Final: 2023/2/8

The Mathematical Society of Japan

2023 Annual Meeting

Titles and Short Summaries of the Talks

March, 2023

at Chuo University

2023 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 15th (Wed)–18th (Sat), 2023

Venue: Chuo University
1–13–27 Kasuga, Bunkyo-ku
Tokyo, 112-8551, Japan

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The Mathematical Society of Japan

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Plenary Talks

March 16th (Thu) 5534, 5F, Bldg. 5

Award Lecture for the 2023 MSJ Spring Prize

Spring Prize Winner ..... (15:20–16:20)

Takayuki Hibi (Osaka Univ.*) Polytopes and Monomials ..... (16:35–17:35)

Summary: The theory of convex polytopes, which has its origins in Euler's theorem (1752) and Pick's formula (1899), is one of the traditional areas of combinatorics. It underwent a dramatic change in trend around 1970. Backed by the trend from abstract to concrete, a fascinating contact of convex polytopes with commutative algebra was discovered, and a bridge was built from the abstract theory of commutative algebra to the concrete theory of convex polytopes. The bridge simultaneously fostered a movement to reimport combinatorial techniques back into commutative algebra, inviting the birth of the rich soil of so-called "commutative algebra and combinatorics" from the mid-1980s, which led to a historic development of commutative algebra for monomial ideals. Later, in the 1990s, with the rapid development of computers and the evolution of software, the theory of convex polytopes took on the color of computational algebra and benefited from Gröbner bases, which is a treasure trove of techniques. This plenary talk will overview the trends in convex polytopes and commutative algebra in the last half-century since 1970 and furthermore report on current of study for reflexive polytopes and Castelnuovo polytopes.

Featured Invited Talks

March 15th (Wed)

Conference Room I

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Maki Yoshida (Nat. Inst. Information Comm. Tech.) — NewSpace security —Cryptography for space development by private companies— (13:00–14:00)

Summary: In the recent NewSpace era, many small satellites have been launched on various academic or commercial missions. A low cost yet highly secure wireless communication has been desired for small satellites and small launch vehicles, for protecting their critical commands and valuable data transmissions. I would like to first explain requirements that are indispensable in such context and whether the various types of cryptography used in existing network systems satisfy them or not. I will then show our approach and results that establish high security and low implementation cost. The latest flight test conducted on July 31, 2021 achieves successful downlink transmission of 34Mbytes at a practical effective bandwidth of 512kbps.

Conference Room VI

Keita Yokoyama (Tohoku Univ.) — Models of arithmetic and reverse mathematics (13:00–14:00)

Summary: Reverse mathematics is an ongoing program in the field of mathematical logic whose aim is to classify mathematical theorems by their logical strengths. Then, how can we say that one theorem τ is logically different from another theorem σ? One way to show this is to construct a mathematical structure which satisfies τ (together with some basic axioms) but not σ. In this talk, I will introduce several types of structures (models) of axioms for the natural number systems (arithmetic) and show some examples of classifications of mathematical theorems from the viewpoints of model theory.

March 17th (Fri)

Conference Room I

Yasuaki Hiraoka (Kyoto Univ.) — Persistent homology: theory and application (13:00–14:00)

Summary: Topological data analysis (TDA) has emerged in this century and shed new light on data science. A particularly important tool in TDA is persistent homology, which can provide useful information about "shape of data" in a multi-scale way. Much of the development of theoretical research on persistent homology has been motivated by applications. This talk will survey the progress of persistent homology from the perspective of both mathematical and applied research.

Conference Room III

Tsukasa Ishibashi (Tohoku Univ.) — Cluster algebras and the topology of surfaces (13:00–14:00)

Summary: Since its foundation by Fomin–Zelevinsky (2001), the study of cluster algebras has been developed with fruitful connections with various areas of mathematics, such as topology, representation theory, integrable systems, mirror symmetry, and so on. It focuses on a common combinatorial structure, called cluster transformations, which typically arises as coordinate transformations on a certain space, such as the decorated Teichmueller space of Penner (1987). Its geometric aspect is formulated as cluster varieties by Fock–Goncharov (2006). One of the motivating examples is the moduli space of decorated (twisted) G-local systems on a marked surface, which includes the decorated Teichmueller space in the case G=SL(2).
In this talk, I would like to talk on the interplay between the cluster algebras and the topology of surfaces, with a focus on the geometry and cluster structure of the moduli space mentioned above. I also mention recent developments on its quantization via the quantum cluster algebra and the relation to the skein theory.

Conference Room V

Takayoshi Ogawa (Tohoku Univ.)♭ End point maximal regularity and its application to a critical nonlinear problem · · · · · · · · · · (13:00–14:00)

Summary: Maximal regularity for the abstract Cauchy problem of evolution equations is well developed in the Lebesgue-Bochner space $L^\rho(I;X)$, where $1<\rho<\infty$, I is a time interval and X is the UMD Banach space. If X is UMD then it is necessarily reflexive and maximal regularity in non-reflexive Banach spaces is depending on each setting. In this talk, we consider the end-point case $\rho=1$ in the homogeneous Besov space $X=\dot{B}^s_{p,1}(\mathbb{R}^n_+)$ in the half Euclidean space. We then apply it to the initial boundary value problem of some nonlinear evolution equations such as the Navier-Stokes equations.

March 18th (Sat)

Conference Room III

Masahito Yamazaki (Univ. of Tokyo) Integrability and Chern-Simons Theory · · · · · · · · · · (13:00–14:00)

Summary: Integrable models, which are "exactly solvable", lie at the intersections of many different topics/areas in mathematics and physics. However, many of the existing results are gradually built up through decades of research, and often involve trials and errors. This makes it newcomers (including myself) to learn the subject. One might therefore hope to find a new conceptual framework for understanding integrable models from scratch. In this lecture, I will discuss recent developments (in collaboration with Kevin Costello and Edward Witten, among others) in understanding integrable models from the perspective of the "four-dimensional Chern-Simons theory." This is a precise analog to Witten's explanation of knot invariants from the three-dimensional Chern-Simons theory, but is based mostly on perturbative methods of quantum field theory, which can be formulated mathematically. If time allows, I will also discuss more recent developments concerning affine Yangians (and quantum toroidal algebras) and five-dimensional version of the Chern-Simons theory. The developments covered in this lecture give rise to many new mathematical structures, many of which are yet to be fully studied in mathematics.

Conference Room VI

Hideto Asashiba (Shizuoka Univ.*/Kyoto Univ./Osaka Metro. Univ.) Applications of quiver representations to persistence modules: approximations and resolutions by interval modules · (13:00–14:00)

Summary: In topological data analysis, an input datum is given as a point cloud P, which is a set of points in $\mathbb{R}^d$ for some positive integer d. Then for each r with $0\le r\le d$ an r-th persistent homology $H^r(P)$ of P over a field $\Bbbk$ is calculated, which is a representation of an equi-oriented type A_n quiver Q for some positive integer n over the field $\Bbbk$. By Gabriel's theorem, the "interval" representations V_I $(I:=[a,b], 1\le a\le b\le n)$ of Q form a complete list of indecomposable representations of Q. For each representation M of Q, let $d_M(I)$ be the multiplicity of V_I in the indecomposable decomposition of M. Then $d_M:=(d_M(I))_I$ is a complete invariant up to isomorphisms of M by the Krull–Schmidt Theorem. The family $(H^r(P))_{0\le r\le d}$ contains information on P valuable in applications, which is analyzed by the the persistence diagrams $d_{H^r(P)}$ of $H^r(P)$ $(0\le r\le d)$. When P varies with another parameter, say, time, it yields a 2D persistence module. In general, persistence modules M are understood as modules over the path algebra (or category) A of an acyclic quiver Q with full commutativity relations. (Thus A is regarded as the incidence algebra of a poset.) We deal only with the case where Q is a finite quiver. Unlike the 1-parameter case, there are an infinite number of indecomposables in the general case, which makes it difficult to use d_M in real time. The interval representation above is generalized as an interval module V_I consisting of $\Bbbk$ and the identity of $\Bbbk$ as a representation of Q whose support I forms a connected and convex subquiver of Q. Instead of using d_M, we use approximations of M by (direct sums of) interval modules in two senses.

Foundation of Mathematics and History of Mathematics

March 15th (Wed) Conference Room IX

9:30–10:15

1 Kohtaro Tadaki (Chubu Univ.) An effectivization of the law of large numbers for algorithmically random sequences and its absolute speed limit of convergence ····· 15

Summary: In this talk, we show that the law of large numbers can be effectivized for an arbitrary Schnorr random infinite sequence, with respect to an arbitrary computable Bernoulli measure. Actually, we show that an absolute speed limit of convergence in this effectivization exists and it equals 2 in a certain sense.

2 Yudai Suzuki (Tohoku Univ.) On the Weihrauch degrees between $\mathsf{C}_{\omega^\omega}$ and ATR ····· 15
Keita Yokoyama (Tohoku Univ.)

Summary: A binary relation over the Cantor space 2^ω is called a Weihrauch problem. In this talk, we introduce ω-model reflection for Weihrauch problems and show that the ω-model reflection of ATR_2 gives an upper bound for problems provable from $\mathbf{ATR}_0$ in the context of reverse mathematics. We also consider the complexity of the existence of fixed point for monotone operators (FP) and its variations (LFP) from the viewpoint of Weihrauch degrees. We will show that LFPs form a linear hierarchy between the ω-model reflection of ATR_2 and $\mathsf{C}_{\omega^\omega}$.

10:30–11:30 Talk Invited by Section on Foundation and History of Mathematics

Makoto Fujiwara (Tokyo Univ. of Sci.) Hierarchy of semi-classical arithmetic and conservative extension theorems

Summary: It is well-known that classical arithmetic PA is Π_2-conservative over intuitionistic arithmetic HA. Using a generalized negative translation, we relativize this result with respect to theories of semi-classical arithmetic, which lie in-between PA and HA. In particular, it follows from our main result that PA is Π_{k+2}-conservative over HA + Σ_k-LEM where Σ_k-LEM is the low-of-excluded-middle scheme for formulas of Σ_k form. In addition, we show that this conservation theorem is optimal in the sense that for any semi-classical arithmetic T, if PA is Π_{k+2}-conservative over T, then T proves Σ_k-LEM. In the same manner, we also characterize conservation theorems for other well-studied classes of formulas by fragments of classical axioms or rules. This reveals the entire structure of conservation theorems with respect to the arithmetical hierarchy of classical principles. This is a joint work with Taishi Kurahashi.

14:15–14:30 Mathematics History Team Meeting

14:30–16:45

3 Makoto Tamura (Osaka Sangyo Univ.) On the equations of "Continuation of Ancient Mathematics" ····· 15
Toshio Harikae (Osaka Sangyo Univ.)

Summary: "Continuation of Ancient Mathematics" was written by early Tang dynasty calendarist and mathematician Wang Xiaotong some time after the year 626, and is known as the oldest extant book solving cubic equations. In this talk, we list up its equations and mention the features of them.

4 Toshio Harikae (Osaka Sangyo Univ.) On restration of lost chinese text in Continuation of Ancient Mathe-
Makoto Tamura (Osaka Sangyo Univ.) matics ····· 15

Summary: "Continuation of Ancient Mathematics" was written by early Tang dynasty calendarist and mathematician Wang Xiaotong some time after the year 626, and was listed as one of the Ten Computational Canons compiled during Tang dynasty. The aim of this talk is to provide a restration of lost chinese text in "Continuation of Ancient Mathematics."

Summary: In this presentation, we first present a workflow for extracting graphic regions in a WASAN book, which is necessary for creating a WASAN database, using the Hough transform, and evaluate the accuracy of the extraction. In the latter half of the presentation, we will show how the character "now," which is the starting point of the graphic problem, is extracted using artificial intelligence and used to determine the graphic region for the rectangular combined region, which is a candidate for the graphic region.

Summary: I present some arguments and summarize the current state of affairs regarding the originality of the mathematical thought of Oka Tadayuki (1791-?), that is, whether his mathematical methods and ideas were unique to him or not. In particular, I suggest that his use of the term "pole" is one clue, even though no new historical documents have been discovered at present.

Summary: We will talk about some episodes concerning to the discovery of Seki Takakazu's carrer in the Kofu clan.

Summary: We will give some theoretical meaning on the calculation of the number Pi by Seki Takakazu and Takebe Katahiro. Seki found the so-called Aitken's delta-sequenced process in his theory, but there were some errors in his calculation and he only claimed that his approximate number of Pi was a little bit less than 3.14159265359. Takebe Katahiro followed Seki's method and discovered another method of calculation of Pi.

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.

Summary: Regarding the random motion, including Brownian motion, Kiyoshi Ito et al. constructed a probabilistic representation, based on P. Levy's point of view. D. Mumford wrote "The Dawning of the Age of Stochasticity", the basic object of study in probability is the random variable and he argues that it should be treated as a basic construct, like spaces, groups and functions, and it is artificial and unnatural to define it in terms of measure theory. This time, based on D. Mumford's article, we discuss stochasticity based on its historical background.

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

Tatsuhiko Kobayashi (Maebashi Inst. of Tech.*/Yokkaichi Univ.) Finishing the editing of the new Seki Takakazu's Collected Works

Summary: Seki Takakazu's life and his mathematical achievements were published in the Takakazu Seki's Collected Works (Osaka Kyouiku Tosho, 1974), edited by Akira Hirayama and others. In the compilation of historical sources, it is natural to check the content of the descriptions in the documents, but issues relating to their history and the authenticity of the sources must also be carefully considered. The collected works by Akira Hirayama and others was carefully compiled based on detailed research. However, a detailed examination of the documents included in this collected works reveals that the compilation was not based on sufficient historical criticism. In June 2023, a new edition of the Seki Takakazu's Collected Works, edited by Kenji Ueno, Tsukane Ogawa, Tatsuhiko Kobayashi and Kenichi Sato will be published by Iwanami Shoten, publishers. The new collected works consists of three volumes with approximately 4000 pages. Volume 1 introduces Seki's life and his mathematical achievements based on new historical documents discovered. Volume 2 is a collection of transliteration from books and manuscripts which written in classical Chinese relating to Seki's mathematical achievements. In preparing these, the editors conducted a comprehensive survey of relevant sources scattered throughout Japan, and then collated the different editions. Volume 3 is a collection of historical documents related to Seki's research on calendrical calculations and his life. In addition, the book contains the writings of his disciples, various records and statements by contemporary mathematicians. Many aspects of Seki Takakazu's life and his biography remain unclear. For this reason, genealogical records relating to the Seki family and him have been included. In this lecture we will introduce the editorial policy of the new Seki Takakazu's Collected Works, how the authenticity of Seki's writings was judged etc.

March 16th (Thu) Conference Room IX

9:15–12:15

Summary: We consider monotonicity of ultrafilter numbers of infinite cardinals. We show that if there are cardinals $\lambda < \kappa$ with $\mathfrak{u}(\kappa) < \mathfrak{u}(\lambda)$, then there is an inner model of a large cardinal. Hence the failure of monotinicity of ultrafilter numbers has large cardinal strength.

Summary: An ifinite L-structure M is said to be indivisible if for any patition $M = X_0 \sqcup X_1$ there is $i < 2$ such that X_i contains an isomorphic copy of M. Many important structures, such as infinite sets, random garphs, countable dense linear order, in model theory has this property. Recently, many structures with metrics are studied by model theorists using continuous model theory. So it seems that investigating the indivisibility of metric structures are interseting from the point of view of continuous logic. In this talk we discuss about the indivisibility of Urysohn universal spaces, which was proven by Sauer.

Summary: We discuss the structure of Hrushovski's pseudoplanes. In the definition of the Hrushovski's pseudoplanes associated to an irrational number α, good approximations k_n/d_n of α from the above are introduced. For each n, a tree B_n with k_n nodes, d_n edges and $d_n + 1$ vertices is introduced. B_n is a biminimal zero extension of the set of its leaves. Let B_∞ be the union of all B_n. Let M be the Hrushovski's pseudoplane associated to α. Let $D_n < M$ be a copy of B_n in M. Let a be a node of D_n and F_n the set of leaves of D_n. The closure of the orbit of a over F_n will be whole M. Let $D_\infty < M$ be a copy of B_∞ and let be the set of leaves of D_∞. Let a be a node of D_∞. We discuss the non-superstability of M by considering the type of a over some finite subset F of F_∞ and also discuss on the orbit of a over F_∞.

Summary: Ramsey's theorem is very easy to prove. However, its relation to the notion of coheir sequences, which is quite important in model theory, has not been discussed much. Here we present a result that illustrates the relationship between the two.

Summary: The μ-calculus is an extension of modal logic by least and greatest fixed-point operators. Its alternation hierarchy characterizes formulas by the entanglement of their fixed point operators. While the alternation hierarchy is usually strict, in many settings it may collapse. We study the consequences of the strictness or the collapse in epistemic logic. We show that different axioms for knowledge imply in different numbers of possible degrees of ignorance. We also show that if we consider two or more agents simultaneously, the alternation hierarchy is strict.

Summary: We investigate the Friedman–Goldfarb–Harrington theorem. In the frameworks of classical and modal propositional logics, we study the forms of sentences whose existence is guaranteed by the FGH theorem.

Summary: We investigate modal logical aspects of provability predicates $\mathrm{Pr}_T(x)$ satisfying the following condition:
M: If $T \vdash \varphi \to \psi$, then $T \vdash \mathrm{Pr}_T(\ulcorner\varphi\urcorner) \to \mathrm{Pr}_T(\ulcorner\psi\urcorner)$.
We proved the arithmetical completeness theorems for monotonic modal logics MN, MN4, MNP, MNP4, and MND with respect to provability predicates satisfying the condition **M**.

Summary: Sacchetti showed the modal logics $\mathbf{wGL}_n$ (Here $\mathbf{wGL}_n$ is obtained from the provability logic **GL** by replacing the axiom $\Box(\Box A \to A) \to \Box A$ by an weaker one $\Box(\Box^n A \to A) \to \Box A$.) have the fixed-point property. Moreover, these logics also have desirable properties (for instance, the Lyndon interpolation property, arithmetical completeness, effective constructibility of fixed-points, etc.). We investigate them in the point of view of proof theory. We introduce sequent calculi for $\mathbf{wGL}_n$ and give a purely syntactical proof of the cut-elimination property for these calculi.

Summary: The logic $\mathbf{IL}^-(\mathbf{P})$ is obtained by adding the persistence principle $\mathbf{P} : A \rhd B \to \Box(A \rhd B)$ to the sublogic $\mathbf{IL}^-$ of the basic interpretability logic **IL**. We investigate $\mathbf{IL}^-(\mathbf{P})$ from several perspectives. Firstly, we show that $\mathbf{IL}^-(\mathbf{P})$ has a weak version of fixed-point property. Secondly, we show that $\mathbf{IL}^-(\mathbf{P})$ is a natural basis for some relational semantics. Thirdly, we introduce a system of sequent calculus for $\mathbf{IL}^-(\mathbf{P})$, and prove the cut-elimination theorem for it. Finally, we show that $\mathbf{IL}^-(\mathbf{P})$ is sound and complete with respect to a suitable arithmetical semantics.

12:15–12:30 Research Section Assembly

Algebra

March 15th (Wed) Conference Room I

9:00–12:00

1 Daisuke Tambara ♭ A linear figure in the Cartesian plane satisfying a condition of rectangle ····· 10

Summary: We say a subset X of the Cartesian plane $\mathbf{R}^2$ satisfies the rectangle condition if for any points (x_1, y_1), (x_1, y_2), (x_2, y_1) of X the point (x_2, y_2) also belongs to X. We are interested in what restrictions on the shape of X the condition imposes. We consider the case where X is a linear figure in the sense that X is a finite union of segments and points. Our result is about the shape of a connected component of X satisfying the rectangle condition.

2 Toshiyuki Abe (Ehime Univ.) Harada's conjecture II and Gramian determinants ····· 10

Summary: We consider Harada's conjeture II for finite groups G. The conjecture states that the number $h(G)$ defined as a ratio of the product of all sizes of conjugacy classes and thay of all irreducible degrees of G is an ineteger. We see that the square $h(G)^2$ is given as a quotient of Gramian determinat for suitable basis of the center of the group algebra $\mathbb{C}G$ by a product of all sizes of centeralizers of representatives of conjugacy classes. We generalize $h(G)^2$ to numbers $\mu_\phi(G)$ associated to a pair of (Z, ϕ) of central subgroup Z and its irreducible character ϕ, and give a factrozation theorem of $h(G)^2$ to of these numbers $\mu_\phi(G)$ for fixed Z. We will show some examples.

3 Kenichiro Tanabe (Tokyo City Univ.) Fusion rules for the fixed point subalgebra of the vertex algebra associated with a non-degenerate and non-positive definite even lattice by an automorphism of order 2 ····· 15

Summary: Let V_L be the vertex algebra associated with a non-degenerate and non-positive definite even lattice L and V_L^+ the fixed point subalgebra of V_L under the action of the automorphism induced from the -1-isometry of L. We determine the fusion rules for weak V_L^+-modules.

4 Takeshi Suzuki (Okayama Univ.) On hook formulas for cylindric skew diagrams ····· 15
Yoshitaka Toyosawa

Summary: We present a conjectual hook formula concerning the number of the standard tableaux on "cylindric" skew diagrams. Our formula can be seen as an extension of Naruse's hook formula for skew diagrams. Moreover, we prove our conjecture in several cases.

5 Yutaka Yoshii (Ibaraki Univ.) Some results on certain subalgebras of the hyperalgebra of a simple algebraic group ····· 10

Summary: Let G be a simply connected simple algebraic group defined over a field $\mathbb{F}_p$ of p elements, where p is a prime number. Then G is associated an $\mathbb{F}_p$-algebra $\mathcal{U}$ which is called a hyperalgebra. We give some results on certain $\mathbb{F}_p$-subalgebras of $\mathcal{U}$.

6 Yuichiro Goto (Osaka Univ.) A remark on the number of quasi-hereditary structures ····· 15

Summary: Dlab and Ringel showed that algebras being quasi-hereditary in all total orders for indices of primitive idempotents becomes hereditary. So, we are interested in for which orders a given quasi-hereditary algebra is again quasi-hereditary. We say that two total orders are equivalent if they induce the same set of standard modules. As a matter of fact, if an equivalence class of orders make an algebra be quasi-hereditary, then we call this class a quasi-hereditary structure. Flores, Kimura and Rognerud gave the counting method of the number of quasi-hereditary structures on path algebras of Dynkin quivers. In this talk, I give a similar result for path algebras of the quivers Q. Here Q is a quiver whose underlying graph is gotten by adding a single vertex to type A_n and a single edge between the new vertex and a vertex originally in A_n.

Summary: In this talk, we report on the τ-tilting finiteness of finite dimensional symmetric algebras of polynomial growth over an algebraically closed field. It is known that τ-tilting finiteness is preserved under Morita equivalence, but usually not preserved under derived equivalence. However, we have not found any examples of symmetric algebras which do not preserve τ-tilting finiteness under derived equivalence. In this talk, any symmetric algebras of polynomial growth preserve τ-tilting finiteness under derived equivalence.

Summary: Let A be a finite-dimensional algebra over a field K. For any complex X in the homotopy category $\mathsf{K}^{\mathrm{b}}(\mathsf{proj}A)$ of the complexes over the category of finitely generated projective modules, we can naturally define the rigid part of X as the maximum presilting direct summand of X. In our study, we found that the rigid part of each element θ in the real Grothendieck group $K_0(\mathsf{proj}A)_{\mathbb{R}}$, which can be identified with an Euclidean space, is also well-defined. In this talk, I will talk about some key properties to prove our result.

Summary: Let R be a ring and J(R) its Jacobson radical. We prove the following lemma. Generalized Nakayama–Azumaya's Lemma "Let M be a direct summand of a direct sum of finitely generated right R-modules. If M satisfies MJ(R) = M, then M = 0."
This unifies the following known results; "Let M be a finitely generated module or a projective module. If MJ(R)=M, then M=0."
As an aplication of this lemma, we show existence of a maximal submodule for some kind of modules.

Summary: Tilting theory plays a central role in representation theory of algebras. Making mutation operations possible, the notion of tilting objects was extended to silting objects. While they are usually assumed to be compact objects in triangulated categories, the definitions have been naturally extended to possibly non-compact objects. In this talk, we give a concrete way to construct (possibly non-compact) silting objects and cosilting objects in the unbounded derived category of a commutative noetherian ring R by using strictly increasing functions from $\operatorname{Spec} R$ to the integers. Then we discuss when they are tilting objects and cotilting objects. Finally, we relate our construction of (co)tilting objects with a question when R is a homomorphic image of a Cohen–Macaulay ring.

Summary: Equivariant Ehrhart theory discusses lattice polytopes admitting a finite group action ρ. Note that the case where ρ is trivial corresponds to the usual Ehrhart theory. Since every lattice polytope admits a trivial group action, we can recover the usual Ehrhart theory. In the equivariant Ehrhart theory, the effectiveness conjecture is one of the central problems. This predicts the following: for any lattice polytope P, if the H^*-series of P, which is a formal power series appearing in the equivariant Ehrhart series, becomes just a polynomial, then the H^*-series becomes effective, i.e., the coefficients really become some representations. In this talk, we give a kind of a counterexample of this conjecture.

14:15–14:50

12 Masamichi Kuroda (Nippon Bunri Univ.)
Kentaro Mitsui (Kobe Univ.)
On the classification of monomial GAPN functions 15

Summary: Perfect nonlinear (PN) functions and almost PN (APN) functions over finite fields of characteristic p have high nonlinearity. When $p = 2$, they have been widely studied due to their applications to cryptography and coding theory. Recently, generalized APN (GAPN) functions were defined as an algebraic generalization of APN functions in characteristic 2 to odd characteristic $p > 2$ and they have been studied. In this talk, we introduce some results of the study for the classification of monomial GAPN functions.

13 So Yamagata (Fukuoka Univ.)
On classification of r-sets and a sufficient condition for non-very genericity of arrangements 15

Summary: Manin and Schechtman introduced a family of arrangements of hyperplanes generalizing classical braid arrangements, which they called the discriminantal arrangements. Athanasiadis proved a conjecture by Bayer and Brandt providing a full description of the combinatorics of discriminantal arrangements in the case of very generic arrangements. Libgober and Settepanella described a sufficient geometric condition for given arrangements to be non very generic in terms of the notion of dependency for a certain arrangement. Settepanella and the author generalized the notion of dependency introducing r-sets and $K_{\mathbb{T}}$-vector sets, and provided a sufficient condition for non very genericity but still not convenient to verify by hand. In this talk we give a classification of the r-sets, and a more explicit and tractable condition for non very genericity.

15:00–16:00 Talk Invited by Algebra Section

Naoki Fujita (Kumamoto Univ.) Schubert calculus and convex polytopes

Summary: A goal of Schubert calculus is to compute the structure constants of the cohomology ring of a flag variety with respect to the basis consisting of Schubert classes. One approach to such computation is to realize Schubert classes as concrete combinatorial objects such as Schubert polynomials. In type A case, monomials in a Schubert polynomial are naturally parametrized by specific faces of a Gelfand–Tsetlin polytope. These faces are called reduced Kogan faces and appear as the limit of a semi-toric degeneration of a Schubert variety. Since the Gelfand–Tsetlin polytope is a Newton–Okounkov body of the flag variety, Newton–Okounkov bodies and induced toric degenerations are expected to give a generalization of theories in Schubert calculus to more general projective varieties. Such generalization has partially developed in the case of flag varieties in different Lie types. In this talk, some fundamental objects in Schubert calculus will be explained from the viewpoints of convex polytopes and of Kashiwara crystal bases. We also discuss their generalization to more general projective varieties.

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

Hiroki Matsui (Tokushima Univ.)♭ Spectra of triangulated categories and reconstruction of schemes from their derived categories

Summary: For a given noetherian scheme X, it is natural to ask whether we can reconstruct X from its perfect derived category $\mathrm{D}^{\mathrm{pf}}(X)$ or not. This reconstruction problem has been well studied so far in algebraic geometry. It is known that we cannot reconstruct X from the triangulated category structure of $\mathrm{D}^{\mathrm{pf}}(X)$. For example, Mukai proved that for an abelian variety A, the perfect derived categories of A and $A^{\vee}$ are equivalent as triangulated categories. On the other hand, Balmer proved that we can reconstruct X from its perfect derived category using its tensor triangulated category structure. For this, Balmer defined the ringed space $\mathrm{Spec}_{\otimes}(\mathcal{T})$ for a given tensor triangulated category $\mathcal{T}$, which is called the *Balmer spectrum* of $\mathcal{T}$. Using Balmer spectra, Balmer developed *tensor triangular geometry* and as an application, he proved that the Balmer spectrum of $\mathrm{D}^{\mathrm{pf}}(X)$ is isomorphic to X as ringed spaces. In this sense, X can be reconstructed from the tensor triangulated category structure of $\mathrm{D}^{\mathrm{pf}}(X)$.
In this talk, I will introduce another ringed space $\mathrm{Spec}_{\triangle}(\mathcal{T})$ for a given triangulated category $\mathcal{T}$ without using tensor structure to develop a "tensor-free" analog of tensor triangular geometry. We call $\mathrm{Spec}_{\triangle}(\mathcal{T})$ the *spectrum* of $\mathcal{T}$. Using the spectra of derived categories, we will prove several reconstruction results. Among them, we will give an alternative and algebraic proof of Bondal-Orlov-Ballard reconstruction theorem.

March 16th (Thu) Conference Room I

9:10–12:00

14 Yuya Otake (Nagoya Univ.) Stable categories of n-spherical modules and n-torisonfree modules ··· 10

Summary: Auslander and Bridger introduced the notions of n-spherical modules and n-torsionfree modules. In this talk, we study the stable category of n-spherical modules. Moreover, we introduce the notion of n-G-spherical modules as a G-analogue and give similar results for the stable category of n-G-spherical modules. As an application, we prove that if R is a Gorenstein local ring of Krull dimension $d > 0$, then there exists a stable equivalence between the category of $(d-1)$-torsionfree R-modules and the category of d-spherical modules relative to the local cohomology functor.

15 Ryo Ishizuka (Tokyo Tech) An explicit construction of perfectoid almost Cohen–Macaulay algebra in mixed characteristic
Kazuma Shimomoto (Nihon Univ.) ····· 15

Summary: The existence and properties of non-Noetherian algebras over a given Noetherian ring play important roles in commutative algebra. Properties of such algebras are, for example, perfectoid and almost Cohen–Macaulay. In positive characteristic, the perfect closure has these properties. In this talk, we construct an analog of the perfect closure in mixed characteristic and show that it has the same properties.

16 Shinnosuke Ishiro (Nihon Univ.) The canonical module of a local log-regular ring ····· 15

Summary: Local log-regular rings are a certain class of Cohen–Macaulay rings that are treated in logarithmic geometry. This class has similar properties to those toric rings. From this perspective, I determined the form of the canonical module of a local-log regular ring. As an application, we gave the Gorenstein criterion of this class of rings. In this talk, we introduce these results.

17 Koji Matsushita (Osaka Univ.) Conic divisorial ideals of toric rings and applications to stable set rings
····· 15

Summary: Conic divisorial ideals of toric rings play important roles in the theory of non-commutative algebraic geometry as well as commutative algebra. In this talk, we introduce an idea to determine a region representing conic classes in the divisor class group of a toric ring and a description of the conic divisorial ideals of stable set rings of perfect graphs.

18 Yuki Ishihara (Tokyo Univ. of Sci.) Computation of ideal operations with parameters · · · · · 15

Summary: Ideal is one of the fundamental concepts in Commutative Algebra and Algebraic Geometry. For one or more ideals, we consider ideal operations that generate new ideals from them, e.g., the ideal intersection $I \cap J$, the ideal quotient $I : J$, the saturation $I : J^\infty$, the radical $\sqrt{I}$, etc., where I and J are ideals in the polynomial ring $\mathbb{C}[x_1, \ldots, x_n]$. In this talk, we consider several algorithms to compute ideal operations with parameters by using Comprehensive Gröbner Systems. In addition, we present an algorithm for "feasible" parameterized primary decomposition by utilizing those operations.

19 Kyohei Hattori (Niigata Univ.)
Hideo Kojima (Niigata Univ.) Rings of nilpotent elements of monomial derivations on polynomial rings · · · · · 15

Summary: In this talk, we give a classification of $\operatorname{Nil} D$ of monomial derivations D on the polynomial ring $R[x, y]$ over a UFD R containing $\mathbb{Q}$. Furthermore, as its application, we show that the minimal number of generators of kernels of derivations on the polynomial ring $R[x, y, z]$ as a R-algebra is unbound.

20 Kaito Kimura (Nagoya Univ.) Asymptotic depths of localizations of modules · · · · · 10

Summary: Let R be a commutative Noetherian ring, I an ideal of R, and M a finitely generated R-module. The asymptotic behavior of the quotient modules M/I^nM of M is an actively studied subject in commutative algebra. In this talk, we consider the existence of an integer k such that for all integers $n \geq k$ and all prime ideals $\mathfrak{p}$ of R, the depth of $(M/I^nM)_\mathfrak{p}$ is equal to the depth of $(M/I^kM)_\mathfrak{p}$.

21 Naoki Endo (Meiji Univ.) On the stratification of one-dimensional Cohen–Macaulay rings · · · · · 15

Summary: The aim of this talk is to discover a good candidate for natural generalizations both of almost Gorenstein and 2-almost Gorenstein rings from the point of view of Sally modules of canonical ideals. Even though our results are at this moment restricted within the case of dimension one, we expect that a higher dimensional notion might be possible after suitable modifications.

22 Tomohiro Okuma (Yamagata Univ.)
Ken-ichi Yoshida (Nihon Univ.)
Kei-ichi Watanabe
(Nihon Univ./Meiji Univ.) The core of ideals in minimally elliptic singularities · · · · · 15

Summary: A two-dimensional normal local domain is called a minimally elliptic singularity if it is Gorenstein and its geometric genus is one. For an m-primary integrally closed ideal I in a minimally elliptic singularity (A, m), we represent its core using a cycle on a resolution of the singularity.

23 Ken-ichi Yoshida (Nihon Univ.)
Tomohiro Okuma (Yamagata Univ.)
Kei-ichi Watanabe
(Nihon Univ./Meiji Univ.) Gorensteinness for normal tangent cones of the maximal ideals in Brieskorn hypersurfaces · · · · · 15

Summary: Let (A, m) be a two-dimensional excellent normal local domain containing an algebraically closed field. The graded ring defined by all integal closures of powers of an ideal I of A is called the normal tangent cone of I. We classify all Brieskorn hypersurfaces for which the normal tangent cone of the maximal ideal m is to be Gorenstein.

13:00–14:10

24 Yoshimune Koreeda (Hiroshima Univ.) Jet scheme of a singular surface of type D_4^1 in characteristic 2 · · · · · 13

Summary: Let k be an algebraically closed field, X a variety over k and m a nonnegative integer. There is a space X_m over X, called the jet scheme of X of order m, parameterizing m-th jets on X. The fiber over the singular locus of X is called the singular fiber. In this talk, we assume k is of characteristic 2 and X is a singular surface of type D_4^1. For $m \gg 0$, we give the irreducible decomposition of the singular fiber of X and determine the maximal elements among the intersections of two different irreducible components.

Summary: In this talk, we show upper bounds for the order of automorphism groups of primitive cyclic covering fibrations of an elliptic surface. The upper bound is an explicit function in the genus of the base curve, the covering degree and the square of relative canonical divisor.

Summary: It is well-known that a smooth plane quartic has twenty-eight bitangents. We consider weak-bitangents which are generalizations on bitangents for a reduced quartic. We study weak-bitangents from the viewpoint of rational elliptic surfaces attached to reduced quartics. In particular, we consider an analogy of syzygetic triads. As a result, we can give new proofs for some classical results on certain singular plane quartics and their bitangents.

Summary: Schoutens constructed big Cohen–Macaulay (BCM) algebras in equal characteristic zero using ultraproducts. In this talk, we show that BCM test ideals with respect to Schoutens' BCM algebras coincide with multiplier ideals, which define the non-klt loci of normal varieties. As an application, we study singularities of pure subrings.

March 17th (Fri) Conference Room I

9:00–12:00

Summary: The so-called AGT correspondence between 4d gauge theories and 2d conformal field theories was under discussion. However, despite much effort by mathematicians (and some physicists), the scope of results is limited, although it is sophisticated. In this report, I will deliver a trial to synthesize the mathematical literature of Beilinson and Drinfeld and some of the more "natural" physics for formulae of "anomalies." Several conventional definitions of "dimensions" will be briefly reviewed. Then I will seek a correct notion of dimensions for chiral fields in the context of S-duality and the geometrical dimension. Some more efforts will be on the (non-)quasi-coherent sheaves for chiral algebra theories and $\mathcal{D}$-modules.

Summary: Based on S. Mori's proof for an three-dimesnional extremal neighborhood $(X, C) \subset \mathbb{C}^4$ of type A in the existence of three-dimensional flips, for an extended extremal nbd (X, C_s) with C_s not necessary irreducible nor reduced ([I2019Mar]), the author found three-dimesional Miyaoka–Yau type inequality $(MY)_{3,c_3}$ with the associated c_3 ([I2018Mar, I2019Sep]), $(MY)_{3,c_3}$ with the differential operators ([I2020Sep]) and related ones, moreover introduced an interemdiate Jacobians $\widetilde{IJ}(X, C_s)$ ([I2022Mar]) and found its strong approximation for its $\mathbb{Z}$-structure ([I2022Sep]). In this talk, as sequel to [I2022Sep], the author will report: a) to show precise form of strong approximation for $\widetilde{IJ}(X, C_s)$ via the differential operators, b) to give slightly extended diagonal decomposition ([Bloch–Srinivas 1983]) to introduce real/Majorana spinor by a), and c) to construct $\mathbb{Z}$-structure by gluing this underlying real structure via b) regarding to integral Hodge conjeture, in order to discuss alternative to [Artin–Mumford 1972].

Summary: In characteristic 0, the Campana–Peternell conjecture claims that the only smooth Fano variety with nef tangent bundle should be homogeneous. In this talk, we present the positive characteristic version of the Campana–Peternell conjecture. In particular, we give a result for Fano 4-folds with nef tangent bundle and Picard number greater than one.

Summary: This is joint work with Lucas Braune. We obtain a lower bound of the degree of irrationality of very general complete intersections over the complex field from the recent results of Braune and Chen–Stapleton. For combining these results, we make a minor adjustment of Chen–Stapleton's method using the trace map of differential modules.

Summary: We construct some examples of noncommutative projective Calabi–Yau schemes by using noncommutative Segre products and quantum weighted hypersurfaces. We also compare them with commutative Calabi–Yau varieties and examples by Kanazawa.

Summary: We give a stably birational classification for algebraic k-tori of dimensions 3 and 4 over a field k.

Summary: We give a stably birational classification for algebraic k-tori of dimensions 3 and 4 over a field k.

Summary: Let D be a tropical divisor in the intersection of two tropical plane curves. We study when it can be realized as the tropicalization of the intersection of two algebraic curves. When a graph theoretic condition determined by these tropical curves is satisfied, we can algorithmically find algebraic curves such that the tropicalization of their intersection is D.

Summary: Let $W(A)$ be a Witt group over A and let $W^n(A)$ be the product of n of $W(A)$. T. Sekiguchi and N. Suwa have constructed a certain endomorphism U_n of $W^n(A)$ related to the deformation group scheme from the additive group scheme to the multiplicative group scheme. We study the equality of kernels of certain homomorphisms related to U_n.

Summary: Genus 1 fibrations play a central role in the classification of surfaces. Let $f : X \to C$ be a genus 1 fibration from a surface to a curve. Then there is a Jacobian genus 1 fibration $j : J \to C$ that satisfies some good properties. In this talk, we prove that the motive of X is isomorphic to the motive of J. As an application, we prove motivic finite-dimensionality for surfaces not of general type with geometric genus 0. This can be regarded as a generalization of Bloch–Kas–Lieberman's result to arbitrary characteristic.

Summary: Let $P_{4,4}$ be the convex cone of quartic homogeneous polynomials of four variables which is positive semidefinite. We present a family of symmetric elements of $P_{4,4}$. Let f be a such polynomial. Then zero locus of f in the complex 3-dimensional projective space is a K3 surface which has 10 real A_1 type rational double points.

39 Emiko Yorisaki (Tokyo Metro. Univ.)
Shinzo Bannai (Okayama Univ. of Sci.)
Hiro-o Tokunaga (Tokyo Metro. Univ.)
Ramified and Split models of rational elliptic surfaces and bitangent lines for a quartic curve 10

Summary: We introduce the notion of ramified and split models of elliptic surfaces. We consider how these two models are related. In particular, we apply our consideration to rational elliptic surfaces which arise as smooth models of double covers of the projective plane branched along quartics. As a result, we determine the number of concurrent bitangent lines for irreducible quartics with at most nodes.

14:15–14:30 Presentation Ceremony for the 2023 MSJ Algebra Prize

14:40–15:40 Award Lecture for the 2023 MSJ Algebra Prize

Yoshinori Gongyo (Univ. of Tokyo) On higher dimensional minimal model theory and its applications

Summary: I will report what I am going on projects related to the minimal model program. First, I will discuss some new invariants for studies of Fano varieties. We call it the "total index", which is natural invariant mixing Shokurov's complexities and the usual Fano index. In this study, the Birkar generalized pair naturally appears. Using this invariant, I propose some conjecture for the characterization of the product of projective spaces, which is some variant of Mukai's type conjecture. The methods are to use the local–global method from singularities rather than studies of rational curves. To study this conjecture, the non-vanishing conjecture and characterization of toric varieties are involved. Second, I will explain what I consider recently on the mainstream of the minimal model theory.

16:00–17:00 Award Lecture for the 2023 MSJ Algebra Prize

Satoshi Wakatsuki (Kanazawa Univ.) Trace formulas and their applications

Summary: The trace formula is one of the main tools in the study of automorphic forms, and its theory has been greatly developed by many researchers (Selberg, Arthur, etc.). The trace formula plays an important role even today, such as the classification of automorphic representations by stable trace formulas and the study of automorphic periods by relative trace formulas. In this talk, I will give an overview of trace formulas and their applications. After that, I will introduce my recent research on asymptotic behaviors for dimensions of spaces of automorphic forms.

March 18th (Sat) Conference Room I

9:15–12:00

40 Shigeru Iitaka (Gakushuin Univ.*) Super perfect numbers of the second kind 13

Summary: Let m denote translation parameter, and let h denote an odd prime.
Defining A to be $\sigma(a)+m$ if $h\sigma(A)=2a(h+1)-h^2+mh$ then a is said to be super perfect numbers of the second kind. A is called a partner of a.

41 Masato Kobayashi (Kanagawa Univ.) Balance for the divisor sum function 13

Summary: Let us say finite $A \subseteq \mathbb{N}$ is balanced if

$$\sum_{n\in A}\sum_{d|n,d\ \mathrm{odd}} d = \sum_{n\in A}\sum_{d|n,d,\ \mathrm{even}} d.$$

For example, $\{1,2\},\{1,3,4\},\{3,6,8,9\}$ are balanced. For each natural number N, does there exist a balanced set A of the cardinality N? I solved this problem affirmatively in June 2022 with Ramanujan's theta function and Jacobi's triple product idenitity. In this talk, I wish to show details of this.

Summary: Let p be a prime number and $\alpha \geq 3$ be an integer. In this talk, a generalized Fibonacci sequence $\mathcal{F}_\alpha = (F_n)_{n\in\mathbb{Z}}$ is defined as $F_0 = 0, F_1 = 1, F_{n+2} = \alpha F_{n+1} + F_n$ $(n \in \mathbb{Z})$, and ${}_{\mathcal{F}_\alpha}\sigma(n) = \sum_{d|n, 0<d\in\mathcal{F}_\alpha} d$ is called the divisor function on $\mathcal{F}_\alpha$. Then we obtain that for two prime numbers p and q the fact $p = 2q + 1$ or $2q - 1$ is equivalent to ${}_{\mathcal{F}_\alpha}\sigma({}_{\mathcal{F}_\alpha}\sigma(F_p)) = {}_{\mathcal{F}_\alpha}\sigma(F_q)$ for some α.

Summary: We propose the conjecture that the error term in the prime number theorem under the RH is $o(\sqrt{x})$.

Summary: Katz and Sarnak suggested a relation between zeros of L-functions in a family and eigenvalues of random matrices in a compact matrix group. In this talk, we consider the analogous conjecture weighted by L-values and verify this conjecture in the case of the family of Dirichlet L-functions attached to nontrivial Dirichlet characters of a prime modulus. This is a joint work with Ade Irma Suriajaya (Kyushu University).

Summary: In 2013, Drungilas et al. proposed the universality theorem for the Selberg zeta function associated with the modular group, which is (probably) the first universality theorem for the zeta function of the order of more than one. Recently in 2021, Mishou extended it by proving the joint universality theorem for the tuple of Selberg zeta functions associated with principal congruence subgroups. In this talk, we present the universality theorem (and joint universality theorem) for the Selberg zeta function associated with (not necessarily congruence) subgroup of the modular group. We also note that our universality theorems are available in wider regions than the regions given in the previous works.

Summary: Furusho, Komori, Matsumoto, and Tsumura introduced the desingularized multiple zeta functions to resolve all singularities of multiple zeta functions (MZF for short). It is a natural question to ask how much desingularized MZFs retain the properties of MZFs. As one of the answers, we show that special values of desingularized MZFs at positive integer points satisfy the shuffle product that holds among special values of MZFs at positive integer points.

Summary: Komori, Matsumoto and Tsumura introduced zeta functions $\zeta_r(\boldsymbol{s}, \Delta)$ associated with root systems Δ. In this talk, we introduce q-analogues of functions $\zeta_r(\boldsymbol{s}, \Delta)$, denoted by $\zeta_r(\boldsymbol{s}, \boldsymbol{a}, \Delta; q)$. We establish q-extensions of the following properties satisfied by $\zeta_r(\boldsymbol{s}, \Delta)$: (a) Integral representations of sums of zeta functions which have Weyl group symmetries. (b) Explicit expressions of Witten volume formulas. (c) Functional relations including Witten volume formulas. We also introduce elliptic analogues of $\zeta_r(\boldsymbol{s}, \boldsymbol{a}, \Delta; q)$, denoted by $\zeta_r(\boldsymbol{s}, \boldsymbol{a}, \boldsymbol{\beta}, \Delta; p, q)$, and investigate their basis properties. To extend the properties (a) and (b) to $\zeta_r(\boldsymbol{s}, \boldsymbol{a}, \boldsymbol{\beta}, \Delta; p, q)$, the factorization formulas of Poincaré polynomials, established by Macdonald, plays important roles.

Summary: In this talk, we consider the value-distribution of the Hurwitz zeta-function with algebraic irrational parameter. The main result is that any complex number can be approximated by values of the Hurwitz zeta-function for arbitrary quadratic irrational parameters but with finite exceptions.

Summary: In 1975, Voronin proved the Universality theorem for the Riemann zeta-function and in 2022, Endo generalized this theorem for the iterated integrals for the logarithm of the Riemann zeta-function. In this talk, we give a more generalization of this theorem for the iterated integrals for the logarithm of L-functions in the Selberg class.

Summary: Siegel defined zeta functions associated with indefinite quadratic forms, and proved their analytic properties such as analytic continuations and functional equations. We discuss the modularity of Siegel's zeta functions on the basis of converse theorems.

14:15–16:45

Summary: The 9th variation of Schur polynomial is known to satisfy determinant formulas such as Jacobi–Trudi, Gambelli, and Hamel–Goulden identities. In this talk, we apply the Plücker relations to these identities. These relations are known to give algebraic dependencies among the determinants of the various minors of an arbitrary matrix. Applying them to the $n \times n$ minors of an $n \times 2n$ matrix, we give some quadratic relations between the 9th variation of Schur polynomials.

Summary: We prove some monotonic properties of special values of the bivariate complete homogeneous symmetric polynomials.

Summary: Let k be a field and T be an algebraic k-torus. In 1969, over a global field k, Voskresenskii proved that there exists an exact sequence $0 \to A(T) \to H^1(k, \operatorname{Pic}\overline{X})^\vee \to Sha(T) \to 0$ where $A(T)$ is the kernel of the weak approximation of T, $Sha(T)$ is the Shafarevich–Tate group of T, X is a smooth k-compactification of T, $\operatorname{Pic}\overline{X}$ is the Picard group of $\overline{X} = X \times_k \overline{k}$. On the other hand, in 1963, Ono proved that for the norm one torus $T = R^{(1)}_{K/k}(G_m)$ of K/k, $Sha(T) = 0$ if and only if the Hasse norm principle holds for K/k. We determine $H^1(k, \operatorname{Pic}\overline{X})$ for norm one tori $T = R^{(1)}_{K/k}(G_m)$ when the Galois group $\mathrm{Gal}(L/k)$ of the Galois closure L/k of K/k is isomorphic to the Mathieu group M_{11} of degree 11. We also give a necessary and sufficient condition for the Hasse norm principle for such extensions K/k with $\mathrm{Gal}(L/k) \simeq M_{11}$.

Summary: Paramodular forms are a part of Siegel modular forms. For degree two case, they are important for Shimura–Taniyama conjecture for abelian surfaces and the new form theory of Roberts and Schmidt. Here we give explicit dimension formulas for paramodular forms of any vector valued weight $det^3Sym(j)$ with $k \geq 3$ of prime level p with fixed sign of the Atkin–Lehner involution. It is known that such forms have a good correspondence with certain algebraic modular forms up to endoscopic part and old forms. We calculate dimensions of the corresponding algebraic modular forms and apply it to paramodular case.

Summary: The talk has two aims. One is to give a new special basis of the polynomial ring $\mathbb{C}[T]$ in components of $n \times n$ symmetric matrix T. The basis $P(T)$ is characterized by the action of $P(\partial_Z)$ on $\det(CZ+D)^s$, where ∂_Z is the matrix of partial derivatives of the variable of the Siegel upper half space and $\det(CZ+D)$ is the automorphy factor. Everything is described explicitly. For example, the basis is obtained as coefficients of certain explicitly described generating series. The second aim is to apply this to the so-called pullback formula of the Siegel Eisenstein series of degree $2n$ and determine all appearing constants.

Summary: In this talk, we give a modular linear differential equation of second order for a cocompact group of discriminant 6, and we also give its solutions. Furthermore we prove a relation between supersingular polynomials and certain polynomials derived from solutions of the modular linear differential equation.

Summary: In this talk, we prove the integrality of Hecke eigenvalues of Hilbert modular forms and Siegel modular forms in a general setting. As applications, we estimate the degrees of Hecke fields of cuspidal automorphic representations of $\mathrm{GL}(2d)$ with a prime number d and $\mathrm{Sp}(2n)$.

Summary: While almost mathematics has various applications to arithmetic geometry, Quillen mentioned linear algebra over non-unital rings which is the same as almost mathematics introduced by Faltings; and Gabber and Ramero. Quillen's work is more conceptional in the sense of using categorical language: in his work, almost mathematics is characterized as bilocalization of an abelian category of modules. By using the theory of bilocalization, we define the derived category (or stable ∞-category) of almost perfect complexes, enabling us to obtain the K-theory of almost modules. Furthermore, by modifying K-theory of almost algebra, we prove that the modified K-groups decompose into the almost algebraic K-theory and the almost acyclic part of them. The main result of almost K-theory is that the almost K-theory of A is represented by the modified K-theory of the corresponding the idempotent non-unital algebra.

Summary: Suppose the base field is perfect. Then, for any generalized motivic cohomology theory, I shall discuss its Zariski sheafifcation which turns out to be unramified in Morel's sense and a Nisnevich sheaf in this particular case.
Amongst of all, I shall emphasize the existence of its Gersten type resolution as Zariski sheaves and its SBNR - stably birationalized Nisnevich subsheaf of the unramified sheaf.

Summary: Some necessary condition for a non-singular complex projective manifold X to be a counter-example for the codimension k integral Hodge conjecture $Z^{2k}(X) \neq 0$ is given.
Our necessary condition is stated as codimension c_k irrationality for some c_k, which grows as k increases. This may suggest that counter-examples to the integral Hodge conjecture become ubiquitous as k increases.

Geometry

March 15th (Wed) Conference Room II

9:30–11:40

1 Antoni Kijowski (Okinawa Inst. of Sci. and Tech. Grad. Univ.) Asymptotically mean value harmonic functions ····· 15

Summary: The Blaschke–Privaloff–Zaremba theorem gives rise to a recently investigated concept of the asymptotic mean value harmonic function on a metric measure space X. For a function $u \in L^1_{loc}(X)$ define the r-laplacian of u as:

$$\Delta_r u(x) := \frac{u_{B_r(x)} - u(x)}{r^2},$$

where $u_{B_r(x)}$ stands for the mean-value of u over a ball $B_r(x)$. We say that u is amv-harmonic if its r-laplacian converges to 0 in an appropriate sense as $r \to 0$. In my talk I will present known results focusing on regularity, blow ups and characterization of these functions in the following settings: weighted Euclidean domains, Carnot groups and RCD spaces.

2 Shigeaki Yokota (Tohoku Univ.) Geometry of geometric data set ····· 15

Summary: Gromov originated a geometric theory of metric measure spaces based on the phenomenon of concentration of measure and the theory of the collapsing of Riemannian manifolds; Pestov pointed out the connection of Gromov's theory with the curse of dimensionality in statistics. To improve time complexity, Hanika, Schneider, Stumme proposed to generalize metric measure space to 'geometric data set'. The total set of the metric measure spaces has two natural distance functions, the observable and box distance functions, and their topological properties are well known, but the properties of the total set of the geometric data set are almost unknown. In this talk, we extend these results of metric measure space to the total set of geometric data sets.

3 Daisuke Kazukawa (Kyushu Univ.), Hiroki Nakajima (Tohoku Univ.), Takashi Shioya (Tohoku Univ.) Topological aspects of the space of metric measure spaces ····· 15

Summary: Gromov introduced two distance functions, the box distance and the observable distance, on the space of isomorphism classes of metric measure spaces and developed the convergence theory of metric measure spaces. We investigate several topological properties on the space equipped with these distance functions toward a deep understanding of convergence theory.

4 Daisuke Kazukawa (Kyushu Univ.), Hiroki Nakajima (Tohoku Univ.), Takashi Shioya (Tohoku Univ.) Principal bundle structure of the space of metric measure spaces ····· 10

Summary: We study the topological structure of the space $\mathcal{X}$ of isomorphism classes of metric measure spaces equipped with the box or concentration topologies. We consider the scale-change action of the multiplicative group $\mathbb{R}_+$ of positive real numbers on $\mathcal{X}$, which has a one-point metric measure space, say $*$, as only one fixed point. We prove that the $\mathbb{R}_+$-action on $\mathcal{X} \setminus \{*\}$ admits the structure of nontrivial and locally trivial principal $\mathbb{R}_+$-bundle over the quotient space. A similar statement is obtained for the pyramidal compactification of $\mathcal{X}$, where we completely determine the structure of the fixed-point set of the $\mathbb{R}_+$-action on the compactification.

5 Takumi Matsuka (Tokyo Metro. Univ.) Free products of metric spaces and the coarse Baum–Connes conjecture 15

Summary: We introduce the notion of free products of metric spaces. When X and Y are coarsely convex, the free product $X * Y$ is coarsely convex. In particular, the free product $X * Y$ satisfies the coarse Baum–Connes conjecture. This talk is based on a ongoing joint work with Tomohiro Fukaya (Tokyo Metropolitan University).

6 Yoshito Ishiki (RIKEN) Continua in the Gromov–Hausdorff space 15

Summary: We first prove that for all compact metrizable spaces, there exists a topological embedding of the compact metrizable space into each of the sets of compact metric spaces which are connected, path-connected, geodesic, or CAT(0), in the Gromov–Hausdorff space with finite prescribed values. As its application, we show that the sets prescribed above are path-connected and their non-empty open subsets have infinite topological dimension. By the same method, we also prove that the set of all proper CAT(0) spaces is path-connected and its non-empty open subsets have infinite topological dimension with respect to the pointed Gromov–Hausdorff distance.

7 Yoshito Ishiki (RIKEN) Metric trees in the Gromov–Hausdorff space 15

Summary: Using the wedge sum of metric spaces, for all compact metrizable spaces, we construct a topological embedding of the compact metrizable space into the set of all metric trees in the Gromov–Hausdorff space with finite prescribed values. As its application, we show that the set of all metric trees is path-connected and its all non-empty open subsets have infinite topological dimension.

14:15–16:00

8 Kentaro Yonemura (Kyushu Univ.) Embedding smooth quandles in Lie groups 10

Summary: We deal with embedding smooth quandles in Lie groups in this talk.

9 Yuuki Sasaki (Tokyo Nat. Coll. of Tech.) Some submanifolds of the associative Grassmann manifold 15

Summary: We construct a totally complex immersion from almost complex submanifolds of the 6-dimensional sphere into the associative Grassmann manifold. Also, as an analogy of almost complex immersions we construct a CR immersion from 3-dimensional CR submanifolds of the 6-dimensional sphere into the associative Grassmann manifold. Moreover, in the associative Grassmann manifold we show that many orbits of the action of the isotropy subgroup of the isometry group are the image of some CR immersions.

10 Taro Kimura (Nat. Inst. of Tech., Tsuruoka Coll.)
Katsuya Mashimo (Hosei Univ.) Biharmonic Cartan embeddings 10

Summary: In this talk, we determine all the proper biharmonic submanifolds in compact Lie groups which are the image of Cartan embeddings defined by automorphism of order 4. Moreover we show that if the Cartan embedding defined by automorphism of order 3 is biharmonic, then it is harmonic.

11 Osamu Ikawa (Kyoto Inst. Tech.)
Katsuya Mashimo (Hosei Univ.) The geometry of orbits of σ-action induced by triality automorphism of $Spin(8)$ 15

Summary: The universal covering group $Spin(8)$ of the special orthogonal group $SO(8)$ has an outer automorphism σ of order 3 called the triality automorphism. From this σ, the action of $Spin(8)$ on $Spin(8)$ itself, called the σ-action, is determined. This action is a hyperpolar action of cohomogeneity (= codimension of maximum-dimensional orbit) 2. We report on the orbit space and properties of orbits of this action.

12 Kazumi Tsukada (Ochanomizu Univ.*) The complexification of Lie sphere geometry and totally complex submanifolds of the real Grassmann manifold 15

Summary: The real Grassmann manifold $Gr_4(R^n)$ of all 4-dimensional subspaces in R^n is known to have the quaternionic Kähler structure. We consider the set $H_2(C^n)$ of all 2-dimensional complex subspaces in C^n that are isotropic with respect to the standard complex inner product. $H_2(C^n)$ is a complex manifold of dimension $2n-7$ and has the holomorphic contact structure. The natural projection of $H_2(C^n)$ onto $Gr_4(R^n)$ is a twistor fibration. Through $H_2(C^n)$, we show the relation between the geometry regarded as the complexification of Lie sphere geometry and that of totally complex submanifolds of $Gr_4(R^n)$.

13 Yusuke Sakane (Osaka Univ.*) Existence and non-existence of Einstein metrics on compact homogeneous manifolds 15

Summary: The study of existence and non-existence of Einstein metrics on G/H is started by Wang and Ziller in 1986. More general results for non-existence are obtained by Böhm in 2005. One of his results is that $G/H = SU(n+k_1+\cdots+k_p)/S(SO(n)U(1)\times U(k_1)\times\cdots\times U(k_p))$ (where $SO(n)U(1)\subset U(n)$) does not admit G-invariant Einstein metrics, if $n > (k_1+\cdots+k_p)^2+2$. He has obtained the results by considering "traceless" part of Ricci tensor. For $G/H = SO(2n+k_1+\cdots+k_p)/SO(n)U(1)\times SO(k_1)\times\cdots\times SO(k_p)$ (where $SO(n)U(1)\subset U(n)\subset SO(2n)$), we can not apply his method directly. In this talk, we will show that, if $n \geq 5(k_1+\cdots+k_p)$ $(k_i \geq 3)$, G/H does not admit G-invariant Einstein metrics. We also discuss existence of Einstein metrics for compact homogeneous manifolds G/H above.

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

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

Summary: This talk deals with 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. These metrics have been known to 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, these developments are briefly reviewed. 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 16th (Thu) Conference Room II

9:30–12:00

14 Masaya Kawamura (Kagawa Nat. Coll. of Tech.) On a k-th Gauduchon metric on compact almost Hermitian manifolds 15

Summary: In this talk, we introduce some results about k-th Gauduchon metrics on compact almost Hermitian manifolds. We have shown that if both the conformally k-th Gauduchon condition and the conformally semi-Kähler condition are satisfied, then it becomes conformally quasi-Kähler. Also, we characterize the k-th Gauduchon condition and by applying its characterization, we have shown some geometric conditions for negative Kodaira dimension on compact almost Hermitian manifolds.

Summary: Simpson introduced the notion of uniformizing variation of Hodge structure (VHS) and showed that the universal covering of a compact Kähler manifold is isomorphic to a bounded symmetric domain if and only if there exists a uniformizing VHS on the Kähler manifold. In this talk, on compact Sasakian manifolds, we consider an analogy of this. We can formulate an analogy of the uniformizing VHS also on compact Sasakian manifolds. However, even if there exists a uniformizing VHS on a compact Sasakian manifold, the constructed map collapses all the points on each leaf of the foliation of the universal covering into one point and can never be an isomorphism. I will explain how to properly take the lift of this map and construct an isomorphism from the universal covering to a homogeneous space.

Summary: A Higgs bundle over a compact Kähler manifold X is the pair (E, θ) consisting of a holomorphic vector bundle $E \to X$ and a holomorphic section θ of $\mathrm{End}E \otimes \bigwedge^{1,0}$ satisfying $\theta \wedge \theta = 0$. The holomorphic section θ is called a Higgs field. Usually, Higgs fields are assumed to be holomorphic. However, in this talk, I will consider Higgs bundles with not holomorphic Higgs fields. I will suppose that the holomorphic vector bundle E decomposes into a direct sum of holomorphic line bundles, and I will give some necessary and sufficient conditions for Donaldson's functional to attain a minimum over diagonal metrics concerning the decomposition. I will also slightly extend the theorem for not-holomorphic splittings of the vector bundle.

Summary: In this talk, I will introduce some generalizations of the Hermitian–Einstein equation of cyclic Higgs bundles on Riemann surfaces. For such generalized equations, I will show the existence and the uniqueness of the time-global solution of the parabolic equations and I will also show the existence and the uniqueness of the solution to the Dirichlet problem.

Summary: In computing of B-model in classical mirror symmetry, Picard–Fuchs equation is very important. In the case of Calabi–Yau hypersurface in CP^{N-1}, its solutions are used in a mirror map, and it is known that a generating function of intersection numbers $w(\mathcal{O}_{h^{N-3}}\mathcal{O}_{h^0})_{0,d}$ of moduli space $\widetilde{Mp}_{0,2}(N,d)$ of quasimaps from CP^1 with 2 marked points to CP^{N-1} coincides with the mirror map. In our previous work, we proved that the solutions are written by using a term $d\cdot w(\sigma_j(\mathcal{O}_{h^{N-2-j}})\mathcal{O}_{h^{-1}})_{0,d} + w(\sigma_{j-1}(\mathcal{O}_{h^{N-1-j}})\mathcal{O}_{h^{-1}})_{0,d}$, where σ_j corresponds to the Mumford–Morita–Miller class. In this talk, we see that the above term can be obtained from a recursion relation on moduli space $\widetilde{Mp}_{0,2|1}(N,d)$ of quasimaps from CP^1 with $2+1$ marked points to CP^{N-1}.

Summary: Let $(X, \check{X})$ be a mirror pair of a complex torus X and its mirror partner $\check{X}$. This mirror pair is described as the trivial special Lagrangian torus fibrations $X \to B$ and $\check{X} \to B$ on the same base space B by SYZ construction. Then, we can associate a holomorphic line bundle $E(s, \mathcal{L}) \to X$ to a pair $(s, \mathcal{L})$ of a Lagrangian section s of $\check{X} \to B$ and a unitary local system $\mathcal{L}$ along it. In this talk, we first construct the deformation $X_{\mathcal{G}}$ of X by a certain flat gerbe $\mathcal{G}$ and its mirror partner $\check{X}_{\mathcal{G}}$ from the mirror pair $(X, \check{X})$, and discuss deformations of objects $E(s, \mathcal{L})$ and $(s, \mathcal{L})$ over the deformed mirror pair $(X_{\mathcal{G}}, \check{X}_{\mathcal{G}})$.

Summary: Strominger–Yau–Zaslow (SYZ) proposed a way of constructing mirror pairs as pairs of torus fibrations. We apply this SYZ construction to toric Fano surfaces as complex manifolds, and discuss the homological mirror symmetry, where we consider Morse homotopy of the moment polytope instead of the Fukaya category.

Summary: Let $\{Z_t\}_t$ be a one-parameter family of complex toric hypersurfaces of dimension $d \geq 1$. We compute asymptotics of period integrals for $\{Z_t\}_t$ by applying the method of Abouzaid–Ganatra–Iritani–Sheridan, which uses tropical geometry. As integrands, we consider Poincaré residues of meromorphic $(d+1)$-forms on the ambient toric variety, which have poles along the hypersurface Z_t. The cycles over which we integrate them are spheres and tori which correspond to tropical $(0, d)$-cycles and $(d, 0)$-cycles on the tropicalization of $\{Z_t\}_t$ respectively.

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

Yoshinori Hashimoto (Osaka Metro. Univ.) ♭ Recent developments 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 17th (Fri) Conference Room II

9:30–11:40

Summary: In this paper, we explain the significance of game theory, which frees a system of differential equations from the spell of integrability conditions. Also using it, we present the system of equations of in-phase and anti-phase circadian rhythms from the viewpoint of variational principle. In addition, the general formulization of the mathematical structure of phase transition and synchronization is carried out.

Summary: The truss structure minimizing the product of axial forces and lengths for a given load and a support condition is called Michell truss, which is classically known in the field of structural mechanics. In this presentation, we have an analytical construction of Michell truss-like structure described by a discrete holomorphic function (discrete conformal map) in the context of discrete integrable systems. The validity of the structure is demonstrated by the result of structural analysis. Moreover, we show the truss structure is composed of so-called discrete log-aesthetic curves. This structure connects three objects (discrete holomorphic functions, discrete log-aesthetic curves, and classical truss structures) having completely different origins which were achieved through the collaboration of mathematics and architecture.

24 Yoshihiko Suyama (Fukuoka Univ.)
Nozomu Matsuura (Kurume Inst. of Tech.)
Extension and approximation of curvature surfaces in generic conformally flat hypersurfaces · · · · · 15

Summary: We talk about curvature surfaces of generic conformally flat analytic-hypersurfaces in the Euclidean 4-space.

25 Satoshi Ishiwata (Yamagata Univ.)
Hiroshi Kawabi (Keio Univ.)
A discretization of a non-symmetric diffusion on a Riemannian manifold · · · · · 10

Summary: In this talk, we give a graph discretized approximation of the diffusion for a Schrödinger operator with drift on a complete Riemannian manifold.

26 Ye Zhang (Okinawa Inst. of Sci. and Tech. Grad. Univ.)
Gradient estimates for the heat semigroup on step-two Carnot groups · · · · · 15

Summary: It is well-known that we can characterize the lower bound of the Ricci curvature by the bound for the gradient of the heat semigroup. However, on a nonabelian nilpotent Lie group endowed with a left-invariant Riemannian metric, there exists a direction of strictly negative Ricci curvature. This implies the gradient bound has exponential growth. In this talk, I will present how to improve the gradient bound to the constant in the setting of step-two Carnot groups on which the H.-Q. Li inequality holds.

27 Yuichiro Taketomi (Osaka Metro. Univ.)
A maximal element of a moduli space of Riemannian metrics · · · · · 15

Summary: For a given smooth manifold X, we consider the moduli space of Riemannian metrics on X up to isometry and scaling. One can define a preorder on the moduli space by the size of isometry groups. We call a Riemannian metric that attains a maximal element with respect to the preorder a maximal metric. Maximal metrics give nice examples of self-similar solutions for various metric evolution equations such as the Ricci flow. In this talk, we construct many examples of maximal metrics on Euclidean spaces.

28 Yoshihiko Matsumoto (Osaka Univ.)
Renormalized energy of maps and conformal geodesics · · · · · 15

Summary: We introduce a certain renormalized energy of maps between asymptotically hyperbolic Einstein manifolds. Then, it is used to give a holographic description of conformal geodesics on the boundary at infinity, in a way deeply inspired by a work of Fine and Herfray on renormalized area minimization and conformal geodesics.

14:15–14:55

29 Tomoshige Yukita (Waseda Univ.)
On nerves and growth rates of 2-dimensional Coxeter systems · · · · · 15

Summary: For a Coxeter system (Γ, S), the nerve $L(\Gamma, S)$ is a simplicial complex defined via the structure of finite parabolic subgroups of Γ. The dimension of (Γ, S) is defined by $\dim L(\Gamma, S) + 1$. In this talk, we consider the relationship between the combinatorial structure of $L(\Gamma, S)$ and the arithmetic properties of the growth rate of (Γ, S). We show that the growth rate of a 2-dimensional Coxeter system (Γ, S) with vanishing (resp. positive) Euler characteristic $\chi(L(\Gamma, S))$ is a Salem (resp. Pisot) number. This is a joint work with Naomi Bredon.

30 Akira Ushijima (Univ. of Hyogo)
Ceva's and Menelaus' theorems in the hyperbolic plane as Cayley–Klein geometry · · · · · 10

Summary: Using the construction of the hyperbolic plane as Cayley–Klein geometry, we will demonstrate how to obtain Ceva's and Menelaus' theorems in the hyperbolic plane from their corresponding theorems in the real projective plane.

15:10–16:10 Talk Invited by Geometry Section

Harish Seshadri
(Indian Inst. of Sci., Bangalore)

On the diameter of Kähler manifolds with positive bisectional curvature

Summary: I will discuss the Kähler analogues of the classical Bishop volume inequality and Myers–Bonnet diameter bound for Riemannian manifolds. In particular, I will outline the proof of diameter rigidity (an analogue of Cheng's theorem in the Riemannian case) for compact Kähler n-manifolds (M, ω) with bisectional curvature $BK \geq 1$. It is known from the work of Li–Wang that $\operatorname{diam}(M) \leq \operatorname{diam}(\mathbb{C}P^n)$ for such manifolds, where $\mathbb{C}P^n$ is endowed the Fubini–Study metric. In joint work with V. Datar, we proved that if $\operatorname{diam}(M) = \operatorname{diam}(\mathbb{C}P^n)$, then M is isometric to $\mathbb{C}P^n$.

Complex Analysis

March 15th (Wed) Conference Room V

9:30–11:45

Summary: The theory of reproducing kernels is very fundamental, beautiful and will have many applications in analysis, numerical analysis and data sciences. Based on a draft paper, I would like to give a global viewpoint for the relation of complex analysis and the theory of reproducing kernels. I listed the basic references on the topics.

Summary: Based on a draft book manuscript, I would like to introduce the basic and essential relations of complex analysis and division by zero calculus. Basic references are cited in the references.

Summary: In the nineteenth century, the reductions of hyperelliptic integrals to elliptic integrals were studied actively and many examples of the reductions were obtained. They are closely related to coverings of curves, split Jacobians, and automorphism groups of curves. This knowledge is applied to the isogeny-based cryptography. In our previous work, by using this knowledge, we derived the relationships between the hyperelliptic functions of genus 2 and the elliptic functions when the curve of genus 2 admits a morphism of degree 2 to an elliptic curve. In this talk, we will derive a relationship between the hyperelliptic functions of genus 3 and the elliptic functions when the hyperelliptic curve of genus 3 admits a morphism of degree 2 to an elliptic curve.

Summary: Equivariant functions associated to a 2-dimensional representation of a Fuchsian group was introduced by Saber and Sebbar. They are regarded as a generalization of automorphic functions. We prove the existence of equivariant functions associated to any generic 2-dimensional representation of any Fuchsian group. We prove such existence by using the Schwarzian derivative.

Summary: It is shown that the bifurcation diagram of circle packings on logarithmic spiral lattices with rotational symmetry is graph-theoretically dual to the bifurcation diagram of Voronoi tessellations, by using the relative metric. If the rotation parameter (called divergence angle) is badly approximable, then the aspect ratio of the quadrilateral Voronoi cells is bounded. If the divergence angle is linearly equivalent to the golden section, then the shape of the quadrilateral cells tend to square as the plastochron ratio tends to 1.

6 Shun Kumagai (Tohoku Univ.) Voronoi decomposition of origamis ····· 15

Summary: The Edwards–Sanderson–Schmidt method uses the Voronoi decomposition to present an excellent criterion for the equivalence class and the Veech group of a finite translation surface. The key argument of their method includes a complicated combinatorial structure. An origami is a typical example of a translation surface defined combinatorially. This talk discusses the Voronoi decomposition of a half-translation version of origami.

7 Shinpei Baba (Osaka Univ.) Bending maps of Teichmüller spaces and character varieties ····· 15

Summary: The space holomorphic quadratic differentials on a compact Riemann surface is a complex vector space. By the holonomy map of complex projective structures, this vector space properly embeds into the PSL(2, C)-character variety of the base surface. We construct certain analogues of such an embedding from the viewpoint of Thurston's parametrization of complex projective structures.

8 Yohei Komori (Waseda Univ.) Applications of canonical polygons of Zieschang–Vogt–Coldewey ····· 15

Summary: As applications of canonical polygons of Zieschang–Vogt–Coldewey, we will show that (1) 6g-6 angles between geodesics on Riemann surfaces of genus g globally parametrize Teichmuller space of genus g surfaces. (2) Mapping classes of genus 2 surface can be represented by the cut and paste argument of canonical polygons.

9 Masashi Kisaka (Kyoto Univ.) Polynomial-like mappings and transcendental entire functions with irrationally indifferent fixed points ····· 15

Summary: In this talk, by using the theory of polynomial-like mappings, we construct various kinds of transcendental entire functions with irrationally indifferent fixed points. This talk is based on the joint work with Hiroto Naba.

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

Toshihiro Nakanishi (Shimane Univ.) Teichmüller space of the genus two surface and Kleinian groups

Summary: In this talk the Teichmüller space is a deformation space of marked Fuchsian groups of finite type, in most cases, genus two Fuchsian groups. We deal with (1) trace functions as parameters for a Teichmüller space, (2) matrix representation of the genus two surface group, (3) mapping classes represented by rational transformations. These materials are used to produce some examples of Kleinian groups related to surface groups.

15:30–16:30 Award Lecture for the 2022 MSJ Analysis Prize

Katsuhiko Matsuzaki (Waseda Univ.) Curves and function spaces of absolutely continuous Teichmüller spaces

Summary: The universal Teichmüller space is the total space containing all quasiconformal Teichmüller spaces and it can be regarded as the space of normalized quasisymmetric functions f on the real line. According to the regularity of these functions f, there are two different directions of subspaces included in the universal Teichmüller space: Teichmüller spaces of Riemann surfaces are typically in the direction of totally singular f, and Teichmüller spaces of function spaces are absolutely continuous f.
Teichmüller spaces can be represented by quasisymmetric homeomorphisms mentioned above, and in other ways, they can be represented by the complex dilatations of quasiconformal mappings, the Schwarzian or pre-Schwarzian derivatives of conformal mappings, and the quasicircles given as the images of the circle. Fundamental studies of particular Teichmüller spaces are composed by the investigation of the relationship between these different representations and structures. In addition, if we deal with absolutely continuous Teichmüller spaces, the derivative f' or $\log f'$ defines the corresponding function spaces, and by using them, we can introduce simpler structures to these Teichmüller spaces.
In this talk, we exhibit several important examples of absolutely continuous Teichmüller spaces and explain how the identification of different representations works. The examples include Weil–Petersson Teichmüller spaces, BMO Teichmüller spaces and the space of chord-arc curves between them. One technical tool is the simultaneous uniformization imported from the theory of quasifuchsian spaces. We represent the space of particular quasicircles by the product of the corresponding Teichmüller spaces and consider biholomorphic correspondence between this parameter space and the complex function space. Furthermore, we apply this method to see (dis)continuous dependence of the Riemann mapping parametrizations of the family of Weil–Petersson curves and chord-arc curves to their arc-length parametrizations.

March 16th (Thu) Conference Room V

9:30–11:45

Summary: We consider the dynamics of a holomorphic skew product with a superattracting fixed point. We proved that it is generally conjugate to a monomial map on an invariant wedge whose closure contains the fixed point. In this talk we provide several kinds of plurisubharmonic functions on the complement of specific fibers in the attracting basin, which describe the vertical dynamics well.

Summary: The main purpose of this talk is to discuss Hardy type spaces, Bloch type spaces and the composition operators of complex-valued harmonic functions. We first establish a sharp estimate of the Lipschitz continuity of complex-valued harmonic functions in Bloch type spaces with respect to the pseudo-hyperbolic metric, which gives an answer to an open problem. Then some classes of composition operators on Bloch and Hardy type spaces will be investigated. The obtained results improve and extend some corresponding known results.

12 Hidetaka Hamada (Kyushu Sangyo Univ.)
Gabriela Kohr (Babeş-Bolyai Univ.)
Mirela Kohr (Babeş-Bolyai Univ)
Fekete–Szegö problem for univalent mappings in one and higher dimensions 15

Summary: In this talk, we will give the Fekete–Szegö inequality for the mappings f in various subclasses of normalized univalent mappings which are the first elements of g-Loewner chains on the unit disc $\mathbb{U}$ in $\mathbb{C}$ and also on the unit ball $\mathbb{B}$ of a complex Banach space. As an application, we give the estimation of the third coefficient for f under the condition that the second coefficient of f is zero. This result gives a generalization of the estimation of the third coefficient for odd univalent functions on the unit disc $\mathbb{U}$. We also give the Fekete–Szegö inequality for the images of the first elements of g-Loewner chains on $\mathbb{U}$ under the Roper–Suffridge type extension operators.

13 Hidetaka Hamada (Kyushu Sangyo Univ.)
Gabriela Kohr (Babeş-Bolyai Univ.)
Loewner PDE in infinite dimensions 15

Summary: In this talk, we generalize the existence and uniqueness result for the solutions of the Loewner partial differential equation (Loewner PDE) from $\mathbb{C}^n$ to the case of separable reflexive complex Banach spaces.

14 Shaolin Chen (Hengyang Normal Univ.)
Hidetaka Hamada (Kyushu Sangyo Univ.)
Some sharp Schwarz–Pick type estimates and their applications of harmonic and pluriharmonic functions 15

Summary: The purpose of this talk is to study the Schwarz–Pick type inequalities for harmonic or pluriharmonic functions. By analogy with the generalized Khavinson conjecture, we first give some sharp estimates of the norm of harmonic functions from the Euclidean unit ball in $\mathbb{R}^n$ into the unit ball of the real ℓ_p space. Next, we give several sharp Schwarz–Pick type inequalities for pluriharmonic functions from the Euclidean unit ball in $\mathbb{C}^n$ or from the unit polydisc in $\mathbb{C}^n$ into the unit ball of the ℓ_p space. Furthermore, we establish some sharp coefficient type Schwarz–Pick inequalities for pluriharmonic functions defined in the ℓ_p space. Finally, we use the obtained Schwarz–Pick type inequalities to discuss the Schwarz–Pick type lemmas of arbitrary order and the Bohr phenomenon of harmonic or pluriharmonic functions.

15 Shaolin Chen (Hengyang Normal Univ.)
Hidetaka Hamada (Kyushu Sangyo Univ.)
Saminathan Ponnusamy (Indian Inst. of Tech. Madras)
Ramakrishnan Vijayakumar (Indian Inst. of Tech. Madras)
Schwarz type lemmas and their applications in Banach spaces 15

Summary: The main purpose of this talk is to develop some methods to investigate the Schwarz type lemmas of holomorphic mappings and pluriharmonic mappings in Banach spaces. Initially, we extend the classical Schwarz lemmas of holomorphic mappings to Banach spaces, and then we apply to establish a sharp Bloch type theorem for pluriharmonic mappings on homogeneous unit balls of $\mathbb{C}^n$ and to obtain some sharp boundary Schwarz type lemmas for holomorphic mappings in Banach spaces. Next, we improve and generalize the classical Schwarz lemmas of planar harmonic mappings into the sharp forms of Banach spaces and give some applications to sharp boundary Schwarz type lemmas for pluriharmonic mappings in Banach spaces. Finally, we give some sharp Schwarz-Pick type estimates of pluriharmonic mappings in JB*-triples.

16 Yuta Watanabe (Univ. of Tokyo) L^2-type Dolbeault isomorphisms and vanishing theorems for logarithmic sheaves twisted by multiplier ideal sheaves 15

Summary: In this speech, we first establish an L^2-type Dolbeault isomorphism for the sheaf of logarithmic differential forms twisted by the multiplier ideal sheaf. By using this isomorphism and L^2-estimates equipped with a singular Hermitian metric, we obtain logarithmic vanishing theorems involving multiplier ideal sheaves on compact Kähler manifolds with simple normal crossing divisors.

17 Takeo Ohsawa (Nagoya Univ.)♭ On the Levi problem on Kähler manifolds under the negativity of canonical bundles on the boundary 15

Summary: It is proved that a bounded smooth pseudoconvex domain D in a Kähler manifold M can be mapped onto a locally closed analytic set in a complex number space holomorphically and properly with connected fibers if the caninical bundle of M is negative on a neighborhood of the boundary of D. A similar result holds for Zariski open domains of compact manifolds.

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

Makoto Abe (Hiroshima Univ.) Domains over a Stein manifold satisfying the Oka–Grauert principle

Summary: We discuss the pseudoconvexity and the Steinness of a complex manifold or a complex space under some conditions. Among others, we announce the recent joint research with Sugiyama on the Steinness of a domain over a Stein manifold that satisfies the Oka–Grauert principle for a complex Lie group of positive dimension and some additional cohomological conditions.

Functional Equations

March 15th (Wed) Conference Room IV

9:30–12:00

1 Yumiko Takei (Ibaraki Nat. Coll. of Tech.) On the expression of Voros coefficients for the hypergeometric differential equation of type (1,1,1,2) in terms of the topological recursion, and its applications · · · · · 12

Summary: Voros coefficients are important objects in the exact WKB analysis for the global study of solutions of differential equations. In this talk I will report that the Voros coefficients for the hypergeometric differential equation of type (1,1,1,2) are given by the generating functions of free energies defined in terms of Eynard and Orantin's topological recursion.

2 Saiei-Jaeyeong Matsubara-Heo (Kumamoto Univ.)
Yoshiaki Goto (Otaru Univ. of Commerce) The signature of the invariant hermitian form for a regular holonomic GKZ system · · · · · 12

Summary: Frits Beukers and Carlos Verschoor conjectured that the signature of the monodromy invariant hermitian form for a regular holonomic GKZ system has an explicit formula. We prove that this conjecture is true, by computing the intersection matrix of the twisted homology group associated to Euler type integral representation of a solution to GKZ system.

3 Hidekazu Ito (Kanagawa Univ.) Birkhoff normalization of a family of symplectic maps and superintegrability of Hamiltonian systems · · · · · 12

Summary: Integrability of a Hamiltonian system is defined by the existence of sufficiently many (Poisson-commuting) integrals. The Liouville–Arnold theorem gives description of the orbit structure near a compact regular level set of those integrals, however, is not valid near singularities of those integrals. The aim of this talk is to clarify the orbit structure of a super (noncommutatively) integrable system near singularities of its integrals. For this purpose, Birkhoff normalization for a family of symplectic maps plays a key role. We show that there exists a convergent Birkhoff normalization if a family of $2n$-dimensional analytic symplectic maps has $n+q$ integrals near a fixed point of resonance degree q.

4 Yutaka Kamimura (Tokyo Univ. of Marine Sci. and Tech.*) Two-component solitons via an energy dependent inverse scattering · · 12

Summary: An extended KdV hierarchy is discussed. Based upon an inverse scattering method on an energy dependent Schroedinger operator, soliton solutions in the hierarchy are constructed in a unified manner.

5 Yuki Hata (Osaka Pref. Univ.)
Hideaki Matsunaga (Osaka Metro. Univ.) Asymptotic stability in a linear differential equation with two delays · · · · · 12

Summary: This study is devoted to the investigation of the effect of delays on the asymptotic stability of a linear differential equation with two delays $x'(t) = -ax(t) - bx(t-\tau) - cx(t-2\tau)$, $t \geq 0$, where a, b, and c are real numbers and $\tau > 0$. We establish some explicit conditions for the zero solution of the equation to be asymptotically stable.

6 Masakazu Onitsuka (Okayama Univ. of Sci.) On Ulam stability of two-dimensional linear differential systems · · · · · 10

Summary: The main purpose of this talk is to classify the Ulam stability of the linear differential equation $\mathbf{u}' = A\mathbf{u}$, where A is a real-valued constant 2×2 matrix. The best Ulam constant is obtained for some special cases of A.

Summary: Sufficient conditions for the existence of positive solutions of quasilinear ODEs are given. Usually, such results are proved under the monotonicity conditions of nonlinear terms. However, in this talk we will give such results without assuming monotonicities on nonlinear terms.

Summary: We consider the global behavior of the bifurcation curves and solution curves of one-dimensional nonlocal elliptic eigenvalue problems. We know that the bifurcation curve λ is a continuous function of the maximum norm $\alpha = \|u_\lambda\|_\infty$ such as $\lambda(\alpha)$. Here, u_λ is the positive solution associated with λ. Our purpose here is to establish the asymptotic formulas for $\lambda(\alpha)$ and u_λ as $\lambda \to \infty$.

Summary: We investigate the best value of the constant in classical Poincaré inequality

$$\int_{B^N} |\nabla \boldsymbol{u}|^2 dx \geq C \int_{B^N} |\boldsymbol{u}|^2 dx$$

for a class of vector fields $\boldsymbol{u}$ with $\boldsymbol{u}|_{\partial B^N} = \boldsymbol{0}$ on the unit ball $B^N \subset \mathbb{R}^N$ which are subject to the curl-free constraint. We find that the best value of C turns out to be the square of the first zero of Bessel function of the $(N/2)$-th order.

Summary: By a survey paper, we shall introduce the basic relations of functional equations and the theory of reproducing kernels, globally, as a summary of the topics. In particular, I would like to introduce typical results with their principles in some concrete way based on the draft paper.
The general theory of reproducing kernels will give the basic tool of these widespread problems.

Summary: We are considering the simple functional equation hf=g. By the paper (REPRESENTATIONS OF QUOTIENTS g/f = h IN TERMS OF g = fh, International Journal of Reproducing Kernels Vol. 2 No. 1 (2023)), we shall introduce quotients g/f of general functions f and g in some deep and natural meanings, in a natural setting.

14:15–16:15

Summary: By introducing $W(R_+) = P(R_+) \cup Q(R_+) = \cup_{a\in[0,\infty]} W_a(R_+)$ as a class of weight functions, we will establish the Caffarelli–Kohn–Nirenberg type inequalities for $p \geq 1$ involving non-doubling weights in $W(R_+)$. The classical Caffarelli–Kohn–Nirenberg type inequalities are categorized into non-critical and critical cases, and it is known that there is some kind of mysterious relationship between them. Interestingly the new framework in this treatise allows them to be integrated and reveals the meaning of mysterious relationships. 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 $C^{-1}w(t) \leq w(2t) \leq Cw(t) \quad (0 < t < \infty)$, 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 talk.

Summary: We study the boundedness of critical points defined by the symmetric mountain pass lemma. We construct three types of functionals, which have an unbounded sequence of critical values. For the first one, the set of all critical points is bounded and the set of critical values is unbounded. The second one has both an unbounded sequence and a bounded sequence of critical points. For the last one, the set of critical points is countably infinite and unbounded.

Summary: This talk is concerned with degenerate elliptic equations involving the p-Laplacian and absorption in unbounded domains. Main results consist of the existence of distributional solutions and their maximal regularity (estimates) for locally integrable forcing terms beyond the duality.

Summary: This talk deals with some quasistatic evolution equation, which relates fracture mechanics and is also written as an evolutionary variational inequality. The main result of this talk is concerned with the existence of strong solutions complying with three qualitative properties, that is, irreversibility, unilateral equilibrium and energy conservation, which were originally proposed in a phase-field model for brittle fracture.

Summary: In this talk, we shall discuss a space-time homogenization problem for fast diffusion equations with periodically oscillating (in space and time) coefficients. The main purpose of this talk is to present a corrector result, i.e., strong convergence of gradient of the solution with a corrector term. The proof is based on the unfolding method and the strong two-scale convergence theory.

Summary: We study Streater's model on Brownian particle gas in statistical mechanics on bounded domain in $\mathbf{R}^n$. If $n \leq 2$, there is a solution global in time, provided that the entropy production is bounded.

Summary: In this talk we study the problems of uniqueness for Hardy–Hénon parabolic equations, which are semilinear heat equations with the singular potential (Hardy type) or the increasing potential (Hénon type) in the nonlinear term. To deal with the Hardy–Hénon type nonlinearities, we employ the weighted Lorentz spaces as the solution space. The purpose of this talk is to prove unconditional uniqueness and non-uniqueness for Hardy–Hénon parabolic equations in the weighted Lorentz spaces.

Summary: We explain a Liouville type of theorem on the positive bounded entire solution of a class of reaction- diffusion systems with nonlocal dispersal. Some application from epidemiology is also given.

20 Masahiko Shimojo (Tokyo Metro. Univ.)
Jong Shenq Guo (Tamkang Univ.)
Spreading behavior of a predator-prey system with fractional Laplacian 12

Summary: We establish a Liouville theorem on the positive bounded entire solution of a class of reaction-diffusion systems with fractional diffusion. As an application, we investigate the spreading phenomena of a predator-prey system with fractional diffusion. More precisely, by a suitable limiting argument along with the Liouville-type theorem, we prove that the solution converges to the unique positive co-existence state behind the spreading front.

16:30–17:30 Award Lecture for the 2022 MSJ Analysis Prize

Masaru Ikehata (Hiroshima Univ.) Development of the time domain enclosure method

Summary: This talk is concerned with a reconstruction method in inverse problems formulated by using the solutions of various partial differential equations. Such equations are called the governing equations and the observation data are described by the solutions. The object to be reconstructed or extracted from the data is the discontinuity such as obstacles, inclusions, cracks etc.

The probe and enclosure methods are general ideas to extract information about unknown discontinuity embedded in a known background medium from the observation data. The data are given by the far field pattern of the scattered field, the Dirichlet-to-Neumann map or its partial knowledge at the boundary of the medium. The methods were introduced by the speaker and it has already been passed more than twenty years. The methods have been applied to several inverse problems, e.g., an inverse boundary value problem related to EIT(electrical impedance tomography), elasticity and inverse obstacle scattering problems of acoustic wave at a fixed wave number, whose governing equations are time-independent.

The next challenge and interest of the speaker were to extend the enclosure method to cover inverse problems governed by time-dependent PDEs. However, as a result of research over the last ten years, it has been found that the enclosure method is also effective for various time-dependent PDEs, such as the heat equation, the wave equation, a system of equations in thermoelasticity, the Maxwell system and quite recently the fractional diffusion equation.

This talk will give a brief history of probe and enclosure method and then describe some of recent developments of enclosure methods in the time domain.

March 16th (Thu) Conference Room IV

9:15–12:00

21 Masaaki Mizukami (Kyoto Univ. of Edu.)
Yuya Tanaka (Tokyo Univ. of Sci.)
Non-simultaneous blow-up in a two-species chemotaxis-competition model with single production 12

Summary: In a two-species chemotaxis-competition model, blow-up of solutions was shown in a previous paper. In this model, the production term seems to promote blow-up phenomena; this implies that the lack of the production term makes the solution likely to be bounded. Thus, it is expected that the model without one of the production terms has a solution such that the species which does not produce the chemical substance remains bounded, whereas the other species blows up. The purpose of this paper is to prove that this conjecture is true.

22 Yuya Tanaka (Tokyo Univ. of Sci.) Finite-time blow-up in a degenerate parabolic–elliptic Keller–Segel system with logistic source 12

Summary: This talk deals with a degenerate parabolic–elliptic Keller–Segel system with logistic source. In the case of nondegenerate diffusion, Black, Fuest and Lankeit (Z. Angew. Math. Phys.; 2021; 72; no. 96, 23 pp.) obtained a condition such that finite-time blow-up occurs. The purpose of this talk is to show that finite-time blow-up occurs also in the case of degenerate diffusion.

23 Yutaro Chiyo (Tokyo Univ. of Sci.)
Masaaki Mizukami (Kyoto Univ. of Edu.)
Boundedness of solutions to a chemotaxis system for tumor angiogenesis 12

Summary: This talk deals with a chemotaxis system for tumor angiogenesis. When the third equation is simplified by the elliptic one and the sensitivity functions are constants, global existence and boundedness were proved by Tao and Winkler (Nonlinear Analysis; 2021; 112324; 16 pp). However, the case that the sensitivity functions are not constants and the third equation is parabolic seems not to have been studied yet. The purpose of this talk is to establish global existence and boundedness in a fully parabolic chemotaxis system for tumor angiogenesis with sensitivity functions.

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

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

25 Tatsuya Hosono (Tohoku Univ.)♭
Takayoshi Ogawa (Tohoku Univ.)
Global existence of solutions to the 4D attraction-repulsion chemotaxis system and applications of Brezis–Merle inequality 12

Summary: We consider the Cauchy problem for an attraction-repulsion chemotaxis system in the four space dimension. One of main topics in the study of such a system is the presence of L^1 threshold. In fact, the critical mass phenomenon called 8π-problem is well-known in the 2-dimensional setting. In this talk, using the Brezis–Merle type inequality and rearrangement arguments, we will show that the solution exists globally in time when the initial mass is less than 4-dimensional L^1 threshold value $(8\pi)^2$.

26 Kiichi Tashiro (Tokyo Tech)
On the construction of canonical generalized mean curvature flow by elliptic regularization 10

Summary: In this talk, we consider a generalized mean curvature flow constructed by elliptic regularization. Elliptic regularization is a method invented by Tom Ilmanen to construct an approximation of the generalized mean curvature flow using real analytic functional. We will show that the area change of the region moved by this flow is given by equality using the generalized mean curvature. The key to the proof is to establish approximate velocity and estimate it in L^2.

27 Tatsuya Miura (Tokyo Tech)
Kensuke Yoshizawa (Kyushu Univ.)
Complete classification of planar p-elasticae 12

Summary: Euler's elastica is defined by a critical point of the total squared curvature under the fixed length constraint, and its L^p-counterpart is called p-elastica. In our talk, we completely classify all p-elasticae in the plane and obtain their explicit formulae as well as optimal regularity. To this end we introduce new types of p-elliptic functions which streamline the whole argument and result. As an application we also classify all closed planar p-elasticae.

28 Takeyuki Nagasawa (Saitama Univ.)
A lower estimate of the life-span and a blow-up rate for non-local curvature flows for plane curves 10

Summary: Several non-local curvature flows for plane curves with general rotation number are considered here. The flows include the area-preserving flow and the length-preserving flow. Previously, we showed sufficient conditions for finite-time blow-up, and gave an upper bound of the blow-up time. Here, we give estimates for solutions including at least two important applications. As the first one, it gives a lower bound of the life span, which is a lower bound of the blow-up time for blow-up solutions. Secondly, our estimate also improves the blow-up rate of blow-up solutions.

29 Tatsu-Hiko Miura (Hirosaki Univ.) Error estimate for classical solutions to the heat equation in a moving thin domain and its limit equation 12

Summary: We consider the Neumann type problem of the heat equation in a moving thin domain around a given closed moving hypersurface. Our main result is an estimate in the sup-norm for the difference of a classical solution to the heat equation in the moving thin domain and a classical solution to a limit equation on the moving hypersurface which appears in the thin-film limit of the heat equation. To prove that error estimate, we construct a suitable approximate solution to the heat equation from a classical solution to the limit equation and then estimate the difference of a classical solution and the approximate one to the heat equation based on the maximum principle.

30 Hirokazu Ninomiya (Meiji Univ.) Example of pattern formation by equal diffusion 12

Summary: In 1952, Turing proposed the mechanism of pattern formation in which a stable equilibrium of some kinetic system is destabilized by diffusion. In the case of two-component reaction-diffusion systems, however, the diffusion coefficients should be different. Conversely, there exist several chemical models that produce the stable patterns even though the diffusion coefficients are equal. To study the pattern formation by equal diffusion, this talk presents an example of a kinetic system with a asymptotically stable equilibrium, while the corresponding reaction-diffusion system has a family of unstable stationary solutions that is arbitrarily close to the homogeneous stationary solution.

31 Hirokazu Ninomiya (Meiji Univ.) Dynamics of area-preserving curvature flow of a convex plane curve in an inhomogeneous medium 12

Summary: In 1986, Gage studied the area-preserving curvature flows in a two-dimensional homogeneous medium. He showed that an initially convex closed curve remains convex and converges to a circle as time goes to infinity. However, in many applications, the medium is not homogeneous. In this talk, we consider the area preserving flow in an inhomogeneous medium when the area enclosed by the interface is small. The reduced equation of its center will be explained.

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

Takeyuki Nagasawa (Saitama Univ.) The decomposition of the Möbius energies and wave maps

Summary: The Möbius energy for knots is known as a functional invariant under Möbius transformations. There is an energy for links having the same properties. For the energies for knots and two-component links, there exists a Möbius invariant decomposition, that is, each decomposed part is still invariant under Möbius transformations.

Recently, the author found two new expressions of decomposition using Gauss maps of knots and links. One is an "indirect expression", the other is a "direct expression."

Using the indirect expression, we can regard the decomposition as the *parallelogram law* of the Möbius energy. Furthermore, the cosine formula of the Möbois energy for knots is generalized to decomposed energies.

It has been known that the first decomposed energy relates to an energy of fractional harmonic maps. We can see from the direct expression that the second one does to an energy of wave maps. As an application, we show the existence or non-existence of knots and links which Gauss maps are wave maps.

March 17th (Fri) Conference Room IV

9:30–12:00

32 Yohei Sato (Saitama Univ.) Even ground state for nonlinear Schrödinger systems with repulsive interaction ····· 12

Summary: It is known that the nonlinear Schrödinger systems with repulsive interaction has no ground states. Here ground state means a positive solution that attains a minimizing problem on the Nehari set with two constrains. On the other hand, when the minimizing problem is restricted to even functions, one calls a positive minimizer as an even ground state. We show the existence of even ground states of nonlinear Schrödinger systems with repulsive interaction. The keys of the proof are estimates of minimizing level and a classificaton of Palais-Smale sequences of even functions. In particular, the case $N = 1$ requires more detailed estimates than $N = 2, 3$.

33 Hiroyuki Hirayama (Univ. of Miyazaki)
Masahiro Ikeda (RIKEN/Keio Univ.) Existence and stability of ground states for the system of nonlinear Schrödinger equations with derivative nonlinearity ····· 12

Summary: We consider the Cauchy problem of the system of nonlinear Schrödinger equations with derivative nonlinearlity. The well-posedness of this system in the Sobolev space H^1 is obtained by the previous works. But the long time behavior of the solution of this system is not well known. In this talk, we prove the existence of ground state solutions of this system. Furthermore, for 1 dimensional case, we also prove the stability of ground states by using the variational method.

34 Noriyoshi Fukaya (Tokyo Univ. of Sci.)
Masayuki Hayashi (Univ. di Pisa/Waseda Univ.) Instability of stationary solutions for double power nonlinear Schrödinger equations in one dimension ····· 12

Summary: We consider a double power nonlinear Schrödinger equation in one dimension and L^2-subcritical setting. The equation has the algebraically decaying stationary solution ϕ_0 as well as exponentially decaying standing waves $e^{i\omega t}\phi_\omega(x)$ with positive frequency. It is known from the general theory that the standing wave with positive frequency is stable if $M'(\omega) > 0$ and unstable if $M'(\omega) < 0$, where $M(\omega) := \frac{1}{2}\|\phi_\omega\|_{L^2}^2$. In this talk we prove the instability of the stationary solution under the condition $M'(0) := \lim_{\omega\downarrow 0} M'(\omega) \in [-\infty, 0)$. The key in the proof is the costruction of the one-sided derivative of $\omega \mapsto \phi_\omega$ at $\omega = 0$, which is effectively used to construct the unstable direction.

35 Yuji Sagawa (Chiba Inst. of Tech.)
Takuya Sato (Tohoku Univ.)
Shota Kawakami (Saitama Univ.) Finite time blow up solutions to the nonlinear Schrödinger equation with harmonic potential for arbitrary small initial data ····· 12

Summary: We construct finite time blow up solutions to the power type nonlinear Schrödinger equation with harmonic potential for arbitrary small initial data in the positive time direction. We simultaneously observe that those solutions exist globally in time and its mass decays in the negative time direction. This part is an improvement of the previous work by Antonelli, Carles and Sparber.

36 Hiroyuki Hirayama (Univ. of Miyazaki)
Shinya Kinoshita (Saitama Univ.)
Mamoru Okamoto (Osaka Univ.) Well-posedness of the Cauchy problem for the two dimensional quadratic nonlinear Schrödinger equation with angular regularity ····· 12

Summary: We consider the Cauchy problem for the two dimensional nonlinear Schrödinger equation with the quadratic nonlinearity $|u|^2$. In the Sobolev space $H^s(\mathbb{R}^2)$, it is known that $s = -\frac{1}{4}$ is the threshold for the Cauchy problem to be well-posed. We prove the well-posedness in $H^s(\mathbb{R}^2)$ for $-\frac{1}{2} < s < -\frac{1}{4}$ by assuming some angular regularity on initial data.

37 Shun Tsuhara (Tohoku Univ.)♭
Takayoshi Ogawa (Tohoku Univ.)
Global well-posedness for the Sobolev critical nonlinear Schrödinger system in four space dimensions 12

Summary: We consider the Cauchy problem of the system of nonlinear Schrödinger equations with cubic nonlinearity in four space dimensions. We prove the existence of the ground state solution and the global well-posedness for the system below the ground state solution under the mass resonance condition. We also show that the ground state solution is written by Aubin–Talenti function. The proof of the gloval well-posedness result is following the well-known results due to Kenig–Merle (2006).

38 Takuya Sato (Tohoku Univ.)♭
Nakao Hayashi (Tohoku Univ.)
Takayoshi Ogawa (Tohoku Univ.)
The initial boundary value problem of nonlinear Schrödinger equations with a nonlinear Neumann boundary condition 12

Summary: We consider the initial-boundary value problem of the nonlinear Schrödinger equation on the half line with a nonlinear Neumann boundary condition. After establishing the boundary Srtichartz estimate in L^2, we consider the time local well-posedness of the problem in the lower regularity spaces as L^2.

39 Yuki Osada (Tokyo Metro. Univ.)
Existence of a minimizer for a nonlinear Schrödinger system with three wave interaction under non-symmetric potentials 12

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 by using interaction estimates.

40 Masahiro Ikeda (RIKEN/Keio Univ.)
Takahisa Inui (Osaka Univ./Univ. of British Columbia)
Masaru Hamano (Waseda Univ.)
Ikkei Shimizu (Osaka Univ.)
Global dynamics below a threshold for the nonlinear Schrödinger equations with the Kirchhoff boundary and the repulsive Dirac delta boundary on a star graph 12

Summary: We consider the nonlinear Schrödinger equations on the star graph with the Kirchhoff boundary and the repulsive Dirac delta boundary at the origin. In this talk, we show scattering-blowup dichotomy result below the mass-energy of the ground state on the real line. The proof of the scattering part is based on a concentration compactness and rigidity argument. Our main contribution is to give a linear profile decomposition on the star graph by using a new idea of decomposition of functions on the star graph.

41 Jumpei Kawakami (Kyoto Univ.)
Averaging of strong magnetic nonlinear Schrödinger equations in energy space 12

Summary: We consider nonlinear Schrödinger equation with strong magnetic field in 3-dimension. To analyze this, R L. Frank, F. Méhats, C. Sparber derived two nonlinear Schrödinger type models. One model is derived by spatial scaling and the other model is obtained by averaging the aforesaid spatial scaled model in time. We study these two models in energy space and obtain global solutions for some cases. We also prove that the time averaged model is energy-critical when this model has the nonic nonlinear power. Furthermore, we improve the previous result that the solution to the spatial scaled model converges to the solution to the time averaged model.

14:15–16:15

42 Kenjiro Ishizuka (Kyoto Univ.)
Long-time asymptotics of the one-dimensional damped nonlinear Klein–Gordon equation with a potential 12

Summary: In this talk, we consider the one-dimensional nonlinear focusing damped Klein–Gordon equation with a potential. When a potential is good conditon, it follows from standard arguments that the Cauchy problem for this equation is locally well-posed in the energy space. When a potential is zero, Cote–Martel–Yuan (2021) proved the full soliton resolution. Anywaw we consider soliton resolution for this equation. Especially we will mainly talk the case that a potential is a repulsive delta potential.

Summary: In this talk, we introduce the classification of cubic nonlinear systems. The critical ingredient is to introduce a matrix representation of a system. It turns out that the rank of the matrix is an invariant quantity that describes the number of linearly independent conserved quantities. We give a classification of systems that have two distinct conserved quantities.

Summary: In this talk, we introduce the classification of complex-valued gauge-invariant cubic systems. The critical ingredient is the matrix-vector representation of a system. This clarifies the effect of the change of variables and describes the systems' Hamiltonian structure. In particular, the rank of the matrix part denotes the number of the conserved quantities, and hence reflects the system's complexity. We show the classification of systems that have only one conserved quantity.

Summary: We consider the Cauchy problem for nonlinear wave equations with time-dependent damping. We show that blow-up in a finite time occurs for the equation with arbitrary power nonlinearity as well as upper bounds of the lifespan of blow-up solutions. We also show the same results for the space derivative nonlinear term.

Summary: In this talk, we consider the Cauchy problem for the generalized KP–Burgers equation in 2D. This is one of the nonlinear dispersive-dissipative type equations, which has a spatial anisotropic dissipative term. Under some suitable regularity assumptions on the initial data u_0, especially the condition $\partial_x^{-1}u_0 \in L^1(\mathbb{R}^2)$, it is known that the solution to this problem decays at the rate of $t^{-\frac{7}{4}}$ in the L^∞-sense. In this study, we investigate the more detailed large time behavior of the solution and construct the approximate formula for the solution at $t \to \infty$. Moreover, we obtain a lower bound of the L^∞-norm of the solution and prove that the decay rate $t^{-\frac{7}{4}}$ of the solution given in the previous work to be optimal.

Summary: We examine the stability of vortex-like configuration of magnetization in magnetic materials, so-called the magnetic skyrmion. These correspond to critical points of the Landau–Lifshitz energy with the Dzyaloshinskii–Moriya interactions. In this talk, we prove that there is an explicit critical value of the parameter in the energy above which the skyrmion is unstable, while stable below this threshold. This mathematically explains the occurrence of phase transition observed in some experiments. We also show that in the unstable regime, the infimum of energy is not bounded below.

Summary: We consider stationary flows over periodic topography modeled by one-dimensional shallow water equation. We first show the nonexistence of stationary solutions with discontinuities as well as the conditions on the existence of continuous subsonic/supersonic stationary solutions. We also claim that the subsonic stationary solutions are not asymptotically stable.

49 Takashi Furuya (Shimane Univ.) Inverse medium scattering problems with Kalman filter techniques ··· 10

Summary: We study the inverse medium scattering problem to reconstruct the unknown inhomogeneous medium from the far-field patterns of scattered waves. The inverse scattering problem is generally ill-posed and nonlinear, and the iterative optimization method is often adapted. A natural iterative approach to this problem is to place all available measurements and mappings into one long vector and mapping, respectively, and to iteratively solve the linearized large system equation. However, this is computationally expensive because we must construct the larger system equations when the number of available measurements increases. In this talk, we propose the reconstruction algorithm based on the Kalman filter, which avoids the construction of a large system equation and retains the information of past updates.

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

Naoyasu Kita (Kumamoto Univ.) ♭ On behaviors of solutions to nonlinear Schrödinger equations with complex coefficient in its nonlinearity

Summary: We consider the Cauchy problem of nonlinear Schrodinger equations. Unlike the conservative system, the equation contains a complex coefficient in its nonlinearity. The physical background of such a non-conservative system is coming from the optical fiber engineering, where nonlinear Ohm's law and nonlinear amplification are applied. My talk consists of two parts. The first part treats a problem of global existence and asymptotic behavior of solutions without size restriction on the initial data, where Hayashi–Naumkin's theory basically contributes to the result. The second part treats a construction of blowing-up solutions. Combining the former result on asymptotic behavior of solutions, we can obtain blowing-up solutions even for small initial data. Recently, the result on the blowing-up solutions has been generalized by Cazenave–Martel–Zhao, Cazenave–Han–Martel and Kawakami–Machihara. If time permits, these recent progresses will be also presented.

March 18th (Sat) Conference Room IV

9:30–12:00

50 Naoyuki Iwata (Nagoya Inst. of Tech.) Masahiro Suzuki (Nagoya Inst. of Tech.) Stationary solutions of the Vlasov–Poisson system for a multicomponent plasma ····· 12

Summary: In this talk, we mathematically investigate the formation of a plasma sheath, and analyze the Bohm criterion which is required for the formation. In 1995, Riemann derived the Bohm criterion from the stationary Vlasov–Poisson system which describes the motion of a multicomponent plasma. We study the solvability of boundary value problems of the system, and show that the Bohm criterion is a necessary condition but not a sufficient condition for the solvability.

51 Masahiro Suzuki (Nagoya Inst. of Tech.) Masahiro Takayama (Keio Univ.) Katherine Zhiyuan Zhang (New York Univ.) Stability and instability of stationary solutions of the Vlasov–Poisson system ····· 12

Summary: We investigate the formation of a plasma boundary layer (sheath) by considering the Vlasov–Poisson system on a half-line with the completely absorbing boundary condition. The solvability of the stationary problem has been established. In this talk, we study the nonlinear stability and instability of these stationary solutions of the Vlasov–Poisson system.

52 Taichi Eguchi (Waseda Univ.) Energy equality of MHD system under a weaker condition on magnetic field ····· 12

Summary: We prove the energy equality of MHD system in the space founded by Cheskidov–Constantin Friedlander–Shvydkoy (2008) and Berselli–Chiodaroli (2020). It is clarified that the energy equality is established for a lager class of the magnetic filed than that of velocity field. Our result covers most of previous theorems on validity of the energy equality on the Navier–Stokes equations.

Summary: We consider the initial-value problem for the compressible Hall-magnetohydrodynamic system with quantum effects in the 3-dimensional Euclidean space $\mathbb{R}^3$. The aim of this talk is to obtain time-decay estimates for solutions as a perturbation from a constant equilibrium state $(1, 0, \bar{B})$ in a critical L^p framework. Here $\bar{B} \in \mathbb{R}^3$ is denoted by constant magnetic fields. To obtain such a result, we establish energy methods on Fourier–Herz spaces $\widehat{L}^p$ introduced by Grünrock (2004). By combining $\widehat{L}^p$ energy methods and a transformation of the momentum equation given by the effective velocity, we will derive the $\widehat{L}^p$-$\widehat{L}^{p/2}$ type time-decay estimate without the smallness requirement of low frequencies for initial data.

Summary: We consider the Hartree equation describing the time evolution of wave functions of infinitely many fermions interacting with each other. The Hartree equation can be formulated in terms of the operators on $L^2(\mathbb{R}^d)$. It has infinitely many stationary solutions, and several authors have studied their stability, for example, Lewin–Sabin(2014), Chen–Hong–Pavloić(2018), and Collot–de Suzzoni(2020, 2022). However, the stability of Fermi gas at zero temperature, one of the most important stationary solutions from the physics point of view, was left open. In this talk, we report that it is stable; that is, any small perturbation from Fermi gas at zero temperature scatters.

Summary: We consider the governing equations for the motion of the inviscid fluids in moving domains and surface from an energetic point of view. We employ an energetic variational approach to derive multiphase flow system with surface flow and tension. We make use of the feature of the barotropic fluid to derive the surface pressure and tension of the compressible fluid in the surface.

Summary: We consider the governing equations for the motion of the fluid particles near air-water interface from an energetic point of view. We employ an energetic variational approach to derive inviscid multiphase flow system with phase transition, where a phase transition means a jump condition. We apply our energetic variational approach and jump condition to study the dominant equations for the densities of the fluids in moving domains.

Summary: We discuss about data assimilation to the primitive equations in maximal L^p-L^q settings in a mathematically rigorous way. The primitive equations describe the flow in a thin domain. The equations combined with some data assimilation methods are used in meteorology and ocean physics for predictions for phenomena. Our results are that the solution to data assimilation equations of the primitive equations converges to the solution to the primitive equations in maximal L^p-L^q spaces at $t \to \infty$.

Summary: In this presentation, we introduce a method to prove space-time analyticity for evolution equations with nonlinear terms represented by multilinear operators via the parameter trick. By extending the case of bilinear operators in the previous work, this method is expected to be applicable not only to the Navier–Stokes equations but also to the equations of Fujita type.

59 Yoshiki Iida (Waseda Univ.) Energy equality for the 3D inhomogeneous Navier–Stokes equations in Lorentz–Besov spaces · · · · · 12

Summary: We establish the energy equality for Leray–Hopf weak solutions of the 3D incompressible *inhomogeneous* Navier–Stokes equations in Lorentz–Besov spaces. This result may be regarded as an extension of that by Cheskidov and Luo (2020).

14:15–16:15

60 Motofumi Aoki (Tohoku Univ.), Tsukasa Iwabuchi (Tohoku Univ.) On the ill-posedness for the full system of the compressible Navier–Stokes equations · · · · · 12

Summary: We consider the Cauchy problem for the equations of the ideal gas in the three space dimensions. In the critical Besov spaces, it is known that the Cauchy problem is uniquely solvable for all $1 < p < 3$ and ill-posed for all $p > 3$. We study the threshold case $p = 3$. We prove that the Cauchy problem is ill-posed by constructing a sequence of the initial data such that the solution map is discontinuous.

61 Dáithí Ó hAodha (Tohoku Univ.), Tsukasa Iwabuchi (Tohoku Univ.) Optimality of the decay estimate of solutions to the linearised curl-free compressible Navier–Stokes equations · · · · · 12

Summary: We discuss optimal estimates of solutions to the compressible Navier–Stokes equations in Besov norms. In particular, we consider the estimate of the curl-free part of the solution to the linearised equations, in the homogeneous case. We prove that our estimate is optimal in the L^∞-norm by showing that the norm is bounded from below by the same decay rate. This is the first time such a bound from below has been obtained for the compressible Navier–Stokes equation.

62 Takahiro Okabe (Osaka Univ.), Lorenzo Brandolese (Univ. Lyon 1) Forced rapidly dissipative Navier–Stokes flows · · · · · 12

Summary: We consider the asymptotic behavior of the solution to the incompressible Navier–Stokes equation on the whole space. By an action of a forcing term we control the nonlinear term of the flow and derive a rapid time decay. This talk is based on the joint work with Lorenzo Brandolese (Univ. Lyon 1).

63 Tomoyuki Nakatsuka (Matsuyama Univ.) On solvability of the time-periodic problem for the Navier–Stokes equation · · · · · 12

Summary: In this talk, we consider the existence of time-periodic solutions to the Navier–Stokes equation in the whole space. We decompose periodic solutions into steady and purely periodic parts, and we analyze the equations they should satisfy. Based on the analysis of the purely periodic solutions represented by the Fourier transform to the Stokes equation, their additional property can be obtained and we use it to construct a time-periodic solution of the Navier–Stokes equation.

64 Yuta Koizumi (Waseda Univ.), Toya Taniguchi (Waseda Univ.) Convergence of approximating solutions of the Navier–Stokes equations · · · · · 12

Summary: We show that the approximating solutions $\{u_j\}_{j=0}^\infty$ of the Navier–Stokes equations constructed by Kato (1984) with the initial data $u(0) \in L^n_\sigma(\mathbb{R}^n)$ converge to the local strong solution u in the topology of $W^{2,n}(\mathbb{R}^n)$ provided the convergence in the scaling invariant norm in $L^p(\mathbb{R}^n)$ with the time weight holds.

65 Hiroki Ohyama (Kyushu Univ.), Keiji Yoneda (Kyushu Univ.) Fast rotation limit for the magnetohydrodynamics equations in a 3D layer · · · · · 10

Summary: We consider the initial value problem for the incompressible magnetohydrodynamics system with the Coriolis force in a three-dimensional infinite layer. We prove the unique existence of global solutions for initial data in the scaling invariant space when the speed of rotation is sufficiently high. Moreover, we show that the global solution converges to that of the coupled system of the 2D incompressible magnetohydrodynamics equations and the 3D incompressible Maxwell equations as the rotation speed tends to infinity.

66 Takanari Egashira (Kyushu Univ.)
Ryo Takada (Univ. of Tokyo)
Large time behavior of solutions to the 3D rotating Navier–Stokes equations 10

Summary: We consider the large time behavior of the solutions for the initial value problem of the Navier–Stokes equations with the Coriolis force in the three-dimensional whole space. We show the temporal decay estimates with the dispersion effect of the Coriolis force for the global solutions. Moreover, we prove the large time asymptotic expansion of the solutions behaving like the first-order spatial derivatives of the integral kernel of the corresponding linear solution.

67 Mikihiro Fujii (Kyushu Univ.)
Global strong solutions to the compressible Navier–Stokes equation with the Coriolis force 12

Summary: In this talk, we consider the global solvability for the compressible Navier–Stokes equation with the Coriolis force in the scaling critical Besov space. Despite many studies on the weak solutions, the existence of global strong solutions has been an open problem. Unlike the incompressible case, the Coriolis force causes the linear solutions to behave like a semigroup $\{e^{-t\Delta^2}\}_{t>0}$, which creates difficulties in nonlinear estimates in the low frequency part. In this research, we propose a new idea of the low frequency analysis and overcome these difficulties.

68 Hirokazu Saito (Univ. of Electro-Comm.)
On decay properties of solutions to the two-phase Stokes equations with surface tension and gravity 10

Summary: In this talk, we consider the two-phase Stokes equations with surface tension in $\dot{\mathbf{R}}^N = \mathbf{R}^N_+ \cup \mathbf{R}^N_-$ and in the presence of a uniform gravitational field acting vertically downward. Let $\rho_\pm$ be positive constants describing the densities of fluids occupying $\mathbf{R}^N_\pm$. It is well-known that the Rayleigh-Taylor instability occurs when the upper fluid is heavier than the lower one, i.e., when $\rho_+ > \rho_-$. On the other hand, this talk aims to introduce time decay estimates of solutions to the two-phase Stokes equations under the condition that the lower fluid is heavier than the upper one, i.e., $\rho_- > \rho_+$.

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

Youhei Tsutsui (Kyoto Univ.)♭
Convergence to the initial data and weighted estimates for the incompressible Navier–Stokes equations

Summary: We discuss conditions on data for which ensure the solution to the incompressible Navier–Stokes equations strongly converges to the initial data from weak L^n space on the whole space. We also consider weighted estimates for the solutions.

Real Analysis

March 17th (Fri) Conference Room V

9:00–11:45

Summary: The purpose of this talk is to introduce a fixed point theorem in a ball space, which is proved without the Axiom of Choice. Moreover, using the fixed point theorem in a ball space, we prove Caristi's fixed point theorem. Therefore the proof of Caristi's fixed point theorem in this paper does not depend on the Axiom of Choice.

Summary: In this talk, we prove weak and strong convergence theorems for monotone nonexpansive mappings and convergence theorems for monotone nonexpansive semigroups in Banach spaces endowed with a partial order.

Summary: This study deals with the approximation of fixed points for nonexpansive and other types of mappings. Using a modified shrinking projection method, we obtain the delta-convergence of generated approximation sequence to a fixed point of the mapping. We also consider a family of mappings and show a convergence theorem to their common fixed point.

Summary: We show a mean convergence theorem for a mapping with an attractive point in a Hilbert space by using a quasinonexpansive extension of the mapping and a mean convergence theorem for a quasinonexpansive mapping. Then using the theorem, we establish a mean convergence theorem for a λ-hybrid mapping in the sense of Aoyama, Iemoto, Kohosaka, and Takahashi (2010).

Summary: The embeddings for Morrey–Lorentz spaces have been previously introduced by Ragusa. This paper describes the major differences between these embedding types.

Summary: In this talk, we introduce the Bourgain–Morrey space which is a one generalization of Morrey spaces. By using this space, it is showed that we can refine the Strichartz estimate for Schrödinger equations. We consider some properties of this space from the viewpoints of harmonic analysis and functional analysis.

Summary: In this talk, we consider the complex interpolation for mixed Morrey spaces via the Calderón product. The mixed Morrey space $\mathcal{M}^p_{\vec{q}}(\mathbb{R}^n)$ is a function space which is a generalization of Morrey spaces. The results in this talk are extensions for classical Morrey spaces.

8 Koichi Taniguchi (Tohoku Univ.)
Masahiro Ikeda (RIKEN/Keio Univ.)
Isao Ishikawa (Ehime Univ.)
Boundedness of composition operators on Besov spaces ····· 15

Summary: In this talk we consider boundedness of composition operators on Besov spaces $B^s_{p,q}$ on one dimensional Euclidean space. The boundedness has been well studied in the lower derivative case $0 < s < 1$. In contrast, there is almost no research on the higher order case $s \geq 1$, and many problems remain unsolved. The purpose of this talk is to give necessary and sufficient conditions for the boundedness when $s > 1 + 1/p$. Similar results for composition operators on Triebel–Lizorkin spaces are provided.

9 Takanobu Hara (Hokkaido Univ.)
Strong barriers for weighted quasilinear equations ····· 15

Summary: We construct strong barriers for weighted quasilinear elliptic equations. There are two applications: (i) solvability of Poisson-type equations with boundary singular data, and (ii) a geometric version of Hardy inequality.

14:15–15:25

10 Toshiharu Kawasaki (Tamagawa Univ./Chiba Univ./Chiba Univ.)
On the difference between the families of extended integrable functions and extended primitive functions ····· 15

Summary: In this talk, we discuss the difference between the families of extended integrable functions and extended primitive functions.

11 Ryoichi Kunisada
On topologically invariant means and almost convergence ····· 15

Summary: In this talk, we discuss applications of topologically invariant means and almost convergence for the theory of analytic functions on the half plane.

12 Takumi Terae (Tokyo Tech)
Toshiaki Murofushi (Tokyo Tech)
An equality condition for supremum increments of distorted measures in non-additive measure theory ····· 15

Summary: In non-additive measure theory, there exist two definitions of null sets, which are weak null sets and strong null sets. Several theorems in measure theory such as the Egoroff theorem and the Lebesgue theorem are described by using the concept of null sets, therefore there exist weak forms and strong forms of these theorems as definitions in non-additive measure theory. The concept of supremum increment is important for studying about the strong forms of them. This paper has an argument that gives a necessary and sufficient condition for two different distorted measures having an equal supremum increment for a simple case. In addition, we define the concept of strong supremum increments in preparation for generalizing this argument.

13 Yoshiaki Okazaki (Fuzzy Logic Systems Inst.)
Ryoji Fukuda (Oita Univ.)
Aoi Honda (Kyushu Inst. of Tech.)
Fréchet–Nikodym uniformity on a ring determined by a non-additive measure ····· 15

Summary: Fréchet–Nikodym difference on a measure ring $\mathcal{R}$ determined by a non-additive measure μ is defined by $\mu(A \ominus B)$. We prove that if μ is quasi-monotone and satisfies (p.g.p)-condition, then the entourages $\{(A, B) \mid \mu(A \ominus B) \leq \epsilon\},\ \epsilon > 0$ is a basis of entourages of a uniform structure on the measure ring $\mathcal{R}$.

15:40–16:40 Award Lecture for the 2022 MSJ Analysis Prize

Eiichi Nakai (Ibaraki Univ.) Generalized Campanato spaces with variable growth condition and related topics

Summary: Generalized Campanato spaces with variable growth condition were introduced by Nakai and Yabuta in 1985 to characterize the space of pointwise multipliers on BMO($\mathbb{R}^n$). This characterization was extended from $\mathbb{R}^n$ to spaces of homogeneous type in 1997, to probability spaces with filtration in 2014, and, to $\mathbb{R}^n$ with non-doubling measures in 2018. On the other hand, this characterization was used by Lerner in 2005 to study the class $\mathcal{P}(\mathbb{R}^n)$ of functions $p(\cdot)$ for which the Hardy-Littlewood maximal operator is bounded on the Lebesgue spaces $L^{p(\cdot)}(\mathbb{R}^n)$ with variable exponent, and positively solve a conjecture of Deining in 2005 saying that there are discontinuous functions belonging to $\mathcal{P}(\mathbb{R}^n)$. Moreover, in 2012 it was discovered by Nakai and Sawano that the dual of generalized Hardy space $H^{p(\cdot)}(\mathbb{R}^n)$ with variable exponent is a generalized Campanato space with variable growth condition. In this talk we discuss generalized Campanato spaces with variable growth condition and related topics.

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

Hitoshi Tanaka (Tsukuba Univ. of Tech.) Dyadic cubes analysis, dyadic rectangles analysis

Summary: After reviewing a history of the dyadic cubes analysis, with rectangular doubling weight, a generalized Hardy–Littlewood–Sobolev inequality for rectangular fractional integral operators is verified. The result is a nice application of M-linear embedding theorem for dyadic ractangles.

March 18th (Sat) Conference Room V

9:00–12:00

14 Goro Akagi (Tohoku Univ.)
Yoshihito Nakajima (Tohoku Univ.)
Solvability of evolution equations involving time-fractional derivatives and applications 15

Summary: This talk is concerned with local and global in time solvability of abstract evolution equations involving time-fractional derivatives as well as subdifferential operators. An application to the initial-boundary value problem for degenerate parabolic equations involving time-fractional derivatives as well as blow-up nonlinearity will also be discussed.

15 Kosuke Kita (Waseda Univ.)
Ôtani Mitsuharu (Waseda Univ.)
Mosco convergence of functionals associated with Laplacian under nonlinear boundary conditions 15

Summary: This talk is devoted to studying the convergence of functionals associated with Laplacian under nonlinear boundary conditions and the asymptotic behavior of solutions to nonlinear evolution equations governed by subdifferential operators of the functionals. To be more precise, we show the continuous dependence of the solution on the power of the nonlinear term of boundary conditions. The proof is based on some modifications of the argument of Mosco convergence by Attouch.

16 Takanori Kuroda (Waseda Univ.)
Mitsuharu Ôtani (Waseda Univ.)
Asymptotic behaviors of complex solutions for the semilinear heat equation with arbitrarily large initial energy 15

Summary: In this talk, we consider the semilinear heat equation (P):

$$u_t - \Delta u - |u|^{q-2}u = 0, \quad u(0) = u_0$$

and the semilinear elliptic equation (E), which corresponds to the stationary problem of (P):

$$-\Delta u - |u|^{q-2}u = 0,$$

with the hohogeneous Dirichlet boundary condition in bounded domains $\Omega \subset \mathbb{R}^N$, $(N \geq 3)$ which are radially symmetric with respect to the first two variables. We seek solutions which takes complex values of the following form:

$$u_k(x_1, x_2, \tilde{x}) = e^{ik\theta} v_k(r, \tilde{x}), \quad (x_1, x_2, \tilde{x}) = (r\cos\theta, r\sin\theta, \tilde{x}) \in \Omega, \quad k \in \mathbb{N}.$$

We show the energy of solutions u_k of (E) tends to infinity as $k \to \infty$. Making use of this fact, for initial data of arbitrarily large energy, we construct two kinds of sets, i.e., stable set W and blow-up set V such that if $u_0 \in W$ (resp. $u_0 \in V$), then u can be continued globally up to $(0, \infty)$ (resp. u blows up in finite time).

17 Shohei Kohatsu (Tokyo Univ. of Sci.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Behavior of weak solutions to a Keller–Segel system with gradient dependent chemotactic coefficient 15

Summary: We consider behavior of weak solutions to a Keller–Segel system with gradient dependent chemotactic coefficient:

$$\begin{cases} u_t = \Delta u - \chi \nabla \cdot (u|\nabla v|^{p-2}\nabla v), \\ v_t = \Delta v - v + u, \end{cases}$$

where $\chi > 0$, $p \in (1, \infty)$.

18 Yutaro Chiyo (Tokyo Univ. of Sci.)
Boundedness and stabilization in a quasilinear attraction-repulsion chemotaxis system 15

Summary: This talk deals with a quasilinear parabolic–parabolic–elliptic attraction-repulsion chemotaxis system. In the case that the second equation is simplified by the elliptic one, boundedness and stabilization have already been obtained. The purpose of this talk is to derive boundedness and stabilization in the case that the second equation is parabolic.

19 Tobias Black (Paderborn Univ.)
Mario Fuest (Leibniz Univ. Hannover)
Johannes Lankeit (Leibniz Univ. Hannover)
Masaaki Mizukami (Kyoto Univ. of Edu.)
Possible points of blow-up in a chemotaxis system with environmental dependent logistic source 15

Summary: We discuss the influence of possible spatial inhomogeneities in the coeffcients of logistic source terms in parabolic–elliptic chemotaxis-growth systems in two-dimensional smoothly bounded domains. Assuming that the coeffcient functions is nonnegative, we prove that finite-time blow-up of the classical solution can only occur in points where the coefficient function is zero.

Summary: This paper discusses the a quasi-variational inequality in plasticity model. In phys- ical terms, it is natural that the threshold function depends on some unknown variable. This model is expected to describe plastic deformation due to the time-nonlocal depen- dence of the constraint on the unknown function. This is a difference from the perfect plasticity model. To prove the existence of a solution of the plastity model, Banach fixed point theorem is applied, taking care to choose the test function.

Summary: We consider the initial-boundary value problems for nonlinear parabolic equations describing moisture transport in a porous material occupying a one-dimensional interval. Our problem is obtained by simplification of the model proposed by Green, Dabiri and Weinaug. Precisely, their system consists of two equations corresponding to conservation law for water in air and liquid regions, and in our problem the water distribution in air is given. The unknown function of the problem indicates the chemical potential of water. Also, we approximate the equation which is type of elliptic-parabolic, originally, as a first step in this research. The aim of this talk is to establish existence and uniqueness of solutions to the approximate problem by applying the standard fixed-point argument.

Summary: We talk about omega-limit sets for strong solutions to the initial and boundary value problem for the beam equation with the viscosity term and the nonlinear stress function having a singularity. Thanks to the singularity, we obtained the uniform estimate of lower bounds for the strain, and already proved existence and uniqueness of weak and strong solutions. By effect of the viscosity, it seems to be natural that the solution converges to the stationary solution. On this conjecture we show existence of a subsequence of the orbit $\{u(t)|t \geq 0\}$ such that it converges to a strong solution to the steady problem. We note that similar result on the weak solutions was reported at the previous meeting.

Summary: In this talk, we propose a multiscale model describing the wetting-drying phenomenon in porous materials. This model consists of a diffusion equation for the relative humidity distributed in materials and a free boundary problem describing the wetting-drying process in microscopic pores. We consider each microscopic pore as a one-dimensional interval and correspond the interval to each point of materials. In our previous results, for a given relative humidity we showed the well-posedness of the free boundary problem. In this talk, we impose a governing equation for the relative humidity and discuss the existence and uniqueness of a locally-in-time solution of this model.

14:15–16:30

24 Daiki Mizuno (Chiba Univ.)
Ken Shirakawa (Chiba Univ.)
Well-posedness and regularity results for a class of total variation flows of pseudo-parabolic types 15

Summary: In this talk, a class of initial-boundary value problems of total variation flows of pseudo-parabolic types is considered. Total variation flow has been adopted as governing equation of various nonlinear phenomena, such as grain boundary motion, image denoising, and so on. The principal characteristic of our problem is in the velocity term of diffusion flux, and the velocity would bring stronger regularity that that as in standard parabolic PDE. Meanwhile, our total variation flow contains singular diffusion, and the singularity would degenerate the regularity of solution. The objective of this paper will be to clarify the power balance between these conflicted effects. Consequently, the mathematical results concerned with well-posedness and regularity of solution will be discussed in the Main Theorems of this talk.

25 Shodai Kubota (Kanagawa Univ.)
Periodic solutions for Warren– Kobayashi–Lobkovsky–Carter type systems of grain boundary motions 15

Summary: In this talk, we consider teh periodic solutions for the parabolic PDE systems denoted by (S). Each system (S) is associated with the phase field model of grain boundary motion, proposed by [Warren, et al.; *Acta Materialia*, 51(20): 6035–6058, 2003]. Under suitable assumptions, the existence of the periodic solution to the system (S) will be reported as the main theorem of this talk.

26 Hiroshi Watanabe (Oita Univ.)
Ken Shirakawa (Chiba Univ.)
Salvador Moll (Univ. València)
Existence of solutions to a phase-field model of 3D-grain boundary motion 15

Summary: We consider a phase-field model of 3D-grain boundary motion. The model is based on the three dimensional Kobayashi–Warren model for the dynamics of polycrystals. To formulate our 3D-model, we use a quaternion formulation for the orientation variable. In this talk, we obtain existence of solutions to the L^2-gradient descent flow of the constrained energy functional via several approximating problems. Moreover, we also obtain an invariance principle for the orientation variable.

27 Takeshi Fukao (Kyoto Univ. of Edu.)
Pierluigi Colli (Univ. of Pavia)
Luca Scarpa (Politecnico di Milano)
The Cahn–Hilliard system of LW model with forward-backward dynamic boundary condition 15

Summary: For Cahn–Hilliard equations with forward-backward dynamical boundary conditions, we consider the vanishing viscosity approach from LW model. In the previous study, the approach from GMS model was discussed. The same idea is used for the LW model. Since the regularity of the solution is lowered in the limit equations, we define a weak solution using the subdifferential with suitable function spaces. In the LW model unlike the GMS model, it is subject to the mass conservations at the bulk and the boundary, respectively, which makes some difficulty. In this talk, we will especially introduce the idea of the uniform estimate.

28 Noriaki Yamazaki (Kanagawa Univ.)
Nobuyuki Kenmochi (Chiba Univ.*)
Ken Shirakawa (Chiba Univ.)
Approximation of singular optimal control problems for doubly quasi-variational evolution inclusions 15

Summary: In this talk, we establish an approximate procedure for singular optimal control problems for abstract doubly quasi-variational evolution inclusions governed by time-dependent subdifferentials with the unknown-dependent constraints. Indeed, we consider the parameter-dependent state inclusion and its control problems. Then, we show the relationship between the original control problem and its approximate one.

29 Akio Ito — Tumor invasion model with quasi-variational structural porous medium diffusion 15

Summary: We consider an initial-boundary value problem of a tumor invasion of Chaplain–Anderson type, in which the coefficient of random motility of tumor cells depends on the extracellular matrix and the diffusion flux of tumor cells is porous medium type whose power depends upon the extracellular matrix. Form these points of view, the Cauchy problem considered in this talk has a quasi-variational structure and this fact makes it more difficult and complicate to analyze this model mathematically. The aim of this talk, we give the global existence of strong solutions by using the general theory, which was established in the paper, Evolution inclusion on a real Hilbert space with quasi-variational structure for inner products, Journal of Convex Analysis, 26 (2019), No. 4, 1185–1252.

30 Toshitaka Matsumoto (Shizuoka Univ.), Naoki Tanaka (Shizuoka Univ.) — Generation of evolution operators under a generalized stability condition 15

Summary: A generation theorem of a linear evolution operator on a Banach spaces is given under a generalized stability condition for a difference scheme. The denseness and the time-independence of the domains of generators are not assumed. A differentiablity theorem of an evolution operator is also given.

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

Shunsuke Kurima (Tokyo Univ. of Sci.) — Time discretization methods for phase field systems

Summary: The speaker has studied approaches by time discretization to a phase field system of Caginalp type and a singular phase field system of conserved type with Pierluigi Colli. The time discretization method is a method of capturing the derivative with respect to time with the limit of the difference quotient, and it has the advantage that evolution equations can be reduced to stationary problems of elliptic equations. In this talk, for phase field systems with inertial term which has already been proved to have solutions, we will confirm if we can apply time discretization methods to show existence of solutions and derive error estimates for the time step. Also, in this talk, for singular nonlocal phase field systems with inertial term which has not yet been proved to have solutions, we will show existence of solutions by time discretization methods.

Functional Analysis

March 15th (Wed) Conference Room VI

9:30–12:00

Summary: In this paper, by replacing the commutator product by the logarithmic representation of unbounded operators [1-9], the generalized/unbounded version of von Neumann equation is presented. The proposed equation is general enough to be valid to bounded situations (i.e., classical mechanics). By taking some concrete examples in the quantum mechanics, the derivation of generalized von Neumann equation is explained.

Summary: We give a new operator-theoretical proof of the existence, uniqueness and smoothness of the solution to the BCS-Bogoliubov gap equation of superconductivity and apply the results to the second-order phase transition.

Summary: The space of entire functions at most of a given order and of normal type (resp. minimal type) is endowed with a locally convex topology as an inductive limit (resp. projective limit) of Banach spaces. Continuous endomorphisms of such spaces include differential operators, translations, dilations, etc., and they can be represented as formal differential operators of infinite order satisfying suitable conditions. We consider continuous homomorphisms between spaces of entire functions with growth given by proximate orders instead of orders, and give their differential operator representations. We also reveal the merits of treating proximate orders and homomorphisms from the view point of inductive and projective descriptions.

Summary: Let H(P) be the renormalized Nelson Hamiltonian with total momentum P. We show that exp(-TH(P)) is positivity improving for any P.

Summary: We consider the pair interaction model which is a models in the quantum field theory. In our previous work, we diagonalize its Hamiltonian by a Bogoliubov transformation. As a consequence, the existence and uniqueness of the ground states are proven. In addition, the explicit formula for the ground state energy has been given. In this talk, we show that the ground state and the ground state energy are analytic in the coupling constant. Their radii of convergence are always finite.

Summary: We consider the eigenvalue problem for self-adjoint Dirac operators. It is known that, near an energy level where the square of the potential makes a simple well, the eigenvalues are approximated by a Bohr–Sommerfeld type quantization rule. A remarkable difference from the Schroedinger case appears in the Maslov correction term. This fact was recently found by Hirota (2017) under the analyticity condition of the potential using a complex WKB method. In this talk, we approach this problem with a microlocal technique focusing on the asymptotic behavior of the eigenfunction along the characteristic set to generalize the result to smooth potentials.

Summary: We characterize resonance free domain for semiclassical inverted harmonic oscillators by employing method of Briet–Combes–Duclos. For fixed non-zero energy E, we assume a certain non-trapping condition; the whole domain can be split into the classically forbidden region and region where virial is bounded by negative constant from above. Then we obtain the absence of resonances in a complex neighborhood of E.

Summary: It is known that Schroedinger operators with sparse potentials have singular continuous spectrum. The graph Laplacian on a sparse tree is identified with one-dimensional discrete Schroedinger operators, and has singular continuous spectrum. The intermittency function describes the behavior of the time averaged momentum and gives the upper bound of the Hausdorff dimension of the spectral measure. We show the intermittency function explicitly and give the Hausdorff dimension of the spectral measure for the graph Laplacian on a sparse tree.

Summary: It is known that the spectrum of Schrödinger operators with sparse potentials consists of singular continuous spectrum. We give a sufficient condition so that the edge of the singular continuous spectrum is not an eigenvalue and construct examples with singular continuous spectrum which have no eigenvalues and which have a single negative eigenvalue.

14:15–16:15

Summary: In a variational method like Lax–Milgram theorem, we define Laplacian on the infinite direct product space $\mathbb{R}^\infty := \prod_{n\in\mathbb{N}} \mathbb{R}$ and show that it is a self-adjoint operator. Here, the most important thing is to define Hilbert space that corresponds to Sobolev space $H^1(\mathbb{R}^\infty)$. To do it, we use square root of density introduced by Hormander in context of Fourier integral operator theory. However, here, we use a measure-theoretic method rather than a geometric method to give a very elementary introduction at least for analyst (inspired by statistical interpretation of quantum mechanical wave function by Born and Heisenberg) of square root of density. All in all, only basic knowledge of analysis (as it is quite possible to study undergraduate) is required.

Summary: We define the generator of a holomorphic semigroup for a countably infinite interacting Brownian particle system on a countable direct product space $\mathbb{R}^\infty := \prod_{n\in\mathbb{N}}\mathbb{R}$ as a maximal monotone self-adjoint operator $\sum_{k=1}^\infty((-\frac{\partial}{\partial x_k}+H_k)(\frac{\partial}{\partial x_k}+H_k))$. At first glance, this may seem like a pretty difficult problem, but it is not too difficult because $\frac{\partial}{\partial x_k}$ on $\mathbb{R}^\infty$ can be defined as just a (generalized) partial derivative. The most important thing is to define a H-partial derivative $\partial_{H,k} := \frac{\partial}{\partial x_k}+H_k$ as a closed operator for a sequence $\{H_k\}_{k=1}^\infty$ of measurable functions whose domain are measurable "subsets" of $\mathbb{R}^\infty$. As with the previous talk, only basic knowledge of analysis (and part of the previous talk) is required.

Summary: The dissipative wave propagation problem with magnetic Laplacian in an exterior domain is considered.The uniform estimates and Hölder conditions of the resolvent are studied for the reduced wave operator without dissipation. Based on these results, the validity of the principle of limiting amplitude is proved for wave propagation problem with dissipation. As byproduct, the result by Mizohata–Mochizuki in 1966 are improved.

Summary: In this talk we are concerned with the embedding properties for several kind of functional spaces in R^N. We will consider the functional spaces called as Weighted Sobolev space with some weight function. If we choose some suitable growing functions in the weight functions, we can derive the continuity and compact embedding for these functional spaces. We also obtain the sufficient conditions for the weight functions to show the above properties. Our method is mainly owed to usual Sobolev's inequality.

Summary: We consider a first order ordinary differential system with two small parameters, which are an adiabatic parameter and an interaction one. This system is a model of a time-dependent Schrödinger equation which describes that two energy-levels with tangential intersections avoid crossings. In this talk, we give asymptotic expansion of the transition probability between avoided crossings as two parameters tend to zero as well as their ratio determined by the tangential order does.

Summary: The Neumann–Poincaré operator (abbreviated by NP) is a boundary integral linear operator known as one of the important tools associated with boundary value problems in the field of partial differential equations. Our purpose here is to introduce the spectral structure of the NP operator. In an asymptotic sense, the NP spectrum distributed in the interval [-1/2, 1/2) as the domains become longer in 2D. In an asymptotic sense, we also find that the NP spectrum densely distributed in the interval [-1/2, 1/2) (resp. [0, 1/2)), as the domains which are defined by spheroids become flatter (resp. longer) in 3D.

16 Yoshihiro Anahara (Yokohama Nat. Univ.)
Norio Konno (Yokohama Nat. Univ.)
Morioka Hisashi (Ehime Univ.)
Etsuo Segawa (Yokohama Nat. Univ.)
Limit theorem for quantum walk on one dimensional lattice with inflows and outflows 15

Summary: To obtain a stationary state of quantum walks on the finite path, we set the sink and source to the boundaries of the path so that the internal path receives the inflow and raditas the outflow at every time step. In this talk we consider one dimensional lattice as finite graph and we show the weak convergence theorem for the scaled limit distribution of the comfortability in the limit of the length of the path.

17 Kenta Higuchi (Ehime Univ.)
Hisashi Morioka (Ehime Univ.)
Etsuo Segawa (Yokohama Nat. Univ.)
Resonance expansion for finitely perturbed free quantum walks on the line 15

Summary: We introduce resonances to a class of quantum walks on the line as poles inside the unit circle of the outgoing resolvent. With each resonance, a resonant state which behaves like an eigenvector is associated. We show that the time evolution with an initial state with compact incoming support exactly coincides with the evolution of a sum of resonant states in each compact set after a finite length of time has passed. Consequently, the exponential decay rate of the time evolution is given by the modulus of resonances. We note that in the special case where a resonance is algebraically multiple, the decay becomes polynomially slower.

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

Toshimitsu Takaesu (Gunma Univ.) On the spectral analysis of interacting quantum field systems

Summary: In this talk, interacting systems of quantum field models are investigated. We mainly consider the system of quantum electrodynamics, which is the interaction system of a Dirac field and the radiation field in the Coulomb gauge, but the Yukawa model and ϕ^4 model are also considered. By introducing momentum and spatial cutoffs, the Hamiltonians are self-adjoint operators on a Hilbert space. Focusing on ground states, the spectral analysis of these systems will be explained.

March 16th (Thu) Conference Room VI

9:30–12:00

18 Takashi Satomi (Univ. of Tokyo)
Inequality for the convolutions on unimodular locally compact groups and the optimal constant of related inequalities 15

Summary: Let μ be the Haar measure of a unimodular locally compact group G and $m(G)$ be the infimum of the volumes of all open subgroups of G. The main result is that $\int_G f\circ(\phi_1 * \phi_2)\,(g)\,dg \le \int_{\mathbb{R}} f\circ(\phi_1^* * \phi_2^*)\,(x)\,dx$ holds for any measurable functions $\phi_1, \phi_2 \colon G \to \mathbb{R}_{\ge 0}$ with $\mu(\operatorname{supp}\phi_1) + \mu(\operatorname{supp}\phi_2) \le m(G)$ and any convex function $f \colon \mathbb{R}_{\ge 0} \to \mathbb{R}$ with $f(0) = 0$. Here ϕ^* is the rearrangement of ϕ.
Let $Y_O(P,G)$ and $Y_R(P,G)$ denote the optimal constants of Young's and the reverse Young's inequality, respectively, on G for the pair of the exponents $P = (p_1, p_2)$ under the assumption $\mu(\operatorname{supp}\phi_1) + \mu(\operatorname{supp}\phi_2) \le m(G)$. Then we have $Y_O(P,G) \le Y_O(P,\mathbb{R})$ and $Y_R(P,G) \ge Y_R(P,\mathbb{R})$ as a corollary of the main result. Thus, we obtain that $m(G) = \infty$ holds if and only if $H(p,G) \le H(p,\mathbb{R})$ in the case of $p' := p/(p-1) \in 2\mathbb{Z}$, where $H(p,G)$ is the optimal constant of the Hausdorff–Young inequality on G for the exponent p.

Summary: Let $\mathfrak{g}$ be a finite dimensional complex simple Lie algebra and $\mathfrak{b}$ a Borel subalgebra. Let $\mathfrak{p} \supset \mathfrak{b}$ be a standard parabolic subalgebra. In 1977, Lepowsky showed that a homomorphism $\varphi\colon M_{\mathfrak{b}}(\nu) \to M_{\mathfrak{b}}(\zeta)$ between Verma modules induces a map $\varphi_{\mathrm{std}}\colon M_{\mathfrak{p}}(\nu) \to M_{\mathfrak{p}}(\zeta)$ between the corresponding generalized Verma modules, provided that ν and ζ satisfy a certain integral condition. He called such a map φ_{std} *standard*. It was also observed that the standard map φ_{std} could be zero and even in the case there could be a non-zero homomorphism $\varphi_{\mathrm{nonstd}}\colon M_{\mathfrak{p}}(\nu) \to M_{\mathfrak{p}}(\zeta)$. Any map that is not standard is called *non-standard*. The classification of standard/non-standard maps is still an open problem.
In this talk, for $\mathfrak{g} = \mathfrak{sl}(3,\mathbb{C})$ with a maximal parabolic subalgebra $\mathfrak{p}$, we shall show that all non-zero homomorphisms $\psi\colon M_{\mathfrak{p}}(\nu) \to M_{\mathfrak{p}}(\zeta)$, where $M_{\mathfrak{p}}(\zeta)$ is of scalar type, are standard.

Summary: We give the inversion formula and the Plancherel formula for Opdam–Cherednik transform associated with a root system of type BC, when the multiplicity parameters are not necessarily nonnegative.

Summary: We develop the spectral analysis for the Dirac operator on symmetric spaces of noncompact type based on harmonic analysis on Lie groups. In this talk, we compute the continuous spectrum of the Dirac operator on irreducible symmetric spaces of noncompact type. We show that the continuous spectrum has a spectral gap if and only if the symmetric space is isomorphic to a coset space of the special pseudo-unitary group of odd matrix size. Furthermore, we give a uniform weighted resolvent estimate for the Dirac operator under a certain assumption on the symmetric space.

Summary: Let $(G, G_1) = (G, (G^\sigma)_0)$ be a symmetric pair of holomorphic type, and we consider a pair of Hermitian symmetric spaces $D_1 = G_1/K_1 \subset D = G/K$, realized as bounded symmetric domains in complex vector spaces $\mathfrak{p}_1^+ := (\mathfrak{p}^+)^\sigma \subset \mathfrak{p}^+$ respectively. Then the universal covering group $\widetilde{G}$ of G acts unitarily on the weighted Bergman space $\mathcal{H}_\lambda(D) \subset \mathcal{O}(D) = \mathcal{O}_\lambda(D)$ on D for sufficiently large λ. Its restriction to the subgroup $\widetilde{G}_1$ decomposes discretely and multiplicity-freely, and its branching law is given in terms of the $\widetilde{K}_1$-decomposition of the space $\mathcal{P}(\mathfrak{p}_2^+)$ of polynomials on $\mathfrak{p}_2^+ := (\mathfrak{p}^+)^{-\sigma} \subset \mathfrak{p}^+$. Our goal is to understand the decomposition of the restriction $\mathcal{H}_\lambda(D)|_{\widetilde{G}_1}$ by studying the weighted Bergman inner product on each $\widetilde{K}_1$-type in $\mathcal{P}(\mathfrak{p}_2^+) \subset \mathcal{H}_\lambda(D)$. Today we deal with the symmetric pair $(G, G_1) = (Sp(2r,\mathbb{R}), Sp(r,\mathbb{R}) \times Sp(r,\mathbb{R}))$.

Summary: With the aim of uniform treatment of multiplicity-free representations of Lie groups including infinite-dimensional representations, T. Kobayashi introduced the notion of visible actions on complex manifolds. In this talk I would like to show a trick for obtaining the multiplicity-freeness property of infinite-dimensional representations of real semisimple Lie groups from that of finite-dimensional ones of compact Lie groups through visible actions on flag varieties.

Summary: In this talk, we explain about the construction and classification problems of all differential symmetry breaking operators $D : C^\infty(S^3, \mathcal{V}_\lambda^{2N+1}) \to C^\infty(S^2, \mathcal{L}_{m,\nu})$ between the section spaces of $\mathcal{V}_\lambda^{2N+1} \to S^3$, a rank $2N+1$ vector bundle over S^3, and $\mathcal{L}_{m,\nu} \to S^2$, a line bundle over S^2.

25 Hideto Nakashima (Inst. of Stat. Math.) Decomposition formulas for gamma matrices of zeta functions associated with homogeneous cones 15

Summary: Associated with homogeneous cones, we are able to construct solvable prehomogeneous vector spaces. In the previous paper, we calculate gamma matrices of the associated zeta functions explicitly. In this talk, we show that the gamma matrices can be decomposed into variable-wise matrices. Moreover, under suitable condition, we show that the associated zeta functions admit a kind of completion forms.

13:10–14:10 Talk Invited by Functional Analysis Section

Takashi Hashimoto (Tottori Univ.) Qunatization of the moment map on symplectic vector spaces and minimal representation

Summary: Let G be $\mathrm{Sp}(n,\mathbb{R})$, $\mathrm{U}(p,q)$, or $\mathrm{O}^*(2n)$, which acts on a symplectic vector space W in a Hamiltonian way with moment map μ. The purpose of this talk is twofold: the first one is to show that the canonical quantization of μ with a choice of a Lagrangian subspace of W provides the oscillator representations of G, which have been extensively studied in relation to the Howe duality and to minimal representations. The second one is to construct the minimal representation of $\mathrm{O}(p,q)$ by applying this method to $\mathrm{O}(p,q)$ and using the fact that $(\mathrm{O}(p,q),\mathrm{SL}_2(\mathbb{R}))$ is a Howe's dual pair.

March 17th (Fri) Conference Room VI

9:30–12:00

26 Shiho Oi (Niigata Univ.) Algebraic reflexivity of isometry groups of Lipschitz algebras 15

Summary: We consider Banach algebras of Lipschitz maps taking the values in a Banach algebra of complex matrices of degree n. The unital subjective linear isometries on the Banach algebras have been obtained. In this talk, we study the algebraic reflexivity of the set of subjective linear isometries. The subset S of the set of all bounded linear operators from A_1 into A_2 is called algebraically reflexive if a bounded linear operator $T : A_1 \to A_2$ which satisfies $Ta \in Sa$ for every $a \in A_1$ implies $T \in S$. We show the set of unital subjective linear isometries is algebraic reflexivity.

27 Yuta Enami (Niigata Univ.)
Takeshi Miura (Niigata Univ.) Surjective isometries on the Banach algebra of analytic functions with C^n-boundary values 12

Summary: Let $\mathbb{D}$, $\overline{\mathbb{D}}$ and $\mathbb{T}$ be the open unit disk, closed unit disk and unit circle in the complex plane $\mathbb{C}$. The disk algebra $A(\overline{\mathbb{D}})$ is the algebra of all continuous functions on $\overline{\mathbb{D}}$ that is holomorphic in $\mathbb{D}$. We consider the subalgebra $A^n(\overline{\mathbb{D}})$ consisting of all $f \in A(\overline{\mathbb{D}})$ whose restrictions $f|_{\mathbb{T}}$ are of class C^n. For each $f \in A^n(\overline{\mathbb{D}})$, we denote by $D^k(f)$ the k-th derivative of $f|_{\mathbb{T}}$. The algebra $A^n(\overline{\mathbb{D}})$ is a Banach algebra, with the norm $\|f\|_\Sigma = \sum_{k=0}^n \|D^k(f)\|_\infty/k!$, where $\|g\|_\infty = \sup_{z\in\mathbb{T}} |g(z)|$. We characterized surjective, not necessarily linear, isometries on $A^n(\overline{\mathbb{D}})$ with respect to the norm $\|\cdot\|_\Sigma$.

28 Takeshi Miura (Niigata Univ.)
Daisuke Hirota (Niigata Univ.) Tingley's problem for uniformly closed function algebras 15

Summary: Let A and B be uniformly closed function algebras on locally compact Hausdorff spaces X and Y, respectively. We shall present a positive answer to Tingley's problem for A and B. More explicitly, we prove that every surjective isometry between the unit spheres, $S(A)$ and $S(B)$, of A and B admits an extension to a surjective real linear isometry between whole spaces A and B.

29 Takashi Sano (Yamagata Univ.)♭
Kazuki Takeuchi (Yamagata Univ.) Inertia of Kraus matrices 10

Summary: Let $r, p_0, p_1 < \cdots < p_n$ be positive numbers. We consider the $n \times n$ matrix whose (i,j) entry is given as $\dfrac{1}{p_i - p_j}\left(\dfrac{p_i^r - p_0^r}{p_i - p_0} - \dfrac{p_j^r - p_0^r}{p_j - p_0}\right)$. We call this a Kraus matrix associated with t^r. We show the inertia of this Kraus matrix.

30 Masaru Nagisa (Ritsumeikan Univ./Chiba Univ.) The p-norm of some matrices ····· 10

Summary: We compute the operator p-norm of some $n \times n$ complex matrices, which can be seen as bounded linear operators on the n-dimensional Banach space $\ell^p(n)$. In particular, a p-norm of a matrix $A = \begin{pmatrix} 8 & 1 & 6 \\ 3 & 5 & 7 \\ 4 & 9 & 2 \end{pmatrix}$ which corresponds to a magic square is 15 for any $p \in [1, \infty]$.

31 Hiroaki Tohyama (Maebashi Inst. of Tech.)
Eizaburo Kamei
Masayuki Watanabe (Maebashi Inst. of Tech.)
Operator inequalities related to Young's inequality ····· 15

Summary: In this talk, we show several operator inequalities concerning Young's inequality by using relative operator entropies and operator valued α-divergence. One of them is partially a refinement of Young's inequality.

32 Takeaki Yamazaki (Toyo Univ.)
Hiroyuki Osaka (Ritsumeikan Univ.)
Limit of iterated induced Aluthge transformations of centered operators ····· 15

Summary: In this talk, we shall discuss on bounded linear operators on a complex Hilbert space. We will introduce convergence property of an operator sequence which is generated by iteration of the induced Aluthge transformation. In this talk, we consider the case of centered operators.

33 Hiroyuki Osaka (Ritsumeikan Univ.)
Tomasz Młynik (Univ. of Gdańsk)
Marcin Marciniak (Univ. of Gdańsk)
On a class of K-entanglement witnesses ····· 15

Summary: Recently, Yang et al.showed that each 2-positive map acting from $\mathcal{M}_3(\mathbb{C})$ into itself is decomposable. It is equivalent to the statement that each PPT state on $\mathbb{C}^3 \otimes \mathbb{C}^3$ has Schmidt number at most 2. It is a generalization of Perez–Horodecki criterion which states that each PPT state on $\mathbb{C}^2 \otimes \mathbb{C}^2$ or $\mathbb{C}^2 \otimes \mathbb{C}^3$ has Schmidt rank 1 i.e. is separable. Natural question arises whether the result of Yang at al. stays true for PPT states on $\mathbb{C}^3 \otimes \mathbb{C}^4$. This question can be considered also in higher dimensions. We construct a positive maps which is suspected for being a counterexample. More generally, we provide a class of positive maps between matrix algebras whose k-positivity properties can be easily controlled.

34 Yuki Seo (Osaka Kyoiku Univ.) On data processing inequality for quantum $\natural_\alpha$-Rényi divergences of positive order ····· 15

Summary: In this talk, we show some fundamental properties of quantum $\natural_\alpha$-Rényi divergences of real order. In particular, we show that the data processing inequality holds for all $\alpha > 0$.

14:15–15:30

35 Hiroshi Inoue (Kyushu Sangyo Univ.) An unbounded generalization of Tomita's observable algebras II ····· 15

Summary: In a previous talk we tried to build the basic theory of unbounded Tomita's observable algebras called $T^\dagger$-algebras which are related to unbounded operator algebras, especially unbounded Tomita–Takesaki theory, operator algebras on Krein spaces, studies of positive linear functionals on $*$-algebras and so on. And we defined the notions of regularity, semisimplicity and singularity of $T^\dagger$-algebras and characterized them. In this talk we shall proceed further studies of $T^\dagger$-algebras and investigate whether a $T^\dagger$-algebra is decomposable into a regular part and a singular part.

Summary: Deaconu and Muhly was defined C^*-algebras associated with branched coverings. But their algebras lack information of branch points. Kajiwara and Watatani tried to modify Deaconu–Muhly algebras and defined C^*-algebras associated with complex dynamical systems. Let R be a rational function and J be its Julia set. It is known that the C^*-algebra $C(J)$ of complex-valued continuous functions on J is a Cartan subalgebra of the Deaconu–Muhly algebra for the dynamical system (J, R), but it was not known whether $C(J)$ is a Cartan subalgebra of the Kajiwara–Watatani algebra for (J, R) or not. In this talk, I explain that $C(J)$ may not be a Cartan subalgebra of the Kajiwara–Watatani algebra for (J, R).

Summary: The Neretin group is the totally disconnected locally compact group consisting of almost automorphisms of the tree. In 2021, P.-E. Caprace, A. Le Boudec, and N. Matte Bon proved that the Neretin group is not of type I. We prove that a distinguished open subgroup of the Neretin group is not of type I either.

Summary: When a non-degenerate commuting square is given, we can construct a hyperfinite II_1 subfactor $N \subset M$ generated by the tower of the given non-degenerate commuting squares. From the original commuting square, we can also construct the flat part commuting squares. If the subfactor $N \subset M$ is of finite depth, we will show that the composite connection of the original and the flat part ones (in the sense of N. Sato) produces a subfactor which is isomorphic to $N \subset M$. We also show an application of this result.

15:45–16:45 Talk Invited by Functional Analysis Section

Summary: We study non-linear traces of Choquet type and Sugeno type on the algebra of compact operators. They have certain partial additivities. We show that these partial additivities characterize non-linear traces of both Choquet type and Sugeno type respectively. There exists a close relation between non-linear traces of Choquet type and majorization theory. We study trace class operators for non-linear traces of Choquet type. More generally we discuss Schatten–von Neumann p-class operators for non-linear traces of Choquet type. We determine when they form Banach spaces. This is an attempt of non-commutative integration theory for non-linear traces of Choquet type on the algebra of compact operators. We also consider the triangle inequality for non-linear traces of Sugeno type.

Statistics and Probability

March 15th (Wed) Conference Room VIII

10:00–11:30

1 Naoki Kubota (Nihon Univ.) Lipschitz-tiype estimates for the time constant of the frog model ····· 15

Summary: We consider the frog model on the multidimensional lattice, whose initial configuration is according to a Bernoulli distribution. The main object of interest is the so-called time constant, which describes the speed of the spread of frogs. The time constant depends on the parameter of the Bernoulli distribution. Hence, in this talk, we discuss how the change in the parameter of the Bernoulli distribution affects the time constant. More precisely, we provide some Lipschitz-type estimates for the time constant.

2 Takumu Ooi (Kyoto Univ.) Convergence of time-changed α-stable processes by GMC ····· 15

Summary: We consider Gaussian fields whose covariance kernels are 1-order green functions of d-dimensional symmetric α-stable processes, Gaussian multiplicative chaos (GMC) and time-changed α-stable processes by GMC. In the case of both d and α are 2, these are the Gaussian free field, the Liouville measure and the Liouville Brownian motion, respectively. In this talk, we explain weak convergence of the time-changed α-stable processes by GMC with Skorokhod's topology.

3 Mikio Hirokane (Osaka Univ.)
Masaaki Fukasawa (Osaka Univ.) A limit theorem for generalized tempered stable processes and their quadratic variations with stable index tending to two ····· 15

Summary: Motivated by Yoshida's martingale expansion theory, we study the limit of the joint distribution of a multidimensional Generalized Tempered Stable (GTS) process and its quadratic covariation process when the stable index tends to two. Under a proper scaling, the GTS processes converges to a Brownian motion that is a stable process with stable index two. We renormalize their quadratic covariation processes so that they have a nondegenerate limit distribution. We show that the limit is a stable process with stable index one and is independent of the limit Brownian motion of the GTS processes.

4 Yuki Suzuki (Keio Univ.)
Hiroshi Takahashi (Keio Univ.)
Yozo Tamura A diffusion process with a symmetric stable potential on the negative side in $\mathbb{R}$ ····· 15

Summary: We investigate a diffusion process with a symmetric stable potential on the negative side in $\mathbb{R}$. In the case of a Brownian potential on the negative side, this process was examined by Kawazu, Suzuki and Tanaka (2001, 2006). We study a long-time behavior of our process by a different method from theirs. We use a method based on a theory of bi-generalized diffusion processes studied by Ogura (1989).

5 Yuki Suzuki (Keio Univ.) Limit theorems for a diffusion process with a non-selfsimilar random potential ····· 15

Summary: We study a one-dimensional diffusion process with a non-selfsimilar random potential. The type of the potential is different on the left and the right hand sides of the origin. We show that the long-time behavior of the process is different from the behaviors of any other previous models.

6 Shigeyoshi Ogawa (Ritsumeikan Univ.) Another representation of the mean value theorem for noncausal stochastic integrals 10

Summary: This is the follow up to the preceding lecture "Mean value theorems for the noncausal stochastic integral" that was presented at the 2022 annual meeting of Math Society of Japan held in Sappro, in Octobre 2022. There we showed a basic fact about the validity of a mean value theorem for the noncausal stochastic integral, also called ogawa integral, with respect to Brownian motion W_t of the form $\int_s^t f(X_r)d_*W_r$ where X_t is an Itô process, We derived formulae of mean value theorem for Itô integral $\int_s^t f(X_r)d_0W_r$ and for the noncausal integral $\int_s^t f(\tilde{X}_r)d_*W_r$ where $\tilde{X}_t(\emptyset)$ is a noncausal variation of X_t.
The aim of the present talk is to give an elementary but important comment on the basic result and show another formula of mean value theorem for each of three cases mentioned above.

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

Shuta Nakajima (Meiji Univ.) First-passage percolation and its related topics

Summary: In this talk, we discuss recent progress on First-passage percolation (FPP). FPP was originally introduced by Hammersley and Welsh as a model of the spread of fluid in a random medium. The model also can be regarded as a dynamic version of percolation. In FPP, a graph with random weights is given, and we consider the optimization problem of the passage time between two fixed vertices. The minimum value is called the first passage time and it represents the time when the fluid reaches from one point to the other. From the viewpoint of an optimization problem, properties of the optimal path that attains minimum value are also of interest. Over 50 years, many mathematical techniques have been developed to study these objects. This talk mainly focuses on the fluctuations and the large deviations of the first passage times, and the geometric properties of geodesics. We also discuss related models such as the chemical distance.

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

Song Liang (Waseda Univ.) A mechanical model of Brownian motion

Summary: We provide a connection between Brownian motion and a classical Newton mechanical system.
Brownian motion is a well-known physical phenomenon concerning the erratic motion of a small particle immersed into a fluid in equilibrium. The physical explanation of Brownian motion is often presented in the following way: since the massive particle is interacted by a large number of very light environmental particles, if we could assume that the interactions from each light particle at each time are independent, then by the central limit theorem for the sums of *i.i.d.* random variables, this will give in a suitable limit the Brownian motion. We notice that this assumption of independence can hardly be justified, even in a collision model, because of the possibility of re-collisions. This becomes a more evident and significant drawback when considering the model of interactions caused by potentials.
In this talk, we consider a mechanical model consisting of a massive particle in an ideal gas, evolved according to non-random Newton mechanical principles, via interaction potentials. We prove that under certain conditions, the (position, velocity)-process of the massive particle converges to a diffusion process, when the mass of the environmental particles converges to 0, while the density and the velocities of them go to infinity promptly. The precise expression of the limiting process is also given.

March 16th (Thu) Conference Room VIII

10:20–11:10

7 Haruyoshi Tanaka (Wakayama Med. Univ.) On dimension estimates in nonconformal graph iterated function systems via asymptotic perturbation 15

Summary: We consider infinite graph-directed iterated function systems (GIFSs) whose contraction mappings are nonconformal. As our main result, we formulate asymptotic perturbations from conformal GIFSs to nonconformal GIFSs, and give the asymptotic behaviour of the Hausdorff dimension of the limit set of the perturbed system. We also investigate perturbed self-affine sets as special cases.

8 Ryoji Takano (Osaka Univ.) Large deviation principle for the Lyons–Victoir extension ····· 15

Summary: We study the large deviation principle for the Lyons–Victoir extension. The Lyons–Victoir extension is known as a method to lift a general continuous path of finite p-variation to a geometric q-variation rough path, where q is grater than p. We use the Lyons–Victoir extension as a method for lifting continuous stochastic processes to geometric rough paths. The main idea of this study is that by using the Lyons–Victoir extension, lifting the large deviation principle for continuous stochastic processes to that for geometirc rough paths. To do so, we will prove the boundedness of the Lyons–Victoir extension map. As consequence of this, the large deviation principle for rough differential equation driven by the Lyons–Victoir extenstion can be obtained.

9 Hiroki Yagisita (Kyoto Sangyo Univ.) Any Gibbs measure on infinite-dimensional space $\mathbb{R}^\infty$ defines a regular Dirichlet form with local property on compact space $(\mathbb{R}\cup\{\infty\})^\infty$ ···· 10

Summary: For Gibbs measure μ on $\mathbb{R}^\infty$, we consider a classical symmetric form formally denoted $E^\mu_{CD}(f_1,f_2) := \sum_{k\in\mathbb{N}}\int_{\mathbb{R}^\infty}\frac{\partial f_1}{\partial x_k}\frac{\partial f_2}{\partial x_k}d\mu$. Following, for example, Albeverio, Kondratiev, Rockner, etc., we adopt definition of Gibbs measure by establishment of integration by parts formula. In our main result, "μ determines a regular Dirichlet form with local property", there are no constraints other than that μ is (what we say) Gibbs measure. It seems that Gibbs measure (as we call it) also includes fairly marginal probability measure in that it is "spatially spread out". Note that we see $\mathbb{R}^\infty$ as a direct product of Riemannian manifolds.

10 Yuta Nakagawa (Kyoto Univ.) Density of states for Schrödinger operators associated with Gibbs point processes and nonpositive potentials ····· 10

Summary: In this talk, we consider the random Schrödinger operator for the potential generated by the nonpositive single site potential and the points randomly located according to the Gibbs point process for the pairwise interaction. We determine the leading term of the asymptotic behavior of the integrated density of states (IDS) for the Schrödinger operator. This IDS vanishes much faster near $-\infty$ than the IDS for the Poisson point process, of which asymptotic behavior is known.

11:20–11:50 Research Section Assembly

March 17th (Fri) Conference Room VIII

9:50–11:35

11 Teruo Tanaka (Hiroshima City Univ.) Prophet inequalities for finite stage multiparameter optimal stopping problems ····· 10

Summary: We consider the optimal stopping problem for discrete time multiparameter stochastic processes. In the classical optimal stopping problems, the comparisons between the expected reward of a player with complete foresight and the expected reward of a player using nonanticipating stop rules, known as prophet inequalities, have been studied by many authors. We shall study the prophet inequalities for optimal stopping problems for finite stage multiparameter stochastic processes.

12 Toshiharu Fujita (Kyushu Inst. of Tech.) Markov decision process with converging branch system —Multiplicative reward system— ····· 10

Summary: We consider multiplicative reward system on a certain finite-stage stochastic converging decision process model. Converging decision process has converging transition, which is one of the nonserial branch systems proposed by Nemhauser. We apply bidecision approach to our model and give a recursive method by dynamic programming technique.

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: Bassino et al. 2010 and Regnier et al. 1998 showed generating functions of the distributions of words for all sample sizes. Robin et al. 1999 presented generating functions of the distributions for the return time of words and demonstrated a recurrence formula for these distributions. These generating functions are rational functions; except for simple cases, it is difficult to expand them into power series. In this paper, we study finite-dimensional generating functions of the distributions of nonoverlapping words and some overlapping words for each fixed sample size, respectively and demonstrate the explicit formulae for the distributions of words for the Bernoulli models.

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 prove that the design matrix of an SBBD is A-optimal under some conditions.

Summary: For the goodness-of-fit test for a multinomial distribution, we consider phi-divergence family of goodness-of-fit test statistics. Members of phi-divergence family of statistics all have an equivalent limiting chi-square distribution under the null hypothesis. We consider a second-order correction term as an index whether the distribution of statistic is close to the limiting chi-square distribution. We derive important properties of the index for selecting a phi-divergence goodness-of-fit statistic. We also discuss an application of the index to the other kinds of tests.

Summary: In this talk, we consider on the null distribution of multivariate normality test statistic using multivariate skewness. Although there are several definitions of multivariate skewness and kurtosis, this talk focuses on Mardia's multivariate skewness and proposes a new chi-square approximation with adjusted degrees of freedom for the null distribution of the normality test statistic using it. Finally, some simulation results are presented to investigate the accuracy of the chi-square approximation of the test statistic proposed in this talk.

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

Takeru Matsuda (Univ. of Tokyo/RIKEN) Shrinkage estimation: from vector to matrix

Summary: In the estimation of a normal mean vector under the quadratic loss, the maximum likelihood estimator (MLE) is inadmissible and dominated by shrinkage estimators (e.g. James–Stein estimator) when the dimension is greater than or equal to three (Stein's paradox). In particular, generalized Bayes estimators with respect to superharmonic priors (e.g. Stein's prior) are minimax and dominate MLE. Note that a function is said to be superharmonic if its average value on a hypersphere is always not greater than its value at the center.

In this talk, I will introduce recent studies on generalizations of the above results to matrices. First, we develop a superharmonic prior for matrices that shrinks singular values, which can be viewed as a natural generalization of Stein's prior. This prior is motivated from the Efron–Morris estimator, which is an extension of the James–Stein estimator to matrices. The generalized Bayes estimator with respect to this prior is minimax and dominates MLE under the Frobenius loss. In particular, since it shrinks to the space of low-rank matrices, it attains large risk reduction when the unknown matrix is close to low-rank (e.g. reduced-rank regression). Next, we construct a theory of shrinkage estimation under the "matrix quadratic loss", which is a matrix-valued loss function suitable for matrix estimation. A notion of "matrix superharmonicity" for matrix-variate functions is introduced and the generalized Bayes estimator with respect to a matrix superharmonic prior is shown to be minimax under the matrix quadratic loss. The matrix-variate improper t-priors are matrix superharmonic and this class includes the above generalization of Stein's prior. Applications include matrix completion and nonparametric estimation.

15:40–16:40 Talk Invited by Statistics and Probability Section

Yuma Uehara (Kansai Univ.) Information criteria for jump diffusion models

Summary: In this talk, we consider ergodic jump diffusion models with high-frequency observations. We mainly focus on the model selection problem for the models. More specifically, our interest is to select all drift and diffusion coefficients, and jump distribution among candidates. For such a problem, the threshold based transition density approximation which corresponds to the case where at most one jump occur within one observation interval is useful. We evaluate such an approximation, and propose explicit AIC-type information criterion constructed by the threshold based quasi-likelihood function.

March 18th (Sat) Conference Room VIII

10:00–11:10

18 Ayaka Yagi (Tokyo Univ. of Sci.), Toya Ozaki (Tokyo Univ. of Sci.), Takashi Seo (Tokyo Univ. of Sci.) On the test for adequacy in growth curve model with two-step monotone missing data 15

Summary: We consider the test for adequacy in growth curve model when the data set has a two-step monotone missing pattern. For the complete data case, to test the adequacy hypothesis, Hotelling's T^2 statistic is presented in Fujikoshi, Ulyanov and Shimizu (2010). In this talk, we propose a test statistic for the adequacy hypothesis with two-step monotone missing data based on the above result. Further, we give the approximation to the upper percentile of this statistic. Finally, we investigate the accuracy of the approximation by Monte Carlo simulation.

Summary: We consider the problem of bounding the normal approximation error over rectangles for a sum of n independent d-dimensional random vectors. Here, our aim is to establish such a bound with poly-logarithmic dependence on the dimension d. It is known that such a bound is available with a nearly $n^{-1/2}$ convergence rate when the covariance matrix of the sum is non-degenerate. In this talk, we show that, if the random vectors are i.i.d. and log-concave, we can derive an error bound with a nearly $n^{-1/2}$ convergence rate and poly-log dependence on d without any restriction on the covariance matrix.

Summary: We herein establish an asymptotic representation theorem for locally asymptotically normal quantum statistical models. This theorem enables us to study the asymptotic efficiency of quantum estimators such as quantum regular estimators and quantum minimax estimators, leading to a universal tight lower bound beyond the i.i.d. assumption. This formulation complements the theory of quantum contiguity developed in the previous paper [Fujiwara and Yamagata, *Bernoulli* **26** (2020) 2105–2141], providing a solid foundation of the theory of weak quantum local asymptotic normality.

Summary: The probability table obtained from a contingency table can be viewed as an element in the simplex. Symmetric probability tables are identified as a linear subspace using the Aitchison geometry of the simplex. Given a probability table, we can obtain the closest symmetric table by orthogonal projection onto the symmetric subspace. The original probability table is decomposed into the symmetric and the skew-symmetric tables that are orthogonal to each other. A procedure to test symmetry of a contingency table, based on a multinomial simulation, is developed and examples of tests carried out are given.

Applied Mathematics

March 15th (Wed) Conference Room VII

9:50–11:50

1 Yuho Tanaka (Waseda Univ.)
Tsuyoshi Miezaki (Waseda Univ.)
Manabu Oura (Kanazawa Univ.)
Himadri Shekhar Chakraborty (Shahjalal Univ. of Sci. Tech.)
Jacobi polynomials and design theory 15

Summary: There are Jacobi polynomials as an analogue to Jacobi forms as a powerful generalization of theta series of Lattices. It is a generalization of weight enumerators that M. Ozeki introduced for codes. A. Bonnecaze et al. constructed various types of designs and did some studies to establish a relationship between Jacobi polynomials and designs by focusing on weight enumerators, Jacobi polynomials, and the Molien series. In this talk, we introduce the concept of multiple Jacobi polynomials and give the MacWilliams type duality for them. We also give generalizations and analogies of some results in their paper. In addition, we introduce a criterion for the existence of (generalized) designs using Jacobi polynomials.

2 Sho Suda (Nat. Defense Acad. of Japan)
Alexander L. Gavrilyuk (Shimane Univ.)
Uniqueness of an association scheme related to the 4-$(11, 5, 1)$-design 10

Summary: It follows from the Delsarte theory that the Witt 4-$(11, 5, 1)$ design gives rise to a (Q-polynomial) association scheme $\mathcal{W}$ defined on the set of its blocks. In this talk, we observe that $\mathcal{W}$ is unique, i.e., defined up to isomorphism by its parameters.

3 Norifumi Ojiro (Toyota Tech. Inst.)
Hajime Matsui (Toyota Tech. Inst.)
LCD property and reversiblity in quasi-cyclic codes 15

Summary: We show a necessary and sufficient condition for which quasi-cyclic codes represented by polynomial matrices are to be LCD (Linear Complimentary Dual), and using this result, a connection between LCD quasi-cyclic codes and reversible quasi-cyclic codes is investigated.

4 Shohei Satake (Meiji Univ.)
Hyungrok Jo (Yokohama Nat. Univ.)
On high-girth arc-transitive expander graphs 15

Summary: Expander graphs are highly-connected sparse graphs which have fruitful connections to mathematics, computer science and cryptography. One of the fundamental problems about expander graphs is to construct explicit high-girth expander graphs, which can be applied for designing cryptographic hash functions, for example. In this talk we introduce new explicit constructions of high-girth expander graphs that are arc-transitive.

5 Shinya Fujita (Yokohama City Univ.)
Connectivity keeping paths in highly connected graphs 15

Summary: Some recent results concerning connectivity keeping paths in highly connected graphs will be reviewed.

6 Sho Fujimura (Fukuoka Univ.)
Shuji SHIRAISHI (Fukuoka Univ.)
On the generation of all Euler trails for an Eulerian graph with 2^n edges 10

Summary: For an Eulerian graph G with 2^n edges, we give a new method of generating all Euler trails in G in parallel efficiently by using 2-chain cover of G.

7 Tomoya Machide (Nat. Inst. of Informatics) — An application of systems of Boolean polynomial equations to list color problems · · · · · 15

Summary: I will talk an application of systems of Boolean polynomial equations to list color problems, in which not only vertex-coloring conditions but also edge-coloring conditions are imposed under Grünbaum method.

8 Tadashi Takahashi (Konan Univ.), Tomohiro Washino (Konan Univ.) — On the proof of lemma in the learning model using Groebner basis · · · · · 10

Summary: We consider the statistical model of three-layer neural network with H hidden units. By using taylor expansion of activation function , the set of parameters that true density function is realizable by a statistical model is a common zero points defined by finite polynomials. First, in this case H = 2, we calculate equations define the algebraic set. The algebraic set is the set of parameters that true density function is realizable by a statistical model with one or zero hidden unit. Next, we determine equations define the algebraic set. The algebraic set is the set of parameters that true density function is realizable by a statistical model with H0 < H hidden unit. We prove the lemma in the learning model applying Hilbert's basis theorem using Groebner basis.

14:15–15:25

9 Shuhei Tsujie (Hokkaido Univ. of Edu.), Ryo Uchiumi (Hokkaido Univ.) — Graph embedding and the product of transpositions associated with edges · · · · · 15

Summary: Given a graph, we associate each edge with the transposition which exchanges the endvertices. Fixing a linear order on the edge set, we obtain a permutation of the vertices. Dénes proved that the permutation is a full cyclic permutation for any linear order if and only if the graph is a tree.
In this article, we characterize graphs having a linear order such that the associated permutation is a full cyclic permutation in terms of graph embeddings.

10 Yumi Yamada (Univ. of Tsukuba), Masahiro Hachimori (Univ. of Tsukuba), Akihiro Higashitani (Osaka Univ.) — The root distributions of Ehrhart polynomials of free sums of lattice polytopes · · · · · 15

Summary: In this talk, we study the root distributions of Ehrhart polynomials of free sums of certain lattice polytopes. We investigate cases where the roots of the Ehrhart polynomials of the free sums of A_d^*'s or A_d's lie on the canonical line $Re(z) = -1/2$ on the complex plane $\mathbb{C}$, where A_d denotes the root polytope of type A of dimension d and A_d^* denotes its polar dual. For example, it is proved that $A_m^* \oplus A_n^*$ with $\min\{m, n\} \leq 1$ or $m + n \leq 7$, $A_2^* \oplus (A_1^*)^{\oplus n}$ and $A_3^* \oplus (A_1^*)^{\oplus n}$ for any n satisfy this property.

11 Akihiro Higashitani (Osaka Univ.), Kenta Ueyama (Hirosaki Univ.) — Classification of skew polynomial algebras by switching of matrices and its associated simplicial complexes · · · · · 15

Summary: Classifying skew polynomial rings is important in noncommutative algebraic geometry because a skew polynomial ring can be regarded as a noncommutative version of the homogeneous coordinate ring of the projective space. In this talk, we focus on a particular class of skew polynomial rings and discuss whether the classification of such skew polynomial rings up to equivalence of their graded module categories can be done by using the switching of matrices and the simplicial complexes associated to switching equivalence classes. We prove that we can do it if the sizes of the matrices are relatively small.

12 Hirotake Kurihara (Yamaguchi Univ.), Takahiro Hashinaga (Saga Univ.) — Construction of homogeneous Lagrangian subalgebras using rooted trees · · · · · 15

Summary: In this talk, we consider the construction and classification problems of homogeneous Lagrangian submanifolds of the noncompact Hermitian symmetric space $M = \mathrm{Sp}(n, \mathbb{R})/\mathrm{U}(n)$ of rank n. We give that rooted trees contribute to the classification of homogeneous Lagrangian submanifolds in $M = \mathrm{Sp}(n, \mathbb{R})/\mathrm{U}(n)$.

15:45–16:45 Talk Invited by Applied Mathematics Section

Kenta Noguchi (Tokyo Univ. of Sci.) Graphs on closed surfaces, expressly triangulations and quadrangulations

Summary: Graphs on closed surfaces are widely studied in the literature. We have been interested in and studied the triangulations and quadrangulations, which are important classes of such graphs. Specifically, we have been investigated the relationship between them to reveal their several properties, such as the chromatic number and the related topics. In this talk, we will present the basic background and some problems, and give recent results on the extension from a quadrangulation to a triangulation and spanning quadrangulation subgraphs of triangulations.

March 16th (Thu) Conference Room VII

10:00–11:45

13 Iwao Sato (Oyama Nat. Coll. of Tech.)
Yusuke Ide (Nihon Univ.)
Takashi Komatsu
(Math. Res. Inst. Calc for Industry/Hiroshima Univ.)
Norio Konno (Yokohama Nat. Univ.)
Metzler/Zeta correspondence 15

Summary: We present an explicit formula for the determinant on the Metzler matrix of a digraph D. Furthermore, we introduce a walk-type zeta function with respect to this Metzler matrix of the symmetric digraph of a finite torus, and express its limit formula by using the integral expression.

14 Iwao Sato (Oyama Nat. Coll. of Tech.)
Takashi Kmatsu
(Math. Res. Inst. Calc for Industry/Hiroshima Univ.)
Norio Konno (Yokohama Nat. Univ.)
Alternating walk/Zeta correspondence 15

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

15 Yoshihiro Anahara (Yokohama Nat. Univ.)
Etsuo Segawa (Yokohama Nat. Univ.)
Morioka Hisashi (Ehime Univ.)
Convergence speed for quantum walks on one dimensional lattice with inflows and outflows 15

Summary: For quantum walks on finite graphs whose time evolution is unitary operator, it is difficult to find a stationary state which is not equal to the initial state. We can consider a quantum walk model with a stationary state on a connected finite graph by introducing infinite length tails and inserting a quantum walker into the internal graph at every time step from the tail. In this talk focusing on the finite path as the internal graph, and also on the spectrum of the truncated submatrix of the unitary time evolution operator with respect to the internal graph, we estimate a convergence speed to the stationary state.

16 Akihiro Narimatsu (Univ. of Fukuchiyama)
Yusuke Ide (Nihon Univ.)
Perfect state transfer, equitable partition and continuous-time quantum walk based search 15

Summary: We consider a continuous-time quantum walk based search algorithm. We introduce equitable partition of the graph and perfect state transfer on it. By these two methods, we can calculate the success probability and the finding time of the search algorithm. In addition, we gave some examples of graphs that we can calculate the success probability and the finding time.

17 Satoshi Yabuoku (Kitakyushu Nat. Coll. of Tech.)
Taro Hasui (Kyushu Univ.)
Tomoyuki Shirai (Kyushu Univ.)
Enumeration of connected bipartite graphs with given Betti number 15

Summary: Let $G = (V, E)$ be a simple connected bipartite graph with bipartition $V = V_1 \sqcup V_2$, and $f(r, s, q)$ denote the number of Gs such that $|V_1| = r, |V_2| = s$ and $|E| = q$. In this talk, we focus on the values $f(r, s, r + s + k - 1)$ for given Betti number k. For $k = 0$, this is the number of spanning trees on $K_{r,s}$, and Scoins proved $f(r, s, r + s - 1) = r^{s-1}s^{r-1}$. By recurrence equation, we obtain the explicit form of exponential generating functions of $f(r, s, r+s+k-1)$ for general k, and we derive the asymptotic behavior of their coefficients. We also give another expression of the generating functions as the summation of rational functions of those for the number of bipartite rooted spanning trees.

18 Hiroyuki Yamagishi (Tokyo Metro. Coll. of Ind. Tech.)
Kohtaro Watanabe (Nat. Defense Acad. of Japan)
The best constant of the discrete ℓ^p Sobolev inequality on the complete graph 15

Summary: We assume a classical mechanical model of the complete graph K_N with N vertices. We put the N atoms on vertices of K_N. Its neighboring two atoms are connected to a linear spring. The spring constant is 1. Let p and q be real numbers satisfying $1/p + 1/q = 1$ $(p, q > 1)$. If u(i) takes a real value, then u(i) represents a deviation from the steady state. The discrete ℓ^p Sobolev inequality shows that the maximum of deviation $|u(i)|^p$ is estimated in a constant multiple of the potential energy on K_N. Hence, the best contants represent the rigidity of the mechanical model on K_N.

13:00–14:10

19 Xiao-Nan Lu (Gifu Univ.)
Covering arrays guaranteeing a passing test 15

Summary: Covering arrays (CAs) are a kind of combinatorial designs proposed for applications in combinatorial testing (CT). For adaptive decoding algorithms in CT using CAs, it is required that a passing test should be contained in the CA. In this talk, a few results on such binary CAs that guarantee at least one passing test are introduced. In particular, it is shown that for no more than two faulty interactions, the known optimal construction for binary CAs is good enough. Then, a general sufficient condition for such CAs in terms of domination numbers of graphs associated to the CAs is proposed.

20 Akira Saito (Nihon Univ.)
Shingo Degawa (Nihon Univ.)
Aiki Masuda (Nihon Univ.)
Hiroki Nishida (Nihon Univ.)
Two upper bounds on secure domination number 15

Summary: A set of vertices S in a graph G is a dominating set if every $v \in V(G) - S$ satisfies $N_G(v) \cap S \neq \emptyset$. A dominating set S is secure if for every $v \in V(G) - S$, there exists $x \in S$ such that $(S - \{x\}) \cup \{v\}$ is a dominating set. The order of a smallest secure dominating set of G is called the secure domination number of G and denoted by $\gamma_s(G)$. In this talk, we report an upper bound $\gamma_s(G) \leq \frac{3}{5}|G|$ for a graph G of minimum degree at least 2. Then we generalize the notion of a secure dominating set. A dominating set $S = \{x_1, \ldots, x_k\}$ in G is weakly secure if for every $v \in V(G) - S$, there exists $y_i \in N_G(x_i) \cup \{x_i\}$ for each i with $1 \leq i \leq k$ such that $\{y_1, \ldots, y_k\}$ is a dominating set and $v \in \{y_1, \ldots, y_k\}$. The order of a smallest weakly secure dominating set of G is called the weakly secure domination number and denoted by $\gamma_{ws}(G)$. We report $\gamma_{ws}(G) \leq \lceil |G|/2 \rceil$ for every onnected graph G of minimum degree at least 1.

21 Yuichi Yoshida (Kitami Inst. of Tech.)
Kazunori Matsuda (Kitami Inst. of Tech.)
On the three graph invariants related to matching of finite simple graphs 15

Summary: We determine the relationship between the matching number,the minimum matching number,the induced matching number and the number of vertices.

22 Robert E. L. Aldred (Univ. of Otago)
Jun Fujisawa (Keio Univ.)
Distance restricted matching extension in 5-connected graphs on surfaces which are not triangulation 15

Summary: In this talk, we show the following result. Let G be a 5-connected graph of even order which is 2-cell embedded in a surface F^2 with sufficiently large face-width, and let M be a matching of G such that any two edges in M are at distance at least $2\left(20 - \frac{12\chi(F^2)+25}{|M|}\right)$ in the face subdivision G. Then G has a perfect matching containing M.

March 17th (Fri) Conference Room VII

9:50–11:50

23 Hironari Miyoshi (Saitama Univ.)
Derivation of Brownian motion from the Goldstein–Taylor model 15

Summary: In this lecture, we consider a random walk associated with the initial value problem of the Goldstein–Taylor model. First, we show the existence of the solution for a scaled Goldstein–Taylor model by using the corresponding telegraph equation. Next, we find the probability density function $p_\varepsilon(x,t)$ associated with a random process of particles for the Goldstein–Taylor model. Finally, we prove that the scaling limit of the cumulative distribution function for $p_\varepsilon(x,t)$ converges to the Brownian motion in the sense of distributions.

24 Itsuki Watanabe (Waseda Univ.)
High-density limit of controlled density-dependent Markov processes 15

Summary: We consider the high-density type scaling limit of the controlled stochastic model. The stochastic model can be constructed as a particle system with birth and death events whose transition rate depends on its density and control. In this talk, we reveal that the scaling limit of this model is governed by the controlled stochastic differential equation by showing the relative compactness and using the continuous mapping theorem.

Summary: Biological phenomena such as the flock of birds or the swarm of bacteria and other active cells reveal that complex self-organized patterns can emerge from active particle systems when the number of particles becomes very large. In this talk, I will describe a modelling framework based on classical tools developed in the mathematical kinetic theory of gas. The core idea is the derivation of PDE models from stochastic many-particle systems. I will illustrate these ideas with a system of so-called body-oriented particles and explain how the behavior of many-particle systems can be inferred by looking at appropriate scaling limits. In particular, this work demonstrates the influence of stochasticity and geometry on self-organization.

Summary: Deep neural network models, which have been rapidly developing and expanding their range of application in recent years, need to be applied to structured data. Specifically, there is a wide range of applications such as face recognition, set matching, and point cloud segmentation. A set data is interpreted as structured data, and representations of a set data based on permutations equivalence / invariance properties are known. In particular, Renhao et al. have made a mathematical discussion of a machine learning model that satisfies equivalence / invariance for hierarchical group actions by introducing the idea of Wreath product. In this paper, we focus on the results of Renhao et al. especially for hierarchical set data, and discuss the representation of hierarchical sets by specifically discussing hierarchical permutation equivalence / invariance.

Summary: The theoretical understanding of deep neural network (DNN) has not yet been fully understood. Nevertheless, even in this recent circumstance, Imaizumi-Fukumizu (2019) and Suzuki (2019) clarified that the learning ability of DNN is superior to the previous theories when the target function is non-smooth functions. In this talk we give a convergence problem in more practical setting. More precisely, we prove that a certain prescribed function pointwisely converges to a step function provided by mini-batch gradient descent process with ReLU DNN.

Summary: As an appendage of the skin, a hair follicle is the source of the hair. Moreover, the hair follicle has a cylinder-like structure. In this study, we attempt to examine the mechanism of hair follicle formation from a mathematical viewpoint by applying a mathematical model of the basement membrane, which enables us to describe plastic deformation. In this presentation, we will introduce numerical examples of our mathematical model and discuss what assumptions play an essential role in shaping the cylinder shape of the hair follicle. If possible, we will also present the numerical results that consider the epithelium, while previous mathematical models have considered only the basal layer, basement membrane, and dermal structure.

29 Karel Svadlenka (Kyoto Univ.) Variational analysis of finite strain elastoplasticity for structured materials 15

Summary: Structured materials, such as metallic alloys with atomic-scale layers, show peculiar deformation patterns, which may have significant implications on material properties. In this talk, we discuss one possible approach to modeling and understanding of this kind of pattern formation through the so-called rate-independent evolution in the variational setting of finite-strain elastoplasticity. Besides mentioning connections to homogenization via Gamma-convergence, we present the underlying mathematical theory and show numerical simulations in comparison to experimental measurements.

14:15–14:40 Presentation Ceremony for the 2022 Applied Mathematics Prize

14:45–16:30

30 Takuya Tsuchiya (Hachinohe Inst. of Tech.)
Makoto Nakamura (Osaka Univ.)
Numerical accuracy and stability of semilinear Klein–Gordon equation in de Sitter spacetime 15

Summary: The Klein–Gordon equation is known as the fundamental wave equation in relativistic phenomena such as near light speed phenomena. We perform numerical simulations of this equation using the structure-preserving scheme in the de Sitter spacetime. The discretization equation proposed in our previous work (J. Comput. Appl. Math. 361 pp.364–412) has good accuracy but poor numerical stability. In this talk, we propose a new discretization equation with the structure-preserving scheme and show numerical results with high-accuracy and high-stability.

31 Takuya Tsuchiya (Hachinohe Inst. of Tech.)
Makoto Nakamura (Osaka Univ.)
On behaviors of solutions of semilinear Klein–Gordon equation in contracting de Sitter spacetime 15

Summary: de Sitter spacetime is a well-known model of expanding or contracting universes. In this spacetime, we investigate numerical solutions of the semilinear Klein–Gordon equation. In particular, in the case of contracting spacetime, it is difficult to investigate the behaviors of the solutions even by numerical calculations because of the blow-up solutions. Therefore, we apply the structure-preserving scheme to the Klein–Gordon equation to obtain accurate and stable numerical solutions and show the behaviors of the solutions.

32 Kota Takeda (Kyoto Univ.)
Takashi Sakajo (Kyoto Univ.)
Computing an invariant measure of the N-vortex problem on the sphere by Hamiltonian Monte Carlo 15

Summary: Hamiltonian Monte Carlo (HMC) is a stochastic method to approximate high-dimensional integrals by the samples from the target distribution, efficiently by utilizing the Hamiltonian dynamics. In general, the efficiency of HMC is characterized by a geometric convergence rate of the associated Markov chain, known as a property 'geometric ergodicity'. For a class of target distributions on the Euclidean space, geometric ergodicity for HMC has been established, however, that has not yet been established on manifolds. Hence, we prove geometric ergodicity for HMC on compact manifolds. As an application, we consider the sampling problem from the invariant measure of the N-vortex problem on the sphere, which is relevant to two-dimensional turbulence on geophysical fluid.

33 Hiroshi Fujiwara (Kyoto Univ.)
Kamran Sadiq
(Johann Radon Inst. for Comput. Appl. Math.)
Alexandru Tamasan
(Univ. Central Florida)
On a Cauchy-type singular integral equation for x-ray computerized tomography with partial measurement ····· 15

Summary: In this talk we propose a direct numerical reconstruction procedure for x-ray tomography with partial measurement. The proposed method is based on Bukhgeim–Cauchy boundary integral formula developed for an inverse source problem of the transport equation, and is characterized by a singular integral equation with Cauchy kernel for the considering partial measurement case. We also show its quantitative stability in terms of the condition number with a particular discretization for reliable numerical reconstruction.

34 Toshimasa Ishige (Chiba Univ.)
Akitoshi Takayasu (Univ. of Tsukuba)
Rigorous numerics for finding the monodromy of Picard–Fuchs differential equations for a family of K3 toric hypersurfaces ····· 15

Summary: In this talk, we introduce a method for finding monodromy matrices of linear differential equations with finite-dimensional solution spaces using rigorous numerics. We also provide a result of computer-assisted proof that yields monodromy matrices of Picard–Fuchs differential equations for a certain family of K3 toric hypersurfaces.

35 Takehiko Kinoshita (Saga Univ.)
Yoshitaka Watanabe (Kyushu Univ.)
Mitsuhiro T. Nakao (Waseda Univ.)
Convergence order estimations of approximate inverse operator norm for second-order elliptic linear operators ····· 15

Summary: In this talk, we consider the convergence order of the approximate inverse operator norm for second-order elliptic linear operators. We show that the general order of convergence is $O(\sqrt{h})$, and give concrete computable error bounds for achieving the same order.

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

Koya Sakakibara
(Okayama Univ. of Sci./RIKEN)
Structure-preserving numerical analysis of interfacial phenomena

Summary: Soap bubbles, falling water droplets, and other phenomena that deform from moment to moment are all around us. The problem of mathematically investigating these phenomena is known as the moving boundary problem, which has been studied in mathematics, physics, and various other fields. Numerical analysis of interfacial phenomena is more complicated than the usual numerical analysis of differential equations on a fixed domain because the problem domain changes from moment to moment. In this talk, we will review what has been known about attempts to design structure-preserving numerical methods for mathematical models describing interfacial phenomena. Further directions of research development will also be discussed.

March 18th (Sat) Conference Room VII

9:50–11:50

36 Toshikazu Kuniya (Kobe Univ.)
Hopf bifurcation in a delayed epidemic model with quarantine ····· 15

Summary: In this study, we construct a time-delayed epidemic model with quarantine and obtain sufficient conditions for a Hopf bifurcation, which represents the recurrent epidemic waves. We show that if the basic reproduction number $\mathcal{R}_0$ is less than 1, then the disease-free equilibrium is globally asymptotically stable, whereas if $\mathcal{R}_0 > 1$, then the unique endemic equilibrium exists and it can be destabilized and a nontrivial periodic solution can arise in a Hopf bifurcation. Our numerical simulation suggests that the quarantine and time delay play important roles in the occurrence of recurrent epidemic waves.

Summary: We consider the susceptible-exposed-infected-removed (SEIR) epidemic model and apply optimal control to it. Our approach is to reduce the computation of the optimal control input to that of the stable manifold of an invariant manifold in a Hamiltonian system. Some numerical examples in which the computer software AUTO is used to numerically compute the stable manifold are given to demonstrate the usefulness of our approach for the optimal control in the SEIR model. Our study suggests how we can decrease the number of infected individuals quickly before a critical situation occurs while keeping social and economic burdens small.

Summary: The intestinal epithelium is a highly flexible and adaptive cell community that is formed and regulated by the proliferation and differentiation of intestinal stem cells (ISCs). We have quantitatively analyzed the nutrient-dependent tissue expansion of the adult Drosophila intestinal epithelium just after eclosion. We have shown that stem cell division alone cannot explain the increase in stem cell number, and have proposed a novel dedifferentiation phenomenon as a possible compensatory mechanism. We have developed a mathematical model of intestinal epithelial cell society and established a simulation system that enables quantitative prediction of cell population dynamics. The analysis is revealing that enteroendocrine cell dedifferentiation is a good way to efficiently achieve intestinal enlargement while maintaining cell diversity.

Summary: We provide a natural correspondence of eigenstructures of Jacobian matrices associated with equilibria for appropriately transformed two systems (describing asymptotic expansions and dynamics at infinity) describing finite-time blow-ups for ODEs with quasi-homogeneity in an asymptotic sense. As a corollary, we see that asymptotic expansions of blow-ups themselves provide a criterion of the existence of blow-ups with an intrinsic gap structure of stability information among two systems.

Summary: This talk is concerned with the initial-boundary value problem for a moderately coupled system of time-fractional diffusion equations with Caputo derivatives of orders in $(0, 1)$. Regarding the coupled part of components as a source term, we define the mild solution by an integral equation. Then we establish fundamental unique existence, limited smoothing property and long-time asymptotic behavior of the solution, which mostly inherit those of a single equation.

41 Tomoyuki Miyaji (Kyoto Univ.)
Robert Sinclair
A conjecture on the asymptotic reflection rule of a self-propelled particle 15

Summary: We consider a four-dimensional ODE model of a self-propelled particle that interacts repulsively with the domain boundary. It is derived from certain planar reaction-diffusion systems. A previous study proves that the particle governed by this model moves almost in a straight line and reflects from the boundary without collision. In addition, numerical simulations suggest that the angle of reflection is greater than that of incidence, which is proved under certain conditions. Recently, we have proposed a conjecture on the functional relationship between the angles. We will discuss how we arrived at the conjecture and became convinced.

42 Hiroshi Ishii (Kyoto Univ.)
Pattern dynamics depending on integral kernel shape in reaction-diffusion equations with sufficiently weak nonlocal effect 15

Summary: In this talk, we consider reaction-diffusion equations with nonlocal effects described by the convolution with an appropriate integral kernel. Such a nonlocal effect is used to describe the diffusion process of substances and cell-cell interactions, for example. This work is particularly concerned with the behavior of the widths of phase-separated patterns. The equation of motion of the width is derived and applied to several integral kernels as examples to explain how the pattern dynamics of the solution depend on the shape of the integral kernel.

14:15–15:05

43 Kota Ohno (Chuo Univ.)
Toshiyuki Ogawa (Meiji Univ.)
Stability of traveling wave in nonlocally coupled oscillator system 15

Summary: Coupled oscillator systems have been studied in various fields of physical and biological phenomena. Among them, systems of nonlocally coupled oscillators can exhibit chimera states, which consist of spatially coherent and incoherent states. However, the stability and bifurcation origin of chimera states have not been understood. Stuart–Landau type nonlinearity enables us to formulate the stability problem of traveling waves precisely through Floquet theory. We analyzed Floquet multiplier and confirmed the transition of stability of traveling wave by changing the parameters of nonlocal coupling. In this study, we will state the relationship between the stability of traveling waves and chimera states.

44 Ayuki Sekisaka (Meiji Univ.)
Toshiyuki Ogawa (Meiji Univ.)
Stability problem of segmented pattern for oscillatory reaction-diffusion systems 15

Summary: In reaction-diffusion systems of oscillatory fields, especially those in which wave bifurcations occur, it is known that traveling waves with periodic profiles appear. Even if the traveling waves are asymptotically stable, starting from a random initial value, several segments are formed, each consisting of different periodic traveling waves. Pattern dynamics is then observed in which the segments change from one to another. The transition between different segments is considered to be the so-called defect solution. In this lecture, we will discuss whether the defect solution can be regarded as a steady-state observation of the segment pattern.

45 Toshiyuki Ogawa (Meiji Univ.)
Shunsuke Kobayashi (Univ. of Miyazaki)
Turing instability on compact metric graph 15

Summary: Studies on the behavior of reaction-diffusion systems on a one-dimensional domain with junctions (metric graph) have been increasing recently. It is expected that joint research with cell physiology and ecology will progress more and more in the future. So, we would like to clarify from the basics what kind of pattern formation occurs in compact metric graphs. First, by preparing 2 or 3 bounded intervals, let us classify the metric graph that is created by connecting them, and consider the eigenvalue problem there. Then, we describe the conditions under which Turing instability occurs for each modes, and discuss the differences in pattern formation by metric graphs.

15:20–16:20 Talk Invited by Applied Mathematics Section

Kei Nishi (Kyoto Sangyo Univ.) Pulse dynamics in a three-component reaction-diffusion system

Summary: The pulse dynamics in a three-component FitzHugh–Nagumo system is considered both numerically and analytically. The system admits a pulse solution of bistable type, which exhibits a variety of interface dynamics, not observed for the two-component FitzHugh–Nagumo systems. In this talk, we focus on the parameter regime $\alpha > 0$, $\beta < 0$, where there appear not only two types of pulse solutions, whose profiles are mutually inverted, but also multiple-pulse solutions which show collective motions such as clustered traveling pulses and an array of oscillating pulses. In order to analytically investigate these pulse behaviors, we apply the multiple scales method to the original reaction-diffusion system, and derive finite-dimensional ordinary differential equations which describe the motions of the pulse interfaces. The reduced ODEs enable us to reveal the global bifurcation structures of the pulse solutions, as well as the clustered multiple-pulse solutions, and to elucidate the mechanism for the rich variety of pulse dynamics in a clear, unified manner.

Topology

March 15th (Wed) Conference Room III

9:30–12:00

Summary: A torus manifold is defined as an even-dimensional compact manifold with a half-dimensional torus action which has fixed points. This notion was introduced by Hattori–Masuda in 2003 as the generalization of the toric and the quasitoric manifolds. The aim of this talk is to classify simply connected 6-dimensional torus manifolds with vanishing odd-degree cohomology. It is shown that there is a one-to-one correspondence between equivariant diffeomorphism types of such manifolds and 3-valent torus graphs introduced by Maeda–Masuda–Panov. Using this correspondence and combinatorial arguments, we prove that such a manifold is equivariantly diffeomorphic to the 6-dimensional sphere or an equivariant connected sum of copies of 6-dimensional quasitoric manifolds or 4-dimensional sphere bundles over the 2-dimensional sphere.

Summary: We present the results that an automorphism of a sofic system has the same limits of resolving directions as those of its canonical support by way of the Krieger cover and that a similar result to this holds for an automorphism of a transitive sofic system and its canonical support by way of the Fischer cover. One of the corollaries to these proves that no automorphism of a transitive sofic system has an irrational unique non-expansive direction.

Summary: In this talk, we consider the embedded topology of plane curves on the complex projective plane $\mathbb{P}^2$. It is known that there are π_1-equivalent Zariski pairs $(\mathcal{C}_1, \mathcal{C}_2)$ of plane curves $\mathcal{C}_1, \mathcal{C}_2 \subset \mathbb{P}^2$, i.e., $\mathcal{C}_1$ and $\mathcal{C}_2$ have the same embedded topology in their tubular neighborhoods but different embedded topology in $\mathbb{P}^2$, and $\pi_1(\mathbb{P}^2 \setminus \mathcal{C}_1) \cong \pi_1(\mathbb{P}^2 \setminus \mathcal{C}_2)$. Known examples of π_1-equivalent Zariski pairs consist of curves containing a component with either singularities or genus $g \geq 1$. The aim of this talk is to give a π_1-equivalent Zariski pair of conic-line arrangements, i.e., a pair of curves consisting of smooth rational curves.

Summary: In this talk, we study extensions of continuous increasing functions, and provide an increasing version of Gillman–Jerison theorem.

Summary: We introduce the structure theorem of the persistent cohomology to describe the representative cocycles in detail. Then, taking cup products of representative cocycles, we can compute the cup length function of a finite metric space.

6 Yu Tajima (Hokkaido Univ.) Magnitude homotopy type of graphs and Mayer–Vietoris type theorem
Masahiko Yoshinaga (Osaka Univ.) 15

Summary: Magnitude homology is defined by Hepworth and Willerton as a categorification of the magnitude (an invariant for metric spaces). They proved the Kunneth formula and Mayer–Vietoris type theorem for magnitude homology of graphs. Recently, Asao–Izumihara introduced the pair of simplicial complexes (K, K') whose homology groups are isomorphic to direct summands of graph magnitude homology groups. We call the CW complex K/K' magnitude homotopy type. In this talk, we give a new proof of Mayer–Vietoris type theorem using Discrete Morse theory on magnitude homotopy types. If time permits, we also talk about generalizatios to metric spaces.

7 Shuichi Harako (Univ. of Tokyo) The modular class of an orientable ρ-Q-manifold 15

Summary: As one generalization of Lie algebras and commutative algebras, we have ρ-Lie algebras and ρ-commutative algebras, respectively. We will introduce a concept of a ρ-manifold, whose functional algebra is locally isomorphic to a ρ-commutative algebra, and discuss its modular class where the ρ-manifold is orientable and equipped with a Q-structure.

8 Shun Wakatsuki (Nagoya Univ.)♭ Independence complexes of grid graphs 10
Takahiro Matsushita
(Univ. of Ryukyus)

Summary: We determine the homotopy types of the independence complexes of $(n \times 4)$, $(n \times 5)$ and $(n \times 6)$-square grid graphs. In fact, they are homotopy equivalent to wedges of spheres.

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

Noboru Ogawa (Tokai Univ.) Liouville and Weinstein structures on convex symplectic manifolds

Summary: In symplectic geometry, there are two important classes on convexity: Liouville structures and Weinstein structures. The former is a symplectic manifold equipped with a conformally expanding symplectic vector field which is pointing outward. The latter is imposed so that the vector field is gradient-like. Such structures have played a significant role in the study of symplectic and contact topology. For example, the convexity provides a constraint on the behavior of pseudo-holomorphic curves by the maximum principle.
By definition, a Weinstein structure is a Liouville structure, but the converse is not true in general; McDuff gave the first example which is a Liouville manifold without any Weinstein structures. The purpose of this talk is to present recent advances on the difference between the two structures, up to homotopy. In particular, I will show that the stabilization of McDuff's example admits a flexible Weinstein structure. The main part is based on a joint work with Yakov Eliashberg (Stanford University) and Toru Yoshiyasu (Kyoto University of Education). If time permits, I would like to discuss some open questions, progress and perspective.

15:40–17:30

9 Naotsugu Chinen Isometry groups of symmetric products of $(\mathbb{R}^k)^q_p$ 15
(Nat. Defense Acad. of Japan)

Summary: By $F_n(X)$, $n \geq 1$, we denote the n-th symmetric product of a metric space (X, d) as the space of the nonempty finite subsets of X with at most n elements endowed with the Hausdorff metric d_H. By $\mathrm{Iso}(X)$ we denote the topological group of all isometries from X onto itself with the topology of pointwise convergence. We are interested in what topological group $\mathrm{Iso}(F_n(X))$ is.The aim is to decide a topological group structure of $\mathrm{Iso}(F_n((\mathbb{R}^k)^q_p))$ for any $(n, k, p, q) \in \mathbb{N} \times \mathbb{N} \times (\mathbb{N} \cup \{\infty\}) \times (\mathbb{N} \cup \{\infty\})$.

Summary: In previous work, the author described the geometry of Bayesian learning on a manifold. In this talk, we take the square of any manifold and a positive function which takes the maximum 1 on the diagonal set. Then we define the mutual Bayesian learning between the factors of the square. Particularly, we consider mutual learning between two copies of the parameter space of a statiscal model, and associate the above function with the relative entropy. Although the mutual learning forgets all about the model except the relative entropy, it still substitutes for the usual Bayesian estimation of the parameter in a certain case.

Summary: Generalizing the work of Fock–Goncharov on rational unbounded laminations, we give a geometric model of the tropical points of the moduli space $\mathcal{X}_{PGL_3,\Sigma}$ of framed PGL_3-local systems on a marked surface Σ based on the Kuperberg's $\mathfrak{sl}_3$-webs. We introduce their tropical cluster coordinates as an $\mathfrak{sl}_3$-analogue of the Thurston's shear coordinates associated with any ideal triangulation. We also describe tropical points of Goncharov–Shen's moduli space $\mathcal{P}_{PGL_3,\Sigma}$. Then we give a tropical anologue of gluing morphisms among the moduli spaces as a geometric gluing procedure of $\mathfrak{sl}_3$-laminations with "shearings". We also investigate a relation to the graphical basis of the $\mathfrak{sl}_3$-skein algebra by Ishibashi–Yuasa, which conjecturally leads to a quantum duality map.

Summary: In this talk, we give a characterization of compact sets in L^p-spaces on metric measure spaces. As its application, we investigate the topological types of the subspace consisting of lipschitz functions with bounded supports.

Summary: We study rigidity properties of surface group actions on the circle via foliated harmonic measures on the suspension bundles. We show a curvature estimate and a Gauss–Bonnet formula for an S^1-connection obtained by taking the average of the flat connection on the suspension bundle with respect to a harmonic measure. As consequences, we give a precise description of the harmonic measure on suspension foliations with maximal Euler number and an alternative proof of rigidity theorems of Matsumoto and Burger–Iozzi–Wienhard.

March 16th (Thu) Conference Room III

9:30–12:00

Summary: The notion of fiber-singularities of continuous maps between topological manifolds are introduced. Then, we investigate some examples of fiber-singularities and, study fiber-singularities of simplicial maps of PL maps of surfaces.

15 Naoki Hamada (KLab Inc.)
Kenta Hayano (Keio Univ.)
Hiroshi Teramoto (Kansai Univ.)
Classification and recognition of constraint function-germs and feasible set-germs in multiobjective optimization 15

Summary: For functions $g_1, \ldots, g_q$ and $h_1, \ldots, h_r$ on the Euclidian space, we consider the minimizing problems of some given functions on the set $M(g,h) = \{x \mid \forall i, g_i(x) \leq 0, \forall j, h_j(x) = 0\}$. The functions g_i's, h_j's and the set $M(g,h)$ are respectively called the constraint functions and the feasible set for the problem. In this talk, we will explain the results on classification and recognition of constraint function-germs under suitable equivalence for them (called $\mathcal{K}[G]$-equivalence). If time permits, we will also discuss how the results are related with classification of feasible set-germs.

16 Erika Kuno (Osaka Univ.)
Uniform hyperbolicity of nonseparating curve graphs of nonorientable surface 10

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

17 Erika Kuno (Osaka Univ.)
Mitsuaki Kimura (Kyoto Univ.)
Uniform hyperbolicity of fine curve graphs of nonorientable surfaces 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 $g \geq 2$ is also uniformly hyperbolic.

18 Ryoma Kobayashi (Ishikawa Nat. Coll. of Tech.)
Nao Imoto
Action on non-separating simple closed curves by the level 2 mapping class group of a non-orientable closed surface 10

Summary: The level 2 mapping class group $\mathcal{M}_2(N)$ of a non-orientable closed surface N is the subgroup of the mapping class group of N consisting of elements acting trivially on $H_1(N;\mathbb{Z}/2\mathbb{Z})$. In our work, we proved that for any non-separating simple closed curves α and β of N, there is $\varphi \in \mathcal{M}_2(N)$ such that $\varphi(\alpha) = \beta$ if and only if α and β are equal as elements in $H_1(N;\mathbb{Z}/2\mathbb{Z})$.

19 Ryoma Kobayashi (Ishikawa Nat. Coll. of Tech.)
Nao Imoto
The group generated by squares of Dehn twists about non-separating simple closed curves of a non-orientable closed surface 15

Summary: The level 2 mapping class group of an orientable closed surface is equal to the group generated by squares of Dehn twists about non-separating simple closed curves. In our work, we proved that the twist subgroup of the level 2 mapping class group of a non-orientable closed surface is not equal to the group generated by squares of Dehn twists about non-separating simple closed curves and Dehn twists about separating simple closed curves. As an application, we gave a finite generating set for this group.

20 Genki Omori (Tokyo Univ. of Sci.)
A finite presentation for the balanced superelliptic handlebody group 15

Summary: The balanced superelliptic handlebody group is the normalizer of the transformation group of the balanced superelliptic covering space in the handlebody group of the total space. We give a finite presentation for the balanced superelliptic handlebody group. To give this presentation, we construct a finite presentation for the liftable Hilden group.

21 Genki Omori (Tokyo Univ. of Sci.) A small generating set for the balanced superelliptic handlebogy group 10

Summary: The balanced superelliptic handlebody group is the normalizer of the transformation group of the balanced superelliptic covering space in the handlebody group of the total space. We prove that the balanced superelliptic mapping class group is generated by four elements. To prove this, we also proved that the liftable Hilden group is generated by three elements. This generating set for the liftable Hilden group is minimal except for some hyperelliptic cases and the generating set for the balanced superelliptic mapping class group above is also minimal for several cases.

13:00–14:00

22 Teruaki Kitano (Soka Univ.) Tatsuro Shimizu (Tokyo Denki Univ.) On the torus sum formula of Reidemeister torsion defined by Morse–Smale flows 10

Summary: We consider Reidemeister torsion for a 3-manifold. It can defined by several ways. For a 3-manifold with a torus decomposition, the torus sum formula of Reidemeister torsion is well known. In this talk we give a proof of the torus sum formula by using Morse–Smale flows.

23 Masakazu Teragaito (Hiroshima Univ.) Hyperbolic L-space knots and their Upsilon invariants 10

Summary: For a knot in the 3-sphere, the Upsilon invariant is a piecewise linear function defined on the interval $[0, 2]$. It is known that for an L-space knot, the Upsilon invariant is determined only by the Alexander polynomial. We exhibit infinitely many pairs of hyperbolic L-space knots such that two knots of each pair have distinct Alexander polynomials, so they are not concordant, but share the same non-zero Upsilon invariant. Conversely, we examine the restorability of the Alexander polynomial of an L-space knot from the Upsilon invariant through the Legendre–Fenchel transformation.

24 Teruhisa Kadokami (Kanazawa Univ.) The Ma–Qiu index and the Nakanishi index for a fibered knot are equal, and ω-solvability 15

Summary: For a knot K, let $G(K)$ be the knot group of K, $a(K)$ the Ma–Qiu index, which is the minimal number of normal generators of the commutator subgroup of $G(K)$, and $m(K)$ the Nakanishi index of K, which is the minimal number of generators of the Alexander module of K. We generalize the notions for a pair of a group G and its normal sugroup N, and we denote them by $a(G, N)$ and $m(G, N)$ respectively. Then it is easy to see $m(G, N) \leq a(G, N)$ in general. We also introduce a notion "ω-solvability" for a group. Our main theorem is that if N is ω-solvable, then we have $m(G, N) = a(G, N)$. As corollaries, for a fibered knot K, we have $m(K) = a(K)$, and we could determine the MQ indices of prime knots up to 9 crossings completely.

March 17th (Fri) Conference Room III

9:30–12:00

25 Eri Matsudo (Nihon Univ.) Kanako Oshiro (Sophia Univ.) Gaishi Yamagishi (Sophia Univ.) Minimum numbers of Dehn colors and $\mathcal{R}$-palette graphs 10

Summary: We consider the number of colors for Dehn-colorings, and we define a $\mathcal{R}$-palette graphs. In this talk, for any Dehn p-colorable knot, we give a lower bound of the minimum number of colors on diagrams.

26 Kazuhiro Ichihara (Nihon Univ.)
Katsumi Ishikawa (Kyoto Univ.)
Masaaki Suzuki (Meiji Univ.)
Eri Matsudo (Nihon Univ.)
Two-tone colorings and surjective dihedral representations for links · · · 10

Summary: It is well-known that a knot group admits a surjective homomorphism to the dihedral group of degree n if and only if the knot is Fox n-colorable. However, it is not true for links with two or more components. In this talk, I will introduce a two-tone coloring on a link diagram, and give a condition for links that the link groups admit surjective representations to dihedral groups.

27 Takefumi Nosaka (Tokyo Tech)
Symmetric rack cocycle invariants of closed 3-manifolds · · · · · · · · · · · · 10

Summary: We establish a new approach to obtain 3-manifold invariants via Dehn surgery. For this, we introduce racks with good involution and Property FR, and define cocycle invariants as 3-manifold invariants.

28 Shosaku Matsuzaki (Int. Affairs Ashikaga Univ.)
Tomo Murao (Waseda Univ.)
Spatial surfaces and multiple group rack cocycle invariants · · · · · · · · · · 10

Summary: A spatial surface is a compact surface embedded in the 3-sphere. A multiple group rack is an algebraic structure motivated from Reidemeister moves of oriented spatial surfaces. In this talk, we introduce a multiple group rack cocycle invariant for oriented spatial surfaces and give some calculation examples.

29 Yuta Taniguchi (Osaka Univ.)
Kokoro Tanaka (Tokyo Gakugei Univ.)
A central extension of the n-quandle of a knot · 15

Summary: The fundamental quandle is a powerful invariant for knots. However, it is difficult to compare them. Then, we often use a certain quotient of the fundamental quandle of a knot, which is called an n-quandle of a knot. In this talk, we show that the fundamental quandle of the n-twist spun knot, which is a 2-knot introduced by Zeeman, is a central extension of the n-quandle. As a corollary, we determine the second quandle homology group of n-quandles.

30 Kokoro Tanaka (Tokyo Gakugei Univ.)
Yuta Taniguchi (Osaka Univ.)
Knot quandles and knot groups for 2-knots · 10

Summary: We give examples of 2-knots with the same knot group but different knot quandles by analyzing the knot quandles of twist-spun knots. As a byproduct of our method, we give a classification of all twist-spun knots with finite knot quandles.

31 Kodai Wada (Kobe Univ.)
Finite type invariants of ribbon 2-dimensional string links with generalized Brunnian properties · 10

Summary: Gusarov and Habiro independently gave a topological interpretation of finite type invariants for 1-dimensional knots in terms of C_k-equivalence. As a 4-dimensional analogue, Watanabe introduced the notion of RC_k-equivalence on ribbon knotted surfaces and proved that two ribbon 2-dimensional knots are RC_k-equivalent if and only if they cannot be distinguished by any finite type invariant of degree less than k. In this talk, we provide an extension of the above result of Watanabe to ribbon 2-dimensional string links with generalized Brunnian properties.

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

Atsushi Ishii (Univ. of Tsukuba)
Alexander type invariants of groups, quandles and MCQs

Summary: Groups, quandles and MCQs are algebraic objects appeared in low-dimensional topology. In particular, the notions of quandles and multiple conjugation quandles (MCQs) were introduced via the axioms corresponding to the Reidemeister moves for oriented knots and handlebody-knots, respectively. In this talk, we discuss Alexander type invariants of groups, quandles and MCQs, which include the Alexander ideal and the (twisted) Alexander polynomial.

15:40–17:00

Summary: Corks of 4-manifolds are one of the most important objects in the study of exotic 4-manifolds. Nevertheless, we only have a few explicit examples of corks of standard simply-connected closed 4-manifolds with small second Betti numbers b_2. In this talk, we give the first example of a cork of $\mathbb{CP}^2\#8\overline{\mathbb{CP}^2}$. This achieves the smallest b_2 where a cork of standard simply-connected closed 4-manifold has been found. We also talk about new examples of corks of $\mathbb{CP}^2\#9\overline{\mathbb{CP}^2}$.

Summary: A trisection is a decomposition of a 4-manifold into three 1-handlebodies. This decomposition is characterized by a diagram called a trisection diagram. A trisection diagram is a 4-tuple consisting of a closed surface and three cut systems. Kirby and Thompson introduced an invariant of a 4-manifold that is a kind of complexity defined by its trisection diagrams. This invariant is called the Kirby–Thompson invariant. In this talk, we give some lower bounds for the Kirby–Thompson invariant of certain 4-manifolds. As an application, we find the first example of a 4-manifold with non-trivial Kirby–Thompson invariant.

Summary: A trisection of a 4-manifold, introduced by Gay and Kirby in 2012, is a decomposition of the 4-manifold into three 4-dimensional 1-handlebodies. A trisection can be described by a trisection diagram that is similar to a Heegaard diagram. In this talk, we construct infinitely many trisection diagrams of the 4-sphere obtained by Gluck twisting along some spun torus knots. We also study the standardness of the trisection diagrams.

Summary: Thanks to the affirmative answer to the symplectic Thom conjecture, all connected symplectic surfaces representing the same homology class in a closed symplectic 4-manifold are diffeomorphic. In higher dimension, for example, take $\mathbb{CP}^3$ with the Fubini–Study form. Then, it is known that its connected symplectic submanifolds representing the class $d[\mathbb{CP}^2]$ are mutually diffeomorphic as long as $1 \leq d \leq 3$. In this talk, I will present arbitrarily (finitely) many codimension 2 connected symplectic submanifolds in a closed symplectic 6-manifold which are mutually homotopy inequivalent but homologous. A key ingredient of the construction is hyperelliptic Lefschetz fibrations.

Infinite Analysis

March 17th (Fri) Conference Room IX

9:45–10:45

Summary: Garnier system is the extension of Painlevé equations and is given as Frobenius integrable multi-time Hamiltonian systems. In this talk, we construct and characterize the quantum Gariner system by certain holomorphic properties. The characterization of the classical Garnier system by holomorphic properties has been given by Sasano, and our result is a quantization of that work. In other words, we introduce quantum canonical transformations such that the Hamiltonian system of the Garnier system is again transformed into a polynomial Hamiltonian system, and show that the Hamiltonian can be uniquely characterized by this holomorphic properties.

Summary: It has been unknown whether Hirota's discrete analogue of the Korteweg-de Vries (KdV) equation have the consistency around a cube (CAC) property, which is known as an integrability of 2-dimensional difference equation. In this talk, we show that Hirota's discrete KdV equation has the CAC property.

Summary: Recently, we formulated the q-Garnier system and its variations as translations of an extended affine Weyl group of type $A^{(1)}_{2n+1} \times A^{(1)}_1 \times A^{(1)}_1$. On the other hand, those systems admit particular solutions in terms of the basic hypergeometric series ${}_{n+1}\phi_n$. In this talk, we investigate an action of the extended affine Weyl group on ${}_{n+1}\phi_n$. This talk is based on a joint work with Taiki Idomoto of Kindai University.

Summary: We study asymptotic analysis on the q-Painleve V equation around the origin. We solve the q-Riemann–Hilbert problem for any asymptotic series of q-Painleve V functions. We show the Mano-type decomposition for q-Painleve V.

11:00–12:00 Talk Invited by Infinite Analysis Special Session

Rei Inoue (Chiba Univ.) Cluster realization of Weyl groups and its applications to representation theory

Summary: The cluster algebra is a commutative algebra introduced by Fomin and Zelevinsky around 2000. The characteristic operation in the algebra called 'mutation' is related to various notions in mathematics and mathematical physics.

In this talk we introduce a realization of Weyl groups in terms of cluster mutations, for finite dimensional semisimple Lie algebras. We discuss its applications to (1) the geometric R-matrix of symmetric power representations for the affine quantum algebra of A-type, and to (2) the q-characters of quantum non-twisted affine algebras introduced by Frenkel and Reshetikhin, when q is a root of unity. If time permits we also mention the application to higher Teichmüller theory.

This talk is based on joint works with Thomas Lam, Pavlo Pylyavskyy, Tsukasa Ishibashi, Hironori Oya, and Takao Yamazaki.

March 18th (Sat) Conference Room IX

10:00–10:45

5 Nao Komiyama (Nagoya Univ.) Associators and the Grothendieck–Teichmüller group in mould theory 10

Summary: In this talk, we explain the mould theory introduced by Jean Ecalle, and we introduce mould theoretic formulations of Drinfeld's notion of the associator set and that of the Grothendieck–Teichmüller group. This talk is based on the joint work with Hidekazu Furusho and Minoru Hirose.

6 Atsuo Kuniba (Univ. of Tokyo)
Shuichiro Matsuike (Univ. of Tokyo)
Akihito Yoneyama (Univ. of Tokyo) New solutions to the tetrahedron equation associated with quantized six-vertex models 15

Summary: In this talk, we present a family of new solutions to the tetrahedron equation of the form $RLLL = LLLR$, where L operator may be regarded as a quantized six-vertex model whose Boltzmann weights are specific representations of the q-oscillator or q-Weyl algebras. When the three L's are associated with the q-oscillator algebra, R coincides with the known intertwiner of the quantized coordinate ring $A_q(sl_3)$. On the other hand, L's based on the q-Weyl algebra lead to new R's whose elements are either factorized or expressed as a terminating q-hypergeometric type series.

7 Toshiki Nakashima (Sophia Univ.) Geometric crystal on unipotent variety and crystal of modified quantum algebra 15

Summary: We shall define a geometric crystal structure on the unipotent variety of a simple, simply connected complex algebraic group. In SL(2)-case, certain relation to crystal base of a modified quantum algebra will be presented.

11:00–12:00 Talk Invited by Infinite Analysis Special Session

Travis Scrimshaw (Hokkaido Univ.)♭ Krystal theory

Summary: Kashiwara's theory of crystal bases has been applied to many different problems in representation theory, physics, and geometry. In this talk, we will focus on their appearance in the K-theoretic Schubert calculus of the Grassmannian. Specifically, we look at the symmetric function representatives of K-theory classes that arise from Schubert varieties called (symmetric) Grothendieck polynomials $\{G_\lambda\}_\lambda$ and three other related bases: the dual basis and their "weak" analogs. We construct a $\mathfrak{gl}_n$-crystal using the combinatorial descriptions of Buch and Lam–Pylyavskyy to describe the decomposition of these bases into Schur functions and describe their multiplicties. We will then discuss extensions to the (refined) canonical Grothendieck polynomials introduced by Hwang *et al.* and Yeliussizov. This suggest an extension of Kashiwara's theory which we call K-crystals, or Krystals for short. We conclude with some open problems. This is based on joint works with Graham Hawkes, Cara Monical, Oliver Pechenik.