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The Mathematical Society of Japan

2021 Autumn Meeting

Titles and Short Summaries of the Talks

September, 2021

at Chiba University

2021 The Mathematical Society of Japan

AUTUMN MEETING

Dates: September 14th (Tue)–17th (Fri), 2021

Venue: Nishi-Chiba Campus, Chiba University
and Online via Zoom Webinar

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The Mathematical Society of Japan

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Plenary Talks

September 15th (Wed) General Studies Complex Bldg. 2 (Online via Zoom Webinar)

Award Lecture for the 2021 MSJ Autumn Prize

Autumn Prize Winner [z] ..... (15:15–16:15)

Kazuo Akutagawa (Chuo Univ.) [z] The Ricci flow on manifolds with boundary ..... (16:40–17:40)

Summary: On the Ricci flow on *closed manifolds*, a large number of fundamental and important results have been obtained even though many unsolved problems have still been remained. On the other hand, there have been not many known results on that on compact manifolds *with boundary*. In this talk, we consider the Ricci-DeTurck flow and the Ricci flow with a geometrically natural boundary condition, including *zero mean curvature condition*, on a compact manifold with boundary. It is different from the known boundary conditions. We would like to explain some results on the short-time existence of these flows and the preserving property of positive scalar curvature of the Ricci flow.

Featured Invited Talks

September 14th (Tue)

Conference Room II

Atsushi Ichino (Kyoto Univ.) Z Automorphic forms of half-integral weight ····· (13:00–14:00)

Summary: We discuss recent progress in the theory of automorphic forms of half-integral weight, which was initiated by Shimura in 1973.

Conference Room V

Yoshiyuki Kagei (Tokyo Tech) Z Stability and bifurcation analysis of the compressible Navier–Stokes equations ····· (13:00–14:00)

Summary: The compressible Navier–Stokes equation, which is the basic equation for compressible viscous fluids, is classified as a quasi-linear hyperbolic-parabolic system. Due to the hyperbolic and parabolic aspects of the system, solutions exhibit interesting behavior. In this talk, I will review the stability and bifurcation analysis of the compressible Navier–Stokes equation, and present some recent results on a related bifurcation phenomenon and singular limit problem.

September 16th (Thu)

Conference Room II

Katsutoshi Yamanoi (Osaka Univ.) Z Topics on value distribution theory for holomorphic mappings ····· (13:00–14:00)

Summary: I will discuss some topics on value distribution theory for holomorphic mappings.

Conference Room V

Yoshio Tsutsumi (Kyoto Univ.) Z Nonlinear dispersive equations and function spaces ····· (13:00–14:00)

Summary: Nonlinear dispersive equations appear in many fields of mathematical physics to model nonlinear wave phenomena. Solutions of these equations rapidly oscillate and so it is difficult to estimate this oscillation precisely. There has been a great development in the field of nonlinear dispersive equations for the past quarter century. To be specific, the Fourier restriction norm spaces for nonlinear dispersive equations were introduced by Bourgain in 1993. After Bourgain's work, many mathematicians presented variants of Fourier restriction norm spaces, which have also made big contributions to the research in this field. I would like to give a brief survey on the recent progress in nonlinear dispersive equations and to explain how the Fourier restriction norm space and its variants work for nonlinear dispersive equations.

September 17th (Fri)

Conference Room II

Motoko Kotani (Tohoku Univ.) Z Discrete geometric analysis and its application ····· (13:00–14:00)

Summary: There are several attempts to discretize geometric notions. In this presentation, we discuss discrete geometric analysis and discrete surface theory. Emphasis is put to connect those notions with corresponding geometric notions for continuum objects. Considering discrete objects as microscopic structure of continuous materials, relations between discrete and continuum is regarded as those between microscopic structure and macroscopic structure of materials. In that way, we apply discrete geometric analysis to study of materials.

Conference Room VII

Shinichi Kotani [Z] KdV equation with ergodic initial data ..... (13:00–14:00)
(Osaka Univ.*/Nanjing Univ.)

Summary: KdV equation is a mathematical model of shallow water waves and GGKM found that it is solvable by the inverse scattering method if initial data decay sufficiently fast. Since then many researchers have been investigating this equation from various points of view. Initial data considered there were decaying or periodic, however recently people get interested in solutions oscillating in space. There are two cases of almost periodic initial data so far which are shown to be solvable. The one is smooth quasi-periodic initial data. Unfortunately in this case the solvability is known to be local in time. The other is the case that the underlying Schroedinger operators with almost periodic potentials have only absolutely continuous spectrum. This is a rather strong restriction, which is preferable to remove it. In this talk the speaker presents a unified method of solving the KdV equation, which admits general initial data including decaying or oscillating. As a byproduct one can treat solutions starting from ergodic initial data, especially a wide class of almost periodic initial data is possible to consider. Our method heavily depends on Sato theory of completely integrable systems. The key idea is to describe Sato theory in terms of the spectral quantities of the underlying Schroedinger operators, namely the Weyl–Titchmarsh functions. To have the global existence of solutions we have to avoid the singularities of the solutions, which is equivalent to the non-vanishing of the tau-function. The non-degeneracy of the tau-function is established by using the Herglotz property of the Weyl–Titchmarsh functions.

Foundation of Mathematics and History of Mathematics

September 16th (Thu) Conference Room I

10:15–12:00

1 Kohtaro Tadaki (Chubu Univ.) Z A refinement of quantum information theory by algorithmic randomness V 15

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

2 Takahiro Seki (Niigata Univ.) Z A classification of a family of associativity associated with exchange 15

Summary: Implicational axioms B, B' and C are regarded as combinations of associativity and exchange. In substructural logics without exchange, since two kinds of implication are introduced, there are several variants of B, B' and C. In this talk, we consider a classification of a family of associativity associated with exchange by using Kripke-style semantics.

3 Yuya Okawa (Chiba Univ.) Z Unary interpretability logics for sublogics of the interpretability logic **IL** 15

Summary: The interpretability logic **IL** and the unary interpretability logic **il** are extensions of the provability logic **GL** with the binary modal operator $\triangleright$ and the unary modal operator **I**, respectively. The modal formula $A \triangleright B$ is intended as "$T + B$ is interpretable in $T + A$ " and the modal formula $\mathbf{I}A$ is intended as "$T + A$ is interpretable in T ". De Rijke proved that **il** corresponds to **IL**, that is, for any modal formula A of unary interpretability logic, **il** $\vdash A$ if and only if **IL** proves the modal formula which is obtained by replacing all occurrences of the formula $\mathbf{I}B$ in A with $\top \triangleright B$.
We investigate unary interpretability logics for twenty sublogics of **IL**. For each sublogic of **IL**, we provide the sublogic of **il** corresponding to that logic.

4 Taishi Kurahashi (Kobe Univ.) Z On inclusions between quantified provability logics 15

Summary: Quantified provability logic $\mathsf{QPL}_\sigma(T)$ is known to be heavily dependent on the theory T and the Σ_1 definition $\sigma(v)$ of T. We investigate several consequences of inclusion relations between quantified provability logics and show that inclusion relations rarely hold. Moreover, we give a necessary and sufficient condition for the inclusion relation between quantified provability logics with respect to Σ_1 arithmetical interpretations.

5 Sohei Iwata (Kobe Univ.)[Z] Topological semantics of extensions of the conservativity logic CL · · · · 15
Taishi Kurahashi (Kobe Univ.)

Summary: It is well known that the logic of provability **GL** is complete with respect to the class of all finite transitive and conversely well-founded Kripke frames. On the other hand, **GL** is not strongly complete with respect to Kripke semantics. This obstacle can be avoided by dealing with topological semantics which is developed by Simmons and Esakia, etc. That is, **GL** is determined by the class of all scattered topological spaces. Moreover, as opposed to Kripke semantics, Shehtman proved that **GL** is strongly complete with respect to scattered spaces. Ignatiev introduced the logic **CL** which is a sublogic of the basic interpretability logic **IL**. The logic **CL** is a basis for study of capturing properties of the notion of conservativity. We propose a topological semantics of **CL** and its extensions (such as **IL**, etc). Using our new semantics, strong completeness of these logics can be proved.

6 Taishi Kurahashi (Kobe Univ.)[Z] Disjunction and existence properties in modal arithmetic · · · · · · · · · · · · 15

Summary: We investigated several versions of disjunction and existence properties in modal arithmetic. Among other things, we proved that for any consistent RE extension T of PA(K4), T has the modal disjunction property if and only if T has the modal existence property. This is a refinement of Friedman and Sheard's result. Moreover, we newly introduced the notion of $\Sigma_1^{\Box}$ formulas, and proved that for any such a theory T, T has the modal disjunction property if and only if T is $\Sigma_1^{\Box}$-sound. This is a joint work with Motoki Okuda.

14:40–15:30

7 Daniel Găină (Kyushu Univ.)[Z] Omitting Types Theorem in hybrid-dynamic first-order logic with rigid symbols · 15
Guillermo Badia (Univ. of Queensland / Johannes Kepler Univ. Linz)
Tomasz Kowalski (La Trobe Univ.)

Summary: In the the present contribution, we prove an Omitting Types Theorem (OTT) for an arbitrary fragment of hybrid-dynamic first-order logic with rigid symbols (i.e. symbols with fixed interpretations across worlds) closed under *negation* and *retrieve*. The logical framework can be regarded as a parameter and it is instantiated by some well-known hybrid and/or dynamic logics from the literature. We develop a *forcing* technique and then we study a *forcing property* based on local satisfiability, which lead to a refined proof of the OTT. For uncountable signatures, the result requires compactness, while for countable signatures, compactness is not necessary. We apply the OTT to obtain upwards and downwards Löwenheim-Skolem theorems for our logic, as well as a completeness theorem for its *constructor-based* variant.

8 Akito Tsuboi (Univ. of Tsukuba*)[Z] Torsion-free groups and model completeness · 10

Summary: A model complete theory allows quantifier elimination in a mild sense. In fact, every formula is equivalent to an existential formula under a model complete theory. In this talk, I show that T_{tf}, the theory of torsion-free groups, has no model companion.

9 Koichiro Ikeda (Hosei Univ.)[Z] Groups in generic structures · 15

Summary: We show that there is no infinite group definable in a normal saturated generic structure.

September 17th (Fri) Conference Room I

9:20–10:15

10 Ryosuke Maki (Osaka Pref. Univ.)[Z] Sierpiński–Zygmund number and Suslin forcing · 15
Masaru Kada (Osaka Pref. Univ.)

Summary: Sierpinski–Zygmund number $\mathfrak{sz}$ is the smallest cardinal κ such that, there exists a function g from the real line to itself whose restriction to any set X of reals of size κ is discontinuous. We show that, by a finite support iteration of Suslin forcing notions of length ω_2 over a model for CH, the value of $\mathfrak{sz}$ is still $\aleph_1$.

11 Toshimichi Usuba (Waseda Univ.) Z Generically extendible cardinals ····· 15

Summary: An uncountable cardinal κ is said to be generically extendible if for every $\alpha > \kappa$, there is a $\beta > \alpha$ and a poset P such that P forces that "there is an elementary embedding j from V_α to V_β^P with critical point κ and $\alpha < j(\kappa)$". In this talk we consider the consistency strength of generically extendible cardinals.

12 Sakaé Fuchino (Kobe Univ.) Z First-order definability of generic and Laver-generic large cardinals ··· 15

Summary: Similarly to the (genuine) large cardinal properties like supercompactness, almost hugeness and hugeness, it is not apparent at first sight if the corresponding generic large cardinal properties are first-order definable. In case of Laver-genericity introduced by the speaker together with André Ottenbreit Maschio Rodrigues and Hiroshi Sakai, it is even more difficult to see the the definability, since the definition includes the condition that the generic set should be included in the target model of the generic elementary embedding.

Nevertheless, we will show that these notions are first-order definable (in the language of ZFC). We shall also mention some applications of the methods involved.

The resuls presented in this talk are obtained in a joint research of the speaker with Hiroshi Sakai.

10:30–10:45 Research Section Assembly

11:00–12:00 Talk Invited by Section on Foundation and History of Mathematics

Takayuki Kihara (Nagoya Univ.) Z Hierarchies of computability and definability

Summary: From their birth to the present, the study of hierarchies of computability and definability have always stood at the center of computability theory and descriptive set theory. Researchers have been gradually exploring these hierarchies and have solved many mysteries. In this talk, I will survey recent developments in this research. Surprisingly, in less than a decade, there have been a series of breakthroughs in the study of these hierarchies, resulting in a dramatic development of the theory. I will give an overview of some of these breakthroughs to which I have made major contributions.

In detail, I will talk about the following topics: 1. The decomposability conjecture of Borel functions; 2. Degree spectra, Borel isomorphism problem, and infinite dimensional topology; 3. Enumeration degrees and nonmetrizable topology; 4. Zigzag structures in descriptive set theory (Wadge theory); 5. Zigzag structures in computability theory (Martin's conjecture); 6. Realizability toposes and Lawvere–Tierney topologies.

Afternoon

13 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) Theory of the Eulerian integrals by Legendre ····· ∗

Summary: Legendre issues the book in 1825. In this first volume, he discusses Eulerian Integral with two sorts of integrals, in relation to Euler's integrals, including his elliptic functions. Legendre complains Euler's integral, saying "they have never been occupied to make the calculation easy, nor to fix the degree of precision of which it is susceptible," (169)*andproposesthatsomefunctionsareexplainedwiththearcsofcircleandofthelogarithms.*(60, etc.)

14 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) Legendre's theory of elliptic functions and Abel's theories ····· ∗

Summary: As soon as Abel contributes the paper in 1828, in which the nature of transcendent is developed. Legendre enhances his theory in 1832. We discuss Legendre's adoption of the Abel's theory.

15 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) Jacobi's papers to Abel and Legendre on the theory of the elliptic functions ····· ∗

Summary: We discuss Jacobi's Latin paper : General Consideration of Abel's Transcendents, which extends Abel's paper : Remarks on some general properties of a certain sort of transcendental functions. The other papers relating to these are also discussed. (Translation is mine.)

16 Saburou Saitoh (Gunma Univ.*/Inst. of Reproducing Kernels) — Division by zero and division by zero calculus ····· *

Summary: We think that modern mathematics is still flawed. It is clear that there are basic defects in function theory, differential equations, geometry, and algebra, and it has been seven years since the discovery. This will be a stain on world history and so, we publish the book: S. Saitoh, Introduction to the Division by Zero Calculus, 2021, Scientific Research Publ., Inc.. and we are founding the basic new international journal on the division by zero calculus: https://romanpub.com/dbzc.php

17 Kyohei Yokomizo (Kanto Gakuin Univ.), Tatsuya Shimura (Nihon Univ.) — The conservativity problem on between fragments of a generalization of Avron's hypersequent calculus **GLCW** ····· *

Summary: Avron's **GLCW** is the propositional intermediate hypersequent calculus which is characterized by all Heyting algebras whose width is 1. Avron has considered properties of $\mathbf{GLCW}_{\mathcal{S}}$ which is the **GLCW** with restricted logical symbols to $\mathcal{S}$ ($\rightarrow \in \mathcal{S} \subseteq \{\rightarrow, \wedge, \vee, \neg\}$). In the previous talk (2017) we generalized **GLCW** to m-**GLCW**, which is characterized by all Heyting algebras whose width is m. In this talk we will consider that whether m-$\mathbf{GLCW}_{\mathcal{S}'}$ is conservative extension over m-$\mathbf{GLCW}_{\mathcal{S}}$ ($\rightarrow \in \mathcal{S} \subsetneq \mathcal{S}' \subseteq \{\rightarrow, \wedge, \vee, \neg\}$) by a similar method to Avron's algebraic one.

18 Kenetsu Fujita (Gunma Univ.), Toshihiko Kurata (Hosei Univ.) — On formalization of logic puzzles à la George Boolos ····· *

Summary: George Boolos posed the puzzle "The hardest logic puzzle ever". We have introduced a simple formalization of the puzzle consisting of questions, answerers, and answers in terms of propositional logic, and showed its adequacy by the truth values semantics. We now pose a general form of the puzzle. Let Gn be the set of gods A1, A2, ..., An (n is greater than 0) where Ai is Random, True, or False. Let NumR(Gn) be the number of Random in Gn, and suppose that NumR(Gn) is less than n. Then is it possible to identify the non-Random god in Gn?

19 Yukinobu Yajima (Kanagawa Univ./Math Art Laboratory), Yasushi Hirata (Kanagawa Univ.) — Inequality and equality for the extent of products with a special factor ····· *

Summary: For a space X,let $e(X)$ denote a cardinal function for X called the extent of X. We discuss whether $e(X \times Y) > e(X) \cdot e(Y)$ or $e(X \times Y) = e(X) \cdot e(Y)$ holds when X is a monotonically normal space and Y is an almost discrete space.

20 Yukinobu Yajima (Kanagawa Univ./Math Art Laboratory), Yasushi Hirata (Kanagawa Univ.), Toshimichi Usuba (Waseda Univ.) — Equalities for the extent of infinite products and Σ-products ····· *

Summary: For a space X, let $e(X)$ denote the extent for X. For an infinite product X, we discuss when $e(X)$ is the supremum of the extent of each factor of X and the cardinality of members of the factors. For a Σ-product Σ of spaces, we also discuss when $e(\Sigma)$ is supremum of the extent of each factor of Σ.

14:45–15:00 Mathematics History Team Meeting

Algebra

September 14th (Tue) Conference Room II

10:00–11:45

1 Toshinori Kobayashi (Meiji Univ.) Z Characterizations of nearly Gorenstein rings 10

Summary: The notion of nearly Gorenstein rings introduced by Herzog, Hibi and Stamate has been studied widely in the area of Cohen–Macaulay rings with applications to combinatorics. In this talk, I will introduce a characterization of nearly Gorenstein rings in terms of certain Ext groups. Such a characterization provides a useful criterion of nearly Gorenstein rings via reductions of regular sequence. I will also explain some applications to numerical semigroups.

2 Maiko Ono (Okayama Univ. of Sci.) Z On naïvely liftable DG modules 15
Saeed Nasseh (Georgia Southern Univ.)
Yuji Yoshino (Okayama Univ.)

Summary: Let $A \to B$ be a homomorphism of DG R-algebras such that the underlying graded A-module B is projective. Let N be a semifree right DG B-module, and denote by $N|_A$ the DG B-module N regarded as a right DG A-module via $A \to B$. We say that N is naïvely liftable to A if the DG B-module epimorphism $\pi_N \colon N|_A \otimes_A B \to N$ defined by $\pi_N(x \otimes b) = xb$ splits. The purpose of my talk is to show the following result:
Let n be a positive integer, A be a divided power DG R-algebra and $B = A\langle X_1, \dots, X_n \rangle$ be a free extension of A obtained by adjunction of variables $X_1, \dots, X_n$ of positive degrees. If N is a bounded below semifree DG B-module with $\mathrm{Ext}^i_B(N, N) = 0$ for all $i > 0$, then N is naïvely liftable to A.

3 Tsutomu Nakamura (Univ. of Tokyo) Z Adelic complexes over commutative noetherian rings 15

Summary: The notion of adeles is an important tool in arithmetic. One can interpret the classical adeles to be defined for certain one-dimensional schemes, and Parshin (1976) introduced the two-dimensional version of adeles. This was further extended to arbitrary noetherian schemes by Beilinson (1980). He used (co)simplicial construction, and it yields a complex of abelian groups, called the adelic complex. In this talk, we give a simpler construction of the adelic complex for an affine noetherian scheme of finite dimension, and explain some advantage of our approach in terms of homological algebra.

4 Hiroki Matsui (Univ. of Tokyo) Z Prime thick subcategories of triangulated categories and its applications 15

Summary: Tensor triangular geometry is an epoch-making theory initiated by Balmer. For a tensor triangulated category, Balmer defined a topological space, called the Balmer spectrum of T, as the set of prime thick tensor ideals together with the Zariski topology. The importance of the theory is that the structure of T is controlled by the Balmer spectrum. However, this theory cannot be applied to triangulated categories without tensor structures. In this talk, we introduce the notion of prime thick subcategories of a triangulated category T and use it to define the spectrum of T. As an application, for a noetherian scheme X, we consider prime thick subcategories of the bounded derived category of coherent sheaves on X and the singularity category of X. We note that these triangulated categories do not have tensor structures naturally.

5 Shinnosuke Ishiro (Nihon Univ.) Z Local log-regular rings and its small tilt 15
Kazuma Shimomoto (Nihon Univ.)
Kei Nakazato (Nagoya Univ.)

Summary: A local log-regular ring is a certain commutative Noetherian ring which was introduced by Kazuya Kato. We proved that the prime-to-p-torsion part of the divisor class group of a local log-regular ring of mixed characteristic with perfect residue field is finite under a mild condition. In order to prove our theorem, we define the small tilt of a tower of commutative rings. This is an analogue of the tilt which is a fundamental tool in perfectoid theory. In this talk, we explain the definition of small tilt of a tower of commutative rings and an outline of the proof of the above theorem.

6 Takeshi Yoshizawa (Toyota Nat. Coll. of Tech.) Annihilators of local cohomology modules over a finite-dimensional Cohen–Macaulay ring ..... *

Summary: We investigate the existence of annihilators of local cohomology modules without dependence on the choice of an ideal over a commutative Noetherian ring. Dao and Takahashi's classification theorem of the dominant resolving subcategories helps observe the existence of annihilators over a finite-dimensional Cohen–Macaulay ring.

14:25–15:25 Talk Invited by Algebra Section

Kazuma Shimomoto (Nihon Univ.) Z Arithmetical commutative ring theory —Beyond the homological conjectures—

Summary: In 1970's, M.Hocshter proposed a series of conjectures on the homological behavior of Noetherian commutative local rings, which were later called the "homological conjectures". Among them, the direct summand conjecture had been attracting many researchers, because of its simple-looking statement. The conjecture was soon solved by Hochster himself in 1973 in his Nagoya paper. The remaining mixed characteristic case was quite difficult and finally resolved by Y. André in 2016, using perfectoid methods. This event brought a revolution to the direction of the research in commutative rings. In this talk, I begin with a review on the history of the homological conjectures and recent related results. Then I talk about the picture of the fusion of number theory and commutative rings and some interesting problems. I want to emphasize that certain non-Noetherina rings, Banach rings, simplicial rings, and cohomology are to come into sight.

15:40–16:50

7 Yoshiharu Shibata (Yamaguchi Univ.) Z On relative almost projectivity and relative generalized projectivity .. 10
Isao Kikumasa (Yamaguchi Univ.)
Yosuke Kuratomi (Yamaguchi Univ.)

Summary: Relative almost projectivity and relative generalized projectivity are important for the study of direct sums of lifting modules. Although a generalized N-projective module is almost N-projective for a module N, the converse is not true. In this talk, we characterize these projectivities by using projective covers, and consider a condition for an almost N-projective module to be generalized N-projective.

8 Haigang Hu (Shizuoka Univ.) Z Noncommutative conics in Sklyanin Quantum Projective Planes 15
Masaki Matsuno (Shizuoka Univ.)
Izuru Mori (Shizuoka Univ.)

Summary: Let S be a 3-dimensional Sklyanin algebra, and $f \in S_2$ a regular central element. We say that $A = S/(f)$ is a noncommutative conic (in a Sklyanin Quantum Projective Plane). For a noncommutative conic A, there is an associated finite algebra $C(A)$ which plays an important role to study A. It is difficult to calculate $C(A)$ directly since S does not have a PBW basis. In this talk, we calculate $C(A)$ using geometric methods.

9 Sota Asai (Osaka Univ.) Z
Osamu Iyama (Univ. of Tokyo)
Canonical decompositions and numerical torsion pairs for elements in the Grothendieck group ····· 15

Summary: Let A be a finite-dimensional algebra over an algebraically closed field K, and $\mathsf{proj}\,A$ be the category of finitely generated projective A-modules. Then, the Grothendieck group $K_0(\mathsf{proj}\,A)$ is a free abelian group whose canonical basis is given by the indecomposable projective A-modules. For each element $\theta \in K_0(\mathsf{proj}\,A)$, we can consider the canonical decomposition $\theta = \bigoplus_{i=1}^{m} \theta_i$ into a direct sum of indecomposable elements in $K_0(\mathsf{proj}\,A)$ introduced by Derksen–Fei and the numerical torsion pairs introduced by Baumann–Kamnitzer–Tingley. We will report some relationship of these two notions which we found in our study.

10 Kazuho Ozeki (Yamaguchi Univ.) Z
The reduction number of stretched ideals ····· 15

Summary: The homological property of the associated graded ring of an ideal is an important problem in commutative algebra and algebraic geometry. In this talk we explore the structure of the associated graded ring of stretched $\mathfrak{m}$-primary ideals in the case where the reduction number attains almost minimal value in a Cohen–Macaulay local ring $(A, \mathfrak{m})$. As an application, we present complete descriptions of the associated graded ring of stretched $\mathfrak{m}$-primary ideals with small reduction number.

11 Shuhei Tsujie (Hokkaido Univ. of Edu.)
Masamichi Kuroda (Nippon Bunri Univ.)
Characteristic quasi-polynomials of hyperplane arrangements over the rings of integers of algebraic number fields ····· ∗

Summary: A list $\mathcal{A}$ consisting of finitely many integer vectors defines a "hyperplane arrangement" over $\mathbb{Z}/q\mathbb{Z}$ for every positive integer q. Kamiya, Takemura, and Terao showed that the function counting the elements of the complement is a quasi-polynomial in q, which is called the characteristic quasi-polynomial of $\mathcal{A}$. We introduce analogues of the characteristic quasi-polynomials for the rings of integers of algebraic number fields.

12 Yousuke Kuratomi (Yamaguchi Univ.)
On direct sums of hollow modules ····· ∗

Summary: In this talk, we consider the problem "When is a direct sum of hollow modules lifting?" This problem was firstly studied by Baba and Harada in 1990 and they gave a necessary and sufficient condition for a direct sum of cyclic hollow modules with local endomorphism rings to be lifting. In 2007, Vanaja studied the problem under certain conditions on whole direct sum which the decomposition complements maximal direct summands and every nonzero direct summand contains an indecomposable direct summand. In this talk, we give equivalent conditions for an infinite direct sum of hollow modules over right perfect ring to be lifting with the finite internal exchange property, without conditions on whole direct sum.

September 15th (Wed) Conference Room II

9:30–12:00

13 Satoshi Usui (Tokyo Univ. of Sci.) Z
Eventually periodic Gorenstein algebras and Tate–Hochschild cohomology rings ····· 15

Summary: The notion of Tate–Hochschild cohomology for algebras, introduced by Wang, gives a generalization of Tate cohomology for finite groups. The Tate–Hochschild cohomology carries a structure of a graded ring, and it is in fact a graded-commutative ring, which was also proved by Wang. On the other hand, an algebra is called eventually periodic if its minimal bimodule projective resolution becomes periodic from some step. In this talk, we investigate the relationship between the eventual periodicity of an algebra and the ring structure of the Tate–Hochschild cohomology. We show that a Gorenstein algebra is eventually periodic if and only if its Tate–Hochschild cohomology ring has an invertible homogeneous element.

Summary: We present a sufficient condition for the kG-Scott module with vertex P to remain indecomposable under the Brauer construction for any subgroup Q of P as $k[Q\,C_G(Q)]$-module, where k is a field of characteristic 2 and G is a finite group. This is useful to obtain a splendid stable equivalence of Morita type.

Summary: We classify principal blocks of finite groups with semidihedral defect groups up to splendid Morita equivalence. This completes the classification of all principal 2-blocks of tame representation type up to splendid Morita equivalence and shows that Puig's Finiteness Conjecture holds for such blocks.

Summary: We show that if the principal p-block of a finite group G has precisely four irreducible ordinary characters, then a Sylow p-subgroup of G has order four or five. Our proof relies on the classification of finite simple groups.

Summary: Fields of a two-dimensional conformal field theory are real analytic, and the holomorphic fields form a subalgebra. The algebra of holomorphic fields is mathematically formulated and called a vertex algebra. Recently, we have formulated the algebra of real analytic fields and called it a full vertex algebra. We have also constructed a family of full vertex algebras using combinatorial data called codes. These full vertex algebras are expected to be useful for the study of moduli spaces of conformal field theories.

Summary: Adamović constructed injective homomorphisms from affine vertex algebras associated with $\mathfrak{sl}_2$ to tensor products of Virasoro algebras and some lattice vertex algebras. This implies that modules of Virasoro algebras induce those of affine vertex $\mathfrak{sl}_2$ algebras, which is "inverse reduction" from the perspective of W-algebras. We generalize these results to cases of $\mathfrak{sl}_3$ and apply to construct relaxed modules of simple affine vertex $\mathfrak{sl}_3$ algebras. This is joint work with Drazen Adamović and Thomas Creutzig.

Summary: A new generating function for semi-standard Young diagram having product expression is derived. The weight of the generating function is determine by the moment of Askey–Wlison polynomials and a combinatorial interpretation of general orthogonal polynomials. As a special case we obtain well-known Stanley's hook-content formula.

Summary: Let $P \subset \mathbb{R}^d$ be a convex lattice d-polytope. Let $v \in \mathbb{Q}^d$ be a rational vector. We will discuss relationships between properties of P (e.g., being a zonotope / centrally symmetric) and that of the Ehrhart quasi-polynomial $L_{v+P}(t)$ (e.g., having GCD-property / symmetric).

21 Toshiya Yurikusa (Tohoku Univ.) Cluster algebras with dense g-vector fans ····· *

Summary: The g-vectors of cluster variables in a cluster algebra form a fan, called g-vector fan. We show that cluster algebras associated with weighted orbifolds introduced by Felikson–Shapiro–Tumarkin have dense g-vector fans. As a consequence, we give a classification of skew-symmetrizable cluster algebras with dense g-vector fans except for finitely many types of cluster algebras.

22 Mamoru Ueda (Kyoto Univ.) Affine twisted Yangians and rectangular W-algebras of type D ····· *

Summary: We define the affine twisted Yangian of type D and construct surjective homomorphisms from affine twisted Yangians of type D to universal enveloping algebras of rectangular W-algebras of type D.

23 Yuanqing Cai (Kanazawa Univ.) Twisted doubling integrals for Brylinski–Deligne extensions of classical groups ····· *

Summary: In the 1980s, Piatetski-Shapiro and Rallis discovered a family of Rankin–Selberg integrals for the classical groups that did not rely on Whittaker models. This is the so-called doubling method. It grew out of Rallis' work on the inner products of theta lifts —the Rallis inner product formula.
Recently, a family of global integrals that represent the tensor product L-functions for classical groups (joint with Friedberg, Ginzburg, and Kaplan) and the tensor product L-functions for covers of symplectic groups (Kaplan) was discovered. These can be viewed as generalizations of the doubling method. In this talk, we explain how to develop the doubling integrals for Brylinski–Deligne extensions of all connected classical groups.

24 Yugen Takegahara (Muroran Inst. of Tech.) p-adic properties of the numbers of representations in wreath products ····· *

Summary: Let p be a prime. Given a nonnegative integer ℓ, C_{p^ℓ} denotes a cyclic group of order p^ℓ. Let $C_p \wr H_n$ denote the wreath product of C_p with a subgroup H_n of the symmetric group S_n on n-letters. Given integers u and v with $u \geq 1$ and $u \geq v \geq 0$, set $A_p^{(u,v)} = C_{p^u} \times C_{p^v}$. The number of homomorphisms from $A_p^{(u,v)}$ to $C_p \wr H_n$ is denoted by $h(A_p^{(u,v)}, C_p \wr H_n)$. For a non-zero integer a, $\mathrm{ord}_p(a)$ denotes the exponent of p in the decomposition of a into prime factors. Let $[x]$ denote the largest integer not exceeding a real number x. For each n, $\overline{\tau}_p^{(u,v)}(n)$ denotes $\sum_{j=0}^{u-1}[n/2^j] + [n/2^{u+1}] - [n/2^{u+2}]$ if $p = 2$ and $u = v$ and denotes $\sum_{j=0}^{u-1}[n/p^j] - (u-v)[n/p^u]$ if either $p \geq 3$ or $u \geq v+1$, which is the lower bound of $\mathrm{ord}_p(h(A_p^{(u,v)}, C_p \wr S_n))$. Let A_n be the alternating group on n-letters. The lower bound of $\mathrm{ord}_2(h(A_2^{(u,v)}, C_2 \wr A_n))$ is $\overline{\tau}_2^{(u,v)}(n)$ if $u + \delta_{v\,0} \leq v + 2$, and is $\overline{\tau}_2^{(u,v)}(n) - 1$ if $u + \delta_{v\,0} \geq v + 3$.

25 Shigeto Kawata (Nagoya City Univ.) On tensor products and Scott lattices over group rings ····· *

Summary: Let $\mathcal{O}$ be a complete discrete valuation ring of characteristic zero with residue class field of characteristic $p > 0$. Let $\mathcal{O}G$ be the group ring of a finite group G over $\mathcal{O}$. Suppose that L is an indecomposable $\mathcal{O}G$-lattice with vertex Q and p'-rank Q-source. Then L is virtually irreducible in the sense of Knörr if and only if the multiplicity of the Scott $\mathcal{O}G$-lattice with vertex Q in $L \otimes_{\mathcal{O}} L^*$ is one. Here L^* is the dual $\mathcal{O}G$-lattice of L.

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

Sven Möller (Kyoto Univ.)[Z] A geometric classification of the holomorphic vertex operator algebras of central charge 24

Summary: Borcherds showed that there is a bijection between the deep holes of the Leech lattice and the Niemeier lattices with non-trivial root system. This allows a geometric classification of these lattices.
Using modular forms we recently established an analogous result for the holomorphic vertex operator algebras of central charge 24 with non-trivial weight-one space.
In this talk I will present a geometric classification of these vertex operator algebras based on this result.
(This is joint work with Nils Scheithauer.)

September 16th (Thu) Conference Room II

9:15–11:15

26 Shingo Yashiro (Japan Univ. of Econ.) Z ACM curves on Del Pezzo surfaces ····· 15

Summary: In this talk, we will introduce Curves on Del Pezzo Surfaces in three parts, Part (I): Coholomological Criteria of ACM Curves, Part(II): Minimal Free Resolutions of ACM Curves on Del Pezzo Surfaces and Part (III): Minimal Free Resolutions of Non-ACM Curves on Del Pezzo Surfaces. Moreover, we explain to be related to a dimension of local Cohomology group and Hilbert Functions/Polynomials.

27 Riku Kudou (Waseda Univ.) Z An affine criterion for affine bundles over quasi-affine varieties ····· 15

Summary: Serre's affine criterion for schemes states that a scheme is affine if and only if the first cohomology of all quasi-coherent sheaves of ideals are zero. In this paper we show that a bundle over a quasi-affine variety, whose fibers are affine, is affine if and only if the first cohomologies of some finite number of quasi-coherent sheaves of ideals are zero, based on the proof of Serre's affine criterion. As an application, we construct counterexamples for Zariski cancellation problem for principal $\mathbb{G}_a$-bundles over non $\mathbb{A}^1$-uniruled quasi-affine varieties. Zariski cancellation problem for an affine variety V asks whether or not the existence of an isomorphism $V \times \mathbb{A}^1 \simeq W \times \mathbb{A}^1$ implies that $V \simeq W$.

28 Akiyoshi Tsuchiya (Univ. of Tokyo) Z Castelnuovo polytopes ····· 15

Summary: It is known that the sectional genus of a polarized variety has an upper bound, which is an extension of the Castelnuovo bound on the genus of a projective curve. Polarized varieties whose sectional genus achieves this bound are called Castelnuovo. On the other hand, a lattice polytope is called Castelnuovo if the associated polarized toric variety is Castelnuovo. Kawaguchi characterized Castelnuovo polytopes having interior lattice points in terms of their h^*-vectors. In this talk, as a generalization of this result, a characterization of all Castelnuovo polytopes will be presented.

29 Selvi Kara (Univ. South Alabama) Z Rigidity of Gorenstein toric Fano varieties arising from graphs ····· 15
Irem Portakal
(Otto-von-Guericke-Univ. Magdeburg)
Akiyoshi Tsuchiya (Univ. of Tokyo)

Summary: A symmetric edge polytope $\mathcal{A}_G$ is a lattice polytope arising from a finite graph G and root system A_n and this polytope is associated to a Gorenstein toric Fano variety X_G with terminal singularities. It is shown by Totaro that a toric Fano variety which is smooth in codimension 2 and $\mathbb{Q}$-factorial in codimension 3 is rigid, namely, it has no nontrivial infinitesimal deformations. In this talk, we classify all graphs G such that X_G is a toric Fano variety which is smooth in codimension 2 and $\mathbb{Q}$-factorial in codimension 3.

30 Kaori Suzuki (Yokohama Nat. Univ.) Z On Fano-3folds of codim 5 with large Fano index ····· 15

Summary: I will explain about the classification of Fano 3-folds with large Fano index when codim 5. Mainly using "Graded Ring Method" by M. Reid and computer software Magma.

31 Norihiko Minami (Nagoya Inst. of Tech.) Z Relations among higheries originating from lower rationality = higher uniruledness —separably (-i) rationally connectedness— ····· 15

Summary: We present a bird's eye view diagram interrelating various hierachies originating from lower rationality = higher uniruledness. Special emphasis is paid to the hierachy of separably (-i) rationally connectedness, from the viewpoint of the nonexistence of a nontrivial section of appropriate sheaves constructed from differential forms.

11:30–12:00 Research Section Assembly

14:25–15:25 Talk Invited by Algebra Section

Atsushi Kanazawa (Keio Univ.) Z Attractor mechanisms of Calabi–Yau manifolds and around

Summary: The attractor mechanism is concerned with the mass functions on the complex moduli space of a Calabi–Yau manifold. It was originally found by Ferrara–Kallosh–Strominger in their study of blackholes in string theory. In the first half of this talk, I will discuss the mathematical theory and recent development of the attractor mechanisms. In light of mirror symmetry, the attractor mechanisms lead us to the notion of Kähler rigidity. In the second half, I will discuss mirror symmetry of Shioda–Inose K3 surfaces (rigid K3 surfaces) as an application of the Kähler rigidity. To be more precise, we consider generalized K3 surfaces studied by Hitchin, Huybrechts and introduce Mukai lattice polarizations to enlarge classical mirror symmetry (Dolgachev's formulation).

15:40–16:50

32 Makoto Sakurai (Kaichi Gakuen) Z Factorization algebras and the quasi-modular form conjecture of mirror symmetry ····· 15

Summary: The chiral-factorization algebra theory of Beilinson–Drinfeld is a generalization of (holomorphic) vertex (operator) algebras. Unfortunately, due to the difficulty of Ziv Ran space and Chevalley–Cousin complex for the derived version of chiral conformal blocks, the progress of chiral homology theory was limited until quite recently. In this talk, I will try to incorporate some physics ideas including the mirror symmetry conjecture together with the modularity conjecture of its generating functions. I will especially struggle to obtain a work related to Ekeren–Heluani and Si Li while pursuing the original ideas and definitions of Beilinson–Drinfeld.

33 Kotaro Kawatani (Osaka Pref. Univ./Yamato Univ.) Z Stability conditions on morphisms on a category ····· 15

Summary: We study a deformation of a gluing stability condition on a triangulated category equipped with a semiorthogonal decomposition. More precisely we construct a continuous family of tilt stability conditions by showing a deformation property introduced by Bridgeland's original paper.

34 Yoshimune Koreeda (Hiroshima Univ.) Z On the configuration of the singular fibers of jet schemes of rational double points ····· 15

Summary: Let $X \subset \mathbb{C}^3$ be a surface with a rational double point singularity at the origin O. For $m \geq 0$, there are schemes X_m parametrizing jets on X, called the m-th jet schemes of X along with truncation morphisms $\pi_m : X_m \to X$. It is known that the irreducible components of the fiber $\pi_m^{-1}(O)$ of the origin correspond to the exceptional curves of the minimal resolution of singularity. We study the configuration of the irreducible components of $\pi_m^{-1}(O)$ for A_n- and D_4-type singular surfaces, especially the intersections of the irreducible components. We show that the configuration contains enough information to reconstruct the resolution graph.

35 Kenta Sato (Kyushu Univ.) Z Shunsuke Takagi (Univ. of Tokyo) Deformation of klt/lc singularities ····· 15

Summary: klt singularities and lc singularities are the classes of singularities which are defined in terms of resolution of singularities and play an important role in Minimal Model Program. It is well-known that these singularities are stable under a flat deformation with a Q-Gorenstein total space. In this talk, we will show that the similar result holds without assuming that the total space is Q-Gorenstein.

36 Tomohiro Iwami (Kyushu Inst. of Tech.) Threefolds whose numerical Kodaira dimensions 1 or 2 and three-dimensional Miyaoka–Yau type inequality with the 3rd Chern classes driven by symmetric 2-forms ····· ∗

Summary: For an semi-stable extremal neighborhood $(X, C) \subset \mathbb{C}^4$ with C is irreducible and reduced, the invariants $l(P), q(P)$ associated to the infinitesimal deformations of C and the abundance property work the existance of three-dimensional flips [S. Mori 1988]. From this fact, the author had reported: (i) three-dimensional Miyaoka–Yau type inequality with c_3, and such inequality in the case of C irreducible nor reduced (called as an extended extremal neighborhood), (ii) such inequality in the case of driven by symmetric 2-forms, (iii) ubiquity of c_3 in such inequality by the sheaves of associated differential operators [Y. Miyaoka 1987]. Based on these works, the author will report: (a) for an extended extremal neighborhood, to construct of co-fibered products of curves of distinct types [Bogomolov–Tschinkel 2009], (b) to show similar ubiquity of related 0-dimensional supports along (a) as (iii), and (c) to give a necessary condition for certain symmetric 2-forms to have a "connection" by (a) and (b), and give a characterization of threefolds whose numerical Kodaira dimension 1 or 2 without global assumptions as Kodaira dimensions, on which the arguments are alternatives of the ones in [Y. Miyaoka 1988] or [Y. Kawamata 1992].

37 Tetsuya Ando (Chiba Univ.) Test set —as an application of characteristic varieties of inequalities— ····· ∗

Summary: Let H be a singed linear system on a semialgebraic variety A. A subset $\Omega \subset A$ is called test set, if $f \in H$ is non-negative on Ω then $f \in H$ is always non-negative on A. We present some example of test sets for certain (A, H).

38 Michio Amano (Meisei Univ.) On the Cartier duality of certain finite group schemes over $\mathbb{Z}_{(p)}$-algebra containing some nilpotent elements ····· ∗

Summary: Let $\mathcal{G}^{(\lambda)}$ be a group scheme which deforms $\mathbb{G}_a$ to $\mathbb{G}_m$. We explicitly describe the Cartier dual of the l-th Frobenius type kernel N_l of the group scheme $\mathcal{E}^{(\lambda,\mu;D)}$ which is an extension of $\mathcal{G}^{(\lambda)}$ by $\mathcal{G}^{(\mu)}$. Here we assume that the base ring A is a $\mathbb{Z}_{(p)}$-algebra containing some nilpotent elements.

39 Mariko Ohara (Oshima Nat. Coll. of Maritime Tech.) On Algebraic K-theory of duoidal category ····· ∗

Summary: Let C be a certain duoidal category with coproduct such that the two monoidal products preserve coproduct separately in each variable. We examined the algebraic K-theory of a duoidal catgory has the similar properties to that of a monoidal category.

40 Momonari Kudo (Univ. of Tokyo) Shushi Harashita (Yokohama Nat. Univ.) Parameterizing generic curves of genus five and its application to finding curves with many rational points ····· ∗

Summary: In algebraic geometry, it is important to give good parameterizations of spaces of curves. In particular, the case of non-hyperelliptic curves is the central issue. We construct a very effective parametrization of curves of genus 5 which are neither hyperelliptic nor trigonal. After that, we also present an algorithm for a complete enumeration of generic curves of genus 5 over finite fields with many rational points, where "generic" here means non-hyperelliptic and non-trigonal with mild singularities of the associated sextic model which we propose. As an application, we execute an implementation on computer algebra system MAGMA of the algorithm for curves over the prime field of characteristic 3.

41 Yusuke Suyama (Osaka City Univ.) 2-Fano Bott manifolds ····· ∗

Summary: A 2-Fano manifold is a Fano manifold with nef second Chern character. In this talk, we give a necessary and sufficient condition for a Fano Bott manifold to be 2-Fano.

42 Taku Suzuki (Utsunomiya Univ.) Slope stability of Fano manifolds ····· ∗

Summary: In this talk, we consider the slope stability of Fano manifolds. I conjecture that Fano manifolds are slope stable with respect to curves on them except some cases. I will explain some partial results of this conjecture.

September 17th (Fri) Conference Room II

9:00–12:00

43 Yoshiaki Okumura (Toyo Univ.) Z On congruence of Galois representations attached to A-motives ····· 12

Summary: The notion of A-motives is a higher-dimensional generalization of Drinfeld modules, and $\mathfrak{p}$-adic representations attached to them are one of the most important objects in function field arithmetic. In this talk, we give a criterion for two congruent $\mathfrak{p}$-adic representations arising from A-motives defined over a global function field to be isomorphic up to semi-simplification when they are restricted to a decomposition group, in terms of Hodge–Pink theory. This is a function field analogue of the criterion for ℓ-adic representations given by Ozeki and Taguchi.

44 Hiroto Horiba Z
Masanari Kida (Tokyo Univ. of Sci.)
Genki Koda (Tokyo Univ. of Sci.)
Galois theoretic study on simultaneous representation of primes by binary quadratic forms ····· 12

Summary: Kaplansy proved that a prime $p \equiv 1 \pmod{16}$ is representable by both or none of $x^2 + 32y^2$ and $x^2 + 64y^2$ whereas a prime $p \equiv 9 \pmod{16}$ is representable by exactly one of these forms. In this talk, we discuss intrinsic Galois structure behind the theorem, and find new theorems like Kaplansky's. Our theorems exhaust all Kaplansky-type theorems involving positive definite quadratic forms under certain assumption. Moreover, we also find theorems in the indefinite case.

45 Akinari Hoshi (Niigata Univ.) Z
Kazuki Kanai (Niigata Univ.)
Davenport and Hasse's theorems and lifts of multiplication matrices of Gaussian periods ····· 10

Summary: Let $e \geq 2$ be an integer, p^r be a prime power with $p^r \equiv 1 \pmod{e}$ and $\eta_r(i)$ be Gaussian periods of degree e for $\mathbb{F}_{p^r}$. By the dual form of Davenport and Hasse's lifting theorem on Gauss sums, we establish lifts of the multiplication matrices of the Gaussian periods $\eta_r(0), \ldots, \eta_r(e-1)$ which are defined by F. Thaine. We also give some examples of the explicit lifts for prime degree e with $3 \leq e \leq 23$ which also illustrate relations among lifts of Jacobi sums, Gaussian periods and multiplication matrices of Gaussian periods.

46 Norihiko Minami Z
(Nagoya Inst. of Tech.)
Relations among higheries originating from lower rationality = higher uniruledness —applications to Noether's problem for finite groups— ····· 12

Summary: We introduce three kinds of hierachies among n-folds, originating from lower rationality = higher uniruledness. For an integer i in [0,n], we define (-i)rationality, stable (-i)rationality, and retract (-i)rationality. When the base field is the complex number, thanks to the examples construced by Schreieder, these higheries are all strict, and we can interprete various counter examples to the Noether's program for finite groups over the complex number field as statements of non retract (-i) rationality.

47 Yasuhiro Terakado (NCTS) Z Mass formulas on the basic loci of unitary Shimura varieties ····· 12

Summary: We study a formula for the mass of a reductive group associated with a point on the basic locus of the reduction of a unitary Shimura variety modulo at a good prime p. We give formulas for the cardinality of the zero-dimensional Ekedahl–Oort stratum on the Shimura variety of $\mathrm{GU}(r, s)$, and for the number of irreducible components of an Ekedahl–Oort stratum in the basic locus of the Shimura variety of $\mathrm{GU}(1, s)$ when p is inert in the underlying quadratic imaginary field. This is joint work with Chia-Fu Yu.

Summary: For a torus over a global field, Bruhat, Colliot-Thélène, Sansuc and Tits proposed a question which is weaker than the weak approximation at a single finite place. It is related to some researches on arithmetic geometry of Shimura varieties when the torus is defined over the field of rational numbers. In this talk, we consider the above question for tori of certain form over the rational number field. In particular, we give sufficient conditions to the positivity and infinitely many negative examples.

Summary: One of the modern methods to study the value-distributions of zeta and L-functions is to compare zeta and L-functions with some probabilistic models. In particular, the distributions of extreme values of zeta and L-functions have been studied via the theory of large deviations in probability theory. In this talk, I will talk about large deviations for values of automorphic L-functions attached to holomorphic primitive cusp forms in the level aspect. The main result provides an estimate on the density of cusp forms for which the attached L-functions have extremely large values.

Summary: We study the square integral of Selberg's zeta functions in the critical strip.

Summary: The Hadamard product was used to obtain a determinant representation of the entire zeta function. By taking the logarithmic derivative of the determinant and Fourier transforming it, we obtain a differential equation including the Laplacian. From the positivity of minus Laplacian, the coefficient is a real number. R.H. is confirmed.

Summary: We studied some infinite series analogous to Riemann's zeta function:

$$\zeta_1(m) = \sum_{n=1}^{\infty} \frac{1}{n^m + 1}$$

with m a natural number ≥ 2. We show the exact value of $\zeta_1(2m)$ and some expression of $\zeta_1(2m+1)$ involving certain improper integral of the hyperbolic cotangent function and a rational function.

Summary: It is known that the Schur multiple zeta functions of shape λ have the determinant formulas such as Jacobi–Trudi, Giambelli, and Dual Cauchy formulas under the assumption for the diagonal elements of the Young diagram corresponding to λ. We generalize the Jacobi–Trudi formula to that without the assumption in some shape. As one of the applications of this formula, we show the analog of the Pieri formula for the Schur functions for the hook type Schur multiple zeta functions.

Summary: M. Kaneko and D. Zagier introduced the element $\zeta(s_1,..,s_r)_{\mathcal{A}}$ of the ring $\prod_{p:prime}\mathbb{F}_p/\bigoplus_{p:prime}\mathbb{F}_p$ called *finite multiple zeta value* (*FMZV* for short) as a variant of multiple zeta value, where $(s_1,..,s_r)$ is a tuple of integers called *index* of the FMZV. It is known that any FMZV with integer index is expressed as $\mathbb{Q}$-linear combination of 1 and FMZVs with all-positive indices. We show that the same holds for the positive characteristic analogues of FMZVs introduced by C.-Y. Chang and Y. Mishiba.

14:25–15:25 Talk Invited by Algebra Section

Daichi Takeuchi (RIKEN) Z Characteristic epsilon cycles of ℓ-adic sheaves on varieties

Summary: For an ℓ-adic sheaf on a smooth variety over a finite field, the constant term appearing in the functional equation of the L-functions, called the global epsilon factor, is an important arithmetic invariant. When the variety is a curve, Deligne and Laumon show that it decomposes as a produc of local epsilon factors.
In this talk, I will explain that, attaching some coefficients to the irreducible components of the singular support, we can define a cycle which satisfies a Milnor-type formula for the local epsilon factors of the vanishing cycles complexes modulo roots of unity. I will also explain that, when the variety is projective, it gives a product formula for the global epsilon factor modulo roots of unity for higher dimensional varieties. I will also give an explicit computation, without modulo roots of unity, of the local epsilon factors in a constant sheaf case.

15:40–16:50

55 Kota Saito (Nagoya Univ.) Z Prime-representing functions and Hausdorff dimension ····· 12

Summary: Let $c \geq 2$ be any fixed real number. In 2010, Matomäki investigated the set of $A > 1$ such that the integer part of A^{c^k} is a prime number for every $k \in \mathbb{N}$. She proved that the set is uncountable, nowhere dense, and has Lebesgue measure 0. In this talk, we show that the set has Hausdorff dimension 1.

56 Daniel Tsai (Nagoya Univ.) Z A recurring pattern in natural numbers of a certain property ····· 12

Summary: Numbers such as 198 have the unusual property that the sum of the prime divisors and corresponding exponents larger than 1 in the prime factorization of 198 is equal to that of its reversal 891. Since palindromes satisfy this trivially, we exclude them from our definition. In the sequence of repeated concatenations of the decimal digits of an arbitrary natural number, not a multiple of 10 nor a palindrome, the pattern of which of them have the unusual property is periodic.

57 Takafumi Miyazaki (Gunma Univ.) Z Number of solutions to the exponential Diophantine equation $a^x + b^y = c^z$ ····· 12

Summary: I will briefly report about recent progress on the number of solutions to the exponential Diophantine equation $a^x + b^y = c^z$ in positive integers x, y and z for any fixed coprime positive integers a, b and c greater than 1. The main result states that there are at most two solutions to the equation except for one specific case. This is a joint work with István Pink (University of Debrecen).

58 Daniel Duverney (Baggio Engineering School) Z
Takeshi Kurosawa (Tokyo Univ. of Sci.)
Iekata Shiokawa (Keio Univ.)
Three irregular continued fractions of finite sums ····· 10

Summary: We state three general formulas allowing us to transform formal finite sums into formal continued fractions and use them to generalize certain expansions in regular continued fractions given by Hone and Varona.

59 Shigeru Iitaka (Gakushuin Univ.*) Z Variants of Mersenne primes ····· 12

Summary: Primes in the form $q = 2^e - 1$ are said to be Mersenne primes.
Here we introduce variants of Mersenne primes.
Given an integer m and a odd prime h, if a positive integer a satisfies the simultaneous equations $A = \sigma(a) - m, B = \sigma(A) - 1 + 2m, \sigma(B) = 3a + 3$ then it is said to be ultra 2 Mersenne perfect number with partner A and shadow B.
Other than Mersenne primes, 499279,1000151 are variants of Mersenne primes.

60 Makoto Minamide (Yamaguchi Univ.)
Yoshikatsu Yashiro (Chubu Univ.)
Yoshio Tanigawa
On an error term for the mean of the sum of congruent divisors ····· ∗

Summary: For fixed positive integers m_1 and m_2, we shall define an arithmetical function $f(n)$ by the sum of divisors d of n satisfying $d \equiv k_1\,(m_1)$ and $n/d \equiv k_2\,(m_2)$. We study an error term of the mean of $f(n)$.

61 Isao Kiuchi (Yamaguchi Univ.)
On sums of sums involving squarefull numbers ····· ∗

Summary: We consider several asymptotic formulas for sums of the modified squarefull numbers.

62 Isao Kiuchi (Yamaguchi Univ.)
Yuki Tsuruta (Yamaguchi Univ.)
On sums involving the Euler totient function ····· ∗

Summary: Let $\gcd(n_1, \cdots, n_k)$ denote the greatest common divisor of the positive integers $n_1, \cdots, n_k$, and let ϕ be the Euler totient function defined by $\mathrm{id} * \mu$. For any real number $x > 3$ and any integer $k \geq 2$, we investigate the asymptotic behaviour of formulas for $\sum_{n_1 \cdots n_k \leq x} \phi(\gcd(n_1, \cdots, n_k))$.

63 Shin-ya Koyama (Toyo Univ.)
Nobushige Kurokawa (Tokyo Tech⋆)
Variations of Ramanujan's Euler product ····· ∗

Summary: We study the meromorphy of various Euler products of degree two attached to holomorphic Hecke eigen cusp forms for the elliptic modular group, including Ramanujan's Δ-function.

64 Hirotaka Kobayashi (Nagoya Univ.)
On the discrete mean of the higher derivative of Hardy's Z-function ····· ∗

Summary: In 1985, Conrey and Ghosh considered the discrete mean value of $Z(\gamma_1)^2$, where $Z(t)$ is called Hardy's Z-function and γ_1 are the zeros of the first derivative of $Z(t)$ with assuming the Riemann Hypothesis. And they obtained an approximate formula. Later, Yildirim generalise their result. He obtained an asymptotic formula of the sum of $Z(\gamma_k)^2$, where γ_k are the zeros of the k-th derivative of $Z(t)$. In this talk, we give more generalised result, namely, an approximate formula of $Z^{(j)}(\gamma_k)^2$, where $Z^{(j)}(t)$ is the j-th derivative of $Z(t)$.

65 Kenta Endo (Nagoya Univ.)
Effective estimate for approximation theorem by zeta-functions ····· ∗

Summary: We consider the effectivity problem of Voronin's multi-dimentional denseness theorem for zeta-functions. He himself refined his theorem to an effective form. We will generalize his effective result to the Selberg class under the certain conditions.

66 Humihiko Watanabe (Nat. Defense Acad. of Japan)
The number of critical points of a product of powers of theta functions in two variables ····· ∗

Summary: We obtained the following theorem: Under a general situation of parameters, the number of nondegenerate critical points of a product of complex powers of theta functions in two variables coincides with the Euler number of an open dense subset which is contained in an abelian surface and obtained by subtracting from it the normal crossing divisor related to the product of complex powers of theta functions.

Geometry

September 14th (Tue) Conference Room III

10:00–12:00

1 Natsuo Miyatake (Osaka Univ.) Z Kobayashi–Hitchin correspondence of harmonic bundles with diagonal harmonic metrics 15

Summary: Simpson established Kobayashi–Hitchin correspondence of harmonic bundles on compact Kähler manifolds about 30 years ago. In this talk, we will give a simplified proof of the Kobayashi–Hitchin correspondence of harmonic bundles with diagonal harmonic metrics on compact Kähler manifolds by applying the speaker's theorem of the existence of the solution of the generalized Kazdan–Warner equations on compact Riemannian manifolds.

2 Soma Ohno (Waseda Univ.) Z Rarita–Schwinger fields on nearly Kähler manifolds 15
Takuma Tomihisa (Waseda Univ.)

Summary: We study Rarita–Schwinger fields on 6-dimensional compact strict nearly Kähler manifolds. In order to investigate them, we clarify the relationship between some differential operators for the Hermitian connection and the Levi–Civita connection. As a result, we show that the space of the Rarita–Schwinger fields coincides with the space of the harmonic 3-forms. Applying the same technique to a deformation theory, we also find that the space of the infinitesimal deformations of Killing spinors coincides with the direct sum of a certain eigenspace of the Laplace operator and the space of the Killing spinors.

3 Tadashi Fujioka (Kyoto Univ.) Z Collapsing to Alexandrov spaces with isolated mild singularities 15

Summary: Let M_j be a sequence of Riemannian manifolds with a lower curvature bound collapsing to an Alexandrov space X. Yamaguchi's fibration theorem states that if X is a Riemannian manifold, then M_j admits a structure of locally trivial fibration over X for large j. It is known that the assumption can be relaxed to the condition that each point of X is strained. In this talk, we show this theorem under the condition that X admits isolated singularities stronger than strained points.

4 Tomohiro Fukaya (Tokyo Metro. Univ.) Z Induced maps between boundaries of coarsely convex spaces 15

Summary: The class of coarsely convex spaces is introduced by myself and Shin-ichi Oguni, which is a coarse geometric analogue of the class of Riemannian manifolds of nonpositive curvature. With Yuuhei Ezawa, we studied maps between coarsely convex spaces which induces continuous maps between their boundaries. Our work is based on the results by Dydak and Virk for the case of Gromov hyperbolic spaces and their boundaries. The main part of this talk is based on the preprint arXiv:2103.11160.

5 Ken Sumi (Kyoto Univ.) Z Riemann–Roch inequality for smooth compact tropical toric surfaces 15

Summary: For a divisor D on a compact tropical curve C, the value of $h^0(C, D)$ appearing in a Riemann–Roch formula for compact tropical curves is difficult to compute in general and cannot be given only by the tropical module $\Gamma(C, \mathcal{O}(D))$ consisting of global sections of the correspondence tropical line bundle $\mathcal{O}(D)$. For a divisor D on a tropical variety X, we give lower and upper bounds of the value of $h^0(X, D)$, which are defined in terms of global sections and computed more easily than $h^0(X, D)$. As an application of this estimation, we show that a Riemann–Roch inequality holds for smooth compact tropical toric surfaces.

6 Xiaodan Zhou (Okinawa Inst. of Sci. and Tech. Grad. Univ.) [z] Quasiconformal and Sobolev mappings in non-Ahlfors regular metric spaces 15

Summary: We show that a mapping $f\colon X \to Y$ satisfying the metric condition of quasiconformality outside suitable exceptional sets is in the Newton–Sobolev class $N^{1,1}_{loc}(X;Y)$. Contrary to previous works, we only assume an asymptotic version of Ahlfors-regularity on X, Y. This allows many non-Ahlfors regular spaces, such as weighted spaces and Fred Gehring's bowtie, to be included in the theory. Unexpectedly, already in the classical setting of unweighted Euclidean spaces, our theory detects Sobolev mappings that are not recognized by previous results.

14:25–15:25

7 Kotaro Kawai (Gakushuin Univ.) Hikaru Yamamoto (Univ. of Tsukuba) [z] Deformation theory of deformed Donaldson–Thomas connections for Spin(7)-manifolds 15

Summary: A deformed Donaldson–Thomas connection for a manifold with a Spin(7)-structure, which we call a Spin(7)-dDT connection, is a Hermitian connection on a Hermitian line bundle L over a manifold with a Spin(7)-structure defined by fully nonlinear PDEs. It was first introduced by Lee and Leung as a mirror object of a Cayley cycle by the real Fourier–Mukai transform. We suggest an alternative definition of Spin(7)-dDT connections which seems to be more appropriate by carefully computing the real Fourier–Mukai transform again. Then we study the deformation theory. We show that each of their deformations on an open set of the moduli space is controlled by a subcomplex of an elliptic complex and show its orientability.

8 Kotaro Kawai (Gakushuin Univ.) Hikaru Yamamoto (Univ. of Tsukuba) [z] Mirror of volume functionals on manifolds with special holonomy 15

Summary: We can define the "volume" V for Hermitian connections on a Hermitian complex line bundle over a Riemannian manifold X, which can be considered to be the "mirror" of the standard volume for submanifolds. This is called the Dirac–Born–Infeld (DBI) action in physics.
We first show the short time existence and uniqueness of the negative gradient flow of V. Then we relate the functional V to a deformed Donaldson–Thomas connection for a Spin(7)-manifold (a Spin(7)-dDT connection). We prove the "mirror" of the Cayley equality, which have many applications. For example, we see that any Spin(7)-dDT connection is a global minimizer of V and its value is given topologically and we can relate Spin(7)-dDT connections to G_2-dDT and dHYM connections. We also prove analogous statements for G_2-manifolds and Kähler manifolds of dimension 3 or 4.

9 Tatsuki Kuwagaki (Osaka Univ.) [z] Symplectic geometry and exact WKB analysis 15

Summary: Exact WKB analysis is a specific way to solve differential equations parametrized by the Planck parameter. I'll describe symplectic/sheaf-theoretic construction expressing solutions of exact WKB analysis, which will lead to a formulation of a variant of the Riemann–Hilbert correspondence.

10 Homare Tadano (Yamaguchi Univ.) Boju–Funar type theorems via m-Bakry–Émery and m-modified Ricci curvatures ..... ∗

Summary: We establish some Boju–Funar type compactness criteria for complete Riemannian manifolds via m-Bakry–Émery and m-modified Ricci curvatures assuming that m-Bakry–Émery and m-modified Ricci curvatures tend slowly to zero as the distance from a fixed point goes to infinity.

11 Homare Tadano (Yamaguchi Univ.) m-Bakry–Émery Ricci curvatures, Riccati inequalities, and bounded diameters ····· ∗

Summary: By using some line integrals in terms of the m-Bakry–Émery and m-modified Bakry–Émery Ricci curvatures, we give various compactness criteria for complete Riemannian manifolds when m is a positive constant, a negative constant, and infinity. Our results generalize previous Myers-type compactness criteria obtained by M. Fernández-López and E. García-Río, M. Limoncu, Z. Qian, G. Wei and W. Wylie, J.-Y. Wu, and W. Wylie, as well as a previous Ambrose-type compactness criterion obtained by K. Kuwae and X.-D. Li. The key ingredients in proving our results are Riccati inequalities obtained from Bochner–Weitzenböck formulas via m-Bakry–Émery and m-modified Bakry–Émery Ricci curvatures.

12 Takayuki Moriyama (Mie Univ.) Quaternionic k-vector fields on quaternionic Kähler manifolds ····· ∗
Takashi Nitta (Mie Univ.)

Summary: In this talk, we introduce a quaternionic k-vector field on a quaternionic Kähler manifold. We prove that any quaternionic k-vector field corresponds to a holomorphic k-vector field on the twistor space.

15:40–16:40 Talk Invited by Geometry Section

Ryunosuke Ozawa (Nat. Defense Acad. of Japan) Z Geometric analysis on directed graphs of Lin–Lu–Yau type Ricci curvature bounded below

Summary: For undirected graphs, the Ricci curvature introduced by Lin–Lu–Yau has been widely studied from various perspectives, especially geometric analysis. In this talk, we discuss generalization problem of their Ricci curvature for directed graphs. We introduce a new generalization by using the mean transition probability kernel which appears in the formulation of the Chung Laplacian. We obtained Ricci curvature of Cartesian products of two directed graphs, Bonnet–Myers type theorem, maximal diamater theorem of Chung type, and characterization of lower Lin–Lu–Yau type Ricci curvature bound.

September 15th (Wed) Conference Room IX

10:10–10:20 Announcement of the 2021 MSJ Geometry Prize

10:35–11:35 Award Lecture for the 2021 MSJ Geometry Prize

Nariya Kawazumi (Univ. of Tokyo) Z In search of the Lie algebra of the mapping class group
Yusuke Kuno (Tsuda Coll.)

Summary: Given an oriented surface, one can consider the associated graded Lie algebra of the filtration of its mapping class group that is defined by the lower central series of the fundamental group of the surface. The Johnson homomorphism is an injective graded Lie homomorphism from this Lie algebra to the Lie algebra of symplectic derivations. In this talk, we explain a geometric approach to the Johnson homomorphism using the Goldman–Turaev Lie bialgebra of the surface. In particular, we show that the Kashiwara–Vergne problem, which originates in Lie theory, is equivalent to the problem of finding Magnus expansions of the fundamental group of the surface which are compatible with the structure of the Goldman–Turaev Lie bialgebra. We will also mention several infinitesimal approaches to topology of the mapping class group.

13:15–14:15 Award Lecture for the 2021 MSJ Geometry Prize

Jun Murakami (Waseda Univ.) Z The Jones polynomial and its applications

Summary: The Jones polynomial is the foundation of the quantum topology of low-dimensional manifolds. The Jones polynomial is related to the quantum group $\mathcal{U}_q(sl_2)$, and is extended to the colored Jones polynomial and the Witten–Reshetikhin–Turaev invariant of three manifolds, and various quantum invariants. Based on Kashaev's observation that certain quantum invariant of knots relates to the hyperbolic volume of the knot complement, the volume conjecture is proposed. This conjecture predicts a relation between the colored Jones polynomial of a knot and the volume of the knot complement. On the other hand, the Jones algebra is generalized to the Kauffman bracket skein algebra, which is expected to be a good tool to quantize some classical geometric theory.
In this talk, I would like to explain the representation theoretical aspect of the Jones polynomial, the volume conjecture and its application, and an application of the skein algebra to the $SL(2,\mathbb{C})$ character variety of a knot.

September 16th (Thu) Conference Room III

10:00–12:00

13 Taito Tauchi (Kyushu Univ.) Z
Tsuyoshi Yoneda (Univ. of Tokyo)
Positivity for the curvature of the diffeomorphism group corresponding to the incompressible Euler equation with Coriolis force ····· 15

Summary: We investigate the geometry of the central extension $\widehat{\mathcal{D}}_\mu(S^2)$ of the group of volume-preserving diffeomorphisms of the 2-sphere equipped with an L^2-metric, for which geodesics correspond to solutions of the incompressible Euler equation with Coriolis force. In particular, we calculate the *Misiołek curvature* of this group. This value is related to the existence of a conjugate point and its positivity directly implies the positivity of the sectional curvature.

14 Masahiro Kawamata (Hiroshima Univ.) Z
On properties of the generalized Monge–Ampère equation and its geometric singular solutions ····· 15

Summary: The set of Monge–Ampère equations is an important class of partial differential equations and has been studied not only by analytical but also by geometrical methods. It is known that the open umbrella which is an important object in singularity theory appears as a geometric singular solution of a Monge–Ampère equation. Therefore, it can be expected that geometric singular solutions of generalized Monge–Ampère equations are also important objects in terms of singularity theory. In this talk, we introduce some concrete examples which have singularities of type cuspidal edge, swallowtail, etc., of geometric singular solutions of generalized Monge–Ampère equations. We also introduce geometric properties of generalized Monge–Ampère equations in terms of exterior differential systems.

15 Yoshiki Jikumaru (Kyushu Univ.) Z
On the stability problem of discrete planar curves ····· 15

Summary: We study planar polygonal curves from the variational methods. We show that equilibrium discrete planar curves for the length functional under the area-constraint condition must be regular polygons. Moreover, we derive the second variation formula for the equilibrium curves and show that non-convex regular polygons and convex regular polygons with the multiplicity are unstable.

16 Yuichiro Sato (Tokyo Metro. Univ.) Z
Duality of hypersurfaces in pseudo-Riemannian space forms and lightcones ····· 15

Summary: When we consider hypersurfaces in pseudo-spheres, pseudo-hyperbolic spaces and lightcones, there exist three types of duality, which we call the duality of hypersurfaces. In this talk, we will introduce the notion of palindromic hypersurfaces and show that infinitesimal symmetries can be shifted by the duality of hypersurfaces.

17 Johannes Jaerisch (Nagoya Univ.) Z
Hiroki Takahasi (Keio Univ.)
Cusp winding spectra for some hyperbolic surfaces 15

Summary: We introduce the multi-cusp winding process for the geodesic flow on a hyperbolic surface modeled by a finitely generated free Fuchsian group with parabolic elements. We use ergodic theory and multifractal analysis to investigate the long-term behavior of the cusp winding process.

18 Tomoki Fujii (Tokyo Univ. of Sci.) Z
Graphical translating solitons for the mean curvature flow and isoparametric functions 15

Summary: In this talk, we give a construction of a translating soliton which is given as the graph of a function over some domain of a Riemannian manifold whose level sets give isoparametric foliation. The translating soliton constructed in this method is the graph of a function which is given as a composition of an isoparametric function and a solution of a certain ordinary differential equation. In particular, in case where the Riemannian manifold is the sphere, we classify the shape of such translating solitons.

14:25–15:25

19 Yoshio Agaoka (Hiroshima Univ.*) Z
Takahiro Hashinaga (Kitakyushu Nat. Coll. of Tech.)
Local isometric embedding of 3-dimensional warped product metrics and the Monge–Ampère equation 15

Summary: We consider the problem of local isometric embeddings of three-dimensional warped product metrics with a two-dimensional base space. We give an (almost) necessary and sufficient condition that this space can be locally isometrically embedded into the four-dimensional Euclidean space. This condition can be expressed as a second-order partial differential equation on the warping function, which is the Monge–Ampère type, in addition to some inequality on the curvature.

20 Kazuyuki Enomoto (Tokyo Univ. of Sci.*) Z
Jin-ichi Itoh (Sugiyama Jogakuen Univ.)
Total integral of curvatures of spherical curves 15

Summary: We study the total integral of the curvature of curves in the unit sphere S^2 in the Euclidean space E^3. We explain how the total Euclidean curvature (total integral of the curvature as a curve in E^3) is related to the total spherical curvature (total integral of the curvature as a curve in S^2) of its evolute. We use this relation to study the problem of finding the minimal possible value of the total Euclidean curvature in a set of curves where the location and the tangential direction at the endpoints are prescribed.

21 Makiko Sumi Tanaka (Tokyo Univ. of Sci.) Z
Hiroyuki Tasaki (Univ. of Tsukuba)
Maximal antipodal sets of classical compact symmetric spaces II 15

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 $UI(n) \cong U(n)/O(n)$ and their quotient spaces.

22 Katsuhiro Moriya (Univ. of Hyogo)
Transforms of minimal surfaces in the unit sphere ..... *

Summary: For a given minimal surface in the n-sphere, two ways to construct a minimal surface in the m-sphere are given. One way constructs a minimal immersion. The other way constructs a minimal immersion which may have branch points. The branch points occur exactly at each point where the original minimal surface is geodesic. If a minimal surface in the 3-sphere is given, then these ways construct Lawson's polar variety and bipolar surface.

23 Yuuki Sasaki (Tokyo Nat. Coll. of Tech.)
Maximal antipodal sets of F_4 and FI ..... *

Summary: We explicitly classify congruent classes of maximal antipodal sets of F_4 and FI by using the exceptional Jordan algebra. Moreover, we construct a new characterization of the compact symmetric space FI.

24 Yuichiro Sato (Tokyo Metro. Univ.) Classification of isoparametric hypersurfaces with diagonalizable shape operator in pseudo-spheres ..... *

Summary: As an application of duality of hypersurfaces in pseudo-Riemannian space forms and lightcones, we will give a classification of isoparametric hypersurfaces in pseudo-spheres whose shape operators are diagonalizable.

15:40–16:40 Talk Invited by Geometry Section

Hitoshi Furuhata (Hokkaido Univ.) [Z] Submanifold theory in statistical manifolds

Summary: A statistical manifold is a Riemannian manifold endowed with a torsion-free affine connection satisfying the Codazzi equation. The submanifold theory in such a space is now developing. The words "statistical submanifold" can be found in the late 1980s in the context of statistical inference or information geometry. We will here introduce recent differential geometric researches in this field, for example, the counterpart of the Chen inequality in the Riemannian submanifold theory.

Complex Analysis

September 14th (Tue) Conference Room IV

10:00–12:00

1 Hiroshi Yanagihara (Yamaguchi Univ.) Z
Shota Hoshinaga (Yamaguchi Univ.)
The sharp distortion estimate concerning Julia's lemma 15

Summary: Let J_α be the class of analytic functions f in D such that $f(D) \subset D$ having the angular derivative α at $1 \in \partial D$. Then for fixed $z_0 \in D$, classical Julia's lemma states that $V_0(z_0, \alpha) = \{f(z_0) : f \in J_\alpha\}$ is a disc. We study the variability region $V_1(z_0, \alpha) = \{f'(z_0) : f \in J_\alpha\}$ and determine the shape of $V_1(z_0, \alpha)$. It is not a disc.

2 Hiroaki Aikawa (Chubu Univ.) Z
Michiel van den Berg (Univ. of Bristol)
Jun Masamune (Hokkaido Univ.)
Intrinsic ultracontractivity for domains in negatively curved manifolds 15

Summary: Let M be a complete, non-compact, connected Riemannian manifold with Ricci curvature bounded from below by a negative constant. We give a sufficient condition for open and connected sets D in M for which the corresponding Dirichlet heat semigroup is intrinsically ultracontractive. That condition is formulated in terms of capacitary width. The key ingredient is that the bottom of the spectrum of the Dirichlet Laplacian for D is comparable with the reciprocal of the square of the capacitary width for D, if the capacitary width is sufficiently small.

3 Shun Kumagai (Tohoku Univ.) Z
Veech groups of general origamis 15

Summary: An atlas μ on a Riemann surface R whose any transition is half-translation is called a flat structure on R. Affine deformations of a flat surface (R, μ) form a Teichmüller disk $\Delta(R, \mu)$, a curve family isometrically embedded into the Teichmüller space $T(R)$ as a disk. $\Delta(R, \mu)$ projects into the moduli space $M(R)$ by the quotient with the Veech group $\Gamma(R, \mu) < PSL(2, \mathbb{R})$, forming an orbifold. $PSL(2, \mathbb{Z})$ acts on the set of origamis (square-tiled flat surfaces) by transforming a combinatorial graph structure characterizing origami. We may calculate Veech groups of origamis by decomposing the set of origamis into $PSL(2, \mathbb{Z})$-orbits. As a result, we find the smallest non-trivial origami with the maximal Veech group $PSL(2, \mathbb{Z})$.

4 Ikkei Hotta (Yamaguchi Univ.) Z
Pavel Gumenyuk
(Univ. Politecnico di Milano)
Univalent functions with quasiconformal extensions: Becker's class and estimates of the third coefficient 15

Summary: We investigate univalent functions $f(z) = z + a_2 z^2 + a_3 z^3 + \cdots$ in the unit disk $\mathbb{D}$ extendible to k-quasiconformal automorphisms of $\mathbb{C}$. In particular, we answer a question on estimation of $|a_3|$ raised by Kühnau and Niske. This is one of the results we obtain studying univalent functions that admit quasiconformal extensions via a construction, based on Loewner's parametric representation method, due to J. Becker.

5 Ikkei Hotta (Yamaguchi Univ.) Z
Makoto Katori (Chuo Univ.)
Andrea del Monaco
(Univ. degli Studi di Roma "Tor Vergata")
Sebastian Schleißinger
(Univ. Würzburg)
Limits of multiple SLE and a Burgers–Loewner differential equation 15

Summary: In this talk we ask whether one can take the limit of multiple SLE as the number of slits goes to infinity.

6 Ikkei Hotta (Yamaguchi Univ.) Z Additive processes on the unit circle and Loewner chains 15
Takahiro Hasebe (Hokkaido Univ.)

Summary: In this talk we defines the notion of generators for a class of decreasing radial Loewner chains which are only continuous with respect to time. For this purpose, "Loewner's integral equation" which generalizes Loewner's differential equation is defined and analyzed. The definition of generators is motivated by the Lévy–Khintchine representation for additive processes on the unit circle.

7 Sei-Ichiro Ueki (Tokai Univ.) Mean Lipschitz condition and growth of area integral mean in the Bergman space ..... *

Summary: We show that the mean Lipschitz condition for f in the weighted Bergman space with admissible Békollé weights is characterized by the growth of the area integral mean of its derivative as well as by the growth of the norm of the difference between f and the dilated function of f. Furthermore we investigate the Bloch and Zygmund-type spaces for admissible weight.

8 Saburou Saitoh (Gunma Univ.*/Inst. of Reproducing Kernels) Mysterious properties of the Laurent expansions in connection with geometry ..... *
Hiroshi Okumura

Summary: Based on the materials in the several papers, we introduce the mysterious and concrete properties of the Laurent expansion in connection with geometry and division by zero calculus. The problem is on the properties at the point at infinity of meromorphic functions and figures, and we found entirely new mathematics and results for the Laurent expansion.

14:25–15:25 Talk Invited by Complex Analysis Section

Yûsuke Okuyama (Kyoto Inst. Tech.) Z Complex dynamics and non-archimedean dynamics: moduli, degeneration, and reduction

Summary: We would give a talk about a few (mutually related) topics from complex and non-archimedean/arithmetic dynamics on (i) a quantitative approximation of the Lyapunov exponent function for rational functions of degree > 1 and quantitative/effective studies of the complex geometry of the dynamical moduli spaces (including our joint work with Thomas Gauthier and Gabriel Vigny), (ii) limiting/asymptotic behaviors of the Lyapunov exponents and the maximal entropy measures for a meromorphic family of rational functions of degree $d > 1$ on $\mathbb{P}^1(\mathbb{C})$ parametrized by $\mathbb{D}$ and possibly degenerating at the origin in the parameter space $\mathbb{D}$ (including our joint work with Laura DeMarco), (iii) GIT-semistable reductions of rational functions of degree > 1 defined over an algebraically closed field that is complete with respect to a non-trivial and non-archimedean absolute value (including our joint work with Hongming Nie). We would try to indicate how complex and non-archimedean dynamics interact with each other.

September 15th (Wed) Conference Room IV

10:00–10:30

9 Takanori Ayano (Osaka City Univ.) Z Restrictions of the domain of the hyperelliptic functions of genus 2 15
Victor M. Buchstaber (Steklov Inst. of Math.)

Summary: In this talk, we consider the problem about the relationships between elliptic functions and hyperelliptic functions of genus 2. We consider a hyperelliptic curve V of genus 2 which admits a morphism of degree 2 to an elliptic curve E. We show that the restrictions of the domain of the hyperelliptic functions associated with V to the subspace in $\mathbb{C}^2$ are elliptic functions and describe them in terms of the Weierstrass elliptic function associated with E. We derive this result by describing the homomorphism between the Jacobian varieties of the curves V and E induced by the morphism from V to E explicitly.

10 Masanori Adachi (Shizuoka Univ.) Z
Judith Brinkschulte (Univ. Leipzig)
Dynamical aspects of foliations with ample normal bundle 15

Summary: We prove the following result that was conjectured by Brunella: Let X be a compact complex manifold of dimension ≥ 3. Let $\mathcal{F}$ be a codimension one holomorphic foliation on X with ample normal bundle. Then every leaf of $\mathcal{F}$ accumulates to the singular set of $\mathcal{F}$.

11 Makoto Abe (Hiroshima Univ.)
Shun Sugiyama
(NEC Comm. Systems, Ltd.)
A characterization of subpluriharmonicity by using quadratic functions ..... *

Summary: We give a characterization of a subpluriharmonic function of several complex variables in the sense of Fujita (J. Math. Kyoto Univ., 30:637-649, 1990) by using polynomial functions of degree at most two.

12 Shinichi Tajima (Niigata Univ.*)
Katsusuke Nabeshima
(Tokyo Univ. of Sci.)
A new deterministic method for computing Milnor number of an ICIS ..... *

Summary: The Milnor number of an isolated complete intersection singularity (ICIS) is considered in the context of symbolic computation. Based on the classical Lê–Greul formula, a new method for computing Milnor numbers is introduced. Key ideas of our approach are the use of auxiliary indeterminates and the concept of local cohomology with coefficients in the field of rational functions of auxiliary indeterminates.

13 Yuta Takada (Hokkaido Univ.)
Katsunori Iwasaki (Hokkaido Univ.)
Siegel disks on K3 surfaces and Picard numbers ..... *

Summary: If a K3 surface admits an automorphism with a Siegel disk, then its Picard number is an even integer between 0 and 18. Conversely, given such an integer p, there exists an automorphism with a Siegel disk on a K3 surface of Picard number p. We can prove this constructing a K3 lattice automorphism using the method of hypergeometric groups. The constructions involve extensive computer searches for appropriate Salem numbers and computations of related algebraic numbers.

14 Masataka Iwai (Tohoku Univ.)
On the structure of a log smooth pair in the equality case of the Bogomolov–Gieseker inequality ..... *

Summary: We study the structure of a log smooth pair when the equality holds in the Bogomolov–Gieseker inequality for the logarithmic tangent bundle and this bundle is semistable with respect to some ample divisor. We also study the case of the canonical extension sheaf.

15 Takeo Ohsawa (Nagoya Univ.)
L^2 cohomology with weights and bundle convexity of certain locally pseudoconvex domains ..... *

Summary: Employing a variant of Hörmander's approach to Andreotti–Grauert's theory, a comparison theorem is proved between some bundle-valued weighted L^2 cohomology groups of a class of locally pseudoconvex bounded domains in complex manifolds. The bundle convexity of such domains is proved as an application. In particular, it turns out that the complement of a complex curve of self-intersection zero in a compact complex algebraic surface is a domain of meromorphy.

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

Summary: It is proved that a bounded C^2-smooth pseudoconvex domain Ω in a Kähler manifold M can be mapped onto a locally closed anallytic set in $\mathbb{C}^N$ holomorphically and properly with connected fibers if the canonical bundle of M is negative on a neighborhood of $\partial\Omega$. A similar result is obtained for Zariski open domains in compact manifolds.

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

Genki Hosono (Tohoku Univ.)[Z] Optimal L^2 extension theorem and L^2 theoretic positivity

Summary: In complex analysis and geometry, L^2 theoretic techniques are important . Among them, Hörmander's L^2 estimates for $\bar{\partial}$-equations and the Ohsawa–Takegoshi L^2 extension theorem are especially important and widely used. Recent study shows that these theorems may characterize curvature-positivity conditions. Such characterizations can be used to describe positivity conditions for singular Hermitian vector bundles, whose curvature is not well-defined in general. In this talk, I'd like to explain the relationship between L^2 theory and positivity conditions.

Functional Equations

September 14th (Tue) Conference Room V

9:00–12:00

1 Saiei-Jaeyeong Matsubara-Heo (Kobe Univ.) Z Localization formulas of cohomology intersection numbers · · · · · 14

Summary: We revisit two types of localization formula of cohomology intersection numbers: one is Cho–Matsumoto type formula valid for any regular integrable connection. The other is stationary phase formula discovered by S. Mizera whose leading term is given by Grothendieck's residue pairing. The latter formula is of hypergeometric nature.

2 Sunao Ōuchi (Sophia Univ.*) Z Transformation and construction of solutions of a system of nonlinear ordinary differential equations by Borel summable functions · · · · · 14

Summary: The following system of nonlinear differential equations is studied

$$x^{1+\gamma}\frac{dY}{dx} = A(x)Y + F(x,Y),\ \ Y = {}^t(y_1.y_2,\cdots,y_n).$$

There are pioneering researches by Hukuhara, Malmquist and others. The theory of Borel summable functions is developed after their studies. By using this theory, we have another look at their studies. It is the main aim to give more precisely the meaning of asymptotic expansion of transformations and solutions.

3 Mika Tanda (Kwansei Gakuin Univ.) Z Exact WKB analysis of the hypergeometric differential equation with a simple pole · · · · · 14

Summary: The Gauss hypergeometric differential equation deformed to a differential equation with a simple pole at the origin is investigated from a view point of the WKB analysis. In this case, the relations between Kummer's solutions in the neighborhood of the singular point 1 and the Borel sums of the WKB solutions are established.

4 Kanam Park (Kwansei Gakuin Univ.) Z A 3×3 Lax form for q-Painlevé equations of type E_6 · · · · · 14

Summary: In a previous work, we introduced a nonlinear q-difference system that includes the q-Garnier system. This was given as a compatibility condition of a matrix Lax form with the product of N-th order square matrices as coefficients. In this talk, we consider one example of the case of $N = 3$ and derive a new Lax form of the q-Painlevé equation with $E_6^{(1)}$ type affine Weyl group symmetry.

5 Masakazu Onitsuka (Okayama Univ. of Sci.) Z Ulam stability for Cayley quantum equations · · · · · 14

Summary: The main purpose of this talk is to classify the Ulam stability of the nonautonomous Cayley quantum equation $D_q z(t) = \alpha(t)\langle z(t)\rangle_\beta$, where $\alpha(t)$ is a complex valued time-varying coefficient, and $D_q z(t) := \frac{z(qt)-z(t)}{(q-1)t}$, $q > 1$, and $\langle z(t)\rangle_\beta := \beta z(qt) + (1-\beta)z(t)$, $0 \le \beta \le 1$.

Summary: Multiple existence of positive even function solutions of

$$\begin{cases} u''(x) + \left(|x|^l + \lambda\right) u(x)^p = 0, \ u(x) > 0, \ x \in (-1,1), \\ u(\pm 1) = 0, \end{cases}$$

are shown, where parameters l and λ are $l \geq 0$ and $\lambda \geq 0$ and exponent p satisfies $p > 1$. It is shown that for fixed $p > 1$, on the majority part of first quadrant of $(l, \lambda) \subset \mathbb{R}^2$, the uniqueness of a positive even function solution of above equation holds and very narrow set remains as the possible region of multiple existence of even function solutions. It may be unexpected that for some triples (l, λ, p) of such narrow set, even function solutions indeed multiply exist and we show this by numerical verification method.

Summary: We consider the nonlinear differential equation $(a(t)|x'|^{p(t)-2}x')' = b(t)|x|^{q(t)-2}x$, where $a(t) > 0$, $b(t)$, $p(t) > 1$, and $q(t) > 1$ are smooth functions. Sufficient conditions are given for the existence and the nonexistence of singular solutions of the first (second) kind. In addition, we study the existence of proper solutions.

Summary: In this talk, we consider the modified Mathieu differential equation

$$x'' + (-\alpha + \beta \cosh(\gamma t))x = 0, \quad t \geq 0,$$

where α, β and γ are real numbers. It is determined by the parameters (α, β, γ) whether all non-trivial solutions of modified Mathieu differential equation are oscillatory (respectively, nonoscillatory). The main result provide parametric conditions for oscillation and nonoscillation. To prove the main result, a simple comparison theorem and Riccati technique are required.

Summary: We consider the asymptotic behavior of bifurcation curves of nonlinear ODEs with nonlinear diffusion, which come from the porous media type equation. The bifurcation curve λ is a continuous function of the maximum norm $\alpha = \|u_\lambda\|_\infty$ of the solution u_λ corresponding to λ, and is written as $\lambda = \lambda(\alpha)$. We obtain the asymptotic formulas for $\lambda(\alpha)$ as $\alpha \to \infty$ and $\alpha \to 0$.

Summary: We study the bifurcation of symmetric nodal solutions for the Moore–Nehari equation. Here we call a solution symmetric if it is even or odd. For a nonnegative integer n, we call a solution n-nodal if it has exactly n zeros in $(-1, 1)$. We denote the unique n-nodal symmetric solution by $u_n(x, \lambda)$. We prove that if n is odd, $u_n(x, \lambda)$ does not bifurcate, however if n is even, it bifurcates at a certain point and a bifurcation branch consists of asymmetric solutions, which have exactly m zeros in each intervals $(-1, 0)$ and $(0, 1)$.

11 Yasuhito Miyamoto (Univ. of Tokyo) Z
Norihisa Ikoma (Keio Univ.)
Stable standing waves of nonlinear Schrödinger equations with potentials and general nonlinearities 10

Summary: The existence and nonexistence of the minimizer of the L^2-constraint minimization problem $e(\alpha) := \inf\{E(u)|\ u \in H^1(\mathbf{R}^N),\ \|u\|^2_{L^2(\mathbf{R}^N)} = \alpha\}$ are studied. Here, $E(u) := \frac{1}{2}\int_{\mathbf{R}^N} |\nabla u|^2 + V(x)|u|^2 dx - \int_{\mathbf{R}^N} F(|u|)dx$, $V(x) \in C(\mathbf{R}^N)$, $0 \not\equiv V(x) \leq 0$, $V(x) \to 0$ $(|x| \to \infty)$ and $F(s) = \int_0^s f(t)dt$ is a rather general nonlinearity. We show that there exists $\alpha_0 \geq 0$ such that $e(\alpha)$ is attained for $\alpha > \alpha_0$ and $e(\alpha)$ is not attained for $0 < \alpha < \alpha_0$. We study differences between the cases $V(x) \not\equiv 0$ and $V(x) \equiv 0$, and obtain sufficient conditions for $\alpha_0 = 0$. In particular, if $N = 1, 2$, then $\alpha_0 = 0$, and hence $e(\alpha)$ is attained for all $\alpha > 0$.

12 Shinji Adachi (Shizuoka Univ.) Z
Tatsuya Watanabe (Kyoto Sangyo Univ.)
G-invariant positive solutions for a class of locally superlinear Schrödinger equations 14

Summary: In this talk, we are concerned with a nonlinear Schrödinger equation whose nonlinear term contains a positive parameter λ and has a superlinear growth only locally. Moreover, we are interested in the situation where the potential $V(x)$ is invariant under a finite group action G, which enables us to treat the case that $V(x)$ is a non-trapping type. By considering several auxiliary problems, we are able to obtain the existence of a G-invariant positive solution when the parameter λ is sufficiently large.

14:25–15:30

13 Tatsuki Mori (Musashino Univ.) Z
Tohru Tsujikawa (Univ. of Miyazaki*)
Shoji Yotsutani (Ryukoku Univ.*)
Representation formulas for stationary solutions of a cell polarization model 14

Summary: We are interested in the global bifurcation diagrams for a nonlinear boundary value problem with nonlocal constraint that appears in a cell polarization model with mass conservation proposed by Y. Mori, A. Jilkine and L. Edelstein-Keshet (SIAM J. Appl. Math., 2011). We obtained primitive representation formulas of all solutions, and investigated a surface consisting of all bifurcation diagrams with heights. However, we could not find any parameterization of the surface. In this talk, we show parameterizations of the surface and concrete representation formulas of all global bifurcation diagrams of the nonlinear boundary value problem.

14 Eita Tomimatsu (Tokyo Tech) Z
Some Allard type regularity theorem for one-dimensional integral varifolds 10

Summary: In this talk, we consider some Allard type regularity theorem for one-dimensional integral varifolds with locally square integrable mean curvature vector. In 1972, Allard proved class 1 and Hölder regularity of varifolds near points at which the multiplicity is close to one, that is the support of varifolds near those points is class 1 and Hölder sub-manifold. We prove class 1 and Hölder regularity of the one-dimensional integral varifolds near points at which the multiplicity is equal to two by using Kolasińsiki–Menne's results in 2017 and Regularity theory of elliptic differential equations.

15 Kensuke Yoshizawa (Tohoku Univ.) Z
The critical points of the elastic energy among curves pinned at endpoints 14

Summary: In this talk we find critical points of the elastic energy among curves whose length is fixed and whose ends are pinned. Applying the shooting method, we obtain the representation formula of all critical points and determine which curve is the global minimizer. Furthermore, with the help of the representation formula, we also obtain geometric properties of curves, such as inflection points, the number of loops.

Summary: We consider the eigenvalue problem for the Lamé operator, which describes the oscillation of the isotropic elastic bodies in $\mathbb{R}^3$ of the infinitesimal displacement. In this paper, the elastic body is supposed to be like a rod with non-uniform cross-section, and we consider two cases that the both ends are clamped and only one end is clamped. In that case, we consider the asymptotic behavior of the eigenvalue, when the cross-section of this rod is not necessarily shrieked isotopically, and clarify the characterization formula for the limit value and the limit function.

Summary: We consider a nonlinear Fuchsian type partial differential equation of the second order in the complex domain, and show the uniqueness of the solution under a very weak assumption. The result is applied to the problem of removable singularities of the solution.

Summary: As an analog of Wirtinger integral, we propose a notion of integrals of hypergeometric type of genus 2. We proved a theorem which says that there exists a linear relation among five of such integrals.

Summary: Asymptotic forms of solutions of a class of perturbed half-linear ordinary differential equations are investigated. Our method is based on the analysis of generalized Riccati equations associated with the half-linear equations under consideration.

Summary: We consider the Cauchy problem for the Laplace operator. We construct approximate solutions by using the iterative method proposed by Bastay, Kozlov and Turesson. In the iterative method, we solve the corresponding boundary value problems repeatedly. Then, we show that the smaller we choose domain where we consider the boundary value problems, more stably we construct them. We also show that this estimate is optimal. Moreover, the iterative method also works with inexact data. In this case, we have the similar result.

Summary: We consider boundary blowup problem for k-Hessian equation of the form $F_k[u] = f(x)g(u)$ in a uniformly $(k-1)$-convex domain $\Omega \subset \mathbb{R}^n$, where $f(x)$ behaves like $\operatorname{dist}(x, \partial\Omega)^\alpha$ as $\operatorname{dist}(x, \partial\Omega) \to 0$ and $g(u)$ behaves like u^p as $u \to \infty$. We obtain the exact principal blowup rate of a boundary blowup solution u near the boundary $\partial\Omega$. Moreover, we obtain the asymptotic behavior of a boundary blowup solution u near the boundary up to the second order, under some hypotheses.

22 Saburou Saitoh (Gunma Univ.*/Inst. of Reproducing Kernels) Many problems in differential equations from the viewpoint of division by zero calculus ····· *

Summary: We think that in the theory of differential equations, we have many fundamental problems still, and so I expect your contribution to the new Journal on the division by zero calculus.
Modern mathematics is still flawed. It is clear that there are basic defects in function theory, differential equations, geometry, and algebra, and it has been seven years since the discovery. This will be a stain on world history and so, we publish the book: S. Saitoh, Introduction to the Division by Zero Calculus, 2021, Scientific Research Publ., Inc.. and we are founding the basic new international journal of Division by Zero Calculus: https://romanpub.com/dbzc.php

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

Kohei Iwaki (Univ. of Tokyo) Z Exact WKB analysis and related topics

Summary: Exact WKB analysis, developed by Voros et.al., is an effective method for global study of (singularly perturbed) ordinary differential equations defined on a complex domain. After recalling fundamental facts about exact WKB analysis, I'll talk about relationships to other research topics, such as cluster algebras, topological recursion, integrable systems of Painlevé type, etc.

September 15th (Wed) Conference Room V

9:00–12:00

23 Masato Hashizume (Hiroshima Univ.) Z Asymptotic behavior of critical points for subcritical Trudinger–Moser functional ····· 14

Summary: We investigate asymptotic behavior of positive critical points for the subcritical Trudinger–Moser functional. In particular, we prove that if the exponent in the Trudinger–Moser functional is small, then limit of sequence of maximizers vanishes for all point.

24 Takashi Suzuki (Osaka Univ.) Z Blowup of solutions to nonlinear elliptic eigenvalue problems ····· 5

Summary: We study a family of blowing-up solutions to the nonlinear elliptic eigenvalue problem on two space dimensions with exponentially dominated nonlinearities. Such a problem has been studied a lot, but most of them are concerned on the perturbed nonlinearity from the extremal case. We present several new arguments and new results for the counter part, which includes the case of the mean field limit of the point vortices with stochastic multi-intensities.

25 Evan William Chandra (Osaka Univ.) Z
Michinori Ishiwata (Osaka Univ.)
Rolando Magnanini (Univ. of Florence)
Hidemitsu Wadade (Kanazawa Univ.)
Variational p-harmonious functions: existence and convergence to p-harmonic functions ····· 14

Summary: In this talk, we consider the existence of variationally p-harmonious functions and their relation to p-harmonic functions.

26 Yuya Tanaka (Tokyo Univ. of Sci.) Z Boundedness and blow-up in a quasilinear parabolic-elliptic chemotaxis system with logistic source and nonlinear production ····· 14

Summary: This talk deals with the quasilinear parabolic-elliptic chemotaxis system with logistic source and nonlinear production. In a special setting Fuest (NoDEA Nonlinear Differential Equations Appl.; 2021; 28; 16) obtained conditions such that solutions blow up in finite time. The purpose of this talk is to give conditions such that solutions remain bounded and such that solutions blow up in finite time in the case of nonlinear production.

Summary: This talk deals with a quasilinear attraction-repulsion chemotaxis system. Here the quasilinear means that the system has nonlinear diffusion and singular sensitivity. Global existence and boundedness in a quasilinear Keller–Segel system without repulsion term were proved by Ding (J. Math. Anal. Appl.; 2018; 461; 1260–1270) and Jia–Yang (J. Math. Anal. Appl.; 2019; 475; 139–153). However, there has been no work on the quasilinear attraction-repulsion chemotaxis system. The purpose of this talk is to establish global existence and boundedness of classical solutions to the system by introducing a new test function.

Summary: We show the existence and uniqueness of local strong solutions of Keller–Segel system of parabolic-parabolic type for arbitrary initial data in the homogeneous Besov space which is scaling invariant. We also construct global strong solutions for small initial data, where the solutions belong to the Lorentz space in time direction. The proof is based on the maximal Lorentz regularity theorem of heat equations.

Summary: We study the simplest parabolic-elliptic model of chemotaxis in space dimensions $N \geq 3$, and show the optimal conditions on the initial data for the finite time blow-up and the global existence of solutions in terms of stationary solutions. Our argument is based on the study of the Cauchy problem for the transformed equation involving the averaged mass of the solution.

Summary: We consider the Cauchy problem for an attraction-repulsion chemotaxis system in $\mathbb{R}^n$ with the chemotactic coefficients of the attractant β_1 and the repellent β_2. In particular, these coefficients are important role for the global existence and blow up of the solutions. In this talk, I will discuss the finite time blow-up of the solution under the condition $\beta_1 > \beta_2$ in higher dimensional spaces.

Summary: We consider steady states of the nonlocal prey-predator system whose nonlocal term is defined by using a positive valued Lipschitz function as its integral kernel. In this talk, we aim to prove the existence of steady states such that they have one or more discontinuous points, and otherwise continuous. We also construct a concrete example that satisfies the sufficient conditions in which discontinuous steady states exist.

Summary: In this talk, we consider the existence of one-peak stationary solutions for the Gierer–Meinhardt model with heterogeneity on the Y-shaped compact metric graph. In 1986, Takagi studied the non-heterogeneity case in the one-dimensional interval. We show that the location of a concentration point is determined by the function represented by the heterogeneity function and the associated Green's function. Moreover, we explain the precise location of a concentration point for non-heterogeneity case, compared with the one-dimensional interval case.

33 Ken-Ichi Nakamura (Kanazawa Univ.) Z
Yoshihisa Morita (Ryukoku Univ.)
Toshiko Ogiwara (Josai Univ.)
Front propagation and blocking of the competition-diffusion system in a domain of half-lines with a junction 14

Summary: We consider the 2-component Lotka–Volterra competition-diffusion system in a domain with a family of half-lines joined at a single junction as a model describing the invasion of the superior species into a new habitat. We first give a condition that the superior species can successfully invade beyond the junction and prevail against the inferior one. We also construct a time-independent sub- and super-solution blocking the propagation if the number of the half-lines initially occupied by the inferior species is large enough.

34 Ken-Ichi Nakamura (Kanazawa Univ.) Z
Toshiko Ogiwara (Josai Univ.)
A classification of strong competition conditions by the speed of traveling waves for Lotka–Volterra competition-diffusion systems 14

Summary: We study the speed of bistable traveling waves for 2-component Lotka–Volterra competition-diffusion systems under strong competition conditions. We give several sufficient conditions determining the sign of the speed. Furthermore, we find a set of interspecific competition coefficients for which the propagation speed is always positive for any diffusion rates and intrinsic growth rates of the biological species.

35 Kenta Nakamura (Kumamoto Univ.)
Masashi Misawa (Kumamoto Univ.)
Intrinsic scaling method for fast diffusive type doubly nonlinear equations ..... *

Summary: In this talk, for a fast diffusive type doubly nonlinear parabolic equation, called p-Sobolev type flows, we introduce a new intrinsic scaling method to transform the prototype doubly nonlinear equation to the p-Sobolev type flows. As an application, we show the global existence and regularity for the p-Sobolev type flows with large data.

36 Yasuhito Miyamoto (Univ. of Tokyo)
Masamitsu Suzuki (Univ. of Tokyo)
Thresholds on growth of nonlinearities and singularity of initial functions for semilinear heat equations ..... *

Summary: Let $N \geq 1$ and $u_0 \geq 0$. We are concerned with existence and nonexistence of a local in time nonnegative solution in a uniformly local Lebesgue space of a semilinear heat equation

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

where $f \in C[0,\infty)$ is nonnegative and nondecreasing. Our existence theorem gives a sharp integrability condition on u_0 in critical and subcritical cases. In a doubly critical case existence and nonexistence results can be determined by special treatment. When $f(u) = u^{1+2/N}[\log(u+e)]^\beta$, $\beta > -3.146(1+2/N)$, a complete classification of existence and nonexistence of a nonnegative solution is obtained.

37 Tomoyuki Tanaka (Nagoya Univ.)
Luc Molinet (Univ. de Tours)
Unconditional well-posedness for some nonlinear periodic one-dimensional dispersive equations ..... *

Summary: We consider the Cauchy problem for one-dimensional dispersive equations with a general nonlinearity in the periodic setting. Our main hypotheses are both that the dispersive operator behaves for high frequencies as a Fourier multiplier by $i|\xi|^\alpha\xi$, with $1 \leq \alpha \leq 2$, and that the nonlinear term is of the form $\partial_x f(u)$ where f is the sum of an entire series with infinite radius of convergence. Under these conditions, we prove the unconditional local well-posedness of the Cauchy problem in $H^s(\mathbb{T})$ for $s \geq 1 - \frac{\alpha}{2(\alpha+1)}$. This leads to some global existence results in the energy space $H^{\alpha/2}(\mathbb{T})$, for $\alpha \in [\sqrt{2}, 2]$.

38 Noboru Chikami (Nagoya Inst. of Tech.)
Masahiro Ikeda (RIKEN/Keio Univ.)
Koichi Taniguchi (Tohoku Univ.)
Optimal well-posedness of Hardy–Hénon parabolic equation ..... *

Summary: The Cauchy problem for the Hardy–Hénon parabolic equation is studied in the critical and subcritical regime in weighted Lebesgue spaces on the Euclidean space $\mathbb{R}^d$. Well-posedness for singular initial data and existence of non-radial forward self-similar solution of the problem are previously shown only for the Hardy and Fujita cases ($\gamma \leq 0$) in earlier works. The weighted spaces enable us to treat the potential $|x|^\gamma$ as an increase or decrease of the weight, thereby we can prove well-posedness to the problem for all γ with $-\min\{2, d\} < \gamma$ including the Hénon case ($\gamma > 0$). As a byproduct of the well-posedness, the self-similar solutions to the problem are also constructed for all γ without restrictions. A non-existence result of local solution for supercritical data is also shown. Therefore our critical exponent s_c turns out to be optimal in regards to the solvability.

39 Atsushi Nakayasu (Kyoto Univ.)
Homogenization of Hamilton–Jacobi equations on the Sierpinski gasket ..... *

Summary: Study homogenization problem for Hamilton–Jacobi equations on the Sierpinski gasket. This is a convergence problem of a sequence of viscosity solutions of the Hamilton–Jacobi equations whose Hamiltonian is given by iteration based on the self-similarity of the Sierpinski gasket. We will show the convergence of supersolutions.

40 Isamu Ohnishi (Hiroshima Univ.)
Characterization of a long-term behavior of solutions to nonlinear parabolic PDEs with a jumping effect ..... *

Summary: I presented existence and some properties of global solutions of a certain nonlinear PDE with a jump term in last March. In this time, I'll continue to make a presentation about a more advanced result, which means that characteristic property of a long time behavior of the nonlinear PDE with the jump term.

41 Kota Ikeda (Meiji Univ.)
Center manifold theory for a mathematical model of camphor boats ..... *

Summary: Various collective motions of camphor boats, called jamming, clustering, and swarming state observed in a one-dimensional circuit, have been studied. It is expected that the center manifold theories proposed in previous works are useful for the analysis of the collective motion of camphor boats. However, spatial discontinuity in our model, in particular the existence of Dirac delta functions in a linearized operator, does not fulfill the requirement in the reduction process. Then we have developed a new theory in $(H^1)^*$-framework. Unfortunately, a reduced equation obtained by our method has no nonlinear terms, and cannot exhibit any collective motions. In this talk, I will develop a new theory in L^2-framework.

42 Yikan Liu (Hokkaido Univ.)
Uniqueness for the simultaneous determination of multiple coefficients in a fractional evolution equation by a single measurement ..... *

Summary: In this talk, we investigate the inverse problem on determining multiple coefficients simultaneously in a fractional evolution equation by a single measurement on the boundary. With a suitably chosen Dirichlet boundary condition, we prove the unique determination of at most two space-dependent coefficients (possibly with an extra unknown fractional order). The key ingredient turns out to be the time-analyticity of the decomposed solution, which enables the construction of Dirichlet-to-Neumann maps in the frequency domain and thus the application of inverse spectral results. This is a joint work with Kian Yavar (Aix-Marseille University), Zhiyuan Li (Shandong University of Technology) and Masahiro Yamamoto (The University of Tokyo).

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

Masahiko Shimojo (Tokyo Metro. Univ.) [Z] Spreading and extinction of solutions to the logarithmic diffusion equation with a logistic reaction

Summary: Logarithmic diffusion is observed in several fields of sciences, such as the central limit approximation of Carleman's model based on the Boltzman equation, a model for long Van-der-Waals interactions in thin fluid films, and the evolution of conformal metric under the Ricci flow on the plane. This lecture focuses on spreading and extinction phenomena of the solution to the logarithmic diffusion equation on a line, in the presence of a logistic reaction term. A new mathematical framework will be introduced to understand the extinction and interfacial phenomena from the point of entire solutions.

September 16th (Thu) Conference Room V

9:00–12:00

43 Nao Hamamuki (Hokkaido Univ.) [Z]
Kuniyasu Misu (Hokkaido Univ.)
Asymptotic shape of solutions to the mean curvature flow equation with discontinuous source terms 14

Summary: We consider the asymptotic shape of solutions to the level-set mean curvature flow equation with a negative driving force and a discontinuous source term. This equation is a model of crystal growth phenomenon called a two-dimensional nucleation. A typical source term in our mind is a characteristic function of a set Ω. It turns out that, if Ω satisfies some weak convexity condition, then the asymptotic shape of the solution is given by the unique solution of the corresponding stationary problem with the Dirichlet boundary condition. We also give a game-theoretic interpretation of the solution as the limit of value functions. Applying this interpretation, we construct a solution with non-trivial growth speed when Ω consists of two disks touching each other.

44 Takashi Kagaya (Kyushu Univ.) [Z]
Qing Liu (Fukuoka Univ.)
Singular Neumann boundary problems for a class of fully nonlinear parabolic equations 14

Summary: In this talk, we discuss singular Neumann boundary problems for a class of nonlinear parabolic equations in one space dimension. Our boundary problem describes motion of a planar curve sliding along the boundary with a zero contact angle, which can be viewed as a limiting model for the capillary phenomenon. We study the uniqueness and existence of solutions by using the viscosity solution theory. We also show the convergence of the solution to a traveling wave as time proceeds to infinity when the initial value is assumed to be convex.

45 Takeshi Suguro (Tohoku Univ.) [Z]
Takayoshi Ogawa (Tohoku Univ.)
Asymptotic behavior of a solution to the drift-diffusion equation for a fast-diffusion case via a generalized entropy 14

Summary: We consider the asymptotic behavior of a solution to the drift-diffusion equation for a fast-diffusion case. By combining the entropy dissipation method with the logarithmic Sobolev and moment inequalities for a generalized entropy, we show that the asymptotic profile for a solution behaves like the Talenti type function.

46 Kotaro Sato (Tohoku Univ.) [Z]
Goro Akagi (Tohoku Univ.)
On some quasistatic evolution equation with irreversibility and energy-conservation 14

Summary: This talk is concerned with some quasistatic evolution equation with irreversibility and energy-conservation. Main results consist of well-posedness for the initial-boundary value problem and qualitative properties of solutions such as irreversibility (unidirectionality), static equilibrium condition and energy balance. Proofs rely on the so-called minimizing movement scheme. The main difficulty resides in deriving a priori estimate for the time-derivative of approximate solutions, since the equation is elliptic rather than parabolic, and therefore, standard arguments do not imply estimates for the time-derivative.

Summary: We solve the L^2 version of Maz'ya's open problem (Integral Equations Operator Theory 2018) on the sharp uncertainty principle inequality

$$\int_{\mathbb{R}^N} |\nabla u|^2 dx \int_{\mathbb{R}^N} |u|^2 |x|^2 dx \geq C_N \left(\int_{\mathbb{R}^N} |u|^2 dx \right)^2$$

for solenoidal vector fields $u = u(x)$ on $\mathbb{R}^N$. The best value of the constant turns out to be $C_N = \frac{1}{4}\left(\sqrt{N^2 - 4(N-3)} + 2\right)^2$ which exceeds the original value $N^2/4$ for unconstrained fields. Moreover, we show the attainability of C_N and specify the profiles of the extremal solenoidal fields.

Summary: It is well-known that (scalar) Schrödinger operators do not have resonances near a non-trapping energy of the underlying classical mechanics (shown by Helffer–Sjöstrand (1986) for analytic potentials, Martinez (2002) for smooth potentials). However, we found that systems of Schrödinger operators create resonances near a non-trapping energy when a closed directed cycle is composed by a couple of non-trapping trajectories. We give an example of such resonances for a system appearing in the Born–Oppenheimer approximation of polyatomic molecules, and describe their precise asymptotic distribution in the semiclassical limit in terms of the geometry of such directed cycles.

Summary: For a nonlinear Schrödinger equation with a L^2-critical nonlinear term and a small perturbation term, it is known that all subcritical mass solutions are global in time and bounded in H^1. On the other hand, a critical mass solution of the equation may blow up. In this talk, we consider the existence of critical-mass (i.e. minimal-mass) blow-up solutions of the nonlinear Schrödinger equation with a potential term added as a small perturbation term and their behaviour near the blow-up time.

Summary: In this talk, we consider the asymptotic behavior of the ground state and its energy for the nonlinear Schrödinger system with three wave interaction on the parameter γ as $\gamma \to \infty$. In addition we prove the existence of the positive threshold γ^* such that the ground state is a scalar solution for $0 \leq \gamma < \gamma^*$ and is a vector solution for $\gamma > \gamma^*$.

Summary: In this talk, we deal with the nonlinear Schrödinger equation with a long range potential. We consider the scattering solutions with the radial initial data below the "radial" ground state to the corresponding elliptic equation. Here, the "radial" ground state is a least energy solution among radial solutions to the elliptic equation. In particular, we prove that if the radial initial data below the "radial" ground state has the positive virial functional, then the corresponding solution to the nonlinear Schrödinger equation scatters.

Summary: We consider the initial value problem for cubic derivative nonlinear Schrödinger equation in one space dimension. Under a suitable weakly dissipative condition on the nonlinearity, we show that the small data solution has a logarithmic time decay in L^2.

53 Yoshinori Nishii (Osaka Univ.) Z Non-decay of the energy for a system of semilinear wave equations ··· 10

Summary: We consider the global Cauchy problem for a two-component system of cubic semilinear wave equations in two space dimensions. We give a criterion for large time non-decay of the energy for small amplitude solutions in terms of the radiation fields associated with the initial data.

14:25–15:30

54 Kimitoshi Tsutaya (Hirosaki Univ.) Z, Yuta Wakasugi (Hiroshima Univ.) On Glassey's conjecture for semilinear wave equations in FLRW spacetime ····· 14

Summary: Consider nonlinear wave equations in the spatially flat Friedmann–Lemaître–Robertson–Walker (FLRW) spacetimes. We show blow-up in finite time of solutions and upper bounds of the lifespan of blow-up solutions to give the FLRW spacetime version of Glassey's conjecture for the time derivative nonlinearity.

55 Kimitoshi Tsutaya (Hirosaki Univ.) Z, Yuta Wakasugi (Hiroshima Univ.) Blow up of solutions of space derivative nonlinear wave equations in FLRW spacetime ····· 14

Summary: Consider nonlinear wave equations in the spatially flat Friedmann–Lemaître–Robertson–Walker (FLRW) spacetimes. We show blow-up in finite time of solutions and upper bounds of the lifespan of blow-up solutions for the space derivative nonlinear term.

56 Fumihiko Hirosawa (Yamaguchi Univ.) Z On the energy estimates of semi-discrete wave equations with time dependent propagation speed ····· 14

Summary: Discretization is a fundamental step in numerical analysis for the problems described by differential equations, and the difference between the continuous model and discrete model is one of the most important problems. In this talk, we consider the difference in the effect of the time-dependent propagation speed on the energy estimate of the solutions for the wave equation and the semi-discrete wave equation which is a discretization with respect to space variables.

57 Hiroshi Takase (Univ. of Tokyo) Z Inverse problems for first-order hyperbolic equations ····· 14

Summary: We consider inverse source and coefficient problems for a first-order hyperbolic equation with a time-dependent principal part. Under the assumption that the coefficients of the equation generate the vector field which has maximal integral curves with finite lengths, we prove global Lipschitz stability for the inverse problems through a global Carleman estimate.

58 Sojiro Murai (Tokyo Metropolitan Coll. of Indus. Tech.) Strichartz estimates for magnetic Schrödinger equation in exterior domain and its application ····· ∗

Summary: Our purpose of this talk is to derive Strichartz estimates for solutions of magnetic Schrödinger equations in exterior to the star-shaped obstacle. For its proof we need the smoothing estimates for solutions of perturbed equations and the Strichartz estimates for solutions of free equations. Moreover as as application of them, we shall investigate the scattering theory for these equations with a power type nonlinearity.

59 Takashi Furuya (Hokkaido Univ.) The direct and inverse scattering problem for the semilinear Schrödinger equation ····· ∗

Summary: We study the direct and inverse scattering problem for the semilinear Schrödinger equation $\Delta u + a(x,u) + k^2 u = 0$ in $\mathbb{R}^d$. We show well-posedness in the direct problem for small solutions based on the Banach fixed point theorem, and the solution has the certain asymptotic behavior at infinity. We also show the inverse problem that the semilinear function $a(x,z)$ is uniquely determined from the scattering amplitude.

60 Gen Nakamura (Hokkaido Univ.)
Manmohan Vashisth (Indian Inst. of Tech., Jammu)
Michiyuki Watanabe (Okayama Univ. of Sci.)
Inverse initial boundary value problem for a non-linear hyperbolic partial differential equation ..... *

Summary: We are concerned with an inverse initial boundary value problem for a non-linear wave equation in space dimension greater than 1. This equation is the perturbation of the usual linear wave equation with a time dependent potential by a space-time divergence of a vector whose components are quadratic with respect to the space-time gradient of the displacement. By many boundary measurements at the boundary of the spatial domain over finite time interval and the final overdetermination, we can uniquely determine the potential and the coefficients of these quadratics.

61 Gen Nakamura (Hokkaido Univ.)
Holmgren–John unique continuation theorem for viscoelastic equations ..... *

Summary: We gave a result on the Holmgren–John type global unique continuation result for a general viscoelastic equation with a memory term.

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

Mamoru Okamoto (Osaka Univ.) Z
Almost sure global well-posedness for a nonlinear Klein–Gordon equation in three dimensions

Summary: In this talk, we consider the Cauchy problem for a quadratic nonlinear Klein–Gordon equation on the three-dimensional torus. We prove that the Cauchy problem is almost surely globally well-posed for initial data in the support of the Gibbs measure. Since the Wiener measure is supported on negative Sobolev spaces in three dimensions, the cubic nonlinearity in the potential energy is not well-defined in the deterministic sense. By renormalizing the potential part of the energy, we construct the renormalized Gibbs measure. We then consider the renormalized quadratic nonlinear Klein–Gordon equation, which is corresponding to the renormalized energy. We use a paracontrolled operator to obtain the well-posedness of the Cauchy problem for the renormalized equation as in the paper by Gubinelli–Koch–Oh. Once the local well-posedness is achieved, by applying Bourgain's invariant measure argument, we obtain the almost sure global well-posedness. This talk is based on a joint work with Tadahiro Oh (Univ. Edinburgh) and Leonardo Tolomeo (Univ. Bonn).

September 17th (Fri) Conference Room V

9:00–12:00

62 Masakazu Kato (Muroran Inst. of Tech.) Z
Hideo Kubo (Hokkaido Univ.)
Existence of a global solution to a nonlinear wave equation with non-negative potential and slowly decreasing initial data 12

Summary: We study the existence of a global radially symmetric solution to a semi-linear damped wave equation with non-negative potential in three space dimensions and non-compactly supported initial data. The first aim of this talk is finding the critical exponent for the semi-linear equations with small initial data. The second aim of this talk is to look for the upper and lower bounds for the life span of the blow-up solutions.

63 Shunsuke Kitamura (Tohoku Univ.) Z
Katsuaki Morisawa (Tohoku Univ.)
Hiroyuki Takamura (Tohoku Univ.)
The lifespan of classical solutions of semilinear wave equations with spatial weights and compactly supported data in one space dimension 14

Summary: In this talk, we consider initial value problems for semilinear wave equations with spatial weights in one space dimension. The lifespan estimates of classical solutions for compactly supported data are established in all the cases of polynomial weights. The results are classified into two cases according to the total integral of the initial speed.

64 Kimitoshi Tsutaya (Hirosaki Univ.) Z
Yuta Wakasugi (Hiroshima Univ.)
Blow up of solutions of semilinear wave equations in de Sitter spacetime 14

Summary: We study the Cauchy problem of the semilinear wave equation in de Sitter spacetime. We prove the blow-up of classical solution as well as an estimate of lifespan for small initial data.

65 Yuta Wakasugi (Hiroshima Univ.) Z
Energy decay of solutions to the wave equation with space-dependent damping and absorbing nonlinearity 14

Summary: We study the initial-boundary value problem of the wave equation with space-dependent damping and absorbing nonlinearity. The aim is to prove the decay property of the energy and weighted L2 norm of solutions. In particular, we treat slowly decaying initial data and study the relationship between the decay rate of solutions and the condition of the data.

66 Yusuke Ishigaki (Tokyo Tech) Z
On L^1 estimates of solutions of compressible viscoelastic system 14

Summary: We consider the large time behavior of solutions of compressible viscoelastic system around a motionless state in a three-dimensional whole space. We show that if the initial perturbation belongs to $W^{2,1}$, and is sufficiently small in $H^4 \cap L^1$, the solutions grow in time at the same rate as $t^{\frac{1}{2}}$ in L^1 due to diffusion wave phenomena of the system caused by interaction between sound wave, viscous diffusion and elastic wave.

67 Kenta Oishi (Waseda Univ.) Z
Yoshihiro Shibata (Waseda Univ.)
Local well-posedness for free boundary problem of viscous incompressible magnetohydrodynamics 12

Summary: Consider the motion of incompressible magnetohydrodynamics (MHD) with resistivity in a domain bounded by a free surface. An electromagnetic field generated by some currents in an external domain keeps an MHD flow in the domain. On the free surface, free boundary conditions for MHD flow and transmission conditions for electromagnetic fields are imposed. In this talk, we establish the local well-posedness in the general setting of domains. To prove this, we make full use of the maximal L_p-L_q regularity theorem for the Stokes equations with free boundary conditions and for the magnetic field equations with transmission conditions.

68 Souhei Sugizaki (Tokyo Tech) Z
Shinya Nishibata (Tokyo Tech)
Itsuko Hashimoto (Kanazawa Univ.)
Asymptotic stability of radially symmetric stationary solutions for the compressible Navier–Stokes equations 14

Summary: We study the decay rates of the stationary solution for the compressible Navier–Stokes equations. Precisely, we obtain the decay rates on its first and second derivative. In addition, we show the asympotic stability of the time dependent solution of the compressible Navier–Stokes equations.

69 Hiroki Ohyama (Kyushu Univ.) Z
Ryo Takada (Kyushu Univ.)
Asymptotic limit of fast rotation for the incompressible Navier–Stokes equations in a 3D layer 14

Summary: In this talk, we consider the initial value problem for the Navier–Stokes equation with the Coriolis force in a three-dimensional infinite layer. We prove the unique existence of global solutions for initial data in the scaling invariant space when the speed of rotation is sufficiently high. Furthermore, we consider the fast rotation limits, and show that the global solution converges to that of 2D incompressible Navier–Stokes equations in some global in time space-time norms.

70 Ryo Kanamaru (Photon Sansu Club) Z
Tatsuki Yamamoto (Waseda Univ.)
Logarithmically improved extension criteria involving the pressure for the Navier–Stokes equations in $\mathbb{R}^3$ 14

Summary: This talk is concerned with the extension criterion involving the pressure for the Navier–Stokes equations in $\mathbb{R}^3$. We prove that if a strong solution u on $[0,T)$ and the pressure π associated with u satisfy the condition

$$\int_0^T \frac{\|\pi(\tau)\|^r_{\dot{B}^{-3/p}_{\infty,\infty}}}{\log(e+\|u(\tau)\|_{H^s})}d\tau < \infty \quad \text{for } \frac{2}{r}+\frac{3}{p}=2 \text{ with } 3\le p\le\infty,$$

then there is $T'>T$ such that u can be continued to the solution on $[0,T')$. Our method is based on the interpolation inequality due to Gérard–Meyer–Oru (1997) and the trilinear estimate due to Guo–Kučera–Skalák (2018).

71 Fumitaka Wakabayashi (Waseda Univ.) Z
Hideo Kozono (Waseda Univ.)
Erika Ushikoshi
(Yokohama Nat. Univ. / Osaka Univ.)
Removability of time-dependent singularities of the Navier–Stokes equations 14

Summary: Let Ω be a bounded domain in $\mathbb{R}^N (N\ge 3)$ and $\xi\in C^\alpha([0,T];\Omega)$ for $1/N<\alpha\le 1$. Suppose that u is a smooth solution of the Navier–Stokes equations in $\bigcup_{0<t<T}(\Omega\setminus\{\xi(t)\})\times\{t\}$, namely, $\{\xi(t)\}\times\{t\}$ is supposed to be moving singularities in $\Omega\times[0,T]$. We give the condition for the removability of the time-dependent singularities of u at $\{\xi(t)\}\times\{t\}$.

72 Kazuyuki Tsuda Z
(Kyushu Sangyo Univ.)
Reinhard Farwig (TU Darmstadt)
The Fujita–Kato approach for the Navier–Stokes equations with moving boundary and its application 14

Summary: The initial value problem of the Navier–Stokes system on a non-cylindrical space-time domain is considered. The aim of the paper is to prove existence and uniqueness of locally-in-time strong solutions for large initial values and to extend them to global ones for small initial data in L^q spaces. The proof uses the Fujita–Kato approach based on decay estimates of evolution operators defined by modified Stokes operators with a uniformly bounded H^∞-calculus and works in time weighted Hölder spaces. Furthermore, the result is applied to show regularity of time periodic solutions obtained by Farwig, Kozono, Tsuda and Wegmann (2020).

73 Tsukasa Iwabuchi (Tohoku Univ.) Z
Takayoshi Ogawa (Tohoku Univ.)
Ill-posedness for two dimensional compressible Navier–Stokes equations with scaling critical regularity 14

Summary: We study the ill-posedness issue for the compressible viscous heat-conductive flows in two dimensions. In the scaling invariant spaces, the discontinuity of solutions on initial data is obtained in almost all Besov spaces and a similar result also holds in Sobolev spaces.

14:25–15:30

74 Ryosuke Nakasato (Tohoku Univ.) Z
Global well-posedness for the Hall-magnetohydrodynamic system in critical Fourier–Besov spaces 14

Summary: We investigate the initial value problem for the incompressible magnetohydrodynamic system with the Hall-effect in the whole space. In this talk, we focus on a solution as a perturbation from a non-zero constant equilibrium state. The aim of this talk is to establish the existence of the global-in-time solution in the critical Fourier–Besov spaces. In order to prove our results, we establish the various type product estimates in the space-time mixed space and smoothing estimates for the solution of the linear equation, which has the non-symmetric diffusion derived from the Hall-term.

75 Tatsu-Hiko Miura (Kyoto Univ.) Z Linear stability and enhanced dissipation for the two-jet Kolmogorv type flow on the unit sphere 14

Summary: The two-jet Kolmogorov type flow is a stationary solution to the vorticity form of the Navier–Stokes equations on the 2D unit sphere given by the zonal spherical harmonic function of degree two. In this talk we consider the linearized equation round the two-jet Kolmogorov type flow. We prove the exponential decay of a solution to the linearized equation towards an equilibrium which grows as the viscosity coefficient decreases. Moreover, we show that the perturbation operator in the linearized equation does not have eigenvalues except for zero by making use of the mixing structure of the perturbation operator which is expressed by a recurrence relation for the spherical harmonics. Using this result, we get the enhanced dissipation without rate for a solution to the linearized equation in the sense that the solution rescaled in time decays arbitrarily fast as the viscosity coefficient tends to zero.

76 Tatsu-Hiko Miura (Kyoto Univ.) Z
Yasunori Maekawa (Kyoto Univ.) Rate of the enhanced dissipation for the two-jet Kolmogorov type flow on the unit sphere 14

Summary: As in the previous talk, we consider the linearized equation around the two-jet Kolmogorov type flow for the vorticity equation on the 2D unit sphere. Our aim is to determine the rate of the enhanced dissipation for the two-jet Kolmogorov type flow. We derive the resolvent estimate along the imaginary axis of the linearized operator based on the abstract theory developed by Ibrahim–Maekawa–Masmoudi (2019). Combining this result with the Gearhart–Prüss type theorem given by Wei (2021), we show that a solution to the linearized equation decays at the rate $O(e^{-\sqrt{\nu}\,t})$ when the viscosity coefficient ν is sufficiently small as in the case of the plane Kolmogorov flow.

77 Zhongyang Gu (Univ. of Tokyo) Z
Yoshikazu Giga (Univ. of Tokyo) On the Helmholtz decomposition of a space of vector fields with bounded mean oscillation in a curved domain 10

Summary: We establish the Helmholtz decomposition for a space of vector fields with bounded mean oscillation in perturbed half spaces and bounded domains of a Euclidean space. There are several possible definitions for a space of bounded mean oscillation in a domain. In our research, we introduce a new space where the tangential and the normal components to the boundary are handled separately.

78 Natsumi Yoshida (Univ. of Yamanashi) Asymptotics toward the rarefaction waves to the Cauchy problem for the scalar non-viscous diffusive dispersive conservation laws ..... *

Summary: We study the large time asymptotics of solutions to the Cauchy problem for the scalar non-viscous diffusive dispersive conservation laws where the far field states are prescribed. Especially, we deal with the case when the flux function is fully convex with a growth condition. Then the Cauchy problem has a unique global in time solution which tends toward a rarefaction wave as time goes to infinity. The proof is given by a technical energy method.

79 Natsumi Yoshida (Univ. of Yamanashi) Global asymptotic stability of a multiwave pattern for the generalized Korteweg–de Vries-Burgers–Kuramoto equation ..... *

Summary: We study the asymptotic decay of solutions toward a multiwave pattern (rarefaction wave and diffusive dispersive contact wave) of the Cauchy problem for the the generalized Korteweg–de Vries-Burgers–Kuramoto equation where the far field states are prescribed. Especially, we deal with the case when the flux function is convex or concave but linearly degenerate on some interval. Then the Cauchy problem has a unique global in time solution which tends toward a multiwave pattern (rarefaction wave and diffusive dispersive contact wave) as time goes to infinity. The proof is given by a technical energy method and the careful estimates for the interactions between the nonlinear waves.

80 Masashi Ohnawa (Tokyo Univ. of Marine Sci. and Tech.)
Masahiro Suzuki (Nagoya Inst. of Tech.)
Asymptotic stability of shock waves in expanding nozzles ····· ∗

Summary: We consider stationary shock waves appearing in nozzle flows modeled by one-dimensional compressible Euler equation of barotropic type. The shock wave connects an upstream supersonic state to a downstream subsonic state discontinuously. If the discontinuity is located in an expanding part of the nozzle, we claim the asymptotic stability of the stationary shock wave whatever large the strength of the shock or the gradient of the section of the nozzle may be.

81 Yoshihiro Shibata (Waseda Univ.) Matsumura–Nishida theory in the L_p-L_q framework ····· ∗

Summary: In this talk, I will present the global well-posedness for the Navier–Stokes–Fourier equations describing the motion of compressible viscous fluid flow in the isothermal situation in a three dimensional exterior domain with non-slip boundary condition. This problem was solved by a celebrated work due to Matsumura and Nishida, Commun. Math. Phys. 89 (1983), 445–464. They used energy method, and so to estimate the L_∞ norm of first derivatives of the velocity field and the mass density they need their third derivatives. In this talk, I report that the L_2 of third derivatives is replaced by L_6 norm of second derivatives yields the global wellposedness in the minimal assumption of the derivatives. The proof is based on the L_p-L_q maximal regularity and the decay estimate of Stokes semigroup.

82 Yoshihiro Shibata (Waseda Univ.) On the Navier–Stokes equations in a periodically moving exterior domain ····· ∗

Summary: I present a unique existence theorem of periodic solutions in a periodically moving three dimensional exterior domain for the Navier–Stokes equations with non-slip boundary conditions. The key issue is to prove the maximal regularity for periodic solutions of Stokes equations by using the operator valued transference theorem for the R-bounded solution operators of the resolvent problem for the Stokes equations in an 3 dimensional exterior domain. This is one of a series of joint works with Thomas Either and Mads Kyed concerning the periodic solutions appearing in Math. Fluid Mechanics.

83 Ken Furukawa (RIKEN)
Yoshikazu Giga (Univ. of Tokyo)
Takahito Kashiwabara (Univ. of Tokyo)
Mathematical justification of the hydrostatic approximation in the primitive equations under the Dirichlet boundary conditions ····· ∗

Summary: The primitive equations are derived from a scaled Navier–Stokes system via a formal limit procedure. In this talk, we justify this procedure mathematically under the Dirichlet boundary conditions. Although there are some results on the derivation under the slip boundary conditions, there were no results under the Dirichlet boundary conditions. In the proof of our main, we also obtained large data global well-posedness for the scaled Navier–Stokes equations under an assumption of a small aspect ratio for the domain.

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

Masahiro Suzuki (Nagoya Inst. of Tech.) Z Mathematical analysis of plasma boundary layers

Summary: In this talk, we discuss mathematically the formation of a plasma sheath near the surface of materials immersed in a plasma, and study qualitative information of such a plasma sheath layer. Analyzing the Euler–Poisson equations, Bohm derived the Bohm criterion which is required for the formation. The sheath corresponds to a stationary solution of the Euler–Poisson equations. To validate rigorously the Bohm criterion, we show the existence and stability of stationary solutions in several domains under the criterion. Plasma physics tells us that the thickness of sheath is the same order of the Debye length which is a small number. To investigate the thickness, we also consider the quasi–neutral limit as letting the Debye length in the Euler–Poisson equations be zero. Throughout these discussions, we make it clear how the Bohm criterion and the thickness depend on the shape of domains.

Real Analysis

September 16th (Thu) Conference Room IV

10:45–12:00

1 Koji Aoyama (Chiba Univ.) Z Characterizations of a Meir–Keeler type mapping ····· 15

Summary: The aim of this talk is to provide characterizations of a Meir–Keeler type mapping in a metric space endowed with a transitive relation.

2 Shin-ya Matsushita (Akita Pref. Univ.) Z On modified primal-dual splitting algorithms ····· 15

Summary: The primal-dual splitting algorithms are existing algorithms that do solve convex optimization problems, and the generated sequences weak convergence to a solution. In this talk, we introduce and investigate modified primal-dual splitting algorithms.

3 Ryoji Fukuda (Oita Univ.) Z On strong zero-set with respect to a k-additive measure ····· 15
Aoi Honda (Kyushu Inst. of Tech.)
Yoshiaki Okazaki
(Fuzzy Logic Systems Inst.)

Summary: For a non-additive set function μ, constructive k-additivity is defined as a set function which can be expressed using a σ-additive signed measure on a set space (a family of all finite sub-sets with their cardinality not more than k). We define a sub-additive non-negative measure $\bar{\mu}$ for a constructively k-additive measure. This sub-additive measure $\bar{\mu}$ satisfies that a measurable set A is a strongly μ-null set if and only if it is a weakly $\bar{\mu}$-null set.

4 Keiji Yoneda (Kyushu Univ.) Z Higher-order interpolation inequalities with weights for radial functions
Ryo Takada (Kyushu Univ.) ····· 15

Summary: We consider higher-order interpolation inequalities of the Gagliardo–Nirenberg type with power weights for radial functions. We show that those inequalities hold for a better range of admissible power weights if we restrict ourselves to the space of radially symmetric functions. The key of the proof is to reduce the problem to a radial improvement for the weighted Hardy–Littlewood–Sobolev inequalities.

14:25–15:00

5 Satoshi Yamaguchi (Ibaraki Univ.) Z An extension of the VMO-H^1 duality and the Riesz transforms ····· 15

Summary: In 1977, Coifman and Weiss gave a proof of the VMO-H^1 duality. We consider generalized Campanato spaces and atomic Hardy spaces with variable growth condition and give an extension of the duality to these spaces. We also apply this duality to the Riesz transforms.

6 Ryota Kawasumi Z Weighted boundedness of the Hardy–Littlewood maximal operator on
Eiichi Nakai (Ibaraki Univ.) Orlicz–Morrey and weak Orlicz–Morrey spaces ····· 15

Summary: For the Hardy–Littlewood maximal operator M, the weighted boundedness on the Lebesgue and weak Lebesgue spaces are well known. We extend these boundedness to the Orlicz–Morrey and weak Orlicz–Morrey spaces. The weighted Orlicz–Morrey space and its weak version contain weighted Orlicz, Morrey and Lebesgue spaces and their weak versions as special cases. Then we also get the boundedness for these function spaces as corollaries. For example, we get the boundedness of M from the weak $\exp L^p(\mathbb{R}^n, w)$ to itself, if w is in the Muckenhoupt class A_∞.

7 Kohei Amagai
Eiichi Nakai (Ibaraki Univ.)
Gaku Sadasue (Osaka Kyoiku Univ.)
Generalized fractional integral operators based on symmetric Markovian semigroups ····· *

Summary: It is known that the fractional integral operator $\mathcal{I}_\alpha$ based on a symmetric Markovian semigroup with Varopoulos dimension d is bounded from L^p to L^q, if $0 < \alpha < d$, $1 < p < q < \infty$ and $-d/p + \alpha = -d/q$, like the usual fractional integral operator defined on the d dimensional Euclidean space. We introduce generalized fractional integral operators based on symmetric Markovian semigroups and extend the L^p-L^q boundedness to Orlicz spaces.

8 Sachiko Atsushiba (Tokyo Woman's Christian Univ.)
Attractive points and convergence theorems for generic 2-generalized hybrid mappings ····· *

Summary: In this talk, we deal with approximation of attrative points of generic 2-generalized hybrid mappings. We also prove some weak and strong convergence theorems for the mappings.

9 Hiroko Manaka (Nihon Univ.)
The projection methods with Bregman distance in Banach spaces ···· *

Summary: Bregman proposed a generalization for the cyclic metric projection method of computing points in the intersection of linear closed subspaces of a Hilbert space, invented by von Neumann. Alber and Butnariu achieve distinction of the study of this Bregman projection method for finding the solution of the consistent convex feasibility problem of computing a common point of the closed convex subspaces in a reflexive Banach space. We will talk about the results of the split feasibility problem with these projection methods in uniformly convex and smooth Banach spaces, which are, strongly convergence theorems using the hybrid methods with these projection methods in mathematical programing in order to find a solution of the split feasibility problem in these Banach spaces.

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

Shohei Nakamura (Osaka Univ.) Z
A study of the Fourier extension operator via X-ray tomography principle

Summary: In this talk, we investigate how large mass can Fourier transform of the function supported on the sphere in $\mathbb{R}^n$ have on affine subspaces. In particular, we establish bounds on quantities of the form $X(|\widehat{gd\sigma}|^2)$, where $g \in L^p(\mathbb{S}^{n-1})$, $d\sigma$ is Lebesgue measure on $\mathbb{S}^{n-1}$, and X denotes the X-ray transform. As an application, we establish some natural variants of conjectures of Stein and Mizohata–Takeuchi from the 1970s. This talk is based on joint works with Professor Jonathan Bennett in University of Birmingham.

September 17th (Fri) Conference Room IV

9:45–12:00

10 Shodai Kubota (Chiba Univ.) Z
Decomposition Theorem of the subdifferential of 1D-regularized total variation with nonhomogeneous coefficients ····· 15

Summary: We consider a convex function defined as a 1D-regularized total variation with nonhomogeneous coefficients. This convex function is based on KWC energy, proposed by [Kobayashi et al.; Phys. D, 140 (2000), 141–150], to describe the grain boundary motion. In this talk, we prove that the subdifferential of the total variation is decomposed to a weighted singular diffusion and a linear nonhomogeneous diffusion. This result is to enhance the previous regularity result, proposed by [Rybka et al.; Math. Methods appl. Sci, 36(17): 2359–2370, 2013] for quasilinear equation with singularity.

11 Hiroaki Naito (Kyoto Univ. of Edu.) Z
Takeshi Fukao (Kyoto Univ. of Edu.)
Long time behavior of single obstacle problems 15

Summary: In this talk, we consider the long time behavior of single obstacle problems. Single obstacle problems for second- and fourth-order parabolic equations in the bounded domain are considered. Note that in the fourth-order case, there is no "conservation of positivity" where the solution is positive if the initial value is positive. In this study, the long time behavior of the solution is discussed in the framework of the abstract equation governed by the subdifferential operator.

12 Yutaro Chiyo (Tokyo Univ. of Sci.) Z
Masaaki Mizukami (Kyoto Univ. of Edu.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Global existence and boundedness in an attraction-repulsion chemotaxis system with signal-dependent sensitivities without logistic source 15

Summary: This talk deals with a fully parabolic attraction-repulsion chemotaxis system with signal-dependent sensitivities. Global existence and boundedness of classical solutions to the system with logistic source have already been obtained by taking advantage of the effect of logistic dampening in our previous work (J. Math. Anal. Appl.; 2020;489;124153). The purpose of this talk is to show existence of global bounded classical solutions despite the loss of logistic dampening.

13 Shunsuke Kurima (Tokyo Univ. of Sci.) Z
A singular nonlocal phase field system with inertial term 15

Summary: In this talk we consider a singular nonlocal phase field system with inertial term. The system has the logarithm of the absolute temperature θ under time derivative. Although the system has a difficult mathematical point caused by the combination of $(\ln\theta)_t$, the inertial term and the nonlocal diffusion term for the order parameter φ, we can establish existence of solutions by a key estimate.

14 Chiharu Kosugi (Japan Women's Univ.) Z
Toyohiko Aiki (Japan Women's Univ.)
Uniqueness of weak solutions for the model representing motions of compressible elastic materials on plane 15

Summary: We talk about uniqueness of weak solutions to the initial and boundary value problem for beam equations with viscosity term. The problem was proved as a mathematical model presenting shrinking and stretching motions of the elastic ring on a plane. In our problem we consider the stress function having a singularity to obtain an estimate for the strain from below. This type of stress functions was investigated in the study of compressible rubber like solids. By using the estimate, we already proved existence of a weak solution. The aim of this talk is to provide the uniqueness of the weak solution by applying the dual equation method. The existence of a strong solution is one of our future work.

15 Kota Kumazaki (Nagasaki Univ.) Z
Global existence of a solution of a free boundary problem describing diffusants penetration into rubber 15

Summary: In this talk, we consider a free boundary problem describing the penetration of diffusants into rubber. Our problem is posed on a halfline with a moving boundary at one of the ends and consists of a diffusion equation for diffusants and an ordinary differential equation describing the growth rate of the front of the penetration region. One of the features of our problem is that it takes into account the stopping effect of the moving boundary due to physical characteristics. Recently, we prove the existence of a globally-in-time solution without the stopping effect and investigated the large-time behaviour of a solution thereof. In this talk, we discuss the existence of a globally-in-time solution in consideration of the stopping effect.

16 Shun Uchida (Oita Univ.) Z Nonlinear evolution equation associated with Hypergraph Laplacian · · 15
Masahiro Ikeda (RIKEN / Keio Univ.)

Summary: In this talk, we consider an ordinary differentail equation asscoiated with the so-called "Hypergraph Laplacian." Main purpose of this talk is to explain basic properties of this nonlinear multivalued operator from the viewpoint of evolution equation theory. More precisely, we proof the Poincaré–Wirtinger type ineqality and show the large time behavior of solution to Cauchy problem and solvability of time-periodic problem.

14:25–15:00

17 Hiroshi Watanabe (Oita Univ.) Z Propagation speed of the interface for entropy solutions to 1D Cauchy problems for scalar parabolic-hyperbolic conservation laws · · · · · · · · · · 15

Summary: We consider one-dimensional Cauchy problems (CP) for scalar parabolic-hyperbolic conservation laws. The equation has both properties of hyperbolic equations and those of parabolic equations. Our recent research have provided the existence of shock wave type solutions and rarefaction wave type super-, sub-solutions to (CP). These functions can be used to investigate the behavior of entropy solutions to (CP). In this talk, we estimate the propagation speed of the interface for entropy solutions to (CP). To see this, we construct entropy super-solutions using our recent works.

18 Noriaki Yamazaki (Kanagawa Univ.) Z Quasi-variational approach to doubly nonlinear evolution inclusions of time-dependent subdifferentials · 15
Nobuyuki Kenmochi (Chiba Univ.*)
Ken Shirakawa (Chiba Univ.)

Summary: In this talk we consider abstract doubly quasi-variational evolution inclusions governed by time-dependent subdifferentials with the unknown-dependent constraints. Then, we establish an abstract result on the existence of solutions to our evolution inclusions. Also, we apply our abstract results to quasi-variational inequalities with time-dependent gradient constraints.

19 Takuto Nagata (Oita Univ.) An error estimate for the structure-preserving finite difference scheme of thermoviscoelastoplasticity under uniform temperature distribution · *
Shuji Yoshikawa (Oita Univ.)

Summary: We show an error estimate for structure-preserving finite difference scheme of the thermoviscoelastoplastic system. On the system, we adopt a stop operator representing perfect elasto-plasticity as a hysteresis operator. We assume that a relation between elasto-plastic stress and temperature is described by a simple multiplication. We first derive a structure-preserving finite difference scheme inheriting an energy conservation law, an increasing law of entropy and a momentum conservation law. Under uniform temperature distribution, we shall prove an error estimate between strict and approximate solutions. Main tools of the proof are the energy method for a structure-preserving finite difference method and the discrete version of variational inequality for a stop operator.

20 Ken Shirakawa (Chiba Univ.) Optimal heat controls of 1D Warren–Kobayashi–Lobkovsky–Carter type systems with dynamic boundary conditions · *
Shodai Kubota (Chiba Univ.)
Ryota Nakayashiki (Salesian Polytech.)

Summary: In this talk, we deal with the optimal control problem motivated by planar grain boundary motion. In this light, the regularized version of the phase-field model, proposed by [Warren et al.; Acta Materialia, 51 (2003), 6035–6058], is adopted as the corresponding state system. Under suitable assumptions, the existence and necessary condition for the optimal control will be demonstrated as the main results of this talk.

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

Hiroki Ohwa (Niigata Univ.)[Z] An L^p shock admissibility condition for conservation laws

Summary: We estimate the L^p $(p > 0)$ local distance between piecewise constant solutions to the Cauchy problem of conservation laws and propose a shock admissibility condition for having an L^p local contraction of such solutions. Moreover, we prove that there exist L^p locally contractive solutions on some set of initial functions, to the Cauchy problem of conservation laws with convex or concave flux functions. As a result, for conservation laws with convex or concave flux functions, we see that rarefaction waves have an L^q $(q \geq 1)$ local contraction and shock waves have an L^r $(0 < r \leq 1)$ local contraction.

Functional Analysis

September 14th (Tue) Conference Room VI

9:30–10:45

1 Yoritaka Iwata (Kansai Univ.) Campbell–Baker–Hausdorff formula for unbounded operators defined in thes B(X)-module ····· 15

Summary: The Campbell–Baker–Hausdorff formula is known as

$$e^A e^B = \exp\left[A + B + \frac{1}{2}[A,B] + \frac{1}{12}[A,[A,B]] - \frac{1}{12}[B,[A,B]] + \cdots\right].$$

For example, this equality is used for operators A and B included in Lie Algebra. On the other hand, it is not able to obtain such a convergent power series representation, if operators A and B are unbounded (cf. Hille–Yosida theorem). In this talk, based on the logarithmic representation of infinitesimal generators, Campbell–Baker–Hausdorff type formula is introduced by means of the alternative infinitesimal generators.

2 Hisashi Morioka (Ehime Univ.) Takashi Komatsu (Math. Res. Inst. Calc for Industry) Norio Konno (Yokohama Nat. Univ.) Etsuo Segawa (Yokohama Nat. Univ.) Time-independent scattering theory for multi-dimensional quantum walks ····· 15

Summary: We consider the time-independent scattering theory for quantum walks on the multi-dimensional square lattice. In particular, we derive generalized eigenfunctions for the time-evolution operator of a quantum walk. The scattering matrix naturally appears in the asymptotic behavior of generalized eigenfunctions. Due to the bias of the shift of quantum walkers, we introduce an anisotropic Banach space and characterize generalized eigenfunctions for quantum walks.

3 Masaki Kawamoto (Ehime Univ.) Atsuhide Ishida (Tokyo Univ. of Sci.) Existence and nonexistence of wave operators for time-decaying harmonic oscillators ····· 15

Summary: Controlled time decaying harmonic oscillator decelerates the velocity of a quantum particle however the particle never be trapped by harmonic potentials. This phenomena changes the threshold of the power of decay order of the potential energy in order to exist the usual wave operators. In this talk, we introduce these facts more precisely.

4 Hajime Moriya (Kanazawa Univ.) Gibbs variational formula for thermal equilibrium states in terms of quantum relative entropy density ····· 15

Summary: We prove the Gibbs variational formula in terms of quantum relative entropy density that characterizes translation invariant thermal equilibrium states in quantum lattice systems. It is a natural quantum extension of the similar statement established by Follmer for classical systems. We shall advocate our viewpoint: Avoid the unique-phase assumption if it is not essential. We finally address some issues of mathematical physics and modular theory of operator algebra.

5 Shuji Watanabe (Gunma Univ.) An operator-theoretical treatment of the critical magnetic field near absolute zero temperature in the BCS-Bogoliubov model ····· ∗

Summary: We study several properties of the critical magnetic field near absolute zero temperature in the BCS-Bogoliubov model of superconductivity from the viewpoint of operator theory. We show that the critical magnetic field is smooth with respect to the temperature, and point out the behavior of both the critical magnetic field and its derivative near absolute zero temperature.

6 Kyohei Itakura (Ritsumeikan Univ.)
Tadayoshi Adachi (Kyoto Univ.)
Kenichi Ito (Univ. of Tokyo)
Erik Skibsted (Aarhus Univ.)
Strong radiation condition and stationery wave operators for one-body Stark operators ····· *

Summary: For a perturbed one-body Stark operator, we present existence and completeness of stationery wave operators, construction of associated generalized Fourier transforms and characterization of asymptotic behavior of generalized eigenfunctions of minimal growth order. A key element of our procedure is an improved, possibly optimal, version of radiation condition bounds obtained previously. This talk is based on a joint work with T. Adachi, K. Ito and E. Skibsted.

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

Haruya Mizutani (Osaka Univ.) Z Global-in-time Strichartz estimates for Schrödinger equations with potentials

Summary: The Strichartz estimate, which is known to be one of fundamental tools to study scattering theory for nonlinear dispersive equations, has been extensively studied and extended to various settings, including the case of Schrödinger equations with an external linear potential. In this talk, I will discuss recent progress on the (global-in-time) Strichartz estimates for the Schrödinger equation with a decaying potential. Two types of conditions are considered: potentials belonging to a scaling-critical Lebesgue space and slowly decaying repulsive potentials. If time permits, I will also report on a recent work, joint with Xiaohua Yao (CCNU), for the case of fractional and higher-order Schrödinger equations.

September 15th (Wed) Conference Room VI

9:00–10:45

7 Takashi Satomi (Univ. of Tokyo) Z An inequality about convolutions on unimodular locally compact groups and the application to Kemperman's theorem ····· 15

Summary: Let G be a unimodular locally compact group that has no open compact groups and $f\colon \mathbb{R}_{\geq 0} \to \mathbb{R}$ be a convex (down) function that satisfies $f(0) = 0$. In this talk, I report the inequality $\int_G f \circ (\phi_1 * \phi_2)(g)dg \leq 2\int_0^{\|\phi_1\|} f(x)dx + (\|\phi_2\| - \|\phi_1\|)f(\|\phi_1\|)$ holds for any integrable functions $\phi_1, \phi_2\colon G \to [0,1]$ that satisfy $\|\phi_1\| \leq \|\phi_2\|$, where $\|\cdot\|$ is the L^1-norm on G (a similar inequality holds when $\|\phi_2\| \leq \|\phi_1\|$ too). When $G = \mathbb{R}$, there are functions ϕ_1, ϕ_2 that the equality is attained. Thus, this inequality can be considered to give the maximum of $\int_G f \circ (\phi_1 * \phi_2)(g)dg$ explicitly when L^1-norm and L^∞-norm of ϕ_1, ϕ_2 are fixed. Furthermore, Kemperman's theorem $\mathrm{vol}(A_1A_2) \geq \mathrm{vol}(A_1) + \mathrm{vol}(A_2)$, that is a generalization of the Brunn–Minkowski theorem for $G = \mathbb{R}$, is deduced from this inequality.

8 Takuma Hayashi (Osaka Univ.) Z Geomtric realization of real absolutely irreducible representations of connected real semisimple algebraic groups ····· 15

Summary: The finite dimensional real irreducible representations of connected real Lie groups and finite dimensional real Lie algebras were classified by the works of Cartan, Malcev, Dynkin, Borel, Tits, Fell, and Onishchik through algebraic approaches. In this talk, I will explain a geometric approach to a criterion of the existence of data of Galois descent on complex irreducible representations of connected real semisimple algebraic groups and to their explicit construction. In particular, we will obtain a geometric realization of real absolutely irreducible representations.

9 Cid Reyes-Bustos (Tokyo Tech) Z Heat kernel for the asymmetric quantum Rabi model ····· 15

Summary: The quantum Rabi model (QRM) is one of most fundamental models describing quantum light-matter interactions. Recently, a closed formula for the heat kernel of the QRM was obtained by the speaker and Masato Wakayama using a method based on the expansion of the Trotter–Kato product formula by using discrete Fourier analysis. In this talk we extend the computation to obtain the heat kernel formula for the asymmetric quantum Rabi model (AQRM), obtained by adding a bias term to the QRM Hamiltonian. The computation of the heat kernel for the AQRM may be considered the first step towards the goal of a complete generalization and characterization of the method for computing heat kernels started with the QRM.

10 Cid Reyes-Bustos (Tokyo Tech) Z
Masato Wakayama (Tokyo Univ. of Sci.)
Degeneracy and hidden symmetry of the asymmetric quantum Rabi model ····· 15

Summary: The quantum Rabi model (QRM) and its generalizations are some of the most fundamental models in the study of quantum interaction. In this talk we discuss the hidden symmetry of the asymmetric quantum Rabi model (AQRM) and the degeneracies in its spectrum (crossings in the spectral curves). In particular, we show the existence, in the general case, of the recently discovered operators commuting with the AQRM Hamiltonian and discuss their properties. Notably, a quadratic relation between the AQRM Hamiltonian and the commuting operator reveals a (conjectural) relation between the symmetry and degeneracy via the constraint polynomials. In addition, we introduce a geometric picture for the the spectral curves that gives further insights into the AQRM and its spectrum.

11 Atsumu Sasaki (Tokai Univ.) Z Visible actions and criteria for multiplicity-freeness of representations of Heisenberg groups ····· 15

Summary: This talk gives a brief summary on a geometric criterion for a quasi-regular representation of the Heisenberg group to be multiplicity-free by coadjoint orbits and visible actions on Heisenberg complex homogeneous spaces.

12 Takeyoshi Kogiso (Josai Univ.) Two deformations of Markov triples and their interrelationships ····· ∗

Summary: In this talk, I talk about two kinds of deformations q-deformation and t-deformation of Markov triples in two different directions. One is generalization in direction of using the q-deformation of rational number introduced by S. Morier-Genoud and V. Ovsienko in connection with cluster algebras, quantum topology and analytic number theory. The other is a generalization in direction of using castling transforms on prehomogeneous vector spaces introduced by M. Sato which plays an important role in the study of representation theory and number theory.

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

Hideto Nakashima (Inst. of Stat. Math.) Z Functional equations of zeta functions associated with homogeneous cones and their gamma matrices

Summary: A homogeneous cone can be regarded as an open orbit of a certain prehomogeneous vector space so that one can construct the associated zeta functions. The theory of zeta functions associated with prehomogeneous vector spaces by F. Sato (1982) ensures the existence of functional equations which these zeta functions satisfy. In this talk, I will give explicit formulas of functional equations of zeta functions associated with homogeneous cones, and discuss the property of their gamma matrices.

September 16th (Thu) Conference Room VI

9:00–10:45

13 Yuki Seo (Osaka Kyoiku Univ.) Z The upper boundary for the ratio between n-variable operator power means 15

Summary: In this talk, we show estimates of the upper boundary for the ratio between n-variable operator power means due to Lawson–Lim–Pálfia by terms of the generalized condition number in the sense of Turing, which are a partial improvement of the known results.

14 Sora Hiramatsu (Osaka Kyoiku Univ.) Z Determinant for positive operators and Oppenheim's inquality 15
Yuki Seo (Osaka Kyoiku Univ.)

Summary: In this talk, by virtue of the Specht ratio, we show Oppenheim type inequalities for the normalized determinant of positive invertible operators on a Hilbert space, and we moreover discuss Hadamard type inequalities for positive definite matrices.

15 Masatoshi Ito (Maebashi Inst. of Tech.) Z A family of weighted operator means including the weighted Heinz and Lehmer means 15

Summary: Recently, we proposed the notion of a transpose symmetric path of weighted $\mathfrak{M}$-means for a symmetric operator mean $\mathfrak{M}$, and also we obtained a family of operator means including the weighted Heron, logarithmic and Heinz means. On the other hand, Kubo, Nakamura, Ohno and Wada discussed a path of operator monotone functions named the Barbour path.
In this talk, we introduce a new family of operator means by using a generalization of the Barbour path, which includes the weighted Heinz and Lehmer means. This family leads relations among the weighted Heinz, Lehmer and some fundamental means.

16 Keiichi Watanabe (Niigata Univ.) Z On Lipschitz continuity of linear contractions with respect to the Möbius operations and metric 15

Summary: For every linear operator between inner product spaces whose operator norm is less than or equal to one, we show that the restriction is Lipschitz continuous with respect to the Möbius operations and metric.

17 Michiya Mori (RIKEN) Z Continuous coexistency preservers on effect algebras 15
Peter Šemrl (Univ. Ljubljana)

Summary: Let H be a complex Hilbert space. The effect algebra $E(H)$ is the collection of effects, i.e., positive semi-definite operators on H with norm at most one. Two effects $A, B \in E(H)$ are said to coexist (and written $A \sim B$) if there are effects $E, F, G \in E(H)$ with $A = E + F$, $B = E + G$ and $E + F + G \in E(H)$. We obtained the following theorem. Assume that $2 \leq \dim H < \infty$. For every continuous map $\phi\colon E(H) \to E(H)$ that satisfies $A \sim B \Leftrightarrow \phi(A) \sim \phi(B)$ for any pair $A, B \in E(H)$, there exists a unitary or antiunitary operator $U\colon H \to H$ such that either $\phi(A) = UAU^*$ $(A \in E(H))$ or $\phi(A) = U(I - A)U^*$ $(A \in E(H))$ holds. We give examples that imply the optimality of this result.

18 Rui Okayasu (Osaka Kyoiku Univ.) Z Injective factors with trivial bicentralizer 15

Summary: I will give an alternative proof that an injective factor on a separable Hilbert space with trivial bicentralizer is ITPFI. The proof is given in parallel with each type of factors and it is based on the strategy of Haagerup. As a consequence, the uniqueness theorem of injective factors except type III_0 follows from Araki-Woods' result. In this talk, I talk about some key points in the proof.

19 Yuhei Suzuki (Hokkaido Univ.) C*-simplicity has no local obstruction ····· ∗

Summary: C*-simplicity of a group is the simplicity of the reduced group C*-algebra. In 2016, I solved a problem of de la Harpe in '06: Is there a non-discrete C*-simple group? However the solution was not fully satisfactory as the provided C*-simple groups (and their operator algebras) are very close to discrete groups. All previously known examples are of this form. In this talk, I give yet another construction of non-discrete C*-simple groups. The statement in the title then follows. This in particular gives the first examples of non-elementary C*-simple groups (in Wesolek's sense).
Based on arXiv:2103.10404.

20 Toshihiko Masuda (Kyushu Univ.) Classification of outer actions of discrete amenable groupoids on injective factors ····· ∗

Summary: We will classify outer actions of measurable discrete amenable groupoids on injective factors. We do not use model action for classification.

21 Yasuo Iida (Kanazawa Med. Univ.) Isometries of the Zygmund F-algebra on the upper half plane ····· ∗

Summary: In 2019 the speaker introduced the Zygmund F-algebra $N\log^{\alpha} N(D)$ $(\alpha > 0)$ of holomorphic functions f on the upper half plane $D = \{z \in \mathbf{C} \,|\, \operatorname{Im} z > 0\}$ that satisfy

$$\sup_{y>0} \int_{\mathbf{R}} \varphi_{\alpha}\left(\log(1 + |f(x+iy)|)\right)\, dx < +\infty,$$

where $\varphi_{\alpha}(t) = t\{\log(c_{\alpha} + t)\}^{\alpha}$ for $t \geq 0$ and $c_{\alpha} = \max(e\,,\, e^{\alpha})$. In this talk we shall characterize linear isometries of $N\log^{\alpha} N(D)$ onto $N\log^{\alpha} N(D)$.

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

Takeaki Yamazaki (Toyo Univ.)[Z] Operator means and operator inequalities

Summary: In this talk, we shall introduce several results of operator means in the viewpoint of operator inequalities. Here an operator means a bounded linear operator on a complex Hilbert space. This talk can be divided into two parts. In the first part, we shall consider operator means of two positive definite operators. Especially, we shall introduce the axiom of operator mean defined by Kubo–Ando. Then we shall introduce some important examples of operator means. Moreover, we shall introduce the interpolation property for operator means. At the end of the first part, we shall introduce an operator inequality which is called the Ando–Hiai inequality (AH), and then we will introduce generalizations of AH. In the second part, we shall introduce recent results of operator means of n-operators, where n is greater than 3. We will focus on generalizations of AH for operator means of n-operators.

Statistics and Probability

September 14th (Tue) Conference Room VII

9:15–11:40

1 Yuki Hirai (Osaka Univ.) Z Itô–Föllmer calculus in infinite dimensions 15

Summary: The Itô–Föllmer calculus, pioneered by Föllmer (1981), is a deterministic counterpart to classical Itô's stochastic calculus. We extend some results in the Itô–Föllmer calculus to infinite dimensions. In particular, we give the $C^{1,2}$-type Itô formula and a generalized C^1-transformation formula of quadratic variations for Banach space valued paths.

2 Kiyoiki Hoshino (Osaka Pref. Univ.) Z Identification of random functions from the stochastic Fourier coefficients by the process with quadratic variation 15

Summary: Let $(V_t)_{t\in[0,L]}$ be a real random function with right-continuous quadratic variation $[V]_t$. Our concern is whether and how a noncausal type stochastic differential $dX_t^{a,b} := a(t)\,dV_t + b(t)\,dt$ is determined from its stochastic Fourier coefficients (SFCs for short) $(e_n, dX^{a,b}) := \int_0^L \overline{e_n(t)}\,dX_t^{a,b}$ with respect to a CONS $(e_n)_{n\in\mathbb{N}}$ of $L^2[0,L]$. In this talk, we use the notion of stochastic derivative to show the following: (i) when $(e_n)_{n\in\mathbb{N}}$ is the Haar system, any stochastic differential $dX^{a,b}$ is determined from its SFCs $((e_n, dX^{a,b}))_{n\in\mathbb{N}}$, (ii) when each e_n is of bounded variation, $dX^{a,b}$ is determined from its SFCs $((e_n, dX^{a,b}))_{n\in\mathbb{N}}$ on a certain condition, where $dX^{a,b}$ is defined by any stochastic integral $\int dV$ which is the inverse of the stochastic derivative.

3 Ryosuke Shimizu (Kyoto Univ.) Z Construction of nonlinear potential theory on fractals 15

Summary: We give a method to construct p-energies on fractals, especially the standard two-dimensional Sierpinski carpet, as scaling limits of discrete p-energies. When $p = 2$, this energy becomes a Dirichlet form and has been actively studied by probabilists since one can obtain diffusion processes through the theory of Dirichlet forms. We also show that the domain of p-energy can be written as Lipschitz–Besov type function space on metric measure space.

4 Yuichi Shiozawa (Osaka Univ.) Z
Jian Wang (Fujian Normal Univ.)
Compactness of semigroups generated by symmetric non-local Dirichlet forms with unbounded coefficients 15

Summary: In this talk, we present sharp criteria for compactness and non-compactness of the Markovian semigroup on $L^2(\mathbb{R}^d)$ associated with a symmetric non-local Dirichlet form with unbounded coefficient. Using these criteria, for a class of Dirichlet forms, we give a necessary and sufficient condition for the associated Markovian semigroups to be compact in terms of the coefficient growth rates at infinity.

5 Takuya Murayama (Chuo Univ.) Z On the continuity of half-plane capacity with respect to Carathéodory convergence 15

Summary: We consider the continuity of half-plane capacity as a function of boundary hulls with respect to the Carathéodory convergence. In particular, our interest lies in the case that hulls are unbounded. Under the assumption that every hull is contained in a fixed hull with finite imaginary part and half-plane capacity, we show that the half-plane capacity is indeed continuous. We also discuss the extension of this result to the case that the underlying domain is finitely connected. This extension is based on Brownian motion with darning.

Summary: In this talk we report a relation between marginals of two probability measures. One is the q-Whittaker measure, which is related to some typical models in the KPZ class such as q-TASEP, q-pushTASEP etc. The other is the periodic Schur measure, which is a typical model of the determinantal point processes and describes free fermions at positive temperature.

Summary: We report that a random interval map by choosing randomly two piecewise linear maps whose orbits converge to 0 or 1 obeys Thaler–Zweimüller's arcsine law. This talk is based on a joint work with Genji Hata.

Summary: We consider an i.i.d. random dynamical system generated by finitely many, fully branched uniformly expanding interval maps with a finite number of branches. For almost every sample, we show that random cycles weighted with random Lyapunov exponents equidistribute with respect to the sample-independent, absolutely continuous stationary measure as the periods of the random cycles tend to infinity. This result is an analogue of Bowen's theorem on periodic orbits of topologically mixing Axiom A diffeomorphisms. Our method of proof is purely deterministic, relying on the property that the canonical skew product map has a symbolic representation by the full shift over finite alphabet.

Summary: We study energy measures of canonical Dirichlet forms on inhomogeneous Sierpinski gaskets. We prove that the energy measures and suitable reference measures are mutually singular under mild assumptions.

Summary: We consider some parameterized planar sets with unbounded digits. We investigate these sets by using the method of "*transversality*", which is the main tool in investigating self-similar sets with overlaps. We calculate the Hausdorff dimension of these sets for typical parameters in some region with respect to the 2-dimensional Lebesgue measure. In addition, we estimate the local dimension of the exceptional set of parameters.

Summary: We show that a piecewise monotonic map with positive topological entropy satisfies the level-2 large deviation principle with a unique measure of maximal entropy as reference under the conditions that the corresponding Markov diagram is irreducible and that the periodic measures of the map are dense in the set of ergodic measures. This result can apply to a broad class of piecewise monotonic maps, such as monotonic mod one transformations and piecewise monotonic maps with two monotonic pieces.

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

Syota Esaki (Fukuoka Univ.)[Z] Stochastic analysis for long range interacting particle systems with jumps

Summary: In this talk, we would like to consider infinite particle systems with jumps. Unlabelled systems (dynamical systems on the configuration space) were constructed by Esaki [Tohoku J, 2019] using Dirichlet form technique. Then, we would like to give infinite dimensional stochastic differential equation (ISDE) representations for each particle on the dynamics. However, the coordinate function can NOT be in the domain of the Dirichlet form associated with the unlabelled dynamics. Hence, we need to "label" the unlabelled dynamics and construct Dirichlet forms associated with these "labelled dynamics". After labelling, we can obtain ISDE representations for each particle using this new Dirichlet form. To show our theorem we assume some conditions. We call them non-collision, non-explosion and no-big jump conditions. We would like to introduce sufficient conditions for these conditions in this talk. Using these sufficient conditions we can apply our theorem to the systems of alpha-stable particles with logarithmic interactions associated with Dyson, Ginibre, Airy and Bessel random point fields, which are related to the random matrix theory. If we have time to talk, we would like to talk discrete versions of these results and our results of the pathwise uniqueness of these ISDEs. This is a joint work with Hideki Tanemura (Keio University).

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

Daehong Kim (Kumamoto Univ.)[Z] Scattering lengths for positive additive functionals and their related problems

Summary: There is a large physics literature involving the concept of scattering length of a potential. When a potential is positive, it has a close relation to potential theory. In 1974, Mark Kac gave a probabilistic representation for the scattering length of positive potential in terms of 3-dimensional Brownian motion and studied some applications of the probabilistic method to scattering problems. In this talk, we will introduce the concept of scattering length of positive additive functionals of symmetric Markov processes. The additive functionals considered here are not necessarily continuous. After giving a systematic presentation of the fundamentals of the scattering length, we study the problems of semi-classical asymptotics for scattering length under relativistic stable processes, which extend previous results for the case of positive continuous additive functionals. We also give an equivalent criterion for the fractional Laplacian with a measure-valued non-local operator as a perturbation to have a purely discrete spectrum in terms of the scattering length, by considering the connection between scattering length and the bottom of the spectrum of Schrödinger operator.

September 15th (Wed) Conference Room VII

10:00–11:40

Summary: In this talk we discuss on random point configurations on Q-polynomial schemes, which has deeply connection with classical combinatorial objects, e.g., orthogonal arrays and combinatorial t-design. We compare random point configurations, including determiantal point processes, jittered samplings and poisson point processes, with designs in Q-polynomial association schemes. Moreover, we also discuss some other energies and discrepancies if possible.

Summary: We have newly introduced a combinatorial structure, called an ordered multi-design (OMD). In this talk, necessary conditions for the existence of an $\mathrm{OMD}_\lambda(k \times c, v)$ are discussed, and several methods of constructing an $\mathrm{OMD}_\lambda(k \times c, v)$ are presented. Finally, it is shown that the necessary conditions are also sufficient for the existence of an $\mathrm{OMD}_\lambda(3 \times 2, v)$ with one possible exception. Note that the ordered multi-design with $c = 1$ coincides with the ordered design defined along with an orthogonal array and a perpendicular array in Rao (1961).

Summary: We consider admissibility of generalized Bayes estimators of the mean of a multivariate normal distribution when the scale is unknown under quadratic loss. The priors considered put the improper invariant prior on the scale while the prior on the mean has a hierarchical normal structure conditional on the scale. This conditional hierarchical prior is essentially that of Maruyama and Strawderman (2021, Biometrika). This paper completes the determination of admissibility/inadmissibility for this class of priors.

Summary: In this report, we consider the distribution of the product of a Wishart matrix and a normal vector with uncommon covariance matrices. We present the stochastic representation, density function and exact moments of the product. While the stochastic representation and density function are directly derived from the result of previous researches, the derivation of exact moments is based on higher order moments of elements of a non-singular Wishart matrix. In addition, the stochastic representation, density function and exact moments of the product remain valid for the product of a singular Wishart matrix and a normal vector. In a numerical illustration, we investigate some properties of the product by computing the moments.

Summary: In this talk, we consider a test for multivariate normality with two-step monotone type of missing data. For multivariate normality tests in the case of complete data, Mardia (1970) has defined the sample measure of multivariate kurtosis and given its exact mean and exact variance to test multivariate normality. In this talk, we define a new sample measure of multivariate kurtosis for two-step monotone type of missing data. Furthermore, we derive asymptotic results of the mean and variance by perturbation method. From this result, we can obtain a multivariate normality test statistic in the case of two-step monotone type of missing data. Finally, the accuracy of the normal approximation for this test statistic is investigated by Monte Carlo simulations.

Summary: Quantum monotone metric was introduced by Petz, and it was proved that quantum monotone metrics on the set of quantum states with trace one were characterized by operator monotone functions. In this paper, we introduce an extension of quantum monotone metrics which have monotonicity under completely positive, trace non-increasing (CPTNI) maps and additive noise. We prove that our extended monotone metrics can be characterized only by static operator monotone functions from few assumptions without assuming continuities of metrics. We show that our monotone metrics have some natural properties such as additivity of direct sum, convexity and monotonicity with respect to positive operators.

September 16th (Thu) Conference Room VII

9:45–11:45

18 Yan Liu (Waseda Univ.) Z Detection of relevant change in frequency domain ····· 15
Yuichi Goto (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)

Summary: We consider the problem of detecting relevant changes in the frequency domain. In this talk, we introduce relevant changes in the framework of nonparametric functionals. We propose a consistent test statistic for detecting relevant changes in the frequency domain. Specifically, we construct a new CUSUM statistic of the nonparametric estimator for the spectral density of time series, and elucidate the consistency of it with the relevant change. The CUSUM statistic consisting only of periodograms is not available here because it is not consistent. The proposed statistic has good features such as asymptotic convergence to the Brown bridge, and can be applied to the detection of relevant changes in hidden structures of integer-valued time series. We will also show some numerical examples and applications of this method to the real data based on the above theoretical results.

19 Yuichi Goto (Waseda Univ.) Z Homogeneity tests for one-way models with dependent errors ····· 15
Koichi Arakaki (Waseda Univ.)
Yan Liu (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)

Summary: In this talk, we introduce homogeneity tests for one-way models with dependent errors. Existing tests are constructed under the assumption of independence between groups. However, this assumption is quite restrictive and impractical. Hence, we propose a test that allows us to deal with correlated groups. A proposed test statistic can be used for both fixed effects model and random effects model. First, we show that, under the null hypothesis, the proposed test statistic converges to the chi-square distribution. From this result, an asymptotically size alpha test can be constructed. Then, we prove the consistency of the test, that is, the power of the test converges to 1 under the alternative hypothesis. Furthermore, we show our test has a non-trivial power under the local alternative hypothesis. In real data analysis, we test whether or not there exist random effects in three industries.

20 Yuichi Goto (Waseda Univ.) Z Test for conditional variance of integer-valued time series ····· 15
Kou Fujimori (Shinshu Univ.)

Summary: Integer-valued time series have been attracted attention recently. We consider models whose conditional expectations have dependence structures. In this talk, we discuss the test for conditional variance. This test can be applied to various testing problems such as the goodness of fit test, the specification test of intensity function, and the test for equidispersion. First, we propose an M-estimator and show the strong consistency and the asymptotic normality. Next, the asymptotic null distribution of a proposed test statistic is derived, which enables us to construct an asymptotically size alpha test. Then, the consistency of the proposed test is established, that is, the power of the test converges to 1 as the sample size increases. Moreover, we show that our test has a nontrivial power under the local alternative hypothesis. Finally, the number of patients with Escherichia coli in the state of Germany is analyzed.

21 Nakahiro Yoshida (Univ. of Tokyo) Z Adaptive estimation for a degenerate diffusion process ····· 15

Summary: Parametric estimation of a degenerate diffusion system from time-discrete observations is discussed. The first component of the degenerate diffusion system has a parameter θ_1 in a non-degenerate diffusion coefficient and a parameter θ_2 in the drift term. The second component has a drift term parameterized by θ_3 and no diffusion term. Asymptotic normality is established in two different situations: an adaptive estimator for θ_3 with some initial estimators for (θ_1, θ_2), and an adaptive one-step estimator for $(\theta_1, \theta_2, \theta_3)$ with some initial estimators for them. The convergence of the estimators for θ_3 is much faster than the other parameters. This is a joint work with A. Gloter.

Summary: We present an Edgeworth expansion for the Euler–Maruyama approximation of a diffusion process. Our methodology is based upon the martingale expansion, that established Edgeworth expansions under asymptotic mixed normality. The asymptotic expansion formula is given by the adaptive random symbol (tangent) and the anticipative random symbol (torsion) described by the Malliavin calculus. Identification of these random symbols is a task in this work. A joint work with M. Podolskij and B. Veliyev.

Summary: We consider the minimax estimation of time series in view of higher order asymptotic theory. Under the framework of Bayesian inference, we focus on the Bayes estimator and the Bayesian Whittle estimator for parameter estimation. It is shown that these estimators are minimax with respect to the Bayes risk of higher order bias appeared in their asymptotic expansion. Our theoretical discovery is justified by simulation studies even when the sample size is small.

Summary: Given an $n \times d$ matrix X with i.i.d. entries with mean 0 and variance 1, we consider Gaussian approximation to the scaled Wishart matrix $XX^\top/\sqrt{d}$ when both n and d tend to infinity. Here, $X^\top$ denotes the transpose of X. It is known that, when X is Gaussian, such Gaussian approximation is possible in terms of the Wasserstein distance if $n^3 = o(d)$. Besides, the condition $n^3 = o(d)$ is conjectured to be sharp. In this talk, we show that the same Gaussian approximation result holds when entries of X have finite sixth moment.

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

Summary: We consider classification and clustering for high-dimension, low-sample-size (HDLSS) data. These topics have been studied as supervised and unsupervised techniques in the field of machine learning. In this talk, we consider support vector machine (SVM) proposed by Vapnik and principle component analysis (PCA) for each issue. We focus on nonlinearity that is one of the key analyzing high-dimensional space. The Kernel trick is a very interesting and powerful tool for nonlinearity. Kernel functions can be used in many applications as they provide a simple bridge from linearity to nonlinearity for algorithms which can be expressed in terms of inner products. In this talk, we apply it to SVM and PCA for classification issues and study their properties for high-dimensional data. In particular, we investigate them with the Gaussian kernel which is the most commonly used. However, we note that their performances are influenced by the scale parameter involved in the Gaussian kernel. By discussing their asymptotic properties for it, we propose a choice of the scale parameter yielding a high performance. Finally, we examine the validity of the choice by numerical simulations and actual data analyses.

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

Keisuke Yano (Inst. of Stat. Math.)[Z] Recent development of predictive densities

Summary: Predictive density is a probability density of future observations based on current observations. It can be used not only to estimate future observations but also to quantify their uncertainty. It has a wide spectrum of application in statistics, information theory, and machine learning. An important class of predictive densities is the class of Bayesian predictive densities, that is, the posterior mixture of densities of future observations. In this talk, I present my recent studies on (i) Bayesian predictive densities in high dimensions and (ii) model assessment based on quasi-Bayesian predictive densities. As for (i), I discuss Bayesian predictive densities for sparse Poisson models and hierarchical Bayes models and present several theoretical results such as the minimaxity. As for (ii), I introduce an information criterion, Posterior Covariance Information Criterion (PCIC), that generalizes Widely-Applicable Information Criterion (WAIC), a model evaluation method based on Bayesian predictive densities, so as to cover a wide range of predictive settings including covariate shift adaptation, causal inference, and quasi-Bayesian prediction. I show that PCIC shares several favorable features of WAIC and illustrate its applicability.

September 17th (Fri) Conference Room VII

Morning

25 Toshiharu Fujita (Kyushu Inst. of Tech.) Decision process with converging branch system —Multiplicative reward system— ∗

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

26 Satoshi Suzuki (Shimane Univ.) KKT optimality condition for quasiconvex programming ∗

Summary: In this talk, we study KKT optimality condition for quasiconvex programming. We introduce KKT optimality condition in terms of Greenberg–Pierskalla subdifferential. We show two constraint qualifications for KKT optimality condition. Especially, we investigate a necessary and sufficient constraint qualification for KKT optimality condition.

27 Shoko Chisaki (Osaka Inst. of Tech.)
Nobuko Miyamoto (Tokyo Univ. of Sci.)
Ryoh Fuji-Hara (Univ. of Tsukuba[⋆]) A construction for spanning bipartite block designs ∗

Summary: It is usually to design an experiment using treatments and its blocks in the design of experiments. Now consider a set of edges of a complete bipartite graph as a treatments set and suppose the treatments have a structure. Then, we propose a new combinatorial structure (named spanning bipartite block design) to achieve better estimation accuracy. In this talk, we introduce spanning bipartite block designs and its constructions.

28 Takao Namiki (Hokkaido Univ.)
Ichiro Tsuda (Chubu Univ./Chubu Univ.)
Shunsuke Kajikawa (Kyoto Univ.)
Masao Matsuhashi (Kyoto Univ.)
Akio Ikeda (Kyoto Univ.) Discrete dynamical system for high frequency oscillation in epileptic seizures ∗

Summary: We focused on the high-frequency oscillation of the EEG waveform in the epileptic focus during seizures, and applied chaotic time series analysis. As a result, a type of discrete dynamical system is found. In the presentation the orbit structure of the dynamical system is discussed.

29 Yoshihide Kakizawa (Hokkaido Univ.) On asymmetric kernel density estimation for biased data ····· ∗

Summary: For the data supported on $[0, \infty)$ or $[0, 1]$, the so-called boundary bias problem is one of the interests, and asymmetric kernel (AK) density estimation has been well studied. In this talk, we consider a situation where a random sample $\{X_1, \ldots, X_n\}$ is not directly available but the data $\{Y_1, \ldots, Y_n\}$ is instead observed from the length-biased density, and we propose two density estimators, on the basis of the AK method.

30 Koji Tsukuda (Kyushu Univ.) Shun Matsuura (Keio Univ.) High-dimensional testing for common principal components hypothesis on two covariance matrices ····· ∗

Summary: For analyzing multivariate data seen as a realization of samples from more than one populations, the common principal component analysis is widely employed. Hence, testing its assumption, the population covariance matrices are simultaneously diagonalizable (CPC hypothesis), has been discussed in the literature. However, test procedures proposed so far have not assumed a so-called high-dimensional situation that means there are a lot of observed variables compared with the sample sizes. In this presentation, we propose a procedure to test the CPC hypothesis on two population covariance matrices when two sample sizes are less than the number of variables based on the asymptotic normality of the trace of products of four independent Wishart matrices under a high-dimensional regime.

31 Kento Egashira (Univ. of Tsukuba) Asymptotic properties of multicategory support vector machine under high dimensional settings ····· ∗

Summary: We investigate asymptotic properties of the multicategory support vector machine (MSVM) theoretically under high dimensional settings. First, we show that MSVM includes a huge bias caused by heterogeneity of covariance matrices or sample imbalance under high dimensional settings. To overcome such difficulties, we propose a bias corrected-MSVM (BC-MSVM) and show that the BC-MSVM can enjoy consistency properties about misclassification rates. Finally, we check the performances of our proposed method by numerical simulations.

32 Shintaro Hashimoto (Hiroshima Univ.) Predictive probability matching priors for non-regular models ····· ∗

Summary: Probability matching priors for Bayesian prediction in non-regular case are considered. For one-parameter family of distributions, the resulting priors match the posterior predictive quantile with the frequentist one up to the order of $o(n^{-2})$, and they are solutions of a certain differential equation (denoted by matching equation). Although predictive probability matching priors depend on a nominal rate α in general, we provide a prior which satisfy the matching equation for every nominal rate α in non-regular location and scale models. A multi-parameter extension including location-scale model is also discussed.

33 Ken-ichi Koike (Nihon Univ.) Shintaro Hashimoto (Hiroshima Univ.) Improvement of Bobrovsky–Mayor-Wolf–Zakai bound ····· ∗

Summary: We show a difference-type lower bound for the Bayes risk as an extension of the Borovkov–Sakhanenko bound. The resulting bound asymptotically improves the Bobrovsky–Mayor-Wolf–Zakai bound which is a difference-type extension of the Van Trees bound. Some examples are also given.

Applied Mathematics

September 14th (Tue) Conference Room VIII

Morning

1 Shinya Fujita (Yokohama City Univ.) Recent results and open problems on safe sets in graphs ····· *

Summary: Some recent results and open problems on safe sets in graphs will be reviewed.

2 Kazuhide Hirohata (Ibaraki Nat. Coll. of Tech.)
Ronald J. Gould (Emory Univ.)
Ariel Keller Rorabaugh (Univ. of Tennessee)
Vertex-disjoint chorded cycles and degree sum conditions ····· *

Summary: Let k be a positive integer. In 1963, Corradi and Hajnal proved that if G is a graph of order at least $3k$ and the minimum degree of G is at least $2k$, then G contains k vertex-disjoint cycles. Finkel proved an analogous result for chorded cycles, and Chiba et al. improved Finkel's result. In this talk, we consider the extension of these results.

3 Robert E. L. Aldred (Univ. of Otago)
Jun Fujisawa (Keio Univ.)
Generalization of the distance restricted matching extension problem in graphs on surfaces ····· *

Summary: In this talk, we show the following result. Let G be a 5-connected triangulation of sufficiently large face-width, and let $H_1, H_2, \ldots, H_m$ be connected subgraphs of G of order at most 4 such that any two of them are at distance at least 9 in G. Then $G - (H_1 \cup H_2 \cup \ldots \cup H_m)$ has a perfect matching if it has an even order. We also discuss the case where H_i is much larger.

4 Xiao-Nan Lu (Univ. of Yamanashi) Searching for edges in a multi-partite graph ····· *

Summary: In this talk, I am devoted to introducing a new graph searching problem restricted on multi-partite graphs. This problem is motivated by the studies in combinatorial interaction testing, which is a method commonly used for software testing in computer science and engineering. In particular, I will focus on the problems for the complete multi-partite graph where each partite set has exactly two vertices. Then, some results on upper bounds derived from algorithmic approaches will be proposed.

5 Ayaka Ishikawa (Yokohama Nat. Univ.) The Sato zeta function corresponding to the Szegedy walk ····· *

Summary: The Szegedy walk is a quantum walk that is a generalization of the Grover walk. Konno and Sato gave the eigenvalues of the Grover transition matrix using the Sato zeta function. However, such a relationship between a graph zeta function and the Szegedy walk is not yet known. In this talk, we show a new graph zeta function associated with the Szegedy walk. We also give a determinant expression called the Ihara expression. It is the significant expression for a graph zeta function and a useful one to get the eigenvalues for the transition matrix of a quantum walk.

6 Chusei Kiumi (Yokohama Nat. Univ.)
Kei Saito (Kanagawa Univ.)
Strongly trapped space-inhomogeneous quantum walks in one dimension ····· *

Summary: Localization is a characteristic phenomenon of space-inhomogeneous quantum walks in one dimension. Additionally, eigenvectors of time evolution operators are deeply related to the amount of localization. In this research, we introduce the analytical method for the eigenvalue problem using a transfer matrix to quantitatively evaluate localization by deriving the time-averaged limit distribution and reveal the condition of strong trapping.

7 Yasuo Nishii (Univ. of Tsukuba) Approximation of Frankl's conjecture in the complement family ····· ∗

Summary: In this study, we propose an approximation of Frankl's conjecture in the complement $\mathcal{C}$ of a union-closed family $\mathcal{F}$ in the power set of $U = \{1, \ldots, n\}$. Frankl's conjecture is the statement that at least half the members of $\mathcal{F}$ contain some common element k in U and it is equivalent to at most half the members of $\mathcal{C}$ containing some k. This study proves that at most $1/2 + 1/2n$ of the members in $\mathcal{C}$ contain some common element k. In addition, we show that, for arbitrarily small $\epsilon > 0$ and any constant c such that $1 > c > 0$, almost all union-closed families $\mathcal{F}$ have at least $1/2 - \epsilon$ of the members which contain some k when $|\mathcal{F}| > c \cdot 2^n$.

14:25–15:30

8 Yuuya Yoshida (Nagoya Univ.) Z Mathematical aspects of classical-quantum differential privacy ····· 15

Summary: Let $\varepsilon > 0$ be a real number and $n \geq 2$ be an integer. An n-tuple $(p_i)_{i=1}^n$ of probability vectors is called (classical) ε-differentially private (ε-DP) if $e^{\varepsilon} p_j - p_i$ has no negative entries for all $i, j = 1, \ldots, n$. An n-tuple $(\rho_i)_{i=1}^n$ of density matrices is called classical-quantum ε-differentially private (CQ ε-DP) if $e^{\varepsilon}\rho_j - \rho_i$ is positive semi-definite for all $i, j = 1, \ldots, n$. Differential privacy (DP) was born in the study to utilize private data while protecting them (privacy-preserving data mining, PPDM). In this talk, I talk about mathematical aspects of classical-quantum differential privacy (CQ-DP).

9 Chie Nara (Meiji Univ.) Z
Jin-ichi Itoh (Sugiyama Jogakuen Univ.) Continuous flattening: the 2-skeleton of a regular 24-cell ····· 15

Summary: We can continuously flatten the surface of a regular octahedron onto any of its faces without stretching and cutting. This is accomplished by moving creases to change the shapes of some faces successively, following Sabitov's volume preserving theorem. We extend this result to a regular 24-cell by considering the 2-dimensional skeleton of a polytope, corresponding to the surface of a three-dimensional polyhedron.

10 Masahiro Hachimori (Univ. of Tsukuba) Z Hierarchy of partitions on nonpure simplicial complexes ····· 15

Summary: For nonpure simplicial complexes, we define four kinds of strengthenings of partitionability: (A) layer-compatibly partitionable, (B) h-compatibly partitionble, (C) sequentially partitionable, and (D) ps-partitionable. While (A) and (B) are equivalent, the rest form a hierarchy so that (A)(or (B)) implies (C) and (C) implies (D). We discuss the gaps between (A)(or (B)) and (C), (C) and (D), and (D) and partitionability.

11 Yuya Ikeda (Hiroshima Univ.) Z Designs on vector bundles ····· 10

Summary: Let M be a homogenous G-space. Fix H as a G-representation consisting of continuous functions on M and denote by S the G-invariant averaging operator on M. A finite subset X of M is called a "design" for (H,S) if the averaging operator S on M is same as the averaging operator on X for H. Designs on spheres, unitary groups and some other compact symmetric spaces have been studied by many researchers in the area of combinatorics. In this talk, we consider G-equivariant vector bundles E on M, and generalize the concept of designs for G-representations H consisting of continuous sections of E, and G-intertwining operators S on H.

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

Keisuke Shiromoto (Kumamoto Univ.) Z Critical Problem for matroids

Summary: The *Critical Problem* in matroid theory is the problem for finding the maximum dimension of a subspace that contains no element of a fixed subset S of $\mathbb{F}_q^k$. This problem was introduced by H. Crapo and G.-C. Rota in 1970 to formulate a number of problems in extremal combinatorial theory including fundamental graph-theoretic problems. The *critical exponent* for the representable matroid M_S over $\mathbb{F}_q$ from a given subset $S \subseteq \mathbb{F}_q^k - \{\mathbf{0}\}$ is defined by

$$c(M_S; q) := k - \max\{\dim D \ : \ D \leq \mathbb{F}_q^k \text{ and } \ D \cap S = \emptyset\}.$$

Thus the Critical Problem is equivalent to determine the critical exponent of a representable matroid. One of the most interesting aspects of this problem is that the critical exponent is an analogue of the *chromatic number* of a graph. Another interesting aspect of this problem is that the critical exponent is corresponding to the *covering dimension* of a linear code over a finite field. This problem also has some applications to other research areas, for instance, the problem of correcting a black and white pixel image with respect to two possible corrected images, one light and one dark.
In this talk, we will introduce some historical prospects and some open problems related to this problem. In addition, we will show the combinatorial approaches including coding theory to these problems.

September 15th (Wed) Conference Room VIII

10:00–12:00

12 Iwao Sato (Oyama Nat. Coll. of Tech.) Z Grover/Zeta correspondence 15
Norio Konno (Yokohama Nat. Univ.)
Takashi Komatsu
(Math. Res. Inst. Calc for Industry/Hiroshima Univ.)

Summary: Recently the Ihara zeta function for the finite graph was extended to infinite one by Clair and Chinta et al. In this paper, we obtain the same expressions by a different approach from their analytical method. Our new approach is to take a suitable limit of a sequence of finite graphs via the Konno–Sato theorem. This theorem is related to explicit formulas of characteristic polynomials for the evolution matrix of the Grover walk. The walk is one of the most well-investigated quantum walks which are quantum counterpart of classical random walks. We call the relation between the Grover walk and the zeta function based on the Konno–Sato theorem "Grover/Zeta Correspondence" here.

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

Summary: Our previous work presented explicit formulas for the generalized zeta function and the generalized Ihara zeta function corresponding to the Grover walk and the positive- support version of the Grover walk on the regular graph via the Konno–Sato theorem, respectively. In this talk, extends these walks to a class of walks including random walks, correlated random walks, quantum walks, and open quantum random walks on the torus by the Fourier analysis.

Summary: We establish the index theorem for one-dimensional split-step quantum walks without assuming Fredholm properties. We employ the spectral shift function induced by the fourth-order difference operator with a rank one perturbation on the half-line. Under some conditions, the Witten index only depends on parameters of two-side limits. Especially, a half-integer index appears.

Summary: Tutte gave a constructive characterization of 3-connected graphs.
Theorem (Tutte's Wheel Theorem, 1961) Every 3-connected graph can be obtained from a wheel by repeated applications of edge addings and proper vertex-splittings.
In this talk we give a 4-connected analogue of Tutte's Wheel Theorem.

Summary: We consider the class of 2-connected cubic graphs having only k-cycles in each 2-factor, and obtain the following two results: (i) Every 2-connected cubic graph having only 8-cycles in each 2-factor is isomorphic to a unique Hamiltonian graph of order 8; and (ii) A 2-connected cubic planar graph G has only k-cycles in each 2-factor if and only if $k = 4$ and G is the complete graph of order 4.

Summary: We derive combinatorial necessary conditions for discrete-time quantum walks defined by regular mixed graphs to be periodic. If the quantum walk is periodic, all the eigenvalues of the time evolution matrices must be algebraic integers. Focusing on this, we explore which ring the coefficients of the characteristic polynomials should belong to. On the other hand, the coefficients of the characteristic polynomials of η-Hermitian adjacency matrices have combinatorial implications. From these, we can find combinatorial implications in the coefficients of the characteristic polynomials of the time evolution matrices, and thus derive combinatorial necessary conditions for mixed graphs to be periodic. For example, 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.

September 16th (Thu) Conference Room VIII

9:30–10:45

Summary: We consider a four-scroll attractor model proposed by Pehlivan. This model has chaotic attractor and several interesting structures. In this talk, this model has the Poisson structure, and it characterizes unbounded orbits.

19 Takashi Sakajo (Kyoto Univ.) Z Rotating and translating vortex sheet equilibria with endpoints 15
Bartosz Protas (McMaster Univ.)
Stefan Llewellyn Smith (UCSD)

Summary: The rotating and translating equilibria of open finite vortex sheets with endpoints in two-dimensional potential flows are considered. First, we show that they are linearly unstable. Moreover, while in the rotating case unstable perturbations grow exponentially fast in time, the growth of such perturbations in the translating case is algebraic. Second, we analyze equations describing the time evolution of a straight vortex sheet in linear external fields. Third, it is demonstrated that the results concerning the linear stability analysis of the rotating sheet are consistent with the infinite-aspect-ratio limit of the stability results known for Kirchhoff's ellipse.

20 Takashi Sakajo (Kyoto Univ.) Z Spot dynamics of a reaction-diffusion equation on the surface of a torus
Penghao Wang (Kyoto Univ.) 15

Summary: Quasi-stationary states consisting of localized spots in a reaction-diffusion system are considered when they are on the surface of a torus. Suppose that the localized spots persist stably. Then the evolution equation of the spot cores is derived analytically based on the higher-order matched asymptotic expansion with the analytic expression of the Green's function of the Laplace–Beltrami operator on the surface. The analytic representation yields equilibria with a single spot, two spots, and the ring configuration where N localized spots are equally spaced along a latitudinal line. The theoretical results and the linear stability of these spot equilibria are compared numerically by using the Brusselator reaction-diffusion model.

21 Koya Sakakibara Z Asymptotic behavior of solutions of the bidomain model 15
(Okayama Univ. of Sci.)
Mitsunori Nara (Iwate Univ.)
Hiroshi Matano (Meiji Univ.)
Yoichiro Mori (Univ. of Pennsylvania)

Summary: We study the asymptotic behavior of fronts and pulses of the bidomain model. We show that a zigzag-shaped solution appears as a Hopf bifurcation from an unstable front and confirm that the type of bifurcation depends on the parameters. In addition, for the pulse solution, we show that it either becomes a zigzag pulse or tears off and disappears.

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

Tomoo Yokoyama (Gifu Univ.)[Z] Topological flow analysis and its application

Summary: First, we review a relation between dynamical systems and topology and fundamental results in hyperbolic dynamical systems and Hamiltonian systems. Moreover, we recall classifications and existing topological invariants of dynamical systems. Especially, we discuss the finiteness and completeness of topological invariants of flows on surfaces. Second, we review the representability and implementability of topological invariants. We introduce a partially Cyclically Ordered rooted Tree (COT) representation of "generic" flows on compact surfaces, which is complete for flows of finite type on surfaces and implementable. Moreover, all generic transitions of generic Hamiltonian flows on compact surfaces can be described as abstract graphs, whose edges are generic transitions between pairs of generic Hamiltonian flows. Inaddition, we introduce several applications of topological invariants of flows to data. Third, to analyze dynamical systems directly, we introduce new topological invariants for flows and homeomorphisms, called abstract weak orbit spaces. In fact, the invariants are refinements of Morse graphs of flows on compact metric spaces, Reeb graphs of Hamiltonian flows with finitely many singular points on surfaces, and the CW decompositions which consist of the unstable manifolds of singular points for Morse flows on closed manifolds. Though the CW decomposition of a Morse flow is finite, the intersection of the unstable manifold and the stable manifold of closed orbits of a Morse–Smale flow need not consist of finitely many connected components. Therefore we show some kinds of the finiteness of Morse–Smale flows on compact manifolds. Moreover, we consider when the time-one map reconstructs the topology of the original flow. We show that the orbit space of a Hamiltonian flow with finitely many singular points on a compact surface is homeomorphic to the abstract weak orbit space of the time-one map by taking an arbitrarily small reparametrization and that the abstract weak orbit spaces of a Morse flow on a compact manifold and the time-one map are homeomorphic. In addition, we state several examples whose Morse graphs are singletons but whose abstract weak orbit spaces are not singletons. Finally, we discuss the application possibilities of the topological invariants.

14:25–15:35

22 Hirofumi Notsu (Kanazawa Univ.)[Z]
Débora O. Medeiros (Univ. of São Paulo)
Cassio M. Oishi (São Paulo State Univ.)
A second-order approximation in time of the upper-convected time derivative based on the generalized Lie derivative 15

Summary: A temporal second-order approximation is presented for dealing with the upper-convected time derivative based on the generalized Lie derivative. The upper-convected time derivative is usually encountered in the constitutive equation of the popular viscoelastic models and is reformulated in the framework of the generalized Lie derivative. For the temporal second-order approximation based on the framework, we prove the truncation error of second-order in time. Combining with the finite difference method, we also prove the final truncation errors of second-order in time and of first- or second-order in space. The theoretical results are observed in numerical experiments for model equations.

23 Shin-ichiro Ei (Hokkaido Univ.) Z
Hiroyuki Ochiai (Kyushu Univ.)
Yoshitaro Tanaka
(Future Univ.-Hakodate)
Method of fundamental solutions for Neumann problems of the modified Helmholtz equation in disk domains 15

Summary: The method of the fundamental solutions (MFS) is used to construct an approximate solution for a partial differential equation in a bounded domain. It is demonstrated by combining the fundamental solutions shifted to the points outside the domain. In this talk, the existence of the approximate solution by the MFS for the Neumann problems of the modified Helmholtz equation in disk domains is rigorously shown. We reveal the sufficient condition of the existence of the approximate solution. Moreover, using the energy method, we show the convergence of the approximate solution by the MFS to the exact solution with exponential order, that is, N^2a^N order, where a is a positive constant less than one and N is the number of collocation points.

24 Tatsuki Mori (Musashino Univ.) Z
Tohru Tsujikawa (Univ. of Miyazaki*)
Shoji Yotsutani (Ryukoku Univ.*)
Semi-analytical methods of obtaining bifurcation diagrams for a cell polarization model 15

Summary: We are interested in the global bifurcation structure of solutions for a nonlinear boundary value problem with nonlocal constraint that appears in a cell polarization model with mass conservation proposed by Y. Mori, A. Jilkine and L. Edelstein-Keshet (SIAM J. Appl. Math., 2011). We obtained primitive representation formulas of all solutions, and investigated a surface consisting of all bifurcation diagrams with heights. However, we could not find any parameterization of the surface. Recently, we have obtained parameterizations of the surface. In this talk, we propose new methods in view of them. By virtue of them, the speed of numerical computation becomes much faster and the approximate values obtained are going to be more accurate.

25 Yasushi Ota (St. Andrew's Univ.) Z
Shunsuke Kaji (Meijo Univ.)
Inverse parabolic problem with the Heaviside function arising in finance 15

Summary: The inverse problem arising in finance is both mathematically and practically interesting problem. First, we attempt to solve the inverse problem arising in binary option model. Using a standard linearization and contraction arguments, we prove the stability and uniqueness of the solution of the inverse problem which originates from the diffusion equation with the initial condition given by the Heaviside function. Second, we numerically identify the local volatilities from given artificial prices of the binary option. In accordance with theory we propose the effective identification around the at-the-money level.

15:50–16:50 Talk Invited by Applied Mathematics Section

Masakazu Akiyama (Meiji Univ.) Z A mathematical study on the left-right asymmetry of living organisms

Summary: I have been interested in the patterns and morphogenesis of living organisms and have continued my research. Especially recent 5 years, in some research projects, I am trying to explore the essence of phenomena while building mathematical models in collaboration with experimental researchers. This time, I will introduce a mathematical study on the left-right asymmetry of living organisms.
Like humans, flies have asymmetrical organ arrangements. In particular, some intestinal organs, called the hindgut, are known to form left-right asymmetry faster than any other organ, but the essential mechanism is unknown.
We constructed a 3D model of the hindgut with cells as the smallest unit. Then, the calculation simulation suggested that the twisting of cells may induce left-right asymmetry. In the talk, I would like to talk about the above details.

September 17th (Fri) Conference Room VIII

10:30–12:00

26 Hiroshi Kokubu (Kyoto Univ.) Z
Masato Hara (Kyoto Univ.)
Learning dynamics by reservoir computing: Case of the logistic maps 15

Summary: Reservoir computing is a kind of machine learning using recurrent neural networks. The learning of the reservoir computing is done only with the output weight vector, and hence the learning is very easy and cheap. In this talk we study the learning of the reservoir computing with a specific target dynamical system, namely the logistic maps, and exhibit several numerical results that suggest a mathematical mechanism for the success of the learning.

27 Hiroshi Kokubu (Kyoto Univ.) Z
Masato Hara (Kyoto Univ.)
Learning dynamics by reservoir computing: A mathematical framework 15

Summary: Reservoir computing is a kind of machine learning using recurrent neural networks. The learning of the reservoir computing is done only with the output weight vector, and hence the learning is very easy and cheap. In this talk, following the previous talk, we propose a mathematical framework that describes a mechanism explaining why the reservoir computing works well for learning dynamics, under some nice assumptions including the invertibility of the target dynamical system.

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

Summary: We study standing waves of reaction-diffusion equations on an infinite graph with two vertices. In particular, we reveal a relation between a number of standing waves and a length of one of edges. Furthermore, their stabilities are also studied by spectral analysis of linearized operators and comparison principles.

29 Masaji Watanabe (Okayama Univ.*) Z
Fusako Kawai (Okayama Univ.*)
Yukitaka Kimura (Okayama Univ.)
Mathematical study on biodegradation of synthetic polymer 15

Summary: This presentation focuses on mathematical study of biodegradation of synthetic polymers. Its outline includes description of mathematical model, illustration of numerical techniques, and presentation of numerical results.

30 Masaharu Nagayama (Hokkaido Univ.) Z
Minsoo Kim (Hokkaido Univ.)
Yasuaki Kobayashi (Hokkaido Univ.)
Satoshi Nakata (Hiroshima Univ.)
Shi-npei Tanaka (Hiroshima Univ.)
Mathematical modeling for the clustering phenomenon of self-propelled oil-droplets 15

Summary: We experimentally and numerically investigate collective behaviors of oil droplets floating on a surfactant solution in a narrow circular channel. In a closed environment where a glass cover is placed on the channel, it is shown that ethyl salicylate droplets on the surface of sodium dodecyl sulfate solution exhibit transient oscillatory dynamics, which leads to the formation of a single cluster via the merging of sub-clusters. To understand these experimental findings, we introduce a mathematical model that combines equations of motion for droplets with a reaction-diffusion system, where droplet dynamics and the chemical reactions are considered on the one-dimensional surface, and the diffusion of chemicals in the air phase and the water phase is treated in the two-dimensional region. We argue that the attractive long-range interaction due to the global concentration profile of the solution suffices for cluster formation.

Afternoon

31 Yoshitaka Watanabe (Kyushu Univ.)
Shuting Cai (Fujian Jiangxia Univ.)
Computer-assisted proofs of a symmetry-breaking bifurcation point for the Kolmogorov problem ····· *

Summary: We propose a computer-assisted method to prove the existence of a symmetry-breaking bifurcation point for the Kolmogorov problem. First, we numerically show that a symmetry-breaking bifurcation point exists. Then, according to the symmetric property, we define a symmetric operator. Using this operator, we divide the space into a symmetric space and an antisymmetric space. Then, considering the Reynolds number as a variable, we construct an extended system. We confirm the existence of the symmetry-breaking bifurcation point by computer-assisted proofs of the extended system that satisfies both conditions of a bifurcation theorem.

32 Koya Sakakibara (Okayama Univ. of Sci./RIKEN)
Yusaku Shimoji (Meiji Univ.)
Shigetoshi Yazaki (Meiji Univ.)
Numerical computations for magnetic Hele-Shaw problems by the method of fundamental solutions ····· *

Summary: Magnetic fluids in Hele-Shaw cells create intriguing patterns. We propose a simple numerical method for Hele-Shaw type problems by the method of fundamental solutions and apply the method for magnetic Hele-Shaw problems. The method of fundamental solutions is one of the mesh-free numerical solvers for potential problems, which provides a highly accurate approximate solution despite its simplicity. Moreover, combining with the asymptotic uniform distribution method, the numerical method satisfies the volume-preserving property. We use Amano's method to arrange the singular points in the method of fundamental solutions. We show several numerical results to exemplify the effectiveness of our numerical scheme.

33 Daisuke Koyama (Univ. of Electro-Comm.)
Estimates of the condition number of matrices arising in an interior penalty method for the biharmonic problem ····· *

Summary: An interior penalty (IP) method for the biharmonic problem is studied. In the method, the displacement and the stress are approximated by polynomials of degree less than or equal to k and $k-1$, respectively. In the case when $k=1$, an a priori error estimate for the stress of the IP method which is the same as that of the Herrmann–Johnson method is obtained by taking a penalty parameter of $O(1/h)$, where h is the mesh size parameter. Huang–Huang [J. Sci. Comput., **69** (2016), 1251–1278] insisted that the penalty parameter should be taken of $O(1/h^2)$ to get the error estimate as above. An estimate for the condition number of a matrix arising in the IP method is established. It implies that the condition number approaches to infinity as the penalty parameter approaches to infinity.

34 Takuya Tsuchiya (Hachinohe Inst. of Tech.)
Structure preserving numerical calculation of hyperbolic partial differential equations with finite element method ····· *

Summary: We perform numerical calculations of the hyperbolic partial differential equations. In addition, the discretized equations are created by the finite element method with structural preservation, and high-precision numerical simulations are performed. In this talk, we show the method of making discretization with structure preserving finite element method for the advection equations and the wave equations. Additionally, we will talk about the simulations of the Klein–Gordon equation using the structure preserving finite element method.

35 Shunsuke Kobayashi (Kyoto Univ./RIKEN)
Shigetoshi Yazaki (Meiji Univ.)
On the existence, uniqueness, and convergence of a Crank–Nicolson scheme for the Kuramoto–Sivashinsky equation defined on an expanding circle ∗

Summary: This talk will present a finite difference method with the Crank–Nicolson scheme of the Kuramoto–Sivashinsky equation defined on an expanding circle, and the existence, uniqueness, and second-order error estimate of the scheme. The equation can be obtained as a perturbation equation from the circle solution to an interface equation and can provide a guideline for understanding the wavenumber selection of solutions to the interface equation. Our proposed numerical scheme can help such a mathematical analysis.

36 Hirotada Honda (Toyo Univ.)
On partial differential equation-based neural network with additional parameters ∗

Summary: In a recent paper, we presented a neural network that is based on an initial-boundary value problem of partial differential equation. In this talk, we will present an extended version of our method that has additional parameters to be optimized. More concretely, we regard the diffusion coefficient and the terminal time as parameters as well. By considering the multi-class classification task, we shall reveal the explicit form of the Frechet derivative, that will be useful to find an updating algorithm of all parameters.

37 Yu Ichida (Meiji Univ.)
Traveling waves with singularities in a damped hyperbolic MEMS type equation in the presence of negative powers nonlinearity ∗

Summary: In this talk, we investigate how the existence of the traveling waves, their shapes, and asymptotic behavior change with the presence or absence of an inertial term in a damped hyperbolic MEMS type equation in the presence of negative powers nonlinearity. These are studied by applying the framework that combines Poincaré compactification, classical dynamical systems theory, and geometric methods for desingularization of vector fields. These allow us to classify all traveling waves and their properties since we know all the solution trajectories of the equations they satisfy, including those to infinity. We report that the presence of this term causes the shapes to change significantly for sufficiently large wave speed.

38 Jumpei Nagase (Shibaura Inst. of Tech.)
Aoi Honda (Kyushu Inst. of Tech.)
Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Constructing inclusion-exclusion integral neural networks with perceptrons ∗

Summary: In this research, we consider the correspondence between Möbius-type inclusion-exclusion integrals and neural networks. The inclusion-exclusion integral proposed by Honda et al. is a generalized integral for non-additive measures. It is known that the inclusion-exclusion integral can be interpreted as a kind of neural network, which has been actively applied in recent years, and its implementation has been discussed. In this research, we clarify the correspondence between the Schoke-type inclusion-exclusion integral and the ReLU perceptron, which has not been addressed in previous research.

39 Yoshikazu Yamagishi (Ryukoku Univ.)
Takamichi Sushida (Salesian Polytech.)
Jean-François Sadoc (Univ. Paris-Sud)
Area convergence of Voronoi cells on spiral lattices ∗

Summary: An Archimedean spiral lattice with a radial distance exponent α, is locally approximated by linear lattices. If the angle parameter is badly approximable, the area of the Voronoi cell converges if it is properly normalized with α.

Topology

September 14th (Tue) Conference Room IX

9:30–12:00

1 Yuta Nozaki (Hiroshima Univ.) Z On the kernel of the surgery map restricted to the 1-loop part ····· 15
Masatoshi Sato (Tokyo Denki Univ.)
Masaaki Suzuki (Meiji Univ.)

Summary: Every homology cylinder is obtained from Jacobi diagrams by clasper surgery. The surgery map $\mathfrak{s}\colon \mathcal{A}^c_n \to Y_n\mathcal{IC}_{g,1}/Y_{n+1}$ is surjective for $n \geq 2$, and its kernel is closely related to the symmetry of Jacobi diagrams. We determine the kernel of $\mathfrak{s}$ restricted to the 1-loop part after taking a certain quotient of the target. Also, we introduce refined versions of the AS and STU relations among claspers and study the abelian group $Y_n\mathcal{IC}_{g,1}/Y_{n+2}$ for $n \geq 2$.

2 Naoyuki Monden (Okayama Univ.) Z On minimal generating sets for the mapping class group of a punctured surface ····· 15

Summary: Let $\Sigma_{g,p}$ be an oriented surface of genus g with p marked points and no boundary components. We denote by $\mathcal{M}_{g,p}$ and $\mathcal{M}^{\pm}_{g,p}$ the mapping class group and the extended mapping class group of $\Sigma_{g,p}$, respectively. We show that $\mathcal{M}_{g,p}$ and $\mathcal{M}^{\pm}_{g,p}$ are generated by two elements for $g \geq 3$ and $p \geq 7$.

3 Erika Kuno (Osaka Univ.) Z The mapping class group of a nonorientable surface is quasi-isometrically embedded in the mapping class group of the orientation double cover I
Takuya Katayama (Gakushuin Univ.) ····· 10

Summary: Let N be a connected nonorientable surface with or without punctures, and $j\colon S \to N$ the orientation double covering. It has previously been proved that the orientation double covering j induces an injective homomorphism $\iota\colon \mathrm{Mod}(N) \hookrightarrow \mathrm{Mod}(S)$. We prove that this injective homomorphism ι is a quasi-isometric embedding. The key idea of our proof is the semihyperbolicity of the extended mapping class group $\mathrm{Mod}^{\pm}(S)$, which has already been established.

4 Takuya Katayama (Gakushuin Univ.) Z The mapping class group of a nonorientable surface is quasi-isometrically embedded in the mapping class group of the orientation double cover II
Erika Kuno (Osaka Univ.) ····· 15

Summary: Paris–Rolfsen and Stukow proved that, for any admissible subsurface F' of a compact surface F such that every component of $F - F'$ has negative Euler characteristic, the natural homomorphism between the mapping class groups is injective. In this talk, we prove that the injective homomorphism is a quasi-isometric embedding. This is a joint work with Erika Kuno.

5 Takuya Katayama (Gakushuin Univ.) Z Right-angled Artin groups and curve graphs of nonorientable surfaces I
Erika Kuno (Osaka Univ.) ····· 15

Summary: Koberda proved in 2012 that sufficiently high powers of Dehn twists about essential simple closed curves in an orientable surface generate a right-angled Artin group in the mapping class group of the surface. In this talk, we prove that the same holds for the mapping class groups of nonorientable surfaces. This is a joint work with Erika Kuno.

6 Erika Kuno (Osaka Univ.) Z
Takuya Katayama (Gakushuin Univ.)
Right-angled Artin groups and curve graphs of nonorientable surfaces II 10

Summary: Let N be a closed nonorientable surface with or without marked points. We prove that, for every finite full subgraph Γ of $\mathcal{C}^{\mathrm{two}}(N)$, the right-angled Artin group on Γ can be embedded in the mapping class group of N. Here, $\mathcal{C}^{\mathrm{two}}(N)$ is the subgraph, induced by essential two-sided simple closed curves in N, of the ordinal curve graph $\mathcal{C}(N)$. In addition, we show that there exists a finite graph Γ which is not a full subgraph of $\mathcal{C}^{\mathrm{two}}(N)$ for some N, but the right-angled Artin group on Γ can be embedded in the mapping class group of N. In this talk, we focus on the proof of the the latter result.

7 Shuhei Maruyama (Nagoya Univ.) Z
Morimichi Kawasaki (Aoyama Gakuin Univ.)
On the spaces of bounded characteristic classes and non-descendable quasimorphisms 15

Summary: Let G be a connected topological group and $\widetilde{G}$ the universal covering group. In this talk, we give an isomorphism between the spaces of bounded (universal) characteristic classes of foliated G-bundles and non-trivial homogeneous quasimorphisms on $\widetilde{G}$ which do not descend to G. As a corollary, we clarify the boundedness and unboundedness of specific characteristic classes of foliated symplectic and contact fibrations.

8 Koji Yamazaki (Tokyo Tech) Z
Fibration structure for Gromov h-principle 15

Summary: H-principle (or homotopy principle) is the property that some solutions to a partial differential equation/inequality can be obtained as a deformed of a formal solution by a homotopy. Gromov defines the *sheaf theoritic h-principle* in his book and shows the existence of h-principle from a very abstract setting. We clarify a categorical structure behind Gromov h-principle. The main result is that a *flexible sheaf* can be understood as a fibrant object in some categories.

14:25–15:25 Talk Invited by Topology Section

Naohiko Kasuya (Hokkaido Univ.) Z
Contact structure on the boundary of a strongly pseudoconcave complex surface

Summary: A. J. Di Scala, D. Zuddas and I constructed the first examples of non-Kähler complex structures on the 4-ball B^4. For our complex structure, the boundary of B^4 can be made to be strongly pseudoconcave and a negative overtwisted contact structure is induced on the boundary 3-sphere. Then, a natural question arises. "Which contact 3-manifold can be realized as the boundary of a strongly pseudoconcave complex surface?" In order to answer this question, we establish the method of holomorphic handle attaching to the strongly pseudoconcave boundary of a complex surface, based on Eliashberg's construction of Stein manifolds. As a consequence, we prove that every closed co-oriented contact 3-manifold can be filled as the boundary of a strongly pseudoconcave complex surface. This is a joint work with Daniele Zuddas.

15:50–16:45

9 Hiroki Okajima (Kochi Univ.) Z
A note on the Greek letter elements in the stable homotopy groups of spheres 10

Summary: The β-elements in the stable homotopy groups $\pi_*(S^0)$ of spheres are studied by many authors such as H. Toda, L. Smith and S. Oka. For the homotopy groups themselves, A. Yabe and K. Shimomura determined the stable homotopy groups of L_2-local spheres. H. R. Miller, D. C. Ravenel, W. S. Wilson and K. Shimomura studied products of β-elements in $\pi_*(L_2S^0)$. Here, L_2 is the Bousfield localization functor with respect to the Johnson–Wilson spectrum $E(2)$. Ravenel defined a beta element, which is not determined uniquely. We study these elements and show that the number of beta elements of the same name is at most two. We further consider $\pi_*(L_2S^0)$ as well as $\pi_*(S^0)$, and obtain some results on products of these.

Summary: In 1954, Capel showed that local connectedness is preserved under inverse limits with monotone bonding maps. And, in 2020, Espinoza and Matsuhashi showed that *n-aposyndesis*, *semi-aposyndesis*, *continuum-chainability*, $Wilder$, D, D^*, and *co-local connectedness* are also preserved under inverse limits with monotone bonding maps. On the other hand, in 2017, Kelly generalized Capel's theorem. In fact, he showed inverse limits with monotone set-valued bonding functions on $[0,1]$ are locally connected. In this talk, I will talk whether the results above by Espinoza and Matsuhashi are correct or not under inverse limits with monotone set-valued bonding functions.

Summary: I shall report how the group cohomology calculation, which is familiar to topologists, allow us to give counter examples of finite groups to the upgraded Noether's program from the view point of lower rationality = higher ruledness

September 15th (Wed) Conference Room IX

10:10–10:20 Announcement of the 2021 MSJ Geometry Prize

10:35–11:35 Award Lecture for the 2021 MSJ Geometry Prize

Nariya Kawazumi (Univ. of Tokyo) Z In search of the Lie algebra of the mapping class group
Yusuke Kuno (Tsuda Coll.)

Summary: Given an oriented surface, one can consider the associated graded Lie algebra of the filtration of its mapping class group that is defined by the lower central series of the fundamental group of the surface. The Johnson homomorphism is an injective graded Lie homomorphism from this Lie algebra to the Lie algebra of symplectic derivations. In this talk, we explain a geometric approach to the Johnson homomorphism using the Goldman–Turaev Lie bialgebra of the surface. In particular, we show that the Kashiwara–Vergne problem, which originates in Lie theory, is equivalent to the problem of finding Magnus expansions of the fundamental group of the surface which are compatible with the structure of the Goldman–Turaev Lie bialgebra. We will also mention several infinitesimal approaches to topology of the mapping class group.

13:15–14:15 Award Lecture for the 2021 MSJ Geometry Prize

Jun Murakami (Waseda Univ.) Z The Jones polynomial and its applications

Summary: The Jones polynomial is the foundation of the quantum topology of low-dimensional manifolds. The Jones polynomial is related to the quantum group $\mathcal{U}_q(sl_2)$, and is extended to the colored Jones polynomial and the Witten–Reshetikhin–Turaev invariant of three manifolds, and various quantum invariants. Based on Kashaev's observation that certain quantum invariant of knots relates to the hyperbolic volume of the knot complement, the volume conjecture is proposed. This conjecture predicts a relation between the colored Jones polynomial of a knot and the volume of the knot complement. On the other hand, the Jones algebra is generalized to the Kauffman bracket skein algebra, which is expected to be a good tool to quantize some classical geometric theory.
In this talk, I would like to explain the representation theoretical aspect of the Jones polynomial, the volume conjecture and its application, and an application of the skein algebra to the $SL(2,\mathbb{C})$ character variety of a knot.

September 16th (Thu) Conference Room IX

9:30–12:00

12 Naoki Kitazawa (Kyushu Univ.) [Z] On special generic maps and Massey products of manifolds 15

Summary: Special generic maps are higher dimensional variants of Morse functions with exactly two singular points on homotopy spheres, playing important roles in so-called Reeb's theorem. This class has been attractive, posing restrictions on the topologies and the differentiable structures of the manifolds. This talk concerns new restrictions: restrictions on triple Massey products of manifolds admitting such maps.

13 Kentaro Saji (Kobe Univ.) [Z]
Samuel Paulino Santos (São Paulo State Univ.)
Geometry of bifurcation sets of generic unfoldings of corank two functions 10

Summary: In this talk, we deal with the bifurcation sets of generic unfoldings of corank two functions. Taking blow-ups, we show each of the bifurcation sets of such functions admits a parametrization as a surface in the Euclidean three space. Using this parametrization, the behavior of the Gaussian curvature and the principal curvatures and their zero sets will be presented.

14 Ippei Ishii [Z]
Masaharu Ishikawa (Keio Univ.)
Yuya Koda (Hiroshima Univ.)
Hironobu Naoe (Chuo Univ.)
Positive flow-spines and contact 3-manifolds 15

Summary: We study a relationship between flow-spines and contact structures. A contact structure ξ on a 3-manifold is said to be supported by a flow-spine P if ξ has a contact form whose Reeb flow is a flow of P. In this talk, we introduce the positivity of flow-spines and define a map from the set of positive flow-spines to the set of contact 3-manifolds by associating to a positive flow-spine P a contact structure supported by P. More specifically, we show that (i) any positive flow-spine supports a contact structure, (ii) two contact structures supported by the same positive flow-spine are contactomorphic, and (iii) any contact structure is supported by a positive flow-spine.

15 Ramón Barral Lijó (Ritsumeikan Univ.) [Z]
Hiraku Nozawa (Ritsumeikan Univ.)
Inverse symbolic coding of geodesics in hyperbolic surfaces 15

Summary: The cut-and-project method has been a fruitful tool to obtain interesting examples of aperiodic tilings and Delone sets (e.g., the Fibonacci tiling). This technique can be adapted to the hyperbolic setting in order to obtain examples that exhibit chaotic behaviour. We show how this can be regarded as a sort of inverse symbolic coding of the geodesic flow in a hyperbolic surface. We also present a computation of some numerical dynamical invariants.

16 Ramón Barral Lijó (Ritsumeikan Univ.) [Z]
Hiraku Nozawa (Ritsumeikan Univ.)
Chaos in the universal space of pointed colored graphs 15

Summary: In this talk we will adapt Devaney's definition of chaos to the Gromov space of isomorphism classes of pointed colored graphs. This setting can be regarded as a generalization of both symbolic dynamics and laminations by graphs. Finally, we prove that being chaotic is a generic conditions in several subspaces of the Gromov space.

17 Tetsuya Abe (Ritsumeikan Univ.) [Z] The construction of slice knots and amphicheiral knots via annulus twists 15

Summary: We will introduce the construction of slice knots and amphicheiral knots via annulus twists.

Summary: The boundary sum of the product of a circle with a 3-ball and the product of a disk with a 2-sphere is called a pochette. For a pochette P embedded in a 4-manifold M, a pochette surgery on M is the operation of removing the interior of P and gluing in P by a diffeomorphism of the boundary of P. Pochette surgery is a generalization of the well-known Gluck surgery. In this talk, we construct various homotopy 4-spheres by applying pochette surgeries on the 4-sphere, and prove that some of them are diffeomorphic to the 4-sphere by Kirby calculus.

Summary: A divide is the image of a generic immersions of a finite number of closed interval and circles into unit disk which is introduced by A'Campo. In this talk, we introduce the notion of the divide with cusps which is a generalization of the divide. We also discuss that the link obtained from the divide with cusps is used to describe the Kirby diagram of the complement of a complexified real line arrangement.

Summary: A multibranched handlebody decomposition is a decomposition of a 3-manifolds with some handlebodies so that the union of the intersections of handlebodies is a multibranched surface. Heegaard splitting admits an operation called stabilization and it is unique up to stabilization and isotopy for any 3-manifolds. We consider the case of multibranched handlebody decomposition. We introduce some stabilizations and a move of multibranched handlebody decomposition and show the stably equivalence of a multibranched handlebody decomposition.

Summary: Special generic maps are higher dimensional variants of Morse functions with exactly two singular points on homotopy spheres, playing important roles in so-called Reeb's theorem. This class has been attractive, posing restrictions on the topologies and the differentiable structures of the manifolds. This talk concerns applications of known restrictions to know dimensions of Euclidean spaces into which closed and simply-connected manifolds of suitable classes admit.

Summary: For any classical knot k^1, we can construct a ribbon 2-knot $spun(k^1)$ by spinning an arc removed a small segment from k^1 about $\mathbf{R^2}$ in $\mathbf{R^4}$. A ribbon 2-knot is an embedded 2-sphere in $\mathbf{R^4}$. $Spun(k^1)$ is the 2-knot called a ribbon 2-knot. If k^1 has an n-crossing presentation, by spinning this, we can naturally construct a ribbon presentation with n ribbon crossings for $spun(k^1)$. Thus, we can define naturally a notion on ribbon 2-knots corresponding to the crossing number on classical knots. It is called the ribbon crossing number. On classical knots, it was a long-standing conjecture that any odd crossing classical knot is not amphicheiral. We show that for any odd integer n there exists an amphicheiral ribbon 2-knot with the ribbon crossing number n.

14:25–15:25 Talk Invited by Topology Section

Yasushi Yamashita (Nara Women's Univ.) Z Computer experiments on Möbius transformations and random Kleinian groups

Summary: Computer experiment has been an important method in studying hyperbolic 3-manifolds. The set of all Möbius transformations form a group called the Möbius group. It is isomorphic to the group of orientation-preserving isometries of hyperbolic 3-space. A Kleinian group is a discrete subgroup of the Möbius group. If a Kleinian group has no nontrivial torsion elements, it is the fundamental group of a hyperbolic 3-manifold.
In this talk, we describe some basic computational methods to study the Möbius group. As an application, we consider geometrically natural probability measures on the Möbius group, and study "random" subgroups of Möbius groups. By computational investigation, we give estimates of the probability that a group generated by a pair of random parabolic transformations is discrete.
A part of this talk is joint work with G. Martin and G. O'Brien.

15:50–16:50

23 Sonia Mahmoudi (Tohoku Univ.) Z Study of weaves using weaving diagrams 15

Summary: The author presents a new way of defining and studying Euclidean and hyperbolic periodic weaving diagrams, from the point of view of low dimensional topology. A systematic method of constructing weaving diagrams from polygonal tessellations will be introduced. Then, since the number of crossings in particular is a suitable concept for studying and classifying such entangled structures, we can use knot theory to better understand their topology. Therefore, the Tait First and Second conjectures are extended to reduced alternating weaving diagrams of minimal size, embedded on higher genus surfaces.

24 Taketo Sano (Univ. of Tokyo) Z A Bar-Natan homotopy type 15

Summary: Following Lipshitz–Sarkar's construction of Khovanov homotopy type, we construct for any link diagram L a CW spectrum $\mathcal{X}_{BN}(L)$ whose reduced cellular cochain complex gives the Bar-Natan complex of L. We prove that $\mathcal{X}_{BN}(L)$ is stably homotopy equivalent to the wedge sum of its canonical cells.

25 Takefumi Nosaka (Tokyo Tech) Z Meta-nilpotent knot invariants and symplectic automorphism groups of free nilpotent groups 15

Summary: We develop nilpotently p-localization of knot groups in terms of (symplectic) automorphism groups of free nilpotent groups. We show that any map from the set of conjugacy classes of the outer automorphism groups yields a knot invariant. We also investigate the automorphism groups and compute the resulting knot invariants.

26 Kazuhiro Ichihara (Nihon Univ.), Toshio Saito (Joetsu Univ. of Edu.) Knots in homology lens spaces determined by their complements ..... *

Summary: A knot K in an oriented closed 3-manifold M is said to be *determined by its complement* if the complement $M - K$ is not orientation-preservingly homeomorphic to the complement of any knot in M unless it is orientation-preservingly equivalent to K. The *Oriented Knot Complement Conjecture* states that any knot in an oriented closed 3-manifold would be determined by its complement. We give supporting evidence to the conjecture when M is a homology lens space and K is not null-homologous in M with additional conditions.

27 Ryoto Tange (Waseda Univ.) Liminal representations and odd cyclic branched coverings of the figure-eight knot ..... *

Summary: We see a relation between liminal representations and odd cyclic branched coverings of the figure-eight knot.

Infinite Analysis

September 14th (Tue) Conference Room I

10:00–12:00

1 Tomohiro Sasamoto (Tokyo Tech) Z *q*-Whittaker function and free fermion at finite temperature 15
Takashi Imamura (Chiba Univ.)
Matteo Mucciconi (Univ. Warwick)

Summary: It is known that Cauchy sums for the q-Whittaker and the skew Schur polynomials produce the same factorized expressions modulo a q-Pochhammer symbol. We consider the sums with restrictions on the length of the first rows for both polynomials and prove an identity which relates them. The sum for the q-Whittaker side is related to the models in the Kardar–Parisi–Zhang(KPZ) class while the sum for the skew Schur side is related to a free fermion at finite temperature. We will give a bijective proof of the identity. This gives a direct connection between KPZ models and a free fermion at finite temperature.

2 Genki Shibukawa (Kobe Univ.) Z An explicit formula of powers of 2×2 quantum matrices 15

Summary: We derive an explicit formula for the n-th power of a 2 by 2 quantum matrix in terms of the Chebyshev polynomials of the second kind. As an application, we give another proof of some relations of entries of powers for 2 by 2 quantum matrices.

3 Akihito Yoneyama (Univ. of Tokyo) Z 3D reflection maps from tetrahedron maps 15

Summary: In this talk, we present a method for obtaining set-theoretical solutions to the 3D reflection equation by using known ones to the Zamolodchikov tetrahedron equation, where the former equation was proposed by Isaev and Kulish as a boundary analog of the latter. By applying our method to Sergeev's electrical solution and a two-component solution associated with the discrete modified KP equation, we obtain new solutions to the 3D reflection equation. Our approach is closely related to a relation between the transition maps of Lusztig's parametrizations of the totally positive part of SL_3 and SO_5, which is obtained via folding the Dynkin diagram of A_3 into one of B_2.

4 Takeo Kojima (Yamagata Univ.) Z Quadratic relations of the deformed W-superalgebra $\mathcal{W}_{q,t}\big(A(M,N)\big)$ 15

Summary: We find the free field construction of the basic W-current and screening currents for the deformed W-superalgebra $\mathcal{W}_{q,t}\big(A(M,N)\big)$ associated with Lie superalgebra of type $A(M,N)$.Using this free field construction,we introduce the higher W-currents and obtain a closed set of quadratic relations among them.These relations are independent of the choice of Dynkin diagrams for the Lie superalgebra $A(M,N)$, though the screening currents are not. This allows us to define $\mathcal{W}_{q,t}\big(A(M,N)\big)$ by generators and relations.

5 Hiroyuki Yamane (Univ. of Toyama) Z Hamiltonian circuits of Cayley graphs of Weyl groupoids of generalized quantum groups 15

Summary: We show an existence of Hamiltonian circuits of Cayley graphs of Weyl groupoids of generalized quantum groups. We exactly draw them for rank three and four cases.

6 Yusuke Ohkubo (Daiichi Univ. of Pharm.)
Jun'ichi Shiraishi (Univ. of Tokyo)
Ayumu Hoshino (Hiroshima Inst. of Tech.)
Z Explicit formula for the q-Toda function of type B 15

Summary: The q-Toda system has been studied in the connection with representation theory of the quantum groups. In this talk, we give the explicit formula for the asymptotically free eigenfunctions of the q-Toda operator of type B. This formula can be regarded as a branching formula from the q-Toda function of type B restricted to the q-Toda functions of type A. The proof is given by a contiguous relation of the q-Toda functions of type A and a recursion relation of the branching coefficients.

7 Masaru Sugawara (Tohoku Univ.) Z The product formulas for universal R-matrices of quantum affine enveloping algebras of type $A_3^{(1)}$, $D_4^{(1)}$ and quantum dilogarithm identities 15

Summary: Dimofte, Gukov, Soibelman discovered remarkable identities for quantum dilogarithm on a non-commutative algebra as wall-crossing formulas in the physics context. On the other hand, K. Ito constructed the product formula for the universal R-matrix of affine quantum enveloping algebra $U_q(\mathfrak{g})$, which is associated with convex orders on affine root system. In our previous study, we showed that explicitly computing the appropriate product presentation of universal R-matrix of $U_q(\widehat{\mathfrak{sl}_3})$ yields one of the identity. In this talk, we report that investigating the higher rank case when $\mathfrak{g}$ is of type $A_3^{(1)}$ and $D_4^{(1)}$ enables us to derive the other identities algebraically, for which no mathematical proofs were known.

8 Masaki Kato (Toyama Nat. Coll. of Tech.) Sums of two-parameter deformations of multiple polylogarithms ..... *

Summary: In this talk, we introduce a generating function of sums of two-parameter deformations of multiple polylogarithms, denoted by $\Phi_2(a;p,q)$, and study a q-difference equation satisfied by it. We show that this q-difference equation can be solved by expanding $\Phi_2(a;p,q)$ into power series of the parameter p and then using the method of variation of constants. By letting $p \to 0$ in the main theorem, we find that the generating function of sums of q-interpolated multiple zeta values can be written in terms of the q-hypergeometric function ${}_3\phi_2$, which is due to Li–Wakabayashi.

9 Takashi Imoto (Nat. Inst. of Adv. Industrial Sci. and Tech.)
Tetsuo Deguchi (Ochanomizu Univ.)
Regularization of the singular solution for the XXX spin chain using twisted boundary condition ..... *

Summary: Bethe ansatz is a method for obtaining all eigenstates of the XXX spin chain. It is known that in order to construction Bethe vectors to satisfy completeness under the periodic boundary condition, it is necessary to add a singular solution where both sides of Bethe ansatz equation diverge in addition to the general solution. The energy corresponding to a singular solution can be obtained by using regularization method. On the other hand, the existing regularization method have difficulty in calculating the norm and so on. In our talk, we propose a new method of regularization using twisted boundary conditions.

10 Youichi Shibukawa (Hokkaido Univ.)
Yudai Otsuto (Hokkaido Univ.)
FRT construction of Hopf algebroids ..... *

Summary: For arbitrary algebras L, Hopf algebroids with base rings L are constructed by means of suitable elements of L.

14:25–15:25 Talk Invited by Infinite Analysis Special Session

Hironori Oya (Shibaura Inst. of Tech.)[Z] Twist maps and their applications

Summary: In the mid-1990s, Berenstein, Fomin, and Zelevinsky introduced a specific biregular automorphism on a unipotent/double Bruhat cell for the study of totally positive elements. Their automorphism is called a twist automorphism, and it plays the essential role in the Chamber Ansatz formula, which leads to total positivity criteria.
Interestingly, the twist automorphism appears in various situations besides the study of total positivity. It might look a technical tool, but it is very useful in many places as a duality-like operation, and it is actually interpreted as a categorical operation via categorification. In this talk, I would like to explain several applications of the twist automorphism in our recent research. The topics include automorphisms on certain cluster varieties, Newton–Okounkov polytopes of Schubert varieties, and the representation theory of quantum loop algebras.

September 15th (Wed) Conference Room I

10:00–11:00

11 Takao Suzuki (Kinki Univ.)[Z] A Lax formulation of a generalized q-Garnier system ····· 15

Summary: Recently, a birational representation of an extended affine Weyl group of type $A^{(1)}_{mn-1} \times A^{(1)}_{m-1} \times A^{(1)}_{m-1}$ was proposed with the aid of a cluster mutation. In this talk we formulate this representation in a flamework of a system of q-difference equations with $mn \times mn$ matrices. This formulation is called a Lax form and is used to derive a generalization of the q-Garnier system.

12 Shota Shigetomi (Kyushu Univ.)[Z] Explicit formulas of curves with constant torsion and discrete curves
Kenji Kajiwara (Kyushu Univ.) with constant torsion angle ····· 15

Summary: We construct explicit formulas of curves with constant torsion and discrete curves with constant torsion angle in terms of elliptic theta function.

13 Masashi Hamanaka (Nagoya Univ.)[Z] Multi-soliton dynamics of anti-self-dual gauge fields ····· 15
Shan-Chi Huang (Nagoya Univ.)

Summary: We study dynamics of multi-soliton solutions of anti-self-dual Yang–Mills equations for G=SL(2,C) in four dimensional real spaces with signatures of the Euclidean, the Minkowski, and the Ultrahyperbolic. The one-soliton solution has its principal peak of action density on a three-dimensional hyperplane in four dimensional space. We call it the soliton wall. We prove that in the asymptotic region, the n-soliton solution actually describes nonlinear superposition of n soliton walls with phase shifts. We calculate the phase shift factors explicitly and find that the action densities can be real-valued in the asymptotic region. Furthermore, we show that the gauge group can be G=U(2) in the Ultrahyperbolic signature. It is remarkable that quasideterminants play important roles in calculations and proofs.

14 Nobutaka Nakazono Special solutions to the multiplicative type discrete KdV equation ···· ∗
(Tokyo Univ. of Agri. and Tech.)

Summary: In 1977, Hirota found the autonomous 2-dimensional difference-difference equation, which is a discrete analogue of the Korteweg–de Vries (KdV) equation. In this talk, we show that its multiplicative versions have special solutions expressed in terms of solutions of the discrete Painlevé equations of $A^{(1)}_3$-, $A^{(1)}_4$-, $A^{(1)}_5$- and $A^{(1)}_6$-type.

11:15–12:15 Talk Invited by Infinite Analysis Special Session

Satoshi Tsujimoto (Kyoto Univ.)[Z] The rational Heun operator and Wilson biorthogonal rational functions

Summary: First, we introduce the bispectral property in classical orthogonal polynomials, and then show that various extensions of the Heun operator can be obtained from the polynomial degree-raising property. After that, we consider the rational Heun operator defined as the most general second-order q-difference operator which sends any rational function of type [(n-1)/n] to a rational function of type [n/(n+1)]. Then the Wilson biorthogonal rational functions will be shown to be solutions to a generalized eigenvalue problem involving rational Heun operators of the "classical" kind. The correspondence with this operator and the one-dimensional degeneration of the Ruijsenaars–van Diejen Hamiltonians will also be discussed.