kenji Ueno (Yokkaichi Univ./Kyoto Univ.*) Yang Hui suanfa and Seki Takakzu ····· (13:00–14:00)

Summary: This talk will focus mainly on the Yang Hui suanfa and discuss how it influenced the mathematics of Seki Takakazu, such as the summation of infinite geometric series, the numerical solution of algebraic equations (Seki–Horner method), and equation theory. Yang Hui was a mathematician active in the Southern Song dynasty in the second half of the 13th century. His three books, published in the 1270s, were compiled in the Ming dynasty and published in 1378 as the Yang Hui suanfa. In this book, counting rods was used as the basis of calculation. However, as the abacus became popular in China, the counting rods was no longer used and the Yang Hui suanfa was lost. The book was reprinted in Korea, and the edition published in 1433 was brought to Japan, where it can still be seen today. This book is considered by historians of mathematics to be an elementary textbook, as it describes how to calculate with counting rods and how to solve equations using counting rods. From a mathematical point of view, however, the first chapter, in which the method of rapid arithmetic is described, is very interesting because it describes how to calculate using various properties of integers. In addition, the method for solving quadratic and degree 4 equations using counting rods in Yang Hui suanfa contains instructions on how to move the rods, which may have helped Seki Takakazu to understand the Tianyuan shu.

Seki Takakazu studied and transcribed this Yang Hui snafu. This transcription is not a mere copy of the original, but a kind of revised edition, in which he corrected errors in the solution, corrected textual errors in the original, and changed the order of the chapters according to the year of publication. Although the original manuscript by Seki Takakazu has been lost, two manuscripts have survived. There are subtle differences between the two manuscripts, such as the different dates of Seki's transcriptions. By comparing the two manuscripts, this talk will show that the two manuscripts may be copies of the same manuscript, and will clarify the dating of Seki Takakazu's manuscript.

March 30th (Wed)

Conference Room II

Masahiro Kubo (Wakayama Univ.) Time-dependent subdifferential evolution equations and quasi-variational evolution equations ····· (13:00–14:00)

Summary: We review the theory of time-dependent subdifferential evolution equations and its application to quasi-variational evolution equations. The key concept is the energy inequality satisfied by the solution of the evolution equation. We consider evolution equations of parabolic as well as elliptic-parabolic types.

Conference Room IV

Kimihiko Motegi (Nihon Univ.) Twisting knots and twisting Dehn surgeries ····· (13:00–14:00)

Summary: Let K be a knot in the 3-sphere S^3. Take a trivial knot c disjoint from K. Cutting K along a disk bounded by c, and connecting it again after n full twists, we obtain a new knot K_n in S^3. We call K_n the knot obtained from K by an n-twist about a twisting circle c. Twisting may be applied to a Dehn surgery (K, r) ("cut and paste" of a tubular neighborhood of K) by twisting K and the surgery slope r (describing the "pasting") simultaneously to obtain a new Dehn surgery (K_n, r_n).

In this talk we explain how we use twisting to construct the "Seifert Surgery Network" which gives us a perspective on the entirety of Dehn surgeries producing Seifert fiber spaces. This viewpoint naturally leads us to a study of twist families of Heegaard Floer L-space knots. Then we illustrate relationships among an asymptotic behavior of K_n as $|n| \to \infty$, the position of twisting circles, and a pattern of occurrence of L-space knots—and more generally, tight fibered knots—in twist families. We will also discuss a novel characterization of braid axes in this context.

March 31st (Thu)

Conference Room III

Akihiro Higashitani (Osaka Univ.) Various commutative rings arising from combinatorial objects · (13:00–14:00)

Summary: One of the goals in the area of combinatorial commutative algebra is to construct commutative rings from combinatorial objects (e.g., graphs, simplicial complexes, matroids, posets, and so on) and to discuss their algebraic properties in terms of the original combinatorial objects. In this talk, we present several typical commutative rings arising from combinatorial objects and some algebraic properties of those rings. Moreover, we focus on a couple of them and discuss their relations.

Conference Room IV

Hiraku Nakajima (Univ. of Tokyo) Towards geometric Satake correspondence for Kac–Moody Lie algebras · (13:00–14:00)

Summary: About 30 years ago, I gave a geometric construction of representations of a Kac–Moody Lie algebra by quiver varieties, motivated by earlier works by Ringel, Lusztig, Ginzburg. In a 2014 proposal 'symplectic duality' by Braden–Licata–Proudfoot–Webster, this construction is regarded as 'dual' to geometric Satake correspondence. Geometric Satake correspondence is formulated by using the affine Grassmannian of the Langlands dual group, hence was known only for finite dimensional Lie algebras. The symplectic dual to more general quiver varieties are Coulomb branches introduced by my joint work with Braverman and Finkelberg in 2016. Hence Braverman, Finkelberg and I hoped geometric Satake correspondence for Kac–Moody Lie algebras using Coulomb branches as substitutes of affine Grassmannian. It is still conjectural in general as we do not have enough tools to analyze Coulomb branches. When the Kac–Moody Lie algebra is of affine type A, I have an alternative description of Coulomb branches as Cherkis bow varieties, as established by joint work with Takayama. It enables me to check geometric Satake correspondence for type A.

Foundation of Mathematics and History of Mathematics

March 28th (Mon) Conference Room IX

9:50–11:20

1 Noriko Tanaka (Aichi Prefectural Asahigaoka High School) — The Experimental Class for Science Education in Kyoto in the near end of the World War II ····· 15

Summary: Following a decision of the Ministry of Education, the Experimental Classes for Science Education were formed in four cities of Japan in the near end of the World War II. The one of the Experimental classes were established in the Kyoto-Prefectural Kyoto First Secondary School, one each in the 3rd, 2nd and 1st year. The origins of the classes, entrance examinations, contents of the courses, teachers are described together until the abolition. I will once again shed light on the Experimental Class for Science Education, and make use of a part of science and technology education in Japan in the future.

2 Makoto Tamura (Osaka Sangyo Univ.) — On the solution of cubic equations in China ····· 15

Summary: "Jigu Suanjing (Continuation of Ancient Mathematics)" written in 626 deals with cubic equations, but does not explain how to solve them. However, the book shows solutions to many cubic equations, it seems that the method was established before the book appeared. Here we consider a numeric solution according to the text proposed by Qian Baocong.

3 Tsukane Ogawa (Yokkaichi Univ.) — Mathemacical thought of Oka Yukitada (1791–?) ····· 15

Summary: Oka Shichibei Yukitada (1791–?) of the Takuma School wrote the "Regular examples for the methods of writing solution and clarifying the path," whch summarized the basic techniques of the "Methods of writing solution and clarifying the path." It can be said to represent Oka's mathematical thought. He analyzed methods for solving problems in plane geometry, extracted the techniques, and organized them into the book. He then illustrated the application of these techniques in the form of problems and their solutions. In this respect, Oka's mathematics is different from mere problem solving.

4 Hideyuki Majima (Ochanomizu Univ.*) — The year 2022, the memorial 314th year of Seki Takakazu and the 300th anniversary of Tetsujjutsu-Sankei ····· 15

Summary: The author talked about the works of SEKI Takakazu (?–1708), and TAKEBE Katahiro (1664–1739) on Pi. In this time, we propose to build a stone monument near his tomb in Jorinji Temple, because of his significant work concerning to Pi.

5 Mitsuo Morimoto (Yokkaichi Univ./Sophia Univ.*) — On the *Sekisan Shidensho* ····· 15

Summary: This is a survey talk on Toita Yasusuke's Sekiryuu Shidensho, which is a collection of more than 500 wasan materials compiled by Toita Yasusuke (1708–1784). This collection contains the Taisei Sankei and works of Seki Takakazu and mathematicians of the school Sekiryuu. The collection is composed of four parts, each of which contain about hundred materials. As Seki Takakazu passed away in 1708, this collection gives us interesting information about mathematical researches after Seki Takakazu's years.

11:30–11:45 Mathematics History Team Meeting

14:30–15:30 Talk Invited by Section on Foundation and History of Mathematics

Naoki Osada (Tokyo Woman's Christian Univ.*) The works of Seki Takakazu and their propagation

Summary: In order to evaluate the mathematics of Seki Takakazu, it is necessary to determine his genuine works. In this lecture, the lecturer first discusses whether or not the works conventionally attributed to Seki Takakazu are his genuine works, and if not, whose works they are, based on the previous study by Tatsuhiko Kobayashi and my recent research. Next, the lecturer describes how Seki's manuscripts were transcribed at Seki Takakazu's school and discusses which of Seki's manuscripts were in the possession of Araki Murahide, the first descendant of the Seki school, and Matsunaga Yoshisuke, the second descendant. Based on these considerations and the previous research of Ken'ichi Satō, the lecturer speculates on how the *Katsuyō Sampō* (*Essential Mathematics*) which has been said to be "Seki's posthumous manuscripts published by his disciple Araki Murahide and Araki's disciple Ōtaka Yoshimasa," was published, In addition, the lecturer also speculates on how the manuscripts of Seki, especially his *Kaikendai no Hō* (*Methods of Solving Explicit Problems*) and *Kaiindai no Hō* (*Methods of Solving Hidden Problems*), were propagated.

15:45–17:15

Summary: It is well-known that the associative substructural logic $\mathbf{FL_{cw}}$, obtained from **FL** by adding both contraction and weakening rules, derives exchange rule. In this talk, we consider the commutativity result in non-associative substructural logics with weakening, contraction, restricted weakening and restricted contraction axioms.

Summary: In the ordinary framework of neighbourhood semantics, the propositions of intuitionistic logic are interpreted as the compact open sets of Heyting spaces. In contrast, we attempt to give another interpretation based on the open sets of spectral spaces.

Summary: It is well-known that the construction of Zariski spectra of commutative rings yields an adjunction between the category of rings and the category of locally ringed spaces. Many constructions of spectra of algebras can be considered as such an adjunction. Michel Coste unified them in the language of categorical logic by showing that, for any triple (T,T',A) such as (rings, local rings, local homomorphisms), each T-model can be associated with a T'-modelled space (Coste spectrum) and that this construction yields an adjunction between the category of T-models and the category of T'-modelled spaces. In this talk, we extend Coste spectra to spectra of T-modelled spaces and then show existence of limits and colimits in categories of modelled spaces.

Summary: In the setting of inductive inference by Solomonoff, we consider predicting the next bit when we observe a finite binary sequence. For a sequence that is random with respect to a computable model measure, any sufficiently general conditional prediction will converge to the conditional model. Furthermore, the sum of the errors between conditional prediction and model is a left-c.e. Martin–Löf random real when the error is measured by Kullback–Leibler. We show that this is also true for the case that the model measure is a Bernoulli measure.

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 Holevo–Schumacher–Westmoreland theorem based on the principle of typicality, in order to demonstrate how properly our framework works in practical problems in quantum mechanics.

March 29th (Tue) Conference Room IX

9:45–11:25

Summary: Kunen constructed a model in which ω_1 carries a saturated ideal. We give a simplified construction by using later improvements. Furthermore, we investigate the extent of saturation of the induced ideal in terms of strong saturation, layeredness, and, centeredness.

Summary: We show under ZF+DC+$\mathrm{AD}_{\mathbb{R}}$ that every set of reals is I-regular for any σ-ideal I on the Baire space ω^ω such that $\mathbb{P}_I$ is proper. This answers the question of Khomskii in his Ph.D. thesis. We also show that the same conclusion holds under ZF+DC+AD^+ if we additionally assume that the set of Borel codes for I-positive sets is $\mathbf{\Delta}^2_1$.

Summary: Uniformization of ladder system colorings has been introduced by analysis of a proof of the Shelah's solution of Whitehead problem. Shelah's proof can be separated into the following two theorems: $\mathsf{MA}_{\aleph_1}$ implies $\mathsf{U}(\{\omega_1 \cap \mathsf{Lim}\})$, and $\mathsf{U}(\{\omega_1 \cap \mathsf{Lim}\})$ implies the existence of a non-free Whitehead group. In MSJ Autumn Meeting 2019, it is explained that the assertion $\mathcal{K}_3$, which is one of Todorcevic's fragments of Martin's Axiom, implies that $\mathsf{U}(\mathsf{stat})$ holds.
σ-uniformizations of ladder system colorings are introduced, and it is proved that $\mathcal{K}_2$ implies that every ladder system colorings can be σ-uniformized. This implies that $\mathcal{K}_2$ implies $\mathsf{U}(\mathsf{stat})$. This improves the above results.

Summary: The theory of a generic structure is said to be normal, if $\bar{a} \in acl(A)$ implies $d(\bar{a}/A) = 0$ for any $\bar{a}, A \subset \mathcal{M}$. We show that any saturated normal generic structure has weak elimination of imaginaries but does not have the finite set property.

Summary: Let $\delta(A) = |A| - \alpha \cdot e(A)$ for any finite graphs A where $|A|$ is the number of all vertices of A and $e(A)$ the number of all edges of A. Let K_f be the class of graphs like amalgamation classes used to construct Hrushovski's pseudoplanes using a log-like control function f. Suppose K_f has the free amalgamation property, and let M be the generic structure of $(K_f, <)$ where $<$ is defined as in the Hrushovski's case. If α is rational then the theory of M is model complete. In the case that α is irrational, with some more mild assumptions on f, the theory of M is also model complete.

Summary: We give a talk on our results related to Keisler's isomorphism theorem.

11:30–11:45 Research Section Assembly

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

Ryoma Sin'ya (Akita Univ.) Separation and measurability problems on an infinite hierarchy of regular languages

Summary: A regular language is a set L of words described by a regular expression, but it has the following alternative characterisation via logic: L is regular if and only if L is "definable" by a monadic second-order formula.

This logical characterisation gives us an infinite hierarchy in the class of all regular languages, e.g., the class SF of "star-free" languages definable by first-order logic FO and the classes of languages corresponding to several fragments of first-order logic (e.g., quantifier alternation hierarchy of FO, FO with restricted number of variables or different predicates, etc.).

The first part of this talk introduces the well-known connection between languages, logics, and algebras (several subclasses of finite monoids). In this part, two important theorems are introduced: (1) Schützenberger's theorem stating that the algebraic counterpart of SF is the class of aperiodic monoids. (2) Eilenberg's variety theorem stating that there is a natural one-to-one correspondence between the subclasses of regular languages and finite monoids equipping certain rich closure properties, so-called "varieties" and "pseudovarieties", respectively.

The second part is an invitation to recent developments on this infinite hierarchy. In this part, two decision problems are described: (1) Separation problem for subclasses of star-free languages. (2) Measurability problem for subclasses of regular languages.

Algebra

March 28th (Mon) Conference Room IV

9:30–11:45

Summary: In this talk, we will discuss a representation of the vacuum spaces of level 2 standard modules of type $A^{(2)}_9$ using Z-operators in accordance with Kanade–Russell's conjecture of partition conditions. Rogers–Ramanujan type identities are the identities represented in the form of (infinite sum)=(infinite product) with the Pochhammer symbols like Rogers–Ramanujan identities. Since the work by Lepowsky–Wilson, there has been an expectation that by assigning a non-negative integer to each vertex of an affine Dynkin diagram, we can obtain Rogers–Ramanujan type identities and integer partition theorems. Related to this, we will propose a conjecture for the relations between the vacuum spaces of level 2 standard modules of type $A^{(2)}_{\mathrm{odd}}$ and Z-operators.

Summary: In the finite-dimensional hyperalgebra $\mathcal{U}_r = \mathrm{Dist}((\mathrm{SL}_2)_r)$, certain elements $B^{(\boldsymbol{\varepsilon})}(\boldsymbol{a}, \boldsymbol{j})$ have been already constructed before. We report that each $\mathcal{U}_r$-module $\mathcal{U}_r B^{(\boldsymbol{\varepsilon})}(\boldsymbol{a}, \boldsymbol{j})$ has a certain basis determined by $\boldsymbol{\varepsilon}$ and $(\boldsymbol{a}, \boldsymbol{j})$ and that the $\mathcal{U}_r$-module has simple head and simple socle, which are isomorphic.

Summary: We consider Schubert varieties in the flag varieties of classical types. For singularities of Schubert varieties, there is a combinatorial formula for the multiplicity in the case of Grassmannian of classical types. We obtained results extending this formula to the case of Schubert varieties associated to vexillary signed permutations of flag varieties of classical types.

Summary: Let $\mathrm{N}_m(R) = \{(a_{ij}) \in \mathrm{M}_m(R) \mid a_{11} = a_{22} = \cdots = a_{mm} \text{ and } a_{ij} = 0 \text{ for any } i > j\}$ for a commutative ring R. We calculate the Hochschild cohomology ring $\mathrm{HH}^*(\mathrm{N}_m(R), \mathrm{N}_m(R))$ as R-algebras. We also calculate $\mathrm{HH}^*(\mathrm{N}_m(R), \mathrm{M}_m(R)/\mathrm{N}_m(R))$ as R-modules.

Summary: Quasi-hereditary algebras were introduced by Cline, Parshall and Scott to study the highest weight categories in Lie theory. On the other hand, bocses were introduced in the context of Drozd's tame and wild dichotomy theorem. Koenig, Külshammer and Ovsienko connected them by giving equivalences between the module categories of Δ-filtered modules over quasi-hereditary algebras and those over directed bocses. In this talk, we discuss some problems occurring when we prove a similar theorem for $\overline{\Delta}$-filtered algebras and give two lemmas necessary for the proof. Here, a $\overline{\Delta}$-filtered algebra is known to be one of natural generalizations of a quasi-hereditary algebra.

Summary: Gabriel's theorem, shown in 1972, is a theorem that classifies path algebras of finite representation type using Dynkin diagrams, and is a very important theorem that suggests a connection between Lie theory and the representation theory of algebras. In this talk, I will generalize Gabriel's theorem by using cluster algebra theory, which has been rapidly developed recently and is closely related to both Lie theory and the representation theory of algebras.

Summary: Bongartz completion is an important subject in representation theory of finite dimensional algebras, in particular, τ-tilting theory. We characterize it using c-vectors. From this point of view, we introduce the notion of Bongartz completion for cluster algebras using c-vectors, and we give some properties. This is a joint work with Peigen Cao and Yasuaki Gyoda.

Summary: Let G be a finite group, k an algebraically closed field of characteristic $p > 0$ and B a block of group algebra kG. Support τ-tilting modules and semibricks over B are corresponding B-modules to two-term tilting complexes and two-term simple minded collections over B, which are both special forms of tilting complexes and simple minded collections over B , respectively. Let $\tilde{G}$ be a finite group containing G as a normal subgroup and $\tilde{B}$ a block of $k\tilde{G}$ covering B. In this talk, we will introduce the methods of constructions of support τ-tilting modules and semibricks over $\tilde{B}$ from the ones over B under the vanising condition of Schur multipliers of the factor group $\tilde{G}/G$ over k.

Summary: Balmer and Dell'Ambrogio introduced the pseudo-functor $\mathcal{P}$ from the bicategory of k-linear Mackey 2-motives to the bicategory of k-linear cohomological Mackey 2-motives over a commutative ring k. They showed that $\mathcal{P}$ maps the general Mackey 2-motives to the cohomological Mackey 2-motives by using the ring homomorphism from the crossed Burnside ring of a finite group G over k to the center ZkG of group algebra kG. We study the behavior of motivic decomposition of cohomological Mackey 2-motives as images by $\mathcal{P}$ of motivic decomposition of Mackey 2-motives.

Summary: Quandle is an algebraic system with one binary operation, but it is quite different from a group. In our talk, we investigate a special kind of quandles, called generalized Alexander quandles $Q(G, \psi)$, which is defined by a group G together with its group automorphism ψ. We develop the quandle invariants for generalized Alexander quandles.

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

Tatsuyuki Hikita (Kyoto Univ.) K-theoretic canonical bases and their elliptic analogues

Summary: Representation theory of semisimple Lie algebras are closely related to the geometry of Springer resolutions. In particular, Lusztig defined certain canonical bases in equivariant K-theory of Springer resolutions and conjectured that they describe modular representation theory of semisimple Lie algebras. This conjecture was proved by Bezrukavnikov–Mirkovic for large enough characteristic by beautifully relating coherent sheaves on Springer resolutions, representations of semisimple Lie algebras in positive characteristic, and certain perverse sheaves on affine flag manifolds.
In this talk, I define canonical bases in equivariant K-theory of more general conical symplectic resolutions and explain their expected properties. If time permits, I will explain an attempt to find their elliptic analogues which reveal new duality under symplectic duality.

15:30–17:40

11 Kohsuke Shibata (Nihon Univ.) F-rationality of two-dimensional graded rings with a rational singularity 15

Summary: It is known that a two-dimensional F-rational ring has a rational singularity. However a two-dimensional ring with a rational singularity is not F-rational in general. In this talk, we investigate F-rationality of a two-dimensional graded ring with a rational singularity in terms of the multiplicity. Moreover, we determine when a two-dimensional graded ring with a rational singularity and a small multiplicity is F-rational.

12 Shinnosuke Ishiro (Nihon Univ.)
Kazuma Shimomoto (Nihon Univ.)
Mohsen Asgharzadeh
Surjectivity of some scalar maps on local cohomology modules and an application to the second vanishing thorem 15

Summary: The second vanishing theorem has a long history in the theory of local cohomology modules over regular local rings and the case of ramified regular local rings is unsolved. We give a partial answer to it using the surjectivity of scalar maps of local cohomology modules. In our talk, we introduce our results and some examples of the vanishing of local cohomology modules to exhibit the non-triviality of our results.

13 Shinnosuke Ishiro (Nihon Univ.)
Kazuma Shimomoto (Nihon Univ.)
Kei Nakazato (Nagoya Univ.)
Perfectoid towers and its small tilts 15

Summary: Perfectoid theory has many applications to commutative ring theory and singularity theory. For example, the direct summand conjecture, perfectoid multiplier/test ideals are such instances. However, rings studied in the perfectoid theory are usually non-Noetherian, which are difficult to study via the standard commutative ring theory. For this reason, we build a new framework that can also treat Noetherian rings via perfectoids, which are called perfectoid towers and small tilts. In this talk, we plan to explain definitions and basic properties.

14 Jun Horiuchi (Nippon Inst. of Tech.)
Kazuma Shimomoto (Nihon Univ.)
Kazufumi Eto (Nippon Inst. of Tech.)
On integrality of rings and the monoidal map 15

Summary: We will derive some ring theoretic properties of the tilt of the ring. In this process, we make use of the monoidal structure of the tilt and so-called monoidal map. We explain the key discussion due to Fontaine, and we will discuss further development and application.

15 Mitsuhiro Miyazaki (Kyoto Univ. of Edu.) On the non-Gorenstein locus of the Ehrhart ring of the stable set polytope of an odd cycle graph 15

Summary: Let $G = (V, E)$ be an odd cycle graph. We describe the non-Gorenstein locus of the Ehrhart ring of the stable set polytope of G by showing the radical of the trace of the canonical module of that ring is the intersection of prime ideals corresponding to certain faces of the stable set polytope of G.

16 Yuki Ishihara (Tokyo Univ. of Sci.) On double ideal quotient and primary decomposition · · · · · · · · · · · · · · · 15

Summary: It is known that "primary decomposition" is a basic notion in Commutative Algebra. In order to analyze properties of primary decomposition, we introduce a special ideal "double ideal quotient", which has the form $I\colon (I\colon J)$. By using double ideal quotient, we can obtain criteria for prime divisors and primary components. Also, we can generate the particular primary component from a given ideal and its prime divisor. We can apply these properties to compute the localization of an ideal at a prime ideal in the multivariable polynomial ring over a computable field.

17 Shinya Kumashiro (Oyama Nat. Coll. of Tech.) Graded filtrations and ideals of reduction number two · · · · · · · · · · · · · · · 15

Summary: We give a way to construct graded filtrations of graded modules. We then apply the filtration to the Sally module, which describes a correction term of the Hilbert function of ideals. As a result, we obtain the inequality of the Hilbert coefficients for ideals of reduction number 2.

18 Kazuho Ozeki (Yamaguchi Univ.) The first Hilbert coefficient of stretched ideals · 15

Summary: In this talk, we explore the almost Cohen–Macaulayness of the associated graded ring of stretched $\mathfrak{m}$-primary ideals with small first Hilbert coefficient in a Cohen–Macaulay local ring $(A, \mathfrak{m})$. In particular, we explore the structure of stretched $\mathfrak{m}$-primary ideals satisfying the equality $\mathrm{e}_1(I) = \mathrm{e}_0(I) - \ell_A(A/I) + 4$ where $\mathrm{e}_0(I)$ and $\mathrm{e}_1(I)$ denote the multiplicity and the first Hilbert coefficient respectively.

March 29th (Tue) Conference Room IV

9:00–12:00

19 Makoto Sakurai (Kaichi Gakuen) Topological chiral algebras and characteristic classes · · · · · · · · · · · · · · · 15

Summary: The chiral-factorization algebra theory of Beilinson and Drinfeld is an algebraic system with a geometric nature inspired by the physics of holomorphic conformal field theories. In this talk, I will try to re-investigate the sigma-model interpretation of the chiral de Rham complex. This interpretation was initiated by the works of Nekrasov and Witten, but my computation is after the toric diagrams and computational algebraic geometry. The assumption was the OPE preservation under the Nekrasov Ansatz after the generalized complex structure of Hitchin school. The sigma-model interpretation was confirmed by Gorbounov, Gwilliam, and Williams in their Astérisque paper, but my work was earlier and has more inclination toward Beilinson and Drinfeld.

20 Akio Nakagawa (Chiba Univ.) Appell–Lauricella hypergeometric functions over finite fields · · · · · · · · · 15

Summary: We study finite fields analogues of integral representations of Appell–Lauricella hypergeometric functions F_A, F_B, F_C and F_D. Furthermore, as an application, we see relations between these functions and the numbers of rational points of some algebraic varieties over finite fields.

21 So Yamagata (Hokkaido Univ.) On the non very genericy of hyperplane arrangements. · · · · · · · · · · · · · · · 15
Simona Settepanella

Summary: In 1989, Manin and Schechtman introduced a family of arrangements of hyperplanes generalizing classical braid arrangements, which they called the discriminantal arrangements. It is well known that there exists an open Zariski set $\mathcal{Z}$ in the space of central generic arrangements of n hyperplanes in $\mathbb{C}^k$ such that the intersection lattice of the discriminantal arrangements $\mathcal{B}(n, k, \mathcal{A})$ are independent from the choice of the arrangement $\mathcal{A} \in \mathcal{Z}$. In this talk we see a sufficient condition for $\mathcal{A}$ to be non very generic in terms of vectors.

Summary: In this talk, we prove that the cone of the extended Catalan arrangement of type A is always hereditarily free, while we determine the dimension that the cone of the extended Shi arrangement of type A is hereditarily free. For this purpose, we define a class of arrangements which contains the extended Shi and Catalan arrangement of type A and which closed under restriction, using digraphs with vertex weights.

Summary: Let $P^+_{3,3}$ be the set of all the cubic homogeneous polynomials $f(x,y,z)$ which satisfy $f(x,y,z) \geq 0$ for all $x \geq 0$, $y \geq 0$, $z \geq 0$. We determine all the extremal elements of $P^+_{3,3}$.

Summary: For an semi-stable extremal neighborhood $(X, C) \subset \mathbb{C}^4$ with C is irreducible and reduced, the bounded terminality of 2-game between the invariants $l(P), q(P)$, related to 0-dimensional supports of $|-K_X|$, gives the existence of 3-dimensional flips ([S. Mori, 1988]). Regarding to [S. Mori, 1988], the author had studied: for $(X, C) \subset \mathbb{C}^4$ where C is not necessary irreducible nor reduced, denoted as $(X, C_s) \subset \mathbb{C}^4$ ([I2019March]), i) to induce Miyaoka–Yau type inequality with c_3, as abbreviated $(MY)_{3,c_3}$, ii) to study $(MY)_{3,c_3}$ by the associated Higgs sheaves, and iii) to more study $(MY)_{3,c_3}$ by introducing diffrential operators "of codimension 2 type" for ii), and so on. In this talk, based on these works i)–iii), the author will report: a) to construct "period space" for (X, C_s), and b) for a), to introduce intermediate Jacobian for (X, C_s), which gives "2-Albanese", or "2-Picard" varieties. Here, the prefix "2-" mainly comes from iii), probably relate to n(≥ 1)-motif. These varieties are expected to work to rationality of (X, C_s) of type A. In the sequel parts, the author will give studies regards to these points.

Summary: Geometric transition is a process of connecting two smooth Calabi–Yau 3-folds by a birational contraction followed by a complex smoothing. It has attracted the interest of both mathematicians and physicists, since it may give the right notion to connect moduli spaces of Calabi–Yau 3-folds. For Calabi–Yau hypersurfaces in toric varieties, a well-known idea of constructing geometric transitions is to use nested reflexive polytopes. In this talk, I will introduce a refinement of this idea and show recent progress.

Summary: Even for an arithmetic D_2 non-singular projective subvariety $X \subseteq \mathbb{P}^N(\mathbb{C}) = P$, when we consider a 1-st infinitesimal embedded deformation of X in P, some classes in the q-th Betti syzygy space (or Koszul homology) $T^{1,q}_m = (\mathbb{Z}^{(q)}_X / S_+ \cdot \mathbb{Z}^{(q)}_X)_{(m)}$ of X in (polynomial) degree m may suddenly disappear. When we once find such an infinitesimally unstable q-th Betti syzygy class, we often find a non-zero $(q+1)$-th Betti syzygy space $T^{1,q+1}_m$ or a non-zero $(q-1)$-th Betti syzygy space $T^{1,q-1}_m$ with the same polynomial degree m at the same time, which has also an infinitesimally unstable Betti syzygy class. Here, in a general situation, we give a steady explanation of this phenomena.

27 Ryo Ohashi (Yokohama Nat. Univ.)
Momonari Kudo (Univ. of Tokyo)
Shushi Harashita
(Yokohama Nat. Univ.)
The a-numbers of non-hyperelliptic curves of genus three with large cyclic automorphism group ····· 15

Summary: In the study of algebraic curves and their moduli spaces, it is important to determine the a-numbers of curves over a field of positive characteristic. It is known that non-hyperelliptic curves of genus 3 are classified by the structures of their automorphism groups as finite groups. In this paper, we determine the a-numbers of non-hyperelliptic curves of genus 3 with cyclic automorphism group of order 6 or 9. Moreover, we also find the exact number of the isomorphism classes of such curves attaining the possible maximal a-number.

28 Ryo Ohashi (Yokohama Nat. Univ.) On the maximality or minimality of Howe curves of genus 3 ····· 15

Summary: A nonsingular curve C over $\mathbb{F}_q$ is called maximal (resp. minimal) if the number of $\mathbb{F}_q$-rational points of C attains the Hasse–Weil upper (resp. lower) bound. It is known that maximal or minimal curves over $\mathbb{F}_{p^2}$ are superspecial, while superspecial curves over $\mathbb{F}_{p^2}$ are not neccesarily maximal nor minimal.
In this lecture, we talk about the maximality or minimality of Howe curves of genus 3. A Howe curve is the desingularization of the fiber product over $\mathbb{P}^1$ of two elliptic curves. We show that if a Howe curve of genus 3 is superspecial, then its standard form is maximal or minimal over $\mathbb{F}_{p^2}$ without taking its $\mathbb{F}_{p^2}$-form.

13:00–14:00

29 Kohei Sato (Oyama Nat. Coll. of Tech.)
Yusuke Sato (Univ. of Tokyo)
Hilb-desingularizations for three-dimensional canonical cyclic quotient singularities ····· 15

Summary: M. Ishida and N. Iwashita classified three-dimensional canonical cyclic quotient singularities. By using this classification, we proved that there exists an iterated Fujiki–Oka resolution which is a Hilb-desingularization for any three-dimensional canonical cyclic quotient singularity.

30 Yuki Mizuno (Waseda Univ.) An explicit construction of derived moduli stacks of Harder–Narasimhan filtrations ····· 15

Summary: Harder–Narasimhan(HN) filtrations are filtrations of sheaves obtained from semistable sheaves. Any pure coherent sheaf has a unique HN filtration. On the other hand, moduli spaces of HN filtrations are constructed as stacks (not as schemes) Moreover, Behrend, Ciocan–Fontanine, Hwang and Rose constructed derived moduli schemes of (semi) stable sheaves as differential graded (dg) schemes coming from bundles of curved dg Lie algebras. Derived schemes and stacks are generalizations of schemes and stacks. Their structure sheaves are sheaves of dg algebras. By using their method, we construct derived moduli stacks of HN filtrations as quotient dg-stacks explicitly. (So, they also become derived moduli stacks of unstable sheaves.)

31 Norihiko Minami (Nagoya Inst. of Tech.) Two applications of the birational motive to the retract $(-i)$-rationality ····· 15

Summary: The birational motives of Kahn–Sujatha and Rost is applied to study the following two types of implications of the retract $(-i)$-rationality of a smooth projective variety: (1) in terms of an arbitrary P^1-invariant Nisnevich sheaf with transfer. (2) in terms of the Bloch-Srinivas type decomposition of the diagonal.

March 30th (Wed) Conference Room IV

9:30–10:30

32 Hiroki Matsui (Tokushima Univ.)
Olgur Celikbas (West Virginia Univ.)
Uyen Le (West Virginia Univ.)
Paraphrasing Huneke–Wiegand conjecture 10

Summary: Huenke–Wiegand conjecture is the long-standing conjecture in commutative algebra. It says that for a one-dimensional local domain, the tensor product of non-free and torsion-free module and its algebraic dual has torsion. This conjecture is quite open and only the known case is for hypersurface local domains. In this talk, I will paraphrase Huneke–Wiegand conjecture over complete intersection local domains to a conjecture over hypersurface local domains.

33 Kaito Kimura (Nagoya Univ.)
Yuya Otake (Nagoya Univ.)
Ryo Takahashi (Nagoya Univ.)
Auslander–Reiten conjecture over Cohen–Macaulay rings 15

Summary: Projectivity of modules in terms of Vanishing of Ext modules over a local ring is an actively studied subject in commutative algebra. One of the most important problems is a celebrated long standing conjecture called the *Auslander–Reiten conjecture*. In this talk, we consider the above problems over Cohen–Macaulay rings, which form one of the most important classes in commutative algebra.

34 Masahisa Sato (Aichi Univ. / Univ. of Yamanashi*)
On generalized Nakayama(Azumaya)'s lemma 10

Summary: Generalized Nakayama(Azumaya)'s lemma is a generalization of well known Nakayama(Azumaya)'s Lemma, i.e., the assertion that MJ(R)=M implies M=0 for a module M which is a direct summand of a direct sum of finitely generated modules, where J(R) is the Jacobson radical of a ring R. First we show this lemma is equivalent to the non-existence of a non-zero Nakayama–Azumaya module. Next we show, in fact, that there is no non-zero (weak) Nakayama–Azumaya module. Also as applications of this lemma, we show the existence of a maximal submodule for some kind modules.

35 Masaki Matsuno (Shizuoka Univ.)
Haigang Hu (Shizuoka Univ.)
Izuru Mori (Shizuoka Univ.)
Noncommutative smooth conics in Calabi–Yau quantum projective planes 15

Summary: Throughout this talk, let k be an algebraically closed field of characteristic 0.Let S be a 3-dimensional Calabi–Yau quantum polynomial algebra, and $f \in S_2$ a regular central element. We call $A = S/(f)$ a noncommutative conic in a Calabi–Yau quantum $\mathbb{P}^2$. Our goal is to classify the associated noncommutative projective schemes $\mathrm{Proj}_{nc}A$. In this talk, we will show that there exist at least 9 isomorphism classes of $\mathrm{Proj}_{nc}A$.

11:00–12:00 Presentation Ceremony for the 2021 & 2022 MSJ Algebra Prize

14:15–15:15 Award Lecture for the 2022 MSJ Algebra Prize

Osamu Fujino (Kyoto Univ.)
Generalization of the Kodaira vanishing theorem and its application to birational geometry

Summary: The Kodaira vanishing theorem plays a crucial role for the study of complex projective varieties. We have already known many important generalizations. One of the most famous generalizations is the Kawamata–Viehweg vanishing theorem. It is the main ingredient of the theory of minimal models for higher-dimensional complex projective varieties. We generalize the Kodaira vanishing theorem from the Hodge theoretic viewpoint. By using the theory of mixed Hodge structures on cohomolgy with compact support, we establish a useful package of vanishing theorems. It greatly generalizes the framework of the minimal model program.

15:25–16:25 Award Lecture for the 2022 MSJ Algebra Prize

Masaaki Furusawa (Osaka City Univ.) On the Gross–Prasad conjecture with its refinement for $(\mathrm{SO}(5), \mathrm{SO}(2))$ and the generalized Boecherer conjecture

Summary: In this talk, I will describe a joint work with Kazuki Morimoto at Kobe University, where we prove the Gross–Prasad conjecture and its refinement, i.e. the Ichino–Ikeda type formula for the Bessel periods, in the case of $(\mathrm{SO}(5), \mathrm{SO}(2))$, by combining several theta correspondences. Our Ichino–Ikeda type formula is valid for any irreducible tempered cuspidal automorphic representations. In the 1980's, Boecherer proclaimed a remarkable conjecture concerning the relationship betwee a certain sum of Fourier coefficients of Siegel cusp forms of degree two which are Hecek eigenforms and a central value of quadratic twists of degree four spinor L-functions, which we proved earlier. As a corollary of our Ichino–Ikeda type formula above, we prove a natural gereralization of Boecherer's conjecture to the not necessarily trivial troidal character case.

16:35–17:35 Award Lecture for the 2022 MSJ Algebra Prize

Izuru Mori (Shizuoka Univ.) Classification of noncommutative projective surfaces (focusing on AS-regular algebras)

Summary: The classification of 3-dimensional AS-regular algebras (introduced by Artin and Schelter) is a starting point of noncommutative algebraic geometry. Noncommutative projective planes are defined as the noncommutative projective schemes (introduced by Artin and Zhang) associated to 3-dimensional quadratic AS-regular algebras, and they are the most basic objects of study in noncommutative algebraic geometry. On the other hand, it is interesting to study more general noncommutative projective surfaces. In fact, classification of noncommutative projective surfaces is one of the major projects in noncommutative algebraic geometry. In this talk, I will give some history of noncommutative algebraic geometry and classification of noncommutative projective surfaces, focusing on AS-regular algebras.

March 31st (Thu) Conference Room IV

9:30–12:00

36 Shigeru Iitaka (Gakushuin Univ.*) Ultra 2 perfect numbers of Mersenne type ····· 10

Summary: Given odd prime h and an integer m, natural numbers a, A defined by $A = \sigma(a) - m$, and B defined by $B = h\sigma(A) + 2\tilde{h}m + \tilde{h}(h-2), (\tilde{h} = h+1)$,
are said to be Ultra 2 perfect numbers of Mersenne type whenever $\sigma(B) = \sigma(2\tilde{h})(a+1)$.
Associated nnmbers A and B are called partner and shadow, repectively.

37 Shigeru Iitaka (Gakushuin Univ.*) Ultra perfect numbers of twin primes type ····· 10
Hikaru Kajita
(Crimson Global Academy)

Summary: Given an odd prime h and an integer m , if natural numbers a , A and B satisfy eualities $a = 2h\varphi(A) + m + 1$, $hA = \varphi(B) - m + 2$and $B = \varphi(a) - 1$ then they are said to be ultra perfect numbers of twin primes type.

38 Daniel Tsai (Nagoya Univ.)♭ The fundamental period of a periodic phenomenon pertaining to v-palindromes ····· 15

Summary: In March 2021, I introduced the concept of v-palindromes and proved a theorem pertaining to v-palindromes and repeated concatenation of the decimal digits of a natural number, illustrating a periodic phenomenon. In this talk, we show how to calculate the fundamental, i.e. smallest, period.

Summary: We compute the exact irrationality exponents of a generalized Hone series using a continued fraction expansion.

Summary: We unravel the mystery of Chebyshev's bias in terms of zeta-parametrization of the counting function of primes. As applications we obtain newly discovered biases. For example, we find the biased distributions of 1) non-principal prime ideals in number fields of class number two, 2) non-splitting primes in certain abelian extensions, 3) Ramanujan's τ-functions in positive values.

Summary: A discrete dynamical system is defined by regarding a rational function ϕ over a field as a self-map on a projective line. In 1995, Hatjispyros and Vivaldi defined the zeta function associated with this dynamical system using a quantity called the multiplier of periodic points, which describes the local behavior of the dynamical system. In this talk, we will give a cohomological interpretation of this zeta function and use it to discuss the rationality of this zeta function, explicit computation of the zeta function, and other issues.

Summary: J. Kaczorowski defined the analogue of the Euler totient function associated with the generalized L-functions including the Riemann zeta function, Dirichlet L-functions and obtained an asymptotic formula. We consider the Volterra integral equation of second type for the remainder term in the asymptotic formula for the associated Euler totient function. Moreover, we split the remainder term in the asymptotic formula for the associated Euler totient function into two summands called the arithmetic and the analytic part respectively.

Summary: The mean square formulas for various multiple zeta-functions have been studied in recent years. We give the asymptotic formula for the mean square values of the Apostol–Vu double zeta-function $\zeta_{AV,2}(s_1, s_2, s_3)$ on the assumption that s_1 and s_2 are fixed.

Summary: In the theory of the Euler–Zagier type multiple zeta functions, the product formula of two multiple zeta values, called Shuffle product, is known. It is obtained by considering their integral expression. In this study, we formulate the Shuffle product formula for the Schur multiple zeta values of hook type by using their integral expression.

Summary: In the study on multiple zeta values, the duality formula is one of the families of basic relations and plays an important role in the investigation of algebraic structure of the space spanned by all multiple zeta values along with the generalized duality formula, so-called Ohno's relation. As a generalization of them, we obtain those for skew type Schur multiple zeta values by introducing the new standard piece of index, called "admissible piece".

46 Yuna Baba (Sophia Univ.)
Maki Nakasuji (Sophia Univ.)
Schur type multi-poly-Bernoulli numbers ····· 10

Summary: The poly-Bernoulli numbers and its relative are defined by the generating series using the polylogarithm series, and we call them type B and C, respectively. As a generalization of these poly-Bernoulli numbers, we introduce Schur type multi-poly-Bernoulli numbers, which has relation with Schur multiple zeta functions. We obtain the relation between Schur type multi-poly-Bernoulli numbers of type B and that of type C. Furthermore, we define a generalization of Arakawa-Kaneko multiple zeta function to Schur type, and obtain their expression using Schur type multi-poly-Bernoulli numbers.

14:15–16:00

47 Masato Kobayashi (Kanagawa Univ.)
Sarth Chavan (Euler Circle)
An integral representation of Apery number and its applications to multiple values ····· 15

Summary: I will talk on an integral representation of Apery number by arcsin function and its applications to multiple values $\zeta(3,2,...,2)$ and $t(3,2,...,2)$.

48 Ryojun Ito (Chiba Univ.)
Hypergeometric expressions of L-values for a Borweins theta product of weight 3 ····· 10

Summary: In 2012, by an analytic method, Rogers–Zudilin gave a hypergeometric expression of the L-value at 2 for a cusp form of weight 2, which is a product of the Borweins theta series. In this talk, by the Rogers–Zudilin method, we express some special values of the L-function of a Borweins theta product of weight 3 in terms of special values of the Kampé de Fériet hypergeometric function, which is a two-variable generalization of generalized hypergeometric functions.

49 Yusuke Nemoto (Chiba Univ.)
On the K_2-regulator of the Hesse cubic curve and hypergeometric functions ····· 10

Summary: In this talk, we discuss the Hesse cubic curve which is defined by $x_0^3+y_0^3+z_0^3=3tx_0y_0z_0$. It is known that its periods are written in terms of Gauss's hypergeometric functions. We construct some elements in K_2-group of the Hesse cubic curve by using the tangent lines at the flex points. We compute their Beilinson regulators via the dlog map and express them in terms of generalized hypergeometric functions ${}_3F_2$.

50 Ryosuke Shimada (Univ. of Tokyo)
Geometric structure of affine Deligne–Lusztig varieties for GL_3 ····· 15

Summary: The Langlands correspondence, which contains class field theory as a special case, is one of the most important topics in number theory. Shimura varieties have been used, with great success, towards applications in the realm of the Langlands program. In this context, geometric and homological properties of affine Deligne–Lusztig varieties have been used to examine Shimura varieties and the local Langlands correspondence. In this talk we study the geometric structure of affine Deligne–Lusztig varieties $X_\lambda(b)$ for GL_3 and b basic. We completely determine the irreducible components of the affine Deligne–Lusztig variety. In particular, we classify the cases where all of the irreducible components are classical Deligne–Lusztig varieties times finite-dimensional affine spaces.

51 Yasushi Mizusawa (Nagoya Inst. of Tech.)
Metabelian 2-class field towers over $\mathbb{Z}_2$-extensions of real quadratic fields ····· 10

Summary: We give a family of real quadratic fields such that the 2-class field towers over their cyclotomic $\mathbb{Z}_2$-extensions have metabelian Galois groups of abelian invariants $[2,2,2]$. We also consider the boundedness of the Galois groups in relation to Greenberg's conjecture with some explicit examples.

Summary: Let h_N^-(resp. h_N^+) be the minus (resp. plus) part of the class number of the Nth cyclotomic function field. By using Goss's criterion, Feng proved that there exist infinitely many irreducible polynomials N with $h_N^- \equiv 0 \pmod{p}$ (resp. $h_N^+ \equiv 0 \pmod{p}$). In this talk, we study the N-divisibility of some Cartliz zeta values, and improve Feng's results.

Summary: This talk focuses on the theory of the Hecke rings associated with the general linear groups originally studied by Hecke and Shimura et al., and moreover generalizes its notions to Hecke rings associated with the automorphism groups of certain algebras. Then, in the case of the Heisenberg Lie algebra, we show an analog of the classical theory.

Geometry

March 28th (Mon) Conference Room VI

9:20–12:00

1 Yoshito Ishiki (RIKEN) On dense subsets of spaces of metrics · 15

Summary: In spaces of metrics, we investigate topological distributions of the doubling property, the uniform disconnectedness, and the uniform perfectness, which are quasi-symmetrically invariant properties appearing in the David–Semmes theorem. We show that the set of all doubling metrics and the set of all uniformly disconnected metrics are dense in spaces of metrics on finite-dimensional and zero-dimensional compact metrizable spaces, respectively. Conversely, this denseness of the sets implies the finite-dimensionality, zero-dimensionality, and the compactness of metrizable spaces. We also determine the topological distribution of the set of all uniformly perfect metrics in the space of metrics on the Cantor set.

2 Yoshito Ishiki (RIKEN) Branching geodesics of the Gromov–Hausdorff distance · · · · · · · · · · · · · · 15

Summary: We first evaluate topological distributions of the sets of all doubling spaces, all uniformly disconnected spaces, and all uniformly perfect spaces in the space of all isometry classes of compact metric spaces equipped with the Gromov–Hausdorff distance. We then construct branching geodesics of the Gromov–Hausdorff distance continuously parameterized by the Hilbert cube, passing through or avoiding sets of all spaces satisfying some of the three properties shown above, and passing through the sets of all infinite-dimensional spaces and the set of all Cantor metric spaces.

3 Daisuke Kazukawa (Osaka Univ.) Boundedness of precompact sets of metric measure spaces · · · · · · · · · · · 15
Takumi Yokota (Tohoku Univ.)

Summary: Gromov introduced a distance function, called the box distance, and a partial order, called the Lipschitz order, on the set of isomorphism classes of metric measure spaces. These are fundamental tools in his theory on the convergence of metric measure spaces. In this talk, we present and prove Gromov's statement comparing two boundedness with respect to the box distance and the Lipschitz order. He only sketched the proof in his book.

4 Kenshiro Tashiro (Tohoku Univ.) On the systolic inequality on compact quotients of Carnot groups · · · · 15

Summary: On a compact Riemannian manifold M^n, the systole represents the 'thickness' of the manifold. Namely it is defined by the minimal length of closed non-null homologous curves. The systolic inequality asserts that there is a constant $C = C(n)$ such that systole $\leq C \cdot (Vol(M))^{\frac{1}{n}}$. It is shown for aspherical manifolds and its technical generalization. We show a sub-Riemannian version of the systolic inequality for compact quotient spaces of Carnot groups. There systole is defined via the sub-Riemannian length structure, the total measure is given by the Popp's volume, and the constant can be chosen so that it depends only on the Hausdorff dimension.

5 Hiroki Nakajima (Tohoku Univ.) A natural compactification of the Gromov–Hausdorff space · · · · · · · · · · 15
Takashi Shioya (Tohoku Univ.)

Summary: We introduce a pseudometric on the family of isometry classes of (extended) metric spaces. Using it, we obtain a natural compactification of the Gromov–Hausdorff space, which is compatible with ultralimit.

Summary: By using some line integrals in terms of the radial m-Bakry–Émery Ricci curvature, we give various compactness criteria for complete Riemannian manifolds when m is a positive constant, a negative constant, or infinity. Our results not only guarantee the compactness of complete Riemannian manifolds allowing the presence of negative amounts of the radial m-Bakry–Émery Ricci curvature, but also give new Myers-type theorems via m-Bakry–Émery Ricci curvature even the line integrals are reduced to pointwise positive lower bounds on the m-Bakry–Émery Ricci curvature. The key ingredients in proving our results are Riccati inequalities obtained from Bochner–Weitzenböck formulas via m-Bakry–Émery Ricci curvature.

Summary: We establish various new compactness criteria for complete Riemannian manifolds via m-Bakry–Émery Ricci curvature when m is a positive constant, a negative constant, or infinity, which not only generalize classical compactness criteria for complete Riemannian manifolds via Ricci curvature by W. Ambrose and E. Calabi allowing some negative amounts of the m-Bakry–Émery Ricci curvature, but also relax previous Myers and Cheeger–Gromov–Taylor type compactness criteria via m-Bakry–Émery Ricci curvature obtained when m is a positive constant, a negative constant, or infinity.

Summary: We establish some new compactness criteria for complete Riemannian manifolds by assuming some exponential decay conditions on the m-Bakry–Émery Ricci curvature. Our results not only generalize Myers type theorems via m-Bakry–Émery Ricci curvature obtained by M. Fernández-López and E. García-Río, M. Limoncu, Z. Qian, G. Wei and W. Wylie, J.-Y. Wu, but also relax quadratic decay conditions on the m-Bakry–Émery Ricci curvature of the Cheeger–Gromov–Taylor type theorems obtained by Y. Soylu and L.F. Wang. The key ingredients in proving our results are Bochner formulas and Laplacian comparison theorems via m-Bakry–Émery Ricci curvature.

Summary: Stimulated by a recent work due to J.-Y. Wu, we establish several new compactness criteria for complete Riemannian manifolds via integral radial m-Bakry–Émery Ricci curvatures when m is a positive constant, a negative constant, or infinity. Our results not only relax a compactness criterion via integral radial Bakry–Émery Ricci curvature due to J.-Y. Wu by allowing some growth conditions on integral radial m-Bakry–Émery Ricci curvatures, but also give new Myers-type theorems for complete Riemannian manifolds even integral radial m-Bakry–Émery Ricci curvatures are reduced to pointwise lower bounds on m-Bakry–Émery Ricci curvatures. Moreover, we generalize these Myers-type theorems in the spirit of the classical compactness criterion via Ricci curvature due to W. Ambrose.

Summary: Inspired by a recent work due to J.-Y. Wu, we extend the classical compactness theorem for complete Riemannian manifolds via Ricci curvature due to Cheeger–Gromov–Taylor by replacing a pointwise lower bound on the Ricci curvature with integral radial m-Bakry–Émery Ricci curvatures when m is a positive constant, a negative constant, or infinity. Our results generalize Cheeger–Gromov–Taylor type compactness theorems for complete Riemannian manifolds via m-Bakry–Émery Ricci curvatures obtained by Y. Soylu and the author in integral sense.

14:15–16:00

11 Masaya Kawamura (Kagawa Nat. Coll. of Tech.) — On estimates for a function on almost Hermitian manifolds and its application to the Monge–Ampère equation ····· 15

Summary: Recently, there have been a lot of studies in almost Hermitian geometry. Especially, the Monge–Ampère type equations have been investigated on almost Hermitian manifolds vigorously. For instance, J. Chu, V. Tosatti and B. Weinkove have derived a priori estimates and have shown existence and uniqueness of solutions to the Monge–Ampère equation on compact almost Hermitian manifolds. In Hermitian geometry, it is well-known that we have $\partial^2 = \bar{\partial}^2 = 0$ and $\partial\bar{\partial} = -\bar{\partial}\partial$. In almost Hermitian geometry, we do not have these appreciated relations, which leads that we have to deal with terms like $\partial\partial\bar{\partial}\varphi$, $\bar{\partial}\partial\bar{\partial}\varphi$, $\partial\partial\partial\bar{\partial}\varphi$ and so on, where φ is a smooth real-valued function. In this regard, we need a new technique for dealing with these terms. From this point of view, we establish a new estimate for $\partial\partial\bar{\partial}\varphi$, $\bar{\partial}\partial\bar{\partial}\varphi$.

12 Satoshi Nakamura (Numazu Nat. Coll. of Tech.) — Calabi type functionals for coupled Kähler–Einstein metrics ····· 15

Summary: The Calabi type functional, called the coupled Ricci–Calabi functional, for coupled Kähler–Einstein metrics is introduced to obtain a moment weight inequality which relates this functional and an algebro-geometric invariant.

13 Naoto Yotsutani (Kagawa Univ.) — Diffeomorphism classes of the doubling Calabi–Yau threefolds ····· 15

Summary: In our previous work (New York J. Math. **20** (2014) 1–33), we constructed Calabi–Yau threefolds by a differential-geometric gluing method using Fano threefolds with their smooth anticanonical K3 divisors. In this talk we further consider the diffeomorphic types of the resulting Calabi–Yau threefolds starting from different pairs of Fano threefolds of Picard number one.

14 Yuta Watanabe (Univ. of Tokyo) — Cohomology on neighborhoods of non-pluriharmonic loci in pseudoconvex Kähler manifolds ····· 15

Summary: The classical result, the Lefschetz hyperplane theorem on complex projective manifolds, has recently been extended by Prof. Tiba to an analogous result on Stein manifolds. This is a claim for cohomology on open neighborhoods in non-pluriharmonic loci of exhaustive plurisubharmonic functions. In this talk, I will introduce a new result, which is an extension from Stein manifolds to pseudoconvex Kähler manifolds with some kind of q-completeness. An example that does not fit into the situation of Stein manifolds is quasi-torus.

15 Takayuki Moriyama (Mie Univ.), Takashi Nitta (Mie Univ.) — Graded algebra structure on the space of quaternionic k-vector fields ····· 15

Summary: We provided the correspondence of a quaternionic k-vector field on a quaternionic Kähler manifold to a holomorphic $(k, 0)$-vector field on the twistor space. The space of holomorphic multi vector fields admits a graded algebra structure, naturally. In this talk, we introduce a graded algebra structure on the space of quaternionic multi vector fields and show that the correspondence induces an isomorphism of these two graded algebras.

16 Isami Koga (Meiji Univ.), Yasuyuki Nagatomo (Meiji Univ.) — Equivariant harmonic immersions of complex projective line into the complex Grassmannian manifolds of rank two ····· 15

Summary: We construct and classify equivariant harmonic immersions of complex projective line into the complex Grassmannian manifolds of rank two.

16:15–17:15 Talk Invited by Geometry Section

Yoshinori Hashimoto (Tokyo Tech) ♭ Recent progress on constant scalar curvature Kähler metrics with cone singularities along a divisor

Summary: We present some recent results concerning constant scalar curvature Kähler metrics with cone singularities along a divisor, henceforth abbreviated as cscK cone metrics. One of the main results is that the existence of cscK cone metrics implies various stability conditions of the underlying pair of the manifold and the divisor, including G-uniform K-stability and K-polystability. We also prove that any Kähler manifold admits a cscK cone metric if the divisor is a generic member of the linear system defined by a sufficiently large multiple of the polarisation, and point out an analogy to the twisted constant scalar curvature Kähler metrics. This talk is based on a joint work with Takahiro Aoi and Kai Zheng.

March 29th (Tue) Conference Room VI

9:45–11:45

17 Noriaki Ikeda (Ritsumeikan Univ.) Yuji Hirota (Azabu Univ.) Homotopy momentum sections on pre-multisymplectic manifold ····· 15

Summary: We introduce a notion of a homotopy momentum section on a Lie algebroid over a pre-multisymplectic manifold. A homotopy momentum section is a generalization of the momentum map with a Lie group action and the momentum section on a pre-symplectic manifold, and is also regarded as a generalization of the homotopy momentum map on a multisymplectic manifold. We show that a gauged nonlinear sigma model with Wess-Zumino term with Lie algebroid gauging has the homotopy momentum section structure.

18 Taika Okuda (Tokyo Univ. of Sci.) Akifumi Sako (Tokyo Univ. of Sci.) Deformation quantization with separation of variables for 2-complex dimensional locally symmetric Kähler manifold ····· 15

Summary: For a Kähler manifold, Karabegov found a method to construct a deformation quantization called deformation quantization with separation of variables. Especially, the deformation quantizations for locally symmetric Kähler manifolds have been studied by Sako–Suzuki–Umetsu, and Hara–Sako, and their constructions have been realized for any complex one-dimensional manifold, $\mathbb{C}^N, \mathbb{C}\mathrm{P}^N$ and $\mathbb{C}\mathrm{H}^N$. In this work, we obtained a formula that explicitly determines the deformation quantization for any complex two-dimensional locally symmetric Kähler manifold.

19 Yuya Takahashi (Nagoya Univ.) The moduli space of spatial polygons and geometric quantization ···· 15

Summary: The moduli space of spatial polygons is known as a symplectic manifold equipped with both Kähler and real polarizations. In this talk, we will construct morphisms of operads $\mathsf{f}_{\mathsf{K\ddot{a}h}}$ and f_{re} by using the quantum Hilbert spaces $\mathscr{H}_{K\ddot{a}h}$ and $\mathscr{H}_{re}$ associated to the Kähler and real polarizations respectively. Moreover, we will relate the two morphisms $\mathsf{f}_{\mathsf{K\ddot{a}h}}$ and f_{re} and prove the equality $\dim \mathscr{H}_{K\ddot{a}h} = \dim \mathscr{H}_{re}$ in general setting. This operadic framework is regarded as a development of the recurrence relation method by Kamiyama (2000) for proving $\dim \mathscr{H}_{K\ddot{a}h} = \dim \mathscr{H}_{re}$ in a special case.

20 Yuji Hirota (Azabu Univ.) Tosiaki Kori (Waseda Univ.) On the existence of (twisted) Dirac structures over the space of connections on 3 and 4 dimensional manifolds ····· 15

Summary: We shall concretely construct (twisted) Dirac structures on the space of irreducible connections on a trivial $SU(n)$-bundle over three and four dimensional manifolds via bundle morphisms to show the existence of (twisted) Dirac structures over those spaces of connections. It turns out that the twist term is given by the Cartan 3-form on those spaces of connections. We find that it vanishes over the subspace of flat connections, and give a Dirac structure on the space of flat connections with degree 0 over the boundary three-manifold.

21 Takeru Asaka (Univ. of Tokyo)♭ Earthquake maps and cluster algebras ····· 15
Tsukasa Ishibashi (Kyoto Univ.)
Shunsuke Kano (Tohoku Univ.)

Summary: Eathquake maps give important flows on the Teichmuller spaces. We calculate earthquake maps in terms of shear coordinates, which are examples of cluster X-variables in the cluster algebra. In this talk, we give a new relation between earthquake maps and the separation formula for cluster X-variables by identifying the former one as a continuation of the latter. In addition, we define an analogue of earthquake maps for any cluster algebras of finite type and prove a similar result to the Thurston's earthquake theorem.

22 Takashi Otofuji (Nihon Univ.) Stokes matrices of tt^*-Toda equations and positive energy representations of affine Lie algebras ····· 10
Martin Guest (Waseda Univ.)

Summary: We give a construction which produces a positive energy representation of the affine Lie algebra $\widehat{\mathfrak{sl}}_{n+1}\mathbb{C}$ from the Stokes data of a solution of the tt*-Toda equations.

23 Masahiro Futaki (Chiba Univ.) Equivariant homological mirror symmetry for CP1 ····· 15
Fumihiko Sanda (Kyoto Univ.)

Summary: We formulate an A-infinity category consisting of equivariant Lagrangian branes for CP1 and prove an equivariant version of the homological mirror symmetry.

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

Daisuke Tarama (Ritsumeikan Univ.) On integrable geodesic flows of a semi-simple Lie group

Summary: This talk deals with the complete integrability and the dynamical property of relative equilibrium points for the geodesic flow of a semi-simple Lie group equipped with a left-invariant metric. After a short review over the geometric settings for general left-invariant Hamiltonian systems on the cotangent bundle to a Lie group, a class of left-invariant metrics is considered on a semi-simple Lie group, following Mishchenko and Fomenko. It is known that these metrics give rise to completely integrable geodesic flows since late 1970's. It is however rather recent that their equilibrium points are studied mostly on the basis of techniques in symplectic/Poisson geometry. In the talk, a brief overview is given on these recent progresses. Then, as a main result, the classification of Williamson types of relative equilibrium points for a large subclass of above integrable geodesic flows is explained in terms of root systems. Related studies and remaining problems are also mentioned.

March 30th (Wed) Conference Room VI

9:10–11:45

24 Yuuki Sasaki (Tokyo Nat. Coll. of Tech.) Maximal antipodal sets of E_6 and some compact symmetric spaces ··· 15

Summary: We explicitly classify congruent classes of maximal antipodal sets of E_6 and compact symmetric spaces of $EI, EII, EIII, EIV$ type by using the complex exceptional Jordan algebra $\mathfrak{J}^{\mathbb{C}}$.Moreover, we realize these compact symmetric spaces as Grassmaniann of $\mathfrak{J}^{\mathbb{C}}$. We describe each antipodal set in this realization and observe some relations between antipodal sets and totally geodesic submanifolds.

25 Shoichi Fujimori (Hiroshima Univ.) Higher genus nonorientable maximal surfaces ····· 15
Shin Kaneda (Hiroshima Univ.)

Summary: We construct higher genus nonorientable maximal surfaces in Lorentz–Minkowski 3-space.

Summary: In locally conformal Kähler geometry (for short LCK), it is said to be Vaisman structure if Lee form is parallel with respect to Levi–Civita connection. The nilradical of a Vaisman solvmanifold is given by $H(n) \times \mathbb{R}^k$, where $H(n)$ is a $(2n+1)$-dimensional Heisenberg Lie group. In the case of Inoue surface S^+ with non-Vaisman LCK structure, its nilradical is given by $H(1)$. In this talk, we prove that a LCK solvmanifold such that the nilradical of the solvable Lie group is given by $H(n) \times \mathbb{R}^k (n \geq 1)$ is Vaisman manifold or Inoue surface S^+.

Summary: Trajectory of mass points inertially moving on a surface is a geodesic. The simplest cosmic model that is uniform and isotropic is the Minkowski space. The Minkowski space is flat because the Christoffel's symbols are all zero, and the timelike, spacelike and lightlike geodesics are all straight lines. We have determined a new connection to preserve the flatness of the Minkowski space.
We discuss geodesics of inertially moving mass points in the Minkowski space with the new connection.

Summary: By using the idea of integral geometry, we define integral invariants of the second fundamental form of a map between Riemannian manifolds and construct a family of energy functionals including the bienergy functional. In this talk, we focus on some energy functionals defined by homogeneous polynomials of degree two among them and show their first variational formulae. From these results, we obtain alternative expression of the Euler–Lagrange equation of the bienergy functional and introduce the Chern–Federer energy functional whose Euler–Lagrange equation is a second-order partial differential equation.

Summary: In this talk, I state the new groups obtained by generalizing the Lodha–Moore group. The Lodha–Moore group is known as a nonamenable finitely presented group and is similar to the Thompson group F. Since the Lodha–Moore group is defined by using infinite binary words, it can be generalized into "n-ary". After I give a short definition of the Lodha–Moore group, I will state the definitions of generalized one and results of "expected" properties.

Summary: In this talk, we give the examples of proper biharmonic submanifolds in compact Lie groups which are the image of Cartan embeddings defined by inner automorphism.

Summary: In this talk, I deal with the complex linear space of holomorphic cross-sections of a homogeneous holomorphic vector bundle over an elliptic adjoint orbit, and give a sufficient condition for the linear space to be finite-dimensional.

Summary: In this talk, we give a classification of real hypersurfaces in a nonflat complex space form whose star-Ricci tensor is $\mathbb{D}$-recurrent. By virtue of this result, we also know a classification of real hypersurfaces in a nonflat complex space form whose star-Ricci tensor is parallel.

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

Takefumi Kondo (Kagoshima Univ.) Nonlinear spectral gaps of Coxeter groups with respect to CAT(0) spaces

Summary: Nonlinear spectral gap is an invariant defined for a pair of a finite graph and a metric space and plays important roles in geometric group theory and metric geometry. Pansu calculated the exact values of nonlinear spectral gaps of cycles and generalized triangles with respect to CAT(0) spaces by applying the Wirtinger inequalities for finite cyclic groups proved by Gromov. However, no example of exact calculation was known other than Pansu's results.
In this talk, we discuss variants of the Wirtinger inequalities for finite irreducible Coveter groups and its application to calculations of nonlinear spectral gaps of Coxeter groups. This contains a nonlinear analogue of computations of spectral gaps of Coxeter groups by Kassabov and Ivrissimtzis–Peyerimhoff.
This is a joint work with Tetsu Toyoda and Takato Uehara.

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

Masatoshi Kokubu (Tokyo Denki Univ.) Flat fronts in hyperbolic three-space and related topics

Summary: Recent works about flat fronts and related topics will be introduced after a brief overview. It is known that a complete flat surface immersed in hyperbolic 3-space is either a horosphere or a hyperbolic circular cylinder. However, if the condition is weakened so that surfaces are not necessarily immersed, then there are many 'complete flat surfaces', properly speaking, weakly complete flat fronts. The word 'front' comes from a wavefront which means a mapping which have a Legendrian lift to the projective cotangent bundle of the target space. In early 2000s, M. Umehara, K. Yamada and I started to study flat fronts. After that, W. Rossman and K. Saji joined and our research was advanced. There are still some interesting problems that I am working on.

March 31st (Thu) Conference Room VI

9:15–12:00

33 Natsuo Miyatake (Osaka Univ.)♭ Generalized Kazdan–Warner equations on foliated manifolds ····· 15

Summary: Generalized Kazdan–Warner equation is a second-order elliptic PDE which was introduced by speaker as a generalization of the classical Kazdan–Warner equation. In this talk, we show that on a compact foliated Riemannian manifold, the unique solution of the generalized Kazdan–Warner equation is a basic function with respect to the foliation if the Laplacian preserves the space of basic functions and if the functions which are given to define the equation are basic.

34 Keita Kunikawa (Utsunomiya Univ.) Liouville type theorem for harmonic maps of controlled growth ····· 15
Yohei Sakurai (Saitama Univ.)

Summary: We show a Liouville type result for harmonic maps from manifolds with nonnegative Ricci curvature into positively curved target spaces under the condition that the maps have controlled growth.

35 Junya Takahashi (Tohoku Univ.) Small eigenvalues of the rough and Hodge Laplacians under fixed volume
Colette Anné (Univ. de Nantes) ····· 15

Summary: For each degree p and each natural number $k \geq 1$, we construct on any closed manifold a family of Riemannian metrics, with fixed volume such that the k th positive eigenvalue of the rough or the Hodge Laplacian acting on differential p-forms converge to zero. In particular, on the sphere, we can choose these Riemannian metrics as those of non-negative sectional curvature. This is a generalization of the results by Colbois and Maerten in 2010 to the case of higher degree forms.

Summary: Boucetta introduced the compatibility between a Poisson structure π and a pseudo-Riemannian cometric g^* on a smooth manifold M using the Levi–Civita connection of g^* on $(T^*M)_\pi$. This is a generalization of Kähler structures on M. This notion can be generalized on a Lie algebroid A over M. In this talk, we generalize this notion more and define the compatibility between Jacobi structures and pseudo-Riemannian cometrics on a Jacobi algebroid (A, ϕ_0). The compatibility behaves well for the Poissonizations of Jacobi structures. We show that this is a generalization of Sasakian structures on M.

Summary: We proved that the log-concavity is the only power concavity preserved by the Dirichlet heat flow in a convex domain of a Riemannian manifold.

Summary: I will introduce an embedding optimization problem for a compact manifold equipped with a volume form and a Riemannian metric. We also introduce a first-eigenvalue maximization problem concerning the Bakry–Émery Laplacian, as the dual problem of the former one. I will discuss an analogue of the Nadirashvili minimal surface theorem.

Summary: A graph can be realized in a Euclidean space by using eigenfunctions of the first nonzero eigenvalue of the graph Laplacian. Göring–Helmberg–Wappler considered the maximization of the first nonzero eigenvalue of the weighted graph Laplacian over all edge weights under a certain normalization. For an optimal edge weight of Göring–Helmberg–Wappler's problem, we obtain a graph embedding having a good geometrical property. We also consider a variant of their problem and establish a similar result.

Summary: For a complex projective manifold, Boucksom–Demailly–Păun–Peternell (J. Algebraic Geom., 2013) characterized its uniruledness by the non pseudoeffectivesness of its canocinal divisor. Furthermore, Campana–Demailly–Peternell (London Math. Soc. Lecture Note Ser., 417, 2015) gave a cohomological characterization of rationally-connectedness. In this talk, I shall report these characterizations can be interporated to give some chomological characterization of the hierarchical structures interpolating the uniruledness and the rationally connectedness.

Summary: Laplacian Eigenmaps is a dimensionality reduction method using eigenvectors of the graph Laplacian which approximates the eigenfunctions of the Laplacian on a submanifold under appropriate assumptions when random samples are obtained on the submanifold in Euclidean space. The convergence of Laplacian Eigenmaps has been discussed assuming lower bound for a quantity called reach, which does not allow non-smooth submanifolds. In this talk, I will discuss the convergence of Laplacian Eigenmaps under the weaker assumptions that non-smooth submanifolds can appear in the limit.

Complex Analysis

March 28th (Mon) Conference Room VIII

9:30–11:50

1 Shun Kumagai (Tohoku Univ.) Family of flat surfaces with a parallelogram decomposition ····· 15

Summary: In this century, a square-tiled translation surface (an origami) is intensively studied as an object with special properties of its translation structure and its $SL(2,\mathbb{R})$-orbit embedded in the moduli space. We generalize this concept in the language of flat surfaces appearing naturally in the Teichmüller theory. We study the combinatorial structure of origamis and show that a certain system of linear equations realizes the flat surface in which rectangles of specified moduli replace squares of an origami. This construction gives a parametrization of the family of flat surfaces with two finite Jenkins–Strebel directions for each combinatorial structure of parallelogram decomposition.

2 Yûsuke Okuyama (Kyoto Inst. Tech.) Uniform perfectness in non-archimedean dynamics ····· 15

Summary: The notion of uniform perfectness of subsets in $\mathbb{C}$ (or $\mathbb{P}^1$) plays an important role in complex analysis, complex dynamics, and (complex) potential theory. In this talk, we will introduce a non-archimedean counterpart to this important notion, and give a few applications of it in non-archimedan dynamics and potential theory on the Berkovich projective line.

3 Katsuhiko Matsuzaki (Waseda Univ.)
Huaying Wei (Waseda Univ.) BMO embeddings, chord-arc curves, and Riemann mapping parametrization ····· 15

Summary: We consider the space of chord-arc curves on the plane passing through the infinity with their parametrization γ on the real line, and embed it into the product of the BMO Teichmüller spaces. The fundamental theorem we prove on this representation is that $\log\gamma'$ also gives a biholomorphic homeomorphism of it into the complex Banach space of BMO functions. Using these two equivalent complex structures, we develop a clear exposition on the analytic dependence on involved parameters in this space. Especially, we examine the parametrization of a chord-arc curve by using the Riemann mapping and its dependence on the arc-length parametrization. As a consequence, we can solve a conjecture of Katznelson, Nag, and Sullivan by showing that this dependence is not continuous.

4 Katsunori Shimomura (Ibaraki Univ.) Real rational function and time transformation of caloric morphism on semi-euclidean spaces ····· 15

Summary: In this talk, we show that any non-constant real rational function appears as a time transformation of a caloric morphism, mapping which preserves caloric functions, between semi-eucledean spaces.

5 Ryoya Fukasaku (Kyushu Univ.)
Shinichi Tajima (Niigata Univ.*) Efficient algorithms for computing univariate residues ····· 10

Summary: We introduce a new algorithm for computing univariate residues, which is based on the theories of local cohomology classes and differential operators. In addition, we compare the algorithm with existing algorithms.

6 Yoshihiko Shinomiya (Shizuoka Univ.) Period matrices of some hyperelliptic Riemann surfaces ····· 15

Summary: We give new examples of period matrices of Riemann surfaces. We construct Riemann surfaces from polygons which are constructed from some rectangles and give their algebraic equations. The algebraic equations are of the form $w^2 = z(z^2-1)(z^2-a_1^2)(z^2-a_2^2)\cdots(z^2-a_{g-1}^2)$ $(1 < a_1 < a_2 < \cdots < a_{g-1})$. We also see that all algebraic curves of these types of equations are constructed from our way. Period matrices are calculated by finding symplectic bases.

7 Sachiko Hamano (Osaka City Univ.) The period matrices of an open Riemann surface and its closings in the Siegel upper half space 15
Masakazu Shiba (Hiroshima Univ.*)

Summary: Let R be an open Riemann surface of genus g ($1 \leq g < \infty$), and $\chi^R = \{A_j^R, B_j^R\}_{j=1}^g$ be a canonical homology basis of R modulo dividing cycles. We show that (R, χ^R) determines a unique point in the Siegel upper half space $\mathfrak{S}_g$ of degree g, which deserves to be called *the* period matrix of the *open* Riemann surface (R, χ^R). We also prove that the period matrices of the closings of (R, χ^R) satisfy a set of inequalities in $\mathfrak{S}_g$.

8 Joe Kamimoto (Kyushu Univ.) Resolution of singularities for C^∞ functions and meromorphy of local zeta functions 15

Summary: We attempt to resolve the singularities of the zero variety of a C^∞ function of two variables as much as possible by using ordinary blowings up. As a result, we formulate an algorithm to locally express the zero variety in the "almost" normal crossings form, which is close to the normal crossings form but may include flat functions. As an application, we investigate analytic continuation of local zeta functions associated with C^∞ functions of two variables.

9 Rikio Yoneda (Kanazawa Univ.) Weighted composition operators between H^p and L_a^q 10

Summary: We study weighted composition operators between the Hardy space and the Bergman spaces.

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

Kazuya Tohge (Kanazawa Univ.) Revisiting the Stothers–Mason theorem with Nevanlinna

Summary: By the Stothers–Mason theorem we mean the well-known *abc* inequality for complex polynomials stating: Three relatively prime and non-constant polynomial a, b and c satisfy the relation $a + b = c$ only if each of them is of degree at most the number of distinct roots of the product abc minus one. It is well known that this estimate is sharp by examples and applies polynomial or rational solutions to Fermat's equation as well as the so-called Davenport inequality. One can bring Picard's Little Theorem over to the observation of $a + b = c$ so that some of the known generalizations of the Stothers–Mason theorem are stated in Nevanlinna's value distribution theory of meromorphic functions on the complex plane. Then it is obvious that Wronskian plays an essential role in order to count the number of distinct roots of abc. In this talk, we change a way of counting roots for another *abc* inequality and give an affirmative partial answer to the strange question: Can difference operation substitute well for differentiation in function theory? The way of judging a root to be multiple in a different angle actually observes the multiplicity as the number of the *stepping-roots* with a fixed stride. Therefore, our operation is naturally a shift or difference operator with the stride. We see an *abc* inequality in this setting and apply it to deduce the corresponding Fermat or Davenport type estimates and reproduce several function-theoretic generalizations of the Stothers–Mason theorem by using this operator. The discussions proceed in parallel to those in the usual differential setting where, for example, Wronskian is simply replaced by Casoratian, and examples to examine the sharpness of the inequalities can be found in a simple translation rule. These are all for entire functions not for integers but a tiny and naive attempt at the very end. This is based on a joint work with K. Ishizaki, R. Korhonen, and N. Li.

March 29th (Tue) Conference Room VIII

9:30–11:30

10 Satoshi Ogawa (Osaka City Univ.) Linearization of transition functions along some Levi-flat hypersurfaces with the structure of S^1-bundle 15

Summary: We introduce suspension construction and we can obtain a Levi-flat hypersurface which has the structure of the unit circle bundle. By focusing on Diophantine condition, we investigate the linearization of transition function along this Levi-flat. Our linearization is based on Ueda's result and primitive KAM-theory for one-variable dynamical systems.

Summary: Hosono obtained sharper estimates of the Ohsawa–Takegoshi L^2-extension theorem by allowing the constant depending on the weight function for a domain in $\mathbb{C}$. In this talk, I explain the higher dimensional case of sharper estimates of the Ohsawa–Takegoshi L^2-extension theorem. In order to prove this, we establish an analogue of Berndtsson–Lempert type L^2-extension theorem by using the pluricomplex Green function with poles along subvarieties.

Summary: $\overline{\partial}$ cohomology groups with polynomial growth $H^{r,s}_{\mathrm{p.g.}}$ will be studied. It will be shown that, given a complex manifold M, a locally pseudoconvex bounded domain $\Omega \Subset M$ satisfying certain geometric boundary condition and a holomorphic vector bundle $E \to M$, $H^{r,s}_{\mathrm{p.g.}}(\Omega, E) = 0$ holds for all $s \geq 1$ if E is Nakano positive and $r = \dim M$. It will be also shown that $H^{r,s}_{\mathrm{p.g.}}(\Omega, E) = 0$ for all r and s with $r + s > \dim M$ if moreover $\mathrm{rank} E = 1$.

Summary: When solutions of differential equations in terms of hyperelliptic functions of genus 2 are given, under conditions when a reduction of these functions to elliptic functions is possible, it is important to find an explicit form of these solutions in terms of elliptic functions. In this talk, we consider a hyperelliptic curve V of genus 2 which admits a morphism of degree 2 to an elliptic curve. Then there exist two elliptic curves E_i, $i = 1, 2$, and morphisms of degree 2 from V to E_i. We express the hyperelliptic functions associated with V on $\mathbb{C}^2$ in terms of the Weierstrass elliptic functions associated with E_i. As a corollary, a solution of the KdV-hierarchy in terms of the Weierstrass elliptic functions is given.

Summary: Let X be a compact Kähler manifold and α be a class in the Dolbeault cohomology class of bidegree $(1, 1)$ on X. When the numerical dimension of α is one and α admits at least two smooth semi-positive representatives, we show the existence of a family of real analytic Levi-flat hypersurfaces in X and a holomorphic foliation on a suitable domain of X along whose leaves any semi-positive representative of α is zero. As an application, we give the affirmative answer to our conjecture on the relation between the semi-positivity of the line bundle $[Y]$ and the analytic structure of a neighborhood of Y for a smooth connected hypersurface Y of X.

Summary: What we call the CR Killing operator D on a contact manifold (M, H) equipped with a compatible almost CR structure J (also known as a strictly pseudoconvex partially integrable almost CR manifold) is the linear differential operator describing trivial deformations of J. We report our recent finding that D can also be found as the first operator in the so-called Bernstein–Gelfand–Gelfand sequence. More precisely, D is the first BGG operator induced by a modified tractor connection introduced by Čap, not by the normal tractor connection, of the adjoint tractor bundle.

Summary: Let M be a projective manifold and L be an ample line bundle over M with a Hermitian metric h whose Chern form is a Kähler form ω. Let $X \subset M$ be a Lagrangian submanifold of (M, ω). When X satisfies the Bohr–Sommerfeld condition, we give an asymptotic estimate of the norm $|f|_{h^k}$ on X for $f \in H^0(M, L^k)$.

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

Shinichi Tajima (Niigata Univ.*) Complex analysis, algebraic analysis and algorithms in singularity theory

Summary: In this talk, we consider singularities of varieties in the context of computational complex analysis and algebraic analysis. Based on the concept of local cohomology and Grothendieck local duality, we introduce a new approach for studying complex analytic properties of singularities. As applications of the proposed approach, effective methods for computing, for instance, logarithmic vector fields, limiting tangent spaces, integral dependence relations, micro-local b-functions are shown.

We introduce a new method for computing holonomic D-modules associated to non-isolated hypersurface singularities. Main ingredient of the approach are Poincaré-Birkhoff-Witt algebra and the theory of comprehensive Gröbner systems. As applications, we present a method for computing vertical monodromy of vanishing cycles sheaves and micro-local b-functions. We discuss some relations between characteristic varieties of relevant holonomic D-modules and Lê cycles introduced by D. Massey.

Functional Equations

March 28th (Mon) Conference Room II

9:00–12:00

1 Daichi Komori (Hokkaido Univ.) The equivalence of the sheaf of pseudodifferential operator and its symbol class · · · · · 12

Summary: The study of pseudodifferential operators was developed by Aoki and Kataoka with symbol theory. Locally they constructed the morphism between the stalks of two sheaves by the aid of the Radon transformation. However their method cannot be extended to the global case. In this talk we introduce the construction of the sheaf morphism from the sheaf of pseudodifferential operators to the sheaf of its symbol class via Čech–Dolbeault cohomology. The theory of Čech–Dolbeault cohomology was originated by Suwa, and it allows us to manipulate the sheaf cohomology without some conditions such as Steinness of coverings. We also show that two morphisms are compatible with each other.

2 Shunya Adachi (Kumamoto Univ.) Monodromy invariant Hermitian forms for second order Fuchsian differential equations with four singularities · · · · · 12

Summary: Gauss hypergeometric differential equation (GHE) is the second order Fuchsian differential equation with three singularities. Under some suitable condition, GHE has a monodromy invariant Hermitian form, which is useful for the study of geometric nature of solutions. More generally, it is known that for the Fuchsian differential equation having an integral representation of solutions, there exists an invariant Hermitian form. In this talk we consider second order Fuchsian differential equations with four singularities, which seems to have no integral representation of solutions in general. As a main result, without assuming the existence of integral representation of solutions, we give sufficient and necessary condition for the existence of monodromy invariant Hermitian form.

3 Genki Shibukawa (Kobe Univ.) Artin-style characterizations for multiple gamma and sine functions · · 10

Summary: We give multiple analogues of Artin's characterizations for the gamma function. As applications of our results, we characterize the multiple gamma and (Kurokawa's) sine functions.

4 Hiroshi Ogawara (Kumamoto Univ.) Differential transcendence of solutions for q-difference equation of Ramanujan function · · · · · 12

Summary: In this talk, we show any non-trivial solution for the second order linear q-difference equation of the Ramanujan function, one of the q-analogue of the Airy function, satisfies no non-trivial algebraic differential equation over the rational function field. Our proof is based on the criterion for differential transcendence of solutions for difference Riccati equations, which is constructed by Nishioka.

5 Takashi Aoki (Kinki Univ.*)
Takao Suzuki (Kinki Univ.)
Shofu Uchida (Kinki Univ.)
Exact WKB analysis for the Pearcey system with a large parameter · · · · · 12

Summary: The Pearcey system is an extension of the Airy equation for multi variables. In this talk, we show that the Borel transform of WKB solutions for the Pearcey system can be written as linear combinations of algebraic functions.

6 Kazuki Ishibashi (Hiroshima Nat. Coll. of Maritime Tech.) Nonoscillation theorems for half-linear dynamic equations with mixed derivatives on a time scale · · · · · 12

Summary: This talk deals with half-linear dynamic equations on a time scale that have two types of derivatives, and obtains sufficient conditions to be nonoscillatory. Note that if the time scale is selected from the set of all real numbers or the set of all natural numbers, then these equations will be half-linear differential equations and half-linear difference equations.

7 Hiroyuki Usami (Gifu Univ.) Manabu Naito (Ehime Univ.*) On the existence and asymptotic behavior of solutions of perturbed half-linear ordinary differential equations · · · 12

Summary: The existence and asymptotic behavior of solutions of half-linear ordinary differential equations with perturbed terms are investigated. The proofs of the results are based on the analysis of generalized Riccati equations associated with this half-linear equation.

8 Tetsutaro Shibata (Hiroshima Univ.) Asymptotic behavior of solution to semilinear eigenvalue problem · · · · 12

Summary: We consider the asymptotic behavior of the solution curve of nonlinear ODEs with logarithmic nonlinear term. It is known that the bifurcation curve λ is a continuous function of the maximum norm $\alpha = \|u_\lambda\|_\infty$ of the solution u_λ associated with λ, and is written as $\lambda = \lambda(\alpha)$. We establish the asymptotic formulas for $u_\alpha(t)$ and $\|u_\alpha\|_1$ as $\alpha \to \infty$.

9 Marius Ghergu (Univ. College Dublin) Yasuhito Miyamoto (Univ. of Tokyo) Vitaly Moroz (Swansea Univ.) Polyharmonic inequalities with nonlocal terms · · · 10

Summary: We study the existence and non-existence of classical solutions for inequalities of type

$$\pm\Delta^m u \geq \big(\Psi(|x|) * u^p\big)u^q \quad \text{in } \mathbb{R}^N (N \geq 1).$$

Here, Δ^m $(m \geq 1)$ is the polyharmonic operator, $p, q > 0$ and $*$ denotes the convolution operator, where $\Psi > 0$ is a continuous non-increasing function. We devise new methods to deduce that solutions of the above inequalities satisfy the poly-superharmonic property. This further allows us to obtain various Liouville type results. Our study is also extended to the case of systems of simultaneous inequalities.

10 Takeyuki Nagasawa (Saitama Univ.) Aya Ishizeki (Saitama Univ.) The Möbius energies of knots and links: Decomposition, the cosine formula, and their Möbius invariance · · · 10

Summary: The Möbius energy of knots is one of O'Hara's energies, named after the invariance under Möbius transformations. A similar energy is defined for links. In this talk, we unify the treatment of these energies, and give a Möbius invariant decomposition in a way simpler than before. For this, we use a map which is called the *Gauss map* in the case of links. Using it, we find that the decomposition of energy density is derived from the *parallelogram theorem*. Also, the cosine formula holds for the decomposed energies, which is known as an alternative expression for the original energy.

11 Takeyuki Nagasawa (Saitama Univ.) Aya Ishizeki (Saitama Univ.) The Möbius energy of knots as a limit of the Möbius energy of links · · · 10

Summary: Analyzing the Möbius energy of knots, we always encounter difficulties of singularity of integrand at the diagonal part. As a simple way to avoid them, we regularize the denominator in the integrand. The regularized energy, however, loses the Möbius invariant property. Introducing the Möbius energy of links, we attempt a way to avoid singularity preserving this geometrically interesting property. Precisely saying, we show that the energy of links with a *compensated term* convergences to the Möbius energy of a knot as two components of links approaches to one closed curve which represents the knot. The link energy diverges without a compensated term. Our compensated term, which is constructed from the Gauss map, vanishes for any knots.

14:15–16:15

12 Toshio Horiuchi (Ibaraki Univ.) The CKN type inequalities involving non-doubling weights ····· 12

Summary: We discuss validity of CKN type inequalities involving non-doubling weights, after a quick review of the classical CKN type inequalities. In one-dimensional case, a function $w(t)$ on $(0,\infty)$ is said to be a doubling weight if there exists a positive number C such that we have

$$C^{-1}w(t) \le w(2t) \le Cw(t) \quad (0 < t < \infty),$$

where C is independent of each $t \in (0,\infty)$. When $w(t)$ does not possess this property, $w(t)$ is said to be a non-doubling weight in the present talk. In one-dimensional case we typically treat $e^{-1/t}$ and $e^{1/t}$. In such cases the limit of ratio $w(t)/w(2t)$ as $t \to +0$ may become 0 or $+\infty$, and hence they are regarded as non-doubling weights according to our notion.

13 Hiroshi Ando (Ibaraki Univ.)
Toshio Horiuchi (Ibaraki Univ.⋆)
Variational problems relating the generalized weighted Hardy's inequalities with compact perturbations ····· 12

Summary: Let Ω be a bounded domain of $\mathbb{R}^N$ with boundary of class C^2. We consider the variational problems relating the generalized weighted Hardy's inequalities with compact perturbations. As weights we treat the functions of distance to the boundary of Ω. We study the infimum of the variational problem and it's achievability. Then we use the generalized weighted Hardy's inequalities with remainder terms on a tubular neighborhood of the boundary of Ω.

14 Naoki Hamamoto (Osaka Pref. Univ.) Sharp Rellich–Hardy inequality for constrained vector fields ····· 10

Summary: We report on sharp constant in the Rellich–Hardy inequality for constrained vector fields, especially for solenoidal fields. This inequality serves as an intermediate between the weighted Hardy and Rellich inequalities for solenoidal fields, which we established in our previous work as a development of Costin–Maz'ya's work on sharp Hardy inequality for axisymmetric solenoidal fields.

15 Yoshinori Kametaka (Osaka Univ.⋆)
Kohtaro Watanabe
(Nat. Defense Acad. of Japan)
Atsushi Nagai (Tsuda Coll.)
Kazuo Takemura (Nihon Univ.)
Hiroyuki Yamagishi
(Tokyo Metropolitan Coll. of Indus. Tech.)
Positivity and hierarchical structure of Green functions and the best constant of Sobolev inequality corresponding to a bending problem of a beam on a half line ····· 10

Summary: We consider the boundary value problem for 4-th order linear ordinary differential equation in a half line $(0,\infty)$, which represents bending of a beam on an elastic foundation under a tension. A tension is relatively stronger than a spring constant of elastic foundation. We here treat 4 self-adjoint boundary conditions, clamped, Dirichlet, Neumann and free edges, at $x = 0$. We show the positivity and the hierarchical structure of 4 Green functions and the best constants of the corresponding Sobolev inequalities.

16 Tatsuki Mori (Musashino Univ.)
Sohei Tasaki (Hokkaido Univ.)
Tohru Tsujikawa (Univ. of Miyazaki⋆)
Shoji Yotsutani (Ryukoku Univ.⋆)
Global structure of stationary solutions for the 1-dimension Fix–Caginalp equation ····· 12

Summary: We are interested in stationary solutions of the Fix–Caginalp equation, which is proposed by Fix (1983) and Caginalp (1986) to understand phenomena of the non-isothermal solid-liquid phase transition. Elliott–Zheng (1990) and Suzuki–Tasaki (2009) obtained some partial results concerning the existence and non-existence of stationary solutions under restricted conditions. In this talk, we show the global structure of all stationary solutions of the 1-dimensional Fix–Caginalp equation with Neumann boundary conditions.

17 Kengo Terai (Univ. of Tokyo) On weak solutions to first-order discount mean field games ····· 10
Hiroyoshi Mitake (Univ. of Tokyo)

Summary: In this talk, we establish the existence and uniqueness of weak solutions to first-order discount mean field games and a stability result to give the existence for the ergodic problem. We show an example to illustrate the multiplicity of weak solutions to the ergodic problem. With this motivation, we address a selection condition, which is a necessary condition that any limit of solutions under subsequence satisfies. As an application, we show a nontrivial example to get the convergence of weak solutions.

18 Ryunosuke Mori (Meiji Univ.) On a strong solution to a generalized mean curvature flow with a
Eita Tomimatsu (Tokyo Tech) transport term in the sense of Brakke's formulation ····· 12
Yoshihiro Tonegawa (Tokyo Tech)

Summary: Suppose that a family of k-dimensional surfaces in $\mathbb{R}^n$ evolves by the generalized mean curvature flow with a given transport vector in the sense of Brakke's formulation of velocity. When the flow is locally close to a time-dependent k-dimensional plane in a weak sense of measure in space-time, it is represented as a graph of a $C^{1,\alpha}$ function over the plane. On the other hand, it is not known if the graph satisfies the corresponding PDE pointwise in general. For this problem, when $k = n - 1$ and the distributional time derivative of the graph is a signed Radon measure, it is proved that the graph satisfies the PDE pointwise. An application to a short-time existence theorem for a surface evolution problem is given.

16:30–17:30 Award Lecture for the 2021 MSJ Analysis Prize

Futoshi Takahashi (Osaka City Univ.) ♭ Mathematical analysis related with Hardy inequalities

Summary: In this talk, I will concern several topics on Hardy inequalities in subcritical or critical regime, Hardy–Leray inequalities for vector fields, and related functional inequalities. This talk is based on several works with Megumi Sano, and Naoki Hamamoto.

March 29th (Tue) Conference Room II

9:00–12:00

19 Tomoyuki Oka (Tohoku Univ.) Space-time periodic homogenization for the porous medium equation
Goro Akagi (Tohoku Univ.) with nonnegative initial data ····· 12

Summary: In this talk, we shall discuss a space-time periodic homogenization problem for the porous medium equation with periodically oscillating (in space and time) coefficients and nonnegative initial data.

20 Ryuichi Sato (Fukuoka Univ.) On existence of solutions to a system of fully nonlinear parabolic equa-
Takahiro Kosugi tions ····· 12
(Tottori Univ. of Environ. Stud.)

Summary: We consider the Cauchy problem for a system of fully nonlinear parabolic equations. In this talk we shall show the existence of global-in-time solutions to the problem. Our condition to ensure the global existence is specific to the fully nonlinear parabolic system.

21 Yu Yoshimi (Kyoto Univ.) Maximal L^1-regularity of the heat equation under the oblique boundary
Takayoshi Ogawa (Tohoku Univ.) condition ····· 10
Senjo Shimizu (Kyoto Univ.)

Summary: For the inhomogeneous oblique boundary data, maximal L^1-regularity of the heat equation is obtained in time end-point case upon the homogeneous Besov space $\dot{B}^s_{p,1}(\mathbb{R}^n_+)$ with $1 < p < \infty$. We use the method of Ogawa–Shimizu (arXiv:2110.10442 to be published in JEE) in which they utilized the almost orthogonal properties between the boundary potential and the Littlewood–Paley dyadic decomposition of unity in the Besov and the Lizorkin–Triebel spaces.

Summary: We study stability of constant steady states of a drift-diffusion equation on n-dimensional Euclidean spaces. Our problem has its constant steady states which can be chosen as arbitrary real number. We have proved that stability of each constant steady states depend on the value of itself.

Summary: We consider long-time asymptotic behavior for solutions to the Fokker–Planck equation, which is related to the mathematical model of the evolution of grain boundaries with two state variables, the lattice misorientation and the triple junction. Since the Fokker–Planck equation satisfies the energy law, the long-time asymptotics of the solutions seems the Boltzmann distribution of the state variables. We show the exponential stability of the Boltzmann distribution in a weighted L^2 space. Furthermore, we explain the relationship between the Boltzmann distribution and the marginal distribution.

Summary: In this talk, we explane the Allen–Cahn equation with transport term in a bounded domain. We prove that the limit interface is mean curvature flow with transport term under the condition that the energy is uniformly bounded with respect to time. Using this result, we can show the existence of mean curvature flow with a gradient vector field as transport term.

Summary: We study the Cauchy problem for the quasi-geostrophic equations in a ball of the two dimensional space under the homogeneous Dirichlet boundary condition. We show the existence, the uniqueness of the strong solution in the framework of Besov spaces. In the proof, we establish a spectral localization technique and commutator estimates.

Summary: We construct a linear approximation of the solution to the Surface Quasi-Geostrophic Equation in two-dimensional Euclidean space, and obtain a convergence rate, in the Lebesgue norm, between the solution and this approximation with respect to time. We also demonstrate that the nonlinear term of the solution is bounded sharply by the same function of time.

Summary: We establish a Liouville type theorem for entire solutions of these reaction-diffusion systems. Based on this theorem, we derive the stabilization of the solutions of the reaction-diffusion system to the unique positive constant state, under the condition that this positive constant state is globally stable in the corresponding kinetic systems. An example about spreading phenomena from epidemiology are given to illustrate the applications of this theory.

28 Masahiko Shimojo (Tokyo Metro. Univ.)
Jong-Shenq Guo (Tamkang Univ.)
Yu-Shuo Chen (Tamkang Univ.)
Spreading problem and traveling wave of a singular predator-prey system 10

Summary: We concern the dynamical behaviors of a singular predator-prey model. We compute the spreading speed of the predator and asymptotic behavior of the spreading solution beyond and behind the front. Some existence theorems of traveling wave on a line is also discussed.

29 Kousuke Kuto (Waseda Univ.)
Global bifurcation structure of segregated steady-states for a cross-diffusion limit in the Shigesada–Kawasaki–Teramoto model 12

Summary: Recently, the author obtained a limiting (shadow) system of the stationary Shigesada–Kawasaki–Teramoto model as both cross-diffusion terms tend to infinity with the same order. This talk is concerned with the bifurcation structure of nonconstant solutions of the limiting system. In the one-dimensional case, this result gives infinitely many branches that connect the positive constant solution with a singular limit.

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

Hiroshi Matsuzawa (Kanagawa Univ.)
A free boundary problem of reaction-diffusion equation with a multi-stable type nonlinearity in high space dimensions

Summary: In this talk, I will treat propagation phenomena in a free boundary problem of reaction diffusion equation of the form : $u_t = \Delta u + f(u)$ $(t > 0,\ x \in \Omega(t))$ with free boundary $\Gamma(t) = \partial\Omega(t)$ which is determined by the Stefan condition of the form $u_t = \mu|\nabla u|^2$ on $\Gamma(t)$. In the work of Du and Lin (2010), this type of problem was introduced when $N = 1$ as a model which describes the spreading of new or invasive species. From this work, propagating phenomena in the free boundary problems attract more and more attention of mathematicians. In this talk, I will present some recent study on propagation profiles of solutions for the free boundary problem of reaction-diffusion equation with some class of multi-stable nonlinearity in high space dimensions. I will give first the result about radially symmetric case. I will also present the general (non-symmetric) case. This talk is based on some joint works with Dr. Yuki Kaneko (Japan Women's University) and Professor Yoshio Yamada (Waseda University).

March 30th (Wed) Conference Room II

9:00–12:00

30 Takeshi Suguro (Tohoku Univ.) ♭
Well-posedness of the Cauchy problem of the parabolic-elliptic Keller–Segel system in uniformly local spaces 12

Summary: We consider the Cauchy problem of the parabolic-elliptic Keller–Segel system. This system is one of the diffusion equations involving a nonlocal term. It is interesting whether this problem is well-posed in function spaces containing non-decaying functions. We show that the Cauchy problem of the Keller–Segel system is well-posed in uniformly local Lebesgue spaces.

31 Tatsuya Hosono (Tohoku Univ.) ♭
Finite time blow-up of solutions to an attraction–repulsion chemotaxis system in four dimensional case 12

Summary: This talk deals with the solution of the Cauchy problem for an attraction-repulsion chemotaxis system in $\mathbb{R}^n$ with the positive parameters $\beta_1, \beta_2, \lambda_1, \lambda_2$. According to previous results in $\mathbb{R}^2$, it has shown that for the initial mass $\|u_0\|_{L^1}$, the value $8\pi/(\beta_1 - \beta_2)$ is the threshold whether the solution exists globally in time or not under the attractive dominant case $\beta_1 > \beta_2$. In this talk, for the 4-dimensional case, we show that the solution with $\|u_0\|_{L^1} > (8\pi)^2/\chi$ may blow up in finite time, where χ is a positive constant explicitly determined by $\beta_1, \beta_2, \lambda_1, \lambda_2$. The constant $(8\pi)^2$ can be regarded as the 4-dimensional threshold value for the global existence corresponding to the system which has 8π-dichotomy in $\mathbb{R}^2$.

Summary: This talk deals with a degenerate parabolic-elliptic chemotaxis system with logistic source and nonlinear production. In a nondegenerate case, a condition such that solutions blow up in finite time was obtained in our previous work (J. Math. Anal. Appl.; 2022; 506; 29). The purpose of this talk is to show that solutions blow up in finite time in a degenerate case.

Summary: Based upon a reflectionless inverse scattering theory we establish an inverse scattering method by which N-soliton solutions of a nonlinear evolution system (the Boussinesq system) are constructed.

Summary: Discrete nonlinear Schrödinger equation (DNLS) is a partial differential equation which appear in various region of physics. We will explain the behavior of the solution of DNLS. In particular, we focus on the stability of soliton. The stability is that the solution of DNLS converge to standing wave solutions in some sense for a long time. The standing wave solution is a special solution of DNLS.We will explain proof of the stability which consists of spectrum theory, linear estimates and boot strap argument.

Summary: In this talk we study the movable singular point of a Hamiltonian system with Hamiltonian $H := H_0 + H_1$. Here H_0 is integrable and has a singular solution v while H_1 is a perturbation. A singular solution for H has the form $F(v)$ for some transformation F defined on a domain of the phase space which contains the orbit of v tending to infinity.

Summary: We study existence and stability properties of ground-state standing waves for two-dimensional nonlinear Schrödinger equation with a point interaction and a focusing power nonlinearity. The Schrödinger operator with a point interaction $(-\Delta_\alpha)_{\alpha\in\mathbb{R}}$ describes a one-parameter family of self-adjoint realizations of the Laplacian with delta-like perturbation. The operator $-\Delta_\alpha$ always has a unique simple negative eigenvalue e_α. We prove that if the frequency of the standing wave is close to $-e_\alpha$, it is stable. Moreover, if the frequency is sufficiently large, we have the stability in the L^2-subcritical or critical case, while the instability in the L^2-supercritical case.

Summary: In this talk, we show the existence of a minimizer for the L^2-constrained minimization problem associated with a nonlinear Schrödinger system with three wave interaction without assuming symmetry for potentials.

38 Masaru Hamano (Saitama Univ.)
Masahiro Ikeda (RIKEN/Keio Univ.)
Shuji Machihara (Saitama Univ.)
Blow-up solutions to nonlinear Schrödinger equation with an inverse power potential 10

Summary: In this talk, we treat nonlinear Schrödinger equation with a mass-critical nonlinear term and an inverse power potential in one dimension. We note that the equation is not scale invariant. We consider the time behavior of solutions for initial data with negative energy. In particular, we prove that the solutions blow up. Ogawa–Tsutsumi proved the similar result for an equation without a potential. They used scale invariance of the equation without the potential. Since our equation has not scale invariance, we cannot apply directly Ogawa–Tsutsumi's argument. Therefore, we change scale of weighted function in a localized virial identity and prove our result.

39 Takuya Sato (Tohoku Univ.)♭
Lower bound estimates of solutions to the dissipative nonlinear Schrödinger equation 12

Summary: We consider the Cauchy problem for the nonlinear Schrödinger equation with a power type nonlinearity $\lambda|u|^{p-1}u$. The condition Im $\lambda < 0$ yields a dissipative property for the solution to the nonlinear Schrödinger equation. We show that $p = 1 + 2/n$ is the critical exponent to exhibit the L^2-decay of dissipative solutions, namely we show the L^2-lower bound of the solution when $p > 1 + 2/n$.

40 Sonae Hadama (Kyoto Univ.)
Well-posedness of the Hartree equation for infinitely many particles with the Riesz potential 12

Summary: We study the Hartree equation describing the time evolution of the wave functions of N fermions interacting with each other. From a physics perspective, the case where N is infinite is also important. In this case, the well-posedness and scattering was first studied by Lewin–Sabin. It has been advanced recently by Chen–Hong–Pavlović and Collot–de Suzzoni. However, these studies only deal with the cases where the interaction is weak, and therefore, there were no results for the cases with strong interaction, for example, the Riesz potential. In this talk, we report the results on the local and global well-posedness of the Hartree equation with the Riesz potential, which is important from a physics perspective.

14:15–16:15

41 Shunya Hashimoto (Saitama Univ.)
Isamu Dôku (Saitama Univ.⋆)
Shuji Machihara (Saitama Univ.)
The local well-posedness of the stochastic nonlinear Schrödinger equations in H^2 10

Summary: The Cauchy problem for the stochastic nonlinear Schrödinger equation with a multiplicable noise is considered where the nonlinear term is of a power type and its coefficients are complex numbers. In particular, it is important to consider the complex coefficients in the noise which cover non-conservative cases, because they include measurement effects in quantum physics. The main purpose of this work is to construct classical solutions in $H^2(\mathbb{R}^d)$ for the problem in question.

42 Isao Kato (Kyoto Univ.)
Ill-posedness for the half wave Schrödinger equation 10

Summary: We study ill-posedness for the half wave Schrödinger equation introduced by Xu (2017). Ill-posedness is obtained in the super-critical or at the critical space. The proof for the super-critical space is based on the argument established by Christ, Colliander and Tao (2003). For the critical space, we use the standing wave solution, which was proved the existence by Bahri, Ibrahim and Kikuchi (2021).

Summary: In this talk, we introduce a classification result of systems with two unknowns and cubic polynomial nonlinearities. We define an equivalence relation between two systems by the linear transformation of unknowns. The goal is to understand a quotient set with respect to the equivalence relation. To this end, we introduce a matrix representation of a system. The representation not only gives us an explicit formula of the equivalence relation and but also describes characteristic properties of the system such as conservation laws. The classification result is based on the study of nonlinear dispersive equations but it is applicable to a wide class of systems of PDEs and ODEs.

Summary: In this talk, we study the asymptotic behavior of solutions to a specific system of the cubic Klein–Gordon equations in one dimension. The cubic nonlinearity is critical in one dimension with respect to the large-time behavior of (small) solutions. It turns out that the system, which is obtained systematically by our classification result, admits a solution with a new type of asymptotic behavior.

Summary: In this talk, we report on the lifespan estimates of classical solutions of semilinear wave equations with characteristic weights and compactly supported data in one space dimension. The results includes those for weights by time-variable, but excludes those for weights by space-variable in some cases. We have interactions of two characteristic directions.

Summary: In this talk, we discuss about the initial value problems for semilinear wave equations of derivative type with spatial weights in one space dimension. The lifespan estimates of classical solutions are quite different from those for nonlinearity of unknown functions itself as the global-in-time existence can be established by spatial decay.

Summary: In this talk, we introduce lifespan estimates for a special class of semi-linear wave equations in one space dimension for which the so-called combined effect is observed. It is remarkable that we have better results than those in the general theory which was established in 1992.

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

Motohiro Sobajima (Tokyo Univ. of Sci.) Weighted energy estimates for wave equations with space-dependent damping

Summary: In this talk we summarize recent progress on weighted energy estimates of polynomial type for the wave equation with space-dependent damping $\partial_t^2 u - \Delta u + a(x)\partial_t u = 0$, where the damping coefficient a decays like a polynomial $|x|^{-\alpha}$ ($\alpha \in [0,1)$) at spatial infinity. When we consider weighted energy estimates to such problems, usually the exponential function of the form $e^{\psi(x,t)}$ appears as a weight function in the energy functional. However, this choice excludes a class of initial data with polynomial decay. In contrast, we introduce another class of weight functions involving the confluent hypergeometic functions to provide corresponding weighted energy estimates which have weight functions with polynomial order. Next, we deal with global existence for the semilinear problem with a power type nonlinearity as an application of such estimates.

March 31st (Thu) Conference Room II

9:00–12:00

48 Takahito Kashiwabara (Univ. of Tokyo), Hiromichi Itou (Tokyo Univ. of Sci.) Unique solvability of a crack problem with Signorini-type and Tresca friction conditions in a linearized elastodynamic body 12

Summary: We consider a time-dependent linear elasticity equation including a crack, which is a thin surface embedded in a bulk domain. On the crack we impose a non-penetrating (a.k.a. Signorini) condition and a given friction (a.k.a. Tresca) condition for the normal and tangential directions, respectively. Since an original Signorini condition involving only displacement leads to a severe mathematical difficulty, we modified it in such a way that it includes velocity. For this problem we are able to prove existence and uniqueness of a strong solution, which is our main result.

49 Ikki Fukuda (Shinshu Univ.), Kenta Itasaka Higher-order asymptotic profiles of the solutions to the viscous Fornberg–Whitham equation 10

Summary: We consider the Cauchy problem for the viscous Fornberg–Whitham equation which is one of the nonlinear and nonlocal dispersive-dissipative equations. In this talk, we establish the global existence of the solutions and study its asymptotic behavior. We show that the solution to this problem converges to the self-similar solution to the Burgers equation called the nonlinear diffusion wave, due to the dissipation effect by the viscosity term. Moreover, we analyze the optimal asymptotic rate to the nonlinear diffusion wave and the detailed structure of the solution by constructing higher-order asymptotic profiles. Also, we investigate how the nonlocal dispersion term affects the asymptotic behavior of the solutions and compare the results with the ones of the KdV–Burgers equation.

50 Souhei Sugizaki (Tokyo Tech), Shinya Nishibata (Tokyo Tech), Itsuko Hashimoto (Kanazawa Univ.) Asymptotic stability of a radially symmetric stationary solution for the compressible Navier–Stokes equation with an inflow boundary condition 12

Summary: We study a radially symmetric stationary solution for the compressible Navier–Stokes equation with an inflow boundary condition. Precisely, we obtain the decay rates of the solution and its first derivatives. Moreover, we show an asympotic stability of the stationary solution.

51 Motofumi Aoki (Tohoku Univ.), Tsukasa Iwabuchi (Tohoku Univ.) On the energy conservation law for the full system of compressible Navier–Stokes equations 12

Summary: We study a sufficient condition such that a weak solution of the full system of compressible Navier–Stokes equations satisfies the energy conservation law. We focus on two and three space dimensions and especially consider the case that the pressure is written by the ideal gas law.

52 Masashi Ohnawa (Tokyo Univ. of Marine Sci. and Tech.)
Masahiro Suzuki (Nagoya Inst. of Tech.)
Asymptotic stability of air flow over mountains with wave breaking 12

Summary: We consider stationary shock waves appearing in air flow over mountains modeled by one-dimensional shallow water equation. The shock wave connects an upstream supercritical state to a downstream subcritical state discontinuously. If the discontinuity is located in a lee side of the mountain, we claim the asymptotic stability of the stationary shock wave whatever large the strength of the shock or the gradient of the mountain height may be.

53 Kota Ikeda (Meiji Univ.)
Stability analysis of a uniform flow in a mathematical model of camphor boats 12

Summary: Various collective motions of camphor boats, called jamming, clustering, and swarming state observed in a one-dimensional circuit, have been studied. It is expected that the center manifold theories proposed in previous works are useful for the analysis of the collective motion of camphor boats. In my previous work, we have developed a new theory for a system with Dirac's delta functions in L^2-framework. In this talk, we will examine the stability analysis in the reduced system and numerically show that the uniform flow can be destabilized even if the length of the circuit is large.

54 Ken Furukawa (RIKEN)
Takahito Kashiwabara (Univ. of Tokyo)
Singular limit problems on the primitive equations and Navier–Stokes equations in anisotropic spaces 10

Summary: In this talk, we introduce the mathematical relationship between the Navier–Stokes equations and the primitive equations. Then we show that the solution of the scaled Navier–Stokes equations converges to the solution of the primitive equations in anisotropic Lebesgue spaces under less regularity assumptions.

55 Takeshi Gotoda (Tokyo Tech)
Energy conservation in 2D incompressible inviscid flows 10

Summary: We consider energy conservation in 2D incompressible inviscid flows through weak solutions of the filtered-Euler equations, which describe a regularized Euler equations. We show that the energy dissipation rate for the filtered weak solution with vorticity in L^p, $p > 3/2$ converges to zero in the limit of the filter parameter. Although the energy defined in the whole space is not finite in general, we formally extract a time-dependent part from the energy and define the energy dissipation rate as its time-derivative. Moreover, the limit of the filtered weak solution is a weak solution of the Euler equations and it satisfies a local energy balance in the sense of distributions.

56 Hiroyuki Tsurumi (Kyoto Univ.)
Yasunori Maekawa (Kyoto Univ.)
Existence of the 2D stationary Navier–Stokes flow on the whole plane around a radial flow 12

Summary: We consider the stationary Navier–Stokes equations on the whole plane $\mathbb{R}^2$. We show that for a given small and smooth external force around a radial flow, there exists a classical solution decaying like $|x|^{-1}$. In our result, it is not necessary to impose any symmetric conditions on external forces.

14:15–16:15

57 Hideo Kozono (Waseda Univ. / Tohoku Univ.)
Yutaka Terasawa (Nagoya Univ.)
Yuta Wakasugi (Hiroshima Univ.)
Asymptotic behavior and Liouville-type theorems for axisymmetric stationary Navier–Stokes equations outside of an infinite cylinder with a periodic boundary condition 10

Summary: We study the asymptotic behavior of solutions to the steady Navier–Stokes equations outside of an infinite cylinder in $\mathbb{R}^3$. We assume that the flow is periodic in x_3-direction and has no swirl. This problem is closely related with two-dimensional exterior problem. Under a condition on the generalized finite Dirichlet integral, we give a pointwise decay estimate of the vorticity at the spatial infinity. Moreover, we prove a Liouville-type theorem only from the condition of the generalized finite Dirichlet integral.

58 Lorenzo Brandolese (Univ. Lyon 1) Takahiro Okabe (Osaka Univ.) Control of weak solutions of the Navier–Stokes equation by external forcing · · · · · · · · · · 10

Summary: We consider the incompressible Navier–Stokes equations in the whole space $\mathbb{R}^n$, $n = 2, 3, 4$. The aim of this talk is to control of the energy decay of weak solutions by external force. For this purpose, we give a refinement of the method in our previous result and derive weighted L^1-estimate of weak solutions of the Navier–Stokes equations which satisfies the strong energy inequality.

59 Keiichi Watanabe (Waseda Univ.) Stability of stationary solutions to a free boundary problem of the Navier–Stokes equations · · · · · · · · · · 12

Summary: We consider the stability of equilibrium figures of uniformly rotating viscous incompressible fluid in $\mathbb{R}^3$ with surface tension, where the equilibrium figures are rotationally symmetric about a certain axis. It is proved that this stability result can be obtained by the positivity of the second variation of the energy functional associated with the equation that determines equilibrium figures, provided that initial data are close to an equilibria state. The solution converges exponentially to an equilibrium. The proof is inspired by a series of papers due to Shibata, but a new orthogonal condition is introduced in order to show the exponential stability of an associated analytic C_0-semigroup. If a value of initial angular momentum is small, the steady-state is determined uniquely.

60 Miho Murata (Shizuoka Univ.) Yoshihiro Shibata (Waseda Univ.) Global well posedness for a Q-tensor model of nematic liquid crystals · · · · · · · · · · 10

Summary: We consider the global well posedness and the decay estimates for a $\mathbb{Q}$-tensor model of nematic liquid crystals in $\mathbb{R}^N$, $N \geq 3$. This system is coupled system by the Navier–Stokes equations with a parabolic-type equation describing the evolution of the director fields $\mathbb{Q}$. The proof is based on the maximal L_p-L_q regularity and the L_p-L_q decay estimates to the linearized problem.

61 Mikihiro Fujii (Kyushu Univ.) Large time behavior of solutions to the 3D anisotropic Navier–Stokes equation · · · · · · · · · · 12

Summary: We consider the large time behavior of the solution to the 3D Navier–Stokes equation with horizontal viscosity and show that the L^p decay rate of the horizontal components of the velocity field coincides to that of the 2D heat kernel, while the vertical component decays like the 3D heat kernel. Moreover, we consider the asymptotic expansion of the solution and find that a portion of the nonlinear term affect the leading term of the horizontal components of the velocity field, whereas the leading term of the vertical component is given by only the linear solution.

62 Yoshihiro Shibata (Waseda Univ.) Global solution of the 3D compressible Navier–Stokes equations with free surface in the maximal regularity class · · · · · · · · · · 10

Summary: In this paper concerns the global wellposedness issue of the barotropic compressible Navier–Stokes equations (CNS) with free surface in the smooth exterior domain in 3D Euclidean space. By using the decay estimate in the semigroup theory, we construct the global-in-time solution in the time weighted maximal L_p-L_q regularity class for some $p > 2$ and $q > 3$. Namely, the solution is bounded as L_p in time and L_q in space. Compared with the previous results of the free boundary value problem of (CNS) in unbounded domains, we relax the regularity assumption on the initial states, which is the advantage by using the maximal L_p-L_q regularity framework.

63 Yoshihiro Shibata (Waseda Univ.) The L_p-L_q decay estimate for the multidimensional compressible flow with free surface in the exterior domain · · · · · · · · · · 10

Summary: The aim of this talk is to develop the general L_p theory for the barotropic compressible Navier–Stokes equations with the free boundary condition in the exterior domain in the N dimensional Euclidean space ($N \geq 3$). By the spectral analysis, we obtain the classical L_p-L_q decay estimate for the linearized model problem in view of the partial Lagrangian transformation.

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

Yoshihiro Ueda (Kobe Univ.) Mathematical analysis of the dissipative structure for the symmetric hyperbolic system with relaxation

Summary: In this talk, we consider the dissipative structure for the linear symmetric hyperbolic system with non-symmetric relaxation. If the relaxation matrix of the system has symmetric property, Shizuta and Kawashima in 1985 introduced the suitable stability condition, and Umeda, Kawashima and Shizuta in 1984 analyzed the dissipative structure. On the other hand, Ueda, Duan and Kawashima in 2012 and 2018 focused on the system with non-symmetric relaxation, and got the partial results. Furthermore, they argued the new dissipative structure called the regularity-loss type. In this situation, our purpose of this talk is to extend the stability theory introduced by Shizuta and Kawashima in 1985 and Umeda, Kawashima and Shizuta in 1984 for our general system.

Real Analysis

March 30th (Wed) Conference Room VIII

9:30–11:45

Summary: In general, geodesic spaces is not linear, but they have generalization of properties in linear spaces. The purpose of this study is to elucidate the geometrical characteristics of geodesic spaces. We report some geometric properties such as uniform convexity in complete Busemann spaces.

Summary: The Douglas–Rachford algorithm is an important and powerful algorithm that can be applied to solving problems, such as minimizing the sum of two proper closed convex functions, or, more generally, finding a zero point of the sum of two monotone operators. In this talk, we study a modified version of the Douglas–Rachford algorithm for convex minimization problem in a real Hilbert space.

Summary: In this talk, we prove nonlinear ergodic theorems for a family of monotone nonexpansive mappings in ordered uniformly convex Banach spaces. We also weak and strong convergence theorems for the mappings.

Summary: We show that, under appropriate conditions, there exists a quasinonexpansive extension of a mapping with an attractive point in the sense of Takahashi and Takeuchi (2011) such that the fixed point set of the extension equals the attractive point set of the given mapping. Then using the quasinonexpansive extension, we establish some convergence theorems for approximating attractive points of a generalized hybrid mapping in the sense of Kocourek, Takahashi, and Yao (2010).

Summary: For Banach spaces X, Y, we say that X is isomorphic to Y with respect to the structure of Birkhoff–James orthogonality, denoted by $X \sim_{BJ} Y$, if there exists a bijection $T : X \to Y$ that preserves Birkhoff–James orthogonality in both directions. It is shown that the finite dimension of a Banach space is preserved under "$\sim_{BJ}$", reflexive smooth Banach spaces are isomorphically classified from the viewpoint of Birkhoff–James orthogonality, and three or more dimensional Hilbert spaces are characterized by their structure of Birkhoff–James orthogonality.

Summary: In this talk, we present some recent results on the skewness of Banach spaces, especially in connection with James constant and characteristic of convexity.

Summary: In this talk, we will describe the points to note regarding the family of indefinite integral with respect to the extended integral.

14:30–16:00

8 Jun Kawabe (Shinshu Univ.) A topology on the space of measurable functions on a nonadditive measure space 15

Summary: In this talk, given a nonadditive measure μ, a topology, which is compatible with convergence in μ-measure, is defined on the real linear space of all measurable functions by using the distance introduced by Dunford and Schwartz. Some properties of the topology, such as the open sphere condition, completeness, the Hausdorff separation axiom, separability, linearlization, and pseudo-metrizability, are related to the characteristics of nonadditive measures.

9 Ryoji Fukuda (Oita Univ.)
Aoi Honda (Kyushu Inst. of Tech.)
Yoshiaki Okazaki (Fuzzy Logic Systems Inst.)
Completion of a monotone measure space and completeness of a measure algebra and L_0 space 15

Summary: Let $(X, \mathcal{B}, \mu)$ be a monotone measure space. We discuss the μ-completion of the σ-algebra $\mathcal{B}$ and completeness of the measure algebra and the L_0 topology. We consider these problems under the condition of weak zero additivity, quasi subadditivity, and some other assumptions for the monotone measure μ. To prove the completeness, we define power transform of a monotone measure or a pseudo metric. This concept is very useful for our proof. Using this concept, we also prove the metrizability of these topologies.

10 Satoshi Yamaguchi (Ibaraki Univ.)
Eiichi Nakai (Ibaraki Univ.)
Generalized fractional integral operators on Campanato spaces and their bi-preduals 15

Summary: In this talk we prove the boundedness of the generalized fractional integral operator I_ρ on generalized Campanato spaces with variable growth condition, which is a generalization and improvement of previous results, and then, we establish the boundedness of I_ρ on their bi-preduals. We also prove the boundedness of I_ρ on their preduals by the duality.

11 Ryota Kawasumi Pointwise multipliers on weak Orlicz–Morrey spaces 15

Summary: In this talk we give the characterization of pointwise multipliers on weak Orlicz–Morrey spaces. To do this we first prove a generalized Hölder's inequality for the weak Orlicz–Morrey spaces. Next, to characterize the pointwise multipliers, we use the fact that all pointwise multipliers from a weak Orlicz–Morrey space to another weak Orlicz–Morrey space are bounded operators. Weak Orlicz–Morrey spaces contain weak L^p, weak Orlicz and generalized weak Morrey spaces. Then our results contain several previous results as corollaries.

12 Naoya Hatano (Chuo Univ.) Weak-type boundedness of commutators with respect to singular integral operators on Orlicz–Morrey spaces 15

Summary: In this paper, we give the weak-type boundedness of its commutators on Orlicz–Morrey spaces.

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

Yasunori Kimura (Toho Univ.) Resolvent operators on complete geodesic spaces

Summary: The convex minimization problem is one of the central topics in convex analysis, and many researchers have investigated this problem in various ways. The notion of resolvent operators is an essential and powerful tool for studying this topic because it connects convex analysis to fixed point theory for nonexpansive and other nonlinear mappings.
This talk focuses on the convex functions defined on complete geodesic spaces with their curvature bounded above. According to the geometric structures of the underlying space, we need to change the definition of the resolvent operator. We first survey the variety of known definitions and their fundamental properties. Then, we consider minimization problems for such functions. To generate an approximating sequence converging to a solution to this problem, we use a resolvent operator. Finally, we obtain some convergence theorems of the generated iterative sequence.
We can extend the notion of resolvent operators for convex functions to that for bifunctions for equilibrium problems. We will also discuss this topic and recent developments.

March 31st (Thu) Conference Room VIII

9:30–12:00

13 Shodai Kubota (Chiba Univ.) Optimal controls in 1D-time-discrete Warren–Kobayashi–Lobkovsky–Carter system 15
Ken Shirakawa (Chiba Univ.)

Summary: We consider optimal control problems for time-discrete state problems of one-dimensional systems. Each state problem is denoted by $(S)_\varepsilon$, with $\varepsilon \geq 0$, and is based on the non-isothermal model of grain boundary motion.In this regard, each optimal control problem is denoted by $(OP)_\varepsilon$, with $\varepsilon \geq 0$, and it is prescribed as a minimization problem of a cost function. Additionally, the problems $(S)_\varepsilon$ and $(OP)_\varepsilon$ are supposed to admit limiting profiles as $\varepsilon \downarrow 0$, and then, the limiting problems are supposed to contain no little singularities. The main mathematical results concerned with: (A) the solvability to the problems $(S)_\varepsilon$; (B) the existence of the optimal control; (C) the necessary condition for the optimal control when $\varepsilon > 0$; (D) limiting observation as $\varepsilon \downarrow 0$; will be reported as the main theorems of this talk.

14 Yutaro Chiyo (Tokyo Univ. of Sci.) A simplified quasilinear attraction-repulsion chemotaxis system: boundedness 15
Tomomi Yokota (Tokyo Univ. of Sci.)

Summary: This talk deals with a quasilinear parabolic-elliptic-elliptic attraction-repulsion chemotaxis system. When there is no repulsion term, global existence and boundedness were obtained by the effect of the diffusion term by Tao–Winkler (J. Differential Equations; 2012; 252; 692–715). The purpose of this talk is to establish global existence and boundedness in a quasilinear attraction-repulsion chemotaxis system by using the repulsion term instead of the diffusion term.

15 Yutaro Chiyo (Tokyo Univ. of Sci.) A simplified quasilinear attraction-repulsion chemotaxis system: stabilization 15

Summary: This talk deals with stabilization in a quasilinear parabolic-elliptic-elliptic attraction-repulsion chemotaxis system. As to a quasilinear parabolic-parabolic Keller–Segel system, it was shown by Cieślak–Winkler (Nonlinear Anal.; 2017; 159; 129–144) that solutions converge to the mean value of the initial data. The purpose of this talk is to confirm that their method is also effective for a quasilinear parabolic-elliptic-elliptic attraction-repulsion chemotaxis system.

16 Chiharu Kosugi (Japan Women's Univ.)
Toyohiko Aiki (Japan Women's Univ.)
Existence of strong solutions for the model representing motions of compressible elastic materials on the plane ····· 15

Summary: We talk about existence of strong solutions to the initial and boundary value problem for beam equations with the viscosity term. For this model, we have already shown the existence and uniqueness of weak solutions. On our problem we suppose that the stress function has a singularity such that the value tends to infinity as the strain goes to -1. By applying this singularity, we obtain an estimate for the strain from below, and from the estimate and the time discretization method, we can prove existence of a strong solution. The uniqueness is guaranteed by the uniqueness of the weak solution. We would like to consider the large time behavior of solutions as future work.

17 Kota Kumazaki (Nagasaki Univ.)
Toyohiko Aiki (Japan Women's Univ.)
Adrian Muntean (Karlstad Univ.)
A one-dimensional free boundary problem describing migration into rubber with a non-monotone boundary condition ····· 15

Summary: In this talk, we consider a one-dimensional free boundary problem describing the migration of diffusants into rubber. In this problem, the free boundary represents the front of the diffusant region and its growth rate is given by an ordinary differential equation including the effect of breaking the growth of the diffusant region. Due to the breaking effect, it is difficult to prove the existence of a solution because the boundary condition imposed on the moving boundary becomes non-monotone. In this talk, we establish the existence and uniqueness of a solution to the problem and give the maximum value of the free boundary.

18 Takeshi Fukao (Kyoto Univ. of Edu.) A quasi ill-posed problem on the boundary ····· 15

Summary: In this talk, we consider a quasi ill-posed problem on the boundary on some two or three dimensional bounded domain. In order to discuss the solvability of the quasi ill-posed problem on the boundary, we consider a transmission problem with the Cahn–Hilliard equations as an auxiliary condition in the bulk. In a previous study, we characterize the second-order nonlinear diffusion equation as an asymptotic limit from the fourth-order Cahn–Hilliard equations. Following this idea, we apply the vanishing viscosity method to LW model, that is, the equation and dynamic boundary condition of Cahn–Hilliard type.

19 Noriaki Yamazaki (Kanagawa Univ.)
Nobuyuki Kenmochi (Chiba Univ.*)
Ken Shirakawa (Chiba Univ.)
Singular optimal control problems for doubly nonlinear evolution inclusions with quasi-variational structure ····· 15

Summary: In this talk we consider singular optimal control problems for abstract doubly quasi-variational evolution inclusions governed by time-dependent subdifferentials with the unknown-dependent constraints. Then, we show the existence of optimal control for our problems. Also, we apply our abstract results to quasi-variational inequalities with time-dependent gradient constraints.

14:15–15:15

20 Shunsuke Kurima (Tokyo Univ. of Sci.) A nonlocal Penrose–Fife type phase field system with inertial term ··· 15

Summary: This talk deals with a nonlocal Penrose–Fife type phase field system with inertial term. Colli–Grasselli–Ito (2002) have proved existence of solutions to a parabolic-hyperbolic Penrose–Fife phase field system. However, nonlocal Penrose–Fife type phase field systems with inertial term seem to be not studied yet. The present work asserts that we can establish existence of solutions to a nonlocal Penrose–Fife type phase field system with inertial term.

21 Hiroshi Watanabe (Oita Univ.) Oleinik type estimates for entropy solutions to scalar parabolic-hyperbolic conservation laws and their applications ····· 15

Summary: We consider one-dimensional Cauchy problems (CP) for scalar parabolic-hyperbolic conservation laws. The equation has both properties of hyperbolic equations and those of parabolic equations. Accordingly, it is difficult to investigate the regularity and the behavior of solutions to (CP). In this talk, we prove Oleinik type estimates for entropy solutions to (CP). Moreover, we also discuss their applications.

22 Goro Akagi (Tohoku Univ.) Naoki Tanaka (Shizuoka Univ.) Gradient flow theory for time-dependent energies and applications to nonlinear PDEs 15

Summary: In this talk, we shall present an abstract theory for (generalized) gradient flows and applications to nonlinear PDEs.

15:30–16:30 Talk Invited by Real Analysis Section

Shuji Yoshikawa (Oita Univ.) Mathematical analysis for the problems related to dynamic deformation of CRFP

Summary: CFRP (Carbon-Fiber-Reinforced Plastics) are well-known materials that are layered plastic plates strengthened by fibered carbons like plywoods. My interest is directed to consider the dynamical behavior of CFRP. To give a mathematical analysis for CFRP, we first decompose the problem into four components: thermo-elastic, plastic, anisotropic, and composite materials. Each problem has interesting open problems from the mathematical viewpoint. I will first introduce some results related to these problems, especially through the perspective of the energy method and structure-preserving discretization technique.

Functional Analysis

March 28th (Mon) Conference Room I

10:00–11:30

1 Shunji Sasaki (Kamiaoki Junior High School) Homage of Riemann zeta function "Zeta one function" ····· 15

Summary: In researching the "Riemann zeta function", we created a new function "zeta-one function" which is obtained by adding 1 to the denominator of the function and derives the relation equation between this new function and the "Riemann zeta function" It was also found to be represented by the "digamma function." It would be greatly appreciated if it could help research future zeta functions.

2 Michio Seto (Nat. Defense Acad. of Japan)
Shuhei Kuwahara (Sapporoseishu High School) On construction of strictly positive definite kernels ····· 10

Summary: In this talk, we give new examples of strictly positive definite kernels with the theory of the Hardy space over the unit disk.

3 Kazuki Kannaka (RIKEN)♭ Multiplicities of stable eigenvalues on compact anti-de Sitter 3-manifolds ····· 15

Summary: A *pseudo-Riemannian locally symmetric space* is the quotient manifold $\Gamma\backslash G/H$ of a semisimple symmetric space G/H by a discontinuous group Γ. Toshiyuki Kobayashi initiated the study of spectral analysis of *intrinsic differential operators* (such as the Laplacian) of a pseudo-Riemannian locally symmetric space. For instance, Kassel–Kobayashi studied the behavior of eigenvalues of intrinsic differential operators of $\Gamma\backslash G/H$ when deforming a discontinuous group Γ. As a special case, they found infinitely many *stable eigenvalues* of the (hyperbolic) Laplacian of a compact anti-de Sitter 3-manifold $\Gamma\backslash \mathrm{SO}(2,2)/\mathrm{SO}(2,1)$ ([Adv. Math. 2016]). In this talk, I would like to explain recent results about *multiplicities* of stable eigenvalues in the anti-de Sitter setting.

4 Toshimitsu Takaesu (Gunma Univ.) On the first order expansion of a ground state energy of the ϕ^4 model with cutoffs ····· 15

Summary: We consider the ϕ^4 model with a spatial cutoff and momentum cutoff. The total Hamiltonian is a self-adjoint operator on a boson Fock space. Suppose regularity conditions of the momentum cutoff. Then we obtain the first order expansion of a non-degenerate ground state energy of the total Hamiltonian.

5 Yoritaka Iwata (Kansai Univ.) Generation of nolinear semigroup by the logarithm of operators ····· 15

Summary: Logarithmic representation of infinitesimal generators are directly associated with the higher order evolution equations, as well as some nonlinear evolution equations. In particular nonlinear transforms such as the Cole–Hopf transform and the Miura transform are the transform to the nonlinear differential equations. Meanwhile the recurrence formula generalizing the Cole–Hopf transform and the Miura transform clarifies the unknown relation between the 1st order and higher order evolution equations. In this talk, nonlinear abstract evolution equation in a Banach space is studied by the logarithmic representation of operators. In conclusion a representation for the nonlinear semigroup is obtained.

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

Megumi Sano (Hiroshima Univ.) Harmonic transplantation and its application to functional inequalities

Summary: First, we will introduce harmonic transplantation proposed by Hersch in 1969. Also, we will explain the difference between harmonic transplantation and Mobius transformation. We will point out that various transformations can be understood as a special case or a general case of harmonic transplantation. As an application, we will derive several improvements and several limiting forms of the Hardy and the Sobolev inequalities via harmonic transplantation. In the half-space, we cannot apply harmonic transplantation to these inequalities directly due to the lack of the explicit form of the p-Green function. Therefore, we will consider a modification of the original harmonic transplantation. By using that, we derive the improved Hardy inequality in the half-space and the critical Hardy inequality as the limiting form.

March 29th (Tue) Conference Room I

10:00–12:00

6 Nobukazu Shimeno (Kwansei Gakuin Univ.)
Yamato Taniguchi (Kwansei Gakuin Univ.)
Mugiho Nakamura (Kwansei Gakuin Univ.)
Zonal spherical function on a real symplectic group ····· 15

Summary: We give explicit expressions of the zonal spherical functions on some weakly symmetric spaces that are close to a rank one symmetric space for a real symplectic group by using the Jacobi function and elementary functions.

7 Junko Inoue (Tottori Univ.)
Ali Baklouti (Univ. of Sfax)
The norm of the L^p-Fourier transform on compact extensions of locally compact groups ····· 15

Summary: We study the norm of the L^p-Fourier transform on locally compact groups. Let G be a separable unimodular locally compact group of type I, and let N be a unimodular closed normal subgroup of type I such that G/N is compact. For all exponents p such that $1 < p \leq 2$, we show the inequality $\|\mathscr{F}^p(G)\| \leq \|\mathscr{F}^p(N)\|$, where $\|\mathscr{F}^p(G)\|$ and $\|\mathscr{F}^p(N)\|$ are the norms of L^p-Fourier transforms on G and N respectively.

8 Víctor Pérez Valdés (Univ. of Tokyo)
Construction of vector-valued differential symmetry breaking operators for the group $SO(4,1)$ ····· 15

Summary: In this talk, we construct and give a complete classification of all the symmetry breaking operators $D : C^\infty(S^3, \mathcal{V}^3_\lambda) \to C^\infty(S^2, \mathcal{L}_{\nu,m})$ that can be written as differential operators, between the spaces of smooth sections of a 3-rank vector bundle $\mathcal{V}^3_\lambda \to S^3$ over the 3-sphere, and a line bundle $\mathcal{L}_{\nu,m} \to S^2$ over the 2-sphere. In particular, we give the necessary and sufficient condition on the tuple of parameters (λ, ν, m) for which these differential symmetry breaking operators exist.

9 Ryosuke Nakahama (Kyushu Univ.)
Computation of weighted Bergman norms on block diagonal matrices in bounded symmetric domains for $Sp(r,\mathbb{R})$ ····· 15

Summary: Let $G/K \simeq D \subset \mathfrak{p}^+$ be a Hermitian symmetric space realized as a bounded symmetric domain, and we consider the weighted Bergman space $\mathcal{H}_\lambda(D)$ on D. Then the norm on each K-type in $\mathcal{H}_\lambda(D)$ is explicitly computed by Faraut–Korányi (1990). In this talk, we consider the case $G = Sp(r,\mathbb{R})$, $\mathfrak{p}^+ = \mathrm{Sym}(r,\mathbb{C})$, fix $r = r' + r''$, and decompose $\mathfrak{p}^+$ into 2×2 block matrices. Then the speaker presents the results on explicit computation of the norm of $\mathcal{H}_\lambda(D)$ on each K'-type in the space of polynomials on the block diagonal matrices $\mathfrak{p}^+_{11} \oplus \mathfrak{p}^+_{22}$. Also, as an application, the speaker presents the results on Plancherel-type formulas on the branching laws for the symmetric pair $(Sp(r,\mathbb{R}), U(r', r''))$.

10 Hideyuki Ishi (Osaka City Univ.) Kazuhide Oshiro (HOSEI Inc.) Continuous wavelet transforms for vector-valued functions ····· 15

Summary: We give a sufficient condition for the existence of admissible vectors for a unitary representation of the semidirect product group of a linear Lie group with the vector group, where the unitary representation is naturally defined on the space of square-integrable vector-valued functions. Moreover, we give a concrete admissible vector explicitly for the unitary representation of the 3-dimensional similitude group realized on the space of square-integrable complex vector fields.

11 Atsumu Sasaki (Tokai Univ.) A realization of the restriction of quasi-regular representations of the Heisenberg group ····· 15

Summary: This talk gives a realization of the restriction of quasi-regular representations of the Heisenberg group to a certain closed subgroup in the continuous representation on the space of holomorphic functions on the complex Heisenberg homogeneous space. Our realization is based on the heat kernels and the heat kernel transforms on $\mathbb{R}^k$ and the Heisenberg group.

12 Koichi Arashi (Nagoya Univ.) Coherent state representation and multiplicity-free representation of a generalized Heisenberg group ····· 15

Summary: We classify holomorphic multipliers of a generalized Heisenberg group over a (not necessarily homogeneous) Siegel domain of the second kind, and show that the natural representations of the group defined by the multipliers are multiplicity-free.

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

Takeshi Ikeda (Waseda Univ.)♭ K-theoretic Schubert calculus

Summary: During the last decade, there were significant progress in K-theoretic (quantum) Schubert calculus. First of all, I will try to give an overview on these works. The spaces we consider are the generalized flag varieties of semisimple linear algebraic group G. We are interested in the basis of the cohomology ring of these varieties associated to Schubert subvarieties. Main question is to determine the coefficients when we multiply two elements from the Schubert basis. Similar questions exist for a reasonable cohomology theory. In this talk, we consider the ordinary cohomology and the algebraic K-theory, and their quantum (equivariant) versions. Even in type A, i.e. G is the special linear group, and for the ordinary cohomology, we do not know an explicit formula for the Schubert structure constants of the full flag variety. On the other hand, the structure constants for the Grassmannian variety is also (well) known as the Littlewood–Richardson rule. I will explain the corresponding results for some typical Grassmannians in other classical types.

In the second part, we will discuss a remarkable new aspects in Schubert calculus stemming from the study on the affine Grassmannian variety. The cohomology groups of the affine Grassmannian has a natural ring structure. D. Peterson discovered a connection between the quantum cohomology ring of flag variety and the homology ring of the affine Grassmannian. The topics were further studied by many authors including Lam, Shimozono, Lapointe, Morse, Schilling. I will report on recent progress on the topics mainly from combinatorial point of view.

March 30th (Wed) Conference Room I

10:00–11:30

13 Yuki Seo (Osaka Kyoiku Univ.) Matrix trace inequalities related to the Tsallis relative entropies of real order ····· 15

Summary: In this talk, we show matrix trace inequalities related to Tsallis relative entropies. Hiai and Petz show the Hiai–Petz inequality related to Umegaki relative entropy and Fujii–Kamei relative entropy and a 1-parameter extension of it. We extend it by virtue of the Tsallis relative entropies.

Summary: Let A, B be Hermitian matrices satisfying $A \geq B \geq 0$. Then we determine $X \geq 0$ and $Y \geq 0$ such that the arithmetic mean and the geometric mean of X and Y are respectively A and B. Further, we refer to a quadratic equation which these X and Y are solutions of.

Summary: We study non-linear positive maps on C*-algebras, which are not necessary completely positive. We give several examples of such non-linear positive maps. We characterize the class of compositions of *-multiplicative maps and positive linear maps as the class of non-linear maps of boundedly positive type abstractly.

Summary: We present a formula for the stable rank of inclusions of unital Banach algebras in the sense of finite Watatani index. As an application we show that the stable rank of ℓ^1-algebras of Disk algebras by any action of finite groups is 2.

Summary: We study the weighted composition operators between the Lipschitz space and the space of bounded functions on the set of vertices of an infinite tree. We characterized the boundedness, the compactness, and the boundedness from below, the isometricity of weighted composition operators.

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

Summary: (Weighted)composition operators have been extensively investigated on various analytic function spaces, especially the Hardy and Bergman spaces, during recent decades. Then the main theme is to characterize the operator-theoretic behavior of weighted composition operators in terms of the function-theoretic properties of their weight and analytic self-map. We here list problems on weighted composition operators and their differences on the Hardy and Bergman spaces.

Statistics and Probability

March 28th (Mon) Conference Room Ⅲ

9:00–11:50

1 Takaaki Toyoshima (Tokyo Tech) Fractional stochastic Navier–Stokes equation driven by space-time white noise ····· 15

Summary: We consider the stochastic Navier–Stokes equation driven by space-time white noise, where the Laplacian is replaced by a fractional one. In this equation, the nonlinearity has no meaning as a product of the distributions due to the poor regularity of the space-time white noise. To handle this type of singular stochastic partial differential equations, we use the renormalization method. In addition, the lower fractional index reduces the order of regularity expected in the Schauder estimate, and as a result, the number of elements to be renormalized increases. To deal with this situation, we use the theory of regularity structure for the construction. In particular, we will solve the equation without changing the form although we need the renormalization procedure.

2 Yu Ito (Kyoto Sangyo Univ.) Backward representation of rough integral: an approach via fractional calculus ····· 15

Summary: Using fractional calculus, M. Zähle (1998) introduced an approach to the Stieltjes integrals. As an extension of the (forward) integral by Zähle (1998), Y. Hu and D. Nualart (2009) and the speaker (2019) introduced an approach to the rough integral of controlled paths along Hölder rough paths of order $\beta \in (1/3, 1/2]$. In this talk, we extend the backward integral by Zähle (1998) to the rough integral, and describe a backward representation of the rough integral. Our definitions of the rough integral are given explicitly in terms of Lebesgue integrals for fractional derivatives, without using any arguments from discrete approximation.

3 Ryoji Takano (Osaka Univ.) A partial rough path space for rough volatility ····· 15
Masaaki Fukasawa (Osaka Univ.)

Summary: A rough volatility model is a stochastic volatility model for an asset price process with volatility being rough, meaning that the Holder regularity of the volatility path is less than half. Unfortunately, this model does not fall into the framework of the existing rough path theory because the integrand is not a controlled path of the integrator. In this talk, we will discuss about a new variant of rough path theory to analyze such a rough volatility model. Our first step is to construct an integration of an uncontrolled path and to prove its continuity. Second step is then to show the continuity of the solution of RDE which is driven by such an integral.

4 Takuto Ugai (Osaka Univ.) Limit distributions for the discretization error of stochastic Volterra equations ····· 15
Masaaki Fukasawa (Osaka Univ.)

Summary: Our study aims to specify the asymptotic error distribution in the discretization of a stochastic Volterra equation with a fractional kernel. It is well-known that for a standard stochastic differential equation, the discretization error, normalized with its rate of convergence $1/\sqrt{n}$, converges in law to the solution of a certain linear equation. Similarly to this, we first consider the rate of convergence to normalize the error. Then we show that the normalized discretization error of the Volterra equation converges in law to the solution of a certain linear Volterra equation.

5 Yushi Hamaguchi (Osaka Univ.) On general solutions of linear stochastic Volterra integral equations · · 15

Summary: We provide a general solution to a linear stochastic Volterra integral equation, which includes a class of fractional stochastic differential equations. By means of the chaos expansion technique, we introduce a notion of the product generalizing the stochastic convolutions and show that the class of stochastic Volterra kernels becomes a Banach algebra. Then, we give a variation of constant formula for a general class of linear stochastic Volterra integral equations.

6 Yuji Shinozaki (Bank of Japan / Tokyo Tech) Syoiti Ninomiya (Tokyo Tech) Application of high-order recombination to weak approximations of stochastic differential equations · 15

Summary: In this presentation, the error evaluation formula for the high-order recombination method given by Litterer–Lyons is improved and some partitioning algorithms based on this improved estimation are also presented. Specifically, it is proved that the error depends not only on the radiuses of the partitioned patches but also the weights of them. The algorithms are applied to some known higher-order discretization methods. Some numerical examples of practical financial problems are also discussed.

7 Isamu Dôku (Saitama Univ.) On a solution for random equations with Lévy noise · · · · · · · · · · · · · · · · 10

Summary: We consider the random equations driven by a Lévy noise. Actually we treat the Cauchy problem for random equations with compensated Poisson random measure. The principal operator part is described in an abstract manner in the sense of functional analysis. Other coefficient parts are given by some measurability and slight regularity assumptions. With an appropriate additional assumption we show that the random equation in question possesses a unique local mild solution.

8 Shigeyoshi Ogawa (Ritsumeikan Univ.) Noncausal integrals and mean value theorems · 10

Summary: The mean value theorem for the integral is well known. But we are now concerned with the validity of a statement like the mean value theorem for the stochastic integral. The aim of the talk is to show that we can establish mean value theorems as exact formula when limitted to the *noncausal stochastic integral*(also called *ogawa integral*) of the form $\int_a^b f(X_t)d_*W_t$, where W_t is Brownain motion and X_t an Itô process, causal or not. We also discsuss the case of Itô integral $\int_a^b f(X_t)d_0W_t$, moreover such a genuin noncausal case where the process X_t is noncausal. Whole discussions are developed in the framework of the noncausal stochastic calculus. hence for the related materials and basic facts we would refer to the monograph "Noncausal Stochastic Calculus" by Ogawa,S.,(2017, Springer).

9 Kensuke Ishitani (Tokyo Metro. Univ.) On the construction of Brownian house-moving and its properties · · · · 15

Summary: The purpose of this presentation is to construct a new stochastic process "Brownian house-moving," which is a Brownian bridge that stays between its starting point and its terminal point. To construct this process, statements are prepared on the weak convergence of conditioned Brownian bridge and conditioned three-dimensional Bessel bridge. Also studied are the sample path properties of Brownian house-moving and the decomposition formula for its distribution.

10 Shun Yanashima (Tokyo Metro. Univ.) Kensuke Ishitani (Tokyo Metro. Univ.) On the construction of Bessel house-moving and its properties · · · · · · · 15

Summary: The purpose of this presentation is to introduce the construction of a new stochastic process "δ-dimensional Bessel house-moving" and its properties. δ-dimensional Bessel house-moving is a δ-dimensional Bessel process hitting a fixed point at $t = 1$ firstly. We have two methods of the construction of this process, which are to characterize it using the first hitting time of a Bessel process, and to obtain it as the weak limit of conditioned Bessel bridges. We also study sample path properties of this process, and give the decomposition formula for its distribution.

14:15–15:05

11 Tetsuo Kurosawa (Tokyo Metro. Univ.)
Shunsuke Nishijima (Tokyo Metro. Univ.)
Kumiko Hattori (Tokyo Metro. Univ.)
Loop erased random walk on a random branched Koch curve ····· 15

Summary: A loop erased random walk is a random walk obtained by removing the loop from a simple random walk. It is a non-Markovian process that has been studied on $\mathbf{Z}^d$ and on fractals. In this talk, we deal with a loop erased random walk under random environments. I will discuss the existence of a continuous limit on a random branching Koch curve and the asymptotic properties of the sample function around time 0.

12 Kohei Sasaya (Kyoto Univ.)
Some relation between spectral dimension and Ahlfors regular conformal dimension of resistance metrics ····· 15

Summary: The spectral dimension d_S of a metric space is an exponent associated with the asymptotic behavior of the heat kernel of the standard Dirichlet form and Brownian motion on the space. The Ahlfors regular conformal dimension $\dim_{\mathrm{AR}}$ of the metric space is a quasisymmetric invariant, where quasisymmetry is a well-studied property of homeomorphisms between metric spaces. For (generalized) Sierpiński carpets or Sierpiński gaskets, Kigami showed that $\dim_{\mathrm{AR}} \leq d_S < 2$ or $\dim_{\mathrm{AR}} \geq d_S \geq 2$ holds, in 2020. In this lecture, we give an appropriate extension of these results to the framework of resistance forms. We also show that another simple extension, which is to be expected, does not hold in the framework in general.

13 Naotaka Kajino (Kyoto Univ.)
On singularity of energy measures for symmetric diffusions with full off-diagonal heat kernel estimates II: Some borderline examples ····· 15

Summary: We present a concrete family of fractals, which we call the *(two-dimensional) thin scale irregular Sierpiński gaskets* and each of which is equipped with a canonical strongly local regular symmetric Dirichlet form. We prove that any fractal K in this family satisfies the full off-diagonal heat kernel estimates with some space-time scale function Ψ_K and the singularity of the associated energy measures with respect to the canonical volume measure (uniform distribution) on K, and also that the decay rate of $r^{-2}\Psi_K(r)$ to 0 as $r \downarrow 0$ can be made arbitrarily slow by suitable choices of K. These results together support [*Ann. Probab.* **48** (2020), no. 6, 2920–2951, Conjecture 2.15] stating that the full off-diagonal heat kernel estimates with space-time scale function Ψ satisfying $\lim_{r\downarrow 0} r^{-2}\Psi(r) = 0$ imply the singularity of the energy measures.

15:15–16:15 Award Lecture for the 2021 MSJ Analysis Prize

Makoto Katori (Chuo Univ.) Multiple Schramm–Loewner evolution and Dyson's Brownian motion model

Summary: Schramm–Loewner evolution (SLE) is a stochastic extension of the classical Loewner theory in complex analysis on a simply connected proper domain of $\mathbb{C}$ such that the driving function of the Loewner chain of conformal maps is given by a one-dimensional stochastic process. Here we assume that the domain is the upper-half complex-plane $\mathbb{H}$ and the driving process runs on $\mathbb{R}$. It was proved that the SLE driven by a time changed Brownian motion on $\mathbb{R}$, $(B_{\kappa t})_{t\geq 0}$, $\kappa > 0$, determines a one-parameter family of probability laws of a random continuous curve in $\overline{\mathbb{H}}$ connecting 0 and ∞, and that this family, denoted by SLE_κ, $\kappa > 0$, covers all probability laws of such curves having the conformal invariance and the domain Markov property. In probability theory and statistical physics, the SLE_κ has been playing a central role in studying critical phenomena associated with continuous phase transitions and fractal geometries in two dimensions. Therefore, it is natural to generalize the SLE theory to describe random multiple curves in $\mathbb{H}$ driven by an interacting particle system on $\mathbb{R}$. The problem is that the requirement of the conformal invariance and the domain Markov property is not sufficient to determine a 'canonical' family of multiple SLEs. Motivated by the recent work by Sheffield on the quantum gravity zipper and a series of papers by Miller and Sheffield on the imaginary geometry, we employ the coupling of Gaussian free fields (GFFs) and multiple SLEs. We show that a multiple SLE is correctly coupled with a certain GFF if and only if the driving particle system is given by Dyson's Brownian motion model studied in random matrix theory. Dyson's Brownian motion model is also a one-parameter ($\beta > 0$) family of one-dimensional log-gases. The coupling is achieved if and only if $\beta = 8/\kappa$. The present study on the GFF/multiple SLE coupling enables us to clarify the basic properties of the constructed multiple SLE (e.g., continuity of multiple SLE curves, 'phase transitions' at $\kappa = 4$ and 8). Moreover, we expect that a notion of conformal invariance of SLE will enrich the study of random matrix theory via the present results on the trinity of the GFF, the multiple SLE, and Dyson's Brownian motion model. The present talk is based on a joint work with Shinji Koshida (Aalto University).

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

Takahiro Hasebe (Hokkaido Univ.) Loewner chains, Markov processes and non-commutative stochastic processes

Summary: Loewner chains had been a key tool for proving the Bieberbach conjecture, which was finally settled by de Branges in 1985. The second main application of Loewner chains was discovered in the field of SLE around 2000, where a randomized Loewner chain is used to describe certain scaling limits of probabilistic models. It was realized more recently that Loewner chains also appear in connection with a certain class of non-commutative stochastic processes, which are further in correspondent with Markov processes. In this talk I will summarize the work on the interplay between those objects (Loewner chains, Markov processes and non-commutative stochastic processes). The talk is based on joint works with Uwe Franz, Sebastian Schleissinger and Ikkei Hotta.

March 29th (Tue) Conference Room III

9:00–11:30

14 Katsunori Fujie (Hokkaido Univ.)
Takahiro Hasebe (Hokkaido Univ.)
The spectra of principal submatrices in unitarily invariant random matrices ····· 15

Summary: In this talk, we observe a concentration phenomenon on the empirical eigenvalue distribution (EED) of the principal submatrix in a random hermitian matrix whose distribution is invariant under unitary conjugacy; for example, this class includes GUE (Gaussian Unitary Ensemble) and Wishart matrices. More precisely, if the EED of the whole matrix converges to some deterministic probability measure $\mathfrak{m}$, then the difference of rescaled EEDs of the whole matrix and of its principal submatrix concentrates at the Rayleigh measure (in general, a Schwartz distribution) associated with $\mathfrak{m}$ by the Markov–Krein correspondence. For the proof, we use the moment method with Weingarten calculus and free probability. This talk is based on joint works with Takahiro Hasebe in Hokkaido university.

15 Makoto Maejima (Keio Univ.*)
Noriyoshi Sakuma (Nagoya City Univ.)
On free selfsimilar additive processes and free selfdecomposable distributions ····· 10

Summary: In this talk, we shall introduce new definition of selfsimilarity in free probability theory and construct free analogue of the theorem by Sato, which connects H-selfsimilar free additive processes and selfdecomposable distributions. In addition, we give stochastic integration with respect to free additive processes and give a stochastic integral representation to construct back driving Lévy process for free selfdecomposable distributions.

16 Kei Noba (Inst. of Stat. Math.)
Noriyoshi Sakuma (Nagoya City Univ.)
Yuki Ueda (Hokkaido Univ. of Edu.)
On Boolean selfdecomposability ····· 10

Summary: In this talk, we will introduce Boolean selfdecomposable distributions. In the case of classical and free case, there are distributional similarities. In Boolean case, they are broken. We will show it with explicit examples.

17 Ryoichi Suzuki (Keio Univ.)
Noriyoshi Sakuma (Nagoya City Univ.)
A modified Φ-Sobolev inequality for canonical Lévy processes and its applications ····· 10

Summary: In this talk, we derive a new modified Φ-Sobolev inequality for canonical L^2-Lévy processes. This is a generalization of Φ-Sobolev inequality for the Poisson space and it for the Wiener space. Moreover, as an application of main theorem, we also get a concentration inequality for canonical Lévy processes and derive several examples.

18 Kei Noba (Inst. of Stat. Math.)
On the optimality of the refraction–reflection strategies for Lévy processes ····· 10

Summary: In this talk, we think about de Finetti's optimal dividend problem with capital injection under the assumption that the dividend strategies are absolutely continuous. In many previous studies, the process before being controlled was assumed to be a spectrally one-sided Lévy process, however in this paper we use a Lévy process that may have both positive and negative jumps. In the main theorem, we show that a refraction–reflection strategy is an optimal strategy.

19 Toshihiro Uemura (Kansai Univ.)
Masayoshi Takeda (Kansai Univ.)
On symmetric stable-type processes with singular Lévy densities ····· 15

Summary: We are concerned with symmetric stable-type processes with singular Lévy densities. We first introduce a class of test functions of the infinitesimal generators of the symmetric Dirichlet forms associated with the processes as a "core" and then show some estimates of the processes in the talk.

20 Nobuaki Naganuma (Kumamoto Univ.) On generalization of the fourth moment theorem ····· 15

Summary: In this talk, we consider generalization of the fourth moment theorem shown by Nualart and Peccati (2005) and provide new criterion on central convergence of Wiener functionals belonging to a fixed Wiener chaos. We show the assertion by borrowing idea developed by Azmoodeh et al. (2016).

21 Masafumi Hayashi (Univ. of Ryukyus)
So Oshiro (Univ. of Ryukyus)
Masato Takei (Yokohama Nat. Univ.)
Rate of moment convergence in the central limit theorem for elephant random walks ····· 15

Summary: The one-dimensional elephant random walk is a typical model of discrete-time random walk with step-reinforcement, and is introduced by Schütz and Trimper (2004). The walk admits a phase transition from the diffusive behavior to the superdiffusive behavior. We study the rate of the moment convergence in the central limit theorem for the position of the walker in the diffusive regime.

22 Hiroki Takahashi (Keio Univ.)
Shintaro Suzuki (Keio Univ.)
Almost-sure weighted equidistibution of cycles for the random Gauss map ····· 15

Summary: We consider an i.i.d. random dynamical system generated by the Gauss map and an alternating Gauss map with a neutral fixed point. We show that cycles of this random system weighted with their random Lyapunov exponents equidistribute with respect to the unique stationary measure that is absolutely continuous with respect to the Lebesgue measure. Our main tool is a level-2 large deviations for topological Markov shifts over countably infinite alphabet.

23 Johannes Jaerisch (Nagoya Univ.)
Hiroki Takahasi (Keio Univ.)
Multifractal analysis of homological growth rates for hyperbolic surfaces ····· 15

Summary: We perform a multifractal analysis of homological growth rates of oriented geodesics on a hyperbolic surface. Our main result provides a formula for the Hausdorff dimension of level sets of prescribed growth rate in terms of a generalized Poincare exponent of the Fuchsian group. Using methods of ergodic theory and thermodynamic formalism we prove the analyticity of the dimension spectrum.

11:30–12:00 Research Section Assembly

March 30th (Wed) Conference Room Ⅲ

9:50–11:40

24 Teruo Tanaka (Hiroshima City Univ.) Markov decision processes with fractional rewards ····· 10

Summary: We consider a Markov decision process with Borel state and action spaces under a discounted fractional criterion. At first, the fractional discounted Markov decision process is transformed to a discounted Markov decision process by using the parametric method. Next, assuming suitable conditions on the components of the corresponding Markov decision process, a standard approach is used. Applying these procedures and the dynamic programming approach, we obtain the optimal value function and policy for our problem.

25 Toshiharu Fujita (Kyushu Inst. of Tech.) Decision process model with feedforward loop system ····· 15

Summary: In this study, we consider a deterministic decision process model with a feedforward loop system which is one of the nonserial transition systems. We introduce recursive equations by using dynamic programming technique.

Summary: It is usually to design an experiment using treatments and its blocks in the design of experiments. Consider a set of edges of a complete bipartite graph as a treatments set and suppose the treatments have a structure. Then, we proposed a spanning bipartite block design (SBBD) to achieve better estimation accuracy. In this talk, using an SBBD as a statistical model, we discuss the optimality of how small the variance of the estimator was. And we prove that the variances of all estimators are equal (variance balanced). We also show the goodness of SBBD by the simulation.

Summary: The existence of affine resolvable block designs has been discussed since 1942 in the literature (cf. Bose (1942), Clatworthy (1973), Raghavarao (1988)). Kadowaki and Kageyama (2010, 2012) obtained a number of results on combinatorics for the existence of an affine resolvable SRGD design. In this paper, a new existence result is shown as a generalization of Theorem 3.3.3 given in Kadowaki and Kageyama (2010). Furthermore, another existence result is shown as a conditional converse of Theorem 3.3.3 and also a generalization of Theorem 3.3.4, both theorems given in Kadowaki and Kageyama (2010).

Summary: We address the expectation of the p-frame potential of two types of point processes on the sphere introduced by Beltrán and Etayo (2018, 2019). In particular, we show that the expectation of the p-frame potential of the process on the odd dimensional sphere has low potential among those of other well-studied random configurations on the sphere. As a by-product, we show that the random configurations of points coming from the process converge more rapidly towards finite unit norm tight frames than those coming from i.i.d. random points according to uniform measure on the sphere.

Summary: In parametric models estimators that are consistent at all parameters are concerned, while in Bayes models those that are consistent at almost all parameters are concerned. The identification of the points at which the posterior distributions weakly converge constitutes the problem (Diaconis and Freedman 1986). We show that for joint probabilities on complete separable metric spaces, the posterior distributions are consistent at almost all parameters if and only if the posterior distributions are consistent at ML-random parameters. Reference: Hayato Takahashi, Bayesian definition of random sequences with respect to conditional probabilities, preprint.

Summary: For the analysis of contingency tables, we are interested in considering a statistical model instead of independence when the independence between row and column variable does not hold. Many association models which indicate the structure of odds ratios have been proposed. Also, symmetry and asymmetry models which indicate the symmetric or asymmetric structure for cell probabilities have been proposed for the analysis of square contingency tables. We propose an asymmetry plus association model for square contingency tables with ordinal categories and provide its characteristics.

12:15–12:45 Presentation Ceremony for the 2021 MSJ Analysis Prize

14:25–15:25 Talk Invited by Statistics and Probability Section

Masayo Hirose (Kyushu Univ.) Small area inference under area level model and its application

Summary: An empirical best linear unbiased predictor (EBLUP) can contribute in terms of the efficiency especially when the sample size within each area is not large enough to make reliable direct estimates. Moreover, it is of importance to assess its mean squared prediction error in small area inference. In this conference, I will briefly introduce to small area inference under area level model and then explain some of our recent results for EBLUP having further desired properties. Some data analysis results will be shown in conclusion.

15:45–16:45 Talk Invited by Statistics and Probability Section

Takeshi Emura (Kurume Univ.) Estimating the difference of survival distributions; a copula-based approach to dependent censoring

Summary: Traditional estimators for survival distributions can handle censored data under the independent censoring assumption. When the assumption of independent censoring fails to hold, the traditional Kaplan–Meier estimator is biased. Accordingly, any two-sample comparison based on two Kaplan–Meier estimators leads to biased results, in particular, the Mann–Whitney effect estimator derived from two Kaplan–Meier estimators. We derive the asymptotic bias of this naive estimator of the Mann–Whitney effect under dependent censoring. We also propose a copula-based estimator of the Mann–Whitney effect, which can adjust for the bias due to dependent censoring. We derive the consistency and asymptotic normality of the proposed estimator under a misspecified copula. Simulations are conducted to check the performance of the proposed method. We apply our proposed method to a real dataset.

March 31st (Thu) Conference Room Ⅲ

9:50–11:40

31 Kou Fujimori (Shinshu Univ.)
Yuichi Goto (Waseda Univ.)
Yan Liu (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
Sparse principal component analysis for high-dimensional stationary time series 15

Summary: In this talk, we discuss the sparse principal component analysis for high-dimensional stationary processes. The standard principal component analysis performs poorly when the dimension of the process is large. We establish the oracle inequalities for penalized principal component estimators for the processes including heavy-tailed time series. The rate of convergence of the estimators is established. We also elucidate the theoretical rate for choosing the tuning parameter in penalized estimators. The performance of the sparse principal component analysis is demonstrated by numerical simulations.

32 Yujie Xue (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
Hellinger distance estimation for non-regular spectra 15

Summary: For a Gaussian stationary process, in this talk, we will derive a time series Hellinger distance for spectra f and g: $T(f,g) = \int \log\{\frac{1}{2}\sqrt{f(\lambda)/g(\lambda)} + \frac{1}{2}\sqrt{g(\lambda)/f(\lambda)}\}d\lambda$. By evaluating $T(f_\theta, f_{\theta+h})$ of the form $O(h^\alpha)$, we elucidate the $1/\alpha$-consistent asymptotics of the maximum likelihood estimator of θ for non-regular spectra. For regular spectra, we introduce the minimum Hellinger distance estimator $\theta^T(\hat{g}_n) = \arg\min_\theta T(f_\theta, \hat{g}_n)$, where $\hat{g}_n$ is a nonparametric spectral density estimator, and as a benchmark, we introduce the Whittle divergence estimator $\theta^W(\hat{g}_n)$. It can be shown that both $\theta^T(\hat{g}_n)$ and $\theta^W(\hat{g}_n)$ are asymptotically efficient, and that the former is more robust than the latter. Small numerical studies will be provided.

33 Xiaofei Xu (Waseda Univ.)♭
Zhengze Li (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
Comparison between the exact likelihood and Whittle likelihood for moving average processes 10

Summary: In this talk, we investigate the difference between the exact likelihood and Whittle likelihood with finite sample size for moving average processes of order one. We elucidate the theoretical expressions of two likelihood functions and their expectations and evaluate the performance between exact likelihood and Whittle likelihood numerically. We find that the exact likelihood and Whittle likelihood perform similarly when the true value of parameter is close to zero, while the difference becomes large and Whittle estimator performs poorly when parameter is close to one. This is an important warning when we use the Whittle likelihood and estimator if the moving average process has near unit root.

34 Yan Liu (Waseda Univ.)
On the model selection of symmetric α-stable processes 15

Summary: In this talk, we consider the model selection problem of symmetric α-stable processes. The symmetric α-stable processes are known as a model with infinite variance. This is a distinct feature from the model with finite variance considered in the usual time series analysis. We consider the GAIC, an extended information criterion of AIC, to choose the correct model. It is shown that the selected order of the model is consistent with the true order of the model. This is a remarkable difference from the original property of AIC for a regular model with finite variance. The proof and numerical results will be shown in the presentation.

35 Yuichi Goto (Waseda Univ.)
Kotone Suzuki (Waseda Univ.)
Xiaofei Xu (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
Tests for the existence of group effects and interactions for two-way models with dependent error 15

Summary: In this talk, we propose tests for the existence of group effects and interactions for two-way models with dependent errors. Our framework allows us to deal with correlated groups, although many existing papers assume the independence of groups. Our test statistics are in the form of the natural extension of the classical F-statistic. We show the asymptotic null distribution of the proposed test statistic and the consistency of the test. Moreover, the nontrivial power of our test under the alternative is derived. A simulation study illustrates the finite-sample performance of the test. In the empirical study, we apply our test to the daily log-returns of 24 stock prices from six countries and four sectors.

36 Jin Hatomoto (Tokyo Nat. Coll. of Tech.)
Poisson limit distributions for diffeomorphisms with weak hyperbolic product structure 12

Summary: We consider a diffeomorphism which admits a weak hyperbolic product structure region, which is the intersection of two transversal families of weak stable and weak unstable disks, with countably many branches and integrable return times. We introduce that for such maps the distribution of the number of visits to balls converges to the Poisson distribution as the radius decays to 0.

37 Takao Namiki (Hokkaido Univ.)
Satoru Tadokoro (Hokkaido Univ.)
Shunsuke Kajikawa (Kyoto Univ.)
Masao Matsuhashi (Kyoto Univ.)
Akio Ikeda (Kyoto Univ.)
Ichiro Tsuda (Chubu Univ./Chubu Univ.)
Evaluation of permutation entropy by time-series transition graph analysis and its application to epilepsy 10

Summary: We proposed a method called time series transition graph for nonlinear time series analysis, which improves the evaluation of permutation entropy. We also applied this method to ECoG recorded brain wave data of epilepsy patients to characterize seizures in the epileptic focus.

14:20–16:25

Summary: In this talk, we consider a sample measure of Mardia's multivariate kurtosis with three-step monotone missing data. In the case of complete data, Mardia (1970) has defined the sample measure of multivariate kurtosis and given its exact mean and exact variance under multivariate normal population. In this talk, we define a new sample measure of multivariate kurtosis for three-step monotone missing data. Furthermore, we derive its expectation and variance using perturbation method. From this result, we obtain a multivariate normality test statistic in the case of three-step monotone missing data. Finally, some simulation results for three-step monotone missing data are presented to investigate the accuracy of the normal approximation of the test statistic proposed in this talk.

Summary: Tests of the hypothesis of conditional independence in J x K x L contingency tables are considered. Class of statistics based on fai-divergence for testing the hypothesis are also considered. All members of the statistics have the same chi-square limiting distribution under the hypothesis. We show derivation of an expression of approximation for the distributions of the class of statistics based on an asymptotic expansion. Using the expression, transformed statistics are obtained which converge to a chi-square limiting distribution faster than the original ones.

Summary: The objective general index is a scale-invariant weighting method for ranking of multivariate data. We show that the sample objective general index is a consistent estimator of the population counterpart in high-dimensional settings together with a set of conditions, where the ratio of the dimension to the sample size is assumed to tend to zero. The proof is based on a recent result on random matrix theory. Numerical experiments are conducted to support the theoretical result. An example of real data analysis suggests an application of the weight to variable selection.

Summary: In this presentation, we will study asymptotic properties of the expectile estimator. We obtain asymptotic representations of the estimator and Edgeworth expansion of the estimator.

Summary: We develop information criteria for the parametric coefficients of a semiparametric ergodic Lévy driven model observed at high-frequency. Our asymptotics is based on the fully explicit two-stage Gaussian quasi-likelihood function of the Euler-approximation type. For model selections of the scale and drift coefficients, we propose explicit Gaussian quasi-information criteria through the stepwise inference procedure.

Summary: The asymptotic mixed normality of the realized covariance matrix of a multi-dimensional continuous semimartingale observed at a high-frequency is established, where the dimension may be much larger than the sample size. More precisely, a mixed-normal approximation of the error distribution in terms of the Kolmogorov distance is shown in such a setting. The proof is based on a variant of the Chernozhukov–Chetverikov–Kato theory on high-dimensional central limit theorems for sums of independent random vectors, where the theory is accommodated to random asymptotic covariance matrices with the help of Malliavin calculus.

Summary: In this talk, we consider outlier detection based on the principal component analysis (PCA) for high-dimensional low-sample-size data. The classical method of outlier detection uses the Mahalanobis distance. However, if the dimension is large, inverting the sample covariance matrix used in the Mahalanobis distance may result in substantial numerical instability, so that the alternative is needed. On the other hand, one example of the methods for the univariate data is the Smirnov–Grubbs test. We propose a test procedure by applying the first PC scores to the Smirnov–Grubbs test. By using asymptotic properties of the PCA, we evaluate its size and power. Finally, we check the performance of the test procedure both theoretically and numerically.

Applied Mathematics

March 28th (Mon) Conference Room V

10:00–12:00

1 Xiao-Nan Lu (Univ. of Yamanashi)
Shota Kawaguchi (Nippon-Engineer Co. Ltd.)
Miwako Mishima (Gifu Univ.)
Almost external difference families via cyclotomy 15

Summary: In this talk, we will introduce a new type of combinatorial designs, called almost external difference families (AEDFs). The notion of AEDFs is a generalization of external difference families, and AEDFs also have natural relationship with well-studied combinatorial designs such as almost difference sets, disjoint difference families, and difference systems of sets. AEDFs can be used as a combinatorial characterization for special types of optimal weak algebraic manipulation detection codes, which are employed as coding schemes for linear secret sharing. Furthermore, a construction of AEDFs via cyclotomy in finite fields will be proposed.

2 Norifumi Ojiro (Toyota Tech. Inst.)
Hajime Matsui (Toyota Tech. Inst.)
Reversible error-correcting codes over rational integer residue rings ... 15

Summary: Codes over the ring of rational integers modulo ideal are called integer codes. We formulate a theorem on reversibility of the prime factorization for generator matrices of integer codes. To show that this theorem brings an effective construction of reversible integer codes of large modulus, we exhibit searching results for reversible and self-dual integer codes of various modulus at code lengths 3 and 4.

3 Tomohiro Kamiyoshi (Matsue Coll. of Tech.)
Makoto Nagura (Osaka Electro-Comm. Univ.)
Shinichi Otani (Kanto Gakuin Univ.)
On exponential extended Riordan array and unified Stirling numbers 10

Summary: We propose the notion of extended Riordan array, permitted negative indices, of exponential type by using the Roman factorial. In this context, we will establish a fundamental theory of the unified Stirling numbers that were introduced by Hsu and Shiue. As a consequence, we give a luminous explanation for the reciprocity law among those numbers that was discovered by Choi, et al. and Maltenfort. Moreover, our methods reveal that some interesting numbers appear in a certain part of the exponential extended array, although the numbers in the area had been regarded as zero until now.

4 Kazuhide Hirohata (Ibaraki Nat. Coll. of Tech.)
Bradley Elliott (Univ. of Kentucky)
Ronald J. Gould (Emory Univ.)
Degree sum conditions for the existence of vertex-disjoint chorded cycles in a graph 15

Summary: Let k be a positive integer. In 2008, Finkel proved that if G is a graph of order at least $4k$ and the minimum degree of G is at least $3k$, then G contains k vertex-disjoint chorded cycles. Chiba et al. and Gould et al. improved Finkel's result. In this talk, we consider a generalization of these results.

5 Kiyoshi Ando (Nat. Inst. of Informatics) Properly 3-contractible edges in a minimally 3-connected graph ····· 15

Summary: A 3-contractible edge is said to be "properly 3-contractible" if it is contained in no triangle. Let $E^*(G)$ denote the set of edges of G which are contained in no triangle and let $E_c^*(G)$ denote the set of properly 3-contractible edges of G. Let $U^{(i)}(G)$ denote the set of degree 3 vertices x of G such that the subgraph of G induced by the neighborhood of x has i edges.
We prove that, "For a minimally 3-connected graph G, the following (1), (2) and (3) are equivalent. (1) G is a wheel, (2) $E^*(G) = \emptyset$ and (3) $U^{(0)}(G) = U^{(1)}(G) = \emptyset$." and (I) $|E_c^*(G)| \geq \frac{1}{2}|U^{(1)}(G)| + |U^{(0)}(G)|$ and (II) $|E_c^*(G)| > \frac{1}{2}|E^*(G)|$." We also show the sharpness of the inequalities.

6 Shinya Fujita (Yokohama City Univ.) Extremal problems on rainbow connectivity in edge-colored graphs ··· 10

Summary: Some recent results on rainbow connectivity in edge-colored graphs will be reviewed.

7 Naoki Matsumoto (Keio Univ.) Chromatic number of triangle-free and broom-free graphs in terms of their order ····· 15

Summary: The Gyárfás–Sumner conjecture asks whether for every tree T, the class of (induced) T-free graphs is χ-bounded. The conjecture is solved for several special trees, but it is still open in general. Motivated by the conjecture, the chromatic number of triangle-free and broom-free graphs is well studied, since a broom is one of the generalizations of a star, where a *broom* $B(m, n)$ is the graph obtained from a star $K_{1,n}$ and an m-vertex path P_m by identifying the center of $K_{1,n}$ and a leaf of P_m. Gyárfás, Szemeredi and Tuza proved that for every triangle-free and $B(m, n)$-free graph G, $\chi(G) \leq m + n - 1$. This upper bound has been improved by Wang and Wu to $m + n - 2$ for $m \geq 2, n \geq 1$. In this talk, we introduce the result that any triangle-free and $B(4, 2)$-free graph G is 3-colorable if the number of vertices of G is at least 17. The sharpness of the bound of the order is attained by the Clebsch graph.

14:15–16:00

8 Kazuki Matsubara (Saitama Univ.)
Chie Nara (Meiji Univ.) Continuous flattening of multi-layered pyramids with rigid radial edges ····· 15

Summary: There are many ways to continuously flatten polyhedra. In this talk, under the assumption that every radial edge is rigid, we prove that a continuous flattening motion exists for any multi-layered pyramid having a common convex base, with each apex having a common perpendicular foot. Furthermore, we illustrate an example of a multi-layered pyramid with a non-convex base that cannot be continuously flattened while maintaining the rigidity of the radial edges.

9 Masashi Shinohara (Shiga Univ.)
Sho Suda (Nat. Defense Acad. of Japan)
Hiroshi Nozaki (Aichi Univ. of Edu.) Uniqueness of optimal two-distance sets in $\mathbb{R}^8$ ····· 15

Summary: A finite subsets X in the d-dimensional Euclidean space $\mathbb{R}^d$ is called a two-distance set if there are only two different values of distances between two distinct points in X. A two-distance set X in $\mathbb{R}^d$ is said to be optimal if $|X'| \leq |X|$ for any two-distance set X' in $\mathbb{R}^d$. It is known that $|X| \leq (d+1)(d+2)/2$ for two-distance set X in $\mathbb{R}^d$. Lisoněk construct a two-distance set L in $\mathbb{R}^8$ with 45 points. By the inequality, L is optimal two-distance set in $\mathbb{R}^8$. In this talk, we prove a uniqueness of optimal two-distance sets in $\mathbb{R}^8$ up to isomorphism.

Summary: We study perfect state transfer in Grover walks, which are typical discrete-time quantum walk models. In particular, we focus on states associated to vertices of a graph. We call such states vertex type states. Perfect state transfer between vertex type states can be studied via Chebyshev polynomials. We derive a necessary condition on eigenvalues of a graph for perfect state transfer between vertex type states to occur. In addition, we perfectly determine the complete multipartite graphs whose partite sets are the same size on which perfect state transfer occurs between vertex type states, together with the time.

Summary: We investigate unitary equivalence classes of quantum walks on cycles and split-step quantum walks (SSQWs). Unitary equivalence classes of quantum walks on a cycle with N vertices are parameterized by 2N real parameters. Moreover, the ranges of two of the parameters are restricted depending on the parity of N. SSQWs are introduced by Kitagawa and generalized by Suzuki. We define a new class of quantum walks which includes the above SSQWs, and clarify their unitary equivalence classes.

Summary: Localization is a characteristic property of multi-state quantum walks. It is well known that the existence of eigenvalues of time evolution operator is a necessary and sufficient condition of the occurrence of localization. The localization of space-homogeneous (i.e., the time evolution is consistent for every position.) multi-state quantum walks is studied by various previous research. However, the mathematical analysis of the space-inhomogeneous case is not studied yet. Therefore, in this paper, we focus on the eigenvalue problem on two-phase three and four-state quantum walks with one defect, which is very important for various applications. We use the transfer matrix to construct a generalized eigenfunction, then we derive the necessary and sufficient condition for the existence of eigenvalue and its concrete solution for some examples.

Summary: A thermoplastic elastomer (TPE) is a polymeric material with rubber elasticity and is removable at high temperatures. In this talk, we present results of modeling the elastoplastic deformation of a TPE by using a network represented as a periodic graph. A TPE consists of a soft domain, which exhibits rubber elasticity, and hard domains, which act as cross-links. This structure can be represented as a graph. We introduce the tension tensor for a periodically realized graph, which induces the stress and the elasticity. The hard domains of a TPE are less robust than the cross-links of vulcanized rubber. We express this as local moves of a graph, which induce the plasticity in elongation.

16:15–17:15 Talk Invited by Applied Mathematics Section

Tetsuji Taniguchi (Hiroshima Inst. of Tech.) A smallest eigenvalues of graphs and a generalization of line graphs

Summary: There is a previous study that uses the root system to classify graphs with smallest eigenvalue≥ -2. It follows that such graphs are classified by the A, D, E-root systems. The A, D-integral lattice is a sublattice of the standard lattice, but the E-integral lattice is not a sublattice of the standard lattice. However, E-integral lattice is 2-integrable. The integrability of integral lattices constructed from graphs with smallest eigenvalue$\geq \lambda$ is a subject of interest.
It is also well known that the smallest eigenvalue of a line graph is greater than or equal to -2. This naturally raises the question of knowing the hierarchical structure of graphs with smallest eigenvalues, but the (well-known) method of constructing line graphs cannot construct graphs with smallest eigenvalues< -2. Therefore, R. Woo and A. Neumaier formulated a method for constructing graphs with smallest eigenvalue<-2 by highly generalizing the method of constructing line graphs, which is a simple task of replacing "edges" by " vertices". They studied graphs with smallest eigenvalue$\geq -1-\sqrt{2}$ (1995). They introduce a graph called a Hoffman graph, and give a generalization of line graphs by the sum of Hoffman graphs. Then comes a relation between graphs and root systems, along with an irreducibility of Hoffman graphs.

March 29th (Tue) Conference Room V

10:00–11:45

14 Norio Konno (Yokohama Nat. Univ.), Yuki Oshima (Yokohama Nat. Univ.) IPS/Zeta Correspondence for the Domany–Kinzel model ····· 10

Summary: Our previous works presented zeta functions by the Konno–Sato theorem or the Fourier analysis for one-particle models including random walks, correlated random walks, quantum walks, and open quantum random walks. Moreover, we gave zeta functions for multi-particle models with probabilistic or quantum interactions, called the interacting particle system (IPS). In this talk, we consider the zeta function for the Domany–Kinzel model, as a special case of the IPS.

15 Norio Konno (Yokohama Nat. Univ.), Shunya Tamura (Yokohama Nat. Univ.) Walk/Zeta Correspondence for quantum and correlated random walks ····· 10

Summary: We compute the zeta function for the three- and four-state quantum walk, correlated random walk, and multi-state random walk on the one-dimensional torus using the Fourier analysis. We deal with also the four-state quantum walk and correlated random walk on the two-dimensional torus. In addition, we introduce a new class of models determined by the generalized Grover matrix bridging the gap between the Grover matrix and the positive support of the Grover matrix. Finally, we give a generalized version of the Konno–Sato theorem for the new class. We calculate the zeta function for the generalized Grover matrix on the d-dimensional torus as a result.

16 Iwao Sato (Oyama Nat. Coll. of Tech.), Norio Konno (Yokohama Nat. Univ.), Takashi Komatsu (Math. Res. Inst. Calc for Industry/Hiroshima Univ.) Vertex-face/Zeta correspondence ····· 15

Summary: We present the characteristic polynomial for the transition matrix of a vertex-face walk on a graph, and obtain its spectra. Furthermore, we express the characteristic polynomial for the transition matrix of a vertex-face walk on the 2-dimensional torus by using its adjacency matrix, and obtain its spectra. As an application, we define a new walk-type zeta function with respect to the transition matrix of a vertex-face walk on the 2-dimensional torus, and present its explicit formula.

17 Ayaka Ishikawa (Yokohama Nat. Univ.) A family of quantum walks on a finite graph corresponding to the generalized weighted zeta function 15

Summary: We obtain a condition that associates the generalized weighted zeta function with a quantum walks on a finite graph. The spectrum of the transition matrix of the quantum walk is given by the zeta function. This result gives a family of quantum walks that follow from the generalized weighted zeta function.

18 Hideaki Morita (Muroran Inst. of Tech.) On an alternating graph zeta function 15

Summary: We consider a zeta function defined for alternating paths on a finite digraph, and provide the three expressions; the exponential expression, the Euler expression, and the Hashimoto expression, in the framework of the combinatorial zeta function.

19 Osamu Kada (Hosei Univ.) Characteristic polynomials and zeta functions of equitably partitioned graphs 15

Summary: It is well known that for an equitable partition of the vertex set of a directed graph (digraph) X, the characteristic polynomial of a quotient graph divides that of X, but the remainder part is not well investigated. In this paper, we define a deletion graph which is a signed directed graph defined for a fixed set of deleting vertices, and give a similarity transformation exchanging the adjacency matrix $A(X)$ which is compatible with the equitable partition for a block triangular matrix whose diagonal blocks are the adjacency matrix of the quotient graph and the deletion graph. In fact, we show the result for more general matrices, and as a corollary, we show a decomposition formula of the reciprocal of the Ihara–Bartholdi zeta function over an equitably partitioned undirected graph into the quotient graph part and the deletion graph part.

20 Seiken Saito (Kogakuin Univ.) The distribution of the error terms of the number of non-backtracking cycles for a regular graph 15

Summary: For the number N_m of non-backtracking cycles of length m in a $(q+1)$-regular graph, we consider the error term t_m of N_m. The sequence t_m can be expressed by the adjacency eigenvalues whose absolute values are less than $2\sqrt{q}$. In this study, we investigate the distribution of the data t_m $(m = 1, 2, ...)$ and give its moment generating function. We also applied this to show that the limit distribution of $t_m/\sqrt{n}$ (where n is the number of eigenvalues whose absolute value is less than $2\sqrt{q}$) becomes a normal distribution when a sequence of growing regular graphs satisfies certain conditions.

11:50–12:10 Presentation Ceremony for the 2021 MSJ Prize for Excellent Young Applied Mathematicians

13:15–14:15

21 Tomoya Machide (Nat. Inst. of Informatics) An application of systems of Boolean polynomial equations to list color problems 10

Summary: We give an application of systems of Boolean polynomial equations to list color problems to obtain a computational complexity result having the bandwidth parameter. To symmetrize the result, we also discuss a generalization of list color problem.

22 Yumiko Ohno (Yokohama Nat. Univ.) Naoki Matsumoto (Keio Univ.) The achromatic number and the pseudoachromatic number of caterpillars ····· 15

Summary: A *pseudocomplete k-coloring* of a graph is a (not necessarily proper) k-coloring such that each pair of colors appears on at least one edge. A *complete k-coloring* is a pseudocomplete k-coloring which is also a proper k-coloring. The *pseudoachromatic number* of a graph G is the largest number k such that G has a pseudocomplete k-coloring and the *achromatic number* of G is the largest number k such that G has a complete k-coloring.
In this talk, we deal with caterpillars, where a *caterpillar* is a tree such that the set of vertices of degree at least two induces a path, and we shall show that pseudoachromatic number and achromatic number are the same for a caterpillar satisfying certain conditions.

23 Kengo Enami (Seikei Univ.) Kenta Ozeki (Yokohama Nat. Univ.) Tomoki Yamaguchi Proper colorings of plane quadrangulations without rainbow faces ···· 15

Summary: We consider a proper coloring of a plane graph such that no face is rainbow, where a face is rainbow if any two vertices on its boundary have distinct colors. Such a coloring is said to be proper anti-rainbow. A plane quadrangulation G is a plane graph in which all faces are bounded by a cycle of length 4. In this paper, we show that the number of colors in a proper anti-rainbow coloring of a plane quadrangulation G does not exceed $3\alpha(G)/2$, where $\alpha(G)$ is the independence number of G. Moreover, if the minimum degree of G is 3 or if G is 3-connected, then this bound can be improved to $5\alpha(G)/4$ or $7\alpha(G)/6 + 1/3$, respectively. All of these bounds are tight.

24 Atsuhiro Nakamoto (Yokohama Nat. Univ.) Kenta Ozeki (Yokohama Nat. Univ.) Chromatic number of quadrangulations of the projective space ····· 15

Summary: Youngs proved that every quadrangulation on the 2-dimensional projective plane is 4-chromatic, if it is non bipartite. In our talk, we define a quadrangulation of a 3-dimensional space, and consider chromatic number of quadrangulations of the 3-dimensional projective space. We can find a similar result on the topic, but we can find an essential difference between this and ours.

March 30th (Wed) Conference Room V

9:00–10:45

25 Yoshiki Jikumaru (Kyushu Univ.) Yohei Yokosuka (Kagoshima Univ.) On the differential geometric formulation of hanging membranes ····· 15

Summary: Antoni Gaudi, famous for his design of the Sagrada Familia, proposed a mechanically efficient structure obtained by a hanging chain to be upside-down. A hanging chain, often referred as catenary, is in equilibrium only with the tension for its own weight, therefore the upside-down object is in equilibrium only with the compression. Due to the complexity of the treatment of membranes compared to curves, previous research of hanging membranes in the architectural field are based on many experiments or numerical analysis. In this talk, we give a mathematically rigorous formulation of hanging membranes from the equilibrium equations of membranes and variational principles and show that our formulation is also efficient for the numerical analysis.

26 Tomoharu Suda (Keio Univ.) Equivalence of topological dynamics without well-posedness ····· 15

Summary: The problem of topological classification is fundamental in the study of dynamical systems. However, when we consider systems without well-posedness, it is unclear how to generalize the notion of equivalence. In this study, we formulate a notion of "topological equivalence" using the axiomatic theory of topological dynamics proposed by Yorke, which we also generalize here to the action of topological groups.

27 Itsuki Watanabe (Waseda Univ.) Deterministic limit of the stochastic model of nonlocal cross-diffusion 15

Summary: The deterministic limit of the stochastic model of nonlocal cross-diffusion is considered. The stochastic model is given by system with types of particle which the diffusion rate depends on the density of another particle system. In this talk, we consider the deterministic limit of this model, and show the existence of solution to some nonlocal cross-diffusion equation by Markov chain approximation method.

28 Satoru Iwasaki (Osaka Univ.), Shuichi Jimbo (Hokkaido Univ.), Yoshihisa Morita (Ryukoku Univ.) Standing unimodal waves of reaction-diffusion equations on an unbounded graph with two vertices 15

Summary: We study standing unimodal waves of reaction-diffusion equations on an unbounded metric graph with two vertices. In particular, we reveal a relation between a number of standing unimodal waves and a length of the bridge. Furthermore, stability of one of the standing unimodal waves is also studied by spectral analysis of linearized operators.

29 Satoru Iwasaki (Osaka Univ.), Yutaro Yamaguchi (Osaka Univ.) Number of stationary solutions of the Allen–Cahn equation in compact metric graphs 15

Summary: In this study, we deal with the Allen–Cahn equation in compact metric graphs. Particularly, this study aims to reveal numbers of all stable stationary solutions of the problem. In this talk, we explain an idea of an algorithm counting up numbers of stable stationary solutions based on analysis about the star graph cases.

30 Toshikazu Kuniya (Kobe Univ.), Tarik Mohammed Touaoula (Univ. Aboubekr Belkaïd) Global dynamics of a class of bistable reaction-diffusion equations with time delay 15

Summary: In this study, we are concerned with a class of bistable reaction-diffusion equations with distributed time delay. We investigate the global attractivity of each steady state and show that there can exist the basins of attraction of the trivial steady state and a positive steady state, which is larger than another unstable positive steady state. We apply our analytical results to a delayed diffusive blowflies model with Allee effect.

11:00–12:00 Talk Invited by Applied Mathematics Section

Yusuke Imoto (Kyoto Univ.) Invitation to single-cell data science

Summary: Single-cell data science is a new research field of applied mathematics in this century. Recent developments of experimental techniques like next-generation sequencing (NGS) enable us to acquire molecular data such as RNA, protein, and epigenome in single-cell resolutions. However, the single-cell data have the following characteristics: high-dimensional, low-sample size, sparsity (low detection rate), non-time series, and lack of 3D connectivity; these properties arose new data science challenges. In this talk, we would like to introduce the mathematical problems in single-cell data science in detail. Moreover, the latest research of the speaker and collaborators, which is a study of noise reduction based on high-dimensional statistics, will be explained.

14:15–17:00

31 Jumpei Nagase (Shibaura Inst. of Tech.)
Aoi Honda (Kyushu Inst. of Tech.)
Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Representation of the Choquet integral by deep neural networks ····· 15

Summary: The inclusion-exclusion integral is a generalized integral on non-additive measures, and the application to neural network models has been proposed as a data analysis method because it deals with the interaction of each input. The Choquet integral, a fuzzy integral, is known as an example of inclusion-exclusion integral. In this research, we consider the relationship between deep neural network models, which have been developing in wide range of fields in recent years, and Möbius-type Choquet integrals. In other words, the calculation of Choquet integrals can be explained as one of the functions that the perceptron model can represent.

32 Kengo Nakai (Tokyo Univ. of Marine Sci. and Tech.)
Miki U. Kobayashi (Rissho Univ.)
Yoshitaka Saiki (Hitotsubashi Univ.)
Natsuki Tsutsumi (Hitotsubashi Univ.)
Reconstruction of invariant sets of dynamical systems by machine learning models ····· 15

Summary: This study evaluates data-driven models obtained by machine-learning approach from a dynamical system perspective, such as unstable fixed points, periodic orbits and chaotic attractors. In addition, we find that hetero-chaotic dynamics with different unstable dimensions can be modeled by a data-driven model. A part of this talk is based on Kobayashi, Nakai, Saiki, Tsutsumi, Phys. Rev. E 104, 044215 (2021).

33 Qiwen Sun (Nagoya Univ./RIKEN)
Takemasa Miyoshi (RIKEN)
Serge Richard (Nagoya Univ./RIKEN)
Control simulation experiments of extreme events with the Lorenz-96 model ····· 15

Summary: In this study, we investigate the controllability of a chaotic dynamical system by adding small perturbations to generate amplified effects and to prevent extreme events. The high sensitivity to initial conditions would ultimately lead to modifications of extreme events with infinitesimal perturbations. Based on this idea, we design the control simulation experiment (CSE) for the Lorenz-96 model, a widely-used toy system in data assimilation studies. We also study the sensitivity of the control to the amplitude of the perturbation, the forecast length, and the localized perturbation. The CSE would be applicable to other chaotic dynamical systems including realistic numerical weather prediction models.

34 Naoto Yamaoka (Osaka Pref. Univ.)
Asymptotic behavior of solutions of discrete replicator equations with the core-periphery model ····· 15

Summary: In this talk, we consider the asymptotic behavior of solutions of the difference equation corresponding to a replicator equation with the core-periphery model $\Delta_h \lambda_i(t_n) = \{\omega_i(t_n) - \bar{\omega}(t_n)\}\lambda_i(t_n)$ $(i = 1, 2)$. We obtain a sufficient condition for solutions $(\lambda_1(t_n), \lambda_2(t_n))$ of the difference equation to tend to the equilibrium $(0, 1)$ as $n \to \infty$.

Summary: Multiple-order asymptotic expansions of blow-up solutions near blow-up for ordinary differential equations are considered. Under a mild assumption of vector fields involving the scale invariance, we develop a general strategy for obtaining asymptotic expansion of blow-up solutions under the knowledge of blow-up rates, which can be obtained through dynamics at infinity. We show that, if the blow-up is type-I, all possible terms appearing the expansion of a blow-up solution are determined by "eigenvalues" of the matrix associated with vector fields near the principal term of the blow-up and lower order terms of vector fields. The "eigenvalues" provide some algebraic aspects of blow-ups.

Summary: Stommel (1950) considered a model of thermal convection in horizontally long liquid layer with gravity. He obtained approximate solutions by asymptotic expansion of the equations with respect to a dimension-less parameter and showed its picture of contour line of the stream function and isothermal line. It may be considered as a simplest model of thermal effect to the ocean current. (cf. Sverdrup 1942). Here we show the existence of stationary solutions under some assumptions including $h << 1/l$ and under stress free boundary conditions on the velocity. Also we show a picture of the isothermal line and the contour lines of the solution.

Summary: In this talk, we deal with an interface model for deformable self-propelled systems in which the surface tension difference is the driving force. Numerical results will be presented as a first step to elucidate the mathematical mechanism.

Summary: The dynamics of traveling multiple-pulse solutions arising in a three-component FitzHugh–Nagumo system is considered. It is numerically found that two traveling multiple-pulses weakly attract with each other to become one larger multiple-pulse solution, and that, by parameter variations, such multiple-pulse solutions are destabilized via a Hopf bifurcation and split up into smaller multiple-pulse solutions. In order to elucidate the dynamics in more detail, we derive ordinary differential equations for the interface motions of the multiple-pulses. The reduced ODEs allow us to reveal the global bifurcation structures of multiple-pulse solutions, especially traveling 2-pulse and 3-pulse solutions, and clarify the mechanism for the numerically observed behaviors from a view point of the bifurcation theory.

39 Masaharu Nagayama (Hokkaido Univ.), Yusuke Yasugahira (Hokkaido Univ.) — On a numerical bifurcation analysis of a particle reaction-diffusion model for a motion of two self-propelled disks 15

Summary: Theoretical analysis using mathematical models is often used to understand a mechanism of collective motion in a self-propelled system. In the experimental system using camphor disks, several kinds of characteristic motions have been observed due to the interaction of two camphor disks. In this paper, we understand the emergence mechanism of the motions caused by the interaction of two self-propelled material by analyzing the global bifurcation structure using the numerical bifurcation method for a mathematical model. Finally, it is also shown that the irregular motion, which is one of the characteristic motions, is chaotic motion and that it arises from periodic bifurcation phenomena and quasi-periodic motions due to torus bifurcation.

March 31st (Thu) Conference Room V

9:00–10:45

40 Fuminori Sakaguchi (Univ. of Fukui) — A reverse application of 'ill-posedness' —an advantage of multiple precision in a integer-type algorithm for solving ODEs— 15

Summary: Usually, in numerical analysis, 'ill-posedness' and 'ill-conditionedness' are unwelcome. However, they affect nothing, in the algorithms based only on four arithmetical operation among integers without round-off errors. There, their 'reverse applications' for simplifying algorithms and reducing computational quantities may be possible. An integer-type algorithm for solving higher-order linear ODEs, proposed by the author and M. Hayashi about ten years ago, turned out to have been a kind of such a 'reverse application of ill-posedness', in the sense that it utilizes simple integer operations among integer basis vectors which are numerically almost linearly dependent (almost parallel). In this study, we investigate to what extent the advantage of its 'reverse application' is enlarged by the use of multiple-precision integer operations. The results are successful in reducing computational quantities considerably.

41 Takuya Tsuchiya (Hachinohe Inst. of Tech.), Ryosuke Urakawa, Gen Yoneda (Waseda Univ.) — Numerical integration of Einstein equations in gravitational collapse spacetime considering mass conservation 15

Summary: We perform numerical simulations of the Einstein equations in the gravitational collapse spacetime. We set the mass density in spherical symmetry as the initial condition, and integrate the Einstein equations and the conservation equations of energy momentum tensor. We reported the simulations with the Crank–Nicolson scheme and the centered space discretization at the MSJ Spring Meeting 2021. Then, the results of the mass density were the partially negative. Therefore, we improve the discretization by using the forth-order Runge–Kutta scheme and the upwind scheme. In addition, we will present some hi-precision numerical simulations by the dynamical equations with the constraint terms.

42 Hirotada Honda (Toyo Univ.) — Revisiting the stability of GAN 10

Summary: In this article, we discuss the stability of min-max GAN originally proposed by Goodfellow et al. We will make use of the theory of iterated function system.

43 Shinya Uchiumi (Gakushuin Univ.) A pressure error estimate for a projection Lagrange–Galerkin scheme of Guermond–Minev type for the Oseen problem 15

Summary: We consider a finite element scheme for the transient Oseen problem, which is a linearization of the Navier–Stokes (NS) problem. We focus on two numerical methods. One is the Lagrange–Galerkin (LG) method, which combines the method of the characteristics and Galerkin method. We also focus on the projection method. The main advantage is the computational efficiency that decouples the velocity and pressure. Guermond and Minev have developed an LG/projection scheme for the NS problem, and derived an error estimate for the velocity. The estimate for the pressure, however, is not known to the best of the author's knowledge. Here, we derive an error estimate for the pressure in the Oseen problem.

44 Yoshitaka Watanabe (Kyushu Univ.)
Kaori Nagatou (Karlsruhe Inst. of Tech.)
Michael Plum (Karlsruhe Inst. of Tech.)
Takehiko Kinoshita (Saga Univ.)
Mitsuhiro T. Nakao (Waseda Univ.)
A computer-assisted proof of critical Reynolds number for Orr–Sommerfeld equation 15

Summary: This talk presents a computer-assisted proofs of the critical Reynolds number for the Orr–Sommerfeld equation describing the hydrodynamic stability of Poiseuille flow. Using spectral Galerkin approximate solutions bounding its small defect and a fixed-point theorem, an enclosure of a strong candidate of the critical Reynolds number is shown.

45 Makoto Okumura (Hokkaido Univ.)
Yasuaki Kobayashi (Hokkaido Univ.)
Masaharu Nagayama (Hokkaido Univ.)
Hironobu Fujiwara (RIKEN)
Yasugahira Yusuke (Hokkaido Univ.)
A mathematical study of the mechanism of hair follicle formation using a mathematical model for large deformation of basement membrane 15

Summary: The skin is the boundary between the body and the outside world. All living things, including humans, interact with the outside world through the skin. The skin is composed of epidermis, dermis, and subcutaneous tissue. Besides, as an appendage of the skin, a hair follicle is the source of the hair. The hair follicle is crucial for maintaining the epidermis and hair tissue homeostasis and for repairing damaged tissue. In this study, we have attempted to examine the mechanism of hair follicle formation from a mathematical point of view by applying a mathematical model, which enables the description of the concave deformation of the basement membrane. In this talk, we show the results obtained from this attempt.

11:00–12:00 Talk Invited by Applied Mathematics Section

Keita Iida (Osaka Univ.) Single-cell gene expression data analysis

Summary: Gene expression is a biochemical process producing RNA and proteins that can regulates cellular processes such as homeostasis, adaptation, and differentiation, however its dysregulation can induce cell death or cancer formation. In recent years, experimental technologies to quantify gene expression such as fluorescence in situ hybridization and single-cell RNA sequencing have been developed and some of these data are available publicly. Furthermore, mathematical and bioinformatics studies offer techniques to model stochastic gene expressions, quantify biochemical parameters, and infer cell states. Here, we introduce our model- and data-driven approaches to analyze such single-cell data to understand gene expression regulations leading to cellular differentiation and dysregulation.

Topology

March 28th (Mon) Conference Room VII

9:30–12:00

1 Shunsuke Kano (Tohoku Univ.)
Tsukasa Ishibashi (Kyoto Univ.)
A characterization of pseudo-Anosov mapping classes by tropical cluster transformations ····· 15

Summary: For a mapping class on a punctured surface, we prove that the kind of pseudo-Anosov property is equivalent to the combinatorial property of mutation loops. In particular, we conclude that the algebraic entropies of the cluster A- and X-transformations induced by the mutation loop given by a pseudo-Anosov mapping class both coincide with its topological entropy.

2 Ramón Barral Lijó (Ritsumeikan Univ.)
Jesús Antonio Álvarez López
(Univ. of Santiago de Compostela)
Realization of manifolds as leaves of foliated spaces ····· 15

Summary: We will present our results about the geometric realization of Riemannian manifolds as leaves of compact foliated spaces with a leafwise Riemannian metric.

3 Hiroki Kodama
(Tohoku Univ./RIKEN)
Naohiko Kasuya (Hokkaido Univ.)
Yoshihiko Mitsumatsu (Chuo Univ.)
Atsuhide Mori (Osaka Dent. Univ.)
Torus fibrations from S^5 to S^3 found from Milnor fibrations of certain complex surface singularities ····· 15

Summary: We explain T_{pqr} cusp singularities and Milnor fibers F_θ of them. We construct a complex map g on a Milnor fiber F_θ so that it has $p+q+r$ critical points and the inverse images of regular values are tori T^2. We also construct a deformation of the Milnor fiber so that all critical points become Lefschetz type.

4 Yoshihiko Mitsumatsu (Chuo Univ.)
Naohiko Kasuya (Hokkaido Univ.)
Hiroki Kodama
(Tohoku Univ./RIKEN)
Atsuhide Mori (Osaka Dent. Univ.)
Lefschetz fibration on Milnor fibers of cusp singularities and topological decomposition of K3 surfaces ····· 15

Summary: We explain that the K3 surface admits a smooth topological decomposition into the two Milnor fibers of T_{pqr} cusp singularities which are dual in the sense of the extended strange duality. Among such 10 decompositions, the pair T_{237}-T_{237} gives a particularly good decomposition.

5 Yasushi Hirata (Kanagawa Univ.)
Yukinobu Yajima
(Kanagawa Univ.*/Math Art Laboratory)
Undecidability for the extent of products of monotonically normal spaces ····· 10

Summary: We say that a space is almost discrete if it has at most one non-isolated point. In this talk, we discuss the extent of product spaces. We show: it is consistent with and independent of ZFC that there are a monotonically normal space X and an almost discrete space Y such that $X \times Y$ is normal and $e(X \times Y) > \omega = e(X) \cdot e(Y)$.

6 Hirokazu Nishinobu
(Nagano Nat. Coll. of Tech.)
Toshihiro Yamaguchi (Kochi Univ.)
An example of non-coformal classifying space with rational $H(2)$-structure ····· 10

Summary: Let $Baut_1X$ be the Dold–Lashof classifying spaces of a space X. In this talk, we give an example that there exists a space X such that $Baut_1X$ are not coformal and are rational $H(2)$-spaces.

7 Kaori Yamazaki (Takasaki City Univ. of Econ.) Exchange economy from viewpoints of general topology ····· 15

Summary: In this talk, we study exchange economy from viewpoints of general topology.

8 Sachiko Saito (Hokkaido Univ. of Edu.), Kosei Takashimizu (Seiryo Junior High School) Newton non-degeneracy and strongly Newton non-degeneracy of mixed weighted homogeneous polynomials ····· 10

Summary: A mixed polynomial f is called a mixed weighted homogeneous polynomial if it is both radially and polar weighted homogeneous. Let f be a mixed weighted homogeneous polynomial with respect to a strictly positive radial weight vector P and a polar weight vector Q. If f is Newton non-degenerate over the face $\Delta(P)$ and f is polar weighted homogeneous of non-zero polar degree with respect to Q, then $f : \mathbb{C}^{*n} \to \mathbb{C}$ has no mixed critical points. Moreover, if $f^{-1}(0) \cap \mathbb{C}^{*n} \neq \emptyset$, then $f : \mathbb{C}^{*n} \to \mathbb{C}$ is surjective. In this talk, we give such an example of a mixed weighted homogeneous polynomial f which is Newton non-degenerate over the face $\Delta(P)$ and for which $f^{-1}(0) \cap \mathbb{C}^{*n} = \emptyset$.

9 Yusuke Mizota (Kyushu Sangyo Univ.), Shunsuke Ichiki (Tokyo Tech), Naoki Hamada (KLab Inc.) All unconstrained strongly convex problems are weakly simplicial ···· 15

Summary: A multi-objective optimization problem is C^0 weakly simplicial if there exists a continuous surjection from a simplex onto the Pareto set such that the image of each subsimplex is the Pareto set of a subproblem. In this talk, we show that all unconstrained strongly convex problems are C^0 weakly simplicial. (Joint work with Naoki Hamada and Shunsuke Ichiki)

14:15–15:05

10 Kazuhiro Ichihara (Nihon Univ.), In Dae Jong (Kinki Univ.) Purely cosmetic surgeries on alternating Montesinos knots ····· 10

Summary: We show that alternating Montesinos knots admit no purely cosmetic surgeries. Precisely, it is shown that no pair of distinct Dehn surgeries on alternating Montesinos knots yield 3-manifolds that are homeomorphic as oriented manifolds.

11 Masaki Ogawa (Saitama Univ.) A characterization of a 3-manifold with a multibranched handlebody decompsition ····· 15

Summary: A decomposition of a 3-manifold by some handlebodies is called a handlebody decomposition. The intersection of handlebodies in handlebody decomposition is called a partition of it. We say handlebody decomposition is multibranched if the partition of a handlebody decomposition is a multibrahced surface. Recently we showed that multibranched handlebody decomposition is stable equivalent if the number of handlebodies is four. In this talk, we consider the 3-manifolds which have a multibranched handlebody decomposition with four handlebodies with genera at most one.

12 Teruaki Kitano (Soka Univ.), Yuta Nozaki (Hiroshima Univ.) Algebraic integrality of Reidemeister torsion ····· 10

Summary: For a 3-manifold M and an acyclic $SL(2,\mathbb{C})$-representation ρ of its fundamental group, the Reidemeister torsion $\tau_\rho(M) \in \mathbb{C}$ is defined. If there are finitely many conjugacy classes of irreducible representations, then the Reidemeister torsions are known to be algebraic numbers. In this talk we report that any value of them is an algebraic integer for a Seifert fibered space under mild conditions, even though there are inifinite conjugacy classes.

15:20–16:20 Talk Invited by Topology Section

Yuya Koda (Hiroshima Univ.) Mapping class groups of Heegaard splittings

Summary: The mapping class group, or the Goeritz group, of a Heegaard splitting for a closed orientable 3-manifold is defined to be the subgroup of the mapping class group of the Heegaard surface consisting of mapping classes that extend to both of the handlebodies of the splitting. Simple problems on the structure of this group such as finiteness, finite generation, finite presentability of the group are already highly non-trivial and still open in general. In this talk, we give a short historical overview of these problems and introduce its recent progress together with some applications.

March 29th (Tue) Conference Room VII

9:30–11:50

13 Akihito Mori (Tohoku Univ.), Yuya Murakami (Tohoku Univ.) The Witten–Reshetikhin–Turaev invariant for plumbed manifolds · · · · 15

Summary: Gukov–Pei–Putrov–Vafa constructed q-series invariants called homological blocks in a physical way in order to categorify Witten–Reshetikhin–Turaev (WRT) invariants and conjectured that radial limits of homological blocks are WRT invariants. In this talk, we prove their conjecture for unimodular H-graphs. As a consequence, it turns out that the WRT invariants of H-graphs yield quantum modular forms of depth two and of weight one with the quantum set $\mathbb{Q}$. In the course of the proof of our main theorem, we first wrie the invariants as finite sums of rational functions. We second carry out a systematic study of weighted Gauss sums in order to give new vanishing results for them. Combining these results, we finally prove that the above conjecture holds for H-graphs.

14 Yuta Taniguchi (Osaka Univ.) A knot invariant obtained from an f-twisted Alexander matrix · · · · · · 15

Summary: Recently, A. Ishii and K. Oshiro introduced a new notion, which is called an f-twisted Alexander matrix. An f-twisted Alexander matrix is a quandle version of an Alexander matrix of knot groups. In this talk, we show that a certain knot invariant obtained from a f-twisted Alexander matrix is a stronger knot invariant than the Alexander invariant.

15 Akihiro Takano (Univ. of Tokyo) The Long–Moody construction and twisted Alexander invariants · · · · · 15

Summary: The Long–Moody construction is a method of constructing a new representation of the braid group from a representation of the semidirect product of the braid group and the free group. In this talk, we show that its matrix presentation is described by the Fox derivation, and also a relation with twisted Alexander invariants.

16 Shuichi Harako (Univ. of Tokyo) Computational results for the symplectic derivation Lie algebras · · · · · 15

Summary: The Lie algebras consisting of symplectic derivations on certain algebras are called the symplectic derivation Lie algebras. We determined the second homology group of the certain Lie ideal of "the commutative world" of the symplectic Lie algebras in terms of symplectic modules.

17 Atsuhiko Mizusawa (Waseda Univ.), Yuka Kotorii (Hiroshima Univ./RIKEN) A classification of 5-component link-homotopy classes through the clasper theory · 15

Summary: The link-homotopy classes of links are obtained from the link-homotopy classes of string links modulo the partial conjugations. Yasuhara and Meilhan gave a standard form of the link-homotopy classes of string links by using the claspers. In this talk, we calculate the actions of the partial conjugations for the 5-component link-homotopy classes of string links by using the clasper theory and give a new presentation of the link-homotopy classes of 5-component links.

18 Takefumi Nosaka (Tokyo Tech) Fox pairings of Poincaré duality groups 10

Summary: We develop the study of Fox pairings of a group G from viewpoints of group cohomology. We compute some cohomology groups of Fox pairings of G, where G admits a Poincaré duality group pair. We also suggest fundamental Fox pairings and higher Fox pairings.

19 Kentaro Yonemura (Kyushu Univ.) Quandles over a one-sheet hyperboloid and longitudinal map 15

Summary: We define quandles over a one-sheet hyperboloid and compute longitudinal map, which is a knot invariant defined by Clark–Saito in 2019.

20 Tsukasa Ishibashi (Kyoto Univ.) Stated and marked skein algebras 10
Wataru Yuasa (Kyoto Univ.)

Summary: For a marked surface Σ and a Lie algebra $\mathfrak{g} = \mathfrak{sl}_2$, $\mathfrak{sl}_3$ or $\mathfrak{sp}_4$, we construct an explicit isomorphism between the reduced stated $\mathfrak{g}$-skein algebra and the boundary-localization of the ("Muller type") marked $\mathfrak{g}$-skein algebra.

12:15–12:25 Presentation Ceremony for the 2021 MSJ Geometry Prize

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

Takefumi Nosaka (Tokyo Tech) Nilpotent knot-invariants and Johnson homomorphisms of the mapping class group

Summary: While there are many studies of knots in the 3-sphere, this study suggests a knot theory from the viewpoints of (nilpotently) rational homotopy theory or Johnson homomorphisms. More precisely, I defined a nilpotent monodoromy from a knot, which should be regarded as an element of an outer automorphism group. Fortunately, the outer automorphism group has been studied in terms from Johnson homomorphisms and the mapping class groups, with a relation to Goldman Lie algebras. In this talk, I explain the definition of the monodoromy, and an interaction between knot theory and studies of the mapping class group; I also take about some approaches to the outer automorphism group in order to give some computations of the monodoromies.

March 30th (Wed) Conference Room VII

9:30–12:00

21 Erika Kuno (Osaka Univ.) Uniform hyperbolicity of nonseparating curve graphs of nonorientable surfaces 10

Summary: Let N be a connected nonorientable surface with or without boundary components and punctures. We prove that the graph of nonseparating curves of N is connected and Gromov hyperbolic with a constant which does not depend on the topological type of surface by using the bicorn curves introduced by Przytycki and Sisto. The proof is based on the argument by Rasmussen on the uniform hyperbolicity of graphs of nonseparating curves for orientable finite type surfaces.

22 Erika Kuno (Osaka Univ.) Uniform hyperbolicity of fine curve graphs of nonorientable surfaces
Mitsuaki Kimura (Kyoto Univ.) 10

Summary: A fine curve graph defined by Bowden, Hensel, and Webb (J. Amer. Math. Soc. (2021)) is a new curve graph consists of all essential simple closed curves on a surface. They proved that the fine curve graph of any closed orientable surface of genus $g \geq 1$ is uniformly hyperbolic in the sense of Gromov. We proved that the fine curve graph of any closed nonorientable surface of genus $g \geq 3$ is also uniformly hyperbolic.

Summary: Two families of one-cone torus bundles parametrized by cone angles are studied. When the cone angles are sufficiently small, the combinatorial structures of the Dirichlet domains with respect to the basepoints in the singular locus are characterized.

Summary: Kulkarni and Prathamesh introduced an invariant of Legendrian knots by using rack colorings. Ceniceros, Elhamdadi and Nelson defined a Legendrian rack and generalized the invariant. In this talk, we define a bi-Legendrian rack and consider a further generalization of the invariant. We show that bi-Legendrian rack coloring numbers can distinguish all Legendrian unknots with the same Thurston–Bennequin number. We also consider pairs of Legendrian knots which cannot be distinguished by bi-Legendrian rack coloring numbers.

Summary: It is known that every orientable surface-link can be described as a closed 2-dimensional braid. In this talk, we introduce a new method of describing a surface-link using a braided surface, which we call a plat form. We prove that every surface-link, which is not necessarily orientable, can be described in a plat form. We show how to obtain the surface-link group from the braided surface group by adding some simple relations.

Summary: Relations between Dehn twists on mapping class groups of surfaces play an important role in the study of symplectic manifolds via Lefschetz fibrations. In higher dimensions, as little is known about symplectic mapping class groups, fibration-like structures are not so powerful yet. In this talk, I will give a relation between 4-dimensional Dehn twists on a Weinstein domain. One of the key ingredients in the construction is a solution to the symplectic isotopy problem for symplectic surfaces in $\mathbb{CP}^2\#3\overline{\mathbb{CP}}^2$.

Summary: The boundary sum of the product of a circle with a 3-ball and the product of a disk with a 2-sphere is called a pochette. For a pochette P embedded in a 4-manifold M, a pochette surgery on M is the operation of removing the interior of P and gluing in P by a diffeomorphism of the boundary of P. In this talk, we give a necessary condition for the operation of surgery on the 4-sphere to generate a homotopy 4-sphere in a more precise manner. Furthermore, we show that any pochette surgery using the trivial 2-knot, which becomes a homotopy 4-sphere, is diffeomorphic to the 4-sphere.

Summary: A divide with cusps is the image of a generic, relative immersion allowing finite cusps of intervals and curves into the unit disk. A divide with cusps is the generalization of the notion of the divide which is introduced by A'Campo. We can associate the link $L(P)$in S^3 to a divide P. There are several ways to draw the diagram of the link $L(P)$ from a divide P. In this talk we introduce the algorithm to draw the diagram of the link $L(P)$ of a divide with cusps P, which is the application of Couture–Perron's method.

Summary: Magnitude is an invariant for metric spaces introduced by Leinster, which measures the number of efficient points. As a categorification of the magnitude, Hepworth and Willerton defined magnitude homology for graphs. Recently, Asao and Izumihara introduced CW-complexes whose homology groups are isomorphic to direct summands of the graph magnitude homology group. We prove that the Asao–Izumihara complex is homotopy equivalent to a wedge of spheres for pawful graphs introduced by Y. Gu.

14:15–15:15

30 Koji Yamazaki (Tokyo Tech) Sheaf theoretic characterization of étale groupoids 15

Summary: The study of Haeflier suggests that it is natural to regard a pseudogroup as an étale groupoid. We show that any étale groupoid corresponds to a *pseudogroup sheaf*, a new generalization of a pseudogroup. This correspondence is an analog of the equivalence of the two definitions of a sheaf: as an étale space and as a contravariant functor.

31 Shuhei Maruyama (Nagoya Univ.) The Dixmier–Douady class, the action homomorphism, and cocycles on the group of symplectomorphisms 15

Summary: For a closed, one-connected, and integral symplectic manifold, there exist three kinds of cohomology classes; the Dixmier–Douady class of symplectic fibrations, Weinstein's action homomorphism, and a cohomology class of Ismagilov–Losik–Michor type. In this talk, we explain a relation between these cohomology classes in terms of the Hochschild–Serre spectral sequence.

32 Hitoshi Moriyoshi (Nagoya Univ.)
Toshikazu Natsume (Nagoya Inst. of Tech.) Quantum walk on the integer lattice and the Nöther index theorem 15

Summary: A formulation of the index theorem for Quantum walk will be discussed. The framework of K-theory provides a novel viewpoint that connects the classical index theorem by Fritz Noether in 1920 with the new index theorem discovered by Suzuki–Tanaka and Matsuzawa.

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

Takahiro Matsushita (Univ. of Ryukyus) Invariant quasimorphisms and mixed commutator lengths

Summary: A *quasimorphism on a group* G is a real-valued function f on G such that the function $f(xy) - f(x) - f(y)$ on $G \times G$ is uniformly bounded. A quasimorphism f on G is said to be *homogeneous* if $f(x^n) = n \cdot f(x)$ for every element x in G and for every integer n. Homogeneous quasimorphisms are closely related to the second bounded cohomology and the stable commutator length, and they have been extensively studied in geometric group theory, symplectic geometry, and theory of diffeomorphism groups.
Let N be a normal subgroup of a group G. A homogeneous quasimorphism f on N is said to be *G-invariant* if $f(gxg^{-1}) = f(x)$ for every element g in G and for every element x in N. In this talk, we discuss several relations among invariant quasimorphisms, the stabilizations of mixed commutator lengths, and the second (bounded) cohomology groups.
This talk is based on joint work with Morimichi Kawasaki (Aoyama Gakuin University), Mitsuaki Kimura (Kyoto University), Shuhei Maruyama (Nagoya University), and Masato Mimura (Tohoku University).

Infinite Analysis

March 30th (Wed) Conference Room IX

10:00–12:00

1 Kohei Motegi (Tokyo Univ. of Marine Sci. and Tech.)
An extension of an identity for Grothendieck polynomials to skew version using Yang–Baxter algebra 15

Summary: Recently, Guo and Sun derived an identity for factorial Grothendieck polynomials which generalizes the one for Schur polynomials by Fehér–Némethi–Rimányi. We give an extension of the identity using skew Grothendieck polynomials by using integrable model and associated Yang–Baxter algebra.

2 Yusuke Ohkubo (Daiichi Univ. of Pharm.)
Ayumu Hoshino (Hiroshima Inst. of Tech.)
Jun'ichi Shiraishi (Univ. of Tokyo)
Deformed Koornwinder operators and Macdonald polynomials of type C I 15

Summary: A certain deformation of the Calogero–Moser–Sutherland operator and the Macdonald operator was given by Sergeev and Veselov, which is related to the Lie superalgebras. In this talk, we present a Fock representation of the Sergeev–Veselov type deformation of the Koornwinder operator. This representation gives another proof of the kernel function identity for the deformed Koornwinder operator which was originally proved by Atai.

3 Ayumu Hoshino (Hiroshima Inst. of Tech.)
Yusuke Ohkubo (Daiichi Univ. of Pharm.)
Jun'ichi Shiraishi (Univ. of Tokyo)
Deformed Koornwinder operators and Macdonald polynomials of type C II 15

Summary: We give explicit forms for the Macdonald polynomials of type C with hook diagrams. Moreover, we give the Pieri formulas for the Macdonald polynomials of type C with hook diagrams and give a conjecture of the Pieri formulas for the type C degenerations of the Koornwinder polynomials with hook diagrams.

4 Toshiki Nakashima (Sophia Univ.)
Manal I. Alshuqayr (Sophia Univ.)
Decomposition theorem for product of fundamental crystals in monomial realization of type C_n 15

Summary: We shall describe the monomial realizations of the fundamental crystals of type C_n and show that their product holds a crystal structure. Finally, we shall give the decomposition theorem of their products explicitly and compare with the decomposition of their tensor product.

5 Yuki Kanakubo (Univ. of Tsukuba)
Gleb Koshevoy (IITP RAS)
Toshiki Nakashima (Sophia Univ.)
An algorithm for Berenstein–Kazhdan decoration functions for minuscule representations 15

Summary: We can define a geometric crystal structure on a variety related to a simply connected connected simple algebraic group, which is a geometric analog of Kashiwara crystals. Defining a rational function 'Berenstein–Kazhdan decoration', one can obtain a crystal in a polyhedral cone isomorphic to the crystal base of negative part of quantum group. In this talk, we give an algorithm to partially compute the BK decoration. In particular, if the algebraic group is special linear group, we can completely calculate BK decoration, which induces an explicit form of the polyhedral cone.

6 Travis Scrimshaw (Osaka City Univ.) Quasi-solvable colored lattice models for types B and C ····· 15

Summary: We describe a colored vertex model whose partition function computes the Demazure atoms and characters for types B and C. A novel feature of this model is that it is not fully solvable (in the sense that the exists a solution to each possible Yang–Baxter equation), but it still retains enough solutions of the Yang–Baxter equations to compute the partition function. This is based on joint work with Valentin Buciumas (arXiv:2101.08907)

14:15–14:50

7 Ryo Takenaka (Osaka City Univ.), Masato Okado (Osaka City Univ.) Vertex operator algebras and fermionic character formulas of affine Lie algebras ····· 15

Summary: Using a vertex algebraic construction, we construct bases of principal subspaces, highest weight modules of highest weight $k\Lambda_0$ and parafermionic spaces for twisted affine Lie algebras. As a consequence, we obtain the fermionic character formula conjectured by Hatayama, Kuniba, Okado, Takagi and Tsuboi.

8 Hiromu Nakano (Tohoku Univ.) On logarithmic modules of the $N = 1$ triplet vertex operator superalgebras ····· 15

Summary: The $N = 1$ triplet vertex operator superalgebra $SW(m)$ was introduced by Adamović and Milas in 2009. We construct logarithmic $SW(m)$-modules and prove that the projective covers of every irreducible $SW(m)$-modules are given by these logarithmic modules.

15:00–16:00 Talk Invited by Infinite Analysis Special Session

Takeo Kojima (Yamagata Univ.) Quadratic relations of the deformed W-algebra $\mathcal{W}_{q,t}(\mathfrak{g})$

Summary: Deformed W-algebra $\mathcal{W}_{q,t}(\mathfrak{g})$ associated with Lie algebra $\mathfrak{g}$ is a two parameter deformation of the classical W-algebra $\mathcal{W}(\mathfrak{g})$, including the W-algebra $\mathcal{W}_\beta(\mathfrak{g})$ and the q-Poisson W-algebra as special cases. Using the free field construction of the basic W-current $T_1(z)$ of $\mathcal{W}_{q,t}(\mathfrak{g})$, we introduce the higher W-currents $T_i(z)$ $(i = 2, 3, 4, \ldots)$ and obtain a closed set of quadratic relations among them. This allows us to define $\mathcal{W}_{q,t}(\mathfrak{g})$ by generators and relations. In this talk, we first review the case of the affine Lie algebra $\mathfrak{g} = A_N^{(1)}$, and then study the extensions to the cases of the twisted Lie algebra $A_{2N}^{(2)}$ and the super Lie algebra $A(M, N)^{(1)}$.

March 31st (Thu) Conference Room IX

10:00–12:00

9 Kazuhiko Aomoto (Nagoya Univ.), Masahiko Ito (Univ. of Ryukyus) Product of Hessians on critical points of level function F attached to hypergeometric integral associated with sphere arrangement ····· 15

Summary: We will talk about product formulae of values of a level function at critical points involved in asymptotic behaviors of hypergeometric integrals associated with a symmetric arrangement of three dimensional spheres. We show in an explicit way how the product of Hessians of the level function at all critical points is related to the behavior of its critical points. We also state two conjectures concerning the same problem associated with general hypersphere arrangements.

10 Taichiro Takagi (Nat. Defense Acad. of Japan) Lax equations using the loop elementary symmetric functions ····· 15

Summary: We consider a set of ordinary differential equations that is a sort of Bogoyavlensky lattices with Ln dependent variables, where L and n are any pair of coprime natural numbers. We show a Lax representation for the system where the elements of the Lax matrix are given by the so-called loop elementary symmetric functions of the dependent variables. The Lax equation is viewed as a continuous limit of the discrete time analog of the Lax equation for the geometric lifting of the integrable cellular automata studied by the author.

11 Shota Shigetomi (Kyushu Univ.)
Kenji Kajiwara (Kyushu Univ.)
Explicit formula of isoperimetric deformation of discrete space curve with constant torsion angle in terms of elliptic theta function ····· 15

Summary: We construct an explicit formula of isoperimetric deformation of discrete space curve with constant torsion angle in terms of elliptic theta function. This formula represents a deformation of Kaleidocycle.

12 Tomoki Nakanishi (Nagoya Univ.) Cluster scattering diagrams, dilogarithm elements, and pentagon relation ····· 15

Summary: The cluster scattering diagrams (CSDs) was introduced by Gross, Hacking, Keel, and Kontsevich to prove several important conjectures on cluster algebras. In this talk we show that every consistency relation in any CSD can be reduced to a trivial one by the pentagon relation among dilogarithm elements in its structure group (possibly applying infinitely many times). The proof is based on a modification of the construction of CSDs by Gross et al.

13 Kodai Matsushita (Nagoya Univ.) Consistency relation of rank 2 cluster scattering diagrams of affine type and pentagon relation ····· 15

Summary: Cluster scattering diagrams are important tools for studying cluster algebra. In rank 2 case, the diagrams are characterized by the consistency relation. In this talk, we prove that the consistency relation of rank 2 cluster scattering diagram of affine type is reduced to the trivial relation by using pentagon relations infinite times.

14 Yuma Mizuno (Chiba Univ.) Mutations of blowups of toric surfaces and q-Painlevé systems ····· 15

Summary: We provide a relation between the geometric framework for q-Painlevé equations and cluster Poisson varieties by using toric models of rational surfaces associated with q-Painlevé equations. We introduce the notion of seeds of q-Painlevé type by the negative semi-definiteness of symmetric bilinear forms associated with seeds, and classify the mutation equivalence classes of these seeds. This classification coincides with the classification of q-Painlevé equations given by Sakai.

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

Tomohiro Sasamoto (Tokyo Tech) Skew RSK, affine crystal and KPZ

Summary: We explain various properties and applications of the skew RSK dynamics, which we introduced recently as a time evolution for a pair of skew Young tableaux (P,Q). The dynamics exhibits solitonic behaviors similar to box ball systems (BBS). Associated affine crystal structure allows to give a bijective proof of the Cauchy identity for the q-Whittaker polynomials. Its refinement provides a connection between Kardar–Parisi–Zhang (KPZ) models and free fermions at finite temperature.