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The Mathematical Society of Japan

2024 Autumn Meeting

Titles and Short Summaries of the Talks

September, 2024

at Osaka University

2024 The Mathematical Society of Japan

AUTUMN MEETING

Dates: September 3rd (Tue)–6th (Fri), 2024

Venue: Osaka University
1–1 Toyonaka, Osaka, 560-0043, Japan

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The Mathematical Society of Japan

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	MSJ Prizes Presentation (Osaka University Hall) ····· (14:30–15:00) Plenary Talks (Osaka University Hall) Autumn Prize Winner ····· (15:15–16:15) Tomoyuki Shirai (Kyushu Univ.) ····· (16:30–17:30) Official Party (Cafeteria Kasane) ····· (18:00–20:00)								
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Plenary Talks

September 4th (Wed) 2F & 3F, Osaka University Hall

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

Tomoyuki Shirai (Kyushu Univ.) Aspects of determinantal point processes ..... (16:30–17:30)

Summary: The importance of determinantal point processes (DPPs) has become widely recognized, within probability theory and diverse application areas, offering both theoretical elegance and practical utility. Their roots trace back to the 1970s when Macchi introduced them as a model for fermions in quantum mechanics. In the late 1990s, driven by the surge of interest in random matrix theory, Soshnikov and Shirai–Takahashi independently extended the framework of DPPs and established the theoretical foundation. Since then, DPPs have seen remarkable growth both in theoretical development and in diverse applications. These applications include studying eigenvalues of certain random matrices, the zeros of certain Gaussian analytic functions, the non-trivial zeros of Riemann zeta function, Poissonized Young diagrams, uniform spanning trees, and even machine learning. In this talk, we provide the background of DPPs, and overview the related topics in DPPs and beyond.

Featured Invited Talks

September 3rd (Tue)

Conference Room I

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

Summary: A sub-Riemannian structure is given by a Riemannian metric on a vector subbundle of the tangent bundle (distribution) over a manifold. Then the notion of geodesics or length minimisers are naturally defined on sub-Riemannian spaces. Unlike Riemannian case, there appear abnormal geodesics or singular curves, as sub-Riemannian geodesics, in addition to normal geodesics. It turns out that singular curves are defined, depending just on the distribution, as critical points of end-point mapping in the context of control theory, and they are significant objects also in geometry and topology in their own right. In this talk, several topics and results on singular curves of distributions will be explained for specific cases, say, (2, 3, 4)-distributions (Engel), in terms of the growth of ranks by taking Lie brackets, (2, 3, 5)-distributions (Cartan), (3, 5)-distributions, (4, 5)-distributions, (3, 6)-distributions, (4, 7)-distributions, (8, 15)-distributions and so on, with some perspectives.

Conference Room II

Tomoki Kawahira (Hitotsubashi Univ.) Analogies of complex dynamics, or an anthology ..... (13:00–14:00)

Summary: I will talk about some analogies between one dimensional complex dynamics (CD1) and other types of analytic dynamical systems. We will begin with classical "Sullivan's dictionary" linking CD1 with Kleinian groups (KG), which later yields the Lyubich–Minsky theory of hyperbolic 3-laminations for CD1. We cannot miss the Bullett–Penrose theory of holomorphic correspondence, and the Hinkkanen–Martin–Sumi theory of (random) rational semigroups which provide fascinating unifications of CD1 and KG. Anti-holomorphic dynamics is often called an "evil twin" of CD1. Complex dynamics in several variables and non-Archimedean dynamics initially developed as analogies to CD1, have recently achieved significant advancements that transcend their original analogical frameworks. With such diversity in the field, we are now at an exciting juncture. The question is: where do we go from here?

Conference Room III

Guest Talk from Taiwan Mathematical Society

Hsueh-Yung Lin (Nat. Taiwan Univ.) On the cone conjectures for Calabi–Yau pairs ..... (13:00–14:00)

Summary: We will discuss the shapes of various positive cones of divisors of a Calabi–Yau pair, with a special focus on the Kawamata–Morrison–Totaro cone conjectures, as well as the analogous conjecture formulated for the effective cone. We will illustrate some relations between these cone conjectures and some finiteness statements in birational geometry. Along the way, we will also survey some known results related to the cone conjectures. The content of the talk is based on the works by many birational geometers, and partly on joint works with C. Gachet, I. Stenger, and L. Wang.

September 5th (Thu)

Conference Room II

Shu Nakamura (Gakushuin Univ.) Microlocal methods in scattering theory ····· (13:00–14:00)

Summary: We discuss how the microlocal analysis methods are applied effectively to the scattering theory. The microlocal analysis was originally developed to investigate very precise singularity properties of solutions to partial differential equations, whereas the scattering theory concerns long time behaviors of solutions to Schrödinger equations or wave equations. Roughly speaking, if we apply the microlocal methods to the equations in the Fourier space, we expect to obtain detailed information on the scattering phenomena. This idea goes back at least to the works by Kitada, Yajima and Isozaki in early 1980's. We introduce very basic concepts of the microlocal analysis and the scattering theory, and we survey some historical developments on the microlocal methods in the scattering theory. Then we review several recent results, including long-range scattering for discrete Schrödinger equations and the microlocal structure of long-range scattering matrices.

Conference Room III

Yasutaka Shimizu (Waseda Univ.) Gerber–Shiu analysis in insurance mathematics: estimation of the scale functions for Levy risk processes ····· (13:00–14:00)

Summary: In insurance mathematics, the theory of the expected discounted penalty function, known as the "Gerber–Shiu function," introduced by Gerber and Shiu (1998, NAAJ), has evolved into a comprehensive framework that fully embraces classical insurance risk theory. Notably, applying this theory using the spectrally negative Levy process as a model for insurance surplus proves to be an effective tool for analyzing unforeseen risks in finance and insurance, a methodology now commonly referred to as "Gerber–Shiu Analysis." Over two decades have passed since its inception, and the foundational aspects of the theory appear to have been extensively studied. Nonetheless, research from a statistical point of view remains underdeveloped.

The general theory of Gerber-Shiu analysis is discussed under an asset process that follows a spectrally negative Levy process, and it is known that many ruin-related risk quantities can be expressed by using its scale function. Thus, the main statistical issue is estimating the scale functions of Levy processes.

In this talk, we will review the development of Gerber–Shiu analysis and introduce a novel method for statistical estimation of scale functions with its asymptotic theory.

September 6th (Fri)

Conference Room II

Yoshihiro Tonegawa (Tokyo Tech) Existence theorems for generalized mean curvature flow ··· (13:00–14:00)

Summary: Suppose that we have a moving n-dimensional surface M_t in $\mathbb{R}^{n+1}$ where t is the time variable. If the speed of motion of M_t is equal to the mean curvature of M_t at that point, M_t is said to be a mean curvature flow. Typically, M_t develops some singularity in finite time and there has been numerous attempts to formulate the existence theorem of generalized solution of the mean curvature flow past the singular time. In my talk, I start with some basics such as the definition and the area-decreasing property, and move on to the finer points such as Huisken's monotonicity formula, the tangent flow and the local regularity theorems, and then describe more recent existence theorems for initial value problem with a reasonable coverage of the definition of the generalized solution. These results led us to new insights on the very notion of the mean curvature flow and, moreover made us rethink what it means for surfaces to move at a specified speed in a generalized setting of measures.

Conference Room III

Toshiro Kuwabara (Univ. of Tsukuba) Vertex algebras associated with symplectic resolutions · · · · (13:00–14:00)

Summary: The central quotient of the universal enveloping algebra of a simple Lie algebra coincides with the algebra of differential operators on the flag manifold of the corresponding Lie group. Therefore, the enveloping algebra of a Lie algebra can be regarded as an algebra obtained by quantizing the coordinate ring of the cotangent bundle, which is a symplectic manifold, of the flag manifold. Relatively new algebras that have appeared in representation theory, such as rational Cherednik algebras and finite W-algebras, are also obtained as quantizations of the coordinate rings of symplectic manifolds that are not cotangent bundles, such as Nakajima quiver varieties and Slodowy varieties. Symplectic manifolds related to such noncommutative algebras are called symplectic resolutions. These are symplectic manifolds that provide a resolution of singularities for a Poisson manifold with singularities, where the morphism giving the resolution preserves the Poisson structure.

Vertex algebras are algebraic structures that can handle the structure of the enveloping algebra of affine Lie algebras, which are infinite-dimensional analogues of simple Lie algebras, in an algebraic manner. Just as simple Lie algebras and rational Cherednik algebras were described using algebras of differential operators on symplectic resolutions, we consider introducing new vertex algebras by constructing sheaves of free field vertex algebras, which are vertex algebra analogues of algebras of differential operators, such as the beta-gamma system, on symplectic resolutions. The sheaves of vertex algebras considered here are partly known as the theory of chiral differential operators (CDOs), but in general, they are a new class of objects that are vertex algebra analogues of sheaves of microlocal differential operators. It is nontrivial whether coordinate transformations between differential operators lift to coordinate transformations of free field vertex algebras, and in fact, nontrivial obstructions appear for the existence of such sheaves.

However, as a result of research, it has gradually become clear that such sheaves of vertex algebras can be explicitly constructed using BRST reduction (quantum Hamiltonian reduction) for at least some symplectic resolutions. Furthermore, it is gradually becoming clear that some of the vertex algebras constructed in this way coincide with vertex algebras arising from 3-4 dimensional conformal field theories studied by theoretical physicists. In this talk, I will explain what is currently known about vertex algebras constructed as sheaves of free field vertex algebras on symplectic resolutions.

Foundation of Mathematics and History of Mathematics

September 5th (Thu) Conference Room VIII

9:30–11:30

Summary: By digitizing the Sakuma Collection, we will build a digital archive of Japanese mathematics books that can be used by researchers, educators, and the general public.

Summary: For over two millennia, Aristotle's logic has ruled over the thinking of western intellectuals. Probability theory and statistical inference now emerge as better foundations for scientific models, especially those of the process of thinking and as essential ingredients of theoretical mathematics, even the foundations of mathematics itself. We look at probability and statistics from P. Levy, Ito and Mumford's perspective.

Summary: The "Suanshu" Jiazhong (arithmetic books, vol 1) in the unearthed bamboo slips of Qin dynasty housed at Peking University is the oldest arithmetic book of the most number of slips ever excavated. In this talk, we will overview this book, and comparing with Yuelu "Shu" and Zhangjiashan "Suanshu-shu", consider the standard of mathematics during the Qin-Han period in China.

Summary: The author talked about the works of SEKI Takakazu (?–1708), and TAKEBE Katahiro (1664–1739) on Pi. In this time, we discuss on the Number 3.16 as Pi in JINKOUKI.

Summary: The authors have finished reading the five volumes of "Kijutsu Kairoho (Methods for creating and clarifying the process of answers),"which are not independent but refer to the younger book in many parts and to the later book in others. In this article, we will introduce and discuss the characteristics of mathematics in "Yakushiki jutsu (Methods for simplifying the expression)." We will also introduce the license of the Takuma school.

Summary: The theory of mathematical plates is an attempt to understand the mathematical culture of pre-modern Japan, not by looking at individual tableaus separately but by considering multiple tableaus in terms of their mathematical, geographical, and voter relationships. Since I first proposed this idea in 2021, employing examples, I have conducted some analyses with my collaborators. This time, I have obtained an instance through Takashi Nakanishi's analysis of a plate at Ohama Shrine in Siga Prefecture, and I would like to discuss the possibility of the theory together with the example of 2021.

Summary: Hypsicles (2nd century BCE) wrote a work on regular polyhedra after examining Apollonius' work on the same topic which in turn was a development of Book 13 of Euclid's *Elements*. Hypsicles' work is usually called "Book 14" of the *Elements*, and its manuscript is often attached to that of the *Elements*. In this talk we will focus on its linguistic expressions rather than its mathematical content, and will compare its style and vocabulary with that of the *Elements*.

11:45–12:00 Mathematics History Team Meeting

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

Etsuro Date (Osaka Univ.*) On "Zenkoku Shijo Sugaku Danwakai"

Summary: "Zenkoku Shijo Sugaku Danwakai" is a series of pamphlets published by Department of Mathematics of Osaka (Imperial) University. The first issue was published in June 1934. It lasted until February 1945. The period of the second series is from November 1946 to July 1949. It was used as a communication tool among mathematical community. We will comment a bit on these pamphlets. The third series (although only 1 issue) was found recently. We will also touch upon it.

15:30–17:00

8 Koichiro Ikeda (Hosei Univ.) On stable theories having a type with infinite weight ····· 15

Summary: In this talk, we explain how to construct stable theories having a type with infinite weight in a finite language.

9 Hisashi Aratake (Oyama Nat. Coll. of Tech.) Axiomatizability of models represented by sheaves ····· 15

Summary: In the theory of sheaf representation of rings, it is well-known that von Neumann regular rings (resp. domain representable rings) are precisely the rings of global sections of sheaves whose stalks are fields (resp. integral domains). More generally, the classes of models represented by some kinds of sheaves have been considered in the context of universal algebra and model theory. However, the existing studies do not seem to answer to the question of why global section models in the above examples can be characterized elementally. In this talk, we present a sufficient condition for first-order axiomatizability of the class of models represented by sheaves whose stalks are T-models for a given first-order theory T. We exploit Coste's theory of categorical spectra and the previous studies on subcategories of locally finitely presentable categories.

10 Koki Okura (Univ. of Tsukuba) Avoiding cell decomposition ····· 15

Summary: Cell decomposition is a central and fruitful technique in model theory for the study of the real and p-adic fields. However, its proof takes much effort, maybe too much for many purposes. This talk is aimed at proposing a substitute for cell decomposition. To be more specific, we discuss some behaviors of types in o-minimal theories and that of the p-adic numbers, and explain how those results reveal some properties of those theories. One of them is the dp-minimality of the p-adic fields, whose known proof largely depends on cell decomposition.

11 Ikuo Yoneda (Tokuyama Coll. of Tech.) Weak one-basedness and CM-triviality in rosy theories ····· 15

Summary: We present the following results; one-basedness is equivalent to weak one-basedness and CM-triviality, moreover modularity is equivalent to weak one-basedness and CM-triviality in the real sort.

12 Wataru Komine (Univ. of Tsukuba) Akito Tsuboi (Univ. of Tsukuba*) On prime models of locally o-minimal theories ····· 15

Summary: It is well-known that every o-minimal theory has a prime model and they are isomorphic. We are interested in locally o-minimal theory, and investigate existence and uniqueness of prime models in definably complete locally o-minimal theory. We give some sufficient conditions for uniqueness.

Summary: Let $H(m,l,s)$ be the class of m-hypergraphs G whose l-element substructures have more than s m-element subsets which form non-hyperedges of G. We obtained the following: Suppose $3 \leq m < l$. $H(m,l,s)$ has a random structure $F(m,l,s)$ if $0 \leq s < {}_{l-2}\mathrm{C}_{m-2}$. If ${}_{l-2}\mathrm{C}_{m-2} < s$ then $H(m,l,s)$ has no random structures. If $0 \leq s < {}_{l-3}\mathrm{C}_{m-3}$ then the theory of $F(m,l,s)$ has SU-rank one. If ${}_{l-3}\mathrm{C}_{l-3} \leq s < {}_{l-2}\mathrm{C}_{m-2}$ then dividing and forking are different in the theory of $F(m,l,s)$.

September 6th (Fri) Conference Room VIII

9:30–10:30

Summary: It is known that (†)-principle arises the compactness phenomenons. In particular, anti-compact objects (like square sequences and non-reflecting stationary subsets) give semistationary subsets in which Namba forcings kill its semistationarity. We give new proofs of these using the minimal walk method.

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

Summary: Y-Proper Forcing Axiom is introduced by Chodounský–Zapletal and implies many consequences from Proper Forcing Axiom. In this talk, we present some consequences from Y-Proper Forcing Axiom which are related to a five element basis for the uncountable linear orders.

Summary: Under a certain large cardinal assumption, it is consistent that the least measurable cardinal is tightly $C^{(1)}$-compact, in particular it is not $C^{(2)}$-correct.

10:45–11:45 Talk Invited by Section on Foundation and History of Mathematics

Tadatoshi Miyamoto (Nanzan Univ.) Families of sets by side conditions

Summary: We consider two propositions, SAD and SC, with uncountable cardinals as parameters. SAD concerns strongly almost disjoint families of uncountable sets. We review the work on SAD by Baumgartner and Zapletal. SC concerns strong chains of uncountable sets. We review the work on SC by Koszmider and Inamdar. We present various forcing techniques utilized in proving the relative consistency of these propositions. We are particularly interested in the proper forcings with side conditions developed by Shelah, Todorcevic, and Aspero–Mota.

12:00–12:15 Research Section Assembly

14:15–16:30

18 Kohtaro Tadaki (Chubu Univ.) A refinement of quantum mechanics by algorithmic randomness IV: Continuous spectrum ····· 15

Summary: The notion of probability plays a crucial role in quantum mechanics. It appears as the Born rule. In modern mathematics which describes quantum mechanics, however, probability theory means nothing other than measure theory, and therefore any operational characterization of the notion of probability is still missing in quantum mechanics. In our former works, based on the toolkit of algorithmic randomness, we presented an operational refinement of the Born rule, called the principle of typicality, for specifying the property of the results of quantum measurements in an operational way. The principle of typicality is about quantum measurements with finite outcomes. In this talk, we show that our framework can be naturally extended over quantum measurements of arbitrary self-adjoint operators on Hilbert spaces of infinite dimension.

19 Masaaki Kumazawa (Abeno Shogaku High School) ♭ On a characterization of the upper semi-lattice in BCK-algebras ····· 15

Summary: Some characterizations of the class that is an upper semi-lattice in BCK-algebras are already known. One is the positive implicative BCK-algebra with condition (S) by K. Iséki, and the other is the BCK-algebra which satisfy Cornish's identity and with condition (S) by W. H. Cornish. We introduced the condition $(\mathrm{I})_{x,y}$ as a generalization of the existence of the infimum in a BCK-algebra, and characterized the lower semi-lattice in BCK-algebras. Here, we will define the "*condition* $(\mathrm{Sp})_{x,y}$" as an analogy of condition $(\mathrm{I})_{x,y}$ and characterize an upper semi-lattice in BCK-algebras by the condition $(\mathrm{Sp})_{x,y}$.

20 Akinori Maniwa (Tokyo Tech) Ryo Kashima (Tokyo Tech) Syntactic cut-elimination for provability logic **GL** via nested sequents ····· 15

Summary: The cut-elimination procedure for the provability logic is known to be problematic: a Löb-like rule keeps cut-formulae intact on reduction, even in the principal case, thereby complicating the proof of termination. In this paper, we present a syntactic cut-elimination proof based on nested sequents, a generalization of sequents that allows a sequent to contain other sequents as single elements. A similar calculus was developed by Poggiolesi (2009), but there are certain ambiguities in the proof. Adopting the idea of Kushida (2020) into nested sequents, our proof does not require an extra measure on cuts or error-prone, intricate rewriting on derivations, but only straightforward inductions, thus leading to less ambiguity and confusion.

21 Yuta Sato (Kobe Univ.) Interpolation properties of some extensions of the pure logic of necessitation **N** ····· 15

Summary: We study interpolation properties of the logic $\mathbf{N}^+\mathbf{A}_{m,n}$, which is obtained by adding a single axiom scheme $\Box^n\varphi \to \Box^m\varphi$ and a rule $\dfrac{\neg\Box\varphi}{\neg\Box\Box\varphi}$ into the pure logic of necessitation **N**. By embedding it to classical propositional logic, we prove that for $m, n \geq 1$, $\mathbf{N}^+\mathbf{A}_{m,n}$ enjoys Lyndon interpolation property (LIP) and uniform interpolation property (UIP), in contrast to $\mathbf{K4} = \mathbf{N}^+\mathbf{A}_{2,1} + \mathrm{K}$, which is known to lack UIP.

22 Haruka Kogure (Kobe Univ.) Taishi Kurahashi (Kobe Univ.) Interpolation properties for the bimodal provability logic **GR** ····· 15

Summary: We study interpolation properties for Shavrukov's bimodal logic **GR** of usual and Rosser provability predicates. For this purpose, we introduce a new relational semantics of **GR**. Based on our new relational semantics, we prove that **GR** enjoys Lyndon interpolation property and uniform interpolation property.

Summary: We study model theoretic characterizations of various collection schemes over $\mathbf{PA}^-$ from the viewpoint of cofinal extensions and end-extensions.

Summary: We discuss the differences and similarities between the intensional and extensional versions of the effectivization of essential incompleteness restricted to finite extensions.

Summary: We give a class of intermediate logics with strong disjunction property. By modifying McKay's result on the logics axiomatized by disjunctionless formulas, we can show that this class contains infinitely many logics with finite model property.

Algebra

September 3rd (Tue) Conference Room Ⅲ

9:30–12:00

Summary: Let A be a finite dimensional associative algebra. A left A-module X is called a brick if the endomorphism algebra of X is a skew-field. It is shown that bricks are in various conceptual correspondences with other important objects in representation theory. Consequently, study of bricks has received a lot of attentions. In our recent work, we study bricks and their properties from a less technical viewpoint and particularly through Hom-orthogonal modules. This leads to some non-trivial results on the algebraic and geometric properties of bricks, which ultimately relate to our studies of some open conjectures. Based on joint work with Charles Paquette.

Summary: Demonet–Iyama–Jasso introduced a new class of finite dimensional algebras, τ-tilting finite algebras. Recently, τ-tilting finiteness has been studied for various finite dimensional algebras since it relates to certain finiteness of other objects: brick finiteness, functorially finiteness of all the torsion classes, completeness of g-fans, and connectivity of silting complexes. For an algebraically closed field k of positive characteristic p and a finite group G, the classical result says that the representation type of a group algebra kG is determined by a p-Sylow subgroup of G. Hence, it is natural to ask what kinds of subgroups control τ-tilting finiteness of group algebras of finite groups. In this talk, we will explain that τ-tilting finiteness of group algebras of some semidirect products is determined by so-called p-hyperfocal subgroups.

Summary: Let p be a prime. Donovan's conjecture states that, for a given finite p-group P, there are only finitely many Morita equivalence classes of blocks of finite groups with defect groups isomorphic to P. In this talk, we show that the principal 2-blocks of infinite series of 2-dimensional general linear groups with wreathed Sylow 2-subgroups are Morita equivalent.

Summary: We proved the following theorem.

Theorem *If V is a VOA with central charge 24 of moonshine type, that is, $\sum_{n\in\mathbb{Z}} \dim V_n q^{n-1} = j(\tau) - 744$, then the space $\mathcal{F}(V) =< \mathrm{Tr}_V o(v) q^{L(0)-1} \mid v \in V >$ of 1-point functions associated to V is precisely $\mathbb{C}$-linear space spanned by the (meromorphic) modular forms of level 1 and integer weight $k \geq 0$ satisfy holomorphic on $\mathcal{H}$ and has Fourier expansion $a_0 q^{-1} + \ldots$.*

This result for $V^\natural$ was already proved by Dong–Mason in 2000.

Summary: In this talk, I will talk about the automorphism groups of parafermion vertex operator algebras associated with simple Lie algebra and positive integral level. The automorphism group is isomorphic to the automorphism group of the root system of the simple Lie algebra if (i) k is at least 3 or (ii) k is two and the simple Lie algebra is non simply laced.

Summary: The notion of free modules over (generalized) vertex algebras is introduced and the Rogers–Ramanujan recursions are realized as short exact sequences among the free modules over free generalized vertex algebras. Some of them are equivalent to exact sequences introduced by S. Capparelli et al. Moreover, a polynomial analogue of the Rogers–Ramanujan recursions are realized as exact sequences among free modules over certain vertex algebras. As applications, we study the following topics in the related fields: $\widehat{\mathfrak{sl}}_2$ spaces of coinvariants $L_{1,0}^{N,\infty}(\mathfrak{n})$ introduced by B. Feigin et al., generalized q-Fibonacci recursions and (q,z)-series related to Urod vertex operator algebras.

Summary: (Affine) W-algebras are vertex algebras defined as quantum Hamiltonian reductions of affine vertex algebras. Madsen and Ragoucy introduced secondary Hamiltonian reductions to show that some W-algebras can be obtained as quantum Hamiltonian reductions of other W-algebras. The finite W-algebra analogs were also conjectured by Morgan and recently proved by Thibault Juillard and the speaker. I'll talk about recent developments in affine W-algebra cases. This is joint work with Thibault Juillard.

Summary: Up until now, constructions such as "crossed products" in low-dimensional semisimple Hopf algebras have not been known in the context of Hopf superalgebras. In this talk, we introduce a new family of semisimple Hopf superalgebras and study its structure. Furthermore, we have shown that using this, the majority of semisimple Hopf superalgebras of dimension up to 10 over an algebraically closed field of characteristic zero can be realized. This is based on joint work with Taiki Shibata and Kenichi Shimizu.

Summary: Skew brace is an algebraic structure that was introduced in the study of the Yang–Baxter equation and it may be viewed as an extension of group. There has been a trend to try and generalize concepts and techniques in the study of groups to that of skew braces. For example, recently factorizations, isoclinism, and Schur covers of skew braces have been studied. In this talk, we introduce the definition of skew brace representation that is due to Letourmy–Vendramin and Zhu. We explain why the analogs of results, such as Maschke's theorem and Clifford's theorem, hold for skew brace representations. We also give some examples to illustrate that irreducible representations are more difficult to understand for skew braces than for groups.

Summary: Association scheme is a generalization of finite homogeneous spaces. The structure of association schemes induces a finite dimensional complex vector space with a matrix product, an Hadamard product, a transpose–conjugate, and a conjugate and a representation of the algebra with respect to the matrix product. The vector space is called the Bose–Mesner algebra of the association scheme. In this talk, we introduce a category of "algebras" that includes the Bose–Mesner algebra of association schemes as objects, and a functor from a category of association schemes to the category of "algebras".

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

Hailong Dao (Univ. of Kansas) Local singularities: algebraic, categorical and combinatorial aspects

Summary: Commutative algebra deals with algebraic structures such as rings, ideals and modules that arise from systems of polynomial equations over a field such as complex numbers or the integers. From a geometric point of view, one seeks to understand how far a commutative ring is from being nonsingular. There are many approaches to doing so, and they frequently reveal fascinating connections, ever since the birth of the subject.

In this talk, I will describe how the nature of singular rings (suitably called singularities) can be understood from different points of views: categorical (via categories of modules and complexes), homological (via behavior of co/homological functors and projective resolutions) and combinatorial (via simplicial co/homology). I will give examples to illustrates how such diverse view points enhance our understanding, and how many unexpected bridges between them remain to be discovered. I will also highlight the very important contributions of Japanese mathematicians, both in the past and the present, on these topics.

15:30–18:00

11 Jun Horiuchi (Nippon Inst. of Tech.)
Kazuma Shimomoto (Tokyo Tech)
Matijevic–Roberts type theorems for certain graded rings ····· 13

Summary: We want to show Matijevic–Roberts type theorems for certain graded rings. As an application, we can derive some ring theoretic properties of the assocaated graded rings.

12 Ryo Ishizuka (Tokyo Tech)
Kei Nakazato (Proxima Tech. Inc.)
A generalization of Kunz's theorem to mixed characteristic via p-adic cohomology theory ····· 13

Summary: The regularity of positive characteristic Noetherian rings is characterized by the faithful flatness of the Frobenius map. This is known as Kunz's theorem. Bhatt–Iyengar–Ma generalized the theorem to mixed characteristic by using perfectoid rings instead of Frobenius maps. In recent years, thanks to Bhatt's insight, the "mixed characteristic Frobenius map" has been studied via certain p-adic cohomology (prismatic cohomology). In this talk, we will explain how the regularity of mixed characteristic rings is characterized by the faithful flatness of the Frobenius lift on prismatic cohomology.

13 Akihiro Higashitani (Osaka Univ.)
Koichiro Tani (Osaka Univ.)
Non-finitely generated monoids corresponding to finitely generated subalgebras ····· 13

Summary: The goal of this talk is to study the possible monoids appearing as the associated monoids of the initial algebra of a finitely generated homogeneous $\Bbbk$-subalgebra of a polynomial ring $\Bbbk[x_1, \ldots, x_n]$. Clearly, any affine monoid can be realized since the initial algebra of the affine monoid $\Bbbk$-algebra is itself. On the other hand, the initial algebra of a finitely generated homogeneous $\Bbbk$-algebra is not necessarily finitely generated. In this talk, we provide a new family of non-finitely generated monoids which can be realized as the initial algebras of finitely generated homogeneous $\Bbbk$-algebras. Moreover, we also provide an example of a non-finitely generated monoid which cannot be realized as the initial algebra of any finitely generated homogeneous $\Bbbk$-algebra.

14 Akiyoshi Tsuchiya (Toho Univ.)
Hidefumi Ohsugi (Kwansei Gakuin Univ.)
Quadratic toric rings and Kempe equivalence ····· 13

Summary: In this talk, we characterize when the stable set ideal of a graph is generated by quadratic binomials by using Kempe equivalence. Moreover, by using this characterization, we give a partial answer to a conjecture of an algebraic characterization of perfectly contractile graphs.

Summary: We compute the dual F-signatures of certain toric rings by using combinatorial techniques. Specifically, we calculate the dual F-signatures of Veronese subrings of polynomial rings. Moreover, we give an upper bound for the dual F-signatures of Segre products of polynomial rings and show that this upper bound is attained in some cases.

Summary: In commutative ring theory, the nearly Gorenstein property is one of several generalizations of the Gorenstein property. In this talk, we introduce a new condition broader than the nearly Gorenstein property defined in (semi) standard graded rings and discuss this condition. It is a concept sharing good properties which are similar to ones nearly Gorenstein rings satisfy.

Summary: We give a new family of complete intersections which have the strong Lefschetz property. The family consists of (Artinian algebras defined by) ideals generated by power sum symmetric polynomials of consecutive degrees and of certain ideals naturally derived from them. This family has a structure of a binary tree and this observation is a key to prove that all members in it have the strong Lefschetz property.

Summary: It is known that a basis for the logarithmic vector field of a braid multiarrangement with constant odd multiplicity has an integral expression by Bandlow and Musiker. It is also known that a basis for an extended Catalan arrangement is obtained by discretizing this integral expression. In this talk, we consider a q-analogue of the integral expression using Jackson integral.

Summary: Let A be a retract of the polynomial ring in three variables over a field k. It is known that if $\mathrm{char}\,(k) = 0$ or $\mathrm{tr.deg}_k A \neq 2$ then A is a polynomial ring. In this talk, we give some sufficient conditions for A to be the polynomial ring in two variables over k when $\mathrm{char}\,(k) > 0$ and $\mathrm{tr.deg}_k A = 2$.

Summary: Let $(R, \mathfrak{m})$ be a regular local ring with $d = \dim R \geq 2$ and I an integrally closed $\mathfrak{m}$-primary ideal of R. In this talk, we investigate a classical question of when the Rees algebra $\mathcal{R}(I)$ of I becomes a Cohen–Macaulay normal domain. When $d = 2$, for every integrally closed $\mathfrak{m}$-primary ideal I of R, Zariski proved that all the powers of I are integrally closed; Lipman and Teissier proved the reduction number of the ideal I is at most one. Thus $\mathcal{R}(I)$ is a Cohen–Macaulay normal domain. When $d \geq 3$, Goto (resp. Ciupercă) studied the case where I is a complete intersection ideal (resp. an almost complete intersection ideal), and proved that the Rees algebras $\mathcal{R}(I)$ of such ideals I are Cohen–Macaulay normal domains. Inspired by their results, we start our investigation by going over the ideals generated by $d + 2$ elements.

September 4th (Wed) Conference Room III

9:15–10:45

21 Hideya Watanabe (Rikkyo Univ.) Integrable modules for quantum symmetric pair coideal subalgebras 10

Summary: One of the central objects in the representation theory of quantum groups is the integrable modules. Although the quantum symmetric pair coideal subalgebras resemble to the quantum groups, their representation theory develops very slowly. For better understanding of the representation theory, I will introduce the notion of integrable modules for the quantum symmetric pair coideal subalgebras. As an evidence that our definition is the correct one, I will explain that the algebra of matrix coefficients of simple integrable modules over a quantum symmetric pair of finite type coincides with Bao–Song's quantized coorinate ring.

22 Robert Muth (Duquesne Univ.)
Thomas Nicewicz (Washington and Jefferson Coll.)
Liron Speyer (Okinawa Inst. of Sci. and Tech. Grad. Univ.)
Louise Sutton (Okinawa Inst. of Sci. and Tech. Grad. Univ.)
A new construction of simple modules for type A KLR algebras 15

Summary: Cuspidal systems parameterise KLR algebra representations via root partitions π, where simple modules $L(\pi)$ arise as heads of proper standard modules. Working in affine type A with an arbitrary convex preorder, we construct explicit skew diagrams $\zeta(\pi)$ such that the skew Specht module $S^{\zeta(\pi)}$ has simple head $L(\pi)$ and a filtration by proper standard modules. In this talk, I will describe this construction, and if time permits, touch on some associated RoCK block combinatorics.

23 Takeshi Suzuki (Okayama Univ.)
Kento Nakada (Okayama Univ.)
Yoshitaka Toyosawa (Okayama Univ.)
Poset structure concerning cylindric diagrams 15

Summary: Cylindric diagrams admit structures of infinite d-complete posets with natural ordering. The purpose of this talk is to provide a realization of a cylindric diagram as a subset of an affine root system of type A via colored hook lengths, and to describe its poset structure. Furthermore, the set of order ideals of a cylindric diagram is described as a weak Bruhat interval of the affine Weyl group.

24 Shunsuke Kano (Tohoku Univ.)
Tsukasa Ishibashi (Tohoku Univ.)
Entropy of cluster DT transformations and the finite-tame-wild trichotomy of acyclic quivers 15

Summary: The cluster algebra associated with an acyclic quiver has a special mutation loop τ, called the cluster Donaldson–Thomas (DT) transformation, related to the Auslander–Reiten translation. In this talk, we characterize the finite-tame-wild trichotomy for acyclic quivers by the sign stability of τ introduced in [IK21] and its cluster stretch factor. As an application, we compute several kinds of entropies of τ and other mutation loops. In particular, we show that the algebraic and categorical entropies of τ are commonly given by the logarithm of the spectral radius of the Coxeter matrix associated with the quiver, and that any mutation loop of finite or tame acyclic quivers have zero algebraic entropy.

25 Ryo Uchiumi (Osaka Univ.)
Masahiko Yoshinaga (Osaka Univ.)
The quasi-polynomiality of mod q permutation representations for a linear finite group action on a lattice 15

Summary: Quasi-polynomials are periodic polynomials that appear in various problems in connection with to counting problems. In particular, Ehrhart quasi-polynomials in Ehrhart theory and characteristic quasi-polynomials in hyperplane arrangements have been studied extensively. Furthermore, in Ehrhart theory, the equivariant Ehrhart theory, which involves counting up including group actions, has been studied. In this talk, we show that the permutation representation associated with the mod q reduction of a lattice acted on linearly by a finite group is a quasi-polynomial. This study is aimed at the equivariant theory of characteristic quasi-polynomials in hyperplane arrangements. If time permits, we also discuss detailed studies for Weyl groups.

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

Sota Asai (Univ. of Tokyo) New trends in tilting theory: semibricks and TF equivalences

Summary: The representation theory of a finite-dimensional algebra A studies the module category over A. Such algebras natually appear in many fields of mathematics, including quiver representations, Fukaya categories, cluster theory, quantum groups, and derived equivalences.

One of the important methods is tilting theory, which compare the module categories and their derived categories over two non-isomorphic algebras. Tilting theory started with quiver reflection functors of Bernstein–Gel'fand–Ponomarev, and then Rickard introduced tilting complexes and showed that they characterize derived equivalences. Tilting complexes were generalized to silting complexes in terms of mutation, motivated by cluster algebras of Fomin–Zelevinsky. Since then, tilting theory has grown rapidly by using silting complexes as a main means.

In this talk, I will survey such development of tilting theory, including newer tools semibricks and TF equivalences introduced by me. These are now accepted by many researchers as important and fundamental notions in tilting theory.

Semibricks are a generalization of semisimple modules in terms of Schur's lemma. They determine abelian subcategories of the module category closed under extensions. In my study, I defined a certain finiteness conditions called left finiteness for semibricks, and proved that left finite semibricks correspond bijectively to many important notions including 2-term silting complexes.

For further study, it is important to consider the real Grothendieck group $K_0(\mathsf{proj}A)_{\mathbb{R}} \simeq \mathbb{R}^n$. For each 2-term silting complex, the g-vectors of its indecomposable direct summands give a simplicial cone in $K_0(\mathsf{proj}A)_{\mathbb{R}}$, and these cones give a non-singular fan in $K_0(\mathsf{proj}A)_{\mathbb{R}}$ called the silting fan. Since this fan is not necessarily complete, I introduced an equivalence relation in $K_0(\mathsf{proj}A)_{\mathbb{R}}$ called the TF equivalence, and showed that the TF equivalence is indeed an extension of the silting fan.

13:00–14:00

26 Shinya Kumashiro (Osaka Inst. of Tech.)
When are trace ideals finite? 15

Summary: In this talk, we explore when a Noetherian local ring has a finite number of trace ideals. We proved that if a ring has a finite number of trace ideals, then the Krull dimension is at most two. Furthermore, if a given ring has positive depth and the integral closure of the ring is local, then the dimension of the ring must be one. In that case, we explore the condition of having a finite number of trace ideals regarding the value.

27 Kaito Kimura (Nagoya Univ.)
Justin Lyle (SLMath)
Yuya Otake (Nagoya Univ.)
Ryo Takahashi (Nagoya Univ.)
On the existence of counterexamples for vanishing problems of Ext and Tor 15

Summary: We prove that there exist a Gorenstein equicharacteristic local unique factorization domain R having an isolated singularity such that $\mathrm{Tor}^R_{>0}(L,M)=0$ does not imply that the pair (L,M) satisfies Auslander's depth formula, and a Cohen–Macaulay local unique factorization domain S having an isolated singularity such that $\mathrm{Ext}^{>0}_S(N,S)=0$ does not imply the total reflexivity of N.

28 Yu Saito (Shizuoka Univ.)
Masaki Matsuno (Tokyo Univ. of Sci.)
Ayako Itaba (Tokyo Univ. of Sci.)
Classification of 3-dimensional cubic AS-regular algebras whose point schemes are reducible 15

Summary: It is known that a 3-dimensional cubic AS-regular algebra A is geometric, so we can write $A=\mathcal{A}(E,\sigma)$ where E is $\mathbb{P}^1\times\mathbb{P}^1$ or curves of bidegree (2,2) in $\mathbb{P}^1\times\mathbb{P}^1$, and $\sigma\in\mathrm{Aut}_k E$. In this talk, in terms of a geometric algebra, we determine the defining relations of A in the cases that the point schemes of A are reducible curves of bidegree $(2,2)$ in $\mathbb{P}^1\times\mathbb{P}^1$. Also, by calculating the twisted superpotential corresponding to A, we check the AS-regularity of A. By the results of Matsuno–Saito and our result in this talk, we give the list of the defining relations of 3-dimensional cubic AS-regular algebra whose point schemes are reducible.

29 Yutaka Yoshii (Ibaraki Univ.)
Some linear isomorphisms induced by the multiplication in the hyperalgebra of a simple algebraic group 10

Summary: Let G be a simply connected simple algebraic group defined and split over $\mathbb{F}_p$ and $\mathcal{U}$ a hyperalgebra of $G_{\mathbb{F}_p}$. We report that some $\mathbb{F}_p$-linear isomorphisms can be obtained from the multiplication in $\mathcal{U}$, using an $\mathbb{F}_p$-linear map which splits the Frobenius endomorphism on $\mathcal{U}$.

September 5th (Thu) Conference Room Ⅲ

9:30–12:00

30 Yuki Imamura (Osaka Univ.)
A formal category theoretic approach to the homotopy theory of dg categories 15

Summary: A dg category is an enriched category over the monoidal category of cochain complexes of $\Bbbk$-vector spaces. Dg categories possess a notion of weak equivalences called quasi-equivalences, and one can construct the localization HodgCat of the category of dg categories with respect to quasi-equivalences. In this talk, we introduce a 2-category (more precisely, a bicategory) that serves as a natural refinement of HodgCat, and show that it is equipped with the additional structure of a proarrow equipment. Proarrow equipments are known as a framework for formal category theory and make it possible to talk about (co)limits in an abstract way. Applying this theory, we explain how the pretriangulatedness of dg categories can be understood as a certain kind of completeness.

31 Yuji Tsuno (Nat. Inst. of Tech., Wakayama Coll.)
On the Grothendieck resolution for a certain finite flat commutative group scheme of order p^n over an $\mathbb{F}_p$-algebra 15

Summary: For any commutative finite flat group scheme, Grothendieck constructed an embedding into some smooth group scheme. This embedding is called the Grothendieck resolution. Let p be a prime number and n a positive integer. We consider the Grothendieck resolution for a certain finite flat commutative group scheme of order p^n over an $\mathbb{F}_p$-algebra.

Summary: This study concerns (not necessarily commutative) Hecke rings associated with certain algebras and describes a formal Dirichlet series with coefficients in the Hecke rings, which can be used to generalize Shimura's series. Considering the case of the Heisenberg Lie algebra, an analog of the identity for Shimura's series derived employing the rationality theorem, presented by Hecke and Tamagawa, is established. Moreover, this analog recovers the explicit formulae for the isomorphic zeta function and pro-isomorphic zeta function of the Heisenberg Lie algebra shown by Grunewald, Segal and Smith.

Summary: Let k be a field, T be an algebraic k-torus, X be a smooth k-compactification of T and $\operatorname{Pic}\overline{X}$ be the Picard group of $\overline{X} = X \times_k \overline{k}$ where $\overline{k}$ is a fixed separable closure of k. Hoshi, Kanai and Yamasaki [HKY22], [HKY23] determined $H^1(k, \operatorname{Pic}\overline{X})$ for norm one tori $T = R^{(1)}_{K/k}(\mathbb{G}_m)$ and gave a necessary and sufficient condition for the Hasse norm principle for extensions K/k of number fields with $[K : k] \leq 15$. Among 1954 transitive subgroups $G = 16Tm \leq S_{16}$ up to conjugacy, we determine 1101 (resp. 774, 31, 37, 1, 1, 9) cases with $H^1(k, \operatorname{Pic}\overline{X}) = 0$ (resp. $Z/2Z$, $(Z/2Z)^{\oplus 2}$, $(Z/2Z)^{\oplus 3}$, $(Z/2Z)^{\oplus 4}$, $(Z/2Z)^{\oplus 6}$, $Z/4Z$). We see that $H^1(k, \operatorname{Pic}\overline{X}) = 0$ implies that the Hasse norm principle holds for K/k. Moreover, we give a necessary and sufficient condition for the Hasse norm principle for K/k with $[K : k] = 16$ for 22 primitive $G = 16Tm$ cases.

Summary: In this talk, by generalizing Iwasawa theory for graphs initiated by Gonet and Vallières to weighted graphs, we establish Iwasawa theory for weighted graphs. In particular, we define the Iwasawa invariants for $\mathbb{Z}_p^d$-covers of weighted graphs following Cuoco–Monsky and prove the analogue of Iwasawa's class number formula for $\mathbb{Z}_p^d$-covers of weighted graphs, which is a generalization of results of DuBose–Vallières and Kleine–Müller. These invariants also allow us to consider the analogue of Kida's formula for $\mathbb{Z}_p^d$-covers of graphs. We also provide several numerical examples.

Summary: As an analogous study of Greenberg's conjecture, we consider the vanishing of the Iwasawa invariants of non-cyclotomic $\mathbb{Z}_2$-extensions of some quartic number fields, which are unramified outside a prime $(1+\sqrt{-7})/2$ of the imaginary quadratic field of discriminant -7, and give some criteria including an analogue of a basic theorem of Ozaki and Taya.

Summary: Let $g \in S_k(\Gamma_0(N))$ be a normalized newform and F be a harmonic Maass form that is good for g. Then there exists a unique p-adic constant α_g and we obtained a p-adic modular form from α_g and the holomorphic part F^+. When g has a complex multiplication by an imaginary quadratic field K and $p \nmid N$ is split in $\mathcal{O}_K$, it is known that $\alpha_g = 0$. On the other hand, the speaker showed that α_g is a p-adic unit for an inert prime $p \nmid 2N$ when $\dim_{\mathbb{C}} S_k(\Gamma_0(N)) = 1$. In this talk, we consider a weight 2 normalized CM form g with rational integer Fourier coefficients and E denotes an elliptic curve corresponding to g. Then, there exists a modular parameterization of E associated to the period lattice of g. We denote the degree of this map by C_g. The speaker proved that $C_g\alpha_g$ is a p-adic unit for almost all inert prime p. In this talk, I will explain this result.

37 Kenji Sakugawa (Shinshu Univ.) Shingo Sugiyama (Kanazawa Univ.) Integrality of Hecke eigenvalues for Hilbert and Siegel modular forms 10

Summary: We prove that Hecke eigenvalues for any Hilbert and Siegel modular forms are algebraic integers. As an application, we give the growth of the fields of rationality of cuspidal automorphic representations of GL(2d) for a prime number d with non-vanishing central L-values. We also apply the integrality of Hecke eigenvalues for holomorphic Siegel cusp forms of general degree in order to give the growth of the Hecke fields of those forms.

38 Kohei Takehira (Tohoku Univ.) On the dynamical height zeta functions 15

Summary: Height functions are fundamental tools in number theory, and their behavior itself is an intriguing subject of study. For instance, Schanuel has demonstrated the asymptotic behavior of the number of rational points with bounded height in N-dimensional projective space over number fields. On the other hand, an analog of the height function in discrete dynamical systems has been defined by Call and Silverman, which is also useful for extracting arithmetic information from dynamical systems. In this talk, we will discuss the number of rational points with bounded dynamical height. The discussion will be conducted by constructing a zeta function from the dynamical height function and examining it.

12:00–12:30 Research Section Assembly

14:15–16:45

39 Tomohiro Iwami (Kyushu Inst. of Tech.) Analogous S. Bloch's formula related to recovering conductors of ($\mathbb{Q}$-)conic bundles via three-dimensional Miyaoka–Yau type inequality with third Chern classes 15

Summary: For three-dimensional extremal neighborhood $(X, C) \subset \mathbb{C}^2$ with C reducible, the author had studied three-dimensional Miyaoka–Yau type inequality with (associated) third Chern classes, abbreviated as $(\mathrm{MY})_{3,c_3}$, or its variant one driven by $S^2\Omega^1_X$, abbreviated as $(\mathrm{MY})_{3,c_3,S^2}$ ([I.2018Mar, I.2019Sep, I.2020Sep, I.2021Sep]), and also investigated related Intermediate Jacobian $\widetilde{IJ}(X, C)$ in order to study period spcaes for $(\mathrm{MY})_{3,c_3}$ or $(\mathrm{MY})_{3,c_3,S^2}$ ([I.2022Mar]). In such serial studies,the author gave strong approximation for integral structure of $\widetilde{IJ}(X, C)$ ([I.2022Sep, I.2023Mar]) and also gave alternative descriptions both for [Iskovskikh 1987] and [S.Mori-Yu.Prokhorov 2021] about rationality of ($\mathbb{Q}$-)conic bundles ([I.2023Sep]), by introducing conductors based on [I.2018Mar, I.2019Sep, I.2020Sep, I.2021Sep, I.2022Mar, I.2022Sep, I.2023Mar], and moreover, as an application, gave canonical embedding of Clemens–Griffiths–Kuznetsov components ([I.2024Mar]). Based mainly on [I.2023Sep, I.2024Mar], the author present relations between Chern classes in $(\mathrm{MY})_{3,c_3}$ or $(\mathrm{MY})_{3,c_3,S^2}$ and related Chow groups (with filtrations), which is possible to be formed as analogous S. Bloch's conductor formula for [S.Bloch 1987, K.Kato-T.Saito 2004], and also as an extended one, in this talk.

40 Michio Amano (Meisei Univ.) On the injectivity of certain homomorphisms between extensions of $\widehat{\mathcal{G}}^{(\lambda)}$ by $\widehat{\mathbb{G}}_m$ over a $\mathbb{Z}_{(p)}$-algebra 15

Summary: Let $\widehat{\mathcal{G}}^{(\lambda)}$ be a formal group scheme which deforms $\widehat{\mathbb{G}}_a$ to $\widehat{\mathbb{G}}_m$. And let $\psi^{(l)} : \widehat{\mathcal{G}}^{(\lambda)} \to \widehat{\mathcal{G}}^{(\lambda^{p^l})}$ be the l-th Frobenius-type homomorphism determined by λ. We show that the homomorphism $(\psi^{(l)})^* : H^2_0(\widehat{\mathcal{G}}^{(\lambda^{p^l})}, \widehat{\mathbb{G}}_m) \to H^2_0(\widehat{\mathcal{G}}^{(\lambda)}, \widehat{\mathbb{G}}_m)$ induced by $\psi^{(l)}$ is injective over a $\mathbb{Z}_{(p)}$-algebra.

41 Rin Gotou (Osaka Inst. of Tech.)♭ Marking-weighted tree stratification of geometric moduli spaces of dynamical systems over $\mathbf{P}^1$ 15

Summary: The moduli space of the dynamical systems $\mathrm{rat}_d := \mathrm{Rat}_d/\mathrm{PGL}_2$ is the quotient of the moduli space of self-rational maps of degree d on $\mathbf{P}^1$ with respect to the conjugation action of $\mathrm{Aut}(\mathbf{P}^1) = \mathrm{PGL}_2$. We consider compactifications of rat_d respecting geometric behavior of dynamical systems. We give invariant-theoretic constructions of compactified moduli spaces and a stratification of the moduli space using marking-weighted trees, analogous to the moduli space $\overline{M}_{0,n}$ of stable rational curves.

42 Yuta Takada (Univ. of Tokyo) Dynamical degrees of automorphisms of K3 surfaces with Picard number 2 15

Summary: We show that there exists an automorphism of a projective K3 surface with Picard number 2 such that the trace of its action on the Picard lattice is 3. Together with a result of K. Hashimoto, J. Keum and K. Lee, we determine the set of dynamical degrees of automorphisms of projective K3 surfaces with Picard number 2.

43 Taiki Takatsu (Tokyo Univ. of Sci.) On automorphism groups of K3 surfaces and their virtual cohomological dimension 15

Summary: In this talk, we discuss the virtual cohomological dimension of automorphism groups of K3 surfaces. We apply the Bestvina–Mess type formula for relatively hyperbolic groups, which is established by Tomohiro Fukaya, to automorphism groups of K3 surfaces, and we show that the virtual cohomological dimension of automorphism groups of K3 surfaces determined by the covering dimension of the blown-up boundaries associated with their ample cones.

44 Hisashi Usui (Gunma Nat. Coll. of Tech.) An example of the explicit generators of the Mordell–Weil lattice of a supersingular elliptic K3 surface in characteristic 11 15

Summary: We consider the Mordell–Weil lattice of the elliptic curve

$E^{(12)} : y^2 = x^3 + t^{12} + 1$

defined over $k(t)$, where $k = \mathbb{F}_{11^2} = \mathbb{F}_{11}[s]/(s^2+1)$. The associated elliptic surface is a supersingular K3 surface of Artin invariant $\sigma_0 = 1$. So the discriminant of the Néron–Severi lattice is $-\mathrm{char}(k)^{2\sigma_0} = -11^2$. We give the explicit generators of the Mordell–Weil lattice and the Néron–Severi lattice of the associated elliptic surface.

45 Ken Sato (Tokyo Tech) ♭ On higher Chow cycles on $K3$ surfaces 15

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

46 Norihiko Minami (Yamato Univ./Nagoya Inst. of Tech.*) Algebro-geometric invariant reflected in counter-examples the integral conjectues of Hodge and Tate 15

Summary: Some algebro-geometric invariant interpreration is given for the obvious invariant which measures the failure of the integral conjectures of Hodge and Tate. In o corollary of our main theorem, some applications of the three dimensional minimal model program show up to impose some algebro-geomtric restriction to counter examples of the integral Hodge conjecture for complex projective maifolds of any dimension equal or larger than three.

17:00–18:00 Talk Invited by Algebra Section

Kenta Hasizume (Niigata Univ.) On minimal model theory for polarized log pairs

Summary: Minimal model theory is a fundamental tool to study birational geometry. Especially, the theory is indispensable to partial resolutions of singularities and moduli problems. In 2010, the breakthrough has been made by Birkar–Cascini–Hacon–McKernan. They have established the minimal model theory for polarized Kawamata log terminal pairs. After that, a remarkable progress in the log canonical case has been made by Fujino, Birkar, and Hacon–Xu. In this talk, I will introduce a recent development of the minimal model theory for polarized log pairs.

September 6th (Fri) Conference Room III

9:15–10:45

47 Takeshi Torii (Okayama Univ.)
Kazunori Nakamoto (Univ. of Yamanashi)
The moduli of subalgebras of the full matrix ring (3) ····· 15

Summary: We describe the moduli of 4-dimensional subalgebras of the full matrix ring of degree 3. We show that the moduli scheme has three irreducible components, whose relative dimensions over $\mathbb{Z}$ are $5, 2, 2$, respectively.

48 Takuya Saito (Hokkaido Univ.)
Simona Settepanella (Torino Univ.)
Pragnya Das
Recent developments in the combinatorics of discriminantal arrangements ····· 15

Summary: A hyperplane is a linear subspace of codimension 1, and a finite set of hyperplanes is called a hyperplane arrangement $\mathcal{A}$. A discriminantal arrangement $\mathcal{B}(\mathcal{A})$ is a hyperplane arrangement induced in the space of parallel translations of a given arrangement $\mathcal{A}$. In this presentation, we will discuss recent developments in the combinatorics of discriminantal arrangements.

49 Akihiro Higashitani (Osaka Univ.)
Norihiro Nakashima (Nagoya Inst. of Tech.)
Characteristic quasi-polynomials of restrictions of Shi arrangements of type B ····· 15

Summary: Kamiya, Takemura, and Terao introduced a characteristic quasi-polynomial which enumerates the numbers of elements in the complement of hyperplane arrangements modulo positive integers. We compute the characteristic quasi-polynomials of restrictions of the Shi arrangement of type B by one given hyperplane. As a corollary, we determine when the characteristic quasi-polynomials of deletions of the Shi arrangement of type B are polynomials. This implies the partial solution for the conjecture regarding period collapse.

50 Nobukazu Kowaki (Osaka Univ.)
Tropical hyperplane arrangements and combinatorial mutations of the matching field polytopes of Grassmannians ····· 15

Summary: A sequence of combinatorial mutations of matching field polytopes preserves the property of giving rise to a toric degeneration of Grassmannians. In this paper, we find a way to check that two matching field polytopes are combinatorial mutation equivalence using tropical hyperplane arrangements, "literally at a glance". Our way can prove that block diagonal matching fields are combinatorial mutations equivalent to diagonal matching fields. This is one of main results in [2]. Our result can be regarded as a generalization of that result.

51 Mao Nagamine (Hokkaido Univ.)
A-hypergeometric series with parameters in the core ····· 15

Summary: We discuss conditions for applying Frobenius's method to A-hypergeometric systems introduced by Okuyama and Saito. We prove that, when the negative support of a fake exponent $\boldsymbol{v}$ with respect to a generic weight $\boldsymbol{w}$ is included in the core, we can construct all A-hypergeometric series with exponent $\boldsymbol{v}$ in the direction $\boldsymbol{w}$ by Frobenius's method.

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

Kota Saito (Univ. of Tsukuba/Sophia Univ.) Arithmetic properties of the integer and fractional parts of a sequence

Summary: For every real number x, we define $\lfloor x \rfloor$ as the integer part of x, and $\{x\} = x - \lfloor x \rfloor$ as the fractional part of x. The speaker will talk about a series of studies on the integer parts and fractional parts of sequences. First, we will examine $\lfloor n^\alpha \rfloor$ $(n = 1, 2, \ldots)$. This sequence is called the Piatetski-Shapiro sequence (with exponent α). In this research, we considered the problem of whether there exists $\alpha > 3$ such that $\lfloor p^\alpha \rfloor + \lfloor q^\alpha \rfloor = \lfloor r^\alpha \rfloor$ has a solution (p, q, r) of positive integers. Considering Fermat's equation, we could expect that there is no such α. However, by collaborating with Toshiki Matsusaka, we find infinitely many such α's. The speaker plans to introduce other studies and results on Diophantine equations involving integer parts.

The speaker next will discuss the randomness of the b-adic expansion of an algebraic irrational number α. This problem is essentially equivalent to examining the distribution of $\{b^n\alpha\}$ $(n = 1, 2, \ldots)$. Borel conjectured that the b-adic expansion of an algebraic irrational number would be sufficiently random. For instance, if Borel's conjecture is true, then the probability that the digit 1 appears in the binary expansion of $\sqrt{2}$ should be $1/2$ like a coin toss. However, even the positivity of this probability is unknown. Despite these difficulties, by collaborating with Yuya Kanado, we revealed a strong relationship between the randomness of $\{b^n\alpha\}$ and the Riemann zeta function. In other words, we succeeded in linking two fields of research that had been studied independently through a completely different approach.

Lastly, we will discuss $\lfloor A^{3^n} \rfloor$ $(n = 1, 2, \ldots)$. In 1947, Mills constructed a real number $A > 1$ such that this sequence is always prime. The smallest such $A > 1$ is called Mills' constant. Although there may be different opinions, we could say that the question of whether Mills' constant is irrational has been unsolved for over 70 years. However, the speaker has successfully proved the irrationality of Mills' constant by using a simple idea. If time permits, the speaker will also discuss a partial result of its transcendency.

14:15–17:30

52 Xin Ren (Osaka Univ.)
Takeyoshi Kogiso (Josai Univ.)
Kengo Miyamoto (Ibaraki Univ.)
Michihisa Wakui (Kansai Univ.)
Kohji Yanagawa (Kansai Univ.)
Arithmetic on q-deformed rational numbers 15

Summary: The q-deformed rational numbers were introduced by Morier-Genoud and Ovsienko based on continued fractions and Euler q-integers. This work is related to many directions including Teichmüller spaces, the 2-Calabi–Yau category of type A_2, the Markov–Hurwitz approximation theory, the modular group and Picard groups, the Jones polynomials of rational knots, and combinatorics on fence posets. In this talk, we give an arithmetic property on q-deformed rational numbers. For two rational numbers with the same denominator, their q-deformed denominator polynomials may not be equal. We give a sufficient condition for their denominator polynomials to be equal.

53 Yasuaki Gyoda (Univ. of Tokyo)
Shuhei Maruyama (Kanazawa Univ.)
Yusuke Sato (Osaka Inst. of Tech.)
$SL(2, \mathbb{Z})$-matrixization of generalized Markov numbers 15

Summary: A k-generalized Markov number refers to an integer that appears in the positive integer solutions of the k-generalized Markov equation $x^2 + y^2 + z^2 + k(yz + zx + xy) = (3 + 3k)xyz$. The k-generalized Markov equation possesses an algorithm that generates two distinct positive integer solutions from a single positive integer solution, forming a tree structure through this algorithm. In this talk, we will introduce two types of elements in $SL(2, \mathbb{Z})$ that have a k-generalized Markov number as their $(1, 2)$-entry and show how these elements preserve the tree structure of the positive integer solutions of the k-generalized Markov equation.

Summary: In 1947, Lehmer conjectured that Ramanujan's τ-function never vanishes, where the function $\tau : \mathbb{Z}_{>0} \longrightarrow \mathbb{Z}$ is defined by

$$x \prod_{n \geq 1} (1 - x^n)^{24} = \sum_{n \geq 1} \tau(n) x^n.$$

This conjecture is still open.

It is natural to consider whether any given integer belongs to the image of τ-function. Recently, it is proved that $\pm\ell, \pm 2\ell, \pm 2\ell^2$ are not τ-values, where $\ell < 100$ is an odd prime by Balakrishnan, Ono, Craig and many other people. The speaker proved that $\pm\ell, \pm 2\ell, \pm 4\ell, \pm 8\ell$ are not τ-values except for 14 cases, where $\ell < 1000$ is an odd prime.

Summary: Multiple Eisenstein series is a holomorphic function on the upper half plane, which is a generalization of double Eisenstein series introduced by Gangl, Kaneko and Zagier. As a connection to multiple zeta value, Bachmann and Tasaka showed that the Fourier expansion of multiple Eisenstein series can be obtained from the coproduct of formal iterated integrals corresponding to multiple zeta values. They also constructed shuffle regularized multiple Eisenstein series. For general level, Yuan and Zhao studied double Eisenstein series of level N and obtained analogous results of Gangl, Kaneko and Zagier. In this talk, we introduce multiple Eisenstein series of level N and expand the results of Bachmann and Tasaka for arbitrary level.

Summary: I plan to talk about relations between multiple Mahler measures of $(X-1)/(X+1)$ and multiple zeta values of level 2.

Summary: J. Rosen('20) proposes a notion of algebraic numbers in the algebra $\mathscr{A}$ related with the finite multiple zeta values. In this talk, we focus on the q-Fibonacci sequence and prove its specific congruence, from which we deduce a construction of certain finite transcendental numbers. This research is a joint work with Hidetaka Funakura.

Summary: Let $R(N)$ be the number of representations of N as a sum of a prime and a square-full number weighted with logarithmic function. We call the function such as $R(N)$ the representation function. In this talk, we show that an asymptotic formula for the sum of $R(N)$ over the short interval $X < N \leq X + H$ holds when $X^{\frac{1}{2}+\varepsilon} \leq H < X^{1-\varepsilon}$.

Summary: We consider the moments of quadratic twists of the Möbius function. By combining the estimate of quadratic character sums and the multivariable Tauberian Theorem, we give unconditional results for their asymptotic behaviors.

Summary: For $\alpha \geq 1$, denote by $\mathrm{PS}(\alpha)$ the set $\{\lfloor n^\alpha \rfloor : n \in \mathbb{N}\}$, which is called a Piatetski-Shapiro sequence when $\alpha > 1$ is non-integral. In this talk, we give asymptotic formulas for the number of solutions of linear equations in $\mathrm{PS}(\alpha)$. We handle the three equations $y - x = d$, $x + y = N$, and $x + y = z$.

Summary: A real number α is called simply normal to base b if its base-b expansion has each digit appearing with average frequency tending to $1/b$. Moreover, α is called normal to base b if α is simply normal to base b^h for all natural numbers h. In this talk, we discuss a relation in between the normality of algebraic numbers and a mean value of the Riemann zeta function on arithmetic progresstions. As a consequence, we show that

$$\lim_{N\to\infty}\frac{1}{\log N}\sum_{1\le|n|\le N}\zeta\left(-k+\frac{2\pi in}{\log b}\right)\frac{e^{2\pi in\frac{\log\alpha}{\log b}}}{n^{k+1}}=0$$

holds for all non-negative integers k if and only if α is normal to base b. This is joint work with Kota Saito (University of Tsukuba).

Summary: For integers $k=0,1,\ldots$, *k-ary* divisors of an integer N are defined. 0-ary divisors are ordinary divisors of N. A divisor d of an integer N is k-ary if the greatest common $(k-1)$-ary divisor of d and N/d is one and *infinitary* if d is a k-ary divisor of N for sufficiently large k. We write $\sigma^{(k)}(N)$ and $\sigma^{(\infty)}(N)$ for the sum of (positive) k-ary divisors and infinitary divisors of N respectively. We determine all odd solutions N to $\sigma^{(\infty)}(\sigma(N))=2N$.

Summary: The lattice point problems of the p-circles, which generalized circles for positive real numbers p, have been solved for approximately p more than 3, based on the series representation of the error term using the generalized Bessel functions by E. Krätzel and the results of G. Kuba. On the other hand, for the cases $0<p<2$, the method via this series representation cannot make progress. Therefore, in this talk, I will discuss the speaker's result that certain functions closely related to the problems can be displayed as a series by a newly generalized Bessel function based on the property p-radial, generalization of spherical symmetry, and highlight the possibility that attempts to solve the problems via this display are suitable especially for the cases $0<p<2$.

Geometry

September 3rd (Tue) Conference Room I

9:30–11:45

1 Yoshito Ishiki (Tokyo Metro. Univ.)♭ Spaces of metrics are Baire ····· 15

Summary: For a metrizable space, we consider the space of all metrics generating the same topology of the metrizable space, and this space of metrics is equipped with the supremum metric. In this paper, for every metrizable space, we establish that the space of metrics on the metrizable space is Baire. We also show that the set of all complete metrics is comeager in the space of metrics. Moreover, we investigate non–Archimedean analogues of these results.

2 Yoshiki Jikumaru (Toyo Univ.) Symmetries in the linear theory of the deformation of thin shells ····· 15

Summary: In this talk, we show that symmetries, which are known in the theory of integrable systems, naturally appeared in the classical linear theory of deformations of thin shells. Our result shows that if the middle surface of a shell becomes 'integrable', infinitely many deformations exist that have no shear strains and twisting of the coordinate lines.

3 Kenzi Satô (Tamagawa Univ.) A intrinsic characterization of a centroid of a spherical or hyperbolic simplex ····· 15

Summary: The centroid of a planar triangle satisfies 6 properties, but the point with properties are divided into 4 points for a spherical or hyperbolic triangle. One of them, the center of gravity, was defined by using Euclidean or Minkowski space contains the sphere or the hyperbolic plane, respectively, but we have found an intrinsic characterization of it. It can be extended to higher dimensional cases.

4 Yuichiro Sato (Waseda Univ.)
Takanao Tsuyuki (Hokkaido Information Univ.) Spatially homogeneous solutions of vacuum Einstein equations in general dimensions ····· 15

Summary: In this talk, we give new solutions to the vacuum Einstein equations without cosmological constant using almost abelian Lie groups. We consider globally hyperbolic spacetimes in which almost abelian Lie groups act on the Cauchy hypersurfaces isometrically and simply transitively. Previous studies and our results show that such solutions are completely found for Lie groups with zero-dimensional moduli spaces of left-invariant Riemannian metrics. For the simplest solution, we show that each of the spatial dimensions cannot expand or contract simultaneously in the late-time limit.

5 Shoichi Fujimori (Hiroshima Univ.)
Yu Kawakami (Kanazawa Univ.)
Masatoshi Kokubu (Tokyo Denki Univ.) Surfaces with concentric or parallel K-contours ····· 15

Summary: Surfaces with concentric K-contours and parallel K-contours in Euclidean 3-space are defined. Crucial examples are presented and characterization of them are given.

6 Yuta Sasahara (Tokyo Metro. Univ.) 4-dimensional isoparametric hypersurfaces of index 2 in the pseudo-Riemannian space forms ····· 15

Summary: We study isoparametric hypersurfaces, whose principal curvatures are all constant, in the pseudo-Riemannian space forms. We give a classification of hypersurfaces of index 2 with respect to a pair of a shape operator and a metric. Therefore, we can define types of isoparametric hypersurfaces of index 2 concerning the classification. In this talk, we give a few examples of some types. Moreover, we show that there exist no isoparametric hypersurfaces of index 2 whose shape operators have complex principal curvatures in certain cases.

7 Jun O'Hara (Chiba Univ.) Residues of manifolds and curvatures ····· 15

Summary: We show that, depending on the parity of the dimension, the energy or the residue of a closed submanifold of Euclidean space or a compact body is invariant under Mobius transformations. We also express the scalar curvature and the squared norm of the mean curvature vector by local (weighted) residues, and the mean curvature of the boundary of a compact body by local relative residues.

14:15–16:15

8 Hiroaki Nagaya (Hiroshima Univ.) A study of bornological proper actions ····· 10

Summary: We study discontinuous groups in non Riemannian geometry, inspired by Toshiyuki Kobayashi's 1980s work. Unlike in Riemannian geometry, discrete groups of isometries acting non Rimeannian spaces do not always become discontinuous groups. However, adding the condition of proper action, discrete groups of isometries become discontinuous groups. Thus, it is important to give a properness criterion. There are concepts called weakly proper and CI which are related to proper. Generally, proper, weakly proper, and CI weaken in that order. In 2006, Yoshino show under which cases these conditions become equivalent using the theory of topologies. We rewrite these conditions from the perspective of bornologies and we show in which cases those conditions are equivalent using the theory of bornologies.

9 Taika Okuda (Tokyo Univ. of Sci.), Akifumi Sako (Tokyo Univ. of Sci.) Recent progress on twisted Fock representations of complex Grassmannians ····· 15

Summary: The Twisted Fock representation of Kähler manifold is the Fock representation defined by Karabegov's star product with separation of variables, introduced by Sako–Suzuki–Umetsu. As an approach to theoretical physics, it is known that twisted Fock representations can be applied to the formulation of noncommutative gauge theories in the context of deformation quantization. In this talk, we will present the results obtained so far in our study of the twisted Fock representations of complex Grassmannians and their application to noncommutative field theories.

10 Kazushi Kobayashi (Mie Univ.) On a B-field transform of generalized complex structures over complex tori ····· 15

Summary: Let $(X^n, \check{X}^n)$ be a mirror pair of an n-dimensional complex torus X^n and its mirror partner $\check{X}^n$. Then, by SYZ transform, we can construct a holomorphic line bundle with an integrable connection from each pair of a Lagrangian section of $\check{X}^n \to \mathbb{R}^n/\mathbb{Z}^n$ and a unitary local system along it, and those holomorphic line bundles with integrable connections forms a dg-category DG_{X^n}. In this talk, we focus on a certain B-field transform of the generalized complex structure induced from the complex structure on X^n, and interpret it as the deformation $X^n_{\mathcal{G}}$ of X^n by a flat gerbe $\mathcal{G}$. Moreover, we construct the deformation of DG_{X^n} associated to the deformation from X^n to $X^n_{\mathcal{G}}$, and also discuss the homological mirror symmetry between $X^n_{\mathcal{G}}$ and its mirror partner on the object level.

11 Yuto Yamamoto (RIKEN) The Gross–Siebert program and non-archimedean SYZ fibrations ···· 15

Summary: For a maximally degenerate Calabi–Yau variety, the Berkovich retraction associated with a (good) minimal dlt model is regarded as an SYZ fibration in non-archimedean geometry. In general, the integral affine structure induced on the base space of the fibration differs from the one defined for the dual intersection complex of a toric degeneration in the Gross–Siebert program. In this talk, using tropical geometry, we construct non-archimedean SYZ fibrations whose bases are integral affine manifolds appearing in the Gross–Siebert program for Calabi–Yau complete intersections of Batyrev–Borisov.

12 Masao Jinzenji (Okayama Univ.)
Ken Kuwata
(Kagawa Nat. Coll. of Tech.)
Elliptic virtual structure constants and generalizations of BCOV-Zinger formula to projective fano hypersurfaces 15

Summary: In this talk, we propose a recipe for B-model computation of genus 1 Gromov–Witten invariants of Calabi–Yau and Fano Projective Hypersurfaces. Our formalism can be applied equally to both Calabi–Yau and Fano cases. In Calabi–Yau case, drastic cancellation of terms used in our formalism occurs and it results in another representation of BCOV-Zinger formula for projective Calabi–Yau hypersurfaces.

13 Natsuo Miyatake (Tohoku Univ.)
Quantification and evaluation in the degree of mutual misalignment of harmonic metrics on cyclic Higgs bundles 15

Summary: Let X be a Riemann surface and $K_X \to X$ the canonical bundle. For each integer $r \geq 2$, each $q \in H^0(K_X^r)$, and each choice of the square root $K_X^{1/2}$ of the canonical bundle, we canonically obtain a Higgs bundle, which is called a cyclic Higgs bundle. In this talk, I will introduce a function called entropy that quantifies the degree of mutual misalignment of harmonic metrics on cyclic Higgs bundles and provide an estimate for the entropy.

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

Hiroshi Iritani (Kyoto Univ.)♭ Quantum cohomology of blowups

Summary: Quantum cohomology is a deformation of the cohomology ring of a smooth projective variety defined by counting rational curves. The relationship between quantum cohomology and birational geometry has attracted much interest. In this talk, I will explain the following decomposition theorem for quantum cohomology of blowups: the quantum cohomology of the blowup $\widetilde{X}$ of X along a smooth subvariety Z is a direct sum of the quantum cohomology of X and $(\mathrm{codim}(Z) - 1)$ copies of the quantum cohomology of Z. The proof idea is based on a D-module version of Teleman's conjecture, which relates the quantum cohomology of a GIT quotient to the equivariant quantum cohomology of the original manifold via Fourier transformation.

September 4th (Wed) Conference Room I

10:00–10:15 Presentation Ceremony for the 2024 MSJ Geometry Prize

10:20–11:20 Award Lecture for the 2024 MSJ Geometry Prize

Hokuto Konno (Univ. of Tokyo) Diffeomorphism group and gauge theory

Summary: The group of diffeomorphisms of a given smooth manifold is a fundamental object of study for topologists and geometers. One of the major advances in topology over the past decade concerns diffeomorphism groups of higher-dimensional manifolds, led by many researchers such as Galatius and Randal-Williams. On the other hand, it has been well-known since the last century that 4 is a special dimension in the classification of manifolds. Special phenomena are typically described in terms of comparisons between the topological and smooth categories, and they are detected using gauge theory. In recent years, advances in gauge theory for families have revealed that special phenomena in dimension 4 also occur for diffeomorphism groups in various ways, contrasting with recent results in higher dimensions. I will survey these new special phenomena in dimension 4, also from the perspective of comparisons between the topological and smooth categories.

12:50–13:50 Award Lecture for the 2024 MSJ Geometry Prize

Shinobu Hosono (Gakushuin Univ.) Families of Calabi-Yau manifolds and mirror symmetry

Summary: Mirror symmetry of Calabi–Yau manifolds is a mysterious symmetry that interchanges the complex geometry of one Calabi–Yau manifold with the symplectic geometry of another Calabi–Yau manifold, called a mirror manifold. 30 years after its discovery, we now have fascinating proposals, such as homological mirror symmetry and SYZ geometric mirror construction, to describe the symmetry mathematically. In this talk, however, I will describe this symmetry in terms of two different, and classical, nilpotent linear actions associated with a Calabi–Yau manifold. One is the Lefschetz action in the hard Lefschetz theorem (which I call A-structure), and the other is a certain monodromy action that arises from a family of Calabi–Yau manifolds (B-structure). I define mirror symmetry as the symmetry which exchanges these two structures. The general existence of a mirror Calabi–Yau manifold for a given Calabi–Yau manifold is still an open problem. However, mirror symmetry defined by these classical actions motivates us to study/construct families of Calabi–Yau manifolds, and to look into the boundary points where Calabi–Yau manifolds degenerate in a specific way. Based on my collaborations with Hiromichi Takagi since 2010, I will present interesting families of Calabi–Yau threefolds which are parametrized by two-dimensional toric varieties.

September 5th (Thu) Conference Room I

9:30–11:45

Summary: We studied the closure of a complex subtorus in a symplectic toric manifold, which is referred to as a torus-equivariantly embedded toric manifold when the closure is a complex submanifold. In this talk, we construct submanifolds with boundary and corners in a Delzant polytope of the corresponding symplectic toric manifold. We also demonstrate that the conditions for the submanifolds with boundary and corners are equivalent to those for torus-equivariantly embedded toric manifolds.

Summary: The parallel transport map is a Riemannian submersion naturally defined over a compact Riemannian symmetric space and its total space is an infinite dimensional separable Hilbert space. In this paper we define the parallel transport map over an affine symmetric space and show that it is an affine submersion with a horizontal distribution.

Summary: We give a classification of three-dimensional homogeneous spaces which can be locally isometrically embedded into four-dimensional spaces of constant sectional curvature.

Summary: A compact Lie group G equipped with a bi-invariant Riemannian metric is a Riemannian symmetric space. The symmetry s_x at x is given by $s_x(y) = xy^{-1}x$. A subset S of G is called an antipodal set if $s_x(y) = y$ holds for any x and y in S. When S is a maximal antipodal set containing the identity element, S is a subgroup of G, which is called a maximal antipodal subgroup. We show that all of the maximal antipodal subgroups in compact Lie groups, which are not necessarily connected, do not change through covering homomorphisms with odd degree.

18 Tadashi Fujioka (Osaka Univ.) A sphere theorem for a positively curved homology manifold and its links · · · · · 15

Summary: We obtain a sphere theorem for a homology manifold of positive curvature in the sense of Alexandrov and its links. More precisely, we show that if a homology manifold of curvature at least 1 contains three/four points with pairwise distances strictly greater than $\pi/2$, then the homology manifold/every space of directions is homeomorphic to a sphere, respectively. This theorem is optimal in the sense that the number of points and the strict inequality cannot be improved.

19 Shota Hamanaka (Osaka Univ.) Scalar curvature lower bounds of steady gradient Ricci soliton · · · · · 15

Summary: In this talk, I will give some upper bounds of the infimum of the scalar curvature of a complete non-compact steady gradient Ricci soliton. The proofs use (warped) μ-bubble method.

20 Kei Funano (Tohoku Univ.) A universal inequality for Neumann eigenvalues of the Laplacian · · · · · 10

Summary: I will explain some universal inequality for Neumann eigenvalues of the Laplacian on a bounded convex domain in a Euclidean space.

14:15–18:00

21 Takahiro Aoi (Nat. Inst. of Tech., Wakayama Coll.) Skoda–Zeriahi type integrability and entropy compactness for Poincaré type Kähler metrics · · · · · 15

Summary: I will talk about an integrability result of plurisubharmonic functions for some measure with L^1-density. In order to prove this, Skoda–Zeriahi's integrability theorem and the Ohsawa–Takegoshi L^2-extension theorem play a very important role. As an application, we obtain a certain compactness result of the relative entropy. This work is motivated by the existence problem of constant scalar curvature Kähler metrics of Poincaré type.

22 Naoto Yotsutani (Kagawa Univ.)
King Leung Lee (IMAG, Univ. of Montpellier) Chow stability of λ-stable toric viarieties · · · · · 15

Summary: For a given polarized toric variety, we define the notion of λ-stability which is a natural generalization of uniform K-stability. At the neighbourhoods of the vertices of the corresponding moment polytope Δ, we consider appropriate triangulations and give a sufficient criteria for a λ-stable polarized toric variety (X, L) to be asymptotically Chow polystable when the obstruction of asymptotic Chow semistability (the Futaki–Ono invariant) vanishes. As an application, we prove that any K-semistable polarized smooth toric variety (X, L) with the vanishing Futaki–Ono invariant is asymptotically Chow polystable.

23 Naoto Yotsutani (Kagawa Univ.) Numerical semistability of projective toric varieties · · · · · 15

Summary: Let $X \to \mathbb{P}^N$ be a smooth linearly normal projective variety. It was proved by Paul that the K-energy of $(X, \omega_{\mathrm{FS}}\big|_X)$ restricted to the Bergman metrics is bounded from below if and only if the pair of (rescaled) Chow/Hurwitz forms of X is *semistable*. In this talk, we provide a necessary and sufficient condition for a given smooth toric variety X_P to be numerically semistable with respect to $\mathcal{O}_{X_P}(i)$ for a positive integer i. Applying this result to a smooth polarized toric variety (X_P, L_P), we prove that (X_P, L_P) is asymptotically numerically semistable if and only if it is K-semistable in the toric sense.

24 Shuhei Yonehara (Osaka Univ.) Actions of cosymplectic groupoids and a reduction theorem · · · · · 15

Summary: The Mikami–Weinstein reduction theorem is a generalization of the classical Marsden–Weinstein reduction theorem to the case of symplectic groupoid actions. In recent years, the notion of cosymplectic groupoids, which is an odd-dimensional counterpart of the one of symplectic groupoids, has begun to be studied. In this talk, we introduce the notion of cosymplectic groupoid actions on cosymplectic manifolds using the notion of Lagrangian–Legendrean submanifolds of cosymplectic manifolds. Following this, we prove a theorem which is a natural analogue of the Mikami–Weinstein theorem.

Summary: The notion of (bundle-valued) homotopy momentum sections, which was introduced by the speakers, is a conception subsuming both momentum maps and momentum sections under a single framework. Bundle-valued homotopy momentum sections are defined for bundle-valued multisymplectic manifolds together with Lie algebroid structures, while usual momentum maps are done for symplectic manifolds with Hamiltonian actions. In this talk, we shall expand the Marsden–Weinstein theorem to the case of vector-valued symplectic manifolds with Lie algebroids which do not necessarily admit Hamiltonian actions.

Summary: Koszul–Vinberg manifolds are a generalization of dually flat manifolds. These manifolds have properties similar to Poisson and symplectic manifolds. It is known that Poisson manifolds are related to Lie algebroids while Koszul–Vinberg manifolds are related to left-symmetric algebroids. By generalizing Lie algebroids, we obtain the notion of Jacobi algebroids. Jacobi structures are the structures on a manifold related to Jacobi algebroids. We defined Jacobi-left-symmetric algebroids by analogy with Jacobi algebroids, and defined the structures on a manifold related to these, called Jacobi–Koszul–Vinberg structures.

Summary: In this talk, we give a necessary condition for a solvmanifold associated to a one-dimensional extension of a nilmanifold has a non-Vaisman locally conformal Kähler structure. Moreover, we prove that such a 6-dimensional solvmanifold has no non-Vaisman locally conformal Kähler structures.

Summary: We study the eigenvalues and eigenfunctions of the Folland–Stein operator $\mathscr{L}_\alpha$ on some examples of 3-dimensional Heisenberg Bieberbach manifolds, that is, compact quotients $\Gamma\backslash\mathbb{H}$ of the Heisenberg group $\mathbb{H}$ by a discrete torsion-free subgroup Γ of $\mathbb{H} \rtimes U(1)$.

Summary: In this talk, we will construct moduli spaces of Sp-equivariant harmonic maps from odd-dimensional complex projective spaces into complex projective spaces.

Summary: We construct a hyperkähler metric on a complex semisimple coadjoint orbit of $\mathrm{SL}_{n+1}(\mathbb{C})$ explicitly in terms of coordinates, realizing the orbit as a twisted cotangent bundle on a complex projective space $\mathbb{CP}^n$, which is an affine bundle associated to the cotangent bundle on $\mathbb{CP}^n$.

Summary: The Lagrange top is one of the typical examples of integrable systems, which describes the motion of a rigid body around a fixed point with the symmetric axis passing through the centre of mass and the fixed point. The complexification of the energy-momentum map induces an elliptic fibration over the complex projective plane in Weierstraß normal form. In this talk, the description of the singular locus of this elliptic fibration is given in detail. Furthermore, the monodromy of the elliptic fibration is described.

September 6th (Fri) Conference Room I

9:30–11:45

32 Sheng-Chen Mao (Fudan Univ.)
Ye Zhang
(Okinawa Inst. of Sci. and Tech. Grad. Univ.)
On gradient estimates of the heat semigroups on step-two Carnot groups 15

Summary: In this work, we give a sufficient condition of measure contraction property type for a step-two Carnot group to satisfy the quasi Bakry–Émery curvature condition. It turns out that the establishment of the quasi Bakry–Émery curvature condition does not require the precise upper and lower bound estimates of the heat kernel and the computation of the Jacobian determinant of the sub-Riemannian exponential map, which are difficult to obtain by current methods.

33 Xiaodan Zhou
(Okinawa Inst. of Sci. and Tech. Grad. Univ.)
Non-uniqueness of Green functions on metric spaces 15

Summary: We construct an explicit example showing that the uniqueness of energy minimizing harmonic Green functions fails on a 2-Ahlfors regular space supporting a Poincare inequality. This result contrasts the uniqueness of Cheeger harmonic Green functions on such spaces obtained earlier by Bonk, Capogna and the speaker. We also discuss some interesting implications of this example including the failure of strong comparison principle. This is joint work with A. Bjorn, J. Bjorn and S. Eriksson-Bique.

34 Naotaka Kajino (Kyoto Univ.)
Ryosuke Shimizu (Waseda Univ.)
Sharp Hölder regularity estimates of harmonic functions for p-resistance forms 15

Summary: Let $p \in (1, \infty)$. The purpose of this talk is to present, on the basis of `arXiv:2404.13668`, our recent result on sharp Hölder regularity estimates of harmonic functions for *p-resistance forms*, which are a class of p-energy forms we have recently introduced to study p-energy forms on fractals systematically. Our Hölder regularity estimates have an application to the proof of the triangle inequality for the p-resistance metric of any p-resistance form, which also seems new in the present abstract setting, and also are one of the key ingredients of our ongoing study on the singularity of p-energy measures among distinct values of p for some p.-c.f. self-similar sets, which the speaker will speak about in his next talk.

35 Naotaka Kajino (Kyoto Univ.)
Ryosuke Shimizu (Waseda Univ.)
On singularity of p-energy measures among distinct values of p for some p.-c.f. self-similar sets 15

Summary: For $p \in (1, \infty)$, a *p-energy form* $(\mathcal{E}_p, \mathcal{F}_p)$, a natural L^p-analog of the standard Dirichlet form for $p = 2$, was constructed on a class of p.-c.f. self-similar sets by Herman–Peirone–Strichartz (2004), on general p.-c.f. self-similar sets by Cao–Gu–Qiu (2022), on Sierpiński carpets by Shimizu (2024) and Murugan–Shimizu (2024+) and on a large class of infinitely ramified self-similar fractals by Kigami (2023), but very little has been understood concerning properties of important analytic objects associated with $(\mathcal{E}_p, \mathcal{F}_p)$ such as p-harmonic functions and p-energy measures. This talk is aimed at presenting the result of our recent ongoing study that, *for a class of p.-c.f. self-similar sets with very good geometric symmetry, the p-energy measure $\mu^p_{\langle u \rangle}$ of any $u \in \mathcal{F}_p$ and the q-energy measure $\mu^q_{\langle v \rangle}$ of any $v \in \mathcal{F}_q$ are mutually singular for any $p, q \in (1, \infty)$ with $p \neq q$.*

36 Naomichi Nakajima
(Shibaura Inst. of Tech.)
Dually flat geometry of plane curves and singularity theory 15

Summary: In the Euclidean plane, classically, it is well-known that extrinsic differential geometric invariants of curves are characterized by singularities of the corresponding envelope, and the singularities are analyzed by the distance-squared functions. In this presentation, I would like to talk about our generalization of the results in the Euclidean space to the ones in a dually flat space, introduced by Amari and Nagaoka to geometrically investigate various fields such as statistics, machine learning, and so on. Additionally, I would like to introduce an application of our results to maximum likelihood estimation in statistics.

37 Kaito Kayo (Hokkaido Univ.) Statistical manifold with degenerate metric · 15

Summary: A statistical manifold is a pseudo-Riemannian manifold endowed with a Codazzi structure. This structure plays an important role in Information Geometry and its related fields, e.g., a statistical model admits this structure with the Fisher-Rao metric. In practical application, however, the metric may be degenerate, and then this geometric structure is not fully adapted. In this study, for such cases, we introduce the notion of quasi-Codazzi structure which consists of a possibly degenerate metric and a pair of coherent tangent bundles with affine connections. As a special case, the quasi-Codazzi structure with flat connections coincides with the quasi-Hessian structure previously studied by Nakajima–Ohmoto.

38 Hikozo Kobayashi (Hiroshima Univ.) Moduli spaces of left-invariant statistical structures, dually-flatness and conjugate symmetries · 15
Yu Ohno (Hokkaido Univ.)
Takayuki Okuda (Hiroshima Univ.)
Hiroshi Tamaru (Osaka Metro. Univ.)

Summary: In the context of information geometry, a concept known as left-invariant statistical structures on Lie groups has been defined by Furuhata–Inoguchi–Kobayashi [Inf.Geom.(2021)]. In this talk, we introduce the classification of important classes called "dually-flat" and "conjugate symmetric" within left-invariant statistical structures on commutative Lie groups $\mathbb{R}^n$ and certain two types of almost abelian Lie groups.

14:15–16:45

39 Kazumasa Narita (Nagoya Univ.) Geometric interpretation of majorization and its application to graph realization problem · 15

Summary: Majorization is an important combinatorial notion that has applications in many areas of mathematics. In 1952, Rado gave a geometric characterization of majorization. By applying this theorem due to Rado, the speaker characterized when a finite sequence of nonnegative real numbers is realized as the degree sequence of some weighted uniform hypergraph. This theorem is an extension of a theorem due to Hakimi (1962). The speaker also studied the properties of the closed convex polytope associated with the set of hypergraphs with a given degree sequence.

40 Takumi Matsuka (Tokyo Metro. Univ.) Boundary of free products of coarsely convex spaces · · · · · · · · · · · · · · · · 15
Tomohiro Fukaya (Tokyo Metro. Univ.)

Summary: We compute (co)homologies of ideal boundaries of free products of geodesic coarsely convex spaces in terms of those of each of the components. The (co)homology theories we consider are, K-theory, Alexander-Spanier cohomology, K-homology, and Steenrod homology. These computations led to the computation of K-theory of the Roe algebra of free products of geodesic coarsely convex spaces via the coarse Baum–Connes conjecture.

41 Masato Mimura (Tohoku Univ.)♭ Generalized mixed Bavard duality · 15
Morimichi Kawasaki (Hokkaido Univ.)
Mitsuaki Kimura (Osaka Dent. Univ.)
Takahiro Matsushita (Shinshu Univ.)
Shuhei Maruyama (Kanazawa Univ.)

Summary: We prove the "generalized and mixed" version of the Bavard duality theorem.

42 Tetsu Toyoda (Kogakuin Univ.) The Andoni–Naor–Neiman inequalities and isometric embeddability into a CAT(0) space · 15

Summary: Andoni, Naor and Neiman (2018) established a family of quadratic metric inequalities that hold true in every CAT(0) space. As stated in their paper, this family seems to include all previously used quadratic metric inequalities that hold true in every CAT(0) space. We prove that there exists a metric space that satisfies all inequalities in this family but does not admit an isometric embedding into any CAT(0) space.

Summary: We show that finitely generated torsion groups with subexponential growth cannot act on finite-dimensional CAT(0) spaces without fixed points. A similar fixed-point theorem can be proved for finitely generated simple groups with subexponential growth.

Summary: A Euclidean space with a Gaussian distribution is called a Gaussian space. The limit object of Gaussian spaces as the dimension diverges to infinity in the pyramid sense is well-studied. This is a central figure in the study of infinite dimensional limit of Riemannian manifolds. In this talk, we study an l_p-normed space with a Gaussian distribution instead of the Euclidean norm. When $p \geq 2$, it is easy to capture its infinite dimensional limit object. On the other hand, when $p < 2$, the situation is different. We determine the limit of l_p-normed Gaussian spaces with suitable scaling as the dimension diverges to infinity, and then apply it to the phase transition phenomenon of convergence of l_p-product spaces.

Summary: We talk about Artin groups and acylindrical hyperbolicity, which are important in geometric group theory. Our main theorem claims that irreducible Artin groups associated with graphs that are not cliques are acylindrically hyperbolic. As a corollary, we see that irreducible Artin groups of type FC and of infinite type are acylindrically hyperbolic.

Complex Analysis

September 3rd (Tue) Conference Room VI

9:30–11:00

Summary: The Wasan (Japanese mathematics in the Edo period (1603–1868: national isolation)) of 1673 contains studies leading to three extended Newton methods and three extended Mandelbrot recurrence formulas. Moreover, the extended Mandelbrot recurrence formula 1 is related to the extended Newton methods (Theorem 3.1). Furthermore, from extended Mandelbrot recurrence formula 1 and 3, we obtain Newton–Mandelbrot set and Murase–Mandelbrot set, respectively. These show the originality of Japanese mathematics Wasan.

Summary: We develop an ergodic theory of entire holomorphic curves. Our theory is analogous to the ergodic theory of Axiom A diffeomorphisms.

Summary: In this talk, we introduce a domain of complex 2 dimension which contains the real 2 dimensional hyperbolic disk and 2 sphere in a special way. This approach enables us to unify the hyperbolic geometry and spherical geometry of real 2 dimension in a holomorphic manner. We apply this idea to show convergence of the Wick star product.

Summary: We provide the complex Banach manifold structure for the Teichmüller space of circle diffeomorphisms whose derivatives are in the Zygmund class. This is done by showing that the Schwarzian derivative map is a holomorphic split submersion. We prove similar results for the pre-Schwarzian derivative map and investigate the fiber space over the Teichmüller space. Especially, we show that this projection is also a holomorphic split submersion and induces the structure of a disk bundle. Finally, we introduce the little Zygmund class and consider the closed subspace given by this family of mappings in the Teichmüller space.

Summary: Using harmonic maps from a punctured Riemann surface to hyperbolic surfaces with totally geodesic boundaries, we obtain a parametrization of Teichmüller space. The parametrization space is the space of meromorphic quadratic differentials on the punctured Riemann surface. In this talk, we consider the degeneration of hyperbolic surfaces parametrized by a ray from the origin in the space of meromorphic quadratic differentials. In particular, taking the universal covers of the Riemann surface, we show the normalized metric spaces of the hyperbolic surfaces converge to the R-tree which is determined by the direction of the ray. Here, we discuss the convergence in the sense of Gromov–Hausdorff.

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

Shinpei Baba (Osaka Univ.)♭ Bers' simultaneous uniformization theorem and complex projective structures on Riemann surfaces

Summary: Bers' simultaneous uniformization theorem is a generalization of the uniformization theorem of Riemann surfaces. It establishes a bijective correspondence between pairs of Riemann surface structures and typical discrete faithful representations into $\mathrm{PSL}(2,\mathbb{C})$. Bers' original proof is based on the quasi-conformal deformation theory. In this talk, we outline a new proof, using the intersection of holonomy varieties.
The deformation space of complex projective structures on a Riemann surface is identified with the vector space of holomorphic quadratic differentials on the surface. This vector space properly embeds into the space of representations of the surface group into $\mathrm{PSL}(2,\mathbb{C})$, so that its image is a smooth analytic subvariety. Given two marked Riemann surface structures on the same topological surface, we show that the intersection of their corresponding subvarieties is a discrete set. From this, one can reprove the simultaneous uniformization theorem.

September 4th (Wed) Conference Room VI

9:30–11:00

6 Takanori Ayano (Osaka Metro. Univ.) Expressions of hyperelliptic functions of genus $2g$ in terms of hyperelliptic functions of genus g ····· 15

Summary: The problem whether the Jacobian variety of a hyperelliptic curve is isogenous to the direct product of the Jacobian varieties of hyperelliptic curves of lower genera is considered in many papers. This problem is naturally connected with the following well-known problem: Let solutions of differential equations and dynamical systems in terms of hyperelliptic functions are given. Under conditions when a reduction of these functions to hyperelliptic functions of lower genera is possible, find an explicit form of these solutions in terms of hyperelliptic functions of lower genera. In our previous work, we solve this problem for a class of hyperelliptic curves of genus 2. In this talk, we generalize our previous results to the case of genus $2g$ for any positive integer g.

7 Tatsuhiro Honda (Senshu Univ.)
Hidetaka Hamada (Kyushu Sangyo Univ.) Bohr's phenomena for pluriharmonic mappings in a separable complex Hilbert space ····· 15

Summary: Let H_1 be the Euclidean space $\mathbb{C}^m$ or ℓ_2, and let $\mathbb{B}_{H_1}$ be the unit ball of H_1. In this talk, we will discuss about Bohr's phenomena for pluriharmonic mappings from $\mathbb{B}_{H_1}$ into H_1, and generalize some results about Bohr's phenomena for locally univalent harmonic functions on the unit disc in $\mathbb{C}$ to pluriharmonic mappings from $\mathbb{B}_{H_1}$ into H_1.

8 Takeo Ohsawa (Nagoya Univ.)♭ On Stein neighborhood basis of certain Stein domains ····· 15

Summary: The purpose of this talk is to outline a proof of the following.
Theorem. There exists a two-dimensional compact complex manifold Y holomorphically embedded in $\mathbb{CP}^5$ and a Stein domain $X \subset Y$ with real-analytic boundary such that X admits a Stein neighborhood system with Hölder continuous boundary in $\mathbb{CP}^5$ but does not admit a Stein neighborhood system with Lipschitz continuous boundary.

9 Yuta Watanabe (Chuo Univ.) ω-trace and Griffiths positivity for singular Hermitian metrics ····· 15

Summary: In this talk, we investigate various positivity for singular Hermitian metrics such as Griffiths, ω-trace and RC, where ω is a Hermitian metric, and show that these quasi-positivity notions induce 0-th cohomology vanishing, rational conected-ness, etc. Here, ω-trace positivity of smooth Hermitian metrics h on holomorphic vector bundles E represents the positivity of $tr_\omega i\Theta_{E,h}$.

Summary: We construct a new ambient metric and a Poincaré metric for the Fefferman conformal manifold over CR 3-manifolds. These are constructed via the self-dual Einstein ACH metric which has the CR manifold as the boundary at infinity. These metrics enable us to construct CR GJMS operators and local scalar invariants of CR 3-manifolds.

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

Hajime Tsuji (Sophia Univ.*) Discrete Kähler–Ricci flows

Summary: To study Kähler–Ricci flows, we consider the dynamical systems of Bergman kernels (or similar dynamical systems) as a discrete version of them. This enables us to deduce the logarithmic plurisubharmonic variation of Kähler Ricci flows. This indicates the metric semipositivity of the relative canonical bundle of a Kähler deformation of compact Kähler manifolds with pseudoeffective relative canonical bundle.

Functional Equations

September 3rd (Tue) Conference Room II

9:00–12:00

1 Yumiko Takei (Ibaraki Nat. Coll. of Tech.)
Yoshitsugu Takei (Doshisha Univ.)
A system of differential-difference equations and an integral representation of solutions for the hypergeometric functions 12

Summary: We consider a system of differential-difference equations satisfied by the Gauss hypergeometric function. By using the Laplace transform with respect to parameters we get an integral representation of solutions in the form of the triple complex integral. By using the gauge transformation the well-known integral representation of solutions is also obtained. Similar results hold for confluent hypergeometric functions as well.

2 Keiji Matsumoto (Hokkaido Univ.)
Jyoichi Kaneko (Univ. of Ryukyus*)
Katsuyoshi Ohara (Kanazawa Univ.)
Tomohide Terasoma (Hosei Univ.)
A system of hypergeometric differential equations in m variables I, the rank and the singular locus. 12

Summary: We define a hypergeometric series in m variables with $p+(p-1)m$ parameters, which reduces to the generalized hypergeometric series ${}_pF_{p-1}$ when $m=1$, and to Lauricella's hypergeometric series F_C in m variables when $p=2$. We give a system of hypergeometric differential equations annihilating the series. Under some non-integral conditions on parameters, we give an Euler type integral representation of the series, and linearly independent p^m solutions to this system around a point near to the origin. We show that this system is of rank p^m, and determine its singular locus.

3 Keiji Matsumoto (Hokkaido Univ.)
Jyoichi Kaneko (Univ. of Ryukyus*)
Katsuyoshi Ohara (Kanazawa Univ.)
Tomohide Terasoma (Hosei Univ.)
A system of hypergeometric differential equations in m variables II, the monodromy representation. 12

Summary: We study the monodromy representation of a hypergeometric system $\mathcal{F}_C^{p,m}(a,B)$ in m variables of rank p^m with parameters a, B, which can be regarded as a multi-variable model of the generalized hypergeometric equation of rank p. We give $m+1$ loops generating the fundamental group of the complement the singular locus of the system $\mathcal{F}_C^{p,m}(a,B)$, and show that they satisfy some relations as elements of the fundamental group. We give circuit matrices along these loops with respect to a fundamental system of solutions to $\mathcal{F}_C^{p,m}(a,B)$ under some non-integral conditions on parameters a, B.

4 Tatsuya Hosoi (Univ. of Tokyo)
Hidetaka Sakai (Univ. of Tokyo)
A study on the bilinear equation of the sixth Painlevé transcendents 12

Summary: The sixth Painlevé equation is a basic equation among the non-linear differential equations with three fixed singularities, corresponding to Gauss's hypergeometric differential equation among the linear differential equations. It is known that 2nd order Fuchsian differential equations with three singular points are reduced to the hypergeometric differential equations. Similarly, for nonlinear differential equations, we would like to determine the equation from the local behavior around the three singularities. In this paper, the sixth Painlevé equation is derived by imposing the condition that it is of type (H) at each three singular points for the homogeneous quadratic 4th-order differential equation.

Summary: It is known that all tau functions of the Painleve equations satisfy the fourth-order quadratic differential equation. Among them, for the III, V, and VI equations, it is possible to express the formal series solutions combinatrically by using conformal blocks. In this paper, we show the convergence of the formal series, including the solutions of more general equations. The convergence of the conformal block function also follows in the case c = 1 by the absolute convergence of tau series, since it is a partial sum of the tau series. We also characterized the form of a homogeneous quadratic equation with a series solution similar to the tau functions of the Painleve equations.

Summary: The notion of mild solutions for linear delay differential equations (DDEs) has been introduced in [J. Nishiguchi, Electron. J. Qual. Theory Differ. Equ. **2023**, No. 32, 1–77] for the purpose of defining fundamental matrix solutions and obtaining a variation of constants formula for linear DDEs. This notion gives a definition of solutions to linear DDEs under discontinuous history functions. For a given linear DDE, the fundamental matrix solutions are locally absolutely continuous on the interval $[0, \infty)$, however, it is not apparent that the same property is true for the mild solutions. Here we obtain a result which shows the regularity of mild solutions by proving the local absolute continuity of a function obtained by the history segment of a locally absolutely continuous function.

Summary: This study is devoted to the stability analysis of a scalar linear differential equation with discrete and distributed delays. We establish necessary and sufficient conditions guaranteeing the asymptotic stability of the zero solution composed of explicit delay-dependent criteria.

Summary: We consider perturbed third order half-linear ordinary differential equations near the infinity. Asymptotic behavior of their positive solutions is established.

Summary: This work focuses on the box-counting dimension of the spiral orbits for two-dimensional nonautonomous nonlinear systems. The main result emphasizes that the box-counting dimension of the spiral orbits of the systems on the phase plane depends on the power of the nonlinear terms.

Summary: This talk considers an ordinary differential system that assumes a fixed internal ratio of severe cases requiring treatment and mild cases not requiring treatment within the infected population. We take into account the limited treatment capacity for severe cases to discuss the impact of treatment capacity and the proportion of severe cases on the spread of diseases, and show the occurrence of backward bifurcation.

11 Kazuki Ishibashi (Hiroshima Inst. of Tech.) — Wintner-type nonoscillation theorems for Sturm–Liouville differential equations using a PD controller · · · · · 12

Summary: In this study, we addressed the nonoscillation of the Sturm–Liouville differential equation with a differential operator, which corresponds to a proportional-derivative controller. A Wintner-type nonoscillation theorem was established to be applied to such equations. Using this theorem, we provided a sharp nonoscillation condition that guarantees that all nontrivial solutions to Euler-type equations do not oscillate. The main nonoscillation theorems can be proven by introducing a Riccati inequality, which corresponds to the Sturm–Liouville type equation with proportional-derivative controller.

12 Tetsutaro Shibata (Hiroshima Univ.) — Asymptotics of solution curves of Kirchhoff type elliptic equations with logarithmic Kirchhoff function · · · · · 12

Summary: The one-dimensional nonlinear bifurcation problem of Kirchhoff type is considered. Let λ be the bifurcation parameter We obtain the precise asymptotic formulas for the solutions u_λ as $\lambda \to \infty$ and $\lambda \to 0$ by using time map method.

13 Satoshi Masaki (Hokkaido Univ.) — On representation of solutions to a class of systems of ordinary differential equations · · · · · 12

Summary: We consider a class of systems of nonlinear ordinary differential equations, which has a background in the study of the asymptotic behavior of solutions to NLS systems. We introduce an integration scheme. The key point is to introduce an intermediate step to obtain quadratic quantities of the unknown.

14:15–16:45

14 Tatsuki Mori (Musashino Univ.)
Sohei Tasaki (Hokkaido Univ.)
Tohru Tsujikawa (Univ. of Miyazaki⋆/Meiji Univ.)
Yasuhito Miyamoto (Univ. of Tokyo)
Shoji Yotsutani (Ryukoku Univ.⋆)
— Stability of stationary solutions of a phase-field model · · · · · 12

Summary: We have obtained all global bifurcation diagrams of stationary problems of a phase-field model in Mori–Tasaki–Tsujikawa–Yotsutani (DCDS-B, 2023). For special parameters, the first bifurcation occurs from a trivial constant solution, and secondary bifurcation occurs from odd-symmetry solutions. In this talk, we investigate the stability of odd-symmetric solutions and asymmetric solutions near the secondary bifurcation point by solving the nonlocal linearized eigenvalue problem by improving and developing methods in Miyamoto– Mori–Tsujikawa–Yotsutani(JDE, 2021).

15 Shoji Yotsutani (Ryukoku Univ.⋆)
Sohei Tasaki (Hokkaido Univ.)
Tohru Tsujikawa (Univ. of Miyazaki⋆/Meiji Univ.)
Yasuhito Miyamoto (Univ. of Tokyo)
Tatsuki Mori (Musashino Univ.)
— All eigenvalues and eigenfunctions of a nonlocal linearized eigenvalue problem · · · · · 12

Summary: We investigate a nonlocal linearized eigenvalue problem arising from a phase-field model, which is related to the Allen–Cahn equation. For the Allen–Cahn equation in a 1D case, Wakasa (Funkcial Ekvac., 2006) and Wakasa–Yotsutani (JDE, 2015, 2016) obtained representation formulas of all eigenvalues and corresponding eigenfunctions. In this talk, we show representation formulas of all eigenvalues and corresponding eigenfunctions of the nonlocal linearized eigenvalue problem.

16 Yuta Ishii (Ibaraki Nat. Coll. of Tech.) Existence of spiky stationary solutions for the Gierer–Meinhardt model with advection term on the Y-shaped metric graph ····· 12

Summary: In this talk, we consider the existence of one-peak stationary solutions for the Gierer–Meinhardt model with advection term on the Y-shaped metric graph. In particular, we focus on the two vertex conditions (the Kirchhoff condition and the Robin condition) and the advection velocity having different constants for each segment. Moreover, it is shown that the location and amplitude of a spike is determined by the choice of the vertex condition, and the size and sign of the advection velocity.

17 Ryunosuke Mori (Meiji Univ.)
Hiroshi Matano (Meiji Univ.) Blocking and propagation in two-dimensional cylinders with spatial periodicity ····· 12

Summary: We consider blocking and propagation phenomena of mean curvature flow with a driving force in two-dimensional cylinders with spatially undulating boundary. In this problem, Matano, Nakamura and Lou in 2006 characterize the effect of the shape of the boundary to blocking and propagation of the solutions under some slop condition about the boundary that implies time global existence of the classical solutions. In this talk, we consider the effect of the shape of the boundary to blocking and propagation of this problem under more general situation that the solutions may develop singularities near the boundary.

18 Ayuki Sekisaka (Meiji Univ.)
Hiroko Yamamoto (RIKEN) Eigenvalue problem and the Evans function of reaction-diffusion systems in cylinder domains ····· 12

Summary: To study the stability problem of solutions of reaction-diffusion systems in cylindrical domains, we consider the eigenvalue problem of the linearized operator associated with a traveling wave solution of reaction-diffusion systems. In this research, we construct the Evans function that vanishes at eigenvalues and is analytic in a simply connected bounded domain in the complex plane. This research is a joint work with Ayuki Sekisaka of Meiji University.

19 Yuki Kaneko (Kanto Gakuin Univ.)
Yasuhito Miyamoto (Univ. of Tokyo)
Tohru Wakasa (Kyushu Inst. of Tech.) Stability and bifurcation diagram for a shadow Gierer–Meinhardt system in one spatial dimension ····· 10

Summary: We are concerned with a Neumann problem of a shadow system of the Gierer–Meinhardt model in an interval $I = (0, 1)$. A stationary problem is studied, and we consider the diffusion coefficient $\varepsilon > 0$ as a bifurcation parameter. Then a complete bifurcation diagram of the stationary solutions is obtained, and a stability of every stationary solution is determined. In particular, for each $n \geq 1$, two branches of n-mode solutions emanate from a trivial branch. All 1-mode solutions are stable for small $\tau > 0$, and all n-mode solutions, $n \geq 2$, are unstable for all $\tau > 0$, where $\tau > 0$ is a time constant. The system is known for having stationary spiky patterns with large amplitude for small $\varepsilon > 0$. Then, asymptotic expansions of maximum and minimum values of a stationary solution as $\varepsilon \to 0$ are also obtained.

20 Masahiko Shimojo (Tokyo Metro. Univ.)
Jong-Shenq Guo (Tamkang Univ.) Stability of traveling waves in non-cooperative systems with nonlocal dispersal of equal diffusivities ····· 12

Summary: We first introduce a stability theorem for traveling waves in a class of non-cooperative reaction-diffusion systems with nonlocal dispersal of equal diffusivities. Our stability criterion is that the initial perturbation is such that a suitable weighted relative entropy function is bounded and integrable. We apply our main theorem to derive the stability of traveling waves for some examples of non-cooperative systems arising in ecology and epidemiology.

21 Masahiko Shimojo (Tokyo Metro. Univ.), Jong-Shenq Guo (Tamkang Univ.), Chin-Chin Wu (Chung Hsing Univ.) — Spreading dynamics for a predator-prey system with two predators and one prey in a shifting habitat ····· 12

Summary: We discuss the spreading dynamics for a three-species predator-prey system with two weak competing predators and one prey in a shifting habitat. First, we explain some extinction results for each species. Then we provide some persistence theorems for each species with moving speeds exceeding the shifting speed, but less than certain quantities. Finally, the convergence to a certain constant state is proven in each persistent regime.

22 Kenta Kumagai (Tokyo Tech) — Bifurcation structure of supercritical semilinear elliptic equations in two dimensions ····· 12

Summary: We consider the Gelfand problem with general supercritical nonlinearities in the two-dimensional unit ball. In this talk, we prove the uniqueness of solutions for any small parameter. As a result, we obtain the existence of a radial singular solution. Moreover, we prove the uniformly boundedness of finite Morse index solutions. As a consequence, we show that the bifurcation curve has infinitely many turning points. These properties are known in N dimensions with $3 \leq N \leq 9$ for general supercritical nonlinearities. On the other hand, these properties are less known in two dimensions. Our results clarify that the bifurcation structure solely depends on the supercriticality/subcriticality of the nonlinearities.

23 Yasuhito Miyamoto (Univ. of Tokyo), Yūki Naito (Hiroshima Univ.) — A bifurcation diagram of solutions to semilinear elliptic equations with general supercritical growth ····· 12

Summary: We study the global bifurcation diagram of positive solutions to the semilinear elliptic equation $\Delta u + \lambda f(u) = 0$. Under general supercritical growth conditions on $f(u)$, we show that an unbounded bifurcation curve has no turning point, which indicates the existence of the singular extremal solution. In particular, our theory can be applied to the super-exponential cases of $f(u)$, and we exhibit that the bifurcation curve has the same qualitative property as a classical Gel'fand problem for $N \geq 3$ except $N = 10$.

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

Fumihiko Nakano (Tohoku Univ.) — Statistics for random Schroedinger operators and random walk

Summary: Disordered quantum systems is one of the fundamental topics in mathematical physics. It is the origin of various important phenomena, such as Anderson localization, quantum Hall effect and topological insulators. A typical feature in its spectral property is the appearance of dense point spectrum and exponential decay of corresponding eigenfunctions. Recently, much attention is being paid for its statistical property, which is believed to reflect the structure of these systems.
In this talk, I will review results on the eigenvalue statistics problem for the following Hamiltonians, through which one can see how the statistics is inked to spectral property and then its essential features.
(i) 1-dimensional model with decaying potentials : it has phase transition depending on the decay rate. Many results have been obtained, including eigenfunction statistics.
(ii) d-dimensional model with decaying potentials : much less is known than (i), but it has another type of phase transition.
(iii) 1-dimensional dimer model : it typically has critical energy where the Lyapunov exponent vanishes, on which it has strange statistical behavior, except which we have usual Poisson statistics.
(iv) 1-dimensional model related to vertex reinforced jumped process (ongoing work) : spectral property is linked to the recurrence of this RW.

September 4th (Wed) Conference Room II

9:00–12:00

24 Minami Watanabe (Tsuda Coll.) Long time perturbation theory for nonlinear Schrodinger equation with exponential nonlinearity ····· 10

Summary: In this talk, we will deal with the nonlinear Schrödinger equation (NLS) in which the nonlinear term is an exponential function. (NLS) has a solution called a scattering solution when the dispersion is more dominant than the nonlinearity of the equation. When doing this analysis, we generally consider a small solution and decompose it into a solitary wave component and a dispersive wave component, and as time passes, the solitary wave component converges to a fixed solitary wave, and the dispersive component converges more strongly to a linear solution. It is necessary to show that In the presentation, we will present the perturbation theory used for the proof.

25 Sho Katayama (Univ. of Tokyo) Existence and multiplicity of solutions to non-homoegeneous Dirichlet problems for the Lane–Emden equation ····· 12

Summary: This talk concerns a structure of positive solutions to the (not necessarily subcritical) Lane–Emden equation $-\Delta u = u^p$ in the half-space $\mathbb{R}^N_+$ with the non-homogeneous Dirichlet boundary condition $u = \kappa\mu$ on $\partial\mathbb{R}^N_+$. Under suitable conditions on the exponent p and a nonnegative continuous boundary data μ, we give a complete classification of the existence/nonexistence of positive solutions with respect to the value of parameter $\kappa > 0$. We also give a result on the multiple existence of solutions via bifurcation theory. The most important aspect of this result is a new-type condition for the exponent p, which reflects the structure of the half-space.

26 Satoshi Tanaka (Tohoku Univ.) Existence of positive solutions to an eigenvalue problem with a variable exponent ····· 12

Summary: The problem $-\Delta_{p(|x|)}u - \Delta_q u = \lambda(|u|^{p(|x|)-2}u + |u|^{q-2}u)$ in B; $u = 0$ on ∂B is considered, where $B = \{x \in \mathbb{R}^N : |x| < R\}$, $N \geq 1$, $\Delta_{p(|x|)}u = \mathrm{div}(|\nabla u|^{p(|x|)-2}\nabla u)$, $p(r)$ is continuous and satisfies $p(r) > 1$ on $[0, R]$, $\Delta_q u = \mathrm{div}(|\nabla u|^{q-2}\nabla u)$, and $q > 1$. The existence of positive solutions is proved for every $\lambda > \lambda_1(q)$, where $\lambda_1(q)$ is the first eigenvalue of q-Laplacian.

27 Mieko Tanaka (Tokyo Univ. of Sci.) Remarks on non-local eigenvalue problems for the p-Laplacian ····· 12

Summary: We consider the p-Laplace eigenvalue problem having a nonlocal term under the zero Dirichlet boundary condition. In particular, we show the existence of the least eigenvalue μ_q^w such that the equation has a nodal solution. We prove that this eigenvalue μ_q^w coincides with the second one in the p-sublinear case $q < p$ provided $w \geq 0$ a.e. in Ω.

28 Ryuji Kajikiya (Osaka Electro-Comm. Univ.)
Mieko Tanaka (Tokyo Univ. of Sci.)
Satoshi Tanaka (Tohoku Univ.) The best constant for the Sobolev–Poincaré inequality, I. Asymptotic behavior ····· 12

Summary: We study the best constant of the Sobolev–Poincaré inequality in the one dimensional case, $\lambda(p, q, L)\|u\|_{L^q}^p \leq \|u'\|_{L^p}^p$ for $u \in W_0^{1,p}(0, L)$. Then $\lambda(p, q, L)$ is the first eigenvalue for the second order differential equation. We study $\lambda(p, q, L)$ and the n-th eigenvalue $\lambda_n(p, q, L)$ also. We give the explicit formula of $\lambda_n(p, q, L)$ and investigate its asymptotic behavior as p and q tend to $1 + 0$ or ∞.

Summary: We study the best constant of the Sobolev–Poincaré inequality in the one dimensional case, $\lambda(p,q,L)\|u\|_{L^q}^p \le \|u'\|_{L^p}^p$ for $u \in W_0^{1,p}(0,L)$. Then $\lambda(p,q,L)$ is the first eigenvalue for the second order differential equation. We study $\lambda(p,q,L)$ and the n-th eigenvalue $\lambda_n(p,q,L)$ also. We compute its partial derivatives and study the monotonicity and non-monotonicity of $\lambda_n(p,q,L)$ with respect to p and q.

Summary: We give two weight inequality for the heat flow by using sparse domination. From the estimates, we provide the existence results of Hardy–Hénon type equations.

Summary: In this talk, we consider the following nonlinear Schrödinger system with three wave interaction:

$$\begin{cases} -\epsilon^2\Delta u_1 + V_1(x)u_1 = \mu_1|u_1|^{p-1}u_1 + \alpha u_2u_3, & \text{in } \mathbb{R}^N, \\ -\epsilon^2\Delta u_2 + V_2(x)u_2 = \mu_2|u_2|^{p-1}u_2 + \alpha u_1u_3, & \text{in } \mathbb{R}^N, \\ -\epsilon^2\Delta u_3 + V_3(x)u_3 = \mu_3|u_3|^{p-1}u_3 + \alpha u_1u_2, & \text{in } \mathbb{R}^N, \end{cases}$$

where $N \le 5$, $1 < p < 2^* - 1$, $2^* = \infty$ $(N \le 2)$, $2^* = 2N/(N-2)$ $(N \ge 3)$, $\epsilon > 0$, $V_j(x) > 0$, $\mu_j > 0$ $(j = 1,2,3)$ and $\alpha > 0$. We construct a peak solution that is concentrating at a local minimum point of a function $c(V_1(x), V_2(x), V_3(x))$ determined from potentials $V_1(x), V_2(x)$ and $V_3(x)$.

Summary: In this talk, we study the multiplicity of solutions for a nonlinear Schrödinger system with three wave interaction under the radial setting. In addition, we consider the vectorness of critical values for sufficiently large coupling parameter.

Summary: We establish a stability result for viscosity solutions of Hamilton–Jacobi equations for a sequence of domains converging in the Hausdorff sense. A background of this study is domain perturbation problems for Hamilton–Jacobi equations. In this talk we introduce the idea of proving the stability of viscosity solutions, starting with the definition of metric viscosity solutions. A key to the proof is a characterization of the metric viscosity solutions by the squared distance functions.

Summary: We study a general class of fully nonlinear boundary-degenerate elliptic or parabolic equations that admit a trivial solution. Although no boundary conditions are posed together with the equations, we show that the operator degeneracy actually generates an implicit boundary condition. Under appropriate assumptions on the degeneracy rate and regularity of the operator, we then prove that there exist no bounded solutions other than the trivial one. Our method is based on the arguments for uniqueness of viscosity solutions to state constraint problems for Hamilton–Jacobi equations. Several concrete examples of the equations that satisfy the assumptions are also given.

35 Yasuhiro Fujita (Univ. of Toyama)
Norikazu Yamaguchi (Univ. of Toyama)
A difference between Weierstrass function and Takagi function from the viewpoint of Hamilton–Jacobi flows ····· 12

Summary: In this talk, we clarify a difference among everywhere continuous and nowhere differentiable functions, especially between famous Takagi function and Weierstrass function. This difference is reflected on Hamilton–Jacobi flows starting from these functions. As far as the authors know, this is the first attempt to clarify such a difference.

36 Tokuhiro Eto (Univ. of Tokyo)
Yoshikazu Giga (Univ. of Tokyo)
A convergence result for a minimizing movement scheme for mean curvature flow with prescribed contact angle in a curved domain ····· 12

Summary: We consider a minimizing movement scheme of Chambolle type for the mean curvature flow equation with prescribed contact angle condition in a smooth bounded domain in $\mathbb{R}^d$ ($d \geq 2$). We prove that an approximate solution constructed by the proposed scheme converges to the level-set mean curvature flow with prescribed contact angle provided that the domain is convex and that the contact angle is away from zero under some control of derivatives of given prescribed angle. We actually prove that an auxiliary function corresponding to the scheme uniformly converges to a unique viscosity solution to the level-set equation with an oblique derivative boundary condition corresponding to the prescribed boundary condition.

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

Mieko Tanaka (Tokyo Univ. of Sci.) Eigenvalue problems for (p, q)-Laplace equations with two parameters

Summary: We consider generalized eigenvalue problems for (p, q)-Laplacian with two parameters under the Dirichlet boundary condition.The equations we are dealing with consist of two eigenvalue problems for p-Laplacian and q-Laplacian, which were introduced by myself and Bobkov. We have considered the classification of parameters such that the equation has positive solutions or sign change solutions in response to the first or second eigenvalue problem. This talk is based on the results of joint research works with Vladimir Bobkov that have been in progress for the last nine years.

September 5th (Thu) Conference Room II

9:00–12:00

37 Junichi Harada (Akita Univ.)
Stability of the nondegenerate ODE type blowup for the Fujita type heat equation ····· 10

Summary: We discuss the stability of nondegenerate ODE type blowup for the Fujita equation. This result is known for the Sobolev subcritical case. We extend this result to the general power nonlinearity case.

38 Ikki Fukuda (Shinshu Univ.)
Shinya Sato (Shinshu Univ.)
Higher-order asymptotic profiles of solutions to the convection-diffusion equation with variable diffusion ····· 12

Summary: We consider the asymptotic behavior of solutions to the convection-diffusion equation with variable diffusion coefficient $a(x) = 1+b(x) > 0$, where $b(x)$ is smooth and decays fast enough at spatial infinity. It is known that the asymptotic profile of the solution to this problem can be given by the heat kernel. Moreover, the second asymptotic profile of the solution have already been obtained. In particular, the following three cases are distinguished: $1 + \frac{1}{n} < q < 1 + \frac{2}{n}$; $q = 1 + \frac{2}{n}$; $q > 1 + \frac{2}{n}$, where q is the nonlinear exponent and n is the dimension. In this paper, we focus on the critical case of $q = 1 + \frac{2}{n}$. By analyzing the corresponding integral equation in details, we have succeeded to give the more higher-order asymptotic expansion of the solution, which generalizes the previous works.

Summary: We consider the large-time asymptotic behavior of global solutions to the Cauchy problem for the convection-diffusion equation in the Fujita-subcritical case. We improve the decay rate of the remainder for the first order asymptotic expansion established by Zuazua (1993). We also prove the optimality and non-optimality for the decay rate of the remainder by deriving the second order asymptotic expansion.

Summary: Our aim is to show boundedness and global asymptotic stability of constant equilibria for an epidemic model with logistic source in bounded domains in $\mathbb{R}^N$ under homogeneous Neumann boundary conditions and initial conditions. Moreover, we give a result on the asymptotic stability of traveling waves of the model in the whole space $\mathbb{R}$ with equal diffusivities under initial conditions with certain perturbations of initial data.

Summary: We continue to study Streater's model on Brownian particle gas on bounded domains in $\mathbf{R}^n$. If $n \leq 2$ and the entropy production is bounded, there is an a priori estimate global in time. Under additional properties on entropy and entropy production this solution converges to a unique steady state strongly and weakly for the models on classical and quantum particles, respectively.

Summary: We consider the long-time asymptotic behavior of solutions to a nonlinear Fokker–Planck model, including the porous medium-type nonlinear diffusion and inhomogeneous spatial diffusion subjected to the Neumann boundary condition. The model is based on the continuity equation and the energy law regarding some free energy. By assuming the diffusion coefficient is sufficiently large, we show the exponential decay of the first derivative of the free energy, which is called the dissipation in terms of the free energy. To prove the main result, we extend the entropy dissipation method to the Fokker–Planck equation with the inhomogeneous spatial diffusion coefficient.

Summary: We consider the long-time behavior of solutions to non-linear Fokker–Planck equations with inhomogeneous diffusion. Based on the energy law with variable coefficients and the continuity equation, we obtain a non-linear partial differential equation related to stochastic differential equations. The entropy dissipation method is a well-known way to study the long-time behavior of the solution to the Fokker–Planck equations. We extend the entropy dissipation methods and show the exponential decay of the free energy's dissipation term concerning the non-linear Fokker–Planck equation when the diffusion coefficient is large enough.

Summary: We discuss the existence of infinite sequences of solutions to Choquard-type equations involving the fractional Laplacian and generalized nonlocal nonlinearities with critical growth. We utilize a generalized version of the concentration compactness method that can be directly applied to nonlocal quantities involving convolution with weak L^p-functions in order to assure the compactness of $(PS)_c$ sequences. We guarantee the existence of a sequence of weak solutions corresponding to critical values converging to zero by a critical point theorem based on the concept of Krasnoselskii genus, which is useful in variational methods.

Summary: We study the fractional in time reaction-diffusion equation

$$\begin{cases} \partial_t^\alpha u = \Delta u + f(u) & \text{in } \mathbb{R}^N \times (0,T), \\ u(x,0) = u_0(x) & \text{in } \mathbb{R}^N, \end{cases}$$

where $0 < \alpha < 1$, $N \geq 1$, $T > 0$ and $u_0 \geq 0$. The fractional derivative ∂_t^α is meant in a generalized Caputo sense. We mainly consider the case where f has an exponential or a superexponential growth, and u_0 has a singularity. We obtain integrability conditions on u_0 which explicitly determine local in time existence/nonexistence of a nonnegative mild solution. Moreover, our analysis can be applied to time fractional systems.

Summary: In this talk, we consider the time-fractional semilinear heat equation with the critical exponent, in uniformly local weak Zygmund spaces. We obtain a sufficient condition for the local-in-time solvability, which does not vanish when the order of the derivative with respect to time goes to one. Through our arguments, we see that the solvability of the time-fractional problem connects to the usual one in a natural way.

Summary: We consider the Ginzburg–Landau heat flow in a curved thin domain under the Naumann boundary condition. When the curved thin domain shrinks to a given closed hypersurface as the thickness of the thin domain tends to zero, we show that the weighted average of a weak solution to the thin-domain problem converges weakly on the limit surface under the assumption that the initial data is in L^∞. Moreover, we derive a limit equation on the limit surface by characterizing the limit function as a weak solution to the limit equation.

Summary: We consider curve diffusion flow for planar open curves with the boundary on two skew lines crossing at the origin with the angle $\theta \in (0, \pi)$. In 2022 Wheeler–Wheeler considered curve diffusion flow for planar open curves with the boundary on two parallel lines and they proved global in time solvability of the problem and exponential convergence of the solution to the line segment. In this talk, we will give a suitable extension of the result of Wheeler–Wheeler to the case of curves with the boundary on two skew lines.

Summary: In this talk we consider stability of critical points of the p-bending energy among open planar curves pinned at the endpoints. By a geometric approach, we obtain optimal necessary conditions for stable critical points, and it leads to uniqueness of stable pinned p-elasticae for $p \in (1, 2]$. Our proof is based on a simple but robust 'cut-and-paste' trick without computing the energy nor its second variation.

12:15–12:45 Presentation Ceremony for the 2024 MSJ Analysis Prize

14:30–16:45

50 Naoki Hamamoto (Osaka Metro. Univ.) Sharp L^2 remainder term in Hardy inequality for curl-free vector fields on the ball ····· 12

Summary: In this lecture we consider Hardy inequality of the form

$$\int_B |\nabla \boldsymbol{u}|^2 dx \geq C_N \int_B \frac{|\boldsymbol{u}|^2}{|\boldsymbol{x}|^2} dx + \gamma_N \int_B |\boldsymbol{u}|^2 dx. \tag{1}$$

Here $\boldsymbol{u} : B \to \mathbb{R}^N$ denotes curl-free vector fields on the ball $B = \{\boldsymbol{x} \in \mathbb{R}^N \mid |\boldsymbol{x}| \leq 1\}$ with $\boldsymbol{u} \,|_{\partial B} = \boldsymbol{0}$ and $C_N > (N-2)^2/4$ denotes the sharp constant in the original Hardy inequality whose explicit value is known under the curl-free constraint. The same form was previously obtained by Brezis–Vázquez for unconstrained vector fields, while we treat the problem what is the best value of the constant γ_N for curl-free fields.

51 Aya Ishizeki (Saitama Univ.) ♭ Takeyuki Nagasawa (Saitama Univ.) Möbius energies for multi-component-links, and their Möbius-invariant decomposition ····· 10

Summary: Möbius-invariant energy for multi-component links was proposed by Freedman–He–Wang. A new energy is proposed here, and demonstrated its Möbius-invariance. When the number of components is 2, both energies are the same. If this number exceeds 2, the energy becomes independent of Freedman–He–Wang's energy. In the previous study, the present authors showed that the energy for 2-component links can be decomposed into two Möbius-invariant energies. In this study, the decomposition of the new energy is demonstrated for m-component. This is decomposed into $2^{\frac{m(m-1)}{2}}$ Möbius-invariant energies.

52 Akitoshi Hoshiya (Univ. of Tokyo) Orthonormal Strichartz estimate for Schrödinger operator ····· 10

Summary: We consider the orthonormal Strichartz estimate for Schrödinger operator, which is a generalization of the ordinary Strichartz estimate. Under some assumptions on potentials, we prove the estimate for the same exponent as the free Hamiltonian. Our proof is based on the smooth perturbation theory by T. Kato. We also discuss some applications to nonlinear Schrödinger equations.

53 Masaki Kawamoto (Okayama Univ.) Haruya Mizutani (Osaka Univ.) Modified scattering for nonlinear Schrödinger equations with long-range potentials ····· 12

Summary: We study the final state problem for the nonlinear Schrödinger equation with a critical long-range nonlinearity and a long-range linear potential. Given a prescribed asymptotic profile which is different from the free evolution, we construct a unique global solution scattering to the profile. In particular, the existence of the modified wave operators is obtained for sufficiently localized small scattering data. The class of potential includes a repulsive long-range potential with a short-range perturbation, especially the positive Coulomb potential in two and three space dimensions. The asymptotic profile is constructed by combining Yafaev's type linear modifier associated with the long-range part of the potential and the nonlinear modifier introduced by Ozawa (1991). This is the first positive result on the modified scattering for the nonlinear Schrödinger equation in the case when both of the nonlinear term and the linear potential are of long-range type.

54 Satoshi Masaki (Hokkaido Univ.) Partial classification of the asymptotic behavior of solutions to NLS systems with coercive conserved quantity ····· 12

Summary: In this talk, we consider the large-time behavior of solutions to a class of systems of cubic nonlinear Schrodinger equations in one space dimension. The cubic nonlinearity is critical in one space dimension and the large-time behavior involves the nonlinear effect. The behavior of systems with a coercive conserved quantity is previously studied and an asymptotic profile was given with the help of an ODE system. We try to provide the profile as explicitly as possible by introducing a scheme to integrate the ODE system.

55 Shunya Hashimoto (Saitama Univ.)
Masaru Hamano (Waseda Univ.)
Shuji Machihara (Saitama Univ.)
Global solutions of stochastic nonlinear Schrödinger system 12

Summary: We consider global existence results for the solutions of systems of stochastic Schrödinger equations with multiplicative noise and quadratic nonlinear terms. The same system in the deterministic treatment was studied by Hayashi, Ozawa, and Tanaka where the mass and energy are conserved. In our stochastic situation, those are not conserved.

56 Kaito Kokubu (Tokyo Univ. of Sci.)
Stability of travelling waves to Benjamin–Ono type equations with double power nonlinearities 12

Summary: We study travelling waves of Benjamin–Ono type equations with double power nonlinearilies $|u|^{p-1}u + |u|^{q-1}u$, where $1 < p < q < \infty$. In this talk, we show that the travelling waves are stable if p is an L^2-subcritical exponent, with the method of Grillakis–Shatah–Strauss (1987).

57 Stephen Gustafson (Univ. of British Columbia)
Takahisa Inui (Osaka Univ.)
Ikkei Shimizu (Osaka Univ.)
Multi-solitons for the nonlinear Schrödinger equation with repulsive Dirac delta potential 12

Summary: In this talk, we consider multi-soliton solutions for the 1-dimensional focusing nonlinear Schrödinger equation (NLS for short) with repulsive Dirac delta potential at the origin (δNLS). The main result is the existence of multi-soliton solutions for (δNLS), where the unmoving part is the standing wave solution of (δNLS), while the moving parts are the solitary wave solutions for NLS without potential.

58 Sonae Hadama (Kyoto Univ.)♭
Antoine Borie (Univ. of Rennes)
Julien Sabin (Univ. of Rennes)
Asymptotic stability of stationary solutions of the Hartree equations for infinite quantum systems 12

Summary: In this talk, we consider the Hartree equation describing infinite quantum systems. It has infinitely many stationary solutions, and we are interested in their asymptotic stability. This problem is an analogy of the nonlinear Landau damping on the quantum side. In the known results, we need strong assumptions for both interactions and stationary solutions when $d \geq 4$. In this talk, we weaken the assumptions for both of them. There are two main difficulties: (1) How to get estimates with fractional derivatives, and (2) We cannot use Christ–Kiselev lemma. We will discuss these difficulties and how to overcome them. This talk is based on the joint work with Antoine Borie (University of Rennes) and Julien Sabin (University of Rennes).

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

Takahisa Inui (Osaka Univ.)
Global dynamics of threshold solutions for the nonlinear Schrödinger equation with repulsive Dirac delta potential

Summary: We consider the L^2-supercritical nonlinear Schrödinger equation with a repulsive Dirac delta potential in one-dimensional space. A previous work clarified the global dynamics of solutions below a threshold. For general solutions, the threshold is given by a moving one-soliton. On the other hand, roughly speaking, that for even solutions is given by the ground state of the equation. Moreover, a sequent work showed that in the general setting the solutions at the threshold scatter or blow up. In this talk, we mainly consider the global dynamic of the even solutions at its threshold. Precisely speaking, the threshold has two regions; one is given by the ground state as stated above, and the other is given by a moving two-soliton. In the former case, we have five scenarios: scattering solutions, blow-up ones, ground states, and asymptotic solutions to the ground state (which scatter or blow up in the opposite time direction). In the latter case, there are only two scenarios: scattering or blow-up. This talk is based on joint works with Prof. Gustafson in the University of British Columbia.

September 6th (Fri) Conference Room II

9:15–12:00

59 Yuki Haruyama (Tohoku Univ.)♭
Hiroyuki Takamura (Tohoku Univ.)
Blow-up of classical solutions of quasilinear wave equations in one space dimension ····· 10

Summary: In this talk, we report on the upper bound of the lifespan of classical solutions of initial value problem for one dimensional wave equation with quasilinear terms of spatial derivative of the unknown function. This result is same as that of semilinear case. But our method of proof is slightly different, which is based on the weighted functional method by Rammaha and the iteration argument. Moreover, it is meaningful to consider the kind of this problem to ensure the optimality of the general theory for nonlinear wave equation.

60 Motohiro Sobajima (Tokyo Univ. of Sci.)
Asymptotic behavior for wave equations with space-dependent damping in a weighted energy class ····· 12

Summary: We consider the initial-boundary value problem of wave equations with space-dependent damping. In the previous works, the asymptotic behavior of solutions has been discussed with a class of regular initial data. In this talk, we deal with the asymptotic behavior of solutions with initial data belonging to a weighted energy space.

61 Yoshinori Nishii (Tokyo Univ. of Sci.)
On the decay estimate for small solutions to nonlinear Klein–Gordon equations with dissipative structure ····· 12

Summary: We consider the Cauchy problem for cubic nonlinear Klein–Gordon equations in one space dimension. We give the L^p-decay estimate for the small data solution and show that it decays faster than the free solution if the cubic nonlinearity has the suitable dissipative structure.

62 Masahiro Takayama (Keio Univ.)
Tatsuo Iguchi (Keio Univ.)
Well-posedness of the initial boundary value problem for degenerate hyperbolic systems with a localized term ····· 12

Summary: We consider an initial boundary value problem for one-dimensional degenerate hyperbolic systems with a localized term and show its well-posedness. This problem arises in the analysis on the well-posedness of the initial boundary value problem for the motion of an inextensible hanging string of finite length under the action of the gravity. One of difficulties of this problem comes from the degeneracy of the coefficient matrix. This difficulty can be overcome by using appropriate weighted Sobolev spaces. Another difficulty of this problem comes from the localized term, which cannot be regarded as a lower order term. However, by introducing an appropriate energy functional we obtain an a priori energy estimate for the solution.

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

Summary: We consider the linearized system for the motion of an inextensible hanging string. Well-posedness of its initial boundary value problem is demonstrated as an application of the result obtained in the first talk. To this end, we reduce the linearized system to a degenerate hyperbolic system with a localized term.

64 Hiroyuki Tsurumi (Tokushima Univ.)
Jin Tan (CY Cergy Paris Univ.)
Xin Zhang (Tongji Univ.)
Solutions to the stationary Hall-MHD equations in Besov spaces ····· 12

Summary: We consider the solutions to the incompressible stationary Hall-magnetohydrodynamic (Hall-MHD) system in $\mathbb{R}^3$. We first show the existence and uniqueness of solutions with given forces in $\dot{B}^{3/p-3}_{p,q}$ for $1 \le p < 3$ and $q = 1$. Moreover, this result can be extended to any $1 \le q \le \infty$ whenever $p = 2$. On the other hand, when $p \ge 3$, we show some ill-posedness results for the Hall-MHD system by using the discontinuity of the solution mapping.

65 Shintaro Kondo (Gifu Univ.)
Tatsuki Nakamura (AISIN CORPORATION)
Global strong solution for the 2D MHD equations with shearing-periodic boundary condition 12

Summary: In this talk, we consider the two-dimensional, two-field MHD equations with imposed shear flow when plasma viscosity and resistivity are positive. We established the global-in-time existence and uniqueness of a strong solution for the 2D two-field MHD equations with shearing-periodic boundary condition which was proposed by Hawley et al. in 1995. The main result is obtained by using Sobolev space.

66 Masahiro Suzuki (Nagoya Inst. of Tech.)
Walter A. Strauss (Brown Univ.)
Gas discharge in an annular region I: stability analysis 12

Summary: We study the initial–boundary value problem of the Morrow model which describes gas discharge over an annular region. This problem has a trivial stationary solution whose electron and ion densities are zero. We analyze the stability and instability of the trivial stationary solution according to the voltage posed as a boundary condition, and also find the threshold of voltage (sparking voltage).

67 Masahiro Suzuki (Nagoya Inst. of Tech.)
Walter A. Strauss (Brown Univ.)
Gas discharge in an annular region II: bifurcation 12

Summary: We study the boundary value problem of the stationary Morrow model which describes gas discharge over an annular region. This problem has a trivial solution whose electron and ion densities are zero. It is known that the trivial solution becomes unstable from stable when the voltage posed as a boundary condition increases. The threshold is called a sparking voltage. In this talk, we analyze the bifurcation of non-trivial solutions around the sparking voltage.

68 Kai Koike (Tokyo Tech)
Franck Sueur (Univ. Bordeaux)
Gastón Vergara-Hermosilla (Univ. Paris-Saclay)
Local exact Lagrangian controllability of the 1D compressible Navier–Stokes equations 12

Summary: We consider barotropic Navier–Stokes equations in a 1D channel $[0, \pi]$ with homogeneous Dirichlet boundary conditions at the ends. Given sufficiently close subintervals $I = [\alpha_1, \alpha_2]$ and $J = [\beta_1, \beta_2]$, we show that there exists an external force on the momentum equation such that the associated flow maps I to J in any given time $T > 0$. We show this by finding two external forces that have independent stretching effects on the interval I, then applying the inverse function theorem. That there exist such external forces is proved as a consequence of a unique continuation property which we prove using Fourier analytic techniques.

69 Naoto Deguchi (Tokyo Tech)
Low Mach number limit of the compressible Navier–Stokes equation with stationary force 12

Summary: We are concerned with the low Mach number limit of the compressible Navier–Stokes equation with stationary external force in the 3D whole space. It is known that if the external force decays in time, then the compressible Navier–Stokes flows converge to the corresponding incompressible Navier–Stokes flow when the Mach number goes to zero. We derive the low Mach number limit of the compressible Navier–Stokes equation when the external force is stationary and small enough.

14:15–16:45

70 Taiki Takeuchi (Kyoto Univ.)
Keiichi Watanabe (Suwa Univ. of Sci.)
Maximal regularity approarch to the Keller–Segel–Navier–Stokes system with nonlinear boundary conditions 12

Summary: The Keller–Segel–Navier–Stokes system in a bounded smooth domain $\Omega \subset \mathbb{R}^N$ $(N \geq 2)$ is considered, where the cell density n satisfies nonlinear boundary conditions due to the tensor-valued chemotactic sensitivity function S. The aim of this talk is to construct a unique global strong solution of the system by applying suitable maximal regularity theorems. In particular, to this end we establish a new maximal regularity theorem for some linear heat equation with an inhomogeneous Neumann boundary condition.

71 Yoshiki Iida (Waseda Univ.) Global well-posedness of the primitive equations on non-flat layers in the framework of maximal L^q-regularity 12

Summary: In this talk, we consider the primitive equations on non-flat layers. We first define the hydrostatic Stokes projection operator on non-flat layers, and we prove the maximal L^q-regularity of the corresponding linearized equation via H^∞-calculus. At the next step, in order to extend the local solution to the global one, we establish an energy estimate in the framework of L^2-space.

72 Ryosuke Nakasato (Shinshu Univ.) Analyticity and asymptotic behavior of solutions to the Navier–Stokes equations in critical Fourier–Herz spaces 12

Summary: We consider the initial value problem of the incompressible Navier–Stokes equations (NS) in the whole space $\mathbb{R}^d$ $(d \geq 2)$. Starting with the pioneering work by Fujita–Kato (1964), many researchers have studied the well-posedness of this problem (NS) in scaling critical spaces. In this talk, we focus on the end-point critical spaces which guarantees the global well-posedness of the problem (NS). In such an end-point framework, we newly establish the Foias–Temam type analyticity and Fujigaki–Miyakawa type asymptotic expansion of mild solutions to the problem (NS).

73 Hideo Kozono (Waseda Univ.)
Yutaka Terasawa (Nagoya Univ.)
Yuta Wakasugi (Hiroshima Univ.) Asymptotic behavior of solutions to elliptic equations in 2D exterior domains 10

Summary: The asymptotic behavior of solutions to the second order elliptic equations in exterior domains is studied. In particular, under the assumption that the solution belongs to the Lorentz space $L^{p,q}$ or the weak Lebesgue space $L^{p,\infty}$ with certain conditions on the coefficients, we give natural and an almost sharp pointwise estimate of the solution at spacial infinity.

74 Kenta Oishi (Kagawa Nat. Coll. of Tech.)
Hirokazu Saito (Univ. of Electro-Comm.) Global solvability of the two-phase problem of inhomogeneous incompressible viscous fluids 12

Summary: We develop the global solvability for a two-phase free boundary problem describing the motion of the inhomogeneous incompressible viscous fluids in $\mathbb{R}^N$ with $N \geq 3$. The fluids are separated from one another by a sharp interface, which is close to the hyperplane $x_N = 0$. The proof is based on the maximal regularity for a linearized problem and the time decay estimate of Stokes semigroup established by Saito. We also introduce a norm of solutions simpler than that employed in the study due to Oishi and Shibata on the one-phase flows of homogeneous incompressible fluids in a half-space-like domain.

75 Kazuyuki Tsuda (Kyushu Sangyo Univ.)
Reinhard Farwig (TU Darmstadt) The time periodic problem for the Navier–Stokes equations on half spaces with moving boundary: Linear theory 12

Summary: In this talk, we study a linear theory to deal with the time periodic problem for the Navier–Stokes equations on unbounded domains with moving boundary. Compared to the case of bounded domains the underlying modified time-dependent Stokes operators are no longer invertible, thus leading to a more sophisticated construction of the evolution operator. Moreover, Sobolev embeddings on L^q spaces imply restrictions on q depending on geometric properties of the domain. The theory is focusing on the half space case, the construction and local-in-time estimates of the evolution operator and its adjoint in view of time periodic solutions.

Summary: This talk studies the construction of mild periodic solutions to the Navier–Stokes system in a family of domains close to the half space with boundary moving periodically in time and perturbed locally in space. In our first talk we dealt with basic properties of the underlying modified Stokes operators, their adjoints and the construction of their evolution operators with estimates locally in time. This talk proves via a decomposition into low and high frequency parts global estimates of the evolution operator with algebraic decay rates less than -1. Then nonlinear estimates using also duality techniques show that a corresponding Poincare map locally has a unique fixed point, the mild periodic solution. Various results also hold globally in time in the case that the compactly supported perturbation of $\partial\mathbb{R}^n_+$ is uniformly bounded.

Summary: We consider the nonhomogeneous boundary value problem for the steady Navier–Stokes equations under the slip boundary conditions in a two-dimensional bounded domain with multiple boundary components. By the incompressibility condition of the fluid, the total flux of the given boundary datum through the boundary must be zero. We prove that this problem has a solution if the friction coefficient is sufficiently large compared with the kinematic viscosity constant and the curvature of the boundary. No additional assumption (other than the necessary requirement of zero total flux through the boundary) is imposed on the boundary data. The required a priori estimate to apply the Leray–Schauder fixed point theorem is proved by a contradiction argument.

Summary: Let Ω be an exterior Lipschitz domain in $\mathbb{R}^2$. It is proved that the Helmholtz decomposition of the vector fields in $L_p(\Omega;\mathbb{R}^2)$ exists if p satisfies $|1/p-1/2| < 1/4+\varepsilon$ with some constant $\varepsilon = \varepsilon(\Omega) \in (0, 1/4]$, where it is allowed to take $\varepsilon = 1/4$ if $\partial\Omega \in C^1$.

Summary: Consider the three-dimensional Navier–Stokes flow past a moving rigid body $\mathscr{O} \subset \mathbb{R}^3$ with prescribed translational and angular velocities, where $\mathscr{O}$ stands for a bounded Lipschitz domain. We prove that the solution to the linearized problem is governed by a C_0-semigroup on solenoidal L^q-vector spaces with the L^q-L^r estimates provided that $|1/q - 1/2| < 1/6 + \varepsilon$ with some $\varepsilon > 0$. As an application, we prove the existence and uniqueness of mild solutions to the Navier-Stokes problem when the translational and angular velocities and the initial are sufficiently small.

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

Jan Brezina (Kyushu Univ.) Long-time behavior of the dissipative compressible MHD

Summary: Dissipative systems are thermodynamically open systems often in the out of equilibrium regime. They are examples of the most interesting real world phenomena developing patterns, structures, or behaviours that they did not have when first formed. The dissipative systems exchange energy and matter with their environment, while dissipating mechanical and other forms of energy in accordance with the Second law of thermodynamics. In continuum fluid mechanics, a family of field equations accompanied with *inhomogeneous* boundary conditions are often used to model dissipative systems.

Many spectacular events occurring in geophysics or astrophysics, among which the dynamics of the solar convection zone, are attributed to the action of the magnetic field. As direct measurements and data collecting are often hampered by obvious technical limitations, reliable mathematical models are indispensable for understanding the observed phenomena. As pointed out by Gough, a correct choice of boundary conditions plays a crucial role.

In this talk we discuss the long time behavior of the complete system of equations governing the motion of a general compressible, viscous, electrically and heat conductive fluid driven by non–conservative boundary conditions. That is, the time evolution of the solutions to a dissipative *compressible magnetohydrodynamics*.

Real Analysis

September 5th (Thu) Conference Room VI

9:00–12:00

Summary: In this talk, we consider bilinear Fourier multipliers that contain some oscillatory factors. In particular, we consider the boundedness of these operators between Lebesgue spaces including endpoint cases. Our results improve Bergfeldt, Rodriguez-Lopez, Rule and Staubach's results for the case of bilinear Fourier multiplier operators.

Summary: We consider operators satisfying a fractionally sparse domination property, according to the definition by Lerner, Lorist and Ombrosi. As a supplement to their strong type estimates, we establish two weighted weak type estimate for those operators. Firstly, we give a quantitative bound in multiplier weak type sense with the Muckenhoupt weight. Then we introduce the class of weights that characterizes the restricted weak type bounds (for example, maximal operator), and establish such bounds for fractionally sparsely dominated operators.

Summary: The main objective of this talk is to define microlocal singularities of functions using the Pandey–Upadhyay wavelet transform and provide a comparison with another microlocal singularities.

Summary: We consider some bilinear Fourier multiplier operators and give a bilinear version of Seeger, Sogge, and Stein's result on Fourier integral operators. Our results improve, for the case of Fourier multiplier operators, Rodríguez-López, Rule, and Staubach's result for bilinear Fourier integral operators. We also give partial results on the sharpness of the estimates.

Summary: For the multiple Fourier series of periodization of some radial functions on $\mathbb{R}^d$, Kuratsubo (2010) investigated the behavior of the spherical partial sum and discovered the third phenomenon other than Gibbs–Wilbraham and Pinsky phenomena. In particular, the third one exhibits prevention of pointwise convergence. On the other hand, in the field of deep learning, one of the purposes is to find an approximation of the function as a universal approximation theorem. Therefore, it is important that a function converges pointwise. In this talk, we clarify the crucial difference between the deep neural network and the Fourier series from pointwise convergence for the indicator function. Further, we define a specific deep neural network and prove pointwise convergence.

Summary: We consider the closure of $C^{\infty}_{\mathrm{comp}}(\mathbb{R}^d)$ with respect to generalized Morrey spaces with variable growth condition. We show the boundedness of generalized fractional integral operators on them.

Summary: In this talk, we consider the boundedness of the Hardy–Littlewood maximal operator on weighted local Bourgain–Morrey spaces. In particular, we consider the case of power weights. The difference of the classical one is only endpoint case.

Summary: We characterize n-order Sobolev spaces defined on open sets in Real numbers in terms of higher-order finite differences (i.e. center difference, forward difference and backward difference). It allows us to give a definition of one-dimensional Sobolev spaces that does not involve derivatives.

Summary: We give an alternative proof of Alvino's embedding by using medians.

Summary: We study the smoothing estimate for the heat semigroup which is related to the nonlinear term of the Hardy–Hénon parabolic equation on Morrey spaces.

14:15–16:45

Summary: The boundedness (continuity) of composition operators from some function space to another one is significant, though there are few results about this problem. Thus, in this study, we provide necessary and sufficient conditions on the boundedness of composition operators from Lorentz spaces to Orlicz spaces. We emphasize that the measure spaces associated with the Lorentz space may be different from those associated with the Orlicz spaces. Moreover we give some examples and counterexamples of the composed mappings in the conditions.

Summary: Let us consider the logarithmic inequalities of Brezis–Gallouet–Wainger type in Triebel–Lizorkin spaces and Triebel–Lizorkin–Morrey spaces. We obtain the inequalities

$$\|f\|_{L_\infty} \lesssim_{n,p,r,s} 1 + \|f\|_{\dot{F}^{n/r}_{r,\infty}} \left(\log^+(\|f\|_{L_p} + \|f\|_{\dot{C}^s})\right)^{1-\frac{1}{r}}$$

for $1 \le p < \infty$, $1 < r \le \infty$, $s > 0$, and

$$\|f\|_{B^0_{\infty,1}} \lesssim_{n,p,q,r,r_1,s} 1 + \|f\|_{\dot{\mathcal{E}}^{n/r}_{r,r_1,\infty}} \log^+ \|f\|_{\mathcal{E}^u_{p,q,\infty}}$$

for $0 < q \le p < \infty$, $1 \le r_1 \le r < \infty$, $n/p < u < \infty$. These inequalities improve the results obtained by Kozono–Wadade (2008) and Sawano–Wadade (2013) respectively.

13 Hiro-o Kita (Kagoshima Univ.*)
Takashi Miyamoto (Osaka Kyoiku Univ.)
Naoko Ogata (Kobe Univ.)
On Δ_0-condition for generalized weak Orlicz space constructed by φ-function 15

Summary: The importannce of Δ_0-condition in generalized weak Orlicz space will be given.

14 Sachiko Atsushiba (Tokyo Woman's Christian Univ.)
Convergence theorems for monotone nonexpansive mappings and mean-demiclosed mappings 15

Summary: In this talk, we prove weak convergence theorems for monotone nonexpansive mappings and α-nonexpansive mappings. Further, we prove convergence theorems for mean-demiclosed mappings.

15 Aoi Honda (Kyushu Inst. of Tech.)
Ryoji Fukuda (Oita Univ.)
Yoshiaki Okazaki (Fuzzy Logic Systems Inst.)
Uniform Structure of the Choquet Function Space $\mathcal{L}_1(\mathsf{Ch})$ 15

Summary: Let μ be a non-additive measure on the measurable space $(X, \mathcal{B})$. For a non-negative $\mathcal{B}$-measurable function f, the Choquet integral is defined by $\int_X f(x)\,d\mu = \int_0^\infty \mu(f > r)\,dr$. The Choquet function space $\mathcal{L}_1(\mathsf{Ch})$ is defined by $\{f | \int_0^\infty \mu(|f| > r)\,dr < \infty\}$. The uniform structure of $\mathcal{L}_1(\mathsf{Ch})$ is investigated.

16 Jun Kawabe (Shinshu Univ.)
The abstract forms of the continuous Choquet integral representation theorems 15

Summary: The purpose of the talk is to present the abstract forms of the Choquet integral representation theorems in such a way that the representing measures are simultaneously inner and outer continuous on appropriate collections of tractable sets such as open, closed, compact, and measurable. This type of theorem is referred to as the continuous Choquet integral representation theorem and will be discussed in a setting general enough for practical use.

17 Toshiharu Kawasaki (Tamagawa Univ. / Chiba Univ.)
On the extended indefinite integral 15

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

18 Yoshifumi Ito (Tokushima Univ.*)
Study on space-time-matter 15

Summary: In this lecture, we give the fundamental facts on the concepts of space, time and matter.
We determine that the cosmic space is the 3-dimensional Euclidean space.
We give the concept of time at first, and the condition which the material particle must satisfy.
We study what are the physical phenomena and the natural statistical phenomena.

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

Hiroki Saito (Nihon Univ.)
Fractional integrals and related phenomena in analysis

Summary: The purpose of this talk is to investigate the behavior of the Riesz potential on several functions spaces containing Choquet and Choquet–Morrey spaces. To clearly describe the connection between Morrey spaces and Hausdorff capacities, Riesz potentials will be placed at the center of the discussion. In the first half of this talk, we will review some elementary facts about Hausdorff capacities and maximal theorems, and introduce its applications to PDEs. In the latter half, several recent works by other authors, as well as the author's results based on joint work with Hatano, Kawasumi, and Professor Tanaka, will be discussed.

September 6th (Fri) Conference Room VI

10:00–12:00

19 Hana Kakiuchi (Japan Women's Univ.)
Toyohiko Aiki (Japan Women's Univ.)
On existence of solutions to free boundary problems representing the baking process 15

Summary: In this talk we establish existence of solutions to the one-dimensional free boundary problem describing a baking process of bread. For the problem we assume that a region occupied by the breads consists of crumb, crust and the evaporation front, and unknown functions are the position of the evaporation front, the temperature field and the mass distribution. By the difficulty of the boundary condition, we have considered only the approximation problem. Now, we aim to show existence of solutions to the original problem by applying the weak formulation.

20 Naotaka Ukai (Chiba Univ.)
Daiki Mizuno (Chiba Univ.)
Ken Shirakawa (Chiba Univ.)
Harbir Antil (George Mason Univ.)
Uniqueness for gray-scale imege-denoising process with anisotropic orientation adjustment 15

Summary: In this talk, we consider a gradient system of a non-convex functional, based on a governing energy for anisotropic image denoising, developed in [Berkels et al., SFB 611, 2006]. A characteristic of our gradient system lies in the nonstandard part, which consists of the (set-valued) subdifferential of an anisotropic norm denoted by γ, and a two dimensional rotation matrix denoted by R. These play a key role in the orientation adjustment within the image denoising process. Under appropriate settings, we will provide the construction of an energy gradient system where the uniqueness of the solution is guaranteed in both the continuous system and the discrete approximation scheme.

21 Daiki Mizuno (Chiba Univ.)
Ken Shirakawa (Chiba Univ.)
Pseudo-parabolic type regularity in parabolic KWC system with relaxation 15

Summary: In this talk, we deal with a parabolic system to represent planar grain boundary motion, known as KWC-type system, proposed by [Kobayashi et al., Physica D, 140, 141–150(2000)]. In this system, the difficulties lie in singular diffusion of the second equation of the system, and unknown-dependent mobilities of grain boundary motion, which cause many challenges especially in the uniqueness. To address these, previous works have proposed specific settings on the spatial dimension, or certain adjustments on the mobility. In this light, we here discuss the pseudo-parabolic type regularity for solutions to our parabolic system. Consequently, we will obtain some positive answer for the uniqueness question, which has been one of open problems in the studies of KWC system.

22 Yoshiho Akagawa (Gifu Nat. Coll. of Tech.)
Continuous dependence of a hardening plasticity model on the threshold function 15

Summary: This paper discusses the continuous dependence of a hardening plasticity model. This model is described as an evolution inclusion with a constraint that is depend on unknown. The constraint set is defined by a threshold function and a parallel shift. In previous work, we obtained a continuous dependence with respect to outer force and initial value. In particular, this talk will discuss the continuous dependence respected to the threshold function and the parallel shift. To obtain continuous dependence, we take care to choose the test function.

23 Masahiro Ikeda (RIKEN/Keio Univ.)
Shun Uchida (Oita Univ.)
Takeshi Fukao (Ryukoku Univ.)
Optimal control problem of ODE governed by hypergraph Laplacian 15

Summary: In this talk, we consider some optimal control problem of an ODE governed by the hypaergraph Laplacian. Since the hypaergraph Laplacian is a set-valued operator, it seems to be difficult to derive the necessary optimality condition for this problem. To cope with this difficulity, we introduce an approximation problem and assure the optimality condition for this. We also discuss the convergence of the condition to that for the original problem.

24 Kota Kumazaki (Kyoto Univ. of Edu.)
Regularity of a solution to a one-dimensional free boundary problem 15

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

25 Risei Kano (Kochi Univ.)
Takahiro Yamanaka (Ogata High School)
On the solvability of the Bernoulli–Euler beam model with piezoelectric effects 15

Summary: This talk presents a discussion of the solvability of the beam model problem for piezoelectric materials proposed by Tiersten and discussed by Morris–Ozer and Alaoui–Ozer–Ouzahra.

14:15–15:05

26 Takeshi Fukao (Ryukoku Univ.)
Pierluigi Colli (Univ. di Pavia)
Luca Scarpa (Politecnico di Milano)
An error estimate of some vanishing surface diffusion 15

Summary: In this talk, some Cahn–Hilliard equation with forward-backward dynamic boundary condition is treated. This problem can be discussed as the limit of the vanishing diffusion on the surface from the equation and the dynamic boundary condition of Cahn–Hilliard type, called the GMS model. Especially, we discuss the error estimate coupled with the regularity theory. We can treat very general monotone terms in the GMS model, such as the maximal monotone graphs. In the previous study, we assumed the growth condition between the bulk and surface. When we add a stronger assumption we can recover the higher regularity and then we deduce the error estimate.

27 Noriaki Yamazaki (Kanagawa Univ.)
Nobuyuki Kenmochi (Chiba Univ.*)
Ken Shirakawa (Chiba Univ.)
Solvability result of second order nonlinear quasi-variational evolution inclusions 15

Summary: In this talk we consider a second order doubly nonlinear evolution inclusion, including a feedback system, in a uniformly convex Banach space. Under appropriate assumptions, we establish the abstract result on the existence of solutions to our problem by applying the abstract theory of the time-derivative operators and the fixed-point theorem of Schauder type.

28 Takuma Yoshizumi (Osaka Univ.) Makoto Nakamura (Osaka Univ.) Global solutions for semi-linear Klein–Gordon equations in FLRW spacetimes 10

Summary: We consider the Cauchy problem of semi-linear Klein–Gordon equations in Friedmann–Lemaítre–Robertson–Walker spacetimes. In this talk, we consider a concrete scale-function $a(\cdot)$, which describes various types of spaces as the expanding space, the blowing-up space (the "Big-Rip" in cosmology), the contracting space and the vanishing space (the "Big-Crunch" in cosmology). We proved global solutions for any initial data under some conditions on semi-linear terms, and global solutions for small initial data. The proofs are based on the contraction argument.

29 Takuma Yoshizumi (Osaka Univ.) Makoto Nakamura (Osaka Univ.) Blowing-up solutions for semi-linear Klein–Gordon equations in FLRW spacetimes 10

Summary: We consider the Cauchy problem of semi-linear Klein–Gordon equations in Friedmann–Lemaítre–Robertson–Walker spacetimes. In this talk, we consider a concrete scale-function $a(\cdot)$, which describes various types of spaces as the expanding space, the blowing-up space (the "Big-Rip" in cosmology), the contracting space and the vanishing space (the "Big-Crunch" in cosmology). For these equations, we have proved the blowing-up solutions for the gauge invariant semi-linear term and the gauge variant one.

15:20–16:20 Talk Invited by Real Analysis Section

Kosuke Kita (Tohoku Univ.) On nonlinear heat equations with nonlinear boundary conditions in a bounded domain

Summary: In this talk, we are mainly concerned with the existence and nonexistence of global solutions to nonlinear heat equations with nonlinear boundary conditions in a bounded domain. In the case of the whole space, it is well known that the Fujita critical exponent is the threshold of the existence of nonnegative global solutions to nonlinear heat equations with a power-type nonlinearity. On the other hand, in the case of a bounded domain, we show that the existence and nonexistence of global nonnegative solutions to nonlinear heat equations of the Fujita type are characterized by not exponents but boundary conditions. Moreover, we also discuss a new comparison theorem for parabolic equations with nonlinear boundary conditions, which is the key to its proof.

Functional Analysis

September 3rd (Tue) Conference Room V

9:00–10:45

1 Nikita Evseev (Okinawa Inst. of Sci. and Tech. Grad. Univ.)
Malte Kampschulte (Charles Univ.)
Alexander Menovschikov (Ben-Gurion Univ. of the Negev)
Zero-extension convergence and Sobolev spaces on changing domains 10

Summary: We extend the definition of weak and strong convergence of a sequence of Sobolev functions whose underlying domains themselves are converging. In contrast to previous works, we do so without assuming any reference configuration. We then develop the respective theory and counterparts to all classical compactness theorems from the fixed domain case.

2 Yoritaka Iwata (Osaka Univ. of Economics Law)
Fractional power representation of general unbounded operators and the Heinz–Kato inequalities 15

Summary: The logarithmic representation theory of infinitesimal generators is generalized to any unbounded infinitesimal generators in abstract Banach spaces. In this paper, the generalized logarithmic representation is applied to improve the theory of fractional power of operators.

3 Shosuke Omori (Gunma Nat. Coll. of Tech./Waseda Univ.)
On the rigged Hilbert space formulation for a quasi-Hermitian operator in composite system 15

Summary: The present talk delves into Dirac's bra-ket formalism for a quasi-Hermitian quantum composite system based on the rigged Hilbert space (RHS). Using the RHS for a composite system, the bra and ket vectors and the spectral decomposition of the quasi-Hermitian operator are built. We also show that all descriptions obtained using the bra-ket formalism are completely developed in the dual spaces.

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

Summary: We deal with a type I superconductor in a constant external magnetic field and the BCS-Bogoliubov gap equation with external magnetic field. We show that there is a unique magnetic field (the critical magnetic field) given by a smooth function of the temperature and that there is also a unique nonnegative solution (the gap function) given by a smooth function of both the temperature and the external magnetic field. We then show that the transition from the normal state to the superconducting state in a type I superconductor is a first-order phase transition. Moreover, we obtain the explicit expression for the gap in the entropy.

5 Itaru Sasaki (Shinshu Univ.)
Yasumichi Matsuzawa (Shinshu Univ.)
Shinnnosuke Izumi (Shinshu Univ.)
Kouta Imura (Nagano Pref. Fujimi High School)
Holomorphy of the ground states of the pair interaction models 15

Summary: We show the analyticity of the ground state of the pair interaction model. Previously, we directly estimated the radius of convergence, but constructing the analytic continuation in the abstract setting improves the prospect of the proof.

6 Fumio Hiroshima (Kyushu Univ.) Exponential decay of the ground state of the renormalized Nelson Hamiltonian by Agmon type metric 10

Summary: Lower bound of the spatial decay of the ground state of the renormalized Nelson Hamiltonian with a continuous and confining potential V is considered. The ground state of the renormalized Nelson Hamiltonian is a boson Fock space -valued L2 function. The boson Fock space norm of the ground state is estimated from below by Agmon type distance.

7 Fumio Hiroshima (Kyushu Univ.) On the ergodicity of renormalized translation-invariant Nelson-type semigroups 10

Summary: We present a simple functional integration based proof that the semigroups generated by the ultraviolet-renormalized translation-invariant non- and semi-relativistic Nelson Hamiltonians is positivity improving (and hence ergodic) with respect to the Froehlich cone for arbitrary values of the total momentum. Our argument significantly simplifies known proofs for ergodicity. In the semi-relativistic case the result is new for non-zero total momentum.

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

Naoto Kumanogo (Kogakuin Univ.) Phase space Feynman path integrals on the torus —An analysis on path space

Summary: We present two general sets of functionals for which phase space Feynman path integrals on the torus have a mathematically rigorous meaning. For each functional in each set, the time slicing approximation of the phase space path integral converges uniformly on compact subsets with respect to the ending point of position paths and to the starting point of momentum paths. Each set of functionals is closed under addition, multiplication, translation of paths, linear transformation of paths by invertible integer matrices, and functional differentiation. Therefore, we can construct a large number of path-integrable functionals. While caution must be exercised when using phase space path integrals, several properties analogous to those of conventional integrals are valid in the phase space path integral.

September 4th (Wed) Conference Room V

10:00–11:45

8 Hiroto Inoue (Nishinippon Inst. of Tech.) F-t joint distributions associated to quadratic maps of homogeneous cones 15

Summary: The Wishart distribution on a homogeneous cone Ω is defined as the image of normal distribution by an Ω-positive quadratic map, and it is a general case of the classical Wishart distribution on the cone of positive-definite symmetric matrices. In this talk, we define probability variables valued in a real Siegel domain associated with the quadratic map, so that we obtain analogies of the multivariate F and t-distributions.

9 Taito Tauchi (Aoyama Gakuin Univ.) Kyo Nishiyama (Aoyama Gakuin Univ.) Real double flag variety for indefinite unitary group $U(p,p)$ 15

Summary: Let G be a real reductive Lie group and H its symmetric subgroup. Then, the product $\mathfrak{X} := H/P_H \times G/P_G$ of two flag manifolds H/P_H and G/P_G is called a real double flag variety, where P_H and P_G are parabolic subgroups of H and G, respectively. Although there are many studies of the theory of double flag varieties over the complex number field, there are few studies in the case over the real number field. In this talk, we give a combinatrial classification of the orbit space $H\backslash\mathfrak{X}$ in the case $(G, H, P_G, P_H) = (U(p,p), GL_p(\mathbb{C}), P_S, B_H)$, where P_S is the Siegel parabolic subgroup of G, and B_H is a Borel subgroup of H.

10 Ryoya Arimoto (Kyoto Univ.) Simplicity of crossed products of the actions of totally disconnected locally compact groups on their boundaries 15

Summary: We prove that if a totally disconnected locally compact group admits a topologically free boundary, then the reduced crossed product of continuous functions on its Furstenberg boundary by the group is simple. We also prove a partial converse of this result.

11 Akifumi Nakada (Hiroshima Univ.)
Kento Ogawa (Hiroshima Univ.)
Takayuki Okuda (Hiroshima Univ.) Harmonic analysis on compact association schemes 15

Summary: In finite homogeneous spaces and their generalizations, compact homogeneous spaces, analytically important propositions such as the Peter–Weyl theorem and the Plancherel theorem hold. It is also known that these theorems hold for the class of finite association schemes, which is another generalization of the class of finite homogeneous spaces. In this talk, we define a compact association scheme as a common generalization of compact homogeneous spaces and finite association schemes, and show that the Peter–Weyl theorem and the Plancherel theorem hold in the commutative case.

12 Koichi Arashi (Tokyo Gakugei Univ.) Multiplicitiy-free representations of nilpotent Lie groups over a quasi-symmetric domain 15

Summary: We investigate the multiplicity-freeness property of a representation of an affine transformation group on a Siegel domain of the second kind. A necessary and sufficient condition for the representation to be multiplicity-free is given. We relate the multiplicity-freeness property to the coisotropicity and the visibility of the group action.

13 Hyuga Ito (Nagoya Univ.) On free divergence-free vector fields 15

Summary: In 1990's, Dan Voiculescu introduced the notion of entropy and Fisher's information measure in free probability theory. Related to this study, he studied a certain non-commutative differential operator, which is called the cyclic derivative (associated with the free difference quotient). In 2020, Voiculescu studied the Euler equation in free probabilistic setting (the free Euler equation). In the free Euler equation, the cyclic derivative and its orthogonal complement play roles of gradient and divergence-free vector field (free divergence-free vector field), respectively. In this talk, I would like to introduce the structure of free divergence-free vector fields with respect to a free semi-circular system. This talk is based on the joint work with Akihiro Miyagawa (UCSD).

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

Hiroyoshi Tamori (Shibaura Inst. of Tech.) Strichartz estimates for the (k, a)-generalized Laguerre operator

Summary: The (k, a)-generalized Laguerre semigroup was introduced by Ben Said–Kobayashi–Orsted as an interpolation of the Hermite semigroup (the $k = 0, a = 2$ case) and the Laguerre semigroup (the $k = 0, a = 1$ case) from the viewpoint of unitary representations of the universal cover of $\mathrm{SL}(2, \mathbb{R})$. Based on a joint work with Kouichi Taira (Kyushu University), I will explain an integral expression of the semigroup and an upper estimate of the integral kernel. As applications, under some conditions on the deformation parameter (k, a), an explicit formula of the integral kernel and Strichartz estimates for the (k, a)-generalized Laguerre operator $(-|x|^{2-a}\Delta_k + |x|^a)/a$ (Δ_k denotes the Dunkl Laplacian) are obtained.

September 5th (Thu) Conference Room V

10:00–12:00

Summary: Let $Lip(I)$ be the Banach algebra of all Lipschitz functions on the closed unit interval I with the norm $\|f\|_L = \|f\|_\infty + L(f)$ for $f \in Lip(I)$, where $L(f)$ is the Lipschitz constant of f. We denote by $C^1(I, Lip(I))$ the Banach algebra of all continuously differentiable functions F from I into $Lip(I)$ equipped with the norm $\|F\|_\Sigma = \sup_{s\in I} \|F(s)\|_L + \sup_{t\in I} \|D(F)(t)\|_L$ for $F \in C^1(I, Lip(I))$. In this presentation, I will discuss the results obtained by determining the form of surjective, not necessarily linear, isometries on $C^1(I, Lip(I))$.

Summary: We show several operator inequalities among the $n+1$-th residual relative operator entropies and the difference of the n-th residual relative operator entropies. It is an extension of operator valued inequalities which start from a refinement of Young's inequality.

Summary: In this talk, we show matrix trace inequalities related to two Tsallis relative entropies of all real order: For density matrices ρ and σ, and each $\alpha \in \mathbb{R}\backslash\{0\}$, the Tsallis relative entropy $\mathrm{D}_\alpha(\rho|\sigma)$ is defined by $\mathrm{D}_\alpha(\rho|\sigma) = -\mathrm{Tr}(\frac{\rho^{1-\alpha}\sigma^\alpha - \rho}{\alpha})$ and $NT_\alpha(\rho|\sigma)$ is defined by $NT_\alpha(\rho|\sigma) = -\mathrm{Tr}[\frac{\rho \natural_\alpha \sigma - \rho}{\alpha}]$, where $\natural_\alpha$ is defined by $\rho \natural_\alpha \sigma = \rho^{1/2}(\rho^{-1/2}\sigma\rho^{-1/2})^\alpha\rho^{1/2}$. Then we show the order relation between two Tsallis relative entropies D_α and NT_α of all real order $\alpha \in \mathbb{R}$ and a 1-parameter extension of the path connecting them of all real order.

Summary: In this talk, based on the result by Pal, Singh, Moslehian and Aujla (2016), we newly introduce the weighted power difference mean and get relations among the weighted power, power difference and arithmetic means. Moreover, we also obtain its generalization by considering the notion of a transpose symmetric path of weighted means.

Summary: The aim of this talk is to construct symmetric means of a finite number of operators on an infinite dimensional Hilbert space.

Summary: We introduce non-linear traces of the Choquet type on a semifinite factor $\mathcal{M}$ as a non-commutative analog of the Choquet integral for non-additive measures. We need weighted dimension function $p \mapsto \alpha(\tau(p))$ for projections $p \in \mathcal{M}$, which is an analog of a monotone measure. They have certain partial additivities. We show that these partial additivities characterize non-linear traces of the Choquet type. For the algebras of compact operators and factors of type II, we completely determine the condition that the associated weighted L^p-spaces for the non-linear traces become quasi-normed spaces in terms of the weight functions α for any $0 < p < \infty$.

20 Yasuo Watatani (Kyushu Univ.) Non-linear traces of the Sugeno type on factors of type II 15
Masaru Nagisa
(Chiba Univ./Ritsumeikan Univ.)

Summary: We introduce non-linear traces of the Sugeno type on a semifinite factor $\mathcal{M}$ as a non-commutative analog of the Sugeno integral for non-additive measures. We need weighted dimension function $p \mapsto \alpha(\tau(p))$ for projections $p \in \mathcal{M}$, which is an analog of a monotone measure. They have certain partial F-additivities. We show that these partial F-additivities characterize non-linear traces of the Sugeno type. We show that any non-linear trace of the Sugeno type gives a certain metric on the factor.

14:15–16:00

21 Hajime Moriya (Kanazawa Univ.) C*-flow extension of discrete shift-translations on one-dimensional lattice systems 10

Summary: Kuiper examined the topological structure of unitary operators on infinite-dimensional Hilbert spaces. This is known as Kuiper's problem, and it has been generalized to general von Neumann algebras and to some C*-algebraic settings. In this talk, we address Kuiper's problem for the discrete group of shift-translations on one-dimensional quantum lattice systems and explore whether its C*-flow extension exists.

22 Ryosuke Sato (Chuo Univ.) CAR algebras and stochastic dynamics on random point processes ... 15

Summary: CAR algebras are one of the fundamental operator algebras and are intimately related to random point processes, which are models of random interacting particles. In this talk, we discuss the construction of stochastic dynamics on random point processes within an operator algebraic framework.

23 Kengo Matsumoto (Joetsu Univ. of Edu.) The Ext-groups and the homotopy groups of the automorphisms groups of Cuntz–Krieger algebras 15
Taro Sogabe (Kyoto Univ.)

Summary: We present the homotopy groups of the automorphism groups of Cuntz–Krieger algebras in terms of the underlying matrices of the Cuntz–Krieger algebras. We also show that the homotopy groups are complete invariants of the isomorphism classes of the Cuntz–Krieger algebras. As a result, the isomorphism type of Cuntz–Krieger algebras are completely characterized by the group structure of the weak extension groups and the strong extension groups.

24 Satoshi Goto (Sophia Univ.) On the connection system arising from the Haagerup fusion categories
Shôryû Suzuki (Sophia Univ.) 15

Summary: The first named speaker generalized Ocneanu's ADE inter-Dynkin connection systems to the case of an arbitrary finite depth subfactor with its maximal atlas. In this talk, we show the computation of the connection system arising from the Haagerup fusion categories, and also show some applications of the computation.

25 Yosuke Kubota (Kyoto Univ./RIKEN) Examples of spectral sequence computations in C*-algebra K-theory 15

Summary: The K-group of a crossed product C*-algebra by a free abelian group is considered computable using Kasparov's spectral sequence, which is a schematic refinement of the iterated use of the Pimsner–Voiculescu exact sequence. However, this method does not guarantee that any such K-group is exactly computable. In this talk, we introduce two examples of such crossed products, both originating from a dynamical system associated with an ax+b semigroup with number-theoretic origin, where the K-group can be computed by comparing the spectral sequence with that of groupoid homology via Raven's equivariant bivariant Chern character.

Summary: For a positive integer n, we study the collection $\mathcal{F}_{\mathrm{fin}}(n)$ formed of all $n \times n$ matrices whose entries a_{ij}, $1 \leq i, j \leq n$, can be written as $a_{ij} = \tau(U_j^* U_i)$ for some n-tuple $U_1, U_2, \ldots, U_n$ of unitaries in a finite-dimensional von Neumann algebra $\mathcal{M}$ with tracial state τ. We show that $\mathcal{F}_{\mathrm{fin}}(n)$ is not closed for every $n \geq 8$.

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

Shigeru Furuichi (Nihon Univ.) Generalized entropies and trace inequalities

Summary: Relative entropies and skew information were given by the trace. In this talk, we consider the trace inequalities on their bounds. Previously obtained results and recent results on the Tsallis relative entropy and the Tsallis relative operator entropy will be reported. Although, partially, skew information and uncertainty relation which is also given by the trace inequality, will be reviewed, almost results are related to the trace inequalities in relation to entropies.

Statistics and Probability

September 3rd (Tue) Conference Room VII

9:30–11:50

1 Ryo Inayoshi (Meijo Univ.) A characterization of the operator entropy in terms of an isometry property related to trace norms ····· 15

Summary: We introduce two new mean operators acting on trace class operators, and using the mean operators, we provide a new characterization theorem of operator entropy in terms of an isometry property between two trace norms. It is a very important point that we can characterize the operator entropy only using the isometry property for a continuous operator on some class of density operators.

2 Jiro Akahori (Ritsumeikan Univ.) A quantization of interacting particle systems ····· 15
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Rikuki Okamoto (Ritsumeikan Univ.)
Iwao Sato (Oyama Nat. Coll. of Tech.)

Summary: Interacting particle systems studied in this presentation are probabilistic cellular automata with nearest-neighbor interaction including the Domany–Kinzel model. A special case of the Domany–Kinzel model is directed percolation. We regard the interacting particle system as a Markov chain on a graph. Then we present a new quantization of the interacting particle system. After that, we introduce a zeta function of the quantized model and give its determinant expression.

3 Hoang-Long Ngo
(Hanoi Nat. Univ. of Edu.) Strong solutions and numerical schemes for non-colliding particle systems ····· 15
Minh Thang Do
(Hanoi Nat. Univ. of Edu.)
Dai Taguchi (Kansai Univ.)

Summary: In this talk, we first prove the existence of strong solution for (time inhomogeneous) non-colliding particle systems. The idea of the proof is to use some Lyapunov function. We also consider numerical schemes for these stochastic processes and provide their rate of convergence.

4 Kôhei Sasaya (Univ. of Tokyo) Construction of p-energy measures associated with strongly local p-energies ····· 15

Summary: A p-energy $(\mathcal{E}, \mathcal{F})$ on a metric space with a measure is an analog of a Dirichlet form in the L^p space. Recently, this energy has been studied in order to considering "$(1,p)$-Sobolev space" on fractals.
In this talk, we construct the p-energy measures associated with strongly local, regular p-energies (the equivalent of the energy measures associated with Dirichlet forms) without any assumptions of symmetry or self-similarity of the metric space. Moreover, with assuming separability of a quotient space of the domain $\mathcal{F}$ induced by the seminorm $\mathcal{E}^{1/p}$, we prove that the non-symmetric form of the p-energy measures satisfy the chain rule and the Leibniz rule.

5 Ryosuke Shimizu (Waseda Univ.) Construction of Korevaar–Schoen p-energy forms and associated p-energy measures ····· 15
Naotaka Kajino (Kyoto Univ.)

Summary: In this talk, I will present our recent result on constructions of good p-energy forms on metric measure spaces as pointwise subsequential limits of Besov-type p-energy functionals. Such forms are often called Korevaar–Schoen p-energy forms in the literature. As an advantage of our approach, the resulting p-energy forms satisfy the strongly local property and a good contraction property called the generalized p-contraction property. In addition, similar to energy measures associated with a regular symmetric Dirichlet form, we obtain the associated p-energy measures through the Riesz–Markov–Kakutani representation theorem.

6 Khanh Duy Trinh (Waseda Univ.)
Fumihiko Nakano (Tohoku Univ.)
Hoang Dung Trinh (VNU Univ. of Science)
Classical beta ensembles at high temperature and the Markov–Krein relation · · · · · 15

Summary: Three classical beta ensembles (Gaussian beta ensembles, beta Laguerre ensembles and beta Jacobi ensembles) are now realized as the eigenvalues of tridiagonal random matrices. In a high temperature regime, the regime where the parameter beta is proportional to the reciprocal of the system size, the empirical distribution of the eigenvalues converges weakly to a limiting measure which is related to associated Hermite / Laguerre / Jacobi polynomials. Moreover, the Gaussian (resp. gamma and beta) distribution and the limiting distribution in the Gaussian (resp. Laguerre and Jacobi) case satisfy the Markov–Krein relation. This talk will explain such relation by investigating the spectral measure of the tridiagonal random matrix model.

7 Yuki Chino (NYCU)
A characterization of symmetric environment for RWRE · · · · · 15

Summary: Random walk in cooling random environment (RWCRE) is one of random walk in dynamical random environment models. RWCRE interpolates the modification from the classical random walk in random environment (RWRE). To characterize recurrence for RWCRE, we need to understand the balance between speed of dynamics and environment, especially for the case that environment is not symmetric. In this talk, we consider one characterization of symmetric environment for classical model. The talk is based on a joint work with Conrado da Costa (Durham University).

8 Zijian Xu (Fukuoka Univ.)
Kazuhiro Kuwae (Fukuoka Univ.)
Syota Esaki (Oita Univ.)
The Littlewood–Paley–Stein inequality for tamed Dirichlet spaces · · · · 15

Summary: In recent years, Erbar–Rigoni–Sturm–Tamanini established the theory of tamed spaces, which are Dirichlet spaces with distribution-valued lower bounds on the Ricci curvature. More precisely, tamed spaces are quasi-regular strongly local Dirichlet forms satisfying a Bakry–Émery curvature lower bound in the sense of distribution. Using the equivalence between these lower bounds and gradient estimates for the heat semigroup in terms of the Feynman–Kac semigroup, we establish the Littlewood–Paley–Stein inequality for L^p-functions for $p > 1$.

9 Toshihiro Uemura (Kansai Univ.)
On semi-Dirichlet forms of jump-diffusion processes based on the Sobolev space $W_0^{1,2}(D)$ · · · · · 10

Summary: We construct the lower bounded, regular semi-Dirichlet forms on $L^2(D)$ associated with jump-diffusion processes on an open convex set D of $\mathbb{R}^d$ having the Sobolev space $W_0^{1,2}(D)$ as their domains under some conditions on the diffusion coefficients, drifts and the Lévy densities. In the talk, we introduce a stable-type jump diffusion process as an example.

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

Takuya Murayama (Kyushu Univ.)
Some problems on the traces and driving functions of the Loewner differential equation

Summary: The Loewner differential equation produces a family of conformal mappings on a planar domain, whose images are expanding or shrinking in time. In probability theory, the most famous case is that the driving term of the equation is a one-dimensional Brownian motion, which turns the complements of these images (let us call them the trace here) into a random path, that is, the Schramm-Loewner evolution (SLE). In this talk, I shall present a brief (and possibly very personal) survey on some problems on the relation of the traces and driving functions, from both function-theoretic and probabilistic points of view.

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

Hiroaki Hata (Hitotsubashi Univ.) An optimal consumption and investment problem with a general nonlinear stochastic factor model and its policy improvement algorithm

Summary: In this talk, we employ a general nonlinear stochastic factor model where the returns and volatilities of assets are random and affected by some economic factors, modeled as diffusion processes. Additionally, we address an optimal consumption and investment problem on a finite time horizon to optimize the discounted expected power utility of consumption and terminal wealth. Furthermore, we propose a policy improvement algorithm, which establishes an iteration procedure converging to the value function and the optimal strategy.

September 4th (Wed) Conference Room VII

9:30–11:40

Summary: Motivated by the geometry of self-affine fractals, an invariant called weighted topological entropy was recently introduced. We have discovered a new formulation, and the coincidence of the two definitions seems highly non-trivial. This provides us with a novel way to calculate the Hausdorff dimension of some fractals such as sofic affine-invariant sets.

Summary: Stehr and Rønn–Nielsen (2021) studies a stationary random field on $\mathbb{Z}^d$ and obtain that under some conditions the normalized version of the distribution of the maximum of the field over an increasing sequence of index sets converges to an extreme value distribution. We consider the increase rate of index sets, which they make conditions on in the paper. We relax the conditions, and, in addition, investigate the cases of faster increase rates.

Summary: The large deviation principle for stochastic differential equations is important from the viewpoint of applications in mathematical finance. In this talk, I will present results on the large deviation principle for one-dimensional stochastic differential equations driven by stochastic integrals. Our results can be proved by combining the large deviation principle of stochastic integrals and rough path theory. First of all, we will show that the large deviation principle for stochastic integrals can be proved. Then, we will show that rough path theory can be applicable to prove the large deviation principle for one-dimensional stochastic differential equations driven by stochastic integrals.

Summary: We are concerned with the weak approximation of the weak solutions of stochastic functional differential equations (SFDEs) by means of the Euler–Maruyama schemes. Under quite general assumptions on the coefficients, we provide an estimate for the Lévy–Prokhorov metric between the paths of the weak solution of the original SFDE and the corresponding scheme. The weak convergence rate in terms of the Lévy–Prokhorov metric is characterized by the probability of a "rare event" where the weak solution of the SFDE exits a large sub-domain, which can be easily estimated in many examples. The proof is based on the generalized coupling approach which has been studied in the field of ergodicity of infinite dimensional stochastic systems.

Summary: We theoretically analyze the original version of the denoising diffusion probabilistic models (DDPMs) presented in Ho, J., Jain, A., and Abbeel, P., *Advances in Neural Information Processing Systems*, **33** (2020), pp. 6840–6851. Our main theorem states that the sequence constructed by the original DDPM sampling algorithm weakly converges to a given data distribution as the number of time steps goes to infinity, under some asymptotic conditions on the parameters for the variance schedule, the L^2-based score estimation error, and the noise estimating function with respect to the number of time steps. In proving the theorem, we reveal that the sampling sequence can be seen as an exponential integrator type approximation of a reverse time stochastic differential equation.

Summary: The self-avoiding walk (SAW) is a model added self-avoidance interaction to the random walk. In other words, each path does not visit the same vertex on a graph more than once. It is known that the spread-out finite-range SAW enjoys the central limit theorem [van der Hofstad and Slade (2003) AAM]. Taking an average on a ball, they also proved a certain type of a local limit theorem. For the spread-out long-range SAW, the power-law decay of the two-point function was shown in [Chen and Sakai (2019) CMP]. In this talk, I will explain an attempt to prove a local limit theorem for the spread-out long-range SAW in the original sense. Our motivations come from combining the results of the previous researches. This is joint work with Lung-Chi Chen (National Chengchi University) and Yuki Chino (National Yang-Ming Chiao-Tung University).

Summary: In this study, we analyze the random walk on $\mathbb{R}$, so called antlion random walk. This model is related to the one concerning decision-making on multi-armed bandit problems via chaotic laser.

Summary: The quantum walk is a quantum counterpart of the classical random walk and the absolute zeta function can be considered as a zeta function over $\mathbb{F}_1$. We showed a connection between the quantum walk and the absolute zeta function. Then we focused Grover walks on cycle graphs, which are typical models of quantum walks, and using cyclotomic polynomials, we calculated the periods and absolute zeta functions of such quantum walk with 3 states previously. In this talk, we report on the development of the method for 3 states and its application to 5 states or a general odd number of states.

11:40–12:10 Research Section Assembly

September 5th (Thu) Conference Room VII

9:30–11:40

Summary: We demonstrate tests of random number generators by exact Kolmogorov–Smirnov tests for discrete probabilities with the exact distributions of runs in H. Takahashi arXiv:2302.14356.

Summary: We propose here a new goodness-of-fit test, named the one-sample OVL-q test ($q = 1, 2, \ldots$), which can be considered an extension of the one-sample Kolmogorov–Smirnov test (equivalent to the one-sample OVL-1 test). We have analyzed the asymptotic properties of the one-sample OVL-2 test statistic and enabled the calculation of asymptotic p-values for the test statistic. We further conducted numerical experiments and demonstrated that the one-sample OVL-2 test can sometimes exceed the detection power of conventional goodness-of-fit tests.

Summary: In this talk, we discuss mean squared error of nonparametric quantile regression. The quantile regression is based on kernel type estimator of conditional distribution function.

Summary: The allometric regression model is a multivariate multiple regression model imposing that the difference between expectation vectors of two observations with different values of explanatory variables is parallel to the first principal eigenvector. In this presentation, estimation of the first principal eigenvector in the allometric regression model is discussed. Considering a class of estimators based on a weighted matrix of the regression sum of square matrix and the residual sum of squares matrix, we propose a new estimator that purposes to decrement an upper bound of the mean squared error of an estimator contained in this class. The proposed estimator and some conventional estimators are numerically compared.

Summary: The spectral clustering algorithm is used as a binary clustering method by applying the principal component analysis. Homoscedasticity of two clusters is commonly supposed in existing studies, but this restrictive assumption is often unrealistic in practice. Therefore, we consider the allometric extension model, that is, the directions of the first eigenvectors of two covariance matrices and the direction of the difference of two mean vectors coincide. A non-asymptotic bound of the error probability is provided for the spectral clustering.

Summary: The recent seminal work of Chernozhukov, Chetverikov and Kato has shown that bootstrap approximation for the maximum of a sum of independent random vectors is justified even when the dimension is much larger than the sample size. In this context, numerical experiments suggest that third-moment match bootstrap approximations would outperform normal approximation even without studentization, but the existing theoretical results cannot explain this phenomenon. In this talk, we derive an asymptotic expansion formula of the bootstrap coverage probability and show that the third-moment match wild bootstrap is second-order accurate in high-dimensions even without studentization when the covariance matrix has identical diagonal entries and bounded eigenvalues.

Summary: We consider parameter estimation for a linear parabolic second-order stochastic partial differential equation (SPDE) in two space dimensions driven by a Q-Wiener process based on high-frequency data with respect to time and space. Applying the methodology of Hildebrandt and Trabs (2021,EJS) to the SPDE in two space dimensions, we obtain minimum contrast estimators (MCEs) of the coefficient parameters of the SPDE in two space dimensions based on temporal and spatial increments. Furthermore, we develop adaptive estimators of the coefficient parameters based on an approximate coordinate process. It is shown that the adaptive estimators have asymptotic normality under certain regularity conditions.

Summary: We propose an M-estimator through the density-power weighting of the conventional Gaussian quasi-score function, and prove its asymptotic mixed normality at the usual rate. It is theoretically shown that the estimator is robust against contamination by jumps and spike-type noise. The estimation procedure involves one user-input tuning parameter.

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

Yuma Uehara (Kansai Univ.) Predictive model selection for jump diffusion models

Summary: A model selection problem is considered for jump-diffusion models based on high-frequency samples. The terminal time is supposed to diverge (ergodic setting), and the interest is to select drift and diffusion coefficients and jump distribution among candidates. An explicit AIC-type information criterion is proposed based on the threshold quasi-likelihood. Unlike the diffusion case, when the jump term is parametrized in some way, the stochastic flow approach cannot be directly used to get the transition density estimates, which is essential to evaluate the bias. To validate such an approximation, new transition density estimates are presented.

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

Shogo Nakakita (Univ. of Tokyo) Recent development in theories of non-sparse high-dimensional statistics

Summary: We introduce two topics and our studies on them: (1) non-sparse high-dimensional linear regression problems and (2) non-sparse high-dimensional logistic regression problems. We first show a study on benign overfitting of linear regression under time series dependence. Benign overfitting is a phenomenon where over-parameterized statistical models can achieve small prediction errors even if they overfit training data. Whilst previous studies on this phenomenon are based on i.i.d. settings, we examine this phenomenon under temporal dependence. We observe that the coherence of autocorrelation matrices serves small prediction errors; such a phenomenon is not seen in under-parameterized regression under dependence. In the second place, we show a novel uniform concentration bound and a uniform law of large numbers of constrained logistic regression. Logistic models are fundamental in the binary classification problem in statistics and machine learning. Under high-dimensional settings, it is known that the maximum likelihood estimation (MLE) for logistic regression can be biased. We investigate when the MLE can perform well even under high-dimensional settings and see that an effective rank of the covariance matrix of inputs plays an important role.

September 6th (Fri) Conference Room VII

10:00–11:45

26 Kento Egashira (Tokyo Univ. of Sci.)
Kazuyoshi Yata (Univ. of Tsukuba)
Makoto Aoshima (Univ. of Tsukuba)
Modification to k-means for high-dimensional data 15

Summary: k-means has been approved as a useful methodology for analysing high-dimensional, low-sample-size data. There remains scope for research on the asymptotic properties of the k-means about high-dimensional data. In the k-means, an appropriate increase in the number of initial data can be expected to enhance performance. In this talk, we derive the asymptotic properties of this approach and conduct a comparison with the conventional k-means. Additionally, based on the asymptotic properties of the conventional k-means, a modified method is proposed and evaluated in comparison to the conventional k-means. At last, we present numerical simulation studies that demonstrate the performance of k-means for high dimensional data, discussing the achieved results.

27 Yoshihiko Konno (Osaka Metro. Univ.)
An adaptive singular value shrinkage for estimation problem of low-rank matrix mean with unknown covariance matrix 10

Summary: Matrix models which are constructed from a deterministic signal plus noise are used in variety of fields. In particular it commonly happens that a signal matrix is of low-rank, however the rank itself is unknown. In this paper it is assumed that the noises are distributed as real normal or complex normal distributions, across columns are independently and identically distributed, and across rows of noise matrix are correlated. But the covariance matrix is unknown. For the problem of estimating a low-rank matrix, estimators with soft-thresholding singular values are considered and a formula to choose a threshold is proposed based on the SURE method.

28 Hirofumi Wakaki (Hiroshima Univ.)
Hirokazu Yanagihara (Hiroshima Univ.)
Complete bias modification of the risk of the model based on KL divergence 15

Summary: Consider the estimation of a risk function based on the KL divergence for a variable selection problem in a linear regression model. Fujikoshi and Satoh (1997) proposed Modified AIC (MAIC) as an asymptotically unbiased estimator of this risk function. MAIC corrects for bias for the underspecified model that does not include the true model, but leaves bias in the overspecified model, which was completely corrected by Corrected AIC by Sugiura (1978). Therefore, this study proposes an unbiased estimator that can fully correct the bias for both overspecified and underspecified models. Numerical experiments are conducted to confirm its performance as an information criterion.

29 Rinka Sagawa (Waseda Univ.)
Yan Liu (Waseda Univ.)
An information criterion for detecting periodicities in functional time series 15

Summary: Let us consider a trigonometric model in functional time series. In practice, functional data often exhibit periodic behaviors. Detecting these periodic behaviors helps us understand the functional features better. In this research, we propose a BIC-type information criterion for detecting the unknown number of periodicities. Additionally, we suggest an iterative algorithm that utilizes the residual processes obtained by the least squares method. We establish the consistency of this estimator minimizing the proposed information criterion. The resulting procedure automatically determines the number of periodicities in both multivariate and functional time series, thereby avoiding the issue of multiple testing.

30 Xiaoqiang Zeng
Yoshihide Kakizawa (Hokkaido Univ.)
Whittle likelihood estimation in INAR(p) process 15

Summary: The frequency domain analysis is considered in the stationary INAR(p) process under a general innovation. Here, we say that the innovation is general, if we do not assume its distributional form. In that case, the ML method is thus unavailable. Strong consistency and asymptotic normality of the Whittle estimator are established. It should be stressed that Silva and Oliveira (2004) gave some simulation studies about the Whittle estimation in the INAR(1) process with the Poisson marginals (Zhang and Wang (2015) for random coefficient INAR(1) process), without no theoretical results.

31 Yuichi Goto (Kyushu Univ.)
Kou Fujimori (Shinshu Univ.)
A test for counting sequences of integer-valued autoregressive models 15

Summary: The integer autoregressive (INAR) model is one of the most commonly used models in nonnegative integer-valued time series analysis and is a counterpart to the traditional autoregressive model for continuous-valued time series. To guarantee the integer-valued nature, the binomial thinning operator or more generally the generalized Steutel and van Harn operator is used to define the INAR model. However, the distributions of the counting sequences used in the operators have been determined by the preference of analyst without statistical verification so far. In this talk, we propose a test based on the mean and variance relationships for distributions of counting sequences and a disturbance process to check if the operator is reasonable. We show that our proposed test has asymptotically correct size and is consistent.

32 Yujie Xue (Inst. of Stat. Math.)
Taniguchi Masanobu (Waseda Univ.)
Introduction of general distributions on sphere and torus in view of time series spectra 10

Summary: There are various fields where observations are taken on directions in three dimensions, e.g., sphere and torus. Here we introduce a very general family of distributions on sphere and torus by use of time series spectra, which includes a lot of proposed classical one as special cases. Because time series spectra can be described by a lot of famous parametric models, e.g., AR, ARMA etc., we can develop the systematic model selection in this field by use of AIC, BIC, etc. Applications are very wide.

14:15–15:45

33 Hidefumi Kawasaki (Kyushu Univ.)
A grading theorem of sets based on Borsuk's antipodal theorem 15

Summary: Borsuk's antipodal theorem states that for any continuous mapping f from the n-sphere S^n to R^n, there exists a point $x \in S^n$ such that $f(x) = f(-x)$. Recently, by applying it to an n-tuple of parametric optimization problems with parameter $u \in S^n$, we presented an antipodal theorem for them. Further, we showed that given n convex sets in R^n, it is possible to divide each width in half with a hyperplane. In this talk, we take another approach, and present a result beyond the scope of the previous research. We call it a grading theorem of sets.

34 Teruo Tanaka (Hiroshima City Univ.)
Optimal stopping problems for discrete time multiparameter Markov processes 10

Summary: We consider optimal stopping problems for discrete time N-parameter Markov processes, and give the multiexcessive characterization of optimal value functions.

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. There is a one-to-one correspondence between the point set of a group divisible design (GDD) with v_1 groups of v_2 points and the edge set of a complete bipartite graph K_{v_1,v_2}. A block of GDD corresponds to a subgraph of K_{v_1,v_2}. Then the set of subgraphs also satisfies the spanning bipartite block design (SBBD) conditions. It's called GDD-type. In this talk, we introduce a method to construct a GDD-type SBBD directly from an (r, λ)-design and a difference matrix over a group.

Summary: We propose a generalized ordinal quasi-symmetry model based on f-divergence for multi-way contingency tables. This model builds upon the work of Saigusa et al. (2015), extending their model to multi-way tables. Additionally, we revisit and modify the properties discussed by Kateri and Agresti (2007), introducing a necessary and sufficient condition for the complete symmetry model.

Summary: In the case of complete data for a one-sample problem, the likelihood ratio (LR) and an asymptotic expansion of the modified likelihood ratio test statistic for the null distribution were given by Muirhead (1982). As an extension, Sato et al. (2024) has discussed the same problem for the two-step and general step monotone missing data. In this talk, we consider sphericity test under general step monotone missing data for a multi-sample problem, and using Box's method, we also give the LR and derive asymptotic expansions of the test statistics for the LR and modified LR. Furthermore, we numerically evaluate the actual type I error rates for approximate upper percentiles using Monte Carlo simulation.

Summary: We consider the one-sample problem of testing for a sub-mean vector. In the case where the data set consists of complete data with $p(= p_1 + p_2 + p_3 + p_4)$ dimensions and incomplete data with $p_1 + p_2$ dimensions, we consider the one-sample problem of testing the $p_2 + p_3 + p_4$ mean vector, $p_3 + p_4$ mean vector, and p_4 mean vector under the given mean vector of remaining dimensions. In considering these hypotheses, we construct test statistics based on Rao's U-statistic structure. Furthermore, we perform a probability expansion to obtain the distribution function of the test statistics and derive the upper 100α percentiles. We also propose a Bartlett-type corrected statistic. Moreover, we perform Monte Carlo simulations to verify approximation accuracy of the proposed approximate upper 100α percentiles and Bartlett-type correction.

Applied Mathematics

September 3rd (Tue) Conference Room IV

9:00–11:40

1 Yoshinori Kametaka (Osaka Univ.*)
Kohtaro Watanabe (Nat. Defense Acad. of Japan)
Atsushi Nagai (Tsuda Coll.)
Kazuo Takemura (Nihon Univ.)
Hiroyuki Yamagishi (Tokyo Metropolitan Coll. of Indus. Tech.)
Hiroto Sekido (Osaka Seikei Univ.)
The best constant of discrete Sobolev inequality on 1812 C60 fullerene isomers 15

Summary: The best constants of discrete Sobolev inequalities corresponding to 1812 isomers of C60 fullerene are found. Classical mechanical models of these isomers with a linear spring on each edge are investigated. The best constants stand for rigidities of these models. We show the best constants of 1812 isomers are distinct rational numbers and among these, Buckyball (or equivalently truncated icosahedron) takes the least. In other words, one can say that the Buckyball is the most rigid among 1812 C60 fullerene isomers.

2 Hideto Asashiba (Shizuoka Univ.)
Etienne Gauthier (École Polytechnique)
Enhao Liu (Kyoto Univ.)
Interval replacements of persistence modules 15

Summary: Persistent homology is a powerful technique in topological data analysis employed to explore topological features of complex datasets. Multi-parameter persistent homology is less understood than one-parameter persistent homology because of its more intricate algebraic structure. This presentation will first introduce the interval rank invariant (under the compression system) of persistence modules. This allows us to define the interval replacement of persistence modules. Then, we will show the main contribution: providing an explicit and general formula to compute the interval rank invariant directly under any compression system, utilizing the Auslander–Reiten theory.

3 Akifumi Nakada (Hiroshima Univ.)
Kento Ogawa (Hiroshima Univ.)
Takayuki Okuda (Hiroshima Univ.)
Compact association schemes 15

Summary: In code theory and design theory, we often consider finite association schemes and compact homogeneous spaces. In these spaces, analytically important propositions such as the Peter–Weyl theorem and the Plancherel theorem hold. In this talk, we define a compact association scheme as a generalization of finite association schemes and compact homogeneous spaces.

4 Kento Ogawa (Hiroshima Univ.)
An algebraization of association schemes 10

Summary: Association scheme is a most important object in algebraic combinatorics. The structure of association schemes induces a finite dimensional complex vector space with a matrix product, an Hadamard product, a transpose–conjugate, and a conjugate and a representation of the algebra with respect to the matrix product. The vector space is called the Bose–Mesner algebra of the association scheme. In this talk, we introduce a category of "algebras" that includes the Bose–Mesner algebra of association schemes as objects, and a functor from a category of association schemes to the category of "algebras".

Summary: Victoir (2004) provided a method for reducing the number of points in a cubature formula with a specific substructure using combinatorial designs and orthogonal arrays. On the other hand, the concept of polynomial space, given by Godsil (1988), refers to a space where certain designs, including combinatorial designs and orthogonal arrays, can be defined. In this talk, we generalize Victoir's point reduction method using polynomial space.

Summary: A quadrature formula is a formula computing a definite integration by evaluation at a set of finitely many points (design). Examining the existence of certain rational quadrature formulas leads to applications to interesting problems such as Waring's problem in number theory and spherical design in combinatorics. A centrally symmetric quadrature is a central research object in the real case. What is a complex analogue of central symmetry? In many interesting quadratures for Bessel polynomials, the points appear with their Galois conjugates. Therefore, it seems natural to consider such quadratures (Galois conjugate quadratures) as a complex analogue of central symmetry. In this talk, we discuss such quadratures with examples. We also describe the relationship with a Diophantine problem called Prouhet–Tarry–Escott problem.

Summary: If the integral of a polynomial with respect to a measure on an interval is represented as a linear combination of the values of the polynomial at finitely many points, this representation is called a quadrature formula. If all the coefficients of the linear combination are equal, the quadrature formula is called a Chebyshev-type quadrature formula, and the set of the points is called an interval design. In this talk, we give explicit construction of interval designs whose points are rational for a certain measure. We also investigate when this construction is applicable by classifying certain algebraic curves.

Summary: Firstly, we give a condition that G_f is a covering graph of G_{f_1} for APN functions $f : \mathbb{F}_2^n \to \mathbb{F}_2^m$ and $f_1 : \mathbb{F}_2^n \to \mathbb{F}_2^{m_1}$ with $m \geq m_1$, where G_f and G_{f_1} are incidence graphs (Cayley graphs) of f and f_1. Using this condition, we see that, for APN functions, Dillon's property is preserved under CCZ-equivalence. Also, some results on Dillon's property are given.

Summary: This talk gives the degree sum condition for covering a graph with some cycles. In fact, we showed that a 2-connected graph G is covered with k cycles if G satisfies the following two conditions for a vertex subset S of G; (i) the minimum degree sum of any independent $k+1$ vertices in S is greater than or equal to $|G|$ or the number of independent vertices in S is less than or equal to k and (ii) the vertex subset other than S is a clique.

10 Shinya Fujita (Yokohama City Univ.) On the existence of rainbow cycles in edge-colored graphs ····· 10

Summary: In this talk, we consider the existence of rainbow cycles in edge-colored graphs. In particular, we discuss color degree conditions for the existence of rainbow 4-cycles in edge-colored graphs. Some recent results will be reviewed.

14:15–15:15 Talk Invited by Applied Mathematics Section

Tsuyoshi Miezaki (Waseda Univ.) Universal graph series, chromatic functions, and their index theory

Summary: In this talk, we introduce the concept of universal graph series. We then present four invariants of graphs and discuss some of their properties. In particular, one of these invariants is a generalization of the chromatic symmetric function and a complete invariant for graphs.

15:30–16:25

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

Summary: For a graph G and $u, v \in V(G)$, a path in G from u to v is called a (u, v)-*path*, and if (u, v)-path is a Hamiltonian path from u to v, then (u, v)-path is called a (u, v)-*Hamiltonian path*. A graph G is said to be *Hamiltonian-connected* if there exists a (u, v)-Hamiltonian path between any two vertices u, v. A k-partite graph is said to be a *balanced k-partite graph* if each partite set has the same number of vertices. We give some conditions for balanced k-partite graphs to be Hamiltonian-connected.

12 Kazuhide Hirohata (Ibaraki Nat. Coll. of Tech.)
Megan Cream (Lehigh Univ.)
Ronald J. Gould (Emory Univ.) Chorded pancyclicity with distance two degree condition ····· 15

Summary: A graph G of order $n \geq 3$ is said to be pancyclic if G contains a cycle of each length from 3 to n. A chord of a cycle is an edge between two nonadjacent vertices of the cycle, and a chorded cycle is a cycle containing at least one chord. We define a graph G of order $n \geq 4$ to be chorded pancyclic if G contains a chorded cycle of each length from 4 to n. We improve some known results on pancyclic and chorded pancyclic graphs.

13 Masaki Kashima (Keio Univ.)
Riste Škrekovski (Univ. of Ljubljana)
Rongxing Xu (Zhejiang Normal Univ.) Analogies of degree coloring in proper conflict-free colorings ····· 15

Summary: A proper coloring of a graph is a map from the vertex set of the graph to positive integers such that every pair of adjacent vertices receive distinct colors. For a graph and its proper coloring, if there is a color that appears exactly once in the neighborhood of a vertex, then we say that the vertex satisfies the conflict-free condition. A proper conflict-free coloring of a graph is a proper coloring such that every vertex satisfies the conflict-free condition. We investigate analogies of degree coloring in proper conflict-free colorings and improve the known upper bound of the proper conflict-free chromatic number of graphs with bounded maximum degree.

14 Inasa Nakamura (Saga Univ.) Transformations of partial matchings and dotted graphs ····· 10

Summary: We present partial matchings by lattice presentations, and we consider transformations of partial matchings. Transformations of partial matchings are associated with transformations of lattice polytopes. We give the notion of the area of a transformation and we consider transformations of partial matchings with minimal area. Further, we consider dotted graphs that are planar graphs associated with lattice polytopes, and we consider deformations of dotted graphs.

16:40–17:40 Award Lecture for the 2023 Applied Mathematics Prize

Mikio Kano (Ibaraki Univ.*) Two degree factors of graphs and related topics

Summary: We first present some results on $(1, f)$-odd factors of graphs, which is a generalization of a 1-factor, and then show some results on degree factors with red-blue vertex coloring of graphs, which is a new type of degree factors. We also present some results together with some problems related to these factors. For a function $f : V(G) \to \{1, 3, 5, ..\}$, a spanning subgraph F of G is called a $(1, f)$-odd factor if $\deg_F(v) \in \{1, 3, \ldots, f(v)\}$ for all vertices v of G. If $f(v) = 1$ for every $v \in V(G)$, then a $(1, f)$-odd factor becomes a 1-factor. For two sets $\mathbb{S}_R, \mathbb{S}_B \subseteq \mathbb{Z}$ of integers, a spanning subgraph F of G is called a two-tone $(\mathbb{S}_R, \mathbb{S}_B)$-factor of G if $\deg_F(x) \in \mathbb{S}_R$ for every red vertex x and $\deg_F(y) \in \mathbb{S}_B$ for every blue vertex y. For example, we show that for every red-blue vertex coloring of an r-regular graph G, in which the distance between any two red vertices is at least 3, G has a two-tone $(\{a\}, \{k, k + 1\})$-factor, where r, a and k be integers such that $1 \leq a \leq r$ and $0 \leq k < r$.

September 4th (Wed) Conference Room IV

9:00–11:40

15 Kenta Ozeki (Yokohama Nat. Univ.)
Mikio Kano (Ibaraki Univ.*)
Yoshimi Egawa (Tokyo Univ. of Sci.*)
Path-cycle systems in regular graphs 10

Summary: A spanning subgraph F in G is said to be a path-cycle system with respect to W if each component of F is either a path or a cycle, and the set of end-vertices of the paths in F is equal to W. For an integer $r \geq 4$, we prove that for an r-edge-connected $K_{1,r}$-free r-regular graph G and a set of even number of vertices of G such that the distance between any two vertices of W in G is at least 3, G contains a path-cycle system with respect to W. We also showed that the conditions in the theorem are best possible in several meanings.

16 Kenta Mori (Kwansei Gakuin Univ.)
Aki Mori (Setsunan Univ.)
Hidefumi Ohsugi (Kwansei Gakuin Univ.)
The number of facets of symmetric edge polytopes arising from join graphs 15

Summary: In this talk, we study the upper and lower bounds for the number of facets of symmetric edge polytopes of connected graphs conjectured by Braun and Bruegge. In particular, we show that their conjecture is true for any graph that is the join of two graphs (equivalently, for any connected graph whose complement graph is not connected). It is known that any symmetric edge polytope is a centrally symmetric reflexive polytope. Hence our results give a partial answer to Nill's conjecture: the number of facets of a d-dimensional reflexive polytope is at most $6^{d/2}$.

17 Yosuke Sato (Waseda Univ.)
Generalization of the vertex-weighted version of the chromatic symmetric function 15

Summary: One of the invariants of graphs is the chromatic symmetric function invented by R.P. Stanley. The result of this study is a synthesis of two generalizations of this function. The first is a generalization using Kneser graphs, which is a complete invariant of simple graphs. The second is a generalization to vertex-weighted graphs. In this study, we newly generalize the vertex-weighted version using Kneser graphs. In conclusion, this new function was found to be a complete invariant of the vertex-weighted graph. In addition, this result allows us to construct a complete invariant for directed acyclic graphs and partially ordered sets.

Summary: It is typical for analysing time series models to take noise as white noise with the Gaussian distribution. This time series is affected by classical noise following a random walk, but we would like to consider the case where it is affected by quantum noise following a quantum walk.

Summary: Quantum walk is a mathematical model which is a quantum version of the random walk, and many applications are known in various research fields, e.g., quantum information. It is important to clarify its eigenvalues and eigenvectors, and the spectral mapping theorem for quantum walk is a very useful tool. In this talk, we present a generalized spectral mapping theorem for quantum walk that can be applied to more general models.

Summary: The main purpose of this talk is contributing to the study of the relationships between the quantum walks and their underlying graphs. The coarse Ricci curvature on graphs is usually defined using random walks. In this talk, we introduce a new definition of the coarse Ricci curvature induced from the Grover walk, which is one of the quantum walks. We refer to this curvature as Grover Ricci curvature. Notably, quantum walks can also be defined on hypergraphs, and we define the Grover Ricci curvature on hypergraphs aiming for further applications. This talk is based on Y. Fujitani and C. Kiumi, Quantum Inf Process 23, 180 (2024).

Summary: We provide a necessary and sufficient condition for perfect state transfer between two vertices in the Grover walk on a graph to occur. Additionally, we prove that automorphisms preserve the occurrence of perfect state transfer. In 2019, Zhan provided an infinite family of circulant graphs of valency 4 that admit perfect state transfer. As an application of our results, we characterize circulant graphs of valency at most 4 that admit perfect state transfer.

Summary: We introduce a new matrix-weighted zeta function, i.e., the second matrix-weighted zeta function of a graph, and give its determinant expression. Furthermore, we define the second matrix-weighted L-function of G, and give a determinant expression of it. As an application, we express the second matrix-weighted zeta function of a regular covering of G by a product of second matrix-weighted L-functions of G.

23 Iwao Sato (Oyama Nat. Coll. of Tech.)
Takako Endo (Tohoku Univ.)
Takashi Komatsu (Univ. of Yamanashi)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Yohei Matsumoto (Shinshu Univ.)
The second matrix-weighted alternating zeta function of a digraph ··· 15

Summary: We define the second weighted alternating zeta function of a digraph D, and give its determinant expression. We present a decomposition formula for the second weighted alternating zeta function of a group covering of D. Furthermore, we introduce the second weighted alternating L-function of D, and present a determinant expression of it. As a corollary, we express the second weighted alternating zeta function of a group covering of D by its second weighted alternating L-functions.

24 Iwao Sato (Oyama Nat. Coll. of Tech.)
Akahori Jiro (Ritsumeikan Univ.)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Suzuki Ryoichi (Ritsumeikan Univ.)
A zeta function of a pseudo quantization of a Markov chain on a graph ····· 15

Summary: We consider a Markov chain on a simple graph, and introduce a pseudo quantization for it. Furthermore, we define a zeta function for the pseudo quantization, and present the Euler product, the exponential generating function and the determinant expression of Ihara type for the zeta function. Moreover, we treat this zeta function for a regular covering of a graph. Finally, we define an L-function of a graph, and present the Euler product, the exponential generating function and the determinant expression of Ihara type of it.

13:00–14:00

25 Tomoki Kato (Nihon Univ.)
Yusuke Ide (Nihon Univ.)
Akihiro Narimatsu
(Univ. of Fukuchiyama)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Construction of multivariate orthogonal polynomials related to birth and death chains ····· 15

Summary: In this talk, we consider multivariate orthogonal polynomials related to birth and death chains. In our construction, we consider d types of birth and death chains. Then we combine these d types of chains by using tensor product. Each of birth and death chains has reversible distribution then the probability transition matrix can be transformed to real symmetric matrix. Thus we can consider orthogonal polynomials related to the chains. By using tensor product construction, we obtain multivariate orthogonal polynomials. We also propose a concrete method for reduction from multivariate polynomial to univariate polynomial.

26 Akihiro Narimatsu
(Univ. of Fukuchiyama)
Yusuke Ide (Nihon Univ.)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Continuous time quantum walk related to the multi- dimensional Ehrenfest model ····· 15

Summary: In this study, we consider and analyze Continuous time quantum walk related to the multi-dimensional Ehrenfest model. We obtain that there exists a form of independence among the random variables in each dimension, which is achieved by scaling time according to the ratio of the number of balls in the multi- dimensional Ehrenfest model. By using the independence, we can analyze the continuous time quantum walk on the path graph easier than the previous study did.

27 Hiroto Sekido (Yokohama Nat. Univ.) Periodicity and rhythmicity of quantum graph walks ····· 15
Etsuo Segawa (Yokohama Nat. Univ.)

Summary: Quantum graph walks are a quantum walk induced by the stationary Schrödinger equation on each vertex of a metric graph satisfying certain boundary conditions. Quantum graph walks are also a generalization of Grover walks. In this study, we obtain the parameters for a quantum graph walk defined from a strongly regular graph to be periodic and its period. In addition, we newly define a strike-in quantum walk, its rhythmicity, and its beat, and clarify the parameters that satisfy the conditions. The strike-in quantum walk is a model that includes quantum search, and rhythmicity is expected to play a role in controlling the length of a period. Periodicity is also a special case of rhythmicity.

28 Taisuke Hosaka (Yokohama Nat. Univ.) Pulsation of the quantum walk on the Johnson graph ····· 15
Etsuo Segawa (Yokohama Nat. Univ.)

Summary: In this talk, we introduce a phenomenon called "pulsation" in quantum walk. This phenomenon is as follows: For two connected graphs G_1, G_2, we consider the composite graph formed by a disjoint union of G_1 and G_2. In addition, we assume that the initial state exists only on G_1. Then almost all states transfer to G_2 on a suitable step. Moreover, almost all states return to G_1 on a suitable step. These phenomena occur periodically. We analyzed the existence of this phenomenon when G_1 is the Johnson graph and G_2 is a star graph by using perturbation theory.

September 5th (Thu) Conference Room IV

9:45–12:00

29 Karel Svadlenka (Tokyo Metro. Univ.) On an approximation method for anisotropic interfacial motions on obstacle ····· 15

Summary: While isotropic interfacial network motion is already well studied, theoretical understanding of curvature-driven motion of interfacial networks with anisotropic energies and global constraints is still lacking. In this talk, I will present theoretical analysis of an intermediate-level problem with three phases, where one phase plays the role of a fixed obstacle and one phase represents a volume-preserving anisotropic particle. A generalization of the so-called heat-content approximation leads to an approximation scheme, which is suitable for both theoretical existence analysis and numerical approximation. Both theoretical convergence results and numerical simulations will be shown.

30 Yu Ichida (Kwansei Gakuin Univ.) Global dynamics of a simple model for wild and sterile mosquitoes ····· 15
Yukihiko Nakata (Aoyama Gakuin Univ.)

Summary: There are known methods to manage the population dynamics of wild and sterile mosquitoes by releasing genetically engineered sterile mosquitoes. Even if a two-dimensional system of ordinary differential equations is considered as a simple mathematical model for developing release strategies, fully understanding the global behavior of the solutions is challenging, due to that the probability of mating is ratio-dependent. In this talk, we combine a geometric approach called the time-scale transformation and blow-up technique to provide a complete understanding of dynamical systems near the origin. Then, the global behavior of the solution of the system is classified in a two-parameter plane represented by the natural death rate of mosquitoes and the sterile mosquito release rate.

Summary: We deal with symmetric solutions of the bistable reaction-diffusion equation on an unbounded root-like metric graph. Our goal is to provide a spreading-transition-vanishing trichotomy result on the asymptotic behavior for symmetric solutions with compact supported initial data on the graph. To this end, we need a convergence result for bounded and symmetric solutions to the equation. The convergence result can be proved using a version of zero number diminishing properties on the graph.

Summary: Recently, Furihata has proposed various types of nonlinear difference operators, such as logarithmic difference, aiming to bring out other superior features instead of relaxing linearity. In this study, a certain summation formula is derived for the square difference operator among the above nonlinear difference operators. Using the summation formula, we construct a structure-preserving scheme based on the discrete variational derivative method (DVDM). In this talk, we report the results.

Summary: In this talk, we concerns an inverse problem for fluorescence diffuse optical tomography (FDOT) reconstructing locations of multiple point targets from the measured temporal response functions. Peak time, the time when the temporal response function of the fluorescence reaches its maximum, is an important measurement in FDOT because it is most less suffered by noise. We derive an approximation peak time formula in an explicit way based on asymptotic analysis and the formula is verified numerically in a practical range of physical parameters including fluorescence lifetime.

Summary: We consider a model problem of thermal convection in a long liquid layer under gravity with non-uniform heat supply. The system is described by the Oberbeck–Boussinesq equations in the two space-dimension. An existence theorem of stationary solutions is proved under some assumptions. Several flow patterns are obtained by the numerical computations which include the cases out of the assumptions of the existence theorem.

Summary: We found two types of expressions for the Green's function $G(x, y)$ in the boundary value problem with clamped conditions at both ends for the differential operator $(-1)^M(d/dx)^{2M}$ on the interval $(-s, s)$ presented in the paper [1] published in 2011. By determining the maximum value of the diagonal value $G(y, y)$ for $|y| \leq s$, the best constant for the corresponding Sobolev inequality was calculated. In this presentation, in addition to the matrix representation of the Green's function in the boundary value problem with clamped conditions at both ends for the differential operator $(-1)^M(d/dx)^{2M}$ on the interval $(0, 1)$, a newly obtained integral representation is reported. Furthermore, the positivity of the Green's function is deduced from this integral representation.

36 Takuya Tsuchiya (Meiji Gakuin Univ.)
Makoto Nakamura (Osaka Univ.)
On convergence and behavior of solutions for semi-linear Klein–Gordon equation ····· 15

Summary: We talk about the convergence, the stability, and the accuracy of the numerical solutions for the semi-linear Klein–Gordon equation. In this talk, we report the changes of the convergence and the behavior of the solutions when the amplitude of the initial condition, the magnitude of the mass, the existence of the nonlinear term, and the numbers of the grid are changed.

14:15–16:00

37 Tomoki Ohsawa (Univ. of Texas at Dallas)
Kazuyuki Yagasaki (Kyoto Univ.)
Semiclassical perturbations of single-degree-of-freedom Hamiltonian systems: Separatrix splitting and nonintegrability ····· 15

Summary: We study semiclassical perturbations of single-degree-of-freedom Hamiltonian systems and provide sufficient conditions for the separatrices to split and for their meromorphic nonintegrability such that the first integrals depend on the small parameter meromorphically. To obtain the former and latter results, we use a Melnikov-type approach and a generalization due to Ayoul and Zung of the Morales–Ramis theory, respectively. We illustrate the theoretical results for bounded potentials including a simple pendulum.

38 Takashi Miura (Kyushu Univ.)
Toshiyuki Ogawa (Meiji Univ.)
Ayuki Sekisaka (Meiji Univ.)
Kei Sugihara (Kyushu Univ.)
Segmented patterns appearing in seminiferous tubules and various properties of defects ····· 15

Summary: We discuss the properties of segmented patterns and defect solutions that appear in seminiferous tubules. defects are a type of modulated traveling waves in reaction-diffusion systems, and the transition phenomena between wave trains. In this talk, we will also discuss some mathematically necessary properties that can be derived from observations when defects appear as segmented patterns in seminiferous tubules.

39 Koichi Anada (Waseda Univ. Senior High School)
Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Takeo Ushijima (Tokyo Univ. of Sci.)
Remark on the asymptotic behavior of curves in a curve shortening problem for convex immersed curves with self-crossing points ····· 15

Summary: We consider a curve-shortening problem for convex immersed curves with self-crossing points. We deal with curve contractions by the power of their curvatures with a positive exponent α. The motion can be described by a quasilinear parabolic partial differential equation and some of the solutions blow up with Type 1 or Type 2 singularities, depending on the exponent α. Our purpose in this talk is to investigate the asymptotic behavior of curves contracting in the case that solutions have Type 1 singularity.

40 Yuuki Ueda (Hokkaido Univ.)
Junyong Eom (Hokkaido Univ.)
Shinya Uchiumi (Hokkaido Univ.)
Yueyuan Gao (Shimane Univ.)
Shinji Nakaoka (Hokkaido Univ.)
Hiroshi Suito (Tohoku Univ.)
Shinji Kume (Shiga Univ. of Medical Sci.)
Hideki Katagiri (Tohoku Univ.)
Masaharu Nagayama (Hokkaido Univ.)
Mathematical modeling of glucose-insulin metabolism dynamics and parameter estimation ····· 15

Summary: We propose a mathematical model of the dynamics of glucose-insulin metabolism. The model describes detailed dynamics in pancreas, hepatocyte and skeleton muscle. We connect each organ by blood circulation and provide the ODE system. We estimate model parameters by fitting the numerical results of glucose and insulin (and C-peptide) concentrations to clinical data. The estimation is based on the Metropolis–Hastings algorithm, which is widely used for sampling in statistics. We can verify that the computational result which fits the clinical data provides valid quantities and properties in terms of medical knowledge.

41 Toshiko Ogiwara (Josai Univ.)
Ken-Ichi Nakamura (Meiji Univ.)
Propagating direction of bistable traveling fronts in the Lotka–Volterra competition-diffusion system ····· 15

Summary: We consider front propagation in the classical 2-species Lotka–Volterra competition-diffusion system under strong competition conditions. The system has a unique traveling front solution (up to translation) connecting two stable states. The sign of the front speed gives us significant information about which species prevails over the other, and identifying the sign is still a challenging problem. In this talk, we give some new results on the sign of the speed of bistable traveling fronts based on comparison arguments. The results determine the propagation direction of the front for a much broader range of parameters than previous results.

42 Hidetomo Hoshino (Waseda Univ.)
Takuya Tsuchiya (Meiji Gakuin Univ.)
Gen Yoneda (Waseda Univ.)
Analysis and improvement of numerical stability of the Einstein equations against homogeneous and isotropic spacetime background ····· 15

Summary: In this study, we investigate the numerical stability of the covariant Baumgarte–Shapiro–Shibata–Nakamura (cBSSN) formulation against homogeneous and isotropic spacetime. To evaluate the numerical stability, we calculate the constraint amplification factor (CAF), which is obtained from an eigenvalue analysis of the evolution of the constraint. We propose a modification to the time evolution equations of the cBSSN formulation that achieves higher numerical stability.

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

Harunori Monobe (Osaka Metro. Univ.)
On compact traveling waves in the singular limit problem of some reaction diffusion systems

Summary: The singular limit method is sometimes used for some mathematical models, written by partial differential equations (PDEs), to describe complex phenomena. The idea is to contract original PDEs and create simple equations which maintains its essential property. As a typical example, it is well known that the singular limit of the Allen–Cahn–Nagumo equation, describing phase transition phenomena, becomes Mean-curvature flow. In this talk, we focus on the Allen–Cahn–Nagumo equation and its singular limit (Mean-curvature flow with driving force), and introduce some results, e.g., spot patterns.

September 6th (Fri) Conference Room IV

10:00–12:00

43 Yu Ichida (Kwansei Gakuin Univ.)
Takashi Sakamoto (Meiji Univ.)
Geometric approach to the bifurcation at infinity: A case study ····· 15

Summary: In this talk, the reaction-diffusion equation in space 1D with negative power nonlinearity is presented as an example the stationary solutions of which are characterized by the bifurcation at infinity. The all dynamics, including to infinity, of the ordinary differential equation concerning with the stationary problem of the reaction-diffusion equation are obtained by the Poincaré-type compactification. The results of this talk give relationship between the bifurcation at infinity of the stationary solutions for the reaction-diffusion equation and the connecting orbits of the ordinary differential equations, especially, that connect the equilibria at infinity. Moreover, this result also answers the question of what kind of solutions appear (or disappear) associated with the bifurcation.

44 Masumi Kondo (Okayama Univ. of Sci.)
Masakazu Onitsuka (Okayama Univ. of Sci.)
Ulam stability for von Bertalanffy growth model with Allee effect ···· 15

Summary: In this study, we consider conditional Ulam stability for von Bertalanffy growth model with Allee effect. Ulam stability means that for any approximate solution, there exists a true solution such that the error between them always remains within a certain width. This study gives a better Ulam constant than a previous result.

45 Kota Takeda (Kyoto Univ.)
Takashi Sakajo (Kyoto Univ.)
Uniform error bounds of the ensemble transform Kalman filter for chaotic dynamics with multiplicative covariance inflation ····· 15

Summary: Data assimilation is a method of uncertainty quantification to estimate the hidden true state by updating the prediction owing to model dynamics with observation data. As a prediction model, we consider a class of nonlinear dynamical systems on Hilbert spaces. For nonlinear model dynamics, the ensemble Kalman filter (EnKF) is often used to approximate the probability distribution with a set of particles called an ensemble. Especially, a deterministic version of the EnKF known as the ensemble transform Kalman filter (ETKF) performs well even with limited ensemble sizes compared to other stochastic implementations of the EnKF. Despite the practical effectiveness of the ETKF, little is theoretically known. The present study aims to establish the theoretical analysis of the ETKF.

46 Hiroshi Ishii (Hokkaido Univ.)
On the propagation of solutions to Fisher-KPP type equation with time-fractional derivative ····· 15

Summary: This talk deals with the Fisher-KPP equation with the Caputo derivative as time derivative. The propagation of the solution is considered and the concept of travelling wave solution, which is different from the usual meaning, is introduced as a characterization of the solution. Assuming that the solution asymptotically approximates the travelling wave solution, asymptotic travelling wave solution is defined, and its existence and usefulness are explained in this talk.

47 Yoshitaka Watanabe (Kyushu Univ.)
A verified operator norm estimation for the inverse of an infinite-dimensional linear operator with singular term by Bünger–Rump's theory ····· 15

Summary: In this talk, we present a verified operator norm estimation for the inverse of an infinite-dimensional linear operator which has a singular term. Our approach is based on a verified computation method by Bünger and Rump, and the operator norm estimation gives important information in the computation of rigorous error bounds for the solution of ordinary differential equations involved with a nonlinear wave equation.

48 Fuminori Sakaguchi (Univ. of Fukui) A new integer-type algorithm with 2nd/3rd-order convergence for calculating eigenvalues of differential operators by using auto-cancellations of the singularities of their eigenfunctions ····· 15

Summary: In this study, a new integer-type algorithm is proposed for calculationg eigenvalues of linear differential operators with a high accuracy, by using a kind of auto-cancellation of the singularities caused by the deviations of eigenvalues from exact ones. This algorithm is baed on non-linear eigenvalue problems in terms of the powers of the left hand sides of the characteristic equations of the linear differential operators. Theoretically the numerical performance of this algorithm has p-th order convergence, with p aritrary chosen, Some succesfull numerical results are given in this presentation.

49 Keita Iida (Osaka Univ.) Semiology-based clustering method for single-cell data ····· 15

Summary: Various cells in living tissues produce numerous molecules to sustain life. However, the molecular basis of life is complex, making theoretical elucidation of its control mechanisms difficult. Here, we present ASURAT, a computational tool for unsupervised clustering and functional annotation of cell type, biological process, and signaling pathway activity for single-cell data (Iida, Bioconductor, 2022). We apply ASURAT to human pancreatic cancer data and identify previously overlooked subpopulations (Iida et al., Bioinformatics, 2022). ASURAT is a powerful tool for dissecting cell subpopulations and improving the biological interpretability of complex and noisy transcriptomic data.

14:15–16:00

50 Yumihiko S. Ikura (Meiji Univ.)
Hirokazu Ninomiya (Meiji Univ.)
A mathematical study on the pattern dynamics of the Greenberg–Hastings cellular automaton. ····· 15

Summary: Periodic solutions appearing in the 3-valued Greenberg Hastings cellular automaton on rectangular lattice points are studied. Here, a von Neumann neighborhood type was used for the interaction between lattice points. Vorticity was used as an index and was shown to be an invariant quantity. Using this index, it was shown that there are restrictions on spontaneously occurring periodic solutions. The results suggest that the 3-period solution is the strongest and the 4-period solution is the weakest. It was also shown that there is no 5-period solution.

51 Shu Kanazawa (Kyoto Univ.)
Yasuaki Hiraoka (Kyoto Univ.)
Jun Miyanaga (Tohoku Univ.)
Kenkichi Tsunoda (Kyushu Univ.)
Large deviation principle for persistence diagrams of random cubical filtrations ····· 15

Summary: The objective of this work is to investigate the asymptotic behavior of the persistence diagrams of a random cubical filtration as the window size tends to infinity. Here, a random cubical filtration is an increasing family of random cubical sets, which are the union of randomly generated higher dimensional unit cubes with integer coordinates in a Euclidean space. In this talk, we discuss the exponential decay rate of the probability that the persistence diagram is far from the typical behavior. This is the first result on the large deviation behavior of persistence diagrams. (Joint work with Yasuaki Hiraoka, Jun Miyanaga, and Kenkichi Tsunoda)

52 Kazuaki Tanaka (Waseda Univ.)
Masahide Kashiwagi (Waseda Univ.)
Yuki Naito (Hiroshima Univ.)
Satoshi Tanaka (Tohoku Univ.)
Kohtaro Watanabe (Nat. Defense Acad. of Japan)
Computer-assisted uniqueness proof for sign-changing radially symmetric solutions of scalar field equations ····· 15

Summary: In this talk, we report on the results of proving the uniqueness of sign-changing radially symmetric solutions of scalar field equations on Euclidean space via computer assistance. The proof employs an approach that combines analytical methods with rigorous numerical computations.

53 Takao Namiki (Hokkaido Univ.)
Satoru Tadokoro (Hokkaido Univ.)
Yuta Kishimoto (Hokkaido Univ.)
Shunsuke Kajikawa (Kyoto Univ.)
Masao Matsuhashi (Kyoto Univ.)
Akio Ikeda (Kyoto Univ.)
Ichiro Tsuda (Sapporo City Univ.)
Permutation entropy and epileptgenetic zone 10

Summary: Epilepsy is a disease that affects about 1/80th of the population. Surgical resection is necessary to treat refractory epilepsy, and the area to be resected should be limited. For this purpose, we apply a mathematical method. First, we show that permutation entropy can be used to identify the epileptic focus. Second, the correlation of permutation entropy allows us to extract the epileptogenic zone. We report these results.

54 Itsuki Watanabe (Oita Univ.)
Taiga Kumagai
(Nat. Inst. of Tech., Maizuru Coll.)
Markov chain approximation for Hamilton–Jacobi–Bellman equation with reflecting boundary 15

Summary: We consider the infinite horizon optimal control problems of the controlled Markov process in which the state 0 is reflecting state. We verify the relationship between the controlled Markov process and its fluid limit by the viscosity solution approach. More precisely, we show that the value function of the controlled Markov process converges to one of its limit process which is the viscosity solution of the corresponding Hamilton–Jacobi–Bellman equation with Neumann boundary condition.

55 Tetsuya Ishiwata
(Shibaura Inst. of Tech.)
Kouya Kawanishi
(Japan Res. Inst., Ltd)
On the learning behavior of SARSA and Q-learning in reinforcement learning and a hybrid algorithm 15

Summary: SARSA and Q-learning are two typical methods of reinforcement learning. We first describe the learning behavior of these two algorithms. Then, we propose a hybrid algorithm that combines these two methods. Finally, we show a convergence result for the proposed hybrid algorithm and demonstrate numerical experiments on the learning behaviors.

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

Kengo Nakai (Okayama Univ.)
Evaluation of a data-driven model using reservoir computing from dynamical system point of view

Summary: It has been reported that reservoir computing is effective in the inference of time-series and some characteristics. A reservoir is a recurrent neural network whose internal parameters are not adjusted to fit the data in the training process. What is done is to train the reservoir by feeding it an input time-series and fitting a linear function of the reservoir state variables to a desired output time-series. We have succeeded in modeling a macroscopic behavior of a three-dimensional chaotic fluid flow, which requires only past time-series data as training data. A single model can infer short time behaviors from various initial conditions. The model also generates statistical properties which mimic the original ones. However, it is not clear to what extent a model constructed by reservoir computing can capture dynamical structures. We confirm that dynamical properties such as fixed points, periodic orbits, and non-hyperbolic structures can be reconstructed by reservoir computing. We will discuss these results and some ongoing works. This talk is based on [1,2].
[1] M.Kobayashi, K.Nakai, Y.Saiki, and N.Tsutsumi, Dynamical system analysis of a data-driven model constructed by reservoir computing, Phys.Rev.E 104, 044215:1-7 (2021) [2] M.Kobayashi, K.Nakai, and Y.Saiki, Reconstruction of hetero-chaos by a data-driven model using reservoir computing, Journal of Physics: Complexity, in press, DOI 10.1088/2632-072X/ad5264.

Topology

September 3rd (Tue) Conference Room IX

9:30–12:00

1 Akihiro Higashitani (Osaka Univ.)
Seiichi Kamada (Osaka Univ.)
Jin Kosaka
Hirotake Kurihara (Yamaguchi Univ.)
Classification of generalized Alexander quandles ····· 15

Summary: In thik talk, we provide a new characterization of isomorphism classes of generalized Alexander quandles in terms of the underlying groups and their automorphisms. This extends the previous result Higashitani–Kurihara (2024). Additionally, we give the computational results of the number of generalized Alexander quandles up to quandle isomorphism arising from groups up to order 127 and their group automorphisms.

2 Erika Kuno (Osaka Univ.)
Mitsuaki Kimura (Osaka Dent. Univ.)
The automorphism groups of the fine curve graphs for nonorientale surfaces ····· 10

Summary: The fine curve graph of a surface was introduced by Bowden, Hensel, and Webb as a graph consisting of the actual essential simple closed curves on the surface. Long, Margalit, Pham, Verberne, and Yao proved that the automorphism group of the fine curve graph of a closed orientable surface S_g of genus $g \geq 2$ is isomorphic to the homeomorphism group of the surface. Based on their argument, we generalized their result to closed nonorientable surfaces N_g of genus $g \geq 4$.

3 Susumu Hirose (Tokyo Univ. of Sci.)
Naoyuki Monden (Okayama Univ.)
On generating mapping class groups by pseudo-Anosov elements ····· 15

Summary: Wajnryb proved that the mapping class group of a closed oriented surface is generated by two elements. We prove that the mapping class group is generated by two pseudo-Anosov elements. In particular, if the genus is greater than or equal to nine, we can take the generators to two conjugate pseudo-Anosov elements with arbitrarily large dilatations. Another result we prove is that the mapping class group is generated by two conjugate reducible but not periodic elements if the genus is greater than or equal to eight. We also give similar results to the first and third results for the hyperelliptic mapping class group when the genus is greater than or equal to one.

4 Yasushi Kasahara (Kochi Univ. of Tech.)
Low dimensional MCG-invariant representations of surface groups in the naive deformation spaces ····· 10

Summary: We report that the Franks–Handel and the Korkmaz theorems on low dimensional linear representations of pure mapping class group of orientable surface (MCG) of sufficiently large genus implies the triviality of the linear representations of the corresponding surface group into GL(r,C) with the property of the title, provided r be less than or equal to the square root of twice the genus of the surface. To derive the result, we apply our construction of linear representation of the MCG starting with a representation of the corresponding surface group MCG-invariant in the naive deformation space we once used to derive the "visualization of the linearity problem" for the MCG.

5 Toyo Taniguchi (Univ. of Tokyo)
Topology of loops via non-commutative differential geometry ····· 15

Summary: The Turaev cobracket is a topologically defined operation on the space of free loops on an oriented surface. When the surface is further bordered and compact, it is factored into two maps in a paper by Alekseev–Kawazumi–Kuno–Naef, one of which is called the divergence map. We reconstruct it in terms of non-commutative differential geometry featuring a non-commutative analog of a flat connection and generalize it to the case of closed surfaces.

6 Aoi Wakuda (Univ. of Tokyo) A generalization of the Center Theorem of the Thurston–Wolpert–Goldman Lie algebra 15

Summary: The Goldman Lie algebra of an oriented surface was defined by Goldman. By the natural involution that opposes the orientation of curves, the Goldman Lie algebra becomes a $\mathbb{Z}_2$-graded Lie algebra. Its even part is isomorphic to the Thurston–Wolpert–Goldman Lie algebra or, briefly, the TWG Lie algebra. Chas and Kabiraj proved the center of the TWG Lie algebra is generated by the class of the unoriented trivial loop and the classes of unoriented loops parallel to boundary components or punctures. The center of the even part can be rephrased as the set of elements of the even part annihilated by all the elements of the even part.

7 Tatsuki Kuwagaki (Kyoto Univ.) On the construction of WKB spectral network 15

Summary: The trajectory of quadratic differentials on Riemann surfaces is an important object in mathematics and mathematical physics. Similar theories for higher-order differentials (spectral networks, Stokes diagrams) have also attracted attention in WKB analysis, Teichmuller theory, and related mathematical physics, but little is known about them. In this talk, we will outline the existence of spectral networks in the case of general higher-order differentials.

14:30–15:30 Talk Invited by Topology Section

Mai Katada (Kyushu Univ.) The stable Albanese homology of the IA-automorphism groups of free groups

Summary: The IA-automorphism group IA_n of the free group F_n of rank n is the kernel of the map between the automorphism groups induced by the abelianization map of F_n. The structure of the rational (co)homology of IA_n is mysterious for small n, but we have made progress for sufficiently large n with respect to the (co)homological degree. In this talk, we will determine the quotient of the rational homology of IA_n that is called the Albanese homology of IA_n, which plays an important role of the whole rational homology of IA_n.

September 4th (Wed) Conference Room I

10:00–10:15 Presentation Ceremony for the 2024 MSJ Geometry Prize

10:20–11:20 Award Lecture for the 2024 MSJ Geometry Prize

Hokuto Konno (Univ. of Tokyo) Diffeomorphism group and gauge theory

Summary: The group of diffeomorphisms of a given smooth manifold is a fundamental object of study for topologists and geometers. One of the major advances in topology over the past decade concerns diffeomorphism groups of higher-dimensional manifolds, led by many researchers such as Galatius and Randal-Williams. On the other hand, it has been well-known since the last century that 4 is a special dimension in the classification of manifolds. Special phenomena are typically described in terms of comparisons between the topological and smooth categories, and they are detected using gauge theory. In recent years, advances in gauge theory for families have revealed that special phenomena in dimension 4 also occur for diffeomorphism groups in various ways, contrasting with recent results in higher dimensions. I will survey these new special phenomena in dimension 4, also from the perspective of comparisons between the topological and smooth categories.

12:50–13:50 Award Lecture for the 2024 MSJ Geometry Prize

Shinobu Hosono (Gakushuin Univ.) Families of Calabi-Yau manifolds and mirror symmetry

Summary: Mirror symmetry of Calabi–Yau manifolds is a mysterious symmetry that interchanges the complex geometry of one Calabi–Yau manifold with the symplectic geometry of another Calabi–Yau manifold, called a mirror manifold. 30 years after its discovery, we now have fascinating proposals, such as homological mirror symmetry and SYZ geometric mirror construction, to describe the symmetry mathematically. In this talk, however, I will describe this symmetry in terms of two different, and classical, nilpotent linear actions associated with a Calabi–Yau manifold. One is the Lefschetz action in the hard Lefschetz theorem (which I call A-structure), and the other is a certain monodromy action that arises from a family of Calabi–Yau manifolds (B-structure). I define mirror symmetry as the symmetry which exchanges these two structures. The general existence of a mirror Calabi–Yau manifold for a given Calabi–Yau manifold is still an open problem. However, mirror symmetry defined by these classical actions motivates us to study/construct families of Calabi–Yau manifolds, and to look into the boundary points where Calabi–Yau manifolds degenerate in a specific way. Based on my collaborations with Hiromichi Takagi since 2010, I will present interesting families of Calabi–Yau threefolds which are parametrized by two-dimensional toric varieties.

September 5th (Thu) Conference Room IX

9:30–12:00

8 Kohei Tanaka (Shinshu Univ.) Cone complexes and group actions 15

Summary: Cone complexes are a generalization of simplicial complexes compatible with the quotients by group actions. In this talk, we focus on group actions on cone complexes, and compare them with the case of small categories.

9 Ryo Kato (Kochi Univ. of Tech.)
Katsumi Shimomura (Kochi Univ.)
Mao-no-suke Shimomura (Kochi Univ.)
On the Greek letter elements of the homotopy groups of the $E(n)$-localized sphere spectrum 10

Summary: Miller, Ravenel and Wilson introduced the n-th Greek letter elements in the E_2-term of the Adams–Novikov spectral sequence. We then have a problem asking whether or not the n-th Greek letter elements $\alpha_t^{(n)}$ survive in the homotopy groups of the sphere spectrum in the spectral sequence. So far, we have answers only when $n \leq 3$. In this talk, we report the condition under which an n-th Greek letter element $\alpha_t^{(n)}$ for $n \geq 1$ exists in the homotopy groups of the $E(n)$-localized sphere spectrum.

10 Takahito Naito (Nippon Inst. of Tech.) Cartan calculus in string topology 15

Summary: In this talk, we investigate a Cartan calculus on the homology of free loop spaces due to Kuribayashi, Wakatsuki, Yamaguchi and the speaker. In particular, it is proved that the Cartan calculus can be described by the loop product and the loop bracket in string topology. As an application, we also show that the Lie derivative on the homology is a derivation with respect to the loop product.

11 Yuki Kato (Ube Nat. Coll. of Tech.) Application of Smith ideal theory to almost ring theory of pointed symmetric monoidal model categories 15

Summary: This talk generalizes a result in Quillen's note, "Module theory over non-unital rings," which gives a one-to-one correspondence between bilocalizations of abelian categories of module categories and idempotent ideals of the base rings. Faltings, Gabber, and Ramero established almost ring theory which is the same as Quillen's bilocalization of a category of modules by nil-modules. By using the theory of Smith ideals theory mentioned by Hovey, we consider the almost ring theory of symmetric monoidal pointed model categories and prove a weak analogue of the one-to-one correspondence.

12 Katsuhisa Koshino (Kanagawa Univ.) The Borel complexity and the complete metrizability of spaces of metrics ····· 15

Summary: For a metrizable space X, let $AM(X)$ be the space of continuous bounded admissible metrics on X with the sup-metric. In this talk, we shall investigate the Borel complexity of $AM(X)$ and show that a separable metrizable space X is σ-compact if and only if $AM(X)$ is completely metrizable.

13 Yasushi Hirata (Kanagawa Univ.), Yukinobu Yajima (Kanagawa Univ.*) Characterizations of irreducibility on GO-spaces and monotonically normal spaces by cardinal functions ····· 15

Summary: We characterize irreducibility on GO-spaces and monotonically normal spaces by cardinal functions. As an application, an irreducible subspace without Property D is found in an ordinal.

14 Kenshi Ishiguro (Fukuoka Univ.), Naito Nishihara (Fukuoka Univ.) Modular invariant rings and the Weyl groups of special unitary groups ····· 10

Summary: We consider certain invariant rings under the actions of reflection groups. The mod p representations come from the Weyl groups of special unitary groups, which are isomorphic to symmetric groups. We will ask, particularly, if such invariant rings are polynomial algebras. In the projective case, the answer is negative.

15 Jun O'Hara (Chiba Univ.) Characterization of generic finite metric spaces by magnitude ····· 15

Summary: We show that a finite metric space can be identified by the magnitude function if the edge lengths are rationally independent.

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

Masahiko Yoshinaga (Osaka Univ.)♭ Topology of real hyperplane arrangements

Summary: We discuss topology of hyperplane arrangements via real structures.

15:40–18:00

16 Mutsuo Oka (Tokyo Tech*/Tokyo Univ. of Sci.) Comment on Briançon–Speder polynomial ····· 15

Summary: Briançon and Speder gave an example of a μ-constant family of weighted homogeneous polynomials for which μ^* is not constant. In this talk, we analyze this example. Briançon–Speder family is given by $f_t(x,y,z) = x^{15} + z^5 + tz^6y + z^7x$ and it has weight ${}^t(1,2,3)$ and degree 15. Its Milnor number is 364 but its plane section give respective Milnor number 26 and 28 for f_1 and f_0. They missed two more class which have different topology for plane sections. We generalize this observation for other similar weighted homogeneous polynomials.

17 Sakumi Sugawara (Hokkaido Univ.) First homology groups of the Milnor fiber boundary for generic hyperplane arrangements in $\mathbb{C}^3$ ····· 15

Summary: A finite set of linear hyperplanes in a complex vector space is called a hyperplane arrangement. A hyperplane arrangement defines a variety with a non-isolated singularity at the origin. In this talk, we study the first homology group of the Milnor fiber boundary of a generic hyperplane arrangement in $\mathbb{C}^3$ and prove it is combinatorially determined. This gives the affirmative answer to the conjecture of Suciu.

18 Masato Tanabe (Hokkaido Univ.) Immersions of surface singularity links and their topology ····· 10

Summary: A surface singularity in complex 3-space defines a closed orientable 3-manifold, known as the link or the Milnor fiber boundary, in a small 5-sphere centered at the singularity itself. The inclusion map of this 3-manifold into the 5-sphere can be considered as an immersion. In this talk, we determine the regular homotopy class of the inclusion map by computing a complete invariant which was introduced by Wu and Saeki–Szűcs–Takase. Furthermore, for each singularity of type ADE, we demonstrate the regular homotopicity between the inclusion map and Kinjo's immersion.

19 Noboru Ogawa (Tokai Univ.) Toru Yoshiyasu (Kyoto Univ. of Edu.) Suspension configuration of Liouville domains and compressibility of contact manifolds ····· 15

Summary: Inspired by Huang's work, we studied the compressibility of contact manifolds and the suspension configuration of Liouville domains. We show that compressible contact manifolds are tight. If time permits, we will also discuss some new concrete examples and applications.

20 Masaki Taho (Univ. of Tokyo) Tangent spaces of diffeological spaces and their variants ····· 15

Summary: Several methods have been proposed to define tangent spaces for diffeological spaces. Among them, the internal tangent functor is obtained as the left Kan extension of the tangent functor for manifolds. However, the right Kan extension of the same functor has not been well-studied. In this paper, we investigate the relationship between this right Kan extension and the external tangent space, another type of tangent space for diffeological spaces. We prove that by slightly modifying the inclusion functor used in the right Kan extension, we obtain a right tangent space functor, which is almost isomorphic to the external tangent space. Furthermore, we show that when a diffeological space satisfies a favorable property called smoothly regular, this right tangent space coincides with the right Kan extension mentioned earlier.

21 Hiroyuki Hayashi (Kobe Univ.) Geometry on curves passing through Whitney umbrella ····· 15

Summary: Whitney umbrella is a singularity which appears most frequently on surfaces. To study differential geometry on a surface, a unit normal vector plays a central role. However, a unit normal vector on Whitney umbrella is not extended. We show that we can extend a unit normal vector beyond a Whitney umbrella if we consider a curve passing through Whitney umbrella. We then study geometry by using invariants defined by a Darboux frame consisting of smoothly defined unit normal and tangent vectors along a curve passing through Whitney umbrella. We also give geometric meanings of the invariants.

22 Tadashi Fujioka (Osaka Univ.) On the stratification of spaces with curvature bounded below ····· 15

Summary: We prove that the extremal stratification of an Alexandrov space defines a CS structure in the sense of Siebenmann. An Alexandrov space is a metric space with sectional curvature bounded below in the generalized sense. The extremal stratification is a decomposition of an Alexandrov space into its geometrically singular sets. The CS structure is a type of topological stratification, i.e., a decomposition of a topological space into topological manifolds of different dimensions. The main theorem improves an earlier result of Perelman–Petrunin, who introduced the extremal stratification.

23 Chong Zheng (Waseda Univ.) On the connectedness homomorphism between discrete Morse complexes ····· 15

Summary: Given two discrete Morse functions on a simplicial complex, we introduce the *connectedness homomorphism* between the corresponding discrete Morse complexes. This concept leads to a novel framework for studying the connectedness in discrete Morse theory at the chain complex level. In particular, we apply it to describe a discrete analogy to 'cusp-degeneration' of Morse complexes. A precise comparison between smooth case and our discrete cases is also given.

September 6th (Fri) Conference Room IX

9:30–12:00

24 Jun Murakami (Waseda Univ.) On the volume conjecture for double twist knots ····· 15

Summary: A proof of the volume conjecture for double twist knots are proposed by using the relation between the $\mathrm{SL}(2,\mathbb{C})$ representation of the fundamental group of the complement and the complexified tetrahedron which is newly introduced. The relation between the colored Jones polynomial and the ADO invariant are also used.

Summary: In this talk, we provide a volume presentation of a hyperbolic fibered knot using the Bell polynomials. More precisely, we show that the hyperbolic volume of a fibered knot can be expressed in terms of the traces of powers of a monodromy matrix. We also explain that the hyperbolic volume of the figure-eight knot is obtained by the asymptotics of a positive integer sequence consisting of the special values of the twisted Alexander invariants.

Summary: We construct a family of Montesinos knots as an extension of symmetric unions. Each Montesinos knot consists of three rational tangles with slopes p/q, -b/a, and b/a where q is even. The Alexander polynomial of each of these knots becomes the product of the Alexander polynomial of the numerator of the rational tangle with the slope p/q and the square of the Alexander polynomial of the denominator of the rational tangle with b/a. Moreover, there is an epimorphism from the knot group of these Montesinos knots to the knot group of the denominator of the rational tangle with b/a whose image of the longitude of these Montesinos knots is trivial.

Summary: Using the notion of Fox $\mathbb{Z}$-colorings, we define 12 equivalence relations on $\mathbb{Z}^m$ for an integer $m \geq 2$. In this talk, we completely characterize these 12 equivalence relations by introducing several invariants of Fox $\mathbb{Z}$-colorings.

Summary: A doubly periodic tangle is the lift of a link in the thickened torus by the universal covering. Then this link is called a motif of a doubly periodic tangle. To investigate doubly periodic tangles, it is necessary to consider relations between finite coverings and isotopies of links in the thickened torus. In this presentation, we show two results. If two links in the thickened torus have isotopic lifts in a common finite covering, then they are isotopic. A non-split doubly periodic tangle has a unique minimal motif. To prove these, we use the standard decomposition of the complement of a link.

Summary: The free action of the quaternion group Q_8 on the 3-sphere S^3 induces the spherical 3-manifold S^3/Q_8. The manifold S^3/Q_8 is covered by the lens space $L(4,1)$ in three ways. A link in S^3/Q_8 has three different lifts in $L(4,1)$ in general. However, their lifts in S^3 coincide. In fact, we obtain infinitely many triples of hyperbolic links in $L(4,1)$ such that the three lifts of each triple in S^3 are isotopic.

30 Koki Yanagida (Tokyo Tech) The Dijkgraaf–Witten invariant in topological K-theory ····· 15

Summary: Given a finite group G, we define a new invariant of odd-dimensional oriented closed manifolds and call it the KDW invariant. This invariant is the Dijkgraaf–Witten invariant in terms of K-homology. In this paper, we compute the KDW invariants of some Brieskorn homology spheres with $G = \mathrm{PSL}(\mathbb{F}_p)$ without 2-torsion. We should remark that, in these computational results, both the fundamental groups of the Brieskorn homology spheres and $\mathrm{PSL}(\mathbb{F}_p)$ are not nilpotent. In the previous studies, there have been no computational results of the Dijkgraaf–Witten invariants in cases where both the fundamental groups of manifolds and finite groups are not nilpotent.

31 Chihaya Jibiki (Tokyo Tech) Construction of isolated orders using properties of $\mathrm{Isom}_+(\mathbb{H}^2)$ ····· 15
Shuhei Maruyama (Kanazawa Univ.)

Summary: This talk is about circular orders on groups. It follows from a dynamical realization that every circular order can be realized as an orientation preserving homeomorphism action on S^1. On certain subgroups of $\mathrm{Isom}_+(\mathbb{H}^2)$, the action can be extended on $\mathbb{H}^2$. By using this action, we constructed isolated orders on the groups. The talk is mainly based on a joint work with Shuhei Maruyama.

14:20–16:50

32 Tsukasa Ishibashi (Tohoku Univ.) Skein and cluster algebras with coefficients for unpunctured surfaces
Shunsuke Kano (Tohoku Univ.) ····· 10
Wataru Yuasa (Kyoto Univ.)

Summary: We propose a skein model for the quantum cluster algebras of surface type with coefficients. We introduce a skein algebra $\mathscr{S}^A_{\Sigma,\mathbb{W}}$ of a *walled surface* $(\Sigma, \mathbb{W})$, and prove that it has a quantum cluster structure. The walled surfaces naturally generalize the marked surfaces with multi-laminations, which have been used to describe the quantum cluster algebras of geometric type for marked surfaces by Fomin–Thurston.

33 Takuya Sakasai (Univ. of Tokyo) Matrix representations for groups of Kim–Manturov ····· 10
Yuuki Tadokoro
(Kisarazu Nat. Coll. of Tech.)
Kokoro Tanaka (Tokyo Gakugei Univ.)

Summary: We construct matrix representations for groups of Kim–Mantorov Γ^4_n. As a corollary, we show that the group Γ^4_n is non-commutative for $n \geq 6$.

34 Hajime Kubota (Kyoto Univ.) On the knot concordance invariant Upsilon using grid homology ····· 15

Summary: The Upsilon invariant is a knot concordance invariant in knot Floer homology. Földvári defined the grid Upsilon invariant using grid homology and proved some properties known in knot Floer homology. I gave another formulation of the grid Upsilon invariant and proved that it is a concordance invariant. In this talk, I will show that the grid Upsilon invariant coincides with the Upsilon invariant in knot Floer homology and that the grid Upsilon invariant behaves additively under connected sums.

35 Yuichi Yamada (Univ. of Electro-Comm.) Exceptional Dehn surgeries along a certain family of two component links ····· 10

Summary: A hyperbolic 3-manifold that has a torus boundary component can change to a non-hyperbolic 3-manifold by filling the boundary by a solid torus. Such surgeries are called exceptional Dehn surgeries. We study the distribution of integral exceptional Dehn surgeries along a certain family of two component links, related 4-dimensional rational blow-down.

Summary: Berge discovered ten families of lens space surgeries over the 3-sphere, in the 1990s. In 2006, the second speaker found twenty families of lens space surgeries over the Poincare homology sphere. These results from the fact that many well-known lens space surgeries are yielded by surgeries of simple (1,1)-simple knots in lens spaces. Indeed, in 2009, and 2023, these families were characterized as lens spaces constructed by Dehn surgery over the 3-sphere or the Poincare homology sphere by Greene and Caudell respectively. This talk will reveal candidates of lens space surgeries over homology spheres with Casson invariant -2 or -3 by using surgeries over (1,1)-simple knots in lens spaces.

Summary: It is known that every compact smooth 4-manifold X admits a (relative) trisection, which is a decomposition of X into three 4-dimensional 1-handlebodies intersecting along a compact surface. In this talk, we show that there exists a 4-manifold with a boundary that admits two non-diffeomorphic minimal genus relative trisections. To prove this, we use a simple operation that produces a trisection diagram of a closed 4-manifold from a relative trisection diagram.

Summary: A trisection is roughly a decomposition of a closed, oriented, smooth 4-manifold into three 4-dimensional 1-handlebodies. As an extension of a trisection, Islambouli and Naylor introduced a multisection or n-section which is a decomposition of a closed, oriented, smooth 4-manifold into n 4-dimensional 1-handlebodies for $n \geq 3$. when $n = 2$, it is called a bisection. Islambouli proved, using a Nielsen equivalent, that for any integer $n \geq 2$, there exist 4-manifolds with non-isotopic $(3n, n)$-trisections of minimal genus. In this talk, we report that for any integer $n \geq 2$, there exist 4-manifolds with non-isotopic $(2n, n)$-bisections of minimal genus. We also introduce a similar result for 4-sections.

Summary: Charts are oriented labeled graphs in a disk. A chart represents an oriented closed surface embedded in 4-space. For each label m, we denote by Γ_m the subset of a chart Γ consisting of edges of label m. For any subset X of Γ, we denote by $w(X)$ the number of white vertices in X. In this talk, we show the following.
Let Γ be a chart. If Γ is a chart of type $(m; 2, 4, 2)$ (In other words, there exists label m such that $w(\Gamma_m \cap \Gamma_{m+1}) = 2, w(\Gamma_{m+1} \cap \Gamma_{m+2}) = 4, w(\Gamma_{m+2} \cap \Gamma_{m+3}) = 2, w(\Gamma) = 8$), and if Γ is a minimal chart, then there does not exist any lens of Γ of type 2. Here, a lens is a disk D such that ∂D contains exactly two white vertices and $\partial D \subset \Gamma_m \cup \Gamma_{m+1}$ for some label m and D satisfies some conditions.

Summary: In 1983, Rudolph introduced braided surfaces as a generalization of braids. He showed that every properly embedded orientable surface with boundaries in a 4-ball is ambiently isotopic to a braided surface if and only if it is ribbon. In this talk, we generalize this concept and introduce knitted surfaces, using knits. Here, knits are a generalization of braids by J. Murakami. We show that every properly embedded surface with boundaries in a 4-ball is ambiently isotopic to a knitted surface.

Infinite Analysis

September 3rd (Tue) Conference Room VIII

9:30–10:35

1 Satoshi Tsuchimi (Kobe Univ.) A multivariate analogue of the Zwegers' μ-function ····· 15
Genki Shibukawa (Kobe Univ.)

Summary: In this talk, we introduce a multivariable μ-function from the view of q-difference equations, and present some properties satisfied by the multivariable μ-function such as symmetries and mock modularity relations.

2 Genki Shibukawa (Kobe Univ.) A generalization of "summatio quarumdam serierum singularium" and specialization of the generalized μ-function ····· 15

Summary: We give a generalization of certain Gauss' summation (special values of q-Bessel function) formulas, and as an application, derive explicit formulas for some specializations of the generalized μ-function.

3 Yumi Arai (Ochanomizu Univ.) On q-middle convolution and q-hypergeometric equations, I ····· 15
Kouichi Takemura (Ochanomizu Univ.)

Summary: Sakai and Yamaguchi introduced a q-deformation of the middle convolution some time ago. Motivated by applications to special functions, we reformulate the q-middle convolution and the associated q-integral transformations. We obtain a better description of additivity on composition of the q-middle convolution by our reformulation.

4 Yumi Arai (Ochanomizu Univ.) On q-middle convolution and q-hypergeometric equations, II ····· 15
Kouichi Takemura (Ochanomizu Univ.)

Summary: We show some examples of the composition of q-middle convolution by using the reformulated q-middle convolution.

10:45–11:45 Talk Invited by Infinite Analysis Special Session

Takahiko Nobukawa (Kobe Univ.) ${}_{10}W_9$, ${}_8W_7$ and variant of ${}_2\varphi_1$ as democratic q-hypergeometric equations

Summary: In this talk, we first study the variant of q-hypergeometric equation for ${}_2\varphi_1$ defined by Hatano–Matsunawa–Sato–Takemura (Funkcial. Ekvac., 2022). We give Euler type integral solutions, series solutions in terms of very-well-poised q-hypergeometric series ${}_8W_7$ for the equation, and connection formulas for these solutions. Second, we introduce a similar extension of the q-hypergeometric equation for ${}_3\varphi_2$. We construct Euler type integral solutions and series solutions in terms of ${}_{10}W_9$ for the equation. These results are obtained using the democratic viewpoint. Here the word "democratic" means that every point can be treated equally.

September 4th (Wed) Conference Room VIII

9:30–10:30

5 Kohei Yamaguchi (Nagoya Univ.) Equivariant K-homology of affine Grassmannian ····· 15

Summary: Let G be the special linear group $SL_n(\mathbb{C})$, and let T be its maximal torus. This study focuses on the T-equivariant K-homology ring $K_*^T(\mathrm{Gr}_G)$ of the affine Grassmannian Gr_G of G. In this talk, I would like to outline two realizations of $K_*^T(\mathrm{Gr}_G)$. One is the realization through the algebra $\hat{\Lambda}_G^{R(T)}$, which is spanned by the "double K-k-Schur functions" representing Schubert classes. The other is the realization through the coordinate ring $\mathcal{O}(\mathcal{Z}_{G^\vee})$ of the affine variety $\mathcal{Z}_{G^\vee}$ over T determined by $G^\vee = \mathrm{PGL}_n(\mathbb{C})$. This talk is based on joint work with Takeshi Ikeda, Shinsuke Iwao, Satoshi Naito, and Mark Shimozono.

6 Yosuke Kawamoto (Okayama Univ.)
Alexander Bufetov
(Steklov Math. Inst. of RAS, etc.)
The intertwining property for Laguerre processes with a fixed parameter 15

Summary: We investigate the intertwining of Laguerre processes of parameter α in different dimensions. We introduce a Feller kernel so that intertwines the α-Laguerre process in $N+1$ dimension and that in N dimension. When α is a non-negative integer, this kernel is interpreted in terms of the conditional distribution of the squared singular values: if the singular values of a unitary invariant random matrix is fixed, then the those of its truncation matrix are given by the new kernel.

7 Akito Tatekawa (Meiji Univ.)
Calculating the energy functions of diamond lattices of general dimensions as a generalization of the Kitaev model 10

Summary: The Kitaev model is an exactly solvable model of a spin 1/2 system on a honeycomb lattice. The purpose of this talk is to describe energy functions of diamond lattices of general dimensions as a generalization of the Kitaev model. The diamond lattices of general dimensions are defined by the A_d-crystal. We describe the Hamiltonian by means of Majorana operators based on the Clifford algebra. Then we express the energy function as eigenvalues of the Hamiltonian by using the discrete Fourier transform. For this calculation we make use of a method of a base graph developed by Sunada in the framework of topological crystallography. We show that the energy function is identified with the one appearing in the tight biding model of diamond lattices of general dimensions.

8 Tetsu Masuda (Aoyama Gakuin Univ.)
Stieltjes type relations for the Umemura polynomials of the fifth Painlevé V equation 15

Summary: We present some relations of Stieltjes type satisfied by the zeros of the Umemura polynomials which arise associated with the rational solutions to the fifth Painlevé V equation.

10:45–11:45 Talk Invited by Infinite Analysis Special Session

Atsushi Nakayashiki (Tsuda Coll.)
Quasi-periodic solutions of the KP-hierarchy and vertex operator

Summary: The KP-hierarchy is the infinite system of differential equations containing the Kadomtsev-Petviashvili (KP) equation as a part. The vertex operator of the KP-hierarchy transforms one solution to another one. Quasi-periodic solutions of the KP-hierarchy are those described by theta functions of non-singular algebraic curves. We apply the vertex operators to quasi-periodic solutions and study their properties. Such solutions had appeared in the study of limits of quasi-periodic solutions. We show, in general, that solutions thus obtained correspond to singular algebraic curves and rank one torsion free sheaves on them. We use the Sato Grassmannian for this purpose. We also show that the solutions obtained here are considered as solitons on quasi-periodic backgrounds.