Final: 2023/8/21

The Mathematical Society of Japan

2023 Autumn Meeting

Titles and Short Summaries of the Talks

September, 2023

at Tohoku University

2023 The Mathematical Society of Japan

AUTUMN MEETING

Dates: September 20th (Wed)–23rd (Sat), 2023

Venue: Tohoku University
6–3 Aramaki Aza-Aoba, Aoba-ku
Sendai, 980-8578, Japan

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The Mathematical Society of Japan

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Plenary Talks

September 21st (Thu) Tohoku University Centennial Hall Kawauchi Hagi Hall

Autumn Prize Winner ····· (15:30–16:30)

Shuji Saito (Univ. of Tokyo) Recent progresses on motivic cohomology ····· (16:45–17:45)

Summary: A quest for theory of *motivic cohomology* dates back to work of Grothendieck and early days of algebraic geometry. Beilinson gave a precise conjectural framework for such hoped-for theory. For *any quasi-compact and quasi-separated (qcqs for short) scheme* X, it foresees the existence of a spectral sequence degenerating after $\otimes_{\mathbb{Z}}\mathbb{Q}$:

$$E_2^{p,q} = H^{p-q}_{\mathcal{M}}(X, \mathbb{Z}(-q)) \Rightarrow K_{-p-q}(X) \tag{1}$$

whose E_2-terms are motivic cohomology of X converging to the homotopy groups of the algebraic K-theory spectrum $K(X)$ of X introduced by Quillen, Waldhausen, Thomason and others. It is defined using the exact category of perfect complexes on X which may be replaced by vector bundles if X is quasi-projective over an affine scheme. The spectral sequence (1) may be viewed as an algebraic analog of the classical Atiyah–Hirzebruch spectral sequence relating the topological K-theory of a topological space to its singular cohomology.

When X is smooth separated of finite type over a field k, the right answer was provided by two constructions: One is Bloch's higher Chow groups $\mathrm{CH}^r(X, n)$, where $\mathrm{CH}^r(X, 0)$ is the classical Chow group of codimension r-cycles modulo rational equivalence. Another is due to Suslin–Voevodsky and both are given in terms of algebraic cycles. The equivalence of two constructions was established by Voevodsky and it provides the motivic complex $\mathbb{Z}(n)^{sm}$ as a presheaf of complexes of abelian groups on the category Sm_k of smooth schemes separated of finite type over a field k. Defining the motivic cohomology $H^i_{\mathcal{M}}(X, \mathbb{Z}(n))$ as the i-th cohomology group of $\mathbb{Z}(n)^{sm}(X)$, which coincides with $\mathrm{CH}^{2n-i}(X, n)$ by definition, the spectral sequence (1) was established by Friedlander–Suslin and Levine.

In an attempt to extend the theory of motivic complexes from Sm_k to the category $\mathsf{Sch}^{\mathrm{ft}}_k$ of separated schemes of finite type over k, Voevodsky used a Grothendieck topology called the *cdh topology*. It is such a topology with respect to which every $X \in \mathsf{Sch}^{\mathrm{ft}}_k$ is "locally smooth over k". Voevodsky considered the cdh cohomology groups

$$H^i_{cdh}(X, \mathbb{Z}(n)^{cdh}) \text{ for } X \in \mathsf{Sch}^{\mathrm{ft}}_k,$$

where $\mathbb{Z}(n)^{cdh}$ is the cdh-sheafication of the left Kan extension of $\mathbb{Z}(n)^{sm}$ along the inclusion $\mathsf{Sm}_k \to \mathsf{Sch}^{\mathrm{ft}}_k$. Unfortunately, it does not gives a right motivic cohomology since the above cohomology group is always $\mathbb{A}^1$-invariant while $K(X)$ is not in general.

Now, about 20 years have passed since the spectacular success on motivic cohomology of smooth schemes over a field. Recently, there have emerged two independent constructions of motivic complex $\mathbb{Z}(n)(X)$ for an arbitrary qcqs scheme X over a field k. One is due to Elmanto–Morrow: A basic idea is to modify $\mathbb{Z}(n)^{cdh}$ by using *Hodge-completed derived de Rham complexes* (in case $\mathrm{ch}(k) = 0$) and *syntomic complexes* (in case $\mathrm{ch}(k) > 0$) constructed first by Bhatt–Morrow–Scholze using topological cycle homology and later by Bhatt–Scholze using prismatic cohomology. Another construction is due to Shane Kelly and myself: We introduce a new Grothendieck topology called the *pro-cdh topology* to define the motivic complex as the pro-cdh sheafication of the left Kan extension of $\mathbb{Z}(n)^{sm}$. Proving its basic properties (a description of points (or fiber functors) of the pro-cdh topos, the conservativity of the family of points and finiteness of cohomological dimension), it is shown that two constructions coincide if X is noetherian.

Featured Invited Talks

September 20th (Wed)

Conference Room I

Katsunori Iwasaki (Hokkaido Univ.) Hypergeometric groups and dynamics on K3 surfaces ····· (13:00–14:00)

Summary: This talk concerns a simple question: What happens if we put the following two topics together? One is hypergeometric groups due to Beukers and Heckman, and the other is dynamics on K3 surfaces due to McMullen, which are seemingly quite unrelated subjects. A hypergeometric group is a matrix group modeled on the monodromy group of a generalized hypergeometric differential equation, a natural extension to a higher rank of the Gauss hypergeometric equation. Hypergeometric groups contain a wide variety of finite groups as well as of infinite ones. While the original motivation of Beukers and Heckman was mainly in the classification of finite hypergeometric groups, our primary interest here is in infinite hypergeometric groups and their applications. K3 surfaces are an interesting class of compact complex surfaces, named by Weil after Kummer, Kähler and Kodaira (and K2, the second-highest peak on the Earth). McMullen was able to synthesize examples of K3 surface automorphisms with Siegel disks. Here a Siegel disk is a type of invariant set which is of interest in complex dynamics. If a K3 surface X admits an automorphism $f : X \to X$ with a Siegel disk, then X must be non-projective, that is, transcendental, and f must have positive topological entropy. In the talk we explain how infinite hypergeometric groups and lattices associated with them — hypergeometric lattices — are used to produce a lot of transcendental K3 surface automorphisms of positive entropy, especially ones with Siegel disks. This talk is based on a joint work with Yuta Takada.

Conference Room II

Tomohiro Okuma (Yamagata Univ.) Analytic invariants of complex surface singularities ····· (13:00–14:00)

Summary: A normal complex surface singularity is locally homeomorphic to a cone over a closed real 3-manifold called the link of the singularity, and the link is determined by the resolution graph. For a given topological type, namely a resolution graph, there are various types of complex structures that realize the graph and even fundamental analytic invariants vary in general. I am interested in problems to give a topological bound for those analytic invariants and to determine them for singularities with some nice properties. I will talk about some topics related to those problems.

Conference Room IX

Guest Talk from Korean Mathematical Society

Jaeyoung Byeon (KAIST) Prescribed Lorentzian mean curvature hypersurfaces and the Born–Infeld model ····· (13:00–14:00)

Summary: We are interested in spacelike graphs over the domain in Minkowski space with a given Lorentzian mean curvature ρ and Dirichlet boundary condition on the boundary. The graph function also represents the electric potential generated by a charge ρ in electrostatic Born–Infeld's theory. Even though it has a variational formulation, it is not easy to see the existence of a solution for a corresponding Euler Lagrange equation since the corresponding energy functional is not differentiable at functions with the supremum of gradient norm 1.

I would like to introduce some recent studies on the solvability for general sources ρ in a measure space and a critical point theory for nonlinear sources. This presentation is based on the cowork with Norishisa Ikoma, Andrea Malchiodi and Luciano Mari.

September 22nd (Fri)

Conference Room I

Kazuhiro Kuwae (Fukuoka Univ.) Analysis and geometry on metric measure spaces having curvature lower bounds ····· (13:00–14:00)

Summary: I will give a survey talk on the analysis and geometry on metric measure spaces having curvature lower bounds. Such a space was initiated by famous statistician A. Wald (1935). After Wald's work, in 1951, A.D. Alexandrov formulated the notion of metric space by comparing the geodesic triangle in two dimensional space form with constant curvature. Such a space is called Alexandrov space. By Toponogov theorem, any complete Riemannian manifolds with sectional curvature lower bounds is an Alexandrov space. M. Gromov (1981) invented the notion of Gromov–Hausdorff distance between isometric class of compact metric space. Then Alexandrov space naturally appears as a limit by Gromov–Hausdorff convergence of compact Riemannian manifolds with sectional curvature lower bounds. So it can be thought as a generalization of complete Riemannian manifolds with sectional curvature lower bound. In 1994, Otsu–Shioya construct the notion of Rimannian metric tensor for Alexandrov space, which was utilized by Kuwae–Machigashira–Shioya (2001) to construct a strongly local regular Dirichlet forms, L^2-Laplacian, Sobolev spaces, and heat kernels on Alexandrov spaces. The following natural question is raised: What is a natural generalization of complete Riemannian manifolds with Ricci curvature lower bounds? In 1987, Bakry formulated the notion of Ricci curvature lower bound as a generalization of Bochner inequality in terms of symmetric diffusion processes. His notion is now called Bakry–Émery condition. Around 2000, new notion of curvature lower bounds was proposed by Lott–Villani–Sturm, so-called the metric measure space satisfying curvature dimension condition (CD in short). Their spaces include not only Riemannian manifolds but also Finsler manifolds, so the Laplacian may not be linear. After 2014, Ambrosio–Gigli–Savaré invented the infinitesimal Hilbertian condition for metric measure space and call CD space under such a condition, RCD-space (metric measure space having Riemannian curvature dimension condition). Very recently, RCD-space is generalized in terms of Dirichlet space, so-called the tamed Dirichlet space, which is formulated as the generalization of Bakry–Émery curvature lower bound condition for strongly local Dirichlet forms having distributional Ricci curvature lower bound.

Conference Room IX

Fumio Hiai (Tohoku Univ.*) Data-processing inequalities and their equality conditions in quantum information ····· (13:00–14:00)

Summary: Different types of quantum divergences have played many roles in quantum information theory so far. The most used and notable one is the relative entropy introduced in 1962 by Umegaki, whose generalizations are standard f-divergences and quasi-entropies. The alpha-z-Rényi divergence is a Rényi type divergence with two parameters alpha, z. Its special cases are the standard Rényi divergence and the sandwiched Rényi divergence, having operational interpretations in the context of quantum hypothesis testing. Another type of quantum quantity is the monotone metric introduced in 1996 by Petz, which plays an important role in study of quantum information geometry. The most significant property common to those quantum divergences is the monotonicity under quantum channels (i.e., trace-preserving and completely positive maps), also called the data-processing inequality (DPI). The present talk is aimed at giving a survey of DPIs for the above mentioned quantum divergences in the finite-dimensional setting, with stress on their equality cases characterizing sufficiency and reversibility of quantum channels for given quantum states. A recent development of approximate recoverability of quantum channels is also touched briefly.

September 23rd (Sat)

Conference Room I

Koichi Nagano (Univ. of Tsukuba) Geometric topology of metric spaces with upper curvature bounds ····· (13:00–14:00)

Summary: We focus on geometry of metric spaces with upper curvature bounds. In the middle of 1980s, M. Gromov formulated the definition of CAT(κ) spaces named in honor of E. Cartan, A. D. Alexandrov, and V. A. Toponogov. A CAT(κ) space means a complete geodesic metric space with curvature globally bounded above by κ. A metric space is said to be CBA (Curvature Bounded Above) if it is locally CAT(κ) for some κ. We present an overview of recent developments on geometry of CBA spaces from viewpoints in geometric topology. While looking back on studies in geometric topology, we discuss topological regularity and topological singularity of CBA spaces as topics in global Riemannian geometry.

Conference Room IX

Shinnosuke Okawa (Osaka Univ.) Noncommutative algebraic geometry ····· (13:00–14:00)

Summary: Derived category of coherent sheaves on algebraic varieties, and more general (enhanced) triangulated categories arising from other mathematical objects, have been very actively studied in recent years. The word 'Noncommutative Algebraic Geometry' loosely refers to such vast and interdisciplinary research area in mathematics. In this talk I will give a gentle introduction to the subject. If time permits, I will explain applications to deformation quantizations of del Pezzo surfaces.

Foundation of Mathematics and History of Mathematics

September 22nd (Fri) Conference Room VI

9:20–10:30

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

Summary: Japanese mathematicians in pre-modern Japan expressed the final equation as a vector of coefficients. However, in obtaining it, there were different methods of expression depending on the school. As one such example, we will discuss the treatment of the equations in the Oka Yukitada of the Takuma school. He expressed equations in the following three ways depending on the purpose. (1) Display all characters (Takuma style), (2) Organize and hide them in ascending order concerning a single character (Seki style), and (3) Sweep out and hide some characters of common factors in the coefficients of the equation (abbreviated expression).

2 Noriko Tanaka (Naragakuen Univ.)
Tsukane Ogawa (Yokkaichi Univ.)
Plane geometry solution devices in Oka Yukitada's "Kijutsu Kairohou" (A method to solve the path to create a formula) in the Takuma School ····· 15

Summary: Oka Yukitada (1791–) was a Japanese mathematician of the Takuma School in the pre-modern. This paper investigates the devices used in solving plane geometry problems in "Kijutsu Kairohou" (A method to solve the path to create a formula) by Oka Yukitada. There are many plane geometry problems from the Edo period, such as nearly 1,000 pieces of "Sangaku" in shrines and temples today. Oka's "Kijutsu Kairohou" is a valuable source that describes the calculation process and shows the thought process for solving the problems. The solution methods at that time included not only auxiliary lines but also folding figures and drawing auxiliary figures, which shows a sharp point of view and way of thinking about plane geometry.

3 Shunji Horiguchi
Relations between Murase Yoshiyasu general recurrence formula, general Newton method, and general Mandelbrot recurrence formula ···· 15

Summary: In 1673, Yoshimasu Murase derives recurrence formulas. We derive a general recurrence formula from these. This general recurrence formula leads to the general Newton's method and the general Mandelbrot's recurrence formula. These show the originality of Wasan (Japanese native mathematics developed in Japan in the Edo era (1603–1868:national isolation)).

4 Makoto Tamura (Osaka Sangyo Univ.)
On the methods by Wang Xiaotong for right triangles ····· 15

Summary: Wang Xiaotong explained a more complex methods for right triangles in the problems [15]–[20] of his book "Jigu Suanjing" (Continuation of Ancient Mathematical Classic) than Liu Hui's methods in the "Jiuzhang Suanshu" (The Nine Chapters on the Mathematical Art). In this talk, we will show proofs of some methods, classify their methods, and show Wang Xiaotong attained at most in some sense.

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

Antonia Karaisl (Waseda Univ.) Wasan 2.0: Building an online sangaku archive

Summary: The practice of dedicating sangaku, votive tablets presenting geometric problems in word and image, flourished in Japan throughout the Edo period. Although many exponents were destroyed thereafter, close to a thousand sangaku survive in shrines and temples to this day; additionally, many lost exponents are still documented in print. Even though presenting a fascinating example for a mathematical discourse developed apart from the West, the custom of sangaku is almost entirely unknown outside the country. Part of the problem may be of linguistic nature, aggravated by the geographic dispersion: although there have been attempts to collect sangaku online, there is not much material to date that would make the tradition collectively accessible to non-Japanese-speaking audience. My project plans to solve for this problem by building a bilingual, open-access online archive for all sangaku surviving in wood and print. In the first instance, this sangaku archive is an attempt to preserve a cultural heritage unique to Japan. Beyond that, the archive aspires to serve as an active research space in its own right, where images, questions and solutions can be freely annotated and shared. Where the original authors of sangaku tablets could rely on the footfall in temples and shrines to communicate with a larger audience, the online sangaku archive means to carry this idea forward and further by making the material accessible to scholars worldwide. My talk will elaborate on this idea in theory and practice to showcase how said tradition can be preserved in the 21st century in both matter and spirit.

12:00–12:15 Mathematics History Team Meeting

14:15–16:45

5 Nobu-Yuki Suzuki (Shizuoka Univ.) A supplementary note on a weak version of the existence property in intermediate predicate logics 15

Summary: A weak variant of the existence property in intermediate predicate logics is introduced. This property is a "double-negated" version of the existence property. Very basic results will be presented.

6 Tatsuya Shimura (Nihon Univ.) A generalization of Minari's theorem on disjunction property 15

Summary: In 1986, Minari proved the intermediate propositional logic axiomatized by Kreisel–Putnam's and Scott's axioms has the disjunction property. We give a series of admissible rules for the intuitionistic logic, which yields a genaralization of Minari's result. Our proof is based on syntactical proof by Kreise–Putnam and Sasaki.

7 Tatsuya Shimura (Nihon Univ.) Cut-elimination for the modal logic $\mathbf{K4Z}^{+}_{14}$ 15

Summary: We give a simple proof of the cut-elimination for the modal logic $\mathbf{K4Z}^{+}_{14}$, following Sasaki's proof for the provability logic **GL**.

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

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

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

Summary: The provability logic D, which was studied by Beklemishev (1999), is an intermediate logic between the provability logics GL and S. A Hilbert-style proof system for D is known, but there has been no sequent calculus. We establish two sequent calculi for D, and show cut-elimination theorems syntactically (for one calculus) and semantically (for both calculi). The syntactic proof is reduced to the cut-elimination for S by Kushida (2020). The semantical proofs are obtained by showing the completeness of cut-free sequent calculi.

Summary: The goal of this research is to find and prove nontrivial equations and inequalities on equilibria of AND-OR trees without assumptions on tree shapes. In particular, we prove that two equilibria of randomized directional algorithms coincide; one is "d" of Saks–Wigderson (1986) and the other is that of probability distributions on the deterministic depth-first directional algorithms. We also show that "a" of Saks–Wigderson (1986) is a lower bound of the equilibrium of randomized depth-first algorithms. This work was done in collaboration with Fuki Ito.

Summary: In the theory of algorithmic randomness, Solovay reducibility is a reducibility to compare the randomness of two real numbers. It has many good properties within the left-c.e. reals. This leads to the question: does a reduction similar to Solovay's exist that well-behaves even for non-left-c.e. reals? One such trial is a computable Lipschitz reducibility, or cL-reducibility, defined by restricting oracle use in Turing reduction. The cL-reducibility is named so because of adapting the concept of Lipschitz continuity for Cantor space. The signed-digit representation is a real number representation used in computable analysis. We characterize Solovay reducibility by replacing the usual binary representation in cL-reducibility with the signed-digit representation. This result answers the classical question in a much better way.

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

September 23rd (Sat) Conference Room VI

9:20–10:30

14 Yudai Suzuki (Tohoku Univ.) On the Π^1_2 part of Π^1_1-CA_0. 15
Keita Yokoyama (Tohoku Univ.)

Summary: It is known that there are some mathematical theorems which are expressed by Π^1_2 sentences and provable from Π^1_1-CA_0, but stronger than ATR_0. In general, such theorems are strictly weaker than Π^1_1-CA_0. In this study, we introduce an increasing sequence of Π^1_2 sentences that captures the Π^1_2 part of Π^1_1-CA_0. With this sequence, for any Π^1_2 sentence between ATR_0 and Π^1_1-CA_0, we can measure how far it is from Π^1_1-CA_0.

15 Hiroyuki Ikari (Tohoku Univ.) On Π^1_1-conservativeness between RT^2 and $\mathrm{B}\Sigma^0_3$ 15
Keita Yokoyama (Tohoku Univ.)

Summary: In this talk we overview a new proof of Π^1_1-conservativeness between RT^2 and $\mathrm{B}\Sigma^0_3$. It's well known that $\mathrm{COH}+\mathrm{D}^2_{<\infty}$ is equivalent to RT^2 (over RCA_0). Some basis theorems for RT^2 are proved by this decomposition. Carrying out this proof within a model of $\mathrm{WKL}_0+\mathrm{B}\Sigma^0_3$, we can prove a conservation result. Using effective coded ω-models of WKL_0, we see a proof of $\ll^2$-basis theorem for $\mathrm{D}^2_{<\infty}$. These discussions and results can give a new view point to conservation results, with help of a view point of some types of basis theorem. The contents are joint work with Keita Yokoyama.

16 Hisashi Aratake (Kyoto Univ.) On the class of models represented by sheaves 15

Summary: We consider the class $\Gamma(T)$ of structures represented by sheaves of T-models for a theory T. For example, while an arbitrary commutative ring can be represented by a sheaf of local rings via its Zariski spectrum, rings represented by sheaves of fields are characterized as von Neumann regular rings. Using machinery of categorical logic, we investigate the case when $\Gamma(T)$ is given by the image of an idempotent dual adjunction between the category of T_0-models (for some Horn theory $T_0 \subseteq T$) and the category of T-modelled spaces. In such a situation, we show that $\Gamma(T)$ is the closure of the class of T-models under limits and filtered colimits in the class of T_0-models.

17 Hirotaka Kikyo (Kobe Univ.) On cyclic automorphisms 15
Akito Tsuboi (Univ. of Tsukuba*)

Summary: We give a new proof that the following countable random structures have continuously many cyclic automorphisms: The random graph, the random tournament, and the random triangle-free graph. We also discuss about random hypergraphs and those structures with no cyclic automorphisms.

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

Kenta Tsukuura (Hosei Univ.) The quotients of Prikry-type forcings and Saturated ideals

Summary: Large cardinals are "large" in the sense that they are inaccessible. But successor cardinals sometimes have behavior like large cardinals, they appear as generic large cardinals. The notions of generic large cardinal axioms are widely used and considered in set theory. There are various formulations of generic large cardinal axioms, just as the definitions of large cardinal axioms have various expressions. One of them is Foreman's generalized large cardinal axioms. These axioms are frequently equivalent to the existence of precipitous ideals on some sets. Then our interest is reduced to forcing properties of ideals. In this talk, we introduce some problems of ideals over successors of singular cardinals and two strong tools to study them. One is "Prikry-type forcings", and the other is the duality theorem.

12:00–12:15 Research Section Assembly

14:15–16:30

18 Toshimichi Usuba (Waseda Univ.) Łoś's theorem without the axiom of choice ····· 15

Summary: We prove that, in ZF, Łoś's fundamental theorem of ultraproducts is equivalent to the following weak form: For every structure M, an ultrapower of M by some ultrafilter is elementary equivalent to M.

19 Rihito Takase (Kobe Univ.) Modal logic of provability and forcing ····· 15
Taishi Kurahashi (Kobe Univ.)

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

20 Yasushi Hirata (Kanagawa Univ.) Countable paracompactness and C^*-embeddings of closed discrete subsets in subspaces of products of ordinals ····· 15
Nobuyuki Kemoto (Oita Univ.)
Yukinobu Yajima (Kanagawa Univ.*)

Summary: In this talk, we discuss countable paracompactness and C^*-embeddings of closed discrete subsets in subspaces of products of ordinals. We show: it is consistent with and independent of ZFC that $(\omega + 1) \times \omega_1$ has a subspace which is not countably paracompact, and in which every closed discrete subset is C^*-embedded.

21 Tatsuya Goto (Kobe Univ.) Game theoretic variations of cardinal invariants ····· 15

Summary: Cardinal invariants play an important role in the set theory of reals. In this study, we consider game versions of some cardinal invariants.
For example, for a set $\mathcal{A}$ of sets of natural numbers, $\mathcal{A}$ is said to be a splitting family if for any infinite set X of natural numbers there exists $Y \in \mathcal{A}$ such that both $X \cap Y$ and $X \setminus Y$ are infinite sets. The splitting number is defined as the minimum of the cardinality of the splitting family. We considered two game-theoretic versions of the splitting number $\mathfrak{s}$ and showed that one of them is equal to $\mathfrak{s}_\sigma$, a cardinal invariant similar to $\mathfrak{s}$, and the other is equal to the continuum.
We also considered the bounding game, the reaping game, and the anti-localizing game.

22 Takashi Yamazoe (Kobe Univ.) Evasion number and Cichoń's diagram ····· 15

Summary: Cichoń's diagram is a table of ten representative cardinal numbers related to the set theory of the reals. Recently it was shown that there is a model of set theory called Cichoń's maximum where all the ten cardinal numbers in the diagram are separated. The evasion number $\mathfrak{e}$ is a cardinal number regarding functions on natural numbers. More specifically, $\mathfrak{e}$ is related to a prediction of a value of a function at some point from its values before the point and to an evasion from the prediction. Our ultimate goal is to add $\mathfrak{e}$ to the Cichoń's maximum. We showed that we can construct a model where nine cardinal numbers in Cichoń's diagram and $\mathfrak{e}$ are separated, which is highly close to our ultimate desired model.

Summary: "Cardinal characteristics" is a well-studied field in set theory. These characteristics are defined by combinatorial properties of reals, and useful for analyzing what happens the set of real $\mathbb{R}$, or the power set of $\aleph_0$.
In recent times, there are some results about generalizing cardinal characteristics to an appropriate cardinal λ. By studying these generalizations, we can indirectly understand the structure of the power set of λ.
We focus on $\mathfrak{d}_{\aleph_\omega}$, which is a generalization of the dominating number $\mathfrak{d}$ to $\aleph_\omega$. We introduce an useful condition for deriving the largeness of $\mathfrak{d}_{\aleph_\omega}$, and outline its applications.

Summary: Woodin introduced stationary tower forcings, and showed that the existence of large cardinals imply regularity properties of sets of reals in $L(\mathbb{R})$. For this result, it is known that we can derive regularity properties in $L(\mathbb{R})$ from certain conditions on stationary tower forcings, without explicit using of large cardinals such as Woodin cardinals. We investigate conditions on stationary tower forcings to derive the universally Baireness in $L(\mathbb{R})$, which is a stronger property than regularity properties. In this talk, we present such conditions and related properties of tower forcings.

Summary: Uniformizations of ladder system colorings has been introduced by analysis of a proof of the Shelah's solution of Whitehead problem. Shelah's proof can be separated into the following two theorems: $\mathsf{MA}_{\aleph_1}$ implies any ladder system coloring can be uniformized, and the uniformizations of ladder system coloring implies the existence of a non-free Whitehead group. In this talk, we give some implications from Todorčević's fragments of Martin's Axiom to variations of uniformizations of ladder system colorings.

Algebra

September 20th (Wed) Conference Room II

9:30–11:45

1 Kohichi Ohki (OK Lab. Co. Ltd.) Proof of Riemann hypothesis ····· 10

Summary: This lecture is almost the same content as that UP Loaded in No. 51 Lecture, 17 Sept. 2021, Fall General Sectional Meeting of the Math. Society of Japan @ Chiba Univ. The main differences are as follows. The title has been changed from the proof that the matrix is Hermitian to the proof of the Riemann Hypothesis. In fact, they are equivalent. The theorem 1,2 and 3 were also added to clarify the proof and to make the content more concise.

2 Daisuke Shiomi (Yamagata Univ.) A polynomial analogue of Girstmair's formulas ····· 10

Summary: For an odd prime p, Girstmair gave class number formulas for subfields of the pth cyclotomic field by using the coefficients of the digit expression of $1/p$. In this talk, we study an analogue of these formulas in polynomial rings.

3 Manabu Yoshida (Toyama Nat. Coll. of Tech.)
Shun'ichi Yokoyama (Tokyo Metro. Univ.)
On the computation of all extensions of a p-adic field of characteristic p ····· 15

Summary: We present an algorithm for the computation of defining polynomials for all extensions of a given degree with restricted ramification over a p-adic function field.

4 Wataru Takeda (Tokyo Univ. of Sci.) Existence of the solutions to the Brocard–Ramanujan problem for norm forms ····· 15

Summary: The Brocard–Ramanujan problem, which is an unsolved problem in number theory, is to find integer solutions (x, ℓ) of $x^2 - 1 = \ell!$. Many analogs of this problem are currently being considered. As one example, it is known that there are at most only finitely many algebraic integer solutions (x, ℓ), up to a unit factor, to the equations $N_K(x) = \ell!$, where N_K are the norms of number fields $K/\mathbf{Q}$. In this talk, we construct infinitely many number fields K such that $N_K(x) = \ell!$ has at least 22 solutions for positive integers ℓ.

5 Maozhou Huang (Tokyo Tech) On the ramification of the torsion points of Drinfeld modules ····· 15

Summary: For a localization K of a function field, the ramification of the extensions generated by torsion points of Drinfeld $\mathbb{F}_q[t]$-module over a local function field has been studied by various people. In this talk, I will discuss a theorem concerning the action of the ramification group on an $\mathbb{F}_q$-base of the space of the torsion points in a specific situation. I will also shed light on the generalization of the theorem.

6 Xuanzhong Dai (Kyoto Univ.)
Bailin Song (Univ. of Sci. Tech. of China)
Chiral de Rham complex and the Rankin–Cohen brackets ····· 15

Summary: It was speculated by W. Eholzer, Y. Manin and D. Zagier long time ago that the Rankin–Cohen brackets are related to vertex operator algebras. We will apply the chiral de Rham complex to the upper half plane, and show that the Rankin–Cohen brackets appear in the vertex operations of the invariant global sections. We will then show that the invariant vertex algebra with a relaxing of cuspidal conditions is simple, and generalize the Rankin–Cohen brackets to meromorphic modular forms according to the vertex algebra structure.

7 Masato Kobayashi (Kanagawa Univ.) Ramanujan differential equations, signed Eisenstein series, Hankel determinants 15

Summary: Ramanujan's differential equations are $qE_2' = \frac{E_2^2 - E_4}{12}$, $qE_4' = \frac{E_2E_4 - E_6}{3}$, $qE_6' = \frac{E_2E_6 - E_4^2}{2}$ for the classical Eisenstein series. The author (2023) proved certain signed analog of this and then derived Hankel determinants such as $\det(E^*_{2(i+j)})_{i,j=1}^3 = \frac{2^8\cdot 3^7}{17^3\cdot 19\cdot 31^2\cdot 43}(-308481E_4^{*6} + 191945E_4^{*3}E_6^{*2} + 116536E_6^{*4})\frac{E_4^{*3} - E_6^{*2}}{1728E_4^{*3}}$.

8 Tadaaki Igawa
Makoto Minamide (Yamaguchi Univ.)
Yoshio Tanigawa
On averages of indexes of congruence subgroups in the modular group II 10

Summary: Let $n \geq 1$ be any integer, $\Gamma_0(n)$ the Hecke subgroup of the modular group. We consider an error term $E_0(x)$ in the average of the index of $\Gamma_0(n)$. We deduce a formula for sum of $E_0(n)$ and an Ω-result for $E_0(n)$.

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

Masaya Yasuda (Rikkyo Univ.) Introduction to mathematical cryptography: Lattice-based and isogeny-based cryptography

Summary: Mathematical cryptography is an application of mathematics to cryptography. Recently, several mathematical theories have received interest to develop post-quantum cryptography (also called quantum-resistant cryptography) for the quantum computing era, such as lattices and isogenies over elliptic curves. In this talk, I briefly introduce the background of mathematical cryptography including post-quantum cryptography. I also introduce lattice-based and isogeny-based cryptography and their underlying mathematics. For lattice-based cryptography, its security is based on the computational hardness of solving lattice problems such as the shortest vector problem (SVP) and the closest vector problem (CVP). I introduce lattice basis reduction techniques to solve such lattice problems. For isogeny-based cryptography, its security is based on isogeny problems. I present a method of solving the supersingular isogeny problem via the Deuring correspondence.

15:30–18:00

9 Tomoyoshi Ibukiyama (Osaka Univ.*) Genus character L functions of quadratic orders in an adelic way 10

Summary: Let O be an order of a quadratic field K over $\mathbb{Q}$. We do not assume that O is maximal. Let $Cl^+(O)$ be the narrow ideal class group of proper ideal classes of O. The real valued character χ of $Cl^+(O)$ is called traditionally a genus character. The genus theory of such orders is well known since Gauss, Dirichlet, Dedekind etc. But explicit formulas for the L functions associated to χ are given only recently, first by Chinta and Offen for special cases and by Kaneko and Mizuno for the whole cases. Here we review the genus theory by adelic language and give an alternative proof of the above formula. This proof is considerably simpler than the original proof.

10 Yuta Katayama (Tokyo Univ. of Sci.) Hecke L-functions of certain subextensions in an extraspecial extension 15

Summary: In 1924, Hecke observed the coincidence of L-functions of quadratic fields. The precise conditions of the phenomena which Hecke observed were given in terms of Galois group of certain abelian extensions of quadratic fields by Kida and Namura. Furthermore, I and Kida studied the coincidence of cyclic extensions of prime degree and generalize the case of quadratic fields. I will talk about the coincidence of L-functions in more general case of elementary abelian extensions.

11 Shota Inoue (Tokyo Tech)
Junxian Li (Univ. Bonn)
Joint value distribution of Dirichlet L-functions in the strip $1/2 < \sigma < 1$ 15

Summary: The speaker will discuss the joint value distribution of Dirichlet L-functions in the strip $1/2 < \sigma < 1$. He will present results for dependence property and joint extreme values of Dirichlet L-functions.

Summary: The mean values of the Riemann zeta function have been studied for many years. As for the continuous mean values, big progress has been made. On the other hand, our knowledge of the discrete mean values is limited. Recently, Li and Radziwiłłrevealed that the twisted second moments of the Riemann zeta function over arithmetic progressions show a notable correspondence with the analogous continuous moment. In this talk, we will give the result of the second moments over arithmetic progressions without twists.

Summary: In this talk, we prove that an asymptotic formula on a prime number race for Fermat curves of odd prime degree is given under the Deep Riemann Hypothesis (DRH), which is a conjecture on the convergence of the partial Euler product on the critical line. We also obtain such asymptotics for some quotients of Fermat curves under DRH. As an application, we compute the order of zero at $s = 1$ for the second moment L-functions of these curves under DRH.

Summary: We extend Chebyshev's bias to algebraic curves, and investigate examples for Fermat curves of genus 3.

Summary: The multiple zeta functions are generalizations of the Riemann zeta function and have expressions in terms of confluent hypergeometric functions. These yield the functional equation for the multiple zeta functions. In this talk, we report the extension of the result to multiple L-functions.

Summary: It is known that there are many $\mathbb{Q}$-linear relations among multiple zeta values. In particular, the Kawashima relation is one of the families of relations expected to generate all $\mathbb{Q}$-linear relations among multiple zeta values. It can be described using the Taylor coefficients of the Kawashima function. In this talk, we generalize the multiple integrals, which have been studied for a long time in transcendental number theory, to give a multiple integral representation of the Kawashima function. Furthermore, we express the Taylor coefficients of the Kawashima function in terms of multiple zeta values with explicit indices.

Summary: In this talk, we consider q- and elliptic generalizations of the inversion formulas satisfied by multiple polylogarithms. We establish inversion formulas for functions $L_{\boldsymbol{k}}(\boldsymbol{a}, \boldsymbol{\alpha}; p, q)$, which can be considered to be common deformations of q- and elliptic multiple polylogarithms. By taking the trigonometric and classical limits in the main theorem, we obtain q- and elliptic analogues of the inversion formulas.

Summary: An algebraic theory, sometimes called an equational theory, is a theory defined by finitary operations and equations, such as groups and rings. It is well known that algebraic theories are equivalent to finitary monads on Set. In this talk, we generalize this phenomenon to locally finitely presentable (LFP) categories from the perspective of partial Horn logic. For each LFP category A, we define an "algebraic concept" relative to A, which will be called an A-relative algebraic theory, and show that A-relative algebraic theories are equivalent to finitary monads on A. Finally, we generalize Birkhoff's variety theorem from classical algebraic theories to our relative algebraic theories.

September 21st (Thu) Conference Room II

9:15–10:45

19 Tomohiro Iwami (Kyushu Inst. of Tech.) Recovering conductor condition of ($\mathbb{Q}$-)conic bundles via three-dimensional Miyaoka–Yau type inequality with the associated third Chern classes 15

Summary: Based on S. Mori's proof for an three-dimesnional extremal neighborhood $(X, C) \subset \mathbb{C}^4$ of type A, with irreducible and reduced C, in the existence of three-dimensional flips,thu author had studied for the case C not necessary irreducible nor reduced, denoted as $(X, C_s) \subset \mathbb{C}^4$, mainly as follows: 1) to find three-dimensional Miyaoka–Yau type inequality with the associated third Chern classes, abbreviated as $(\mathrm{MY})_{3,c_3}$ ([I2018Mar, I2019Sep, I2020Sep)]), 2) in order to study period space of $(\mathrm{MY})_{3,c_3}$,2a) to introduce an interemdiate Jacobians $\widetilde{IJ}(X, C_s)$ ([I2022Mar]), 2b) to study strong approximation of $\widetilde{IJ}(X, C_s)$ ([I2022Sep]), and to study double solid for it by introducing associated quaternion algebra data ([I2023Mar]). As succeeding our results, the author will report, as main results: i) to show a kind of "relativization" for [S. Mori–Y. Prokhorov, 2008, 2009, 2021] which removes conductor condition of [V. A. Iskovskikh, 1987], by recovering conductor condition via 1) amd 2), and ii) to give an alternative of [M. Artin–D. Mumford, 1972] via i), up to "relativization".

20 Masatomo Sawahara (Saitama Univ.) Cylindrical ample divisors on Du Val del Pezzo surfaces 13

Summary: A cylinder in an algebraic variety is its open subset, which is isomorphic to the direct product of the affine line and an algebraic variety. Letting X be a normal projective variety and H be an ample $\mathbb{Q}$-divisor on X, we can consider a special kind of cylinder in X depending on H, so-called an H-polar cylinder. Note that polarized cylinders in smooth del Pezzo surfaces are well studied. In this talk, we will construct an H-polar cylinder in a Du Val del Pezzo surface S of degree at least 3 for every ample $\mathbb{Q}$-divisor H on X.

21 Ken Sato (Tokyo Tech)♭ On higher Chow cycles on Kummer surfaces 15

Summary: The higher Chow group $\mathrm{CH}^p(X, q)$ introduced by Bloch is a generalization of the classical Chow groups. It satisfies many interesting properties, but its structure is still mysterious for almost all varieties when p is greater than 1. In this talk, I will explain the explicit construction of higher Chow cycles in $\mathrm{CH}^2(X, 1)$ on a family of Kummer surfaces. By computing their images under the Beilinson regulator map, in very general cases, these cycles generate at least rank 18 subgroup of $\mathrm{CH}^2(X, 1)_{\mathrm{ind}}$, which is the quotient of $\mathrm{CH}^2(X, 1)$ by the images of the intersection product maps. To compute the images under the regulator map, we use automorphisms of the family and the explicit description of the action of the automorphisms on the Picard–Fuchs differential equations of the family.

22 Kazuki Utsumi (Ritsumeikan Univ.) Mordell–Weil lattices of Inose surfaces 15

Summary: An elliptic $K3$ surface with two II^* fibers is called Inose surface. It is known that any Inose surface can be constructed as a double cover of a Kummer surface associated two elliptic curves. We give a method to find a section of an Inose surface corresponding to an isogeny of general degree between two elliptic curves.

23 Natsuo Saito (Hiroshima City Univ.)
Yoshiki Ohtsu (Setouchi High School)
Hiroyuki Ito (Tokyo Univ. of Sci.) On the Mordell–Weil group of some quasi-elliptic K3 surfaces 15

Summary: Ito classified rational quasi-elliptic surfaces in characteristic 2 and provided a detailed description of the structure of the Mordell–Weil group. In this talk, we focus on K3 surfaces with quasi-elliptic surface structures in characteristic 2. Specifically, we analyze the structure of the Mordell–Weil group of the quasi-elliptic surfaces which has 20 reducible fibers of the Kodaira-type III. Moreover, we demonstrate that a good code can be constructed from the surface we studied.

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

Sho Tanimoto (Nagoya Univ.) Exceptional sets in Manin's conjecture and their applications to algebraic geometry

Summary: Manin's conjecture is a conjectural asymptotic formula for the counting function of rational points on Fano varieties over global fields. When you count rational points, it is important to remove the contribution of rational points from exceptional sets so that the asymptotic formula reflects the global geometry of the underlying variety. With Brian Lehmann, I have been studying exceptional sets arising in this conjecture. In this talk I would like to discuss my joint work with Brian Lehmann and Akash Sengupta on birational geometry of exceptional sets, then I will discuss applications of this study to understand the geometry of moduli spaces of sections on Fano fibrations over a curve which is joint work with Brian Lehmann and Eric Riedl. The minimal model program and BAB conjecture (proved by Birkar) play essential roles in these studies.

13:00–14:15

24 Linghu Fan (Univ. of Tokyo)♭ Crepant resolution of $\mathbb{A}^4/A_4$ and its Euler number in characteristic 2 15

Summary: In characteristic 0, it is known that the quotient singularity $\mathbb{C}^4/A_4$ has a crepant resolution and by McKay correspondence, the topological Euler number of the crepant resolution is 4, which equals the number of conjugacy classes of the alternating group A_4. In this talk, we construct a crepant resolution of $\mathbb{A}^4/A_4$ in characteristic 2. By computing its topological Euler number, we obtain a new counterexample to the analog of McKay correspondence in positive characteristic.

25 Makoto Miura (Osaka Univ.) On the global connectedness of polytopes 15

Summary: In this talk, I plan to discuss an approach to determining whether a specific class of polytopes forms a connected category. The question is closely related to a famous unsolved question, posed by Miles Reid, which asks whether all smooth Calabi–Yau 3-folds are connected via a sequence of geometric transitions. I have already reported during MSJ Autumn Meeting 2022 that the category of reflexive or terminal polygons is connected. Hence, this time, I would like to focus on introducing examples and reporting on the latest developments aimed at generalizing this result to higher dimensions.

26 Hiroshi Sato (Fukuoka Univ.) Anti-flips of the blow-ups of the projective spaces at torus invariant points 10

Summary: We explicitly construct the smooth toric Fano variety which is isomorphic to the blow-up of the projective space at torus invariant points in codimension one by anti-flips.

27 Hirotaka Onuki (Univ. of Tokyo) On Fujita's freeness conjecture in mixed characteristic 15

Summary: Fujita's freeness conjecture predicts that for an ample line bundle $\mathscr{L}$ on an n-dimensional smooth projective variety X over $\mathbb{C}$, the adjoint bundle $\omega_X \otimes \mathscr{L}^{n+1}$ is globally generated. This conjecture holds if $\mathscr{L}$ is globally generated, and similar results are known in positive and mixed characteristics. Popa–Schnell generalized this globally generated case to the relative setting in characteristic zero, and Ejiri showed an analogous result in positive characteristic. In this talk, we discuss its analog in mixed characteristic.

28 Atsushi Noma (Yokohama Nat. Univ.) The number of the irreducible components of the locus of nonbirational projection centers 10

Summary: We work over an algebraically closed field of characteristic zero. For a nondegenerate projective variety $X \subseteq \mathbb{P}^N$, the locus of points from which X is projected nonbirationally onto its image, is called the *Segre locus* of X. The purpose here is to give an upper bound of the number of the irreducible components of the Segre locus of a projective variety in terms of its invariants.

September 22nd (Fri) Conference Room II

9:15–11:30

29 Sin Yi Tsang (Ochanomizu Univ.) A generalization of Ito's theorem to skew braces ····· 15

Summary: The famous theorem of Ito in group theory states that a group which is the product of two abelian subgroups is metabelian. We are able to generalize this to the setting of skew braces. In this talk, we shall first give a brief introduction of skew braces; they are algebraic objects introduced to study solutions to the quantum Yang–Baxter equation. We shall then explain the basic terminology needed in order to state our main theorem.

30 Kiyoto Yoshino (Hiroshima Inst. of Tech.) The Lemmens–Seidel conjecture for base size 5 ····· 15

Summary: In 1973, Lemmens and Seidel raised the so-called Lemmens–Seidel conjecture, and proved it for base size 6. In order to prove it, we need to show it for base sizes 3, 4 and 5. In 2020, Lin and Yu proved the conjecture for base size 3 with a computer, and claimed to prove it for base size 5. However, there is a gap. In 2022, Cao, Koolen, Lin and Yu proved the conjecture for base sizes 3 and 4 without a computer. In this talk, I show the conjecture for base size 5.

31 Hideya Watanabe (Osaka Metro. Univ.) On the stability of $\imath$canonical bases of locally finite type ····· 10

Summary: We prove the stability conjecture of $\imath$canonical bases, which was raised by Huanchen Bao and Weiqiang Wang in 2016, for all locally finite types. To this end, we characterize the trivial module over the $\imath$quantum groups of such type at $q = \infty$. This result can be seen as a very restrictive version of the $\imath$crystal base theory of locally finite type.

32 Hideya Watanabe (Osaka Metro. Univ.) A branching rule from $GL_{2n}(\mathbb{C})$ to $Sp_{2n}(\mathbb{C})$ arising from the representation theory of quantum symmetric pairs ····· 10

Summary: We provide a new branching rule from the general linear group $GL_{2n}(\mathbb{C})$ to the symplectic group $Sp_{2n}(\mathbb{C})$ by establishing an easy algorithm which gives rise to a bijection from the set of semistandard tableaux of a fixed shape to a disjoint union of several copies of the set of symplectic tableaux of various shapes. It arises from the representation theory of the quantum symmetric pair of type $A\mathrm{II}_{2n-1}$, which is a q-analogue of the classical symmetric pair $(\mathfrak{gl}_{2n}(\mathbb{C}), \mathfrak{sp}_{2n}(\mathbb{C}))$.

33 Toshitaka Aoki (Kobe Univ.)
Emerson Gaw Escolar (Kobe Univ.)
Shunsuke Tada (Kobe Univ.)
On interval global dimension of posets: a characterization of case 0 ····· 15

Summary: In topological data analysis, the persistence diagram captures the births and deaths of the topological features of data in a filtration. Algebraically, this can be understood using interval decompositions of representations of a finite totally ordered set (or a Dynkin quiver of type A) as guaranteed by Gabriel's theorem. In general, representations of a finite poset are not necessarily interval decomposable. In this work, we study the relative homological algebra of posets with respect to the intervals. We introduce our recent research exploring the properties of the supports of interval approximations and interval resolution global dimension. We also provide necessary and sufficient conditions on a poset to ensure that any representation is interval decomposable (interval resolution global dimension 0).

34 Yasuaki Gyoda (Univ. of Tokyo) Bijection between support τ-tilting modules of GLS path algebra and c-clusters in finite root system ····· 15

Summary: In 2006, Ingalls–Thomas discovered a bijective correspondence that preserves the graph structure between support tilting modules in representation-finite path algebras and c-clusters in simply-laced finite root systems. In this presentation, we extend path algebras to GLS path algebras, and report on the construction of a bijective correspondence that preserves the directed graph structure between support τ-tilting modules in GLS algebras and c-clusters in finite root systems that are not necessarily simply-laced.

35 Yuta Kozakai (Tokyo Univ. of Sci.) On the induction/restriction of support τ-tilting modules 10
Ryotaro Koshio (Tokyo Univ. of Sci.)

Summary: Let k be an algebraically closed field of characteristic $p > 0$, G a finite group and N a normal subgroup of G. We discuss induced kG-modules from support τ-tilting kN-modules and restricted kN-modules from support τ-tilting kG-modules.

36 Ryuji Tanimoto (Shizuoka Univ.)♭ Representations of the additive group into Heisenberg groups in positive characteristic 15

Summary: Let k be an algebraically closed field of positive characteristic p and let $\mathbb{G}_a$ denote the additive group of k. It is a natural problem to classify representations of $\mathbb{G}_a$. In this talk, we describe representations of $\mathbb{G}_a$ into Heisenberg groups. So, we can describe modular representations of elementary abelian p-groups into Heisenberg groups.

11:30–12:00 Research Section Assembly

14:15–16:15

37 Ryota Wakao (Okayama Univ. of Sci.) On integrals in low-dimensional Hopf superalgebras 10

Summary: Integrals in finite-dimensional Hopf superalgebras also have an application to the theory of low-dimensional topologies. In this talk, we begin with the definition of an integral in a Hopf superalgebra and give a concrete description of integrals in Hopf superalgebras of low dimension. Moreover, we determine its unimodularity.

38 Wenda Fang (Kyoto Univ.) A new scheme of integrability via vertex algebra 15

Summary: It is well-known that the affine Kac–Moody vertex algebra at the critical level has a large center called the Feigin–Frenkel center. Also, Victor Kac and his collaborators showed that Poisson vertex algebra plays an important role in studying infinite-dimensional Hamiltonian systems. In this talk, we define the classical R-matrix of Lie conformal algebra. By using the Feigin–Frenkel center and the classical R-matrix we give a new integrability scheme.

39 Tomoyuki Arakawa (Kyoto Univ.) Quasi-lisse vertex algebras and chiral differential operators 15
Xuanzhong Dai (Kyoto Univ.)

Summary: It is known that the global chiral differential operators (CDO) on any smooth affine variety is quasi-lisse as its associated scheme is canonically isomorphic to the cotangent bundle. We will consider global CDO on the quasi-affine variety G/N, where G is a special linear group and N is its maximal unipotent subgroup. We will state a conjecture that describes the relations between associated variety of the global CDO and the affine closure of cotangent bundle of G/N, and verify the lower dimensional cases by free field realizations.

40 Shun Furihata (Kyoto Univ.) On the Beem–Nair conjecture 15

Summary: For a simple linear algebraic group G, the chiral universal centralizer $\mathbf{I}_{G,k}$ is a vertex operator algebra, which is the chiralization of the universal centralizer $\mathfrak{Z}_G$ of G. Beem and Nair conjectured that an open symplectic immersion from KT_G, the cover of the Kostant–Toda lattice associated with G, to $\mathfrak{Z}_G$ gives rise to a free field realization of the chiral universal centralizer at the critical level. We construct a free field realization of $\mathbf{I}_{G,k}$ at any level, which coincides with the one conjectured by Beem and Nair at the critical level.

41 Ana Kontrec (Kyoto Univ.) Zesting the minimal models ····· 15

Summary: Zesting is a category-theoretical method for constructing new modular tensor category (MTC) structures out of existing ones. It has been used to provide categorification of certain fusion rule algebras and minimal modular extensions of super-modular categories, but it has never been studied in the context of vertex operator algebras. In a joint work with A. Mejia, J. Plavnik and A. Ros Camacho, our aim is to understand what VOA structure can be reconstructed after zesting the associated modular tensor categories. We establish a certain decomposition result which we will use to find a description of the genus of associated VOAs.

42 Masahiko Miyamoto (Univ. of Tsukuba) Rationality of holomorphic vertex operator algebras ····· 10

Summary: In this talk, we prove the rationality of holomorphic vertex operator algebra, that is, if V is a holomorphic vertex operator algebra of CFT-type and V has a positive definite invariant bilinear form, then all N-gradable V-modules are direct sums of copies of V.

43 Masahiko Miyamoto (Univ. of Tsukuba) Borcherds' Lie algebra and C_2-cofiniteness of moonshine VOAs ····· 15

Summary: The classification of holomorphic vertex operator algebra of central charge 24 was almost done except for vertex operator algebras of moonshine type. So the remaining problem is to prove the uniqueness of vertex operator algebra of moonshine type. In this talk, by using Borcherds' Lie algebra, we will show that if V is a vertex operator algebra of central charge 24 and its character is $J(z) = j(z) - 744$, then V is C_2-cofinite.

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

Taiki Shibata (Okayama Univ. of Sci.) Representations of algebraic supergroups

Summary: The representation theory of algebraic supergroups over a field of positive characteristic has applications to non-super modular representations, making it more than just a generalization and quite interesting. However, compared to the non-super case, the behavior of super root systems is quite special, and that's why the representation theory does not always proceed in parallel. In this talk, we will begin with the definition of algebraic supergroups, explain what is already known, and what is yet to be understood (or where difficulties lie).

September 23rd (Sat) Conference Room II

9:15–10:45

44 Ayako Itaba (Tokyo Univ. of Sci.) Quantum projective planes and Beilinson algebras of 3-dimensional quantum polynomial algebras for Type S' ····· 15

Summary: Let $A = \mathcal{A}(E, \sigma)$ be a 3-dimensional quantum polynomial algebra where E is $\mathbb{P}^2$ or a cubic divisor in $\mathbb{P}^2$, and $\sigma \in \mathrm{Aut}_k E$. In this talk, we prove that, for a Type S' algebra A, the following conditions are equivalent; (1) The quantum projective plane $\mathsf{Proj}_{\mathrm{nc}} A$ is finite over its center. (2) The Beilinson algebra ∇A of A is 2-representation tame. (3) The isomorphism classes of simple 2-regular modules over ∇A are parametrized by $\mathbb{P}^2$. This result holds for a Type S algebra by I. Mori.

Summary: In noncommutative algebraic geometry, classification of Artin–Schelter regular (AS-regular) algebras is one of the main interests. Artin–Tate–Van den Bergh found a nice one-to-one correspondence between the set of 3-dimensional AS-regular algebras and the set of regular geometric pairs (E, σ) where E is a scheme and σ is an automorphism of E. From the point of view, we introduce the notion of geometric algebra $\mathcal{A}(E, \sigma)$ which plays an important role to classify 3-dimensional AS-regular algebras. In this talk, we give all possible defining relations of 3-dimensional cubic AS-regular algebras of Type S.

Summary: Dlab and Ringel gave a realization of quasi-hereditary algebras as an endomorphism algebra of a projective generator of the smallest extension-closed subcategory containing a standardizable set. Ágoston, Dlab and Lukács introduced the notion of stratified algebras of type s (mixed stratified algebras), which is a generalization of quasi-hereditary algebras. In this talk, we construct stratified algebras of type s following Dlab–Ringel's method.

Summary: We investigate when a given module can be embedded in a module of finite projective dimension, and as an application, we examine the behavior of Ext modules related to the residue field over local rings. In particular, we observe that the n-torsionfreeness of syzygies of the residue field characterizes the Gorensteinness of the local ring.

Summary: Characterizing the projectivity of a module in terms of vanishing of Ext modules has been actively studied in ring theory. One of the most celebrated long-standing conjectures is the Auslander–Reiten conjecture. In this talk, sufficient conditions for finitely generated modules over a ring satisfying Serre's condition (S_2) to be projective are given in terms of vanishing of Ext modules. Applying those results, we consider the Auslander–Reiten conjecture over normal rings.

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

Summary: In the study of abelian categories, particularly in the representation theory of algebras, one topic of interest is the examination of subcategories within a given abelian category that satisfy specific conditions. For instance, Serre subcategories are subcategories closed under taking subobjects, quotients, and extensions. In this presentation, we will explore various conditions such as closure under taking images, kernels, cokernels, and others. We will provide a classification of these types of subcategories, and establish non-trivial combinatorial relationships between them.

14:15–17:00

Summary: Let R be a commutative ring, $A \to B$ be a homomorphism of commutative DG R-algebras such that the underlying graded A-module B is free. Under the situation, a semi-free right DG B-module N is said to be naively liftable to A if the DG B-module epimorphism $\pi_N : N \otimes_A B \to N$ defined by $\pi_N(n \otimes b) = nb$ splits. In my talk, we explain the existence of an obstruction to naive liftability of a semi-free right DG B-module N as a certain homology class in $\mathrm{Ext}^1_B(N, N \otimes_B J)$, where J is a diagonal ideal. In particular, we give an explicit description of a DG B-homomorphism $\Delta_N : N \to N \otimes_B J(-1)$ whose homology class $[\Delta_N]$ is the obstruction to naive liftability. Moreover, we show that Δ_N is given by a "connection" which was introduced by A. Connes in non-commutative differential geometry.

Summary: Let (A, m) be a two-dimensional excellent normal local domain containing an algebraically closed field. The graded ring defined by all integral closures of powers of an ideal I of A is called the normal tangent cone of $I = I_Z$. We give a criterion for Gorensteinness of normal tangent cones in terms of the cycle Z.

Summary: We investigate a naive question of how many non-principal ideals whose residue class rings are Gorenstein exist in a given Gorenstein ring. The main result provides that the number of such graded ideals in a symmetric numerical semigroup ring R over a field coincides with the conductor of the semigroup. We furthermore provide a complete list of non-principal graded ideals I in R whose quotient rings R/I are Gorenstein.

Summary: The homological property of the associated graded ring of an ideal is an important problem in commutative algebra. In this talk, we explore the structure of the associated graded ring of $\mathfrak{m}$-primary ideals in a Cohen–Macaulay local ring $(A, \mathfrak{m})$, in the case where the first Euler characteristic attains almost minimal value.

Summary: In this talk, we discuss nearly Gorensteinness of Ehrhart rings arising from lattice polytopes. We give necessary conditions and sufficient conditions on lattice polytopes for their Ehrhart rings to be nearly Gorenstein. Moreover, we determine the structure of $(0, 1)$-polytopes whose Ehrhart rings are standard graded and nearly Gorenstein.

Summary: We characterize nearly Gorenstein projective monomial curves of codimension 1, 2 or 3.

Summary: In 1989, Hibi conjectured that the h-vectors of Cohen–Macaulay standard graded domains over a field are flawless. The h-vector $(h_0, h_1, \ldots, h_s)$, $h_s \neq 0$ of a Cohen–Macaulay standard graded algebra is flawless if $h_i \leq h_{s-i}$ for $0 \leq i \leq \lfloor s/2 \rfloor$ and $h_{i-1} \leq h_i$ for $1 \leq i \leq \lfloor s/2 \rfloor$. Niesi and Robbiano disproved this conjecture by constructing a Cohen–Macaulay standard graded domain whose h-vector is $(1, 3, 5, 4, 4, 1)$. Further, Hibi and Tsuchiya showed that the Ehrhart rings of the stable set polytopes of cycle graphs of length 9 and 11 have non-flawless h-vectors by computation. Moreover, we showed that the Ehrhart ring of the stable set polytope of any odd cycle graph with length at least 9 has non-flawless h-vector by proving the conjecture of Hibi and Tsuchiya.
However, these examples have slightest flaws, i.e., there exists i with $0 \leq i \leq \lfloor s/2 \rfloor$ and $h_i = h_{s-i} + 1$. In this talk, we show that for a given number, there is a standard graded Cohen–Macaulay domain which have the h-vector with a flaw deeper than the given number.

Summary: For a partition λ of n, the Specht ideal $I_\lambda \subset K[x_1, \ldots, x_n]$ is the ideal generated by all Specht polynomials of shape λ. In their unpublished manuscript, Haiman and Woo showed that I_λ is a radical ideal, and gave its universal Gröbner basis (Murai et al. published a quick proof of this result). On the other hand, an old paper of Li and Li studied analogous ideals. In this talk, we introduce a class of ideals generalizing both Specht ideals and Li–Li ideals (of special type), and show their radicalness and give their Gröbner bases. However the universality of our Gröbner bases is an open problem.

Summary: The Buchberger algorithm, which is the basis of Gröbner basis calculations, repeatedly divides the S-polynomial obtained by canceling the leading terms. One problem with this operation is that the result or process of the division has unpredictable behavior. To solve this problem, it is essential to construct a theory that accurately represents the mathematical structure of each computation instance. In this presentation, I will describe the relationship between syzygies and Gröbner basis calculus using the signature theory, which has been formulated in recent years, and explain the results obtained from this relationship.

Geometry

September 20th (Wed) Conference Room I

9:30–11:45

1 Yusei Aoki (Nagoya Inst. of Tech.)
Toshiaki Adachi (Nagoya Inst. of Tech.)
Trajectories on nonflat complex space forms and those on their real hypersurfaces of type (A) ····· 15

Summary: We study the condition that trajectories for Sasakian magnetic fields on real hypersurfaces of type (A) are seen as those for Kähler magnetic fields. We show that how many congruency classes of non-geodesic trajectories on a real hypersurface correspond to a given congruency classes of trajectories for a Kähler magnetic field.

2 Naotoshi Fujihara (Tokyo Univ. of Sci.)
Graph-preserving property and long-time existence of mean curvature flows on warped product manifolds ····· 15

Summary: We investigate mean curvature flows on warped product manifolds defined by open intervals and closed Riemannian manifolds. We consider the geodesic graphs on the warped product manifolds and assume that the warping functions on the intervals are monotonic and convex. In this talk, we prove the preservation of graphs under the mean curvature flow and the long-time existence of the flow.

3 Hirotaka Kiyohara (Hokkaido Univ.)
Construction of minimal null scrolls in the three-dimensional Heisenberg group ····· 15

Summary: Non-vertical timelike minimal surfaces in the three-dimensional Heisenberg group equipped with some left invariant Lorentzian metric can be represented by a quadratic form which is an analogy of the Hopf differential and the support function which denotes the angle between a certain normal vector field and the Reeb vector field of Heisenberg group. In this presentation, we show that a timelike minimal surface with a special quadratic form can be represented as one which is a generalization of ruled surfaces, and such surfaces can be constructed by an elementary method.

4 Yuta Sasahara (Tokyo Metro. Univ.)
Inhomogeneous isoparametric hypersurfaces of OT-FKM-type in the pseudo-sphere ····· 15

Summary: We study isoparametric hypersurfaces, whose principal curvatures are all constant, in the pseudo-Riemannian space forms, especially in the pseudo-sphere S_s^{2l-1}. A connected submanifold L of S_s^{2l-1} is homogeneous if a Lie subgroup of the isometry group of S_s^{2l-1} acts on L transitively. In this talk, we show that (connected) isoparametric hypersurfaces of OT-FKM-type and each connected component of its focal variety in S_s^{2l-1} are inhomogeneous if the signature (m, r) of its Clifford system satisfies $m \equiv 0 \pmod 4$ and $r \equiv 0 \pmod 2$.

5 Jun Matsumoto (Tokyo Tech)
The classification of complete improper affine fronts of low total curvature in affine three space $\boldsymbol{R}^3$ and new examples ····· 15

Summary: We describe a classification of complete improper affine fronts in unimodular affine three-space whose total curvature is greater than or equal to -8π. We also describe the asymptotic behavior of complete embedded ends of improper affine fronts and give new examples with embedded ends.

6 Masahiro Morimoto (Tokyo Metro. Univ.)
Non-existence of exceptional orbits under polar actions on Hilbert spaces ····· 15

Summary: In this talk, we show that any polar action on a separable Hilbert space by a connected Hilbert Lie group does not have exceptional orbits. This generalizes a result of Berndt, Console and Olmos in the case of finite dimensional Euclidean spaces. Using this result, we give an alternative proof of the fact that any hyperpolar action on a simply connected compact Riemannian symmetric space by a connected Lie group does not have exceptional orbits.

Summary: The notion of generalized complex structures, which was introduced by Hitchin and Gualtieri, is a geometric framework on even-dimensional manifolds which encompass both complex and symplectic structures. Then it is natural to study an odd-dimensional analogue of generalized complex structures. There are several approaches to this problem. In this talk, we adopt the definition and notation of generalized contact structures by Sekiya. This concept has two typical cases: almost contact structures and contact structures. Ben-Bassat and Boyarchenko defined a notion of suitable submanifolds of generalized complex manifolds, which is called generalized complex submanifolds. In this talk, we introduce an odd-dimensional analogue of this concept, namely, generalized contact submanifolds of generalized contact manifolds, and investigate its nature.

14:15–16:15

Summary: Nilpotent Lie groups with left-invariant metrics provide non-trivial examples of Ricci solitons. A quiver is a directed graph where loops and multiple arrows between two vertices are allowed. In this talk, we introduce a new method for obtaining nilpotent Lie algebras from finite quivers without cycles. For all of these Lie algebras, we prove that the corresponding simply connected nilpotent Lie groups admit left-invariant Ricci solitons. This constructs a large family of examples of Ricci soliton nilmanifolds with arbitrarily high nilpotency steps.

Summary: Considering the nonnegative and bounded solution of the heat equation $\partial_t u - \Delta u = 0$ on $\Omega \times (0, +\infty)$ with Dirichlet boundary condition $u|_{\partial\Omega} = 0$ and initial data $u(\cdot, 0) = \phi$, it is well-known that logconcavity is preserved by the Dirichlet heat flow on Euclidean spaces. That is, if ϕ is logconcave, then so does $u(\cdot, t)$ for every $t > 0$. We will show in this talk that due to the non-triviality of the cut-locus, the heat kernel on the Heisenberg group fails to be h-quasiconcave. As a result, we can show that for every $t > 0$, we can find a h-logconcave function ϕ such that $u(\cdot, t)$ fails to be h-quasiconcave.

Summary: In previous MSJ meetings we gave the classification of maximal antipodal sets of some classical compact symmetric spaces. This talk is a continuation of the previous talk. We give the classification of maximal antipodal sets of $UII(n) = U(2n)/Sp(n), AI(n) = SU(n)/SO(n), AII(n) = SU(2n)/Sp(n)$ and their quotient spaces.

11 Yoshihiro Ohnita (Waseda Univ./Osaka Metro. Univ.)
Jong Taek Cho (Chonnam Nat. Univ.)
Kaname Hashimoto (Yamato Univ./Osaka Metro. Univ.)
Totally complex submanifolds and R-spaces 15

Summary: We study totally complex submanifolds immersed in a quaternionic projective space and related minimal submanifolds in its quaternionic Kaehler geometry. In this talk our main result is the construction of a (non Levi–Civita) canonical connection on the inverse image of a totally complex submanifold under the Hopf fibration over a quaternionic projective space such that the parallelism of the second fundamental form of the inverse image with relative to our canonical connection is equivalent to the parallelism of the second fundamental form of a totally complex submanifold. From this result we obtain that the inverse image of a totally complex submanifold with parallel second fundamental form is obtained as a certain R-space associated with a quaternionic Kaehler symmetric pair.

12 Isami Koga (Math. Res. Inst. Calc for Industry/Hiroshima Univ.)
Yasuyuki Nagatomo (Meiji Univ.)
Equivariant harmonic maps of the complex projective spaces into the quaternion projective space 15

Summary: In this talk we would like to introduce the classification result of Equivariant harmonic maps of the complex projective space into the quaternion projective space. To classify them, we use the gauge theoretic approach.

13 Yusuke Shinoda (Okayama Univ.)
Kei Kondo (Okayama Univ.)
Another proof of the Myers–Steenrod theorem for Finsler manifolds from geodesic theory 15

Summary: In 1939 S. B. Myers and N. E. Steenrod proved that the group of isometries of a Riemannian manifold is a Lie transformation group. In this talk we will give another proof of the Myers–Steenrod theorem for Finsler manifolds from geodesic theory inspired by Myers–Steenrod.

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

Boris Doubrov (Belarusian State Univ.) Extrinsic nilpotent differential geometry and linear PDEs of finite type

Summary: The goal of this talk is to extend the principles of nilpotent differential geometry developed by N. Tanaka and T. Morimoto to the geometry of submanifolds in filtered homogeneous spaces. Namely, we study filtration preserving embeddings of filtered manifolds into flag varieties, $\mathrm{Flag}(V,\phi)$ or, more generally, into filtered homogeneous spaces $L/L^0 \subset \mathrm{Flag}(V,\phi)$. It turns out that the category of such embeddings is equivalent to the category of special linear finite type PDEs modelled by the L-module V. This generalizes a well-known correspondence between non-degenerate curves in P^n and linear scalar ODEs of order $n+1$. Formalizing the notion of normalization conditions, we prove the existence of a normal "moving frame" for osculating embeddings with constant symbol. This solves the local equivalence problem of filtration preserving embeddings and allows to describe their fundamental invariants in terms of Lie algebra cohomology.
Finally, we apply these results to study symbol preserving deformations of rational homogeneous varieties, where these cohomology spaces can be effectively computed.

September 21st (Thu) Conference Room I

9:40–11:30

14 Hiroaki Izumi (Hiroshima Univ.) New micro-macro dynamical systems 15

Summary: If macroscopic phenomena were derived from microscopic laws, it would be a dream come true for economists, physicists, biologists, and others. In this talk, I will present "New Micro-Macro Dynamical Systems" and "Fundamental Theorem of Micro-Macro". Through this, the mathematical structures of "phase transition", "synchronization", and "circadian rhythm" proposed by Hiroaki Izumi can be understood in a unified manner. We can say that we are one step closer to realizing our dreams.

Summary: For an acute triangle, we consider a circle C_G centered at the centroid G. Then, the inversion of the circumscribed circle C_O with respect to C_G is the nine-point circle C_N. In addition, let C_{GH} be the circle with segment GH (H is the orthocenter) as a diameter, and l_A be the radical axis of C_O and C_N. Then, the inversion of C_{GH} with respect to C_G is l_A. Further, we consider a circle C_H centered at the orthocenter H. If we take the stereographic projection from the plane containing the triangle to a sphere with C_H as an equator, then, the five images of C_{GH}, C_N, C_G, C_O, and l_A are symmetrical and parallel small circles on the sphere.

Summary: We know that circular shapes we encounter in daily life may appear to be elliptical from some viewing points. It is reasonable to expect that an ellipse may appear to be circular from certain viewpoints. We investigate the locus of viewpoints from which an ellipse appears circular. The locus of viewpoints is a hyperbola passing through the two foci of the ellipse. Conversely, the locus of viewpoints from which a hyperbola looks circular is an ellipse passing through the two foci of the hyperbola. Further, the locus of viewpoints from which a parabola looks circular is itself a parabola, passing through the focus of the original parabola. There is a simple duality between the object to be observed and the observer.

Summary: We construct a one-matrix model (Φ^3-Φ^4 Hybrid-Matrix-Model) with multiple potentials, which is a combination of a 3-point interaction and a 4-point interaction, where the 3-point interaction of Φ^3 is multiplied by some positive definite diagonal matrix M. This model is solvable due to the effect of this M. First, we construct Feynman rules for Φ^3-Φ^4 Hybrid-Matrix-Model and calculate perturbative expansions of some multipoint functions in ordinary methods. Second, we calculate the path integral of the partition function $\mathcal{Z}[J]$ and use the result to compute exact solutions for 1-point function $G_{|a|}$ with 1-boundary, 2-point function $G_{|ab|}$ with 1-boundary, 2-point function $G_{|a|b|}$ with 2-boundaries, and n-point function $G_{|a^1|a^2|\cdots|a^n|}$ with n-boundaries. They include contributions from Feynman diagrams corresponding to nonplanar Feynman diagrams or higher genus surfaces.

Summary: Given a closed hyperbolic surface S of genus g, Mirzakhani proved that the number of closed geodesics of length at most L and of a given type is asymptotic to cL^{6g-6} for some $c > 0$. Since a closed geodesic is corresponding to a conjugacy class of the fundamental group G of S, as a generalization, we consider the counting problem of conjugacy classes of finitely generated subgroups of G. In this context, instead of measuring the length of a closed geodesic, we use "half the sum of the lengths of the boundaries of the convex cores of a subgroup". We find that the number of conjugacy classes is also asymptotic to cL^{6g-6} for some $c > 0$. Moreover, we observe that this particular length associated with a subgroup has a natural significance from the perspective of subset currents.

Summary: The equation defining a kind of centroids of hyperbolic simplices is derived by Minkowski theorem on Minkowski spaces.

11:40–12:00 Announcement of the 2023 MSJ Geometry Prize

September 22nd (Fri) Conference Room I

9:30–11:45

20 Masao Jinzenji (Okayama Univ.) Geometrical proof of generalized mirror transformation of projective hypersurfaces · · · · · 15

Summary: In this talk, we outline a geometrical proof of the generalized mirror transformation of genus 0 Gromov–Witten invariants of degree k hypersurface in CP^{N-1}.

21 Hiroshi Sawai (Numazu Nat. Coll. of Tech.) Non-Vaisman LCK structures on a solvmanifold constructed by a 2-step nilpotent Lie group · · · · · 15

Summary: Inoue surface S^+ is a solvmanifold, and it has a non-Vaisman locally conformal Kähler structure. In this talk, we consider a non-Vaisman locally conformal Kähler structure on a solvmanifold constructed by a one-dimensional extension of a nilmanifold. Concretely, we prove that, if a solvmanifold constructed by a one-dimensional extension of a 2-step nilmanifold has a non-Vaisman locally conformal Kähler structure, then it is 4-dimensional and Inoue surface S^+.

22 Satoshi Nakamura (Tokyo Tech) Calabi type functionals for coupled Kähler–Einstein metrics · · · · · 15

Summary: We introduce the coupled Ricci–Calabi functional and the coupled H-functional which measure how far from a coupled Kähler–Einstein metric in the sense of Hultgren–Witt Nyström. We first give corresponding moment weight type inequalities which estimate each functional in terms of algebraic invariants. Secondly, we give corresponding Hessian formulas for these functionals at each critical point, which have an application to a Matsushima type obstruction theorem for the existence of a coupled Kähler–Einstein metric.

23 Kazuyuki Hasegawa (Kanazawa Univ.)
Vicente Cortés (Univ. of Hamburg) The H/Q-correspondence and a generalization of the supergravity c-map · · · · · 15

Summary: Given a hypercomplex manifold M with a rotating vector field and additional data, we construct a conical hypercomplex manifold $\hat{M}$ of $\dim \hat{M} = \dim M + 4$ with $\mathbb{H}^*(:= \mathbb{H}\backslash\{0\})$-action and show that $\bar{M} := \hat{M}/\mathbb{H}^*$ possesses a quaternionic structure. As a consequence, we associate the quaternionic manifold $\bar{M}$ to the hypercomplex manifold M of the same dimension. This is a generalization of the HK/QK-correspondence. We call this construction $\bar{M}$ from M the H/Q-correspondence. We can apply the H/Q-correspondence to a hypercomplex Hopf manifold which does not admit any hyperKähler structure. A compact Lie group SU(3) with the left invariant hypercomplex structure can be also applied to the H/Q-correspondence.

24 Rei Murakami (Tohoku Univ.) J-equations on fiber spaces · · · · · 15

Summary: Finding a canonical metric is a central topic in complex differential geometry. The constant scalar curvature Kaehler metric (cscK metric, for short) is one class of canonical metrics. Dervan–Sektnan proved that a total space of a holomorphic submersion admits a cscK metric if its fibers and base space admit (twisted) cscK metrics. On the other hand, the J-equation was discovered by X. X. Chen and S. K. Donaldson and has appeared in various contexts. One such context is that the solvability of the J-equation implies the existence of a cscK metric under some conditions. In this talk, we prove that the result of Dervan–Sektnan's type also holds for the J-equation.

25 Natsuo Miyatake (Tohoku Univ.) Generalization of the Hermitian-Einstein equation for cyclic Higgs bundles using subharmonic functions and a priori estimates of the solutions to the equation · · · · · 15

Summary: We derive a priori estimates for the solution to the generalization of the Hermitian-Einstein equation for cyclic Higgs bundles which is defined by using subharmonic functions.

Summary: The existence of constant scalar curvature Kähler (cscK) metrics is a fundamental problem in complex geometry. In this talk, we consider cscK metrics with some singularities along a smooth divisor. Guenancia shows that a Kähler–Einstein metric of Poincaré type can be approximated by the sequence of Kähler–Einstein metrics with cone singularities. If there is no nontrivial holomorphic vector field, we can show an analogue of this Guenancia's result for cscK metrics. As a corollary, we can show log K-semistability with angle 0. This corollary is related to two conjectures of J. Sun–S. Sun and Székelyhidi.

14:15–16:15

Summary: We show that in a conformal class on a closed manifold, if its Yamabe constant is nonpositive, the total scalar curvature upper bound is preserved under the C^0-convergence of metric tensors. Moreover, we also show that in a conformal class on a closed manifold whose Yamabe constant is positive, the total scalar curvature upper bound is preserved under the C^0-convergence of metric tensors providing that those scalar curvatures are uniformly bounded from below.

Summary: Inspired by a recent work due to B.Y. Wu (Internat. J. Math. **32** (2021), 2150048), we establish several Myers-type theorems by assuming some quadratic decays of the m-Bakry–Émery Ricci curvature when m is a positive constant, a negative constant, or infinity. Moreover, in a spirit of V. Boju and L. Funar (Z. Anal. Anwendungen **15** (1996), 275–278), we generalize them by assuming some weaker decays of the m-Bakry–Émery Ricci curvature when m is a positive constant, a negative constant, or infinity. Our results not only generalize the Myers-type theorem by B.Y. Wu (Internat. J. Math. **32** (2021), 2150048) and L.F. Wang (Kodai Math. J. **37** (2014), 187–195), but also are new even the m-Bakry–Émery Ricci curvature is reduced to the Ricci curvature.

Summary: We establish several Myers-type theorems for n-dimensional complete Riemannian manifolds assuming some quartic decays of the m-Bakry–Émery and m-modified Bakry–Émery Ricci curvatures with $m \in (-\infty, 1] \cup [n, +\infty]$ in terms of the distance function from a fixed point.

Summary: For each degree p and each natural number $k \geq 1$, we construct a one parameter family of Riemannian metrics on any connected oriented closed manifold with volume one and sectional curvature bounded below such that the k-th positive eigenvalue of the Hodge–Laplacian acting on differential p-forms converge to zero. This is a generalization of our previous results in 2022.

Summary: We introduce a quantitatively weak version of sufficient statistics such that the Fisher metric of the induced parametrized measure model is bi-Lipschitz equivalent to the Fisher metric of the original model. We characterize such statistics in terms of the conditional probability or by the existence of a certain decomposition of the density function in a way similar to characterizations of due to Ay–Jost–Lê–Schwachhöfer and Fisher–Neyman for sufficient statistics.

32 Yasuaki Fujitani (Osaka Univ.) Aronson–Bénilan gradient estimates for porous medium equations under lower bounds of N-weighted Ricci curvature with $N < 0$ ····· 15

Summary: As a counterpart to the Li–Yau gradient estimate for the heat equation, the Aronson–Bénilan gradient estimate for the porous medium equation has been studied. In this talk, we show the Aronson–Bénilan gradient estimate for the porous medium equation on weighted Riemannian manifolds under lower bounds of N-weighted Ricci curvature with ε-range for some $N < 0$. This generalizes those estimates under constant lower bounds of N-weighted Ricci curvature with $N \in [n, \infty)$.

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

Kotaro Kawai (BIMSA / Osaka City Univ.) Manifolds with exceptional holonomy and mirrors of their submanifolds

Summary: The existence of manifolds with exceptional holonomy was implied by the Berger's classification of Riemannian holonomy groups, and it was later confirmed that they actually existed. In addition, there is a special parallel differential form on them, which is a calibration, and we can define calibrated submanifolds. Manifolds with exceptional holonomy are considered to be analogous to the Calabi–Yau manifolds, and it is also considered that a higher-dimensional analogue of gauge theory might be established. From these viewpoints, the introduction of enumerative invariants and mirror symmetry for these manifolds are expected. In fact, what is considered as a mirror of a calibrated submanifold is defined.
In this talk, after introducing these outlines, I would like to explain the properties of the mirror of a calibrated submanifold, such as the similarities to calibrated submanifolds and gauge-theoretic objects.

September 23rd (Sat) Conference Room I

9:30–10:45

33 Asuka Takatsu (Tokyo Metro. Univ.)♭ Riemannian starshape and capacitary problems ····· 15
Kazuhiro Ishige (Univ. of Tokyo)
Paolo Salani (Univ. di Firenze)

Summary: I first define the notion of starshaped set in Riemanian manifold. Then I consider capacitary problems in Riemannian manifolds. I show that every level set of the capacitary potential of a starshaped ring in a rotationally symmetric domain is starshaped. This talk is based on joint work with Kazuhiro Ishige and Paolo Salani.

34 Asuka Takatsu (Tokyo Metro. Univ.)♭ On geometric properties of sliced Monge–Kantorovich metrics ····· 15
Jun Kitagawa (Michigan State Univ.)

Summary: A sliced Monge–Kantorovich metric is a metric on the space of probability measures over the Euclidean space.This is a variant of the Monge–Kantorovich metric and two special case are originally proposed as a way to use 1D transport to speed up computation of the usual Monge–Kantorovich metrics. In this talk, I explain some geometric properties of sliced Monge–Kantorovich metrics. This talk is based on joint work with Jun Kitagawa.

35 Tadashi Fujioka (Osaka Univ.) Quantitative Lipschitz homotopy convergence of Alexandrov spaces ·· 15
Ayato Mitsuishi (Fukuoka Univ.)
Takao Yamaguchi (Univ. of Tsukuba*)

Summary: We obtain a quantitative version of the Lipschitz homotopy convergence of Alexandrov spaces introduced by Mitsuishi–Yamaguchi (2019). They proved that if two compact Alexandrov spaces of the same dimension are close enough in the Gromov–Hausdorff distance, then they are Lipschitz homotopy equivalent. We improve this result by showing that the Lipschitz constant can be chosen to depend only on the dimension, lower bounds on curvature and volume, and an upper bound on diameter, and the time of homotopy can be chosen to be the Gromov–Hausdorff distance.

Summary: We give an explicit formula for the Euler characteristic of a collapsing Alexandrov space in terms of those of the strata of the limit Alexandrov space and of the fibers over the strata. This was conjectured by Alesker (2018).

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

Daisuke Kazukawa (Kyushu Univ.) Convergence theory of metric measure spaces based on the concentration of measure phenomenon

Summary: In recent years, convergence theory of Riemannian manifolds and metric measure spaces has been actively studied. Gromov introduced a distance function, called the observable distance, on the set of isomorphism classes of metric measure spaces and developed his distinctive theory. The observable distance induces a very characteristic topology, called the concentration topology, based on the concentration of measure phenomenon due to Lévy and Milman. The concentration topology is effective to capture the high-dimensional aspects of spaces. In this talk, I would like to present recent developments in convergence theory with respect to the concentration topology. This talk will focus on three topics: Examples of sequences that converge as the dimension diverges to infinity, Continuity of invariants of metric measure spaces, Geometry of the space of metric measure spaces.

Complex Analysis

September 20th (Wed) Conference Room V

9:30–11:30

1 Rikio Yoneda (Kanazawa Univ.) Composition operators between the Hardy space H^p and the Bergman spaces L^q_a 15

Summary: We study C_φ between H^p and L^q_a, between the Besov type space $B_{p,p-1}$ and L^q_a. Using the main results, we can prove the following : If $0 < q \leq p$, then $C_\varphi : H^p \to L^q_a$ is bounded, while there is no symbol φ such that it is bounded below.

2 Katsunori Shimomura (Ibaraki Univ.)
Yôsuke Hishikawa (Gifu Univ.)
Masaharu Nishio (Chubu Univ.)
Masahiro Yamada (Gifu Univ.)
A remark on the dual spaces of bi-parabolic Bergman spaces 15

Summary: In this note, we give a remark on the dual spaces of bi-parabolic Bergman spaces, where the bi-parabolic Bergman spaces are spaces of all integrable solutions of bi-parabolic equation $(\partial_t + (-\Delta)^\alpha)^2 u = 0$ for $0 < \alpha \leq 1$ on the upper half space.

3 Yoshihiko Shinomiya (Shizuoka Univ.) Period matrices of L-shapes 15

Summary: A period matrix Π of a curve X of genus g is a $g \times g$ matrix defined by the pairing of a symplectic basis of $H_1(X, \mathbb{Z})$ and a basis of $\Omega(X)$. L-shape is a curve of genus 2 constructed from a polygon whose form is L. We give a formula for period matrices of L-shapes with some symmetry. The period matrices are described by a Euclidean length parameter of the polygon.

4 Gou Nakamura (Aichi Inst. of Tech.) Weierstrass points of the complex double for non-orientable extremal surfaces of genus 3 15

Summary: In this talk we give the Weierstrass points of the complex doubles for non-orientable extremal surfaces of genus 3. As an application, we construct a canonical polygon for the complex double and consider it as an element of Teichüller space. We also calculate the distance between the marked complex double and a marked extremal Riemann surface of genus 2.

5 Ryo Matsuda (Kyoto Univ.) Maximal cusps are not dense 15

Summary: It is known that the Bers boundary of a finite-dimensional Teichmüller space has only a cusp and totally degenerate. McMullen has also shown that the set of all maximal cusps is dense in the Bers boundary. In this talk, we first show that a new type of degenerate called the David-quasiconformal b group, exists when Riemann surfaces satisfy the lower condition. Using this result, I will prove that the maximal cusps are not dense if the Riemann surface has at least two non-planar ends and satisfies the Shiga condition.

6 Hiroshige Shiga (Kyoto Sangyo Univ.) Quasicircles and Dirichlet finite harmonic functions on Riemann surfaces 15

Summary: A Jordan curve in C is called a quasicircle if it is the image of the unit circle by a quasiconformal self-mapping of the complex plane. While a lot of characterizations of quasicircles are known, we are interested in the characterization by an extendability condition on Dirichlet finite harmonic functions. Recently, Schippers and Staubach (2020) consider quasicircles on compact Riemann surfaces and characterize the circles by the extendability condition. In this talk, we present a generalization of their result.

7 Hiroshige Shiga (Kyoto Sangyo Univ.) Uniform domains and generalized Cantor sets · 15

Summary: We consider a generalized Cantor set $E(\omega)$ for an infinite sequence $\omega = (q_n)_{n=1}^{\infty}$ of positive numbers with $0 < q_n < 1$, and examine the quasiconformal geometry of the Cantor set $E(\omega)$. We may give a necessary and sufficient condition for the complement of $E(\omega)$ to be a uniform domain in terms of ω.

14:15–15:15

8 Shunji Horiguchi Generalized Mandelbrot sets by $z_{k+1} = (z_k^m + c)^n$ · · · · · · · · · · · · · · · · · · 15

Summary: We find how to make a general recurrence formula from the recurrence formulas of Wasan (Japanese native mathematics developed in Japan in the Edo era (1603–1868:national isolation)). Using this method, we derive a general Mandelbrot recurrence formula. This shows originality of Wasan. We lead four types of general Mandelbrot recurrence formulas. Next, we show that these become the same generalized Mandelbrot set and connected and closed set.

9 Takumi Yagi (Kyoto Univ.) Connectedness and hyperbolicity of perturbations of semi-parabolic Hénon maps · 15

Summary: We consider a family of dissipative quadratic complex Hénon maps $H_{a,t}$ with $a \in \mathbb{D}_\delta$ and $t \in [0, 1]$, where $\delta > 0$ is a small number. Suppose that $H_{a,t}$ has a fixed point $\mathbf{q}_{a,t} \in \mathbb{C}^2$, depending continuously on a and t, with one eigenvalue λ_t such that $\lambda_t \to \lambda_0 = \exp(2\pi ip/r), (p, r) \in \mathbb{Z} \times \mathbb{N}$ as $t \to 0$. Let λ_t/λ_0 be expressed by $\exp(L_t + i\theta_t)$ and suppose $\theta_t \to 0$ as $t \to 0$. We see that $H_{a,t}$ is hyperbolic if $\theta_t = O(L_t)$ and $L_t \neq 0$. By hyperbolicity of $H_{a,t}$ for $t \neq 0$, we obtain that the Julia set $J_{a,t}$ of $H_{a,t}$ is connected for $t \neq 0$. Without using hyperbolicity, we prove that $J_{a,t}$ is connected if $\theta_t^2 = o(L_t)$. Moreover, we prove that there is a family $\{\lambda_t\}$ of one eigenvalues with $\theta_t^2 \asymp |L_t|$ such that $J_{a,t}$ is disconnected for $t \neq 0$ and $r = 1$.

10 Yûsuke Okuyama (Kyoto Inst. Tech.) A local a priori bound for endomorphisms of the projective spaces · · · · 15

Summary: We will discuss about a local a priori bound of a rational function or a holomorphic endomorphism of (algebraic) degree more than 1 on the complex projective space and the (Berkoivch) projective line under some assumption on the mass of the equilibrium measure on the boundary of Fatou components. In complex setting, this assumption would be conjecturely always the case and, in one complex variable case, is related to the non-existence problem on a lake of Wada Fatou components and to the Abikoff theorem-type problem.

11 Takanori Ayano (Osaka Metro. Univ.) Difference between the solutions for the inversion problem of the hyperelliptic integrals of genus 2 · 15

Summary: Let V be a curve of genus 2 defined by $y^2 = f(x)$, where $f(x)$ is a polynomial with degree 5, and σ be the sigma function of V. We consider the inversion problem of the integral of the holomorphic one forms on V. Grant expressed the x-coordinate of V in terms of a function F which is defined by the ratio of the derivatives of σ. Matsutani expressed the x-coordinate of V in terms of a function G which is defined by the logarithmic derivatives of σ. Since F and G coincide on the zero set of σ, it is expected that $F - G$ can be divided by σ. We decompose $F - G$ into the product of σ and a meromorphic function explicitly.

15:35–16:35 Talk Invited by Complex Analysis Section

Michio Seto (Nat. Defense Acad. of Japan) Holomorphic functions vs positive definite matrices

Summary: In complex analysis, the Schwarz–Pick inequality is elementary, and it is often mentioned as an exercise topic that the inequality is equivalent to the solvability of some two point interpolation problem in the open unit disk. Generally, for n points, such problem is called Pick interpolation problem. It might be unexpected for complex analysts that Pick interpolation problem is fundamental in functional analysis. In fact, functional analysis brought by Pick interpolation problem has been very developed by a number of people. In this talk, I would like to give an introductory survey on the progress in this research field.

September 21st (Thu) Conference Room V

9:30–11:30

12 Shun Sugiyama (Nat. Inst. of Tech., Kitakyushu Coll.) An open set satisfying a local intermediate Cousin-I condition in a complex space · · · · · 15

Summary: Let D be an open set in a pure n-dimensional complex space X, q an integer such that $1 \leq q \leq n$ and $S(X)$ the set of singular points in X. In this talk, we prove the following two theorems: If D is exhausted by open sets $\{D_\nu\}$ such that $H^q(D_\nu \cap U, \mathcal{O}) \to H^q(D_\nu \cap U, \mathcal{M})$ is injective for every $\nu \in \mathbb{N}$ and for every relatively compact Stein open set U, then D is locally q-complete with corners at every point $x \in \partial D \setminus S(X)$. If D has a continuous boundary and $H^q(D \cap U, \mathcal{O}) \to H^q(D \cap U, \mathcal{M})$ is injective for every relatively compact Stein open set U, then D is locally q-complete with corners at every point $x \in \partial D \setminus S(X)$.

13 Katsusuke Nabeshima (Tokyo Univ. of Sci.), Shinichi Tajima (Niigata Univ.*) A new look at Yano–Kato method for computing s-parametric annihilators · · · · · 15

Summary: Local b-functions and s-parametric annihilators associated to hypersurfaces with an isolated singularity are considered. A new computational methods of s-parametric annihilators are introduced. The underlying ideas of the proposed methods are adopting T. Yano method and modern computer algebra techniques. The resulting methods do not require non-commutative Groebner bases computation. It is shown that, for the case of semi-weighted homogeneous hypersurface singularities, Yano–Kato method for computing s-parametric annihilators can also be realized as an algorithm. As an application, a new effective method is obtained for computing local b-functions associated to semi-weighted homogeneous hypersurface singularities. The results of benchmark test are also given.

14 Shinichi Tajima (Niigata Univ.*), Katsusuke Nabeshima (Tokyo Univ. of Sci.) Testing tameness of a complex polynomial map via comprehensive Gröbner systems · · · · · 15

Summary: The tameness of a complex polynomial function is considered in the context of symbolic computation. The method due to S. A. Broughton for testing tameness is realized as an algorithm via comprehensive Gröbner systems.

15 Jinichiro Tanaka (Osaka Metro. Univ.) Generalizations of the Bochner–Martinelli kernel to complex abelian Lie groups · · · · · 15

Summary: This talk is on constructions of solutions of $\overline{\partial}$-equations for given differential forms with compact support. In previous research, a solution of such a $\overline{\partial}$-equation on $\mathbb{C}^n$ was given by using the Bochner–Martinelli kernel. We generalize the argument on $\mathbb{C}^n$ to complex abelian Lie groups. In the last half, we construct the integral kernel on some complex abelian Lie groups and confirm the vanishing of the cohomology of some toroidal group under some condition which comes from Dynamics.

16 Satoshi Ogawa (Osaka Metro. Univ.) Full linearization along a compact complex curve and Brjuno like condition of unitary flat line bundles · · · · · 15

Summary: Linearization of horizontal and transverse transitions on a neighborhood of a compact complex manifold is full linearization. X. Gong and L. Stolovitch gave a sufficient condition for full linearization by focusing on estimates of operator norms of a Čech coboundary map with L^2 norm. In this research, we give an explicit criterion for full linearization along a compact complex curve embedded holomorphically in a complex surface. We obtain Brjuno-like condition of unitary flat line bundles as a result.

17 Masanori Adachi (Shizuoka Univ.)
Séverine Biard
(Univ. Polytechnique Hauts-de-France)
Judith Brinkschulte (Univ. Leipzig)
A residue formula for meromorphic connections and applications to stable sets of foliations 15

Summary: We discuss residue formulae that localize the first Chern class of a line bundle to the singular locus of a given holomorphic connection. As an application, we explain a proof for Brunella's conjecture about exceptional minimal sets of codimension one holomorphic foliations with ample normal bundle and for a nonexistence theorem of Levi flat hypersurfaces with transversely affine Levi foliation in compact Kähler surfaces.

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

Summary: A theorem asserting the existence of nonconstant holomorphic functions on certain bounded domains in Kähler manifolds will be improved by removing the Kählerness assumption. Related results of Takayama on the holomorphic embeddability and holomorphic convexity of pseudoconvex manifolds will be extended by weakening the curvature conditions.

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

Taiji Marugame
(Univ. of Electro-Comm.)
Hyperkähler ambient metrics associated with twistor CR manifolds

Summary: The ambient metric, introduced by Fefferman, is a Ricci-flat Kähler metric associated with CR manifolds embedded in a complex manifold. It is defined on (a fractional power of) the canonical bundle of the complex manifold with the zero section removed, and gives a powerful tool to construct invariants of CR manifolds. In this talk, we consider the ambient metric for a special class of CR manifolds, namely the twistor CR manifolds, introduced by LeBrun. A twistor CR manifold is a Lorentzian (neutral) CR 5-manifold defined as a sphere bundle over a 3-dimensional conformal manifold. In the flat case, it appears in Penrose's twistor theory as the set of light rays (null twistors) in the Minkowski spacetime. Another construction of LeBrun shows that in the real analytic case the base conformal 3-manifold can be realized as the conformal infinity of an anti self-dual Einstein metric. We prove that the twistor CR manifold can be embedded to the twistor space of this metric and construct the ambient metric as a neutral hyperkähler metric defined on the total space of the spinor bundle with the zero section removed.

Functional Equations

September 20th (Wed) Conference Room IX

9:00–12:00

1 Haru Negami (Chiba Univ.) Katz–Long–Moody construction of braid group representations and multiplicative middle convolution of KZ equation ····· 10

Summary: The Long–Moody construction is a technique to obtain representations of braid groups, introduced by Long and Moody. Through this method, various braid group representations can be constructed. In this talk, we will introduce the Katz–Long–Moody construction, which is an extension of the Long–Moody construction. Additionally, we will show that the representation of pure braid group obtained through KLM-construction is isomorphic to Haraoka's middle convolution, a method to gain a monodromy representation of KZ-type equations, which is a Pfaffian system of differential equations. Lastly, we will show that the KLM construction preserves unitarity, and so is Haraoka's middle convolution. This talk includes joint work with Kazuki Hiroe.

2 Kazuki Hiroe (Chiba Univ.)
Yasunori Okada (Chiba Univ.)
Ken Shibusawa (Chiba Univ.) On an extension of contiguity relations for the solution spaces of the confluent hypergeometric system of Kummer type ····· 10

Summary: Kimura, Haraoka, and Takano gave confluent hypergeometric systems and contiguity relations for the solution spaces. To make differential operators giving those relations, they used eigenvectors in an eigenspace corresponding to the system. In the talk, we use generalized eigenvectors to give extended relations.

3 Takashi Aoki (Kindai Univ.*)
Toshinori Takahashi (Kwansei Gakuin Univ.)
Mika Tanda (Kwansei Gakuin Univ.) The relation between the hypergeometric function and WKB solutions ····· 10

Summary: The Gauss hypergeometric equation with a large parameter is considered from the view point of the exact WKB analysis. In this talk,we give the linear relation between the solution basis to the Gauss equation in the neighborhood of the origin, one of which is the Gauss hypergeometric function, and the Borel sums of the WKB solutions.

4 Toshinori Takahashi (Kwansei Gakuin Univ.)
Mika Tanda (Kwansei Gakuin Univ.) Relation between the standard solutions of the hypergeometric differential equation and WKB solutions with a simple-pole-type turning point ····· 10

Summary: The Gauss hypergeometric differential equation with a large parameter deformed to a differential equation with a simple-pole-type turning point at the origin is considered. In this talk, the relations between the standard solutions of the hypergeometric differential equation in the neighborhood of the origin and Borel sums of WKB solutions are given.

5 Sunao Ōuchi (Sophia Univ.*) Remarks on Cauchy problem in function spaces with asymptotic expansions with respect to time variable t ····· 10

Summary: We study an initial value problem of a system of nonlinear partial differential equations in $(t, x) \in \mathbb{C}^{n+1}$.

$$\partial_t u_i = f_i\big(t, x, U, \nabla_x U\big) \quad u_i(0, x) = u_i(x) \quad 1 \le i \le m$$

Suppose $\{f_i(t, x, u, p)\}_{i=1}^m$ have asymptotic expansion with respect to t at $t = 0$. Then there exists formal power series solution $\widetilde{U}(t, x) = \sum_{n=0}^{\infty} U_n(x) t^n$. We study the asymptotic behavior of $\widetilde{U}(t, x)$ at $t = 0$ by using summability theory of asymptotic analysis. A generalization of Cauchy–Kowalevskaja theorem is given...

Summary: The nonoscillation of Mathieu-type half-linear differential equations was investigated. The particular equation under consideration is an extension of the Mathieu equation, which has been widely applied in mechanical and electrical engineering. The investigation led to the main finding that all nontrivial solutions of the Mathieu-type half-linear differential equations are nonoscillatory under simple parametric conditions. Proving the finding requires a simple nonoscillation theorem to compare the two equations.

Summary: We consider the Poincaré–Perron problem for second order half-linear ordinary differential equations. The classical results concerning Poincaré–Perron problem for linear equations by Hartman–Wintner and most of recent results for half-linear equations are unified and generalized to our results.

Summary: We construct the transseries solution of a nonintegrable Hamiltonian system via the summability theory for the partial differential equation. We solve the Hamiltonian system by using the formal transseries solution and the Borel summability.

Summary: In this talk, we introduce the imaginary diamond-alpha ellipse and use it to establish the stability regions for the Lyapunov and Ulam stabilities of a diamond-alpha difference equation.

Summary: In this study, stability properties of a linear delay differential system $x'(t) = -ax(t-\tau) - by(t)$, $y'(t) = -cx(t) - dy(t-\tau)$ are considered, where a, b, c, and d are real numbers and $\tau > 0$. Some explicit conditions are presented for the zero solution of the system to be asymptotically stable. The results demonstrate that delay-dependent stability switches in the system can occur not only when $bc < 0$ but also when $a > 0$, $b > 0$, $c > 0$, and $d > 0$.

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

Summary: We consider the N-dimensional Poincaré inequality with 0-Dirichlet condition:

$$\int_{B_N} |\nabla \boldsymbol{u}|^2 dx \geq C_N \int_{B_N} |\boldsymbol{u}|^2 dx, \qquad \boldsymbol{u}|_{\partial B_N} = \boldsymbol{0}$$

for vector fields $\boldsymbol{u}$ on the ball $B_N = \left\{ \boldsymbol{x} \in \mathbb{R}^N \ ; \ |\boldsymbol{x}| \leq 1 \right\}$ with $N \geq 2$. The best value of the constant C_N on the right-hand side is known to be $z_{\frac{N-2}{2}}$ when $\boldsymbol{u}$ is unconstrained, where z_ν denotes the first zero of Bessel function of degree ν with $z_\nu > 0$. The problem is what is the new best value of C_N when the solenoidal condition $\mathrm{div}\boldsymbol{u} = 0$ is assumed. Our result is that $C_N = z_{N/2}$ and it is attained by a class of solenoidal fields satisfying $\boldsymbol{x} \cdot \boldsymbol{u} = 0$.

13 Hiroshi Ando (Ibaraki Univ.)
Toshio Horiuchi (Ibaraki Univ.*)
Eiichi Nakai (Ibaraki Univ.*)
On the critical Caffarelli–Kohn–Nirenberg type inequalities involving super-logarithms · · · · · 10

Summary: We establish the Caffarelli–Kohn–Nirenberg type inequalities involving super-logarithms (infinitely iterated logarithms). As a result the critical Caffarelli–Kohn–Nirenberg type inequalities will be improved, and in certain cases the best constants will be discovered.

14 Ryuji Kajikiya (Osaka Electro-Comm. Univ.)
Mieko Tanaka (Tokyo Univ. of Sci.)
Satoshi Tanaka (Tohoku Univ.)
Radial eigenvalues for the p-Laplacian, I. Asymptotic behavior · · · · · 10

Summary: We study the radial eigenvalues of the p-Laplacian in a domain Ω with the Dirichlet boundary condition, where Ω is a ball or an annulus. For the k-th eigenvalue $\lambda_k(p,\Omega)$, we study the asymptotic behavior of $\lambda_k(p,\Omega)$ as $p \to 1+0$ or $p \to \infty$.

15 Ryuji Kajikiya (Osaka Electro-Comm. Univ.)
Mieko Tanaka (Tokyo Univ. of Sci.)
Satoshi Tanaka (Tohoku Univ.)
Radial eigenvalues for the p-Laplacian, II. Monotonicity · · · · · 10

Summary: We study the radial eigenvalues of the p-Laplacian in a domain Ω with the Dirichlet boundary condition, where Ω is a ball or an annulus. For the k-th eigenvalue $\lambda_k(p,\Omega)$, we study the monotonicity of $\lambda_k(p,\Omega)$ with respect to p.

14:15–16:30

16 Shuhei Kitano (Waseda Univ.)
Harnack inequalities and Hölder estimates for fully nonlinear integral equations with weak scaling conditions · · · · · 10

Summary: In this talk, we present Harnack inequalities and Hölder estimates for fully nonlinear integral equations with general scaling condition. Our relaxed condition allows to treat integral kernels of variable order and critically close to 2. We also demonstrate that the Harnack inequality fails for harmonic functions of the variable order fractional Laplacian, by constructing a counterexample.

17 Mieko Tanaka (Tokyo Univ. of Sci.)
Vladimir Bobkov (Ufa Federal Research Cente)
Multiplicity of solutions for (p,q)-Laplace equations with two parameters · · · · · 10

Summary: We consider the (p,q)-Laplace equations with two parameters under the Dirichlet boundary condition, and provide the results on the multiplicity of solutions via Lusternik–Schnirelman method.

18 Kenta Kumagai (Tokyo Tech)
Classification of boundedness of extremal solutions to semilinear elliptic equations with weighted terms · · · · · 10

Summary: We consider the Gelfand problem with the exponential nonlinearity and a radially-symmetric weighted term $0 < a(|x|) \in C^2(\overline{B_1})$ in the unit ball. We are interested in the boundedness of extremal solutions. It is known that the extremal solution is bounded if the dimension $N \le 9$ and is singular if $a = 1$ and $N \ge 10$. We consider the following: when $N \ge 10$, does the perturbation of a change the boundedness of extremal solutions? For any $h > 0$, we find singular solutions U_h with specific weighted terms a_h and study the stability of the solutions. As a result, we verify that the boundedness of extremal solutions changes depending only on h. Moreover, we give an optimal classification of the boundedness of extremal solutions for general a.

Summary: In this talk, we are interested in the existence of ground state solutions for a class of semilinear elliptic equations of Berestycki–Lions' type with Sobolev critical term. By introducing a new cut-off technique and performing a detailed asymptotic estimate, we show the existence of a ground state solution for a wide class of nonlinearities. Our existence result for the case $N = 3$ covers many important cases such as the cubic-quintic problem and the doubly critical problem.

Summary: We consider a large solution for the semilinear Poisson equation $\Delta u = u^p + \varphi(u)$ in a bounded smooth domain $D \subset \mathbb{R}^n$ where $p > 1$ and $\varphi(u)$ behaves like αu^q with $q < p$. We obtain the precise asymptotic behavior of a solution u near the boundary ∂D up to the third term.

Summary: This talk is devoted to an obstacle problem for the p-elastic energy among graph curves with fixed ends. There are two causes of the loss of regularity of solutions to the obstacle problem: one is 'degeneracy' of the Euler–Lagrange equation; the other is the presence of the 'obstacle'. In this talk we address the question which is the main cause of the loss of regularity.

Summary: We consider elastic flows of closed curves in Euclidean space. We obtain optimal energy thresholds below which elastic flows preserve embeddedness of initial curves for all time.

Summary: Huisken's problem asks whether there is an elastic flow of closed planar curves that is initially contained in the upper half-plane but 'migrates' to the lower half-plane at a positive time. Here we consider variants of Huisken's problem for open curves under the natural boundary condition, and construct various migrating elastic flows both analytically and numerically.

Summary: For a general k-dimensional Brakke flow in the n-dimensional Euclidean space locally close to a k-dimensional plane in the sense of measure, it is proved that the flow is represented locally as a smooth graph over the plane with estimates on all the derivatives up to the end-time.

Summary: We consider weak solutions to anisotropic singular elliptic or parabolic equations, which involve one-Laplacian. The aim of this talk is to briefly report recent regularity results, related to continuity of a spatial gradient.

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

Yoshihisa Miyanishi (Shinshu Univ.) Spectral theory of layer potential type operators and its applications

Summary: Spectral theory of boundary integral operators is discussed. Especially, we consider operators of layer potential type on boundaries of bounded domains. Then we find some relationships between geometric structures of boundaries and spectra of canonically defined layer potential type operators. These facts are applicable to many PDEs. As more concrete examples, the Neumann–Poncaré operators (abbreviated by NP) are considered as boundary integral operators. We then introduce the details of the NP spectral properties. We also apply the results for Transmission problems, Dirichlet–Neumann map, partition problem, etc. as long as time permits.

September 21st (Thu) Conference Room IX

9:00–12:00

26 Kiichi Tashiro (Tokyo Tech) On the area formula for the mean curvature flow with transport term via phase-field method ····· 10

Summary: We investigate a mean curvature flow obtained by the Allen–Cahn equation with transport term, and prove that the change in volume of the evolving phase can be expressed in terms of the generalized mean curvature of the Brakke flow and the transport term. Under suitable assumptions on the initial datum, this property resolves the non-uniqueness of the Brakke flows obtained from this method.

27 Kana Minami (Nara Women's Univ.) ♭ Long-time asymptotic profile of the n-dimensional heat equation ····· 10
Taku Yanagisawa (Nara Women's Univ.)

Summary: We construct a long-time asymptotic profile to the initial value problem of the n-dimensional heat equation. Specifically, we present a modified heat kernel as a long-time asymptotic profile which changes the mass, the center of mass and the variance of the n-dimensional heat kernel in accordance with the moments of the initial data.

28 Ryunosuke Kusaba (Waseda Univ.) Commutator estimates between the heat semigroup and monomial weights and its application ····· 10
Tohru Ozawa (Waseda Univ.)

Summary: In this talk, we present a new approach to obtain weighted estimates of global solutions to the semilinear heat equation with a single power of supercritical Fujita-exponent. Our method is based on direct and explicit calculations of commutation relations between the heat semigroup and monomial weights, while it is independent of standard parabolic arguments which rely on the comparison principle or some compactness arguments.

29 Taiki Takeuchi (Waseda Univ.) Breakdown of C^∞-smoothing effects for the Fujita type equation ····· 10

Summary: The Fujita type equation in the whole space $\mathbb{R}^n$ is considered, where the nonlinear terms are given as the forms $\pm|u|^\kappa$ or $\pm|u|^{\kappa-1}u$. In particular, we focus on the global mild solutions for small initial data in $L^{(\kappa-1)n/2}(\mathbb{R}^n)$ under the conditions $1+2/n<\kappa<\infty$ and $\kappa\notin\mathbb{N}$. We show that the global mild solutions become classical solutions. In addition, by taking special initial data, we also show that the solutions do not belong to C^∞-class in space.

30 Mizuki Kojima (Tokyo Tech) On solvability of a time-fractional semilinear heat equation, and its quantitative approach to the classical counterpart ····· 10
Kotaro Hisa (Tohoku Univ.)

Summary: The global or local-in-time solvability of the typical semilinear heat equation, the Fujita equation fails under certain critical conditions. However, the problem in which the derivative with respect to time is replaced by the fractional one is solvable even under such conditions. We study how the solvability of the time-fractional model quantitatively approaches the unsolvability of the corresponding problem.

Summary: We investigate solutions of complex valued semilinear heat equations for complex time. We provide the asymptotic behavior of blowup solutions from the viewpoint of their blowup rates. Our result agrees with numerical computations in A. Takayasu–J. p. Lessard–J. Jaquett–H. Okamoto (2022).

Summary: We formulate a quasi-linear parabolic equation to describe blowup and quenching patterns of semilinear parabolic equations. Methods of functional analysis and viscosity solutions are applied for this equation, which results in the convergence of the approximate solution and a comparison principle.

Summary: We prove a lemma for a strong copmarison principle of a nonlinear parabolic equation. We show that a subsolution minus a supersolution of an equation becomes a subsolution of another equation that may not coincide with the original equation.

Summary: This talk discusses the influence of possible spatial inhomogeneities in the coefficients of logistic source terms in fully parabolic chemotaxis-growth systems in two-dimensional smoothly bounded domains, and shows that finite-time blow-up of the classical solution can only occur in points where the coefficient function is zero.

Summary: This talk deals with a quasilinear Keller–Segel system with indirect signal production. In the two-dimensional case, a critical mass phenomenon was shown by Tao–Winkler (2017). The purpose of this talk is to obtain a critical mass phenomenon in the higher dimensional cases.

Summary: We consider the Cauchy problem of a drift-diffusion equation on Euclidean space. This equation is one of the diffusion equations involving a nonlocal drift term given by the Poisson equation. A nonlocal effect of the Green's function influences the solution to the problem, and it is interesting how much decaying we need to impose on the function for the problem to be well-posed. We show that the Cauchy problem of the drift-diffusion equation is well-posed in amalgam spaces.

37 Shohei Kohatsu (Tokyo Univ. of Sci.)
Johannes Lankeit (Leibniz Univ. Hannover)
Transient growth phenomena in a two-species chemotaxis-competition model on domains without radial symmetry 10

Summary: We deal with a two-species chemotaxis system with Lotka–Volterra type competitive kinetics. For the one-species chemotaxis-growth system under the radially symmetric setting, it is known that if death rate is small enough, then under some conditions on initial data, there is some time up to which any threshold of the population density is surpassed, provided that diffusion rate is sufficiently small. The purpose is to show this transient growth phenomena for the two-species model on domains without radial symmetry.

38 Yuta Ishii (Ibaraki Nat. Coll. of Tech.)
On the existence of spiky stationary solutions for the Schnakenberg model with advection term on the Y-shaped metric graph 10

Summary: In this talk, we consider the existence of one-peak solutions for the Schnakenberg model with advection term on the Y-shaped compact metric graph. In particular, we show that the location and the amplitude of a spike is determined by the interaction of the advection term with the geometry of the Y-shaped graph, represented by the associated Green's function. Moreover, by considering the Neumann boundary condition and the Robin boundary condition, it is shown that the location of a spike moves to the junction point or the boundary point depending on boundary conditions.

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

Yoshihito Kohsaka (Kobe Univ.) A threshold-type approximation algorithm for the Willmore flow

Summary: The motion of evolving surfaces by the Willmore flow is studied in this talk. Let Γ_t be an evolving surface in $\mathbb{R}^3$. Then the Willmore functional is defined as

$$\mathcal{W}[\Gamma_t] = \int_{\Gamma_t} H^2 \, dS,$$

where H denotes the mean curvature of Γ_t and dS is the area measure. The Willmore flow is the L^2-gradient flow of $\mathcal{W}[\Gamma_t]$ and is given by

$$V = -\Delta_{\Gamma_t} H - 2H(H^2 - K),$$

where Δ_{Γ_t} is the Laplace–Beltrami operator on Γ_t and K is the Gaussian curvature of Γ_t. We will propose a threshold-type approximation algorithm for the Willmore flow. This algorithm is constructed based on an asymptotic expansion of the convolution of the fundamental solution to the 4th order diffusion equation and an indicator function. A threshold-type approximation algorithm for the gradient flow of the modified Willmore functional $\mathcal{W}[\Gamma_t] + \lambda \mathcal{A}[\Gamma_t]$, where $\lambda \in \mathbb{R}$ is a Lagrange multiplier and $\mathcal{A}[\Gamma_t]$ is the area of Γ_t, will be also discussed.

September 22nd (Fri) Conference Room IX

9:15–12:00

39 Yuki Tsukamoto (Meiji Univ.) Convergence of the fast reaction limit 10

Summary: Singular limit problems called the fast reaction limit have been studied extensively when the reaction terms of each component are the same function in a two-component system. However, fast reaction limits with different fast reaction terms are still far from being well understood. In this talk, we will consider the problem where the reaction term is represented by a power term that is different from each other. We proved that the initial interface does not move and the function converges to a function satisfying the heat equation for Dirichlet boundary conditions.

Summary: Mathematical models involving nonlocal interactions have been proposed in ecology, biology, neuroscience, and so on. In this talk, we will introduce a reaction-diffusion approximation of nonlocal reaction-diffusion equations. By this result, we can see nonlocal interactions as a phenomenon resulting from a number of reactions and diffusion.

Summary: We consider steady states of the nonlocal Allen–Cahn equation whose nonlocality is composed of unbounded kernel. The goal of this talk is to prove the existence of the steady states which have discontinuities. The key idea of proving the existence is to define the functional in weighted L^1 space whose fixed point is the Volterra integral of the first kind.

Summary: or a balanced bistable reaction-diffusion equation, an axisymmetric traveling front has been studied. We prove that an axially asymmetric traveling front with any positive speed does exist in a balanced bistable reaction-diffusion equation. Our method is as follows. We use a pyramidal traveling front for an imbalanced reaction-diffusion equation whose cross section has a major axis and a minor axis. Preserving the major axis and the minor axis to be given constants and taking the balanced limit, we obtain an axially asymmetric traveling front in a balanced bistable reaction-diffusion equation. This traveling front is monotone decreasing with respect to the traveling axis, and its cross section is a compact set with any given major axis and any given minor axis.

Summary: We discuss the existence of forced waves for a 3-species diffusive competition system in shifting environments. We derive two different classes of forced waves connecting two unstable constant equilibria. The minimal environmental shifting speeds are determined under the equal diffusivities condition.

Summary: We are interested in all exact solutions of full stationary problem for a cell polarization model proposed by Y. Mori, A. Jilkine and L. Edelstein-Keshet (SIAM J. Appl. Math., 2011). We reported some exact solutions of this problem under special conditions in MSJ autumn meeting 2016. In this talk, we report that we have obtained all exact solution. This is a joint work with Professors K. Kuto (Waseda Univ.), T. Tsujikawa (Univ. of Miyazaki, Meiji Univ.) and S. Yotsutani (Ryukoku Univ.).

Summary: For a coupled nonlinear elliptic system having both attractive and repulsive couplings involved, we construct a non-radial bound state solution characterized as the ground state in the subspace of even symmetric functions while it is known that the ground state in the full space of Sobolev functions does not exist.

Summary: In this talk, we consider standing wave solutions for a certain nonlinear Schrodinger system which appears in nonlinear optics. This two-component system contains a cubic nonlinear term which is called χ^3-interaction, and has a strong coupling on one side only.
Oliveira–Pastor (2021) showed the existence of ground state solutions for the corresponding stationary problems, and investigated their stability and instability. In our study, by considering the solvability of a constraint minimization problem, we show the existence of stable standing wave solutions. We also investigate the correspondence between minimizers and ground state solutions.

Summary: We consider scalar-type standing wave solutions to a class of nonlinear elliptic systems in an abstract setting. The setting is made to handle the standard forms of a class of nonlinear cubic systems introduced in my talk at the previous MSJ meeting. We also consider the stability problem as a standing-wave solution to the corresponding NLS system.

Summary: We prove a local uniqueness by the monotonicity based method for a potential q of the magnetic Schrödinger operator $-D_A^2 u + qu = 0$ in a bounded domain Ω from partial boundary data. Moreover, we give monotonicity tests to detect an unknown obstacle for the magnetic Schrödinger equation.

Summary: In this talk, we study the estimate of the solutions of the Schrödinger equation in a magnetic field by initial data in the modulation space. Comparing with the Schrödinger equation in the cases of free or scalar potentials, it is difficult to estimate the solutions using conventional methods for the case of magnetic fields due to the increase in frequency components caused by first-order derivative term. In this presentation, we discuss the estimate of the $M^{p,p}$ norm of the solutions by the $M^{p,p}$ norm of the initial data in the cases of spatially decaying magnetic fields and its proof. This talk is based on the joint work with Professor Keiichi Kato (Tokyo University of Science).

Summary: We consider nonlinear Schrödinger equation with strong magnetic fields in 3D. This model was derived by R L. Frank, F. Méhats, C. Sparber in 2017. We prove modified scattering for small initial data and the existence of modified wave operator for small final data. To describe asymptotic behavior of the NLS we use the time-averaged model which was derived by the same authors as "the strong magnetic confinement limit" of the NLS. We construct asymptotic solutions which satisfy both asymptotic in time evolution and convergence in the strong magnetic confinement limit. We also analyze the error between the solution to the NLS and the time-averaged model for the same initial data.

Summary: We consider the initial-boundary value problem of the nonlinear Schrödinger equation on the half plane with a nonlinear Neumann boundary condition. After establishing the boundary Strichartz estimate in $L^2(\mathbb{R}^2_+)$, we consider the time local well-posedness of the problem in $L^2(\mathbb{R}^2_+)$.

14:15–16:30

52 Kenta Tomioka (Waseda Univ.)♭ The global well-posedness of the initial boundary value problem for nonlinear dispersive systems 10
Tohru Ozawa (Waseda Univ.)

Summary: We consider the initial boundary value problem for Zakharov system (Z) and Schrödinger-improved Boussinesq system (S-iB) in two space dimensions. We show the global well-posedness for these systems. Moreover, we prove the vanishing improvement limit problem for (S-iB). We focus on a general domain with the smooth boundary. There are many results for these problems in the whole space. However, there are few papers for these problems in a general domain since it is difficult to use the Fourier analysis in a general domain. We use the method of the modified energy for these problems without the Fourier analysis. These results are based on joint works with Professor Tohru Ozawa (Waseda University).

53 Takuya Sato (Kumamoto Univ.)♭ Asymptotic behavior of large solutions to dissipative nonlinear Schrödinger equations in the analytic class 10

Summary: We consider the Cauchy problem for the dissipative nonlinear Schrödinger equation with a critical cubic nonlinearity in one space dimension. We show the a priori bound of dissipative solutions in the analytic class and its L^2-decay order without any restriction of the size of smooth initial data.

54 Masaru Hamano (Waseda Univ.) Scattering and blow-up solutions to energy critical NLS with an inverse square potential 10
Masahiro Ikeda (RIKEN/Keio Univ.)

Summary: In this talk, we deal with energy critical nonlinear Schrödinger (NLS) equation with an inverse square potential. Prof. Kai Yang (in his thesis) investigated time behavior of solutions to the NLS equation under the following two situations : The first case is that the potential is attractive and the energy of initial data is less than or equal to the energy of the static solution to the NLS equation. The second case is that the potential is repulsive and the energy of initial data is less than the energy of the static solution to the NLS equation without a potential. In this talk, we consider time behavior of solutions with initial data having the equal energy for the second case.

55 Koichi Komada (Chukyo Univ.) Scattering problem for fourth-order nonlinear Schrödinger equations in one dimension 10
Satoshi Masaki (Hokkaido Univ.)

Summary: We consider fourth-order nonlinear Schrödinger equations with focusing, L^2-supercritical nonlinearity in one dimension. In this talk, we prove global existence and scattering of solutions below the ground state threshold under the evenness assumption.

56 Ikki Fukuda (Shinshu Univ.) Large time behavior and optimal decay estimate for solutions to the generalized Zakharov–Kuznetsov–Burgers equation 10
Hiroyuki Hirayama (Univ. of Miyazaki)

Summary: In this talk, we consider the Cauchy problem for the generalized Zakharov–Kuznetsov– Burgers equation in 2D. This is one of the nonlinear dispersive-dissipative type equations, which has a spatial anisotropic dissipative term. In this study, we consider the large time behavior of the solution to this problem. In particular, we give the time decay estimates for the solution, in L^2 and L^∞. In addition, we also derive an asymptotic formula for the solution in the L^∞-sense. Moreover, in view of the asymptotic profile of the solution, we show that the optimal decay rate for the L^∞-norm of the solution is given by $t^{-\frac{3}{4}}$.

57 Kouichi Taira (Ritsumeikan Univ.) Strichartz estimates for (k,a)-generalized Laguerre operators 10
Hiroyoshi Tamori (Shibaura Inst. of Tech.)

Summary: In this talk, we introduce results on Strichartz estimates for the (k,a)-generalized Laguerre operators. The cases $a = 1, 2$ were studied previously. Here we consider more general cases. These proof depends on symbol-type estimates of special functions and a discrete analog of the stationary phase theorem inspired by the work of Ionescu–Jerison.

Summary: Kato–Yajima smoothing estimates are one of the fundamental results in study of dispersive equations such as Schrödinger equations and Dirac equations. For $d(\geq 2)$-dimensional free Schrödinger equations, optimal constants of smoothing estimates were given by Bez–Saito–Sugimoto (2015). In contrast, optimal constants for free Dirac equations are known only in the 2-dimensional case (Ikoma, 2022). In this talk, we give another proof of optimal constants for the 2-dimensional free Dirac equation. We also give the optimal constants for 1-dimensional free Schrödinger and Dirac equations.

Summary: We will discuss an equivalence between energy decay estimates for damped Klein–Gordon equations and geometric conditions for the damping coefficient. To show this equivalence, we use the Paneah–Logvinenko–Sereda type uncertainty principle. We will briefly introduce these uncertainty principles and show how energy decay estimates and uncertainty principles are connected.

Summary: We consider the solution of the cubic nonlinear Klein–Gordon equation with Gaussian random initial data. We prove that the solution is the limit of solutions with smoothed Gaussian initial data obtained by mollification. We also show that there is a regularization of the Gaussian initial data so that the corresponding smooth solutions almost surely have no limit.

Summary: We consider the Cauchy problem for the semilinear wave equations with weakly dissipative nonlinearities in two space dimension. We show the energy of small solutions decays like $(\log t)^{-1/(4\nu)}$ for $\nu \geq 2$. This part is an improvement of the previous work by Nishii–Sunagawa–Terashita (2021). Furthermore, we find that this decay rate is optimal by giving a lower estimate of the same order.

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

Takafumi Akahori (Shizuoka Univ.) Global dynamics above the ground state threshold for nonlinear Schrödinger equations

Summary: We consider the dynamics above the ground state threshold for the following nonlinear Schrödinger equations in $\mathbb{R}^d \times \mathbb{R}$: (1) $i\partial_t\psi + \Delta\psi + |\psi|^{p-1}\psi = 0$, (2) $i\partial_t\psi + \Delta\psi + |\psi|^{p-1}\psi + |\psi|^{\frac{4}{d-2}}\psi = 0$.
The first half of my talk deals with (1) under the assumption that $d \geq 1$ and p is mass-supercritical and energy-subcritical (namely, $1 + \frac{4}{d} < p < 1 + \frac{4}{d-2}$ if $d \geq 3$, and $1 + \frac{4}{d} < p < \infty$ if $d = 1, 2$). When $d = 3$ and $p = 3$, Nakanishi and Schlag (Calc. Var. PDE, 2012) proved that the behavior of radial solutions whose energies are slightly larger than the energy of the ground state is classified into 9 scenarios described by the scattering, blowup and trapping; employing their idea, we can generalize the range of d and p. However, it is still open whether the same conclusion holds for nonradial solutions. I would like to give a partial answer to this problem.
The second half deals with (2) under the assumption that $d \geq 3$ and $1 + \frac{4}{d} < p < 1 + \frac{4}{d-2}$. Since (2) is not scale invariant and the limiting profiles of ground states differ for low and high frequencies, we need to pay attention to the frequencies of ground states; in particular, for $d = 3$ and $1 < p \leq 3$, there exists a frequency threshold above which there is no ground state. For low frequencies, we see that the behavior of radial solutions whose energies are slightly larger than the energy of the ground state is classified into 9 scenarios as well as (1). For high frequencies, a similar result can be proved except for the case $d = 3$ and $1 < p \leq 3$. The study for the intermediate frequencies is still developing.

September 23rd (Sat) Conference Room IX

9:30–12:00

62 Shunsuke Kitamura (Tohoku Univ.)♭ Instant blow-up of solutions of one-dimensional semilinear wave equations with increasing spatial weights ····· 10

Summary: In this talk, I will report on the "instant blow-up" of solutions of semilinear wave equations with spatial weights and non-compactly supported data in one space dimension. This technical term means that there is no local-in-time solution. I found a sufficient condition to occur the instant blow-up by means of spatial weights and the decay of initial data.

63 Shu Takamatsu (Tohoku Univ.)♭ The lifespan of classical solutions of one dimensional wave equation with semilinear terms of the spatial derivative ····· 10
Takiko Sasaki (Musashino Univ. / Tohoku Univ.)
Hiroyuki Takamura (Tohoku Univ.)

Summary: In this talk, we report on the lifespan estimates of classical solutions of solutions of one dimensional wave equation with semilinear terms of the spatial derivative. The result is same as one of semilinear terms of the time derivative. But there are so many differences among their proofs. Moreover, it is meaningful to study this problem in the sense that it may help us to investigate its blow-up boundary in the near future.

64 Mishio Kawashita (Hiroshima Univ.) Asymptotic behavior of the indicator function in the inverse problem of the wave equation for media with multiple types of cavities ····· 10
Wakako Kawashita (Hiroshima Univ.)

Summary: In this presentation, we consider the inverse problem of the wave equation by the enclosure method for a medium with multiple types of cavities. In the case considered here, the sign of the indicator function of the enclosure method is not determined and sign cancellation may occur, resulting in loss of information. By using the asymptotic solution and examining in detail the main terms of the asymptotic expansion of the indicator function, we show that the shortest distance to the cavities can be obtained even in such a case.

65 Tomoyuki Oka (Univ. of Tokyo) Space-time quasi-periodic homogenization for damped wave equations 10

Summary: In this talk, we shall discuss a space-time quasi-periodic homogenization problem for damped wave equations with periodically oscillating in space and quasi-periodically oscillating in time coefficients. The main purpose of this talk is to present a homogenization theorem, i.e., convergence of solutions and characterization of the homogenized equation. The proof is based on the space-time two-scale convergence theory.

66 Motohiro Sobajima (Tokyo Univ. of Sci.)
Masahiro Ikeda (RIKEN)
Koichi Taniguchi (Tohoku Univ.)
Yuta Wakasugi (Hiroshima Univ.)
On the lifespan of solutions to the critical semilinear damped wave equation in an 2d-exterior domain 10

Summary: The semilinear damped wave equation $\partial_t^2 u - \Delta u + \partial_t u = u^2$ in the exterior of the two-dimensional closed unit ball with the Dirichlet boundary condition are dealt with. The main result is the sharp lifespan estimate of the double exponential type from below under the radially symmetric setting.

67 Kagei Yoshiyuki (Tokyo Tech)
Hiroshi Takeda (Fukuoka Inst. of Tech.)
Stability of time periodic solution of nonlinear elastic wave equations with viscoelastic terms 10

Summary: In this talk we consider time periodic problem of quasi-linear elastic wave equations with the viscoelastic term. We prove the existence of time solution for small time periodic external force. We also show the stability of the time periodic solution for small perturbations. Our proof of the stability is based on the regularity estimates of the time periodic solution.

68 Yoshiyuki Kagei (Tokyo Tech) Eckhaus instability of compressible Taylor vortices 10

Summary: This talk is concerned with the stability of the bifurcating compressible Taylor vortex. Consider the compressible Navier–Stokes equations in a domain between two concentric infinite cylinders. If the outer cylinder is at rest and the inner one rotates with sufficiently small angular velocity, a laminar flow, called the Couette flow, is stable. When the angular velocity of the inner cylinder increases, beyond a certain value of the angular velocity, the Couette flow becomes unstable and a vortex pattern, called the Taylor vortex, bifurcates. In this talk, the compressible Taylor vortices are shown to satisfy the Eckhaus criterion for the stability under axisymmetric perturbations.

69 Hideo Kozono (Waseda Univ. / Tohoku Univ.)
Yutaka Terasawa (Nagoya Univ.)
Yuta Wakasugi (Hiroshima Univ.)
Liouville-type theorems for the Taylor–Couette flow of the stationary Navier–Stokes equations 10

Summary: We study the stationary Navier–Stokes equations in the region between two rotating concentric cylinders. We first prove that, under the small Reynolds number, if the fluid is axisymmetric and if its velocity is sufficiently small in the L^∞-norm, then it is necessarily a generalized Taylor–Couette flow. Next, we give a certain bound of the Reynolds number and the L^∞-norm of the velocity such as the fluid is indeed, necessarily axisymmetric.

Summary: We consider a 1D viscous compressible flow and construct an asymptotic expansion of the flow in the long-time regime $t \gg 1$. It is well-known that the leading order asymptotic profile in the $L^p(\mathbb{R})$-norm $(1 \leq p \leq \infty)$ is described by the diffusion wave (see e.g., Y. Zeng, Comm. Pure Appl. Math., 1994). In a work by van Baalen, Popović, and Wayne (SIAM J. Math. Anal., 2008), they investigated an asymptotic expansion of the solution beyond the leading-order term. However, they studied in the L^2-framework and the case $p < 2$ is excluded. In our work, we extend this result to all p by proving a sharp space-time pointwise estimates.

Summary: We study an inviscid limit problem of radially symmetric stationary solutions for an exterior problem to compressible Navier–Stokes equation, describing the motion of viscous barotropic gas without external forces, where boundary and far field data are prescribed. For both inflow and outflow problems, the inviscid limit is considered in a suitably small neighborhood of the far field state. The estimates of algebraic rate toward the inviscid limit are also obtained.

Summary: We consider the two-dimensional stationary Navier–Stokes equations on the whole plane $\mathbb{R}^2$. In the higher-dimensional cases $\mathbb{R}^n$ with $n \geqslant 3$, the well-posedness and ill-posedness in scaling critical spaces are well-investigated by numerous papers. However, despite the attention of many researchers, the corresponding problem in the two-dimensional whole plane case was a long-standing open problem due to inherent difficulties of two-dimensional analysis. The aim of this talk is to address this issue and prove the ill-posedness in the scaling critical Besov spaces based on $L^p(\mathbb{R}^2)$ for all $1 \leqslant p \leqslant 2$ in the sense of the discontinuity of the solution map and the non-existence of small solutions.

Summary: We establish the global well-posedness and some decay properties for a free boundary problem of the incompressible Navier–Stokes equations in $\mathbb{R}^N_+$ with $N \geq 2$. For $N = 2$, the decay of the solution to the free boundary problem is too slow to control the nonlinear term on the boundary and that is why we could not handle the case $N = 2$ in our preceding work. We overcome this difficulty owing to the trace estimate in the half space $\|f(x', 0)\|_{L_q(\mathbb{R}^{N-1})} \leq \|f\|^{1-1/q}_{L_q(\mathbb{R}^N_+)} \|\nabla f\|^{1/q}_{L_q(\mathbb{R}^N_+)}$, where $x' = (x_1, \cdots, x_{N-1})$.

14:15–16:00

Summary: We consider the stability of the stationary solution of the compressible Navier–Stokes equation in the 3D whole space with an external force which decays at spatial infinity. We obtain the global existence result of the non-stationary problem under the smallness assumptions on the initial value and the external force. We also derive the time decay rates of the perturbations around the stationary solution under the smallness assumption on the initial perturbations.

75 Ryosuke Nakasato (Shinshu Univ.) ♭
Takayuki Kobayashi (Osaka Univ.)
Long time behavior of solutions to the compressible Navier–Stokes–Korteweg equations in critical spaces 10

Summary: We consider the initial value problem of the compressible Navier–Stokes–Korteweg equations in the whole space $\mathbb{R}^d$ $(d \geq 2)$. The aim of this talk are to obtain the global-in-time solution around the constant equilibrium states $(\rho_*, 0)$ and investigate the L^p-L^1 type time-decay estimates. In addition, we consider the diffusion wave property came from the wave equation with strong damping for the solution with the initial data belonging to the critical spaces. The key idea is the derivation of the time-decay for the Fourier–Besov norm with higher derivatives by using L^1-maximal regularity for the linearized system.

76 Masakazu Yamamoto (Niigata Univ.)
Time evolution of the incompressible Navier–Stokes flow in far-field 10

Summary: In this talk, the incompressible Navier–Stokes flow in two-dimensional whole space is treated. Asymptotic expansion of the velocity in far-field are established. Especially time evolution of them are clarified. In this study the related vorticity and the technique of renormalization are applied through Biot–Savart law.

77 Masatoshi Okita
(Kurume Nat. Coll. of Tech.)
On the blow-up criterion for the Navier–Stokes equations with critical time order 10

Summary: We prove that every smooth solution $u(t,x)$ on $(0,T)$ of incompressible Navier–Stokes equations on whole space is extensible beyond $t > T$ if $u(t,x) \in L^r_w(0,T;L^p_\sigma)$ for $\frac{2}{r} + \frac{n}{p} = 1$ and $p > n$ satisfies blow-up critical time order estimate: $\|u(t)\|_{L^p} \leq \epsilon(T-t)^{-\frac{p-n}{2p}}$ for $T - \delta < t < T$ with sufficiently small positive constants ϵ and δ. Here L^r_w denote the weak L^r space. It is well-known that if the solution u satisfies $u \in L^r(0,T;L^p_\sigma)$ with $n < p \leq \infty$ and $2 \leq r < \infty$ such that $\frac{2}{r} + \frac{n}{p} = 1$ then u is extensible continued beyond the time T. In this talk, we consider the blow-up criterion when $u \notin L^r(0,T;L^p_\sigma)$.

78 Jou-chun Kuo (Waseda Univ.)
Maximal L^1 regularity for the compressible Stokes equations 10

Summary: This talk is devoted to proving the maximal L^1 regularity of the linearized system of the compressible Navier–Stokes equations with homogeneous boundary conditions in the half-space. Here, we build the continuous C_0 analytic semigroup in $B^s_{q,1}$ space, where q and s are taken such that $1 < q < \infty$ and $-1 + 1/q < s < q/1$. Moreover, we prove the L^1 integrability of this semigroup. The approach is by means of the analytic semigroup theory and we use real interpolation and duality argument in order to obtain the estimates for the semigroup. The restrictions of q and s above implies that $C^\infty_0(\mathbb{R}^N_+)$ is dense.

79 Yoshihiro Shibata
Keiichi Watanabe (Suwa Univ. of Sci.)
Maximal L_1-regularity of the Navier–Stokes equations with free boundary conditions: Local well-posedness 10

Summary: We show the maximal regularity theorem of the Stokes equations with free boundary conditions in the half-space $\mathbb{R}^d_+$, $d \geq 2$, within the L_1-in-time and $B^s_{q,1}$-in-space framework, where q and s satisfy $1 < q < \infty$ and $-1 + 1/q < s < 1/q$, respectively. The theorem is applied to show the unique existence of a local strong solution to the Navier–Stokes equations with free boundary conditions provided that the initial velocity $\boldsymbol{v}_0$ belongs to $B^s_{q,1}(\mathbb{R}^d_+)^d$ without any restriction on the size of initial data, where q and s satisfy $d-1 < q \leq d$ and $-1 + d/q < s < 1/q$. This improves the previous result established in the maximal L_p-L_q-framework due to a long series of papers by Y. Shibata.

80 Yoshihiro Shibata
Keiichi Watanabe (Suwa Univ. of Sci.)
Maximal L_1-regularity of the Navier–Stokes equations with free boundary conditions: Global well-posedness 10

Summary: We show the maximal regularity theorem of the Stokes equations with free boundary conditions in the half-space $\mathbb{R}^d_+$, $d \geq 2$, within the L_1-in-time and $\dot{B}^s_{q,1}$-in-space framework, where q and s satisfy $1 < q < \infty$ and $-1 + 1/q < s < 1/q$, respectively. The theorem is applied to show the unique existence of a global strong solution to the Navier–Stokes equations with free boundary conditions provided that the initial velocity $\boldsymbol{v}_0$ is small in $\dot{B}^{-1+d/q}_{q,1}(\mathbb{R}^d_+)^d$, where q satisfies $d - 1 < q < 2d$. This improves the previous result established by Danchin et al. (preprint, arXiv:2011.07918).

81 Keiichi Watanabe (Suwa Univ. of Sci.)
Large time behavior of the Stokes semigroup in exterior Lipschitz domains 10

Summary: We prove the local energy estimate of the Stokes semigroup in exterior Lipschitz domains $\Omega \subset \mathbb{R}^d$, $d \geq 3$. As an application, we show L^p-L^q decay estimates of the gradient of the Stokes semigroup $(T(t))_{t\geq 0}$ generated by the negative of the Stokes operator in Ω, provided that p and q satisfy $|1/p - 1/2| < 1/(2d) + \varepsilon$, $|1/q - 1/2| < 1/(2d) + \varepsilon$, and $p \leq q \leq d$ with some $\varepsilon > 0$. We also obtain the existence theorem of global-in-time strong solutions to the three-dimensional Navier–Stokes equations in the critical space $L^\infty((0,\infty); L^3_\sigma(\Omega))$ provided that the initial velocity is small in the L^3-norm. It should be emphasized that the large time behavior of the Navier–Stokes flow is completely recovered in exterior Lipschitz domains Ω along exactly the same argument as usual, even though the boundary $\partial\Omega$ is not smooth.

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

Hirokazu Saito
(Univ. of Electro-Comm.)
Asymptotic stability of the trivial steady state for the two-phase Navier–Stokes equations

Summary: In this talk, we consider a two-phase problem for two immiscible, viscous, incompressible fluids in the presence of a uniform gravitational filed acting vertically downward in the N-dimensional Euclidean space for $N \geq 3$. The two fluids are separated from one another by the sharp interface $x_N = \eta(x', t)$, where $x' \in \mathbf{R}^{N-1}$ is the tangential variable and $t \geq 0$ is the time variable. The fluid occupying the region $x_N > \eta(x', t)$ is called the upper fluid, while the other fluid occupying the region $x_N < \eta(x', t)$ is called the lower fluid. It is well-know that the trivial steady state, i.e., the motionless state with the flat interface $x_N = 0$, is unstable if the upper fluid is heavier than the lower one due to the effect of gravity. On the other hand, we prove the asymptotic stability of the trivial steady state in the case where the lower fluid is heavier than the upper one in this talk.

Real Analysis

September 22nd (Fri) Conference Room V

9:00–12:00

Summary: I report weak uniform convexity of complete Busemann spaces. As a main result, I prove a characterization of weak uniform convexity of complete Busemann spaces. This is a generalization of the characterization of uniform convexity of Banach spaces.

Summary: The convex minimization problem is a central topic of convex analysis, and it has been investigated in various settings of underlying spaces such as Euclidean spaces, Hilbert spaces, Banach spaces, and others. This work considers a convex function defined on a Hadamard space and proposes a new approximation technique to solve the problem. We use a notion of resolvent operators to generate an iterative sequence converging to a solution to our problem.

Summary: A lot of studies have done with respect to the approximation methods of solutions for nonlinear problems in a Hilbert space and Banach spaces. In this talk, we introduce our results of approximation for the split feasibility problem and strong convergence theorems for common fixed points of nonlinear mappings with some projection methods in Banach spaces. It is well-known that there are many convergence theorems with the metric projection methods. We treat with not only the metric projection methods, but also the generalized projection methods as a special case of Bregman projection methods.

Summary: In this talk, we study the set of fixed points and the set of attractive points of nonlinear mappings. We prove convergence theorems for monotone Lipschitzian mappings in Banach spaces endowed with a partial order. We also prove convergence theorems for families of monotone nonexpansive mappings.

Summary: In this talk, we propose and analyze primal-dual splitting algorithms for finding a minimizer of the convex optimization problem. We show the convergence of the proposed algorithm and confirm the effectiveness by numerical experiments.

Summary: It is known that

$$(H^1(\mathbb{R}^d))^* = \mathrm{BMO}(\mathbb{R}^d) \quad \text{and} \quad \left(\overline{C^\infty_{\mathrm{comp}}(\mathbb{R}^d)}^{\mathrm{BMO}(\mathbb{R}^d)}\right)^* = H^1(\mathbb{R}^d).$$

The function space $\mathrm{BMO}(\mathbb{R}^d)$ is a special case of generalized Campanato spaces $\mathcal{L}_{p,\phi}(\mathbb{R}^d)$ with variable growth condition. The first duality is extended to $\mathcal{L}_{p,\phi}(\mathbb{R}^d)$. In this talk we extend the second duality to $\mathcal{L}_{p,\phi}(\mathbb{R}^d)$.

7 Mathav Murugan (Univ. of British Columbia)
Ryosuke Shimizu (Waseda Univ.)
Construction and regularity of first-order Sobolev spaces on the planar Sierpiński carpet 15

Summary: In this talk, we will provide a tuple of p-energy and associated $(1,p)$-Sobolev space on the Sierpiński carpet for all $p > 1$ via discrete approximations. The main difficulty is to show its regularity in the following sense: the intersection of the continuous functions and our $(1,p)$-Sobolev space is dense in the continuous functions. As observed by the classical Sobolev embedding theorems, it is hard to get the regularity when p is less than or equal to the "dimension" of the underlying space. We establish the regularity for p between 1 and the dimension so-called Ahlfors regular conformal dimension of the Sierpiński carpet. This is joint work with Mathav Murugan (University of British Columbia).

8 Naoya Hatano (Chuo Univ.)
Ryota Kawasumi
Hiroki Saito (Nihon Univ.)
Hitoshi Tanaka (Tsukuba Univ. of Tech.)
Fractional operators on weak Choquet spaces with Hausdorff capacities 15

Summary: The purpose of this paper is to prove that fractional integral and maximal operators are bounded on weak Choquet spaces with Hausdorff capacity. These results generalize the previous works of Adams, Orobitg and Verdera.

9 Toru Nogayama (Chuo Univ.) Littlewood–Paley characterization for mixed Morrey spaces 15

Summary: In this talk, we consider the Littlewood–Paley characterization for mixed Morrey spaces. The topology to converge the Littlewood–Paley decomposition for the element of mixed Morrey spaces is the weak-* topology. If we consider the topology of mixed Morrey spaces, we must give other characterization by using the heat semigroup.

12:15–12:45 Presentation Ceremony for the 2023 MSJ Analysis Prize

14:15–15:25

10 Ryota Kawasumi
Masahiro Ikeda (RIKEN)
Isao Ishikawa (Ehime Univ.)
Boundedness of composition operators on Orlicz–Morrey spaces 15

Summary: In this talk, motivated the result about boundedness of composition operators on Morrey space by Hatano, Ikeda, Ishikawa and Sawano in 2021, we extend the result to Orlicz–Morrey spaces. To do this, we first prove the boundedness of composition operators from Orlicz–Morrey spaces to themselves. Next, to find a bi-Lipschitz map, using singular value decomposition, we prove that the first singular value is greater than a positive constant. Orlicz–Morrey spaces contain Lebesgue and generalized Morrey spaces. Thus our results contain previous results on their spaces as corollaries. Composition operators are often called Koopman operators and have been applied to data science and dynamical system.

11 Hiroki Saito (Nihon Univ.) Some embedding inequalities for fractional Sobolev spaces 15

Summary: In this talk, we investigate a classical embedding $\dot{W}^{1,1} \subset L^q(\mu)$ and a sufficient condition for μ so that one guarantees this embedding. We extend this embedding inequality to the fractional Sobolev spaces. Note that these inequalitis are related to the classical isoperimetric inequalities and Sobolev's inequality.

12 Takeshi Iida (Fukushima Nat. Coll. of Tech.) Remarks on the fractional operators on Orlicz–Morrey spaces ····· 15

Summary: Fractional integral operators I_α and Orlicz fractional maximal operators are essential for studying partial differential equations and harmonic analysis. In this talk, we focus on the boundedness of these operators in the framework of Orlicz–Morrey spaces. We examine specific examples of triplets of Young functions where the boundedness of these operators can be established. By these examples, we aim to reinforce the boundedness property for the fractional integrals and Orlicz fractional maximal operators in Orlicz–Morrey spaces.

13 Jun Kawabe (Shinshu Univ.) Topological and linear topological properties of the Sugeno–Lorentz spaces ····· 15

Summary: The properties of the spaces of Sugeno integrable functions are quite different from those of ordinary spaces of Lebesgue integrable functions. In this talk, the Sugeno–Lorentz spaces and Sugeno–Lorentz topologies are defined by the Sugeno integral and their topological and linear topological properties are discussed. Of particular interest is that the Sugeno–Lorentz spaces and their topologies are unique regardless of indices p and q.

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

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

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

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

Toshiharu Kawasaki (Tamagawa Univ.) On some directions of extension of the integral

Summary: Nowaday, there is no doubt that the Lebesgue integral is usually referred to as an integral. The reason is that the Lebesgue integral has various useful properties. However, various extensions are conceivable, such as expanding the domain of integrable functions, changing the range to a vector space, and changing the measure to a non-additive measure. In this talk, we discuss some directions of extension of the integral.

September 23rd (Sat) Conference Room V

9:30–12:00

14 Goro Akagi (Tohoku Univ.) Yoshihito Nakajima (Tohoku Univ.) Global solutions for evolution eqations involving fractional time-derivatives and their decay rates ····· 15

Summary: In this talk, we discuss global-in-time existence of strong solutions to abstract evolution equations (of gradient flow type for nonconvex energies) involving fractional time-derivatives for small initial data and apply it to degenerate parabolic equations associated with the so-called p-Laplacian as well as fractional time-derivative. Finally, the optimal decay rate of small strong solutions is determined.

Summary: In this talk we consider the initial and boundary value problem for the partial differential equations accompanying non-linear diffusion on the one-dimensional interval. Our research is strongly motivated from the mathematical model describing moisture transport in porous materials. Unknown functions of the model are distributions of water and air. For the model we assume the air distribution and obtain the present problem. However, we do not expect existence of strong solutions to the problem since the boundary condition is not monotone. For this problem we define a solution by a weak formulation and prove existence and uniqueness. The existence is obtained by the standard fix-point argument and our proof of the uniqueness is based on the dual equation method.

Summary: In this talk, we deal with a system consisting of two pseudo-parabolic PDEs, denoted by (S). This system is based on a dissipation system of Kobayashi–Warren–Carter energy, which was proposed by [Kobayashi et al., Physica D, 140, 141–150(2000)], as a mathematical model of grain boundary motion. The most characteristic point of (S) is in the point that (S) includes singular diffusion equation, with variable-dependent mobilities. This brings down non-smoothness of regularity of the solution, and the lack of smoothness leads to the difficulty of well-posedness, especially uniqueness. On the other hand, the pseudo-parabolic structure in our system (S) will encourage smoothness to the solution. Therefore, our system (S) can be expected to be a kind of mathematical model of grain boundary motion, that fulfills the well-posedness. Based on the above, we set the goal of this talk to discuss about the solvability of the system, regularity, uniqueness and continuous dependence of the solution, and large-time behavior.

Summary: Artificial intelligence (AI) technology, exemplified by Chat-GPT, has advanced in recent years, astonishing us humans. However, the underlying principle of this technology, deep learning, which possesses remarkable learning capabilities, still needs to be fully understood. E et al. proposed the formulation of deep learning through gradient flow to establish this principle from the standpoint of mathematical and numerical analysis. Nevertheless, even fundamental mathematical results, such as convergence properties, have yet to be known for this gradient flow. Therefore, in this talk, we consider the gradient flow of the objective function in deep learning. In particular, we prove a convergence result of this gradient flow.

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

19 Yutaro Chiyo (Tokyo Univ. of Sci.)
Kazuma Sugawara (Tokyo Univ. of Sci.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Global existence of classical solutions to an indirect chemotaxis-consumption model with signal-dependent sensitivity ····· 15

Summary: This talk deals with an indirect chemotaxis-consumption model with signal-dependent sensitivity. In the case that signal-dependent sensitivity is not included, global existence and boundedness were obtained by Frassu–Viglialoro (Appl. Math. Lett.;132;Paper No. 108108;2022). However, the system including signal-dependent sensitivity has not been studied yet. Also, in the literature there is a scope for improvement. The purpose of this talk is to improve conditions for global existence and boundedness and generalize them to the case that the system includes signal-dependent sensitivity.

20 Chiharu Kosugi (Yamaguchi Univ.)
Existence and uniqueness weak solutions for the energy conservation system representing motions of elastic curve on the plane ····· 15

Summary: In this talk, we aim to establish existence and uniqueness of solutions to the energy conservation system P_0 for the beam equation with the nonlinear stress function having singularity. We have already proved existence and uniqueness of the weak solution for the energy dissipative system P_μ. The proof idea is to show that the solution u_μ of P_μ converges to the solution of P_0 as μ tends to 0. By the energy inequality for solutions of P_μ, we can obtain uniform estimates independent of μ. The estimates and Aubin's compact theorem imply convergence of u_μ. The uniqueness is a direct consequence of our previous theorem.

21 Makoto Okumura (Konan Univ.)
Takeshi Fukao (Ryukoku Univ.)
Structure-preserving numerical schemes for the Cahn–Hilliard equation with dynamic boundary conditions in two spatial dimensions ····· 15

Summary: Recently, the Cahn–Hilliard equation with dynamical boundary conditions has been proposed by Goldstein–Miranville–Schimperna (GMS) and Liu–Wu (LW). These models have characteristic conservation and dissipation laws. From the perspective of numerical computation, the properties often lead us to stable computation. Hence, if the designed schemes retain the properties in a discrete sense, then the schemes are expected to be stable. In this study, we propose structure-preserving schemes for the two-dimensional GMS and LW models that retain the conservation and dissipation laws as mentioned above in a discrete sense. Also, we will talk about the solvability of the proposed scheme for the GMS model and show the results of numerical computations in the presentation.

14:15–16:25

22 Yoshiho Akagawa (Gifu Nat. Coll. of Tech.)
Risei Kano (Kochi Univ.)
Takeshi Fukao (Ryukoku Univ.)
Continuous dependence of a perfect plasticity model ····· 15

Summary: This paper discusses the continuous dependence of a perfect plasticity model. This model is described as an evolution inclusion with a constraint. The constraint set is defined by a threshold function and a parallel shift. In previous work, we obtained a continuous dependence respected 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 Kosuke Kita (Waseda Univ.)
Ôtani Mitsuharu (Waseda Univ.)
On global and blow-up solutions to nonlinear heat equations with nonlinear boundary conditions ····· 15

Summary: This talk is devoted to studying the global existence and blowing-up of solutions of nonlinear heat equations with nonlinear boundary conditions. Due to the lack of a homogeneous degree of the functional associated with Laplacian under nonlinear boundary conditions, it is difficult to apply the method using a usual potential well. In this talk, we introduce a new definition of a prohibited area, which is available without the best constant. Moreover, we also discuss the global existence and blow-up for high-energy solutions.

Summary: We are concerned with sufficient conditions which assure that the sum of two monotone operators $A, B : H \to 2^H$ on the Hilbert space H becomes maximal monotone. In most previous studies, the perturbation term B is assumed to be maximal monotone or single-valued hemi-continuous, and hence we cannot apply them to the cases for the non-maximal perturbation, for instance, differential operators with degenerate coefficients. In this talk, we propose a new type of sufficient condition where the assumption of maximality of B is compensated by the level-set compactness of the principal part A and the demiclosedness of the perturbation B.

Summary: We consider a phase-field model of 3D-grain boundary motion with time-dependent external forces. The model is based on the three dimensional Kobayashi–Warren model for the dynamics of polycrystals. To formulate our 3D-model, we use a quaternion formulation for the orientation variable. In this talk, we prove global existence and asymptotic behavior of solutions to the L^2-gradient descent flow of the constrained energy functional with time-dependent external forces. In particular, we show that the ω-limit set of the solutions is compact and that the ω-limit points satisfy the corresponding elliptic system.

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

Summary: The well-posedness problem for the Cahn–Hilliard equation with the forward-backward dynamic boundary conditions was treated in the previous work. We next consider the vanishing viscosity to the Cahn–Hilliard equation on the boundary with the auxiliary bulk equation. We prepare two variables of viscosity, one at the interior and the other at the boundary, and clarify the problem corresponding to each limit. We also discuss the asymptotic analysis.

Summary: We introduce a class of abstract doubly nonlinear evolution equations associated with subdifferential operators depending on the unknown. This is modeled on quasi-variational inequalities for systems of elliptic-parabolic partial differential equations that arise from the flows of multi-component fluids in partially saturated porous media. We prove the existence of a solution by employing the theory of time-dependent subdifferential evolution equations and its generalization.

16:45–17:45 Talk Invited by Real Analysis Section

Yasuhito Miyamoto (Univ. of Tokyo) Structure of positive radial solutions for supercritical elliptic problems

Summary: We study bifurcation structures of positive radial solutions for supercritical elliptic problems in a ball. Since the nonlinear term is supercritical, the energy cannot be controlled by an H^1-norm, and hence it is not well-defined in an H^1 space. We have to take another approach. In this talk we consider only the case where the domain is a ball. Then, every classical solution is radially symmetric. Using various ODE techniques, we clarify bifurcation structures of supercritical elliptic problems.

Functional Analysis

September 20th (Wed) Conference Room IV

10:00–12:00

1 Yuto Miyadera (Saitama Univ.) Remark on the formula for L^p norm characterized by weak L^p norm ····· 15

Summary: We give a remark on the formula for L^p norm characterized by weak L^p norm which was introduced by Gu and Yung in 2021. We generalize their formula and discuss relation between them.

2 Shosuke Omori (Gunma Nat. Coll. of Tech./Waseda Univ.)
Junichi Takahashi (Waseda Univ.)
On the spectral decomposition of quasi-Hermitian operator based on rigged Hilbert space ····· 15

Summary: In my talk, focusing on a quasi-Hermitian operator for a non-Hermitian quantum system with a positive definite metric, its spectral decomposition based on rigged Hilbert space (RHS) is introduced. First, a RHS associated with the positive definite metric is established. Based on the obtained space, the spectral decomposition for quasi-Hermitian and its bra-ket formalism are shown. As the application to a physical model, the Swanson model is focused on.

3 Masaki Kawamoto (Ehime Univ.)
Atsuhide Ishida (Tokyo Univ. of Sci.)
Nonexistence of wave operators for sub-quadratic repulsive potential ····· 15

Summary: In this talk, we consider the Schrödinger operator with sub-quadratic repulsive potentials $-\sigma|x|^\alpha$. First prove the new propagation estimates for the time propagator that can be applied to scattering theory. Second, we prove that the wave operators do not exist if the power is greater than or equal to $-(1-\alpha/2)$ and that the threshold expectation of $-(1-\alpha/2)$ is true using the new propagation estimates.

4 Hisashi Morioka (Ehime Univ.)
Kenta Higuchi (Ehime Univ.)
A study of shape resonances for quantum walks via the complex translation method ····· 15

Summary: Some properties of resonances for multi-dimensional quantum walks are studied. Resonances for quantum walks are defined as eigenvalues of complex translated time evolution operators in the pseudo momentum space. We show some results of existence or nonexistence of resonances in an analogue of shape resonance models which is a perturbation of a quantum walk with a non-penetrable barrier.

5 Itaru Sasaki (Shinshu Univ.)
Yasumichi Matsuzawa (Shinshu Univ.)
Shinnnosuke Izumi (Shinshu Univ.)
Kouta Imura (Nagano Pref. Fujimi High School)
On the scattering theory of the pair interaction model ····· 15

Summary: We discuss scattering theory of the abstract pair interaction model. The pair interaction model is a quantum field model which have quadratic interactions of the fields, and can describe nucleon-meson interactions and interacting electron-light systems in the dipole approximation. Since this model is diagonalized by a Bogoliubov transformation, its scattering theory can also analyzed in detail. It is shown that the scattering operator in this model is non-trivial. This is in contrast to the van Hove model which have trivial scattering operator.

6 Vincent Louatron (Ritsumeikan Univ.) Semiclassical resonances for matrix Schrödinger operators with vanishing interactions at crossings of classical trajectories ····· 15

Summary: We study the semiclassical distribution of resonances of a 2×2 matrix Schrödinger operator. The energy considered is above the energy-level crossing of the two associated classical trajectories, and is respectively trapping and non-trapping for those trajectories. Under a condition between the contact order m of the crossings and the vanishing order k of the interaction term at the crossing points, we show that, asymptotically in the semiclassical limit $h \to 0^+$, the imaginary part of the resonances is of size $h^{1+2(k+1)/(m+1)}$ in the general case and shrinks to $h^{1+2(k+2)/(m+1)}$ when both k and m are odd. We also compute the first term of the associated asymptotic expansions.

7 Kenta Higuchi (Ehime Univ.) Local scattering matrix for a degenerate avoided-crossing in the non-coupled regime ····· 15

Summary: A Landau–Zener type formula for a degenerate avoided-crossing is studied in the non-coupled regime. More precisely, a 2×2 system of first order h-differential operator with $\mathcal{O}(\varepsilon)$ off-diagonal part is considered in 1D. Asymptotic behavior as $\varepsilon h^{m/(m+1)} \to 0^+$ of the local scattering matrix near an avoided-crossing is given, where m stands for the contact order of two curves of the characteristic set. A generalization including the cases with vanishing off-diagonals and non-Hermitian symbols is also given.

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

Michiyuki Watanabe (Okayama Univ. of Sci.) Inverse N-body scattering with the time-dependent Hartree–Fock approximation

Summary: The speaker presents a talk on an inverse N-body scattering problem in quantum mechanics. The problem involves determining two potentials: an external potential acting on all particles and a pair interaction potential, from the behavior of scattered particles.

The speaker proposes using the time-dependent Hartree–Fock approximation in a three-dimensional setting to address this inverse scattering problem. Specifically, they focus on high-velocity initial states.

The speaker demonstrates that the leading part of the asymptotic expansion of the scattering operator allows for the unique reconstruction of the Fourier transform of the pair interaction potential. Additionally, they find that the second term of the expansion enables the unique reconstruction of the X-ray transform of the external potential.

In summary, the speaker's work utilizes the time-dependent Hartree–Fock approximation and asymptotic analysis to tackle an inverse N-body scattering problem in quantum mechanics. Their findings reveal that the asymptotic expansion of the scattering operator for the Hartree–Fock equation provides a means to recover the Fourier transform of the pair interaction potential and the X-ray transform of the external potential.

September 21st (Thu) Conference Room IV

9:30–11:15

8 Yoritaka Iwata (Osaka Univ. of Economics Law) Cumulant generating function in infinite-dimensional abstract spaces based on the logarithmic representation of unbounded operators ····· 15

Summary: A mathematical framework for defining cumulant generating function in infinite-dimensional abstract spaces is presented based on the logarithmic representation of unbounded operators. Much attention is paid to obtain the abstract evolution equation of moment.

9 Ryo Tabata (Ariake Nat. Coll. of Tech.) Matrix Identities Corresponding to Plethysm ····· 15

Summary: Plethysm is another type of the product of Schur functions introduced by Littlewood, which originates from the representation theory of the general linear groups. A classical problem to give a combinatorial description for plethysm coefficient remains open since the 1940s. Since Schur functions also have an aspect of the representations of the symmetric groups, Robinson constructed the representations corresponding to plethysm in terms of the symmetric groups. In this talk, we design a matrix type of identities which are parallel to plethysm, following Robinson's construction.

10 Akifumi Nakada (Hiroshima Univ.) The Delsarte theory for probability measures on homogeneous spaces from compact Gelfand pairs ····· 15

Summary: In combinatorial optimization, which aims to find the optimal objects under certain conditions, coding theory and design theory are both important and active researching themes. The goal of coding theory is efficient and trustworthy communications, and the goal of design theory is efficient and trustworthy samplings. The Delsarte theory links these two theories as dual concepts through Fourier analysis, and give a fundamental tool to study codes and designs. For example, the Delsarte theory for finite subsets on spheres contributes to the kissing number problem and the sphere packing problem. In this talk, we give a formulation of the Delsarte theory for probability measures.

11 Ryosuke Nakahama (NTT Inst. for Funda. Math.) Symmetry breaking operators of holomorphic discrete series representations for $(SU(3,3), SO^*(6))$ ····· 15

Summary: Let (G, G') be a symmetric pair of tube type, and let $\mathcal{H}$ be a holomorphic discrete series representation of scalar type of G. Then the restriction $\mathcal{H}|_{G'}$ is decomposed into a direct sum of unitary representations of G' multiplicity-freely, and for each subrepresentation $\mathcal{H}'$, there exists uniquely (up to scalar multiple) a G'-intertwining operator (symmetry breaking operator) from $\mathcal{H}|_{G'}$ to $\mathcal{H}'$. In this talk, the speaker presents the results on explicit construction of symmetry breaking operators for the case $(G, G') = (SU(3,3), SO^*(6))$.

12 Takahiro Nagaoka, Akihito Wachi (Hokkaido Univ. of Edu.) The strong Lefschetz property of Gorenstein algebras generated by relative invariants ····· 15

Summary: We report the strong Lefschetz property for Artinian Gorenstein algebras generated by the relative invariants F of prehomogeneous vector spaces of commutative parabolic type. In this setting F includes determinants, determinants of symmetric matrices, pfaffians and so on. The set of Lefschetz elements is precisely determined, and the annihilator of F is also precisely determined.

13 Akihito Hora (Hokkaido Univ.) Application of spin Jucys–Murphy elements of symmetric groups to dynamical spin limit shapes ····· 15

Summary: We consider a spin JM element in the group algebra of a representation group of a symmetric group and show a formula for its moments. As an application, we discuss the problem of dynamical limit shapes in ensembles of Young diagrams arising from spin representations of symmetric groups.

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

Koichi Tojo (RIKEN) Classification of irreducible symmetric spaces which admit standard compact Clifford–Klein forms

Summary: Let G be a Lie group, H a closed subgroup of G and Γ a discrete subgroup of G. If Γ acts on G/H properly discontinuously and freely, then the double coset space $\Gamma\backslash G/H$ has a natural manifold structure and is called a Clifford–Klein form of G/H. Moreover, if G/H is of reductive type and there exists a reductive subgroup of G containing Γ and acting on G/H properly, $\Gamma\backslash G/H$ is said to be standard. One of important problems in this field is "Which homogeneous space G/H admits a compact Clifford–Klein form?". In this talk, we consider the subproblem "Classify homogeneous spaces G/H of reductive type which admit standard compact Clifford–Klein forms". More precisely, we give the classification in the class of irreducible symmetric spaces, and see our strategy to obtain the classification.

September 22nd (Fri) Conference Room IV

9:30–11:00

14 Hiroshi Ando (Chiba Univ.) Andreas Thom (TU Dresden) Common transversals for coset spaces of compact groups · · · · · 15

Summary: Let G be a Polish group and let $H \leq G$ be a compact subgroup. We prove that there exists a Borel set $T \subset G$ which is simultaneously a complete set of coset representatives of left and right cosets, provided that a certain index condition is satisfied. Moreover, we prove that this index condition holds provided that G is locally compact and G/G° is compact or H is a compact Lie group. This generalizes a result which is known for discrete groups under various finiteness assumptions, but is known to fail for general inclusions of infinite groups. As an application, we prove that Bohr closed subgroups of countable, discrete groups admit common transversals.

15 Kan Kitamura (Univ. of Tokyo) Discrete quantum subgroups of complex semisimple quantum groups · · · · · 15

Summary: In this talk, discrete quantum subgroups of the quantum double of a compact quantum group will be examined. It will be observed that such quantum groups often do not admit a quantum version of lattices. In the case of the quantum double of q-deformation of a compact semisimple Lie group regarded as its complexification, we can obtain a classification of its discrete quantum subgroups.

16 Masato Tanaka (Nagoya Univ.) Cocycles on quantum groups · · · · · 15

Summary: A 1-cocycle on a group is a map which is compatible with a given representation. This map has many information on a group (e.g. Haargerup property and property (T) etc.) and appears in many areas (e.g. the theory of the theory of Lévy processes and Popa's deformation/rigidity theory etc.). In this talk, we consider consider 1-cocycles on (operator algebraic) quantum groups. In particular, we construct 1-cocycles on the Drinfeld double of the compact quantum group $SU_q(2)$ and on the locally compact quantum group $\widetilde{SU}_q(1,1)$.

17 Toshihiko Masuda (Kyushu Univ.) Actions of discrete amenable groups into the normalizers of full groups of ergodic transformations · · · · · 15

Summary: We apply Evans–Kishimoto's intertwining argument to the classification of actions of discrete amenable groups into the normalizer of a full group of an ergodic transformation. Our proof does not depend on the types of ergodic transformations.

18 Masaru Nagisa (Ritsumeikan Univ.) Yasuo Watatani (Kyushu Univ.*) Non-linear Choquet traces on compact algebras —dual norms, quasi norms— · · · · · 15

Summary: Let $\{\alpha(n)\}_{n=0}^{\infty}$ be an increasing sequence with $\alpha(0) = 0$, which corresponds to a monotone measure on $\{0, 1, 2, \ldots\}$. Then the Choquet trace on compact operators is functional on compact operators defined by $\varphi_\alpha(a) = \sum_{i=1}^{\infty}(\alpha(i) - \alpha(i-1))\lambda_i(a) (\in [0, \infty])$ for a compact positive operator a, where $\lambda_i(a)$ means the i-th eigenvalue of a by the decreasing order. We have already given the equivalent condition that $|||a|||_\alpha = \varphi_\alpha(|a|)$ satisfies triangle inequality. In this talk, (1) we determine the form of the dual norm of $|||a|||_\alpha$ on the algebra of finite rank operators, and (2) we determined the equivalent condition that φ_α is quasinorm on this algebra.

14:15–16:00

19 Shigeru Furuichi (Nihon Univ.) Operator inequalities between geometric mean and spectral geometric mean · · · · · 15

Summary: Two operator inequalities between geometric mean and spectral geometric mean are shown. Studying properties of the generalized Kantorovich constant, we determine two bounds superior or inferior.

20 Yuki Seo (Osaka Kyoiku Univ.) The Hadamard product of positive invertible operators and Karcher geometric mean ····· 15

Summary: In this talk, we estimate the difference between the Hadamard product and the Karcher mean of n positive invertible operators on the Hilbert space in terms of the Specht ratio and the Kantorovich constant.

21 Hiroaki Tohyama (Maebashi Inst. of Tech.)
Eizaburo Kamei
Masayuki Watanabe (Maebashi Inst. of Tech.) Operator valued inequalities based on Young's inequality ····· 15

Summary: Various refinements of Young's inequality have been obtained by many authors. Based on one of those refinements we will construct a new operator inequality, which is obtained by generalizing the operator valued α-divergence.

22 Michiya Mori (Univ. of Tokyo/RIKEN)
Peter Šemrl (Univ. of Ljubljana) Nonexpansive and noncontractive mappings on the set of quantum pure states ····· 15

Summary: Wigner's theorem characterizes isometries of the set of all rank one projections on a Hilbert space. In metric geometry nonexpansive maps and noncontractive maps are well studied generalizations of isometries. We show that under certain conditions Wigner symmetries can be characterized as nonexpansive or noncontractive maps on the set of all projections of rank one. The assumptions required for such characterizations are injectivity or surjectivity and they differ in the finite and the infinite-dimensional case. We also give a description of nonexpansive maps which satisfy a condition that is much weaker than surjectivity. Such maps do not need to be Wigner symmetries. The optimality the results is shown by counterexamples.

23 Takeshi Miura (Niigata Univ.)
Yuta Enami (Niigata Univ.) Tingley's problem for Banach spaces with deferential structures ····· 15

Summary: Let A be a uniformly closed, extremely C-regular subspace of $C_0(X)$ for a locally compact Hausdorff space X. Let $B = A \oplus_{\ell^1} \mathbb{C}$ and S_B the unit sphere of B. We shall prove that each surjective isometry between S_B admits a surjective isometry between the whole space B.

24 Osamu Hatori (Niigata Univ.*) The Mazur–Ulam property for spaces of harmonic functions ····· 15

Summary: We study the Mazur–Ulam property for real Banach spaces including spaces of harmonic functions.

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

Shiho Oi (Niigata Univ.) The relationship between norm, algebraic, and order structure of Banach algebras

Summary: The Banach–Stone theorem states that every unital surjective linear isometry on unital commutative C^*-algebras is an algebra isomorphism. Moreover, Gelfand and Kolmogorov, and Kaplansky show that algebra isomorphisms and lattice isomorphisms on unital commutative C^*-algebras can be represented by weighted composition operators. These imply that the maximal ideal spaces of unital commutative C^*-algebras are uniquely determined by the isometric structure, the algebraic structure, and the order structure. Kadison generalized a series of the theorems to unital C^*-algebras. This emphasizes the interplay between these structures and their role in characterizing the underlying space. Motivated by that, we study the relations between the isometric structure, the algebraic structure, and the order structure on Banach algebras. Specially, we study Banach algebras of continuous maps or Lipschitz maps which take values in unital C^*-algebras. We also study Fourier algebras on locally compact groups. We obtain representations of several linear preserving maps on the Banach algebras and consider the isometric structure, the algebraic structure, and the order structure of given Banach algebras.

Statistics and Probability

September 20th (Wed) Conference Room VII

9:30–11:30

1 Yuto Nakagawa (Tohoku Univ.) Consideration of eigenvalues and multiplicity of stochastic matrix using left regular band ····· 15

Summary: We consider eigenvalues and multiplicity of stochastic matrix. A left-regular band is a semigroup S that satisfies $x^2 = x, xyx = xy$. A deck of n cards are shuffled by removing the card labeled i with probability w_i and replacing it on top. This process can be considered as a Markov chain on the symmetric group, and called Tsetlin library. In this talk, we consider the colored Tsetlin library and q-analog of the Tsetlin library.

2 Yuichi Shiozawa (Osaka Univ.)
Jian Wang (Fujian Normal Univ.) Hausdorff dimensions of inverse images and collision time sets for symmetric Markov processes ····· 15

Summary: In this talk, we establish the Hausdorff dimensions of inverse images and collision time sets for a large class of symmetric Markov processes on metric measure spaces. We develop the approach of the works by Hawkes and Jain–Pruitt, and make full use of heat kernel estimates. We apply our results to symmetric diffusion processes and symmetric jump processes on d-sets.

3 Yuji Hamana (Univ. of Tsukuba) Hitting times of hyperbolic Bessel processes ····· 10

Summary: The generalization of the radial part of Brownian motion on a hyperbolic space is called hyperbolic Bessel process. We give the Laplace transform of its hitting time and the probability that the hitting time is finite. Moreover we give the limiting value of the expectation of the hitting time under the condition that the hitting time is finite.

4 Yuji Hamana (Univ. of Tsukuba) Brownian hitting to spheres ····· 15
Hiroyuki Matsumoto
(Aoyama Gakuin Univ.)

Summary: We consider linear Brownian motions with constant drifts. The aim is to show explicit formulae by means of spherical harmonics for the densities of the joint distributions of the first hitting times to spheres and the positions. We also study the asymptotic behavior of the distribution function as time tends to infinity.

5 Tomohiro Aya (Kyoto Univ.) Quantitative stochastic homogenization of elliptic equations with unbounded coefficients ····· 15

Summary: In this talk, we consider stochastic homogenization of elliptic equations with unbounded and non-uniformly elliptic coefficients. Extending subadditive arguments, we get an estimate for the rate of the convergence of the solution of the Dirichlet problem under the condition that coefficients in the unit cube have a certain exponential integrability. For the coefficient field in this talk, we only assume a constant decrease at a constant distance of the maximal correlation as an assumption of ergodicity, and stationarity with respect to $\mathbb{Z}^d$-translations.

6 Yushi Hamaguchi (Osaka Univ.) Markovian lifting and asymptotic log-Harnack inequality for stochastic Volterra integral equations ····· 15

Summary: We introduce a new framework of Markovian lifts of stochastic Volterra integral equations (SVIEs for short) with completely monotone kernels. We define the state space of the Markovian lift as a separable Hilbert space which incorporates the singularity or regularity of the kernel into the definition. We show that the solution of an SVIE is represented by the solution of a lifted stochastic evolution equation, which is a Markov process on the Hilbert space. Furthermore, we establish an asymptotic log-Harnack inequality and some consequent properties for the Markov semigroup associated with the Markovian lift.

Summary: In this talk, we consider stochastic wave equations in four or more spatial dimensions. We assume that the driving noise is given by the Gaussian noise that is white in time and has the Riesz kernel as a spatial correlation. Using the Malliavin–Stein approach, we show that the spatial average of the solution over a ball converges to the standard normal distribution as the radius of the ball increases to infinity. We also present the corresponding functional central limit theorem.

Summary: We find a surprising relationship between two properties for bijective functions $F : \mathcal{X} \times \mathcal{X} \to \mathcal{X} \times \mathcal{X}$ for a set $\mathcal{X}$ which are introduced from very different backgrounds. One of the property is that F is a Yang–Baxter map, namely it satisfies the set-theoretical Yang–Baxter equation, and the other property is the independence preserving property (IP property for short), which means that there exist independent random variables X, Y such that U, V are also independent with $(U, V) = F(X, Y)$.

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

Kouhei Matsuura (Univ. of Tsukuba) Discrete approximation of reflected Brownian motions by Markov chains on partitions of domains

Summary: Discrete approximation of a space is one of the problems that appear in many areas of mathematics. In probability theory, this is often studied in relation to the scaling limits of random walks or Markov chains. One of the most typical examples is approximating the Brownian motion on the d-dimensional Euclidean space $\mathbb{R}^d$ by the simple random walks on the scaled lattices $n^{-1}\mathbb{Z}^d$, $n \in \mathbb{N}$, and this result has been extended in a wide range of directions.

In this talk, we will consider discrete approximation of the reflected Brownian motion (RBM) on a domain $D \subset \mathbb{R}^d$. Our approximation is given by Markov chains on a sequence of general partitions of $\overline{D}$ whose sizes converge to 0 in an appropriate sense. A typical example of such partitions is the Voronoi partition associated with uniformly distributed independent random points in D. In this kind of situation, it is a non-trivial problem to construct appropriate Markov chains approximating RBM because partitions are inhomogeneous. We will explain how to construct a specific Markov chain on each partition in such a way that the inhomogeneity is taken into consideration and prove that its distribution converges weakly to RBM in the Skorohod space. This is a joint work with Masanori Hino and Arata Maki.

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

Ryuya Namba (Kyoto Sangyo Univ.) Limit theorems for random walks on nilpotent covering graphs

Summary: A nilpotent covering graph is an infinite covering graph of a finite graph whose covering transformation group is finitely generated and nilpotent. In this talk, we discuss recent progress in limit theorems for random walks on nilpotent covering graphs, by putting emphasis on geometric features of underlying graphs. In particular, we focus on central limit theorems including their rates of convergences, large and moderate deviation principles, and laws of the iterate logarithm for non-symmetric random walks on nilpotent covering graphs. Some possible directions of these topics are discussed as well.

September 21st (Thu) Conference Room VII

9:30–11:30

9 Atsushi Komaba (Univ. of Yamanashi)
Hisashi Johno (Univ. of Yamanashi)
Kazunori Nakamoto (Univ. of Yamanashi)
An application of the method of images in calculations on the range of a one-dimensional simple random walk ····· 15

Summary: It is known that the general term of Catalan numbers can be derived with the *method of images*, a tool to solve some differential and difference equations. In this study, we apply this method in calculations on the range D_n of a one-dimensional simple random walk $\{S_i\}_{i=0}^n$, defined as $S_0 = 0$, $S_i = S_{i-1} + X_i$ $(i = 1, \ldots, n)$, and $D_n = \#\{S_0, \ldots, S_n\}$, where $X_1, \ldots, X_n$ are independent random variables which take the values ± 1 with probability $1/2$ each. We think of infinite reflections by two parallel mirrors, which gives us an expression for $\Pr(D_n \leq d, S_n = 0)$ where d is a positive integer.

10 Noe Kawamoto (Hokkaido Univ.)
Rate of convergence of the critical point of the memory-τ self-avoiding walk in dimensions $d > 4$ ····· 15

Summary: We consider the spread-out models of the self-avoiding walk and its finite-memory version, called the memory-τ walk. For both models, each step is uniformly distributed over the d-dimensional box $\{x \in \mathbb{Z}^d : \|x\|_\infty \leq L\}$. The critical point p_c^τ for the memory-τ walk converges to the critical point p_c^∞ for the self-avoiding walk as $\tau \uparrow \infty$. By using the lace expansion, we show that for $d > 4$ and L sufficiently large,

$$p_c^\infty - p_c^\tau = \frac{2}{d-2} \left(\frac{d}{2\pi\Sigma_U^2} \right)^{\frac{d}{2}} L^{-d} \tau^{-\frac{d-2}{2}} \left[1 + O(L^{-1}) \right] + O(1/(\tau^{\frac{d-2}{2}} \log \tau))$$

where $\Sigma_U^2 = \int_{x \in \mathbb{R}^d : \|x\|_\infty \leq 1} |x|^2 d^d x$.

11 Naoki Kubota (Nihon Univ.)
Masato Takei (Yokohama Nat. Univ.)
Comparison of limit shapes for Bernoulli first-passage percolation ···· 10

Summary: We consider Bernoulli first-passage percolation on the d-dimensional hypercubic lattice with $d \geq 2$. The passage time of edge e is 0 with probability p and 1 with probability $1 - p$, independently of each other. Let p_c be the critical probability for percolation of edges with passage time 0. When $0 \leq p < p_c$, there exists a nonrandom, nonempty compact convex set $\mathcal{B}_p$ such that the set of vertices to which the first-passage time from the origin is within t is well-approximated by $t\mathcal{B}_p$ for all large t, with probability one. The aim of this paper is to prove that for $0 \leq p < q < p_c$, the Hausdorff distance between $\mathcal{B}_p$ and $\mathcal{B}_q$ grows linearly in $q - p$.

12 Shigeyoshi Ogawa (Ritsumeikan Univ.)
Noncausal calculus approach to Wong–Zakai's theorem on the approximation of SDE ····· 15

Summary: The aim of the present talk is two-fold: First point is to show extended results for Wong–Zakai's theorem in two directions: one is sharper than Wong–Zakai's theorem and the second is a noncausal version of the first result. The second point is that we do it in the framework of the noncausal stochastic calculus. This way of study gives us many merits. For instance, in that framework we can treat the subject in those different two cases in a unified manner, Besides we can give proofs of those theorems in a much simpler way than in Wong–Zakai's paper. Whole discussions being developed in that framework, for the details about materials and related facts we would refer to "Noncausal Stochastic Calculus" by Ogawa, S., (2017, Springer).

13 Toru Sera (Osaka Univ.)
Large deviations related to arcsine laws for intermittent maps ····· 15

Summary: Interval maps with indifferent fixed points are called intermittent maps. They are typical examples of infinite ergodic transformations. Many researchers have studied various probabilistic limit theorems for intermittent maps, such as Darling–Kac type limit theorem and Dynkin–Lamperti type arcsine laws. In this talk, we study large deviations related to Dynkin–Lamperti type arcsine laws for intermittent maps.

14 Yuto Nakajima (Keio Univ.) Mandelbrot set for fractal n-gons and zeros of power series 15

Summary: We give a framework to study the connectedness of the set of zeros of power series with coefficients in a finite subset $G \subset \mathbb{C}$. We prove that the set of zeros in the unit disk is connected and locally connected if some graph on the set G of coefficients is connected. Furthermore, we apply this result to the study of the Mandelbrot set $\mathcal{M}_n$ for fractal n-gons. We prove that $\mathcal{M}_n$ is connected and locally connected for any n.

15 Yuki Ueda (Hokkaido Univ. of Edu.)
Octavio Arizmendi (CIMAT)
Katsunori Fujie (Hokkaido Univ.)
Limit theorems and new combinatorial identities in finite free probability theory 15

Summary: In 2010s, the finite free probability theory was initiated by Marcus, Spielman and Srivastava to show link between recent theory via the polynomial convolutions introduced by Szegő and free probability theory. Moreover, Arizmendi and Perales introduced the finite version of free cumulants to understand finite free probability via the combinatorial theory. In this talk, we will give the limit theorems for the finite free multiplicative convolution. More strictly, we investigate the finite free analogue of Sakuma and Yoshida's free limit theorem and give an alternative proof of Kabluchko's limit theorem for free unitary normal distribution which was introduced by Biane. To prove them, we need to get rigorous combinatorial identities for partitions of a finite set, so we explain these results obtained from our works. This is a joint work with Octavio Arizmendi (CIMAT) and Katsunori Fujie (Hokkaido University).

16 Tomoyuki Terada (Kanazawa Inst. of Tech.)
Yusuke Ide (Nihon Univ.)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Return probabilities for random walks and quantum walks on the path graph 15

Summary: In this talk, we focus on discrete-time random walks (DTRWs) on the path graph with reflecting walls. Also we consider the corresponding continuous-time random walks (CTRWs), discrete-time quantum walks (DTQWs) and continuous-time quantum walks (CTQWs). We give formulas for the return probabilities of these four walks (DTRWs, CTRWs, DTQWs, CTQWs) at the boundary point of the path graph and discuss their relationships.

11:30–12:00 Research Section Assembly

September 22nd (Fri) Conference Room VII

9:30–11:30

17 Hirofumi Wakaki (Hiroshima Univ.) On model selection criteria for mixed linear models for longitudinal data. 15

Summary: The models treated are polynomial regression models in which some partial regression coefficients are random variables. The maximum likelihood estimators of the covariance parameters and the asymptotic expansion of the bias of the AIC are derived. We consider the correction of the bias.

18 Hiroki Masuda (Univ. of Tokyo)
Yuki Fujinaga (Kyushu Univ.)
Asymptotic inference for a non-Gaussian location-scale mixed-effects model 15

Summary: Motivated by better modeling of intra-individual variability in longitudinal data, we propose a class of location-scale mixed effects models, in which the data of each individual is modeled by a parameter-varying generalized hyperbolic distribution. We first study the local maximum-likelihood asymptotics and reveal the instability in the numerical optimization of the log-likelihood. Then, we construct an asymptotically efficient estimator based on the Newton–Raphson method based on the original log-likelihood function with the initial estimator being naive least-squares-type. Numerical experiments are conducted to show that the proposed one-step estimator is not only theoretically efficient but also numerically much more stable and much less time-consuming compared with the maximum-likelihood estimator.

Summary: The classical approach to analyzing extreme value data is the generalized Pareto distribution (GPD). When the GPD is used to explain a target variable with the large dimension of covariates, the shape and scale function of covariates included in GPD are sometimes modeled using the generalized additive models (GAM). In contrast to many results of application, there are no theoretical results on the hybrid technique of GAM and GPD, which motivates us to develop its asymptotic theory. We provide the rate of convergence of the estimator of shape and scale functions, as well as its local asymptotic normality.

Summary: A sample measure of multivariate kurtosis under general monotone missing data is provided. This definition is an extension of the multivariate sample kurtosis under two and three-step monotone missing data that were already given. To test a multivariate normality on the monotone missing data, we derive the evaluation of the expectation and variance of the sample measure of multivariate kurtosis by asymptotic expansion procedure. The expectation and variance are used to standardized the multivariate sample kurtosis and we propose test statistics. The statistics asymptotically follow a standard normal distribution under the null distribution. Finally, the normal approximation for the null distribution of the test statistics is investigated via Monte Carlo simulation.

Summary: We propose a Langevin-type Monte Carlo algorithm for sampling from non-log-concave non-smooth distributions. A basic idea of the algorithm is empirical mollification; we mollify the gradient of the potential function of a target distribution by a Monte Carlo method and run the unadjusted Langevin algorithm. The proposed algorithm can approximate target distributions satisfying mild conditions with arbitrary precisions in 2-Wasserstein distance.

Summary: We consider uniform estimates of total variation distances between Markov kernels of ergodic solutions of stochastic differential equations in a class and its invariant probability measures. Our main result is simple sufficient conditions for such estimates with exponential or sub-exponential decay. We apply it to non-asymptotic risk bounds for estimation of stochastic differential equations under discrete observations.

Summary: We give the formulation of discrete time optimal stopping problems with the criterion of a fractional reward. Using the standard mathematical arguments in the theory of mathematical programming, we prove the existence of optimal stopping times for these problems under the certain assumption on the regularity of the stochastic process.

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

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

Daisuke Kurisu (Univ. of Tokyo) Modeling and statistical inference for nonstationary spatial data

Summary: In this talk, we will begin by introducing various models for (nonstationary) spatial data and then delve into the topic of statistical inference for nonstationary spatial data.
In the first part of the talk, we begin with reviewing autoregressive and moving average (ARMA) processes and consider continuous ARMA (CARMA) random fields, which serve as an extension of ARMA processes specifically designed for spatial data on d-dimensional Euclidean space. Furthermore, we will discuss the extension of CARMA random fields to nonstationary cases by introducing locally stationary Levy-driven moving average random fields.
In the second part of the talk, we will address three problems related to statistical inference of nonstationary spatial data. Specifically, we will focus on the following areas: (1) high-dimensional central limit theorems and bootstrap for high-dimensional spatial data, (2) nonparametric inference of spatial trend function, and (3) nonparametric regression for locally stationary spatial data.
By covering these topics, we aim to provide an overview of the challenges and approaches involved in statistical inference for nonstationary spatial data.

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

Ayaka Sakata (Inst. of Stat. Math.) Probabilistic inference with graphical models for regression problems

Summary: Since the end of 2000, approximate probabilistic inference on graphical models has witnessed significant advancements. One notable algorithm that has emerged in this context is approximate message passing (AMP). Originally proposed for sparse estimation, AMP not only offers tractability as a polynomial time algorithm but also enables theoretical analysis, including convergence conditions under certain assumptions.
In this talk, we will focus on applying the AMP algorithm to regression problems. We will begin by introducing a graphical model representation of regression problems and demonstrate how the AMP algorithm can be used to obtain marginalized posterior distributions. Our presentation will showcase two key results. Firstly, we will explore the efficient calculation of the model selection criterion using the AMP algorithm, employing a perturbative approach. Secondly, we will derive the convergence condition of the AMP algorithm for nonconvex regularizations.
By examining these findings, we aim to shed light on the potential of the AMP algorithm in addressing regression problems.

September 23rd (Sat) Conference Room VII

9:30–11:30

25 Keita Nakamura (Yokohama City Univ.)
Tomoyuki Nakagawa (Meisei Univ.)
Kouji Tahata (Tokyo Univ. of Sci.)
Quasi-symmetry and geometric marginal homogeneity in square contingency tables using Aitchison geometry 15

Summary: We consider square contingency tables with the same row and column classifications. The set of independent probability tables and the set of symmetric probability tables are identified as linear subspaces of the simplex with Aitchison geometry. As a result, we can orthogonally decompose a simplex into four parts and express quasi-symmetry and geometric marginal homogeneity using their combinations. We propose measures of departure from quasi-symmetry and geometric marginal homogeneity and present the arrays which express the strength and direction of departure from quasi-symmetry and geometric marginal homogeneity.

Summary: For the analysis of multi-way contingency tables with ordered categories, Yamamoto, Iwashita, and Tomizawa (2007) proposed and discussed an asymmetry model, which is thought to fit well if it is reasonable to assume an underlying multivariate normal distribution. In this presentation, an asymmetry model based on f-divergence is proposed for multi-way contingency tables with ordered categories. The nature of the proposed model allows for a new information-theoretic interpretation of the model by Yamamoto et al. (2007). Additionally, by using the proposed model, necessary and sufficient conditions for the symmetry model to hold are provided.

Summary: Some existence, construction methods, and applications of additive BIB designs, denoted by AB(v, k, λ), have been discussed in Sawa et al. (2007). This talk is devoted to providing a new construction method of AB$(v, k, k-1)$ using affine resolvable semi-regular group divisible designs.

Summary: It is usually to design an experiment using treatments and its blocks in the design of experiments. Consider a set of edges of a complete bipartite graph as a treatments set and suppose the treatments have a structure. Then, we proposed a spanning bipartite block design (SBBD) to achieve better estimation accuracy. In this talk, we introduce a construction for SBBDs which of design matrix is A-optimal, using a BIBD with prime power number of blocks and an ordered design.

Summary: Circulant almost orthogonal arrays (CAOAs) are a type of circulant arrays used for statistical designs of fMRI experiments that generalize circulant orthogonal arrays. This talk specifically focuses on binary CAOAs with strength 2 designed for n treatments, where $n \equiv 2 \pmod 4$. Our main aim is to characterize D-optimal CAOAs and investigate their constructions. In this regard, this talk presents a new sufficient condition for a CAOA to be D-optimal, which relies on the existence of specific negacyclic matrices as substructures within the CAOAs.

Summary: k-means has been approved as a useful methodology for analysis of high-dimensional, low-sample-size data. But k-means is not sufficiently studied theoretically under high dimensional settings. In this talk, we show the asymptotic properties of k-means under mild and practical settings for HDLSS data. We also introduce a result for high dimensional data about hierarchical clustering and compare k-means with hierarchical clustering. At last, we present numerical simulation studies that demonstrate the performance of k-means for high dimensional data, discussing the achieved results.

31 Yumu Iwana (Univ. of Tsukuba)
Kazuyoshi Yata (Univ. of Tsukuba)
Aki Ishii (Tokyo Univ. of Sci.)
Makoto Aosima (Univ. of Tsukuba)
Correlation test for high-dimensional correlation matrix under the strongly spiked eigenvalue model ····· 15

Summary: In this talk, we consider a test for the high-dimensional correlation matrix. Aoshima and Yata (2018) proposed two eigenvalue models for high-dimensional data and constructed two-sample test procedures. One is called strongly spiked eigenvalue (SSE) model and the other one is called non-SSE (NSSE) model. Yata and Aoshima (2016) constructed a test for the high-dimensional correlation matrix under the NSSE model. We focus on the SSE model that is often seen when we analyze the microarray data set. We give a new test procedure by using the extended cross data method given by Yata and Aoshima (2013).

32 Koji Tsukuda (Kyushu Univ.)
Shun Matsuura (Keio Univ.)
On testing the hypothesis of the allometric extension model in high-dimensional settings ····· 15

Summary: Considering two populations, if the directions of the first principal component vectors of the two populations coincide and they also coincide with the direction of the difference of the mean vectors, then the populations are called to form an allometric extension. In this presentation, we suppose a high-dimensional setting with an assumption that some eigenvalues of the covariance matrices are strongly spiked. Under this setting, we construct a test statistic for the allometric extension model that is asymptotically normally distributed and discuss properties of the test.

14:15–16:20

33 Shuhei Mano (Inst. of Stat. Math.)
Masayo Y. Hirose (Kyushu Univ.)
On a quasi-linear partial differential equation of the first order appears in estimation and the solution with differential geometry ····· 15

Summary: Integration of a quasi-linear partial differential equation of the first order with the aid of differential geometry is discussed. The partial differential equation appears in a procedure for asymptotic bias reduction of maximum likelihood estimates of a function of parameters. The procedure for statistical model manifolds with equiaffine connections is discussed as a special case.

34 Kou Fujimori (Shinshu Univ.)
Koji Tsukuda (Kyushu Univ.)
The Dantzig selector for semiparametric models of stochastic processes ····· 15

Summary: We consider the sparse estimation for stochastic processes with possibly infinite-dimensional nuisance parameters, by using the Dantzig selector which is a sparse estimation method similar to Z-estimation. When a consistent estimator for a nuisance parameter is obtained, it is possible to construct an asymptotically normal estimator for the parameter of interest under appropriate conditions. Motivated by this fact, we establish the asymptotic behavior of the Dantzig selector for models of ergodic stochastic processes with high-dimensional parameters of interest and possibly infinite-dimensional nuisance parameters. The applications for ergodic diffusion processes and ergodic time series including integer-valued autoregressive models are presented.

35 Noboru Nomura (Kochi Univ.)
Integral calculation for orthant probability with polar coordinates ···· 15

Summary: Evaluation of probability that vectors distributed with elliptical distribution falls in orthant by integration with polar coordinate system is considered. The probability is evaluated by repeating splitting regions and calculating one dimensional integration. Coordinate system used in the process affect roughness of functions which appear in the process. Numerical experiments were carried out and showed that the procedure using polar coordinate systems gave satisfactory results and functions appear in the computation process are smooth.

Summary: We study dimension-free concentration inequalities for sums of random matrices and operators under weak dependence. The derivation of our results is based on a duality formula for moment-generating functions. We apply the results to the estimation of covariance matrices of dependent processes.

Summary: Asymptotic normality of two-step conditional least squares estimator is revisited for a new parameter in the stationary alternative dependent counting nonnegative integer-valued autoregressive process of the first-order, under a general innovation. It is shown through the stochastic expansion that plugging a consistent estimator for the parameter α affects the resulting asymptotic variance, compared to the case where α is known.

Summary: Coherence is a similarity measure between two time series and takes the form of the time series extension of Pearson's correlation. However, only a linear relationship between two time series can be measured by coherence. In this talk, we introduce a residual spectrum in order to measure non-linear relationships and show the existence and uniqueness of the residual spectrum by decomposing the regression model we consider into orthogonal processes. Moreover, we propose a test for the existence of the residual spectrum and show that our proposed test has asymptotically correct size and is consitent.

Summary: We consider the empirical likelihood of the data coming from the circular distribution. Many circular distributions have probability densities proportional to ones among the ARMA spectra family. These circular models have shown promising potential for analyzing and interpreting circular data. However, many parameters of interest do not have explicit forms. This reveals a significant challenge arises in the statistical inference due to the loss of explicit forms of normalizing constants in these circular models. We propose a semiparametric empirical likelihood method for statistical inference for circular distributions. The empirical likelihood ratio has a chi-squared limiting distribution. The theoretical results are illustrated by numerical simulations and real data analysis.

Summary: In this talk, we consider estimation problems of the coefficient matrices of vector autoregressive models. The innovation process is assumed to have zero-multivariate median, and the model can represent both finite and infinite variance processes. We consider self-weighted least distance and GMM based reduced rank estimators and derive the limit distributions of the proposed estimators. By comparing the asymptotic covariance matrices of the estimators, we discuss the asymptotic relative efficiency of the estimators.

Applied Mathematics

September 20th (Wed) Conference Room VIII

9:30–11:50

1 Naoki Matsumoto (Univ. of Ryukyus) Game connectivity of graphs 15
Tomoki Nakamigawa (Shonan Inst. of Tech.)

Summary: We introduce a new game invariant of graphs, called *game connectivity*, which is related to the connectivity of graphs. We investigate many fundamental and significant topics of the game connectivity of graphs, and propose many open problems and conjectures. In this talk, we introduce some of them.

2 Kiyoshi Yoshimoto (Nihon Univ.) On connectivities of edge-colored graphs 15

Summary: Let (G, c) be an edge-colored graph where $c : E(G) \to \mathbf{N}$ is an edge-coloring. The color of the edge incident to an end vertex x of a path P in G is denoted by $c_x(P)$. For any vertices $x, y \in V(G)$, if there exist two properly colored paths P, Q joining x and y such that $c_x(P) \neq c_x(Q)$ and $c_y(P) \neq c_y(Q)$, then we say (G, c) is *color-connected*. Color-connectivity is a generalization of strong connectivity of digraphs. In this talk, we discuss structures and properties of color-connected graphs, comparing strong connected digraphs.

3 Kiyoshi Ando (Nat. Inst. of Informatics) A constructive characterization of 4-connected 4-regular graphs 15

Summary: We introduce two new operations on a 4-connected 4-regular graph G. (I) Delete a vertex x from G, (II) Add K_4 to $G - x$, (III) Add a perfect matching between $V(K_4)$ and $N_G(x)$. We call this operation "K_4-expansion". (I) Delete independent 2 edges e_1, e_2 from G, (II) Add K_4 to $G - e_1 - e_2$, (III) Add a perfect matching between $V(K_4)$ and $V(e_1) \cup V(e_2)$, where $V(e_i)$ stands for the set of end vertices of e_i for $i = 1, 2$. We call this operation "K_4-edge-binding".

Theorem *Every 4-connected 4-regular graph can be obtained from K_5 or $K_{4,4}$ by repeated applications of edge-bindings, K_4-expansions and K_4-edge-bindings.*

4 Daiki Takahashi (Yokohama Nat. Univ.) 2-Connected spanning subgraphs of 3-connected planar graph 15

Summary: Kaneko et al. proved that every 3-connected planar graph G has a 2-connected spanning subgraph K such that $|E(K)| \leq \frac{4}{3}(|V(G)| - 1)$, and they also conjectured that the constant of the estimation can be improved to $\frac{4}{3}(|V(G)| - 2)$. To prove the result, they showed the statement for circuit graphs, which is obtained from a 3-connected planar graph by deleting one vertex, and the theorem is best possible for circuit graphs. In this paper, we give a characterization of a circuit graph G each of whose 2-connected spanning subgraph K of G requires $|E(K)| \geq \frac{4}{3}(|V(G)| - 1)$ and then we improve the bound for the 3-connected planar case.

5 Sho Kubota (Osaka Inst. of Tech.) Mixed strongly regular graphs to induce periodic quantum walks 15

Summary: We derive combinatorial necessary conditions for discrete-time quantum walks defined by regular mixed graphs to be periodic. One useful necessary condition is that if a k-regular mixed graph with n vertices is periodic, then $2n/k$ must be an integer. As an application of this work, we determine periodicity of mixed complete graphs and mixed graphs with a prime number of vertices. Furthermore, we study periodicity of mixed strongly regular graphs and several classes of mixed distance-regular graphs, and extend existing results to mixed graphs.

Summary: We study periodicity of the Grover walk and see relation between structure of the underlying graph. By combinations of matchings and cycles of the underlying graph, we completely characterize the graphs admitting an odd-periodic Grover walk. Through such characterization, we see relation between quantum walks and geometric information of graph.

Summary: The purpose of this presentation is a characterization of graphs that induce periodic Grover walks with given periods. In previous studies, Yoshie has shown that the only graphs that induce odd periodic Grover walks are cycle graphs. However, this problem is largely unsolved for even periods. In this study, using spectral graph theory and Galois theory, we calculate eigenvalues of a graph and their multiplicities and sum of eigenvalues, and then characterize graphs. As a result, we show that regular graphs that induce $2l$-periodic Grover walks are also restricted to cycle graphs in most cases, where l is an odd number.

Summary: Recently, a bipartite walk on a bipartite graph was introduced, and the periodicity of its time evolution matrix was discussed. We resent a formula for the time evolution matrix of the bipartite walk, and so give its spectra. As an application, we provide a formula for the time evolution matrix of the bipartite walk on a semiregular bipartite graph, and show its spectra. Furthermore, we treat a relation between the Grover walk and the bipartite walk on a bipartite graph. Finally, we present a formula for the time evolution matrix of the bipartite walk on a regular covering of a bipartite graph.

14:15–16:10

Summary: In this talk, we introduce a Parrondo's game of quantum search based on quantum walks. Parrondo's game is the game that a winning strategy is constructed a combination of losing strategies. This situation is called Parrondo's paradox. Unlike the previous model, the paradox is defined by the average of probability of finding marked vertex. We show that the paradox exists for our model by numerical simulations on the cycle and the 2-dimensional torus. Moreover, we give the range in which the paradox occurs is symmetric about the origin on the d-dimensional torus with even vertices and one marked vertex.

Summary: In this talk, we consider a spectral analysis of the Correlated Random Walk. We obtain the result for the isospectral coin cases by using the Jacobian Matrix.

Summary: The quantum walk (QW) is a quantum version of the classical random walk (RW) and is known as one of the fundamental elements of quantum algorithms. In this study, eigenvalues are derived for one-defective non-unitary QWs with perturbations at the origin using the transfer matrix method.

Summary: We propose a generalization of a unified Stirling numbers introduced by Hsu and Shiue and the bivariate generating functions of exponential generating functions by using the Roman factorial. As a consequence, we conclude that a horizontal generating function of generalized Stirling numbers with certain parameters is simply the principal part of the Laurent series of the vertical generating function with reciprocal parameters. Moreover, by specializing the parameters of generalized Stirling numbers, we can obtain some equations concerning the fourth quadrant of the exponential recursive matrix.

Summary: Let $n \geq 2$ and $d_1, \ldots, d_n \geq 2$ be integers, and $\mathcal{F}$ be a field. A vector $u \in \mathcal{F}^{d_1} \otimes \cdots \otimes \mathcal{F}^{d_n}$ is called a product vector if $u = u^{[1]} \otimes \cdots \otimes u^{[n]}$ for some $u^{[1]} \in \mathcal{F}^{d_1}, \ldots, u^{[n]} \in \mathcal{F}^{d_n}$. In this talk, we estimate the number of linearly independent product vectors in subspaces over finite fields. This result is an extension of our previous work from the case of infinite fields to that of finite fields.

Summary: The classification problem of P- and Q-polynomial association schemes has been one of the central problems in algebraic combinatorics. Generalizing the concept of P- and Q-polynomial association schemes to multivariate cases has been tried by some authors, but it seems that so far, there were neither very well-established definition nor results. Very recently, Bernard, Crampé, d'Andecy, Vinet, and Zaimi defined bivariate P-polynomial association schemes, as well as bivariate Q-polynomial association schemes. In this talk, we study these concepts and propose a new modified definition concerning a general monomial order, which is more general and more natural and also easy to handle. We prove that there are many interesting families of examples of multivariate P- and/or Q-polynomial association schemes.

Summary: There is a close relationship between MAT-free graphic arrangements, derived from the theory of hyperplane arrangements, and strongly chordal graphs, derived from graph theory. In this talk, we will further study the correspondence with locally regular vines, which are objects derived from statistics.

16:30–17:30 Talk Invited by Applied Mathematics Section

Shoichi Tsuchiya (Senshu Univ.) HISTs and Halin graphs

Summary: A spanning tree with no vertices of degree 2 is called a homeomorphically irreducible spanning tree (HIST). The structure of a HIST is sometimes used as an essential tool to construct an explicit class of edge-minimal 3-connected plane graphs (such graphs are called Halin graphs). In this talk, we introduce theorems, problems and open problems on HISTs and Halin graphs with a particular focus on conjectures which are solved in last about 10 years.

September 21st (Thu) Conference Room VIII

9:30–11:30

16 Shinya Fujita (Yokohama City Univ.)
Remiko Iida (Yokohama City Univ.)
Shun-ichi Maezawa
(Tokyo Univ. of Sci.)
Orientations for properly ordered coloring on vertex weighted trees · · · 10

Summary: Let (G,w) be a vertex weighted graph, where w is a weight function on V(G) such that w: V–> 1,2,.... A vertex coloring c: V–>0,1,2,... is called properly ordered coloring (POC) of (G,w), if for every edge e=uv in E(G), c(u)>c(v) if w(u)>w(v) and c(u) is different from c(v) if w(u)=w(v). In this talk, we discuss giving an orientation on E(G) such that the in-degrees of vertices of the resulting digraph D achieve a POC on (G,w) for the case where G is a tree T and w: V–>1,2.

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

Summary: A k-partite graph is said to be a *semi-balanced k-partite graph* if each partite set has either n or m vertices. We obtain a degree condition of a semi-balanced 3-partite Hamiltonian graph. We also show a degree condition of a semi-balanced 3-partite pancyclic graph.

18 Takafumi Saikawa (Nagoya Univ.)
Yosuke Tsuji (Kitami Inst. of Tech.)
Kazunori Matsuda
(Kitami Inst. of Tech.)
Formalization of matching theory in Coq · · · 15

Summary: We formalize the notions of matching, maximal matching, induced matching and related invariants.

19 Iwao Sato (Oyama Nat. Coll. of Tech.)
Takashi Kmatsu (Univ. of Yamanashi)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
CTM/Zeta correspondence · · · 15

Summary: In our previous work, we investigated the relation between zeta functions and discrete-time models including random and quantum walks. We introduce a zeta function for the continuous-time model (CTM) and consider CTMs including the corresponding random and quantum walks on the d-dimensional torus.

20 Kohei Sato (Oyama Nat. Coll. of Tech.)
Takashi Komatsu (Univ. of Yamanashi)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Iwao Sato (Oyama Nat. Coll. of Tech.)
Ronkin/Zeta correspondence · · · 15

Summary: We present a new relation between the Ronkin function and the logarithmic zeta function for several random walks and quantum walks. Fortunately, the Laurent polynomials were obtained through those Ronkin functions. Finally, we describe some properties about them by using the terminology of tropical geometry.

21 Takashi Komatsu (Univ. of Yamanashi)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Iwao Sato (Oyama Nat. Coll. of Tech.)
Shunya Tamura (Yokohama Nat. Univ.)
Mahler/Zeta correspondence 15

Summary: The Mahler measure was introduced by Mahler in the study of number theory. It is known that the Mahler measure appears in different areas of mathematics and physics. On the other hand, we have been investigated a new class of zeta functions for various kinds of walks including quantum walks by a series of our previous work on Zeta Correspondence. In this talk, we present a new relation between the Mahler measure and our zeta function for quantum walks. Our results bridge between the Mahler measure and the zeta function via quantum walks for the first time.

22 Hikari Sakamoto (Kanagawa Univ.)
Norio Konno
(Ritsumeikan Univ./Yokohama Nat. Univ.*)
Kei Saito (Kanagawa Univ.)
A property of the summation of random variables determined by the Konno distribution 15

Summary: The state-space model for time-series analysis typically uses a white noise given by the Gaussian distribution. This means that the noise follows a random walk on the one-dimensional lattice. In this study, we report the results obtained for the noise containing quantum effects, i.e., when the noise follows a quantum walk determined by the Konno distribution. In particular, we consider a property of a sum of random variables determined by the Konno distribution.

13:00–14:15

23 Madoka Awada (Waseda Univ.)
A note on t-designs in isodual codes 15

Summary: Shells of the extended binary quadratic residue code C_ℓ are known to support combinatorial 2-designs. In the present talk, by computing Jacobi polynomials and harmonic weight enumerators, we show that $C_\ell \cup (C^\perp)_\ell$ is a 3-design whenever $C_\ell \cup (C^\perp)_\ell$ is non-empty.

24 Masatake Hirao (Aichi Pref. Univ.)
Hiroshi Nozaki (Aichi Univ. of Edu.)
Koji Tasaka (Aichi Pref. Univ.)
Spherical designs and modular forms of the D_4 lattice 15

Summary: In this talk, we study shells of the D_4 lattice with the concept of spherical design of harmonic index T (spherical T-design for short). We first introduce that the $2m$-shell of D_4 is an antipodal spherical $\{10, 4, 2\}$-design on the 3-sphere. In addition, the 2-shell, which is the D_4 root system, is a tight $\{10, 4, 2\}$-design, using the linear programming method. Moreover, we introduce the the uniqueness of the D_4 root system as an antipodal spherical $\{10, 4, 2\}$-design with 24 points. Finally, we give two applications of the uniqueness.

25 Kenji Tanino (Kobe Univ.)
Masanori Sawa (Kobe Univ.)
Masatake Hirao (Aichi Pref. Univ.)
An upper bound for the degree of a certain type of B_d-invariant weighted spherical designs 15

Summary: In this talk we give an upper bound for the degree of a certain type of B_d-invariant weighted spherical designs, as a generalization of Bajnok(2007), Heo–Xu (2001) and Sawa–Xu (2014). We also discuss the best possibility of our bound in low dimensions.

26 Teruyuki Mishima (Kobe Univ.)
Masanori Sawa (Kobe Univ.)
Yukihiro Uchida (Tokyo Metro. Univ.)
The problem of the existence of centrally symmetric rational designs 15

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

September 22nd (Fri) Conference Room VIII

9:30–12:00

27 Noboru Ito (Ibaraki Nat. Coll. of Tech.)
Integrating curvature and quantizating Arnold strangeness invariant 15

Summary: There are three classical Arnold invariants for plane curves. Two of them have been quantized by Viro (1996) and by Lanzat–Polyak (2013), respectively. Although the quantization of the Arnold strangeness St remained unrealized. In this talk, we express a quantization of St by integrating curvatures multiplied by non-trivial densities. This integral indues a polynomial of variable q. This quantized Arnold strangeness polynomial includes the rotation number, the original Arnold strangeness St, and the Tabachnikov invariants as coefficients in its Taylor expansion.

28 Kamolphat Intawong (Ibaraki Nat. Coll. of Tech.)
Application of linking number theory to authentication technology ... 15

Summary: In this study, we introduce the application of linking number theory of knot theory in mathematics to information security technology. Firstly, we introduce new variations of Milnor's triple linking number. Secondly, we define a notion of the multiple linking number, which implies two kinds of invariants. Lastly, we apply a multiple linking number to the authentication technology.

29 Takuya Nakagawa (Ritsumeikan Univ.)
Existence of density functions for the running maximum of SDEs by non-truncated pure-jump Lévy processes. 15

Summary: We verify the existence of density functions of the running maximum of a stochastic differential equation driven by a Brownian motion and a non-truncated stable process. This is proved by the existence of density functions of the running maximum of Wiener–Poisson functionals resulting from Bismut's approach to Malliavin calculus for jump processes.

30 Itsuki Watanabe (Waseda Univ.)
Markov chain approximation for Hamilton–Jacobi–Bellman equation with absorbing boundary 15

Summary: In this talk, we consider the infinite horizon optimal control problems of the controlled Markov process. 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.

Summary: In recent years, the use of data-driven methods has provided insights into underlying patterns and principles behind culinary recipes. In this work, we introduce the use of persistent homology, a tool in topological data analysis that can describe the multiscale holes in data, in the study of culinary recipes. In particular, persistent homology analysis provides a set of recipes surrounding holes in the space of existing recipes. We then propose a method to generate novel ingredient combinations using this topological information with combinatorial optimization. We made biscuit-like baked goods using the novel ingredient combinations. Our findings indicate that persistent homology has the potential for suggesting novel culinary recipes.

Summary: We study the existence of real-analytic first integrals and real-analytic integrability for perturbations of integrable systems including non-Hamiltonian ones in the sense of Bogoyavlenskij such that the first integrals and commutative vector fields depend analytically on the small parameter. We compare our results with the classical results of Poincaré and Kozlov for systems written in action and angle coordinates and discuss their relationships with the subharmonic and homoclinic Melnikov methods for periodic perturbations of single-degree-of-freedom Hamiltonian systems. Moreover, we apply our theory to the periodically forced Duffing oscillator and reveal that the perturbed systems can be real-analytically nonintgrable even if there exists no transverse homoclinic orbit to a periodic orbit.

Summary: In this talk, we consider regularizing the optimal transport problem using Bregman divergence and present the results of the error estimate. We also show that there exists a Bregman divergence that converges faster than the commonly used regularization by Shannon entropy and provide an actual example.

Summary: In this study, we propose a variable classification method based on the Groebner basis, motivated by the analysis of peripheral blood hematopoietic stem cell mobilization data. This data analysis requires the extraction of particularly important variables from the given data, but the hidden algebraic relationships make it difficult to identify the important variables. We attempt to extract hidden algebraic equations from the data and classify the variables by rearranging these equations using a computational algebraic method.

Summary: In this talk, we introduce a new definition of discrete holomorphic functions and a discrete circumscription. And we report a theorem of the discrete version of Cauchy's integral representation obtained in our setting.

14:15–16:30

36 Kota Ohno (Chuo Univ.)
Toshiyuki Ogawa (Meiji Univ.)
The characteristic of the limit cycle and the growth of the chimera state in coupled oscillator system 15

Summary: Coupled oscillator systems have been studied in various fields of physical and biological phenomena. Among them, systems of nonlocally coupled oscillators can exhibit chimera states, which consist of spatially coherent and incoherent states. However, chimera states' stability and bifurcation origin has not been understood. In this study, we investigate the relationship between the characteristic of the limit cycle and the growth of the chimera state. We consider the control principle and bifurcation origin for the chimera state.

37 Mamoru Aizawa (Meiji Univ.)
Yu Ichida (Meiji Univ.)
Yuki Kamaya (Meiji Univ.)
Shiori Kato (Meiji Univ.)
Minami Kosuge (Meiji Univ.)
Takashi Sakamoto (Meiji Univ.)
Rika Yamada (Meiji Univ.)
Shigetoshi Yazaki (Meiji Univ.)
Mathematical model to describe the material properties of paste-like artificial bone 15

Summary: A mathematical model for expressing the material properties of paste-like artificial bone constructed based on biomaterials experiments and a discussion on the validity of the model based on the simulation and experimental results are presented. The model is based on an experiment comparing calcium cement using IP6 with pure water and adopts the Allen–Cahn equation. In this talk, we will present the experiments that led to the construction of the model, the experiments for the construction of the model, and the model, as well as the results obtained in cooperation with the experiments.

38 Yu Ichida (Meiji Univ.)
Takashi Sakamoto (Meiji Univ.)
Classification of traveling wave solutions for certain degenerate parabolic equations and the bifurcation at infinity 15

Summary: This talks reports results on the classification of traveling wave solutions, including nonnegative weak sense, in the spatial 1D degenerate parabolic equation. These are obtained through dynamical systems theory and geometric approaches (in particular, Poincaré compactification). The results examine a different range of parameters included in the equation, using the same techniques as discussed in the earlier my work. In a clear departure from this previous work, the classification results obtained in this paper and the successful application of known transformation also yield results for the classification of (weak) nonnegative traveling wave solutions for spatial 1D porous medium equations with special nonlinear terms and the simplest porous medium equation. Finally, the bifurcations at infinity occur in the two-dimensional ordinary differential equations that characterize these traveling wave solutions are shown.

39 Koichi Anada (Waseda Univ. Senior High School)
Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Takeo Ushijima (Tokyo Univ. of Sci.)
A Remark on traveling wave solutions for a quasi-linear parabolic partial differential equation 15

Summary: Blow-up phenomena of curvatures on cusp singularities in contractions of convex immersed curves with self-crossing points have been studied by many authors. They deal with blow-up solutions of a quasi-linear parabolic equation and a rescaled one. In their analysis, particularly in estimating the blow-up rate, the slowly traveling wave solutions play a significant role. Our purpose of this talk is to investigate the behavior of slowly traveling wave solutions.

Summary: The time-domain fluorescence diffuse optical tomography (FDOT) problem is to recover the distribution of fluorophores in biological tissue from the time-domain measurement on the boundary. The measurement is conducted by several pairs (S-D pairs) of a point source and a point detector. In this talk, we identify the location of the fluorophore over a point, refer as a point target. We first express a solution for the forward problem in a dimensionless form and derive its asymptotic behavior when the point target is far from the boundary. Based on the asymptotic behavior, we show local solvability and make a numerical inversion scheme for locating a single point target. Further we discuss about locating well-separated multiple point targets.

Summary: To describe biological phenomena such as cell migration and cell adhesion many evolutional equations are proposed in which an advective convolution term with a suitable integral kernel is imposed. It is well known that such nonlocal equations can reproduce various behaviors depending on the shape of the integral kernel. These nonlocal evolutional equations are often difficult to analyze, and the analytical method is developing. In the light of these background we approximate the nonlocal Fokker–Planck equations by the combination of a Keller–Segel system which is a typical local dynamics. We will show that the solution of the nonlocal Fokker–Planck equation with any even continuous integral kernel can be approximated as a singular limit of the Keller–Segel system by controlling parameters.

Summary: In the field of traffic flow, self-organized wave propagation, which characterizes congestion, has been reproduced in both macro and micro models. Hydrodynamic models, a type of macro-model, include those that can be derived from micro-level car-following models, and the relationship between the two has been investigated. However, since most of them have been verified by numerical methods and formal analysis, analytical approaches are also necessary to rigorously guarantee their validity. The aim of this research is to discuss the relationship between macro and micro models through the properties of solutions corresponding to congestion with sparse and dense waves. Specifically, we will show the existence of traveling wave solutions in the macro model and investigate their properties.

Summary: We deal with the bistable reaction-diffusion equation on an unbounded metric graph consisting of half-lines L_i $(1 \le i \le m)$ joined at a point (junction). Assume that on $\mathbb{R}$ the equation has a monotone decreasing traveling front wave $\phi(x - ct)$ with $c > 0$ connecting the two stable constant steady states and set $L_i = \{-\infty < x_i < 0\}$ $(1 \le i \le k)$ with $k \le m$. Then we prove that given numbers θ_i $(1 \le i \le k)$, there exists an entire solution which converges to the front profile $\phi(x_i - ct - \theta_i)$ on each L_i as $t \to -\infty$.

16:45–17:45 Award Lecture for the 2022 Applied Mathematics Prize

Shin-ichiro Ei (Hokkaido Univ.) On pattern formation problem and its contraction

Summary: There are three major stages in the process of pattern formation. The process of pattern generation, in which various patterns are generated from small initial perturbations, and convergence of individual patterns to a specific pattern, such as a stationary state or a traveling wave, and the pattern interaction process, in which multiple formed patterns converge to a final shape through the interaction between them. In this talk, I will focus on the phenomena described by the reaction-diffusion type model equations, and apply the method of contraction to the mathematical analysis for the behavior of solutions in each process involved in pattern formation.

September 23rd (Sat) Conference Room VIII

9:30–12:00

44 Masaki Imagawa (Kyoto Univ.) Daisuke Kawagoe (Kyoto Univ.) Convergence rates of an elliptic regularization applied to a stationary advection equation 15

Summary: Elliptic regularization is a method of capturing a solution to a partial differential equation by adding an elliptic operator with a small parameter. In this talk, we consider a boundary value problem of a stationary advection equation with the homogeneous inflow boundary condition in a bounded domain with Lipschitz boundary, and consider its perturbation by $\varepsilon\Delta$, where ε is a positive parameter and Δ is the Laplacian, as an example of elliptic regularization. We discuss convergence rates assuming H^1 or H^2 regularity for original solutions. A key observation is that the convergence rate depends on boundary conditions posed to the perturbed equation, the regularity of original solutions, and a relation between the boundary and the advection vector field.

45 Sohei Tasaki (Hokkaido Univ.) Eigenpairs of the linear elasticity operator on the disk 15

Summary: Although the linear elasticity operator is an important elliptic operator that describes the core of the deformation theory of elastic bodies, the form of its eigenfunctions, even the first eigenfunction, seems to be not well understood. This is due to the fact that the conservation of ordered structure, such as the maximum principle, is not obvious in vector fields. Another difficulty is the existence of non-diagonal components of the operator. Therefore, the next step is to find eigenvalues and eigenfunctions on the two-dimensional disk domain, which seems to be the simplest case where the non-diagonal components essentially play a role. In this talk, we report all eigenvalues and eigenfunctions of the linear elastic operator on the disk.

46 Takashi Sakajo (Kyoto Univ.) Yuta Tsuji Statistical laws of a one-dimensional turbulence model as a random PDE 15

Summary: We propose a one-dimensional model of turbulent flows generating the cascade of the conserved quantity. We show the global existence of a unique global solution of the equation subject to random forcing functions that are chosen from a given distribution. Moreover, we numerically investigate the solutions' statistical laws such as enstrophy spectra and structure functions by Galerkin approximation of random variables with generalized Polynomial Chaos.

Summary: We consider the evolution of N point vortices in a doubly-periodic rectangle. In this talk, we provide the analytic formula of the hydrodynamic Greeb's function in the domain utilizing the Schottky–Klein prime function associated with an annular domain. With the conformal mapping approach, we have derived the governing equation from the analytic representation. In the derivation, the sum of vortex strengths doesn't necessarily vanish, which is not covered by the previous works. Utilizing the equation, we show a Hamiltonian structure for the equation and discuss the integrability of the system. We also find new lattice equilibria arranged in doubly-periodic rectangular and parallelograms.

Summary: Viscous salt water motion under gravity with non-uniform heat supply in a long horizontal strip domain is considered. An existence theorem of stationary solutions and some numerical computations are shown.

Summary: We propose the usage of the IMT-type variable transformation, which is used in the IMT-type numerical integration formula, in various numerical computation such as numerical indefinite integral, numerical solution of ordinary differential equations, and so on. Recently, the DE (double exponential) transformation, which is used in the DE numerical integration formula, has been applied to various numerical computations coupled with the Sinc approximation. We show that the IMT-type transformation can be applied as the DE one coupled with the Sinc approximation for periodic functions.

Summary: We propose a novel algorithm for quantitative comparisons between compact surfaces embedded in the three-dimensional Euclidian space. The key idea is to identify those objects with the associated surface measures and compute a weak distance between them using the Fourier transform on the ambient space. In particular, the Sobolev norm of negative order for a difference between two surface measures is evaluated via the Plancherel theorem. This approach amounts to approximating a weighted integral norm of smooth data on the frequency space and allows several advantages in terms of accuracy and efficiency. As a validation, we present numerical experiments where the 2-sphere is compared with its icosahedral discretization and observe that the piecewise linear approximations converge to the smooth object.

Summary: In this study, we evaluate directly the mean square errors in numerical solutions by an integer-type high-accuracy algorithm for linear higher-order ODEs using quasi-orthogonalizations of integer-valued vectors which was proposed recently by the author and M. Hayashi. Their direct evaluation is very difficult by usual methods, since the accuarcy of this algorithm is very high while we have hardly a simple method for calculating the true values of the expansion coefficients with a very high accuracy in usual cases. In this study, we show how we can execute the direct evaluation by means of the recurrence relation among the expansion coefficients.

52 Tokuhiro Eto (Univ. of Tokyo)
Yoshikazu Giga (Univ. of Tokyo)
On a minimizing movement scheme for mean curvature flow with prescribed contact angle in a curved domain and its computation ····· 15

Summary: We introduce a capillary Chambolle type scheme for mean curvature flow with prescribed contact angle. Our scheme includes a capillary functional instead of just the total variation. We show that the scheme is well-defined and has consistency with the energy minimizing scheme of Almgren–Taylor–Wang type. Moreover, for a planar motion in a strip, we give several examples of numerical computation of this scheme based on the split Bregman method instead of a duality method.

14:15–16:00

53 Haruki Takemura (Univ. of Tokyo)
Takahito Kashiwabara (Univ. of Tokyo)
Convergence analysis of CIP method for the one-dimensional advection equation ····· 15

Summary: Cubic Interpolated Pseudo-particle (CIP) scheme is a semi-Lagrangian method for numerical calculation of hyperbolic partial differential equations. The CIP method has low numerical diffusion and high accuracy. It is observed by experiments that the CIP scheme for the one-dimensional advection equation has third-order accuracy in time and space. We present convergence analysis of the CIP scheme for the one-dimensional advection equation. Since the scheme can be interpreted as the repetition of translation and the Hermite interpolation, properties of the piecewise Hermite interpolation play an important role in the proof.

54 Ryoki Endo (Niigata Univ.)
Xuefeng Liu (Niigata Univ.)
Verified computation for shape derivative of the Laplacian eigenvalues ····· 15

Summary: The shape derivative of Laplacian eigenvalues with respect to domain deformations was studied theoretically by Hadamard in the early 20th century. In this study, we propose a verified computation method for the shape derivative of clustered eigenvalues using guaranteed computation of both eigenvalues and eigenfunctions.

55 Yuki Chiba (Univ. of Tokyo)
Norikazu Saito (Univ. of Tokyo)
Nitsche's method for a Robin boundary value problem in a smooth domain ····· 15

Summary: The Robin boundary value problem (BVP) is interpreted as the classical penalty method with the penalty parameter ε. The optimal choice of the mesh size h relative to ε is a non-trivial issue. In this talk, we carefully examine the dependence of ε on error estimates and prove several optimal-order error estimates for a Nitsche's method applied to an inhomogeneous Robin BVP for the Poisson equation defined in a smooth bounded domain.

56 Makoto Mizuguchi (Chuo Univ.)
Mitsuhiro T. Nakao (Waseda Univ.)
Kouji Hashimoto (Nakamura Gakuen Univ.)
Kouta Sekine (Chiba Inst. of Tech.)
Shin'ichi Oishi (Waseda Univ.)
The quantitative error estimates for a full-discrete approximate solution ····· 15

Summary: We consider constructive error estimates for a full discrete approximate solution of the heat equation with the Dirichlet boundary condition. In particular, we mainly focus on formulas for obtaining the values of the error constants. The formulas giving sharp estimates for the constants improve the numerical verification methods. The previous formula requires some large-size complicated matrices to get the values. We lead a formula constructed by only the error constants for the Ritz-projections in a domain and a time interval without the matrices. The effectiveness of the formula will be introduced in this talk.

57 Gabriel W. Duchesne (McGill Univ.)
Jean-Philippe Lessard (McGill Univ.)
Akitoshi Takayasu (Univ. of Tsukuba)
Computer-assisted proofs for global existence of solutions to semilinear parabolic equations 15

Summary: We propose a strategy to prove the global existence (in time) of solutions to initial value problems of semilinear parabolic PDEs via the mechanism of convergence towards an asymptotically stable non-trivial equilibrium solution. Our method is based on the pseudo-diagonalization of the Fréchet derivative at a non-trivial equilibrium using Gershgorin's approach, which gives access to the "eigenvalues" of the equilibrium. Then, by constructing a trapping region of the asymptotically stable equilibrium, we perform rigorous integration so that the solution goes into the trapping region. Therefore, we conclude that the solution exists globally in time and it converges to the non-trivial equilibrium.

58 Yoshitaka Watanabe (Kyushu Univ.)
Tomoyuki Miyaji (Kyoto Univ.)
Computer-assisted proofs of unimodality of solutions for Proudman–Johnson equation 15

Summary: This talk presents a computer-assisted proof of the existence and unimodality of steady-state solutions for the Proudman–Johnson equation which is representative of two-dimensional fluid flow. The proposed approach is based on an infinite-dimensional fixed-point theorem with interval arithmetic, and is another proof by Miyaji and Okamoto (2019). Verification results show the validity of both proofs.

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

Kenta Ishimoto (Kyoto Univ.) Jeffery's orbits and hydrodynamic shape of life

Summary: When observing fluid flow, our perception of its motions often relies on tracking the movements of small particles within the fluid. In this talk, we will discuss the dynamics of microscopic objects, particularly those capable of self-propulsion, such as living organisms. Nearly a century ago, G. B. Jeffery derived an exact solution to the Stokes equation for a spheroidal object in simple shear, revealing that its orientation vector traces a closed, time-periodic trajectory now referred to as Jeffery's orbit. By introducing the concept of hydrodynamic symmetry, based on the equation of motion, we extend Jeffery's equation to encompass general chiral axisymmetric objects. Further, we will demonstrate by a classical multi-scale perturbation theory that various complex self-propelling motions can be explained by generalized asymptotic Jeffery's equation.

Topology

September 20th (Wed) Conference Room Ⅲ

9:30–12:00

1 Masaaki Suzuki (Meiji Univ.)
Takayuki Morifuji (Keio Univ.)
On the minimal order of knots ····· 10

Summary: Based on a vanishing theorem for non-fibered knots due to Friedl and Vidussi, we define the minimal order of a knot to be the order of the smallest finite group such that the corresponding twisted Alexander polynomial is zero. In this talk, we report that the lower bound of the minimal order of every knot is 24. This is the best possible in the sense that there exists a knot whose minimal order attains the bound. Moreover, we provide several explicit values for the minimal order of knots with 10 or fewer crossings.

2 Yasutaka Nakanishi (Kobe Univ.*)
Shin Satoh (Kobe Univ.)
Colors of virtual tangles ····· 15

Summary: For Fox n-colorings of virtual tangles, we consider a condition on colors of endpoints of tangles.

3 Takuji Nakamura (Univ. of Yamanashi)
Yasutaka Nakanishi (Kobe Univ.)
Shin Satoh (Kobe Univ.)
Kodai Wada (Kobe Univ.)
Virtualized Δ-moves for virtual knots and links ····· 10

Summary: In this talk, we introduce a local deformation for virtual knots and links, called the $v\Delta$-move, as a virtualized version of the Δ-move. We show that the $v\Delta$-move is an unknotting operation for virtual knots, and then define the $v\Delta$-unknotting number of a virtual knot K as the minimal number of $v\Delta$-moves needed to transform K into the trivial knot. For any positive integer m, we construct a family of infinitely many virtual knots with $v\Delta$-unknotting number m. Moreover we give a classification of virtual links of two or more components up to $v\Delta$-moves.

4 Atsuhiko Mizusawa (Waseda Univ.)
Yuka Kotorii (Hiroshima Univ./RIKEN)
A classification of the component-homotopy classes of spatial graphs ····· 15

Summary: Two links are called link-homotopic if they are transformed to each other by a sequence of self-crossing changes and ambient isotopies. Two spatial graphs are called component-homotopic if they are transformed to each other by a sequence of self-crossing changes and ambient isotopies. The set of the link-homotopy classes of links were classified as the set of the link-homotopy classes of string links modulo certain relations by Habegger and Lin. We give new relations for the set of the link-homotopy classes of "colored" string links and classify the set of the component-homotopy classes of spatial graphs.

5 Koki Yanagida (Tokyo Tech)
Parabolic Dijkgraaf–Witten invariants of links ····· 15

Summary: The Dijkgraaf–Witten invariant is a topological invariant of closed orientable 3-manifolds. Based on this invariant, we define a new invariant of links in the 3-sphere and call it the parabolic Dijkgraaf–Witten invariant. Considering covering spaces branched over links or quandle theory, we establish two procedures to compute parabolic Dijkgraaf–Witten invariants of links. In this talk, we introduce the definition of the parabolic Dijkgraaf–Witten invariant and some computational results.

6 Jun Murakami (Waseda Univ.) From bottom tangle to A_q polynomial 15

Summary: Construct a quantization of the fundamental group of a knot complement by using the bottom tangle. Then applying the Kauffman bracket skein relation, we obtain the skein module of the knot complement. The boundary of a knot is a torus, and the skein algebra of the torus acts to the skein module of the knot complement. Investigating this action, we get a recurrence relation of the colored Jones polynomial.

7 Hajime Kubota (Kyoto Univ.) A combinatorial proof of the connected sum formula for knot Floer homology 15

Summary: Grid homology is a combinatorial reconstruction of knot Floer homology. We research the extended grid homology for transverse spatial graphs and show that grid homology vanishes if the underlying graph has a cut edge as a spatial graph. Then as a corollary, we give a combinatorial proof of the connected sum formula for knot Floer homology.

8 Yasuharu Nakae (Akita Univ.), Teruaki Kitano (Soka Univ.) A construction of epimorphisms between groups of fibered knots that preserve a meridian but the image of its longitude is killed 15

Summary: We study epimorphisms between knot groups, especially focusing on the case that these epimorphisms are induced by a map of degree zero. We construct a family of infinitely many fibered knots that each knot group maps to the knot group of the figure eight knot by an epimorphism, and these epimorphisms are induced by maps that preserve its meridian but the image of its longitude is killed in the knot group of the figure eight knot.

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

Teruaki Kitano (Soka Univ.)♭ Epimorphisms between knot groups and relations to geometric structures and invariants of a knot

Summary: Let K be a knot in S^3 and $G(K) = \pi_1(S^3 \setminus K)$ its knot group. Here we assume that an epimorphism maps a meridian to a meridian. It is well known that a degree one map between knot exteriors induces an epimorphism which preserves a pair of a meridian and a longitude. However, there are a lot of epimorphism between knot groups which preserve a meridian but a longitude to the trivial element. In this talk, we discuss the following: if there exists a meridian preserving epimorphism from $G(K_1)$ onto $G(K_2)$, then what we can see geometric structures or invariants of K_1 and K_2? Mainly we will discuss the genus, twisted Alexander polynomials, symmetric union, and character varieties. This talk will be partially based on several joint works with Michel Boileau, Steven Sivek, Raphael Zentner, Yuta Nozaki, and Yasuharu Nakae.

15:40–17:30

9 Michihiko Fujii (Univ. of Ryukyus), Takuya Sakasai (Univ. of Tokyo) The spherical growth series of amalgamated free products of infinite cyclic groups 15

Summary: Let n be an integer greater than 1. Then we consider an amalgamated free product G of n infinite cyclic groups. The group G is geometrically realized as the fundamental group of a Seifert fiber space over the 2-dimensional disk with n cone points. We present a formula for the spherical growth series of the group G with respect to its standard generating set, from which a rational function expression for the spherical growth series of G is derived concretely.

10 Chihaya Jibiki (Tokyo Tech) Left-orderings on inductive limits of amalgamated free products 15

Summary: We study left orderings on countably generated groups. In particular, we construct left orderings of inductive limits of amalgamated free products by using isolated left orderings of the groups appearing in the inductive system. Moreover, we show that they are no longer isolated orderings.

11 Akihiro Takano (Univ. of Tokyo) The p-colorable subgroup of Thompson's group F ····· 15
Yuya Kodama (Tokyo Metro. Univ.)

Summary: Recently, Jones introduced a method of constructing knots and links from elements of Thompson's group F by using its unitary representations. He also defined a subgroup of F as the stabilizer subgroup, called the 3-colorable subgroup. We proved that all knots and links obtained from non-trivial elements of this group are 3-colorable. In this talk, we extend this result to any odd integer p greater than two. Namely, we define the p-colorable subgroup of F whose non-trivial elements yield p-colorable knots and links and show it is isomorphic to the certain Brown–Thompson group.

12 Yuya Kodama (Tokyo Metro. Univ.) Alexander's theorem for stabilizer subgroups of Thompson's group ··· 15
Akihiro Takano (Univ. of Tokyo)

Summary: Recently, Jones introduced a method of constructing knots and links from elements of Thompson's group F by using its unitary representations. He also showed that this construction is surjective. Namely, any knot or link can be obtained from F. To understand this construction well, we focus on subgroups of F. In this talk, we show that almost all stabilizer subgroups (under the natural action on $[0, 1]$) also give all knots and links.

September 21st (Thu) Conference Room III

9:30–11:30

13 Ryo Kato (Kochi Univ. of Tech.) The first cohomology of the monochromatic comodule M^1_{n-1} at any prime ····· 10
Katsumi Shimomura (Kochi Univ.)
Maonosuke Shimomura (Kochi Univ.)

Summary: We determined the structure of the first cohomology of the monochromatic cohomodule M^1_{n-1} at any prime.

14 Hiroki Okajima W-originated elements in the stable homotopy groups of spheres ····· 10
Ryo Kato (Kochi Univ. of Tech.)
Katsumi Shimomura (Kochi Univ.)

Summary: We prove new result around W-originated elements in the stable homotopy groups of spheres.

15 Ryo Kato (Kochi Univ. of Tech.) Deformed cohomological Bousfield classes ····· 10

Summary: We prove that deformed cohomological Bousfield classes form a set.

16 Ryo Kato (Kochi Univ. of Tech.) A relation between Picard groups of some local categories ····· 10

Summary: We give a new relation between Picard groups of some stable homotopy categories.

17 Kenshi Ishiguro (Fukuoka Univ.) Genus problem of the classifying spaces ····· 10
Makoto Yamagata (Fukuoka Univ.)

Summary: We consider the spaces that their p-completions are homotopy equivalent to the classifying space BG of a compact connected Lie group G at any prime p. Such spaces are said to be in the genus set of BG. Particularly we investigate the case of G being a product of the 3-dimennsional spheres. We will generalize some previous results.

18 Hitoshi Moriyoshi (Nagoya Univ.) Corona index theorem for Cantor sets ····· 15
Toshikazu Natsume
(Nagoya Inst. of Tech.)

Summary: Let X a topological space with its corona the Cantor set. We choose as X either a binary tree or a binary tube. An index formula on X developed, which connect the index class in $K_*(C^*X_{top})$ to a topological invariant obtained from the Cantor set.

19 Naotsugu Chinen (Nat. Defense Acad. of Japan), Takamitsu Yamauchi (Ehime Univ.) — On equivariant asymptotic dimension of actions of discrete groups on non-compact Hausdorff spaces ····· 15

Summary: We extend $\mathcal{F}$-eq-asdim$(\Gamma \curvearrowright X)$ to $\mathcal{F}$-eq-asdim$_{\mathrm{fin}}(\Gamma \curvearrowright X)$ of actions on (not necessarily compact) Hausdorff spaces satisfying that $\mathcal{F}$-eq-asdim$(\Gamma \curvearrowright X) = \mathcal{F}$-eq-asdim$_{\mathrm{fin}}(\Gamma \curvearrowright X)$ whenever X is a compact Hausdorff space. And we also give a characterization theorem for $\mathcal{F}$-eq-asdim$_{\mathrm{fin}}(\Gamma \curvearrowright X)$ in terms of maps into $\ell_1(V)$, which is a generalization of it due to Guentner, Willett and Yu.

September 21st (Thu) Conference Room I

11:40–12:00 Announcement of the 2023 MSJ Geometry Prize

September 21st (Thu) Conference Room III

13:00–14:00

20 Masahiro Takeda (Kyoto Univ.), Daisuke Kishimoto (Kyushu Univ.) — Torsion in the space of commuting elements in a Lie group ····· 15

Summary: Let Hom(Z^m, G) denote the space of commuting m-tuples in a Lie group G. This space is identified with the based moduli space of flat bundles over a torus, so it is an important object not only in topology but also in geometry and physics. I will talk about torsion in the homology of Hom(Z^m, G). We prove that for $m \geq 2$, Hom$(Z^m, SU(n))$ has p-torsion in homology if and only if $p \leq n$. The proof includes a new homotopy decomposition of Hom(Z^m, G) in terms of a homotopy colimit. This talk is based on the joint work with Daisuke Kishimoto.

21 Toshiyuki Akita (Hokkaido Univ.) — Embeddings of Alexander quandles into conjugation quandles ····· 10

Summary: For any twisted conjugate quandle X, and in particular any Alexander quandle, there exists a group G such that X is embedded into the conjugation quandle of G.

22 Shunsuke Kano (Tohoku Univ.) — Train track combinatorics and cluster algebras ····· 15

Summary: The concepts of train track was introduced by W. P. Thurston to study the measured foliations/laminations and the pseudo-Anosov mapping classes on a surface. In this talk, I will translate some concepts of train tracks into the language of cluster algebras using the Goncharov–Shen's potential function. Moreover, I will explain the sign stability of the general pseudo-Anosov mapping classes by using this translation.

September 22nd (Fri) Conference Room III

9:30–12:00

23 Tatsumasa Suzuki (Tokyo Tech) — The d-invariants of the Brieskorn homology spheres with almost simple linear graphs ····· 15

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

Summary: One of the most important problems in the topology of 3-manifolds is the question of which 3-homology sphere bounds a 3-homology ball. In 2003, Ozsváth and Szabó introduced an invariant of rational homology spin^c cobordisms called a d-invariant. Karakurt constructed a formula for the invariants of the Brieskorn homology spheres, one of the most important classes of 3-homology spheres. From this formula, we can find the correspondence between the invariants of these homology spheres and those of lens spaces. In this talk, we introduce a reciprocity law which is effective for obtaining the invariant of any lens space. Furthermore, we explain that by combining these results, we can specifically calculate the invariants of some Brieskorn homology spheres.

Summary: The pochette is the boundary sum $P = S^1 \times D^3 \natural D^2 \times S^2$ of $S^1 \times D^3$ and $D^2 \times S^2$. Pochette surgery on a 4-manifold X is an operation of removing the interior of P from X and gluing P by a diffeomorphism of ∂P. In this talk, we show that for any non-trivial ribbon 2-knot there exists a non-trivial cord such that any pochette surgery yielding a homology S^4 gives the double of a homology D^4 without 3-handles. Furthermore, we give infinitely many examples of pochette surgeries on S^4 with a non-trivial core sphere and a non-trivial cord such that the surgeries give S^4. We also show that there exists the non-trivial fundamental group of the homology S^3 by a Dehn surgery on a knot, which can be constructed along a ribbon 2-knot by that of pochette operations on S^4.

Summary: The complements of plane algebraic curves are well studied from topological and algebro-geometric viewpoints. In this talk, we will describe the explicit handle decompositions and the Kirby diagrams for the complement of plane algebraic curves. The method is based on the notion of braid monodromy. We refined this technique to obtain handle decompositions and Kirby diagrams.

Summary: The Kirby–Thompson invariant for a knotted surface was defined in 2021 using the bridge trisection for the knotted surface and the pants complex or the dual curve complex of the trisection surface. In this talk, we review the definition of bridge trisections of knotted surfaces and the Kirby–Thompson invariants for them. Moreover, we determine some Kirby–Thompson invariants for distant sums of finitely many standard knotted surfaces.

Summary: A 2-sphere embedded in the 4-sphere invariant under a circle action is called a branched twist spin. A branched twist spin is constructed from a 1-knot in the 3-sphere and a pair of coprime integers uniquely. Fundamental groups of 3-orbifolds of cyclic type are obtained as quotient groups of the fundamental groups of the complements of branched twist spins. In this talk, by using such fundamental groups, we give some conditions to distinguish branched twist spins.

Summary: Gay and Meier asked whether a trisection diagram for Gluck twisting on the spin or the twist spin of a non-trivial knot in the 3-sphere constructed by using its doubly pointed Heegaard diagram is standard. The diagram is a potential counterexample of so called 4-dimensional Waldhausen's conjecture. In this talk, we depict the trisection diagram explicitly in the case of the spin of the $(p+1, -p)$-torus knot, where $p \geq 2$, and show that the trisection diagram is standard for all p.

30 Natsuya Takahashi (Osaka Univ.) Trisection genera for an exotic pair of 4-manifolds with boundary · · · · 15

Summary: A trisection is a decomposition of a 4-manifold into three 1-handlebodies. The notion of a trisection is a natural 4-dimensional analogue of Heegaard splittings for 3-manifolds. A trisection genus is a fundamental invariant of smooth 4-manifolds defined by trisections. In this talk, we show that there exists an exotic pair of 4-manifolds with boundary whose trisection genera are 4. We also show genus-3 relative trisections for the infinite family $\{W^{\pm}(l,k)\}_{l,k\in\mathbb{Z}}$ of contractible 4-manifolds introduced by Akbulut and Kirby.

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

Kouichi Yasui (Osaka Univ.) Smooth structures on 4-manifolds and genus functions

Summary: The genus function of a smooth oriented 4-manifold is the function that maps a second homology class to the minimal genus of an embedded closed oriented surface representing the class. This function is sensitive to the smooth structure of a 4-manifold and has many applications to low dimensional topology. In this talk, I will briefly review genus functions, and give applications to exotic smooth structures and properties of smooth 4-manifolds such as the geometric simple connectivity and the (mod 2) simple type conjecture. I will also discuss a limitation of genus functions and its applications.

15:40–17:00

31 Genki Omori (Tokyo Univ. of Sci.) A minimal generating set for the quasitoric braid group · · · · · · · · · · · · 10

Summary: A toric braid is a braid whose closure is a torus link in $\mathbb{R}^3$. Manturov generalized toric braids that is called *quasitoric braids* and showed that the subset of quasitoric braids in the classical braid group is a subgroup of the braid group. We call this subgroup the *quasitoric braid group*. In this talk, we give a minimal generating set for the quasitoric braid group.

32 Ryoma Kobayashi (Ishikawa Nat. Coll. of Tech.) The level d principal congruence subgroup of $\mathrm{SL}(n;\mathbb{Z})$ · · · · · · · · · · · · · · 10
Nao Imoto

Summary: The abelianization of the level d principal congruence subgroup $\Gamma_d(n)$ of $\mathrm{SL}(n;\mathbb{Z})$ was determined by Lee–Szczarba. By this result and a result of Tits, we can obtain a minimal generating set for $\Gamma_d(n)$. In this work, we gave three theorems about $\Gamma_d(n)$.

33 Ryoma Kobayashi (Ishikawa Nat. Coll. of Tech.) The level d mapping class group of a non-orientable closed surface · · · 10

Summary: Let N_g be a genus g non-orientable closed surface. We explain about relations on the level d mapping class group $\mathcal{M}_d(N_g)$ of N_g and the level d principal congruence subgroup of $\mathrm{GL}(g-1;\mathbb{Z})$. As applications, we can give a normal generating set of $\mathcal{M}_d(N_g)$ and a finite generating set of $\mathcal{M}_{2^l}(N_g)$ for $g \geq 4$.

Infinite Analysis

September 20th (Wed) Conference Room VI

9:30–12:00

1 Wenda Fang (Kyoto Univ.) Generalized AKS scheme of integrability via vertex algebra · · · · · 15

Summary: It is well-known that the affine Kac–Moody vertex algebra at the critical level has a large center called the Feigin–Frenkel center. Also, Victor Kac and his collaborators showed that Poisson vertex algebra plays an important role in studying infinite-dimensional Hamiltonian systems. In this talk, we define the classical R-matrix of Lie conformal algebra. By using the Feigin–Frenkel center and the classical R-matrix of Lie conformal algebra we give a new integrability scheme.

2 Yousuke Ohyama (Tokushima Univ.) Global theory on q-Painlevé equations and special solutions · · · · · 15

Summary: We study the space of connection matrices of the Lax pair of the q-Painlevé VI equation. The space is the Segre surface, which is the del Pezzo surface of degree four. We observe that a holomorphic solution of the q-Painlevé VI equation corresponds to an intersection of two lines of the Segre surface. This result is a q-analogue of Kaneko's solutions of the Painlevé VI equation, which correspond to an intersection of two lines of the Fricke cubic.

3 Kouichi Takemura (Ochanomizu Univ.) Kernel function, q-integral transformation and q-Heun equations · · · · · 15

Summary: We find kernel functions of the q-Heun equation and its variants. We apply them to obtain q-integral transformations of solutions to the q-Heun equation and its variants.

4 Tetsu Masuda (Aoyama Gakuin Univ.)
Teruhisa Tsuda (Aoyama Gakuin Univ.) Rational solutions to the q-Painlevé system of type $E_7^{(1)}$ · · · · · 15

Summary: We explain a construction of a family of rational solutions to the q-Painlevé system of type $E_7^{(1)}$.

5 Hidehito Nagao (Akashi Coll. of Tech.) Multivariable generalization of the additive difference Painlevé equation with the affine Weyl group symmetry of type $D_4^{(1)}$ · · · · · 15

Summary: We construct a multivariable generalization of the additive difference Painlevé equation with the affine Weyl group symmetry of type $D_4^{(1)}$ and give three representations of the Lax forms. Also, we show some relations to additive difference Painlevé equations and the q-Garnier system (given as the multivariable generalization of the q-Painlevé equation with the affine Weyl group symmetry of type $D_5^{(1)}$). In this talk, we present the results.

6 Takahiko Nobukawa (Kobe Univ.)
Taikei Fujii (Kobe Univ.) Integral solutions and series solutions for the variant of the q-hypergeometric equation of degree three · · · · · 15

Summary: Papperitz's differential equation is essentially obtained by applying a Moebius transformation to Gauss' hypergeometric system, thus it has Euler type integral solutions and series solutions in terms of Gauss hypergeometric function ${}_2F_1$. The variant of the q-hypergeometric equation of degree three, introduced by Hatano–Matsunawa–Sato–Takemura (Funkcial. Ekvac., 2022) from the viewpoint of quantum integrable systems, is a linear q-difference system of rank 2. It can be regarded as a q-analog of Papperitz's equation, and from this aspect we give Euler type Jackson integral solutions and series solutions in terms of very-well-poised q-hypergeometric function ${}_8W_7$ for the above q-difference systems. As an application, we obtain new relations among those integrals and series.

7 Genki Shibukawa (Kobe Univ.)
Satoshi Tsuchimi (Kobe Univ.)
The generalized Zwegers' μ-function and transformation formulas for the bilateral basic hypergeometric series 15

Summary: By applying Slater's transformation formulas for the bilateral basic hypergeometric series ${}_2\psi_2$, we derive three-type translation formulas for the generalized Zwegers' μ-function ("continuous q-Hermite function") which was introduced by Shibukawa–Tsuchimi (SIGMA, 2023). From some Bailey's transformation formula of ${}_2\psi_2$, we also give a formula for the expression of the generalized Zwegers' μ-function by some Very-Well-Poised bilateral basic hypergeometric series.

8 Hidetoshi Awata (Nagoya Univ.)
Koji Hasegawa (Tohoku Univ.)
Hiroaki Kanno (Nagoya Univ.)
Ryo Okawa
(Osaka Metro. Univ./Kyoto Univ.)
Shamil Shakirov (Univ. of Geneva)
Jun'ichi Shiraishi (Univ. of Tokyo)
Yasuhiko Yamada (Kobe Univ.)
Non-stationary difference equation, affine Laumon space and quantization of discrete Painlevé equation 1 15

Summary: We clarify relation between the non-stationary difference equations proposed by Shakirov and the quantized discrete Painleve VI equations proposed by Hasegawa.

9 Hidetoshi Awata (Nagoya Univ.)
Koji Hasegawa (Tohoku Univ.)
Hiroaki Kanno (Nagoya Univ.)
Ryo Okawa
(Osaka Metro. Univ./Kyoto Univ.)
Shamil Shakirov (Univ. of Geneva)
Jun'ichi Shiraishi (Univ. of Tokyo)
Yasuhiko Yamada (Kobe Univ.)
Non-stationary difference equation, affine Laumon space and quantization of discrete Painlevé equation 2 15

Summary: We conjecture that the instanton partition function coming from the affine Laumon space provides a solution to Shakirov's equation. We show that this conjecture is true in a special limit of parameters.

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

Saiei-Jaeyeong Matsubara-Heo
(Kumamoto Univ./Kumamoto Univ.)
Algebraic equations and hypergeometric equations

Summary: It has been decades since Gelfand, Graev, Kapranov, and Zelevinsky shed new light on the theory of hypergeometric systems. They discovered that it is intimately related to a system of algebraic equations, especially the theory of discriminants. This is the theory of GKZ systems. We highlight that rich combinatorics of discriminants reveals analytic properties of GKZ hypergeometric functions. A more interesting, yet challenging, function arises in the context of Feynman integrals. It is beyond GKZ system, but it is still hypergeometric. We introduce a new approach to understanding such integrals. The key is again a system of algebraic equations, called likelihood equations.

September 21st (Thu) Conference Room VI

9:30–10:45

10 Yas-Hiro Quano
(Suzuka Univ. of Med. Sci.)
Causal inference in statistics and probability formulae for counterfact 15

Summary: In this talk I shall reprot some probability formulae for counterfact.

Summary: The algebraic Bethe ansatz is a well-known technique used for constructing eigenvectors of integrable models, most notably the Heisenberg XXX and XXZ spin chains. It was pioneered by Soviet mathematicians in the 1970s, and has since undergone countless generalisatons. Among these generalisations, the nested Bethe ansatz has been used to tackle integrable models with higher rank Lie symmetry than the $SU(2)$ of the XXX model. However, these implementations have generally been considered on a case-by-case basis. In this talk I would like to unify the theory for rational closed spin chains into a single formalism based on the theory of Yangians in the RTT presentation.

Summary: In 2021, De Commer–Talla constructed a quantum deformation $SL_q(2,\mathbb{R})$ of $SL(2,\mathbb{R})$. To reveal properties of groups, we consider interesting maps called 1-cocycles, for example. In the case of (operator algebraic quantum) groups, we can give characterization of Haargerup property and property (T) via the languages of 1-cocycles and 1-cocycles appear in many areas (e.g. the theory of Lévy processes and Popa's deformation/rigidity theory). In this talk, we construct a 1-cocycle on $SL_q(2,\mathbb{R})$ and introduce some properties $SL_q(2,\mathbb{R})$ has.

Summary: We show an existence of Hamiltonian cycles of Cayley graphs of almost Weyl groupoids.

Summary: We introduce a category of q-oscillator representations over the quantum affine superalgebras of type D and construct a new family of its irreducible representations. Motivated by the theory of super duality, we show that these irreducible representations naturally interpolate q-oscillator representations of type $X_n^{(1)}$ and finite-dimensional representations of type $Y_n^{(1)}$ for $(X,Y)=(C,D),(D,C)$ under exact monoidal functors. This can be viewed as a quantum affine analogue of the correspondence between irreducible oscillator and irreducible finite-dimensional representations of classical Lie algebras arising from Howe's reductive dual pairs (g,G), where $g=sp_{2n},so_{2n}$ and $G=O_l,Sp_{2l}$.

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

Makiko Sasada (Univ. of Tokyo) Discrete integrable systems from probabilistic perspectives

Summary: The box-ball system (BBS) was introduced by Takahashi and Satsuma as a simple discrete model in which solitons (i.e. solitary waves) could be observed, and it has since been shown that it can be derived from the classical Korteweg–de Vries equation, which describes waves in shallow water by a proper discretization. The last few years have seen a growing interest in the study of the BBS and related discrete integrable systems started from random initial conditions. Particular aims include characterizing probability measures that are invariant for the dynamics, exploring the soliton decompositions of random configurations, and establishing (generalized) hydrodynamic limits. These studies have generated new research topics in both probability theory and integrable systems, as well as given new perspectives on classical results. In this talk, I will explain some recent progress in this direction. This talk is based on joint works with David Croydon, Tsuyoshi Kato, Matteo Mucciconi, Tomohiro Sasamoto, Hayate Suda, Satoshi Tsujimoto, and Ryosuke Uozumi.