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The Mathematical Society of Japan

2020 Annual Meeting

Titles and Short Summaries of the Talks

March, 2020

at Nihon University

2020 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 16th (Mon)–19th (Thu), 2020

Venue: Surugadai Campus, Nihon University
1-8-14 Kandasurugadai, Chiyoda-ku
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Plenary Talks

March 17th (Tue) CST Hall, 6F, Bldg. No. 1

The 2020 MSJ Spring Prize

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

Shigeru Mukai (Kyoto Univ.) Algebraic varieties and their symmetry with emphasis on K3 surfaces and their companions ..... (16:45–17:45)

Summary: There are many phenomena where algebraic geometry and group theory interplay. Algebraic varieties often have apparent or hidden symmetry such as the Schlafli configuration of 27 lines on a cubic surface or ADE-type degeneration of elliptic curves. In 80s I classified finite groups acting symplectically on a K3 surface, in terms of the Mathieu group M24, one of the 26 sporadic finite simple groups. In 90s Kondo determined the (infinite) automorphism group of generic Jacobian Kummer surfaces using the Higman–Sims(or Menser) graph. Besides these topics, I will also discuss recent results on the decomposition groups of certain plane curves and a conjecture on the virtual cohomological dimension of the automorphism groups if time permits.

Featured Invited Talks

March 16th (Mon)

Conference Room V

Takashi Horiyama (Hokkaido Univ.) Folding and unfolding of polyhedra · (13:00–14:00)

Summary: A development of a polyhedron is a simple polygon obtained by cutting the surface of the polyhedron and unfolding it into a plane. In this talk, we focus on the problems related to the following two big issues:
(1) Does every convex polyhedron have a nonoverlapping development?
(2) Are there any common developments for two (or more) polyhedra?

Conference Room IX

Hiroshi Fujita (Ehime Univ.) Transfinite ordinals and the continuum problem · · · · · · · · · · (13:00–14:00)

Summary: We will explain how Georg Cantor introduced transifinite ordinals into mathematics. From this point of view, we also explain Cantor's continuum problem. The problem can be understood as the question asking how the continuum is well-ordered. We review some known results about definable well-ordering of the continuum.

March 18th (Wed)

Conference Room I

Ryoko Oishi-Tomiyasu (Kyushu Univ.) Lattice problems in mathematical crystallography · · · · · · · · (13:00–14:00)

Summary: The concept of lattices was originally introduced and studied by August Bravais in botany and crystallography. Nowadays, lattice problems are also studied for lattice-based crystallography, an important candidate for post-quantum cryptography. In such application, to what extent can abstract results in pure mathematics be useful? Starting from the pioneer works of Bravais, I'd explain about several problems in modern crystallography and examples for actual use of number theory I have obtained so far.

Conference Room II

Katsuhiko Kuribayashi (Shinshu Univ.) Derived string topology —Toward a two dimensional open-closed topological quantum field theory for classifying spaces— · (13:00–14:00)

Summary: String topology introduced by Chas and Sullivan gives fruitful structures to the loop homology of orientable closed manifolds, more general Gorenstein spaces whose class contains Poincaré duality space, classifying spaces and Borel constructions. In particular, a result due to Chataur and Menichi asserts that the loop homology of the classifying space of a Lie group is endowed with the structure of a two dimensional topological quantum field theory (TQFT). Guldberg has proved that such a structure is generalized to that of a labeled open-closed TQFT. However, there are few calculations of labeled cobordism operations in the theory. In this talk, after recalling the original string topology and derived one due to Félix and Thomas, we survey computations of string operations for the classifying space of a Lie group. Moreover, we consider the non-triviality of the whistle cobordism operation with a label in the set of maximal rank subgroups of the given Lie group. It turns out that the open TQFT and closed one are not separated in general. A part of this talk is based on joint work with Luc Menichi and Takahito Naito.

March 19th (Thu)

Conference Room III

Masatoshi Noumi (Kobe Univ.) Expanse of hypergeometric functions · · · · · · · · · · · · · · · · · · (13:00–14:00)

Summary: I will give an overview of various topics related to hypergeometric functions, and discuss the present status and possible future directions in the study of special functions.

Conference Room V

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Shigenori Uchiyama (Tokyo Metro. Univ.) Recent topics in post-quantum cryptography ..... (13:00–14:00)

Summary: In recent years, research on public key cryptosystems, which are expected to be secure against attacks using quantum computers called post-quantum cryptography (PQC), has been actively conducted. In this talk, I am going to talk about an overview of the recent research in post-quantum cryptography.

Conference Room VIII

Kazuo Kobayasi (Waseda Univ.) A kinetic approach to stochastic partial differential equations ..... (13:00–14:00)

Summary: We study some stochastic partial differential equations, in particular stochastic scalar conservation laws on a bounded domain. We see that these equations appear in the hydrodynamical limit of a stochastic kinetic equation where the interactions in velocity are modelled by a nonlinear operator (Bhatnager–Gross–Krook) or a linear operator (Linear Boltzmann or Fokker–Planck). Moreover we drive a stochastic kinetic equation from the stochastic differential equation called the Langevin equation: Consider the motion of a particle with the position X(t) and the velocity V(t). We assume that (X(t),V(t)) satisfies the Langevin equation which is interpreted as Newton's second law of motion applied to the position X(t). Then the stochastic kinetic equation is satisfied with the density function f(t,x,v), with respect to the Lebesgue measure dxdv, of the conditional law of (X(t),V(t)). Finally we treat the stochastic scalar conservation laws obtained above. We discuss them on a bounded domain. First, we consider a more general equation, that is a quasilinear degenerate parabolic stochastic partial differential equation with a multiplicative noise on the N-dimensional torus. We propose to construct a sequence of approximations by applying a time splitting method and prove that this converges to a kinetic solution. Secondarilly, we discuss a stochastic scalar conservation law with non-homogeneous Dirichlet boundary condition. By introduction a notion of renormalized kinetic solutions in which the kinetic defect measures on the boundary of a domain are truncated, we establish a result of well-posedness of renormalized kinetic solutions.

Foundation of Mathematics and History of Mathematics

March 16th (Mon) Conference Room IX

9:30–12:00

1 Teruyuki Yorioka (Shizuoka Univ.) YPFA implies MRP 15
Tadatoshi Miyamoto (Nanzan Univ.)

Summary: It is proved that YPFA implies MRP.

2 Daisuke Ikegami (Shibaura Inst. of Tech.) Generic absoluteness in ZF 15

Summary: By the discovery of forcing by Cohen, in ZFC, one can show that there is a partial order which forces the Continuum Hypothesis (CH) while there is a partial order which forces the negation of CH. What if we do not assume the axiom of choice and work in ZF? Can we still find such a statement as CH? Note that the formulation of CH and the arguments to force CH heavily depend on the axiom of choice.
In this talk, we show that in ZF, one can find a statement ϕ such that there is a partial order which forces ϕ while there is a partial order which forces the negation of ϕ.
This is joint work with Philipp Schlicht and W. Hugh Woodin.

3 Toshimichi Usuba (Waseda Univ.) On generically extendible cardinals 15

Summary: We study generically extedible cardinals. We show that the consistency strength of the generic extendability of ω_1 is weak, but ω_3 is not.

4 Diego A. Mejía (Shizuoka Univ.) Lebesgue measure zero modulo ideals 15

Summary: Lebesgue measure zero subsets of the real line can be characterized, in a combinatorial way, through the ideal Fin of finite subsets of the natural numbers. But, what happens if we consider this combinatorial statement through an arbitrary idea on the natural numbers, instead of the ideal Fin? We present a dichotomy deciding whether this new property characterizes Lebesgue measure zero or not, and show the connections of this property with Baire category and with the sigma ideal generated by closed measure zero sets. This is a joint work with Viera Sottova.

5 Kenetsu Fujita (Gunma Univ.) George Boolos' "The Hardest Logic Puzzle Ever" revisited 15

Summary: Following R. Smullyan, G. Boolos posed the puzzle "The Hardest Logic Puzzle Ever" (1996), and provided an answer in the form of "iff". After that, Roberts (2001) and Rabern–Rabern (2008) showed a simple solution to the puzzle by using the embedded question lemma. We introduce a formalization of such Knights and Knaves puzzles in term of propositional logic, and observe that the two answers by Boolos and Roberts–Rabern are essentially logically equivalent. This elegant method can be applied to an analysis of the puzzle in the fantasy film Labyrinth as well.

6 Takahiro Seki (Niigata Univ.) A Gentzen-style formulation for involutive substructural logics with contraposition 15

Summary: Involutivity, called double-negation axiom in classical logic, is one of the important additional axioms to intuitionistic substructural logics. In this talk, we consider a Gentzen-style formulation for some involutive non-associative substructural logics and show the cut elimination theorem. The logics in our formulation include contraposition axiom, regarded as a restricted associativity.

Summary: By incorporating the Jónsson–Tarski Theorem with the Rasiowa–Sikorski Lemma, Tanaka–Ono gives an embedding which preserves countably many infinitary meets and joins, from every modal algebra which satisfies certain conditions including a weaker form of complete additivity into the complex algebra of a subframe of the prime filter Kripke frame. In this talk, we give another representation for modal algebras without assuming complete additivity. We show that for every modal algebra, there exists an embedding preserving countably many infinitary meets and joins into the complex algebra of a subframe of the prime filter neighborhood frame.

Summary: A sentence φ is said to be Γ-conservative over T if for every Γ sentence θ, if $T + \varphi \vdash \theta$, then $T \vdash \theta$. For $\Gamma = \Sigma_n$ (resp. Π_n), let $\Gamma^d = \Pi_n$ (resp. Σ_n). In 1979, Guaspari asked that for any reasonable sequence $\{T_i\}_{i\in\omega}$ of theories, whether there is a Γ^d sentence which is simultaneously independent and Γ-conservative over each T_i. For two theories, this problem was investigated by Bennet. He completely characterized the existence of simultaneously independent and Σ_n-conservative Π_n sentences over two theories.
We generalized Bennet's results to the case of theories more than two.

14:15–15:00

Summary: Legendre issues Traite des fonctions elliptiques et des *integrales euleriennes*, in 1825. In this books 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) and proposes that some functions are explained with the arcs of circle and of the logarithms. (§60, *etc.*)

Summary: In 1825, Legendre defines as the most important function among his elliptic functions, the complete function (=c.f.) F^1, E^1, Π^1. Afterward in modern times, these functions are newly expressed with K, E and Π such as in the study of a quantum mechanics, where it shows as $F^1 = K$. We call E and Π c.f.s of newly defined versions, then $E = E^1$, $\Pi = \Pi^1$. Legendre uses the c.f. in variously applied arena, such as Geometry, Mechanics, Construction of the Tables, Eulerian Integrals, etc. We discuss the c.f. as the original by Legendre, his objects, effects, and so on.

Summary: The year 2022 has various meaning for mathematics, mathematical history and mathematical education: the 314th year after his death of SEKI Takakazu (?–1708), the 400th year after the publication of Division-Instruction (Wariznsyo), the 300th anniversary of TAKEBE Katahiro's Tetsujjutsu-Sankei, and so on. We describe research problems towards the year.

15:15–16:15 Talk Invited by Section on Foundation and History of Mathematics

Masahito Takase Shaping the fountains in Modern Western Mathematics

Summary: There are several impressive fountains in the history of the mathematics on which Modern Western Mathematics is founded as follows: Descartes's method of normals, Fermat's method of tangents, Fermat's number theory, Leibniz's analysis of the infinity, Johann Bernoulli's beautiful formula $\frac{\log\sqrt{-1}}{\sqrt{-1}} = \frac{\pi}{2}$, Euler's observation on dividing 0 by 0, Euer's discovery of the concept of function, Gauss' idea of transfering number theory from rational integers to Gaussian integers, The concept of an Abelian equation discovered by Abel, Kronecker's "Jugendtraum", Kummer's idea of ideal prime factors, Jacobi's inverse problem of Abelian integrals invented by Jacobi, Riemann's idea of Riemann surfaces, Hartogs' inverse problem invented by K. Oka.
I will explain the significances of returning to the fountains and make a critical observation on comtemporary mathematics.

March 17th (Tue) Conference Room IX

9:00–10:30

12 Kohtaro Tadaki (Chubu Univ.) A refinement of quantum information theory by algorithmic randomness III ····· 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 theory of quantum error-correction based on the principle of typicality, in order to demonstrate how properly our framework works in practical problems in quantum mechanics.

13 Kenshi Miyabe (Meiji Univ.)
Toru Takisaka (Nat. Inst. of Information)
The speed of convergence of induction ····· 15

Summary: Consider trying to predict the next bit from a given finite binary string when the sequence is sampled from a computable probability measure on the Cantor space. There exists the best betting strategy among a class of effective ones up to a multiplicative constant, the induced prediction from which is called algorithmic probability or universal induction by Solomonoff. The prediction converges to the true induced measure for sufficiently random sequences. However, the prediction is not computable. We introduce a framework to study the properties of computable predictions. In this framework, we can prove that all sufficiently general computable predictions also converge to the true induced measure. We also discuss the speed of convergence.

14 Hisashi Aratake (Kyoto Univ.) Classifying toposes for existentially closed models and finite-generic models ····· 15

Summary: In the context of first-order categorical logic, Blass and Scedrov constructed classifying toposes for existentially closed models and finite-generic models. We make some categorical analysis of these toposes and deduce model-theoretic results.

15 Kazuyuki Tanaka (Tohoku Univ.) On eigen-distributions for Boolean trees in the ID case · · · · · · · · · · · · · · 15

Summary: Our primary objective is to characterize the "eigen-distribution" d in ID(r) for a (weighted) Boolean tree (with a fixed probability $0 < r < 1$ for the root), which achieves the distributional complexity. In this talk, we introduce two new concepts on independent distributions: "proportional" ID (PID for short) and "decent" ID. For a fixed root probability $0 < r < 1$, a PID(r) on a weighted tree is uniquely constructed by a technique "Super-RAT". As a main theorem, we show that if the eigen-distribution d in ID(r) is decent then it is PID, from which we can deduce our previous theorem that for a balanced AND-OR tree (with no weights considered), the eigen-distribution d in ID(r) is IID.

16 Keita Yokoyama (JAIST) Kripke models and separations of logical principles · · · · · · · · · · · · · · · · · 15
Makoto Fujiwara (Meiji Univ.)
Hajime Ishihara (JAIST)
Takako Nemoto (JAIST)
Nobu-Yuki Suzuki (Shizuoka Univ.)

Summary: In this talk, I will explain some ideas of separating non-constructive logical principles (omniscience principles) over Heyting arithmetic by using Kripke models.

17 Toshiyasu Arai (Univ. of Tokyo) Some contributions to proof theory · 15

Summary: I will report some recent results in proof theory.

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

Nobu-Yuki Suzuki (Shizuoka Univ.) Disjunction and existence properties in intermediate predicate logics

Summary: We discuss relationships between the disjunction property (DP) and existence property (EP) in intermediate predicate logics. These properties are regarded as characteristics of constructivity of intuitionistic logic. Since existence-quantifier could be written as powerful (possibly infinitary) disjunction, we expected that there must be some relationship between them. They are, however, indepedent in intermediate predicate logics. This result contrasts with those e.g., in intuitionistic and modal arithmetic, and also gives a negative answer to Ono's problem P52 posed in 1987. The key is the quantifier-annihilation axiom Z. This axiom is abnormal in intermediate logics; but it works when we discuss DP and EP in superintuitionistic predicate logics. We introduce a condition, Z-normality, that excludes the Z and is a natural condition for reasonable logics. Then, we can show that EP implies DP for Z-normal logics. This result suggests a reason why Ono's problem P52 has remained open. We also report some recent results related to DP and EP.

11:45–12:00 Research Section Assembly

12:00–12:15 Mathematics History Team Meeting

Algebra

March 16th (Mon) Conference Room I

10:00–12:00

1 Hiroyuki Nakasora (Kobe Gakuin Univ.) The extended doubling of the Golay code and the Moonshine code ····· 10

Summary: In this talk, we present an example of codes all of whose weight classes support 1-designs, with duals whose classes include two that support 2-designs. We can find this example in the triply even binary codes of length 48.

2 Bernhard Mühlherr (Univ. Giessen) Koji Nuida (Univ. of Tokyo) Locally finite continuations and Coxeter groups of infinite ranks ····· 10

Summary: In some previous works on the isomorphism problem in Coxeter groups, certain special kind of subgroups called finite continuations have played a central role. However, the definition of finite continuations assumes finiteness of the rank (cardinality of generating set) of the underlying Coxeter group and is in general not available in the infinite rank cases. In our present work, we propose a generalization of finite continuations to the infinite rank cases (which itself is also defined for arbitrary groups), and study how the previous results in the finite rank cases do or do not extend to the infinite rank cases.

3 Naoki Chigira (Kumamoto Univ.) Solutions of a certain equation on a group and group structure ····· 10

Summary: We consider the set of solutions of two variable equation $y^{-1}[x,y]^{[x^2,y]} = a$ on a finite group G and $a \in G$. We discuss some properties of a group G using the number of solutions of the equation.

4 Fumihito Oda (Kindai Univ.) Yugen Takegahara (Muroran Inst. of Tech.) Crossed Burnside rings and Mackey 2-functors ····· 10

Summary: Balmer and Dell'Ambrogio introduced Mackey 2-functors. They showed that the 2-endomorphism ring of the identity of a finite group G in certain 2-category of Mackey 2-motives is isomorphic to the so called crossed Burnside ring of G. We show that a decomposition of $\mathcal{M}(G)$ for a Mackey 2-functor $\mathcal{M}$ into additive categories corresponds to the set of conjugacy classes of perfect subgroups of G.

5 Akihiko Hida (Saitama Univ.) On the relation of the product of character degrees and the product of conjugacy class lengths of a finite group ····· 10

Summary: Let G be a finite group. K. Harada conjectured that the product of degrees of all irreducible character of G divides the product of lengths of all conjugacy classes of G. We verify this conjecture for symmetric groups, alternating groups and wreath products.

6 Akihiko Hida (Saitama Univ.) Lower defect groups and vertices of simple modules ····· 10

Summary: Let kG be the group algebra of a finite group G over an algebraically closed field k of positive characteristic p. Let b be a block idempotent of kG. We compare p-regular lower defect groups of b with vertices of simple kGb-modules.

Summary: Let k be an algebraically closed field of prime characteristic p and P a finite p-group. We compute the Scott kG-module with vertex P when $\mathcal{F}$ is a fusion system on P and G is Park's group for $\mathcal{F}$. Further when $\mathcal{F}$ is a fusion system of the 2-dimensional special affine groups of transformations $\mathrm{ASL}(2,p) = \mathrm{Qd}(p) = (\mathbb{Z}/p\mathbb{Z} \times \mathbb{Z}/p\mathbb{Z}) : \mathrm{SL}(2,p)$ on a Sylow p-subgroup P of Qd(p) and G is Park's group for $\mathcal{F}$, we prove that the Scott kG-module with vertex P is Brauer indecomposable.

Summary: Given a dihedral 2-group P of order at least 8, we classify the splendid Morita equivalence classes of principal 2-blocks with defect groups isomorphic to P. To this end we construct explicit stable equivalences of Morita type induced by specific Scott modules using Brauer indecomposability and gluing methods; we then determine when these stable equivalences are actually Morita equivalences, and hence automatically splendid Morita equivalences. Finally, we compute the generalised decomposition numbers in each case.

Summary: We prove that splendid Morita equivalences between principal blocks of finite groups with dihedral Sylow 2-subgroups realised by Scott modules can be lifted to splendid Morita equivalences between principal blocks of finite groups with generalised quaternion Sylow 2-subgroups realised by Scott modules.

Summary: Plane partition is a two-dimensional array of nonnegative integers which is not increasing in rows and columns. Recently, some new generating functions of plane partitions are studied in view of orthogonal polynomials and integrable systems. We use Kamioka's framework that interpret biorthogonal polynomials in terms of lattice paths and derive some combinatorial identities that generalizes the generating functions derived by MacMahon and Stanley.

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

Summary: The notion of a vertex algebra was introduced by Borcherds in 1986 and is a mathematically precise algebraic counterpart of the concept of a 2-dimensional conformal field theory in physics. The vertex algebra V_L associated to a non-degenerate even lattice L is a basic example of a vertex algebra. In this talk, we discuss the fixed point subalgebra V_L^+ of V_L under the action of the automorphism of V_L induced from the -1 symmetry of L. The fixed point subalgebras play an important role in the study of vertex algebras, particularly in the construction of interesting examples. For example, the moonshine vertex algebra $V^\natural$ is constructed from V_Λ^+ and its irreducible module where Λ is the Leech lattice.
When L is positive definite, the representations of V_L^+ have been intensively studied. However, when L is not positive definite, little is known about the representations of V_L^+ so far. I will talk about the classification of irreducible weak V_L^+-modules for any non-degenerate even lattice L.

15:30–16:50

11 Mamoru Ueda (Kyoto Univ.) Affine super Yangian ····· 10

Summary: In this talk, we define the affine super Yangian $Y_{\varepsilon_1,\varepsilon_2}(\widehat{\mathfrak{sl}}(m|n))$ with a coproduct structure. We also obtain an evaluation homomorphism, that is, an algebra homomorphism from $Y_{\varepsilon_1,\varepsilon_2}(\widehat{\mathfrak{sl}}(m|n))$ to the completion of the universal enveloping algebra of $\widehat{\mathfrak{gl}}(m|n)$.

12 Satoru Urano (Univ. of Tsukuba) Modular moonshine ····· 10

Summary: The original modular moonshine conjectures of Ryba asserted the existence of vertex algebras over finite fields with finite group actions, such that the graded Brauer characters are genus zero modular functions. Borcherds and Ryba reinterpreted the conjectures in terms of Tate cohomology of a prime order element of the monster acting on an integral form of the monster vertex algebra. In this talk, I shall briefly explain the modular moonshine conjectures and consider generalized modular moonshine for any element of the monster group.

13 Scott Carnahan (Univ. of Tsukuba) Monstrous moonshine over the integers ····· 10

Summary: We briefly describe the construction of a self-dual integral form of the "Moonshine Module" vertex operator algebra that has Monster symmetry. This construction resolves the last open assumption in Borcherds and Ryba's proof of the Modular Moonshine conjectures. As a corollary, we obtain a positive definite unimodular lattice of rank 196884 with a faithful Monster action.

14 Kazuya Kawasetsu (Kumamoto Univ.)
David Ridout (Univ. of Melbourne) Relaxed highest-weight modules over affine vertex operator algebras ····· 10

Summary: Recently, irrational vertex operator algebras are becoming more and more important. Affine vertex operator algebras $L_k(\mathfrak{g})$ with fractional levels k are one of the most fundamental examples of such algebras. T. Creutzig and D. Ridout investigated a category of *relaxed highest-weight modules* (and their twists) over $L_k(sl_2)$ and proposed a continuous analog of modular invariance of characters and Verlinde formula. Today, we explain recent developments on classification and characters of relaxed highest-weight modules over affine vertex operator algebras for general $\mathfrak{g}$.

15 Hiroki Shimakura (Tohoku Univ.) On automorphism groups of the holomorphic VOAs associated with Niemeier lattices and the -1-isometries ····· 10

Summary: Recently, it has been proved that there exist exactly 70 holomorphic VOAs of central charge 24 whose weight one Lie algebras are non-trivial. One of the next projects is to determine the automorphism groups of holomorphic VOAs of central charge 24. We discuss the 14 cases related to Niemeier lattices and the -1-isometries.

16 Ching Hung Lam (Academia Sinica)
Hiroshi Yamauchi
(Tokyo Woman's Christian Univ.) On a c=33 extremal VOA ····· 10

Summary: Tener–Wang and Grady–Tener classifed rank two extremal VOAs. In this talk I will construct an example of a c=33 extremal VOA as a framed VOA which fills the last missing piece of their classification. This is a joint work with Ching Hung Lam.

17 Sota Asai (Kyoto Univ.) Wide intervals in lattices of torsion classes ····· 10

Summary: This talk is based on joint work with Calvin Pfeifer (Bonn). For a fixed abelian length category $\mathcal{A}$, the poset $\mathsf{tors}\,\mathcal{A}$ of torsion classes in $\mathcal{A}$ is a lattice. Any interval $[\mathcal{U},\mathcal{T}]$ in $\mathsf{tors}\,\mathcal{A}$ is a sublattice of $\mathsf{tors}\,\mathcal{A}$, and the difference between the two torsion classes $\mathcal{U}$ and $\mathcal{T}$ is described by the subcategory $\mathcal{W} := \mathcal{U}^{\perp} \cap \mathcal{T}$. Motivated by τ-tilting reduction of Jasso, we mainly studied the case that $\mathcal{W}$ is a wide subcategory of $\mathcal{A}$; such $[\mathcal{U},\mathcal{T}]$ are called wide intervals. In this talk, I will explain our main result that a wide interval $[\mathcal{U},\mathcal{T}]$ is isomorphic to the lattice $\mathsf{tors}\,\mathcal{W}$ of torsion classes in the abelian category $\mathcal{W}$. If time permits, I would like to talk about some characterization of wide intervals obtained in our work.

March 17th (Tue) Conference Room I

10:00–11:45

18 Masahisa Sato (Aichi Univ.) Some examples of rings and modules relating to Ware's problem ····· 10

Summary: We give some example of rings and modules, which gives a counter example of the assertion that Ware's problem is negative.

19 Yoshiharu Shibata (Yamaguchi Univ.)
Isao Kikumasa (Yamaguchi Univ.)
Yosuke Kuratomi (Yamaguchi Univ.)
On dual square full modules ····· 10

Summary: A module M is said to be *dual square free* if, for any nonzero module N, there are no epimorphisms from M to N^2. Oppositely, a module M is called *dual square full* if, for any proper submodule X of M, there exist a proper submodule Y of M containing X and an epimorphism from M to $(M/Y)^2$. We will give a decomposition of quasi-discrete modules using the concepts "dual square free" and "dual square full", and show a condition for a quasi-discrete module to be quasi-projective as its application.

20 Ayako Itaba (Tokyo Univ. of Sci.) On finite generations over centers of non-commutative projective schemes associated to 3-dimensional quadratic AS-regular algebras ····· 10

Summary: In this talk, for generic 3-dimensional quadratic AS-regular algebras $A = \mathcal{A}(E, \sigma)$, we show that a non-commutative projective schemes $\mathsf{Proj}_{\mathrm{nc}}A$ associated to A is finitely generated over its center if and only if the norm $\|\sigma\|$ of σ is finite. This result is a generalization of Mori's result for a 3-dimensional quadratic AS-regular algebra of Type S.

21 Masaki Matsuno (Shizuoka Univ.) The classification of 3-dimensional quadratic AS-regular algebras whose point schemes are elliptic curves ····· 10

Summary: It is known that there is a one-to-one correspondence between 3-dimensional quadratic AS-regular algebras and regular geometric pairs. In this talk, we give a complete list of regular geometric pairs which correspond to 3-dimensional quadratic AS-regular algebras whose point schemes are elliptic curves in $\mathbb{P}^2$ up to isomorphism.

22 Ji-Wei He (Hangzhou Normal Univ.)
Haigang Hu (Shizuoka Univ.)
Hopf dense Galois extensions over a ring ····· 10

Summary: Let R be a commutative domain, let H be a Hopf R-algebra which is a finitely generated free R-module, and let A be an R-algebra which is also an H-comodule algebra. We will say that A/A^{coH} is a Hopf dense Galois extension if the cokernel of the associated canonical map $\beta : A \otimes_{A^{coH}} A \to A \otimes_R H$ is quotient finite. It is a generalization of a Hopf dense Galois extension over a field. A weaker version of Auslander theorem holds for Hopf dense Galois extensions over R. We also give a sufficient condition for that the localization of H is dual to a finite dimensional group algebra over an algebraic closed field containing R.

23 Hiroki Matsui (Univ. of Tokyo) Construction of spectra of triangulated categories and their applications to commutative algebra 10

Summary: Classification of thick subcategories has been one of the main approaches in the studies of triangulated categories. It has been studied so far in many areas. In this century, a beautiful theory, called *tensor-triangular geometry*, is initiated by Balmer. He defined a topological space for a given tensor-triangulated category. Using this topological space, he classified radical thick tensor ideals and this result enables us to do algebro-geometric studies of tensor-triangulated categories. However the Balmer theory is successful, it does not work for triangulated categories that are not tensor triangulated. Such triangulated categories include two of the most important triangulated categories in commutative algebra: the bounded derived category and the singularity category of a commutative noetherian ring. In this talk, I will introduce a way to construct spectra for (not necessarily tensor) triangulated categories and give applications to commutative algebra.

24 Ayana Hirano (Kitami Inst. of Tech.) Matching numbers and dimension of edge ideals 10
Kazunori Matsuda (Kitami Inst. of Tech.)

Summary: We determine the relationship between the induced matching number, the minimum matching number, the matching number and the dimension of edge ideals.

25 Mitsuhiro Miyazaki (Kyoto Univ. of Edu.) On the traces of the canonical modules of the Ehrhart rings of order and chain polytopes 10
Janet Page (Univ. of Michigan)

Summary: Let R be a commutative ring and M an R-module. The ideal $\sum_{\varphi\in \mathrm{Hom}_R(M,R)} \varphi(M)$ is called the trace of M. It is known that if R is a Cohen–Macaulay local ring with a canonical module ω, then the trace of ω is a defining ideal of non-Gorenstein locus of R. In this talk, we state a criterion of a given Laurent monomial is a member of the radical of the trace of the canonical module of the Ehrhart ring of the order polytope (resp. chain polytope).

26 Akihiro Higashitani (Osaka Univ.) Toric ideals of generalized permutohedra 10
Hidefumi Ohsugi (Kwansei Gakuin Univ.)

Summary: In this talk, we discuss the toric ideals of generalized permutohedra. More precisely, we prove that the toric ideal of Minkowski sum of unit simplices has a squarefree initial ideal and is generated by quadratic binomials. Moreover, we also prove that Minkowski sums of unit simplices have the integer decomposition property. Those results are a partial contribution to Oda conjecture and Bøgvad conjecture.

13:00–14:15

27 Hidefumi Ohsugi (Kwansei Gakuin Univ.) Nef-partitions arising from unimodular configurations 10
Akiyoshi Tsuchiya (Univ. of Tokyo)

Summary: Reflexive polytopes have been studied from viewpoints of combinatorics, commutative algebra and algebraic geometry. A nef-partition of a reflexive polytope $\mathcal{P}$ is a decomposition $\mathcal{P} = \mathcal{P}_1 + \cdots + \mathcal{P}_r$ such that each $\mathcal{P}_i$ is a lattice polytope containing the origin. Batyrev and van Straten gave a combinatorial method for explicit constructions of mirror pairs of Calabi–Yau complete intersections obtained from nef-partitions. In this talk, by means of Gröbner basis techniques, we give a large family of nef-partitions arising from unimodular configurations.

Summary: In this talk, given an arbitrary integer $d > 0$, we construct a homogeneous ideal I of the polynomial ring $S = K[x_1, \ldots, x_{3d}]$ in $3d$ variables over a filed K for which S/I is a Cohen–Macaulay ring of dimension d with the property that, for each of the integers $0 \leq r \leq d$, there exists a monomial order $<_r$ on S with $\mathrm{depth}(S/\mathrm{in}_{<_r}(I)) = r$, where $\mathrm{in}_{<_r}(I)$ is the initial ideal of I with respect to $<_r$.

Summary: Let W be a finite group acting linearly on a polynomial ring R, and let $R^W \subset R$ be its invariant subring. The equivariant coinvariant ring of W is defined to be the tensor product $R \otimes_{R^W} R$; if W is a Weyl group it is isomorphic to the equivariant cohomology ring of the associated flag variety with respect to its natural torus action. In a 1976 paper, J. Watanabe obtained two important results: (1) $R \otimes_{R^W} R$ is Cohen–Macaulay if and only if W is generated by pseudo-reflections, and (2) if W is generated by pseudo-reflections then $R \otimes_{R^W} R$ is a reduced ring. In this talk, we will discuss these and other more recent related results obtained in part in collaboration with J. Watanabe and L. Smith.

Summary: The notion of the principal radical system was introduced by Hochster and Eagon in 1971 and they used it to prove that the determinantal ideals are radical and Cohen–Macaulay. We will simplify the definition to prove that the Specht ideals of type $(n-k, k)$ are radical in any characteristic and Cohen–Macaulay in characteristic zero, independent of the proofs of Yanagawa and Etingof.

Summary: For a partition λ of positive integer n, let I_λ^{Sp} be the ideal of $R = K[x_1, \ldots, x_n]$ generated by all Specht polynomials of shape λ. It is known that if $R/I_\lambda^{\mathrm{Sp}}$ is Cohen–Macaulay then λ is of the form either $(n-d, 1, \ldots, 1), (n-d, d)$, or $(d, d, 1)$, and it is also known that the converse is true if $\mathrm{char}(K) = 0$.
In this talk, we compute that the (Castelnuovo–Mumford) regularity of $R/I_\lambda^{\mathrm{Sp}}$, when $\lambda = (n-d, d)$ or $(d, d, 1)$. More precisely, the regularities of $R/I_\lambda^{\mathrm{Sp}}$ for $(n-d, d)$ and $(d, d, 1)$ are d and $d+1$, respectively.

Summary: The Sally module was introduced by W. V. Vasconcelos and it is useful to connect the Hilbert coefficients to the homological properties of the associated graded module of a Noetherian filtration. In this report we give a complete structure of the Sally module in the case the second normal Hilbert coefficient attains almost minimal value in an analytically unramified Cohen–Macaulay local ring. As a consequence, in this case we present a complete description of the Hilbert function of the associated graded ring of the normal filtration.

March 18th (Wed) Conference Room I

9:30–12:00

Summary: For a three-dimensional extremal neighborhood $(X, C) \subset \mathbb{C}^4$ of semistable type, infinitesimal deformations of C and the abundance property contribute to the existence of three-dimensional flips for (X, C) (S. Mori, 1988). Based on these facts, the author gave an analogue of Miyaoka–Yau type inequality for (X, C) with the associated c_3, and gave a slight generalization of such a inequality with non-trivial coefficients of c_2, by the associated Higgs sheaves (Y. Miyaoka, 2009) and formal neighborhoods of C (M. Ebihara, 1992), for related local automorphisms. In this talk, by framed-form fans (or, T-complexes) as a toric analogue of formal scheme (M. Ishida, 1989–), the author will give: i) a concept of extremal neighborhood rigged by the framed-form fan $\Gamma := (\Gamma_a, C_a, K_a)$ associated to (X, C), denoted as (X, Γ), ii) infinitesimal deformations of (X, Γ) by the associated Higgs sheaves, and, iii) a proto-type of characterization of Mukai–Umemura 3-folds by ii).

Summary: The group structure on the rational points of elliptic curves plays several important roles, in mathematics and recently also in other areas such as cryptography. However, the famous proofs for the group property (in particular, for its associative law) require somewhat advanced mathematics and therefore are not easily accessible by non-mathematician. This talk introduces a self-contained proof for this property, assuming mathematical knowledge only at the level of basic linear algebra and not requiring heavy computation.

Summary: The formalism of chiral conformal field theory by Beilinson and Drinfeld was inspired by the perturbative physics of Costello, Nekrasov, and Witten. However, the progress does not acquire sufficient consensus of both mathematicians and physicists. This “chiral algebra theory” was applied from a kind of tensor category theory in the operads to cousins of vertex algebras. In the topological field theory, this theory has a “factorization algebra” theory with a sophisticated theory of higher categories. In my talk, I will report two trials of weakening the toric condition and seeking for the hidden relation to topological vertex theory.

Summary: By using a non-commutative analogue of Marsden–Weinstein quotients, we may define non commutative complex Kähler plane. In this talk we talk about curves on it.

Summary: For study of algebraic inequalities, theory of PSD (positive semidefinite) cones provides various new methods. A merits of theory of PSD cones is that we can use many results and ideas of algebraic geometry. Moreover, we can understand algebraic and geometric meanings of inequalities. For an example, we proved that the edge discriminant of cyclic homogeneous inequalities with three variables of degree d agrees with the discriminant of one variable equations of degree d. For an another example, we proved that extremal rays are determined by equality conditions. In PSD method, we determine the characteristic variety, and its critical decomposition. Irreducible components of the boundary of the PSD cone are obtained as the dual of a critical set. Using this idea, we determine extremal rays and discriminants.

Summary: Recently, the author obtained a sufficient criterion for a stronger hierarchy of higher uniruledness = lower unirationality via Bott tower. In this talk, the author clarifies the following points: (1) This sufficient criterion is actually for a stronger hierarchy than the natural hierarchy arising from higher uniruledness = lower unirationality, especially from the view point of Hodge conjecture. (2) Still, this sufficient criterion has some reasonable acceptable applicability. From this reason, the author would like to call those Fano manifolds satisfying this sufficient criterion as Higher Fano manifolds.

Summary: We introduce a local coordinates system to the Grassmann variety $Gr(k;n)$ and express the curvature matrix of the universal bundle E simply and independently of the choice of local coordinates. We state the relation between the local coordinate system and the Schubert cells of Gr(k; n). By using and the expression of the cells, we obtain explicit integral formulas corresponding to Young diagrams.

Summary: We introduce a local coordinates system to the Flag variety and construct a vector field which is expressed explicitly with respect to the system. Each Schubert cell becomes a union of some flows of the vector field. We associate a certain diagram to the cell and investigate the relation between the diagrams and Schubert polynomials. We present some conjectures.

Summary: We consider the moduli space of logarithmic connections of rank 2 on the projective line minus 5 points with fixed spectral data. We compute the cohomology of such moduli space, and this computation will be used to extend the results of geometric Langlands correspondence due to D. Arinkin to the case where this type of connections have five simple poles on P1. In this talk, I will review the geometric Langlands correspondence in the tamely ramified cases, and after that, I will explain how the cohomology of above moduli space will be used.

Summary: We study the embedded topology of reducible plane curves having a smooth irreducible component. In previous studies, the relation between the topology and certain torsion classes in the Picard group of degree zero of the smooth component was implicitly considered. We formulate this relation clearly and give a criterion for distinguishing the embedded topology in terms of torsion classes.

Summary: The existence of crepant resolutions for three dimensional Gorenstein quotient singularities has proved by Y. Ito, D. G. Markushevich, S. S. Roan on a case-by-case based on the classification table of the finite subgroups of $\mathrm{SL}(3,\mathbb{C})$.
In this talk, we shall discuss a sufficient condition of the existence of crepant resolutions for Abelian quotient singularities by using Ashikaga's continued fractions. As a corollary, we have an alternative proof of the abelian case of the above results.

44 Takahiro Nagaoka (Kyoto Univ.) The universal covers of hypertoric varieties and Bogomolov's decomposition · · · · · 10

Summary: Hypertoric varieties are singular symplectic varieties with good positive weight $\mathbb{C}^*$-actions, and they can be studied from the corresponding combinatorial objects (hyperplane arrangements) as toric varieties. In general, for such symplectic varieties, one can consider the universal covering which is also a symplectic variety. In this talk, we describe the universal covers of hypertoric varieties explicitly, and we also establish the analogue of Bogomolov's decomposition for them. Moreover, as a byproduct, we can show that the $\mathbb{C}^*$-equivariant isomorphism class of hypertoric varieties is classified by the associated combinatorial objects.

45 Hiroto Akaike (Osaka Univ.)$^\flat$ Slope inequalities for irregular cyclic covering fibration · · · · · 10

Summary: The relative invariant slope is defined as the ratio of the self intersection number of relative canonical divisor and the relative Euler number. In this time, I studied the slope of primitive cyclic covering fibration with positive relative irregularity. I obtained the lower bound described by the genus of general fiber, covering degree and relative irregularity.

14:15–14:30 Presentation Ceremony for the 2020 MSJ Algebra Prize

14:40–15:40 Award Lecture for the 2020 MSJ Algebra Prize

Ryo Takahashi (Nagoya Univ.) Generation in module categories and derived categories of commutative rings

Summary: Let R be a ring, and let M, N be R-modules. It is a natural question to ask whether or how one can build M out of N by iteration of fundamental operations such as direct sums, direct summands, extensions etc. This can be thought of not only in module categories but also in derived categories. I will speak about it in the case where the base ring is commutative.

15:50–16:50 Award Lecture for the 2020 MSJ Algebra Prize

Takuzo Okada (Saga Univ.) Birational Mori fiber structures of Fano varieties and its application to rationality problems

Summary: I will talk about birational geometry of Fano varieties. Fano varieties of Picard number 1 are so called Mori fiber spaces, that is, they appear as outputs of Minimal Model Program (MMP). Outputs of MMP are not necessarily unique and in general a Fano variety can be birationally transformed into other Mori fiber spaces. For a given Fano variety of Picard number 1, we can sometimes determine the Mori fiber structure of it, that is, the Mori fiber spaces birational to the given Fano variety. I will survey results concerning this kind of birational studies on Fano varieties and explain a direct connection to rationality problems of algebraic varieties.

March 19th (Thu) Conference Room I

9:20–12:00

46 Fumitsuna Maruyama
Masao Toyoizumi (Toyo Univ.)
Yozo Deguchi
Recent progress on Euler–Fermat type theorem on matrix ring · · · · · 10

Summary: We share new results for Euler- Fermat type theorem on the matrix ring over F_p.

Summary: For a positive integer s, a lattice L is said to be *s-integrable* if $\sqrt{s} \cdot L$ is isomorphic to a sublattice of $\mathbb{Z}^n$ for some integer n. Conway and Sloane found two non 2-integrable lattices of rank 12 and discriminant 7. We found two more lattices of rank 12 and discriminant 15. By a joint work with Dr. Qianqian Yang, we derived a necessary condition for the discriminant of a non 2-integrable lattice of rank 12 by embedding a lattice of rank 12 to a unimodular lattice of rank 14. Furthermore, we give a sufficient condition for a non 2-integrable lattice to be indecomposable in terms of quadratic forms, and show that Conway and Sloane's lattices and ours satisfy it.

Summary: Hoshi and Yamasaki (2017, Mem. AMS) classified stably/retract k-rational algebraic k-tori of dimensions 4 and 5. There exist 710 (resp. 6079) cases of 4-dim. (resp. 5-dim.) algebraic k-tori and 216 (resp. 3003) cases of them are not retract k-rational. Using this, we prove:
Theorem (Hoshi, Kanai and Yamasaki, arXiv:1910.01469). Let k be a field, T be an algebraic k-torus of dimension n and X be a smooth k-compactification of T.
(1) Among 216 cases of not retract rational algebraic k-tori T of dimension 4, there exist exactly 2 (resp. 20, 194) algebraic k-tori with $H^1(k, \operatorname{Pic}\overline{X}) \simeq (\mathbb{Z}/2\mathbb{Z})^{\oplus 2}$ (resp. $H^1(k, \operatorname{Pic}\overline{X}) \simeq \mathbb{Z}/2\mathbb{Z}$, $H^1(k, \operatorname{Pic}\overline{X}) = 0$).
(2) Among 3003 cases of not retract rational algebraic k-tori T of dimension 5, there exist exactly 11 (resp. 263, 2729) algebraic k-tori with $H^1(k, \operatorname{Pic}\overline{X}) \simeq (\mathbb{Z}/2\mathbb{Z})^{\oplus 2}$ (resp. $H^1(k, \operatorname{Pic}\overline{X}) \simeq \mathbb{Z}/2\mathbb{Z}$, $H^1(k, \operatorname{Pic}\overline{X}) = 0$).

Summary: Theorem (Hoshi, Kanai and Yamasaki, arXiv:1910.01469). Let $2 \leq n \leq 15$ be an integer with $n \neq 12$. Let k be a field, K/k be a separable field extension of degree n and L/k be the Galois closure of K/k. Let $G = \operatorname{Gal}(L/k) = nTm$ be a transitive subgroup of S_n and $H = \operatorname{Gal}(L/K)$ with $[G : H] = n$. Let $T = R^{(1)}_{K/k}(\mathbb{G}_m)$ be the norm one torus of K/k of dimension $n-1$ and X be a smooth k-compactification of T. Then $H^1(k, \operatorname{Pic}\overline{X}) \neq 0$ if and only if G is given as in Table 1. In particular, if L/k is unramified extension, then $A(T) = 0$ and $H^1(k, \operatorname{Pic}\overline{X}) \simeq Sha(T)$.
Moreover, we give a necessary and sufficient condition for the Hasse norm principle for K/k where $[K : k] = n \leq 15$ and $n \neq 12$.

Summary: In the arithmetic of function fields, Drinfeld modules play the role that elliptic curves play in the arithmetic of number fields. The aim of this talk is to study a non-existence problem of Drinfeld modules with constraints on torsion points, which is motivated by a conjecture of Rasmussen and Tamagawa on abelian varieties over number fields. We prove the non-existence in the case where the inseparable degree of the base field is not divisible by the rank of Drinfeld modules. Conversely if the rank divides the inseparable degree, then we prove the existence of a Drinfeld module satisfying Rasmussen–Tamagawa-type conditions. We also prove a partial result on the Drinfeld module analogue of the uniform Rasmussen–Tamagawa conjecture.

Summary: We first present a comparison of two upper bounds of relative class numbers of cyclotomic function fields.
We then give some explicit lower bound of the relative class number of cyclotomic function field of a prime conductor, whose constant field is the field of 3 elements.
These bounds describe the size of determinants in a class number formula of cyclotomic function fields.

Summary: In 2017 Jakubec gave a formula for the relative class number of the p-th cyclotomic field, p an odd prime, by using a determinant related to the multiplication theorem for Bernoulli polynomials. We generalize his formula to an imaginary abelian number field, and we also determine the sign of the formula, which he had not given.

Summary: Let R be a (Noetherian) regular local ring. Then we can obtain there perfectiodificatin R_∞ such that R_∞ is a perfectios ring which is faithfully flat over R. If R is regular coherent ring, then the K-theory has the homotopy invariant property. In this talk, we consider the étale K-theoryfor perfectoid algebras and we compare the étale K-theory spectrum and homotopy invariant étale K-theory spectrum of R_∞.

Summary: For Galois cohomology groups of big Galois representations attached to Hida families (of elliptic cuspforms), Howard has constructed the systems of big Heegner points. On the other hand, for members of Hida families there are Euler systems of generalized Heegner cycles, which are constructed by Bertolini–Darmon–Prasanna. Castella recently proved that the systems of big Heegner points interpolate the systems of generalized Heegner cycles. In this talk, we will explain a different approach to show the interpolation property and slightly improve Castella's work.

Summary: We characterize simple vertex operator algebras of CFT type satisfying several conditions which arise from a family of simple Virasoro vertex operator algebras, so-called minimal models.

Summary: We consider the number of solutions of $F(x_1, \ldots, x_n) = H_l$, where F is a norm form of an order of a number field and H_l is a variant of factorial. In a previous study, we prove that for any norm form $F(x_1, x_2)$ of an order of a quadratic field, there exists only finitely many l such that H_l is represented as F. The aim of this talk is to show the same result for any norm form $F(x_1, \ldots, x_n)$ of an order of a number field $K \neq \mathbf{Q}$.

Summary: We discuss the Katok–Sarnak correspondence (a lifting map from Maass forms of weight 0 to those of weight 1/2) from the view point of the theory of prehomogeneous zeta functions. A key role is played by the zeta functions associated with the space of symmetric matrices of degree 2 whose coefficients involve periods of Maass wave forms. Analytic properties of these zeta functions have been investigated by Fumihiro Sato, and by using his results and a Weil-type converse theorem for Maass forms, we can construct the lifting.

58 Ryojun Ito (Chiba Univ.) On special values at integers of L-functions of Jacobi theta products of weight 3 10

Summary: In 2012, Rogers–Zudilin gave a hypergeometric expression of the special value at $s = 2$ of the L-function of a cusp form of weight 2 by an analytic method. In this talk, by the Rogers–Zudilin method, we express special values at some integers of L-functions of modular forms of weight 3 that are products of the Jacobi theta series in terms of special values of the Kampé de Fériet hypergeometric function, which is a two-variable generalization of generalized hypergeometric functions.

59 Masatoshi Suzuki (Tokyo Tech) On a family of integral operators arising from zeta functions. II. 10

Summary: We consider a family of integral operators arising from the Riemann zeta function and state an equivalence condition of the Riemann hypothesis in terms of such operators. This equivalence condition is related to a positive property of the Riemann xi-function studied by Lagarias and Garunkstis.

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

Kenichi Namikawa (Kyushu Univ.) Explicit constructions of automorphic forms and its applications to Iwasawa theory

Summary: The study of L-functions is one of major theme in number theory, since it is expected to include various arithmetic information. An important method for the study of L-functions is automorphic representation theory. By using elements in automorphic representations, which are called automorphic forms, we can observe connections between special values of L-functions and arithmetic phenomena. In this talk, we introduce how automorphic forms are used to study special values of L-functions. Namely, we discuss Iwasawa theoretic properties of certain L-functions of degree 4, which are called Asai L-functions, by constructing automorphic forms in an explicit way.

15:25–16:50

60 Masahiro Mine (Tokyo Tech) Moments of L-functions associated with cubic fields 10

Summary: In this talk, we study L-functions arising from the factorizations of Dedekind zeta-functions of non-Galois cubic fields. We prove asymptotic formulas for their complex moments by applying the probability density function for the value-distribution of such L-functions. As an application, we obtain a cubic analogue of Siegel's formula on quadratic class number sums.

61 Ade Irma Suriajaya (Kyushu Univ. / RIKEN)
Shōta Inoue (Nagoya Univ.)
Sumaia Saad Eddin (JKU Linz) An upper bound for Stieltjes constants of L-functions in the extended Selberg class 10

Summary: The coefficients of the Laurent expansion of the Riemann zeta function near $s = 1$ were first studied by Stieltjes in 1885 followed by many authors, such as Briggs, Mitrovič, Matsuoka, and Saad Eddin. For this reason, these coefficients are widely known as "Stieltjes constants". An explicit upper bound for the Stieltjes constants of Dirichlet L-functions is also known. We are interested in investigating the Stieltjes constants for L-functions in the extended Selberg class. In this talk, we show an upper bound we obtained for these coefficients.

62 Shota Inoue (Nagoya Univ.) On the value distribution of the Riemann zeta-function on the critical line 10

Summary: There are many remaining problems for the Riemann zeta-function such as the Riemann Hypothesis and the Lindelöf Hypothesis. The speaker derived a result on the value distribution of the Riemann zeta-function on the critical line. This result is an improvement of Jutila's result and Radziwiłł's result, and also related with the mean value estimates and the Lindelöf Hypothesis.

Summary: In this talk, we will consider the values of the Riemann zeta function for any positive integers by means of the division by zero calculus. In particular, the values for odd positive integers were considered as mysterious ones, however, their values may be considered as in even integers case. We will give both analytical formulas and numerical results. A basic reference is H. Okumura and S. Saitoh, Values of the Riemann Zeta Function by Means of Division by Zero Calculus, viXra:1907.0437 but we will talk more up-to-date information. Our purposes of this talk is to introduce of the division by zero calculus and to show its power.

Summary: We give conditions for algebraic independence of solutions to a certain system of algebraic Mahler functional equations, which are extensions of a result of Amou and Väänänen. As an application of our results, we give algebraic independence of special values of certain power series and infinite products.

Summary: We consider the average of number of divisors of square free integers $n \leq x$.

Summary: Given integers A, B, C, D, if positive integers a satisfy $A\sigma(a) + B\varphi(a) - Ca = D$ then a are said to be (A,B,C) perfect numbers with constant D.

Geometry

March 16th (Mon) Conference Room II

9:40–11:40

1 Takahiko Yoshida (Meiji Univ.) Adiabatic limits, theta functions, and geometric quantization ····· 15

Summary: In the geometric quantization of toric manifolds, Baier–Florentino–Mourão–Nunes have given a one-parameter family of compatible complex structures such that the associated Kähler polarizations converge to the real polarization determined by the moment map. One of the generalizations of the Kähler quantization to possibly non-Kähler symplectic manifolds is the Spin^c quantization. In this talk, for a non-singular Lagrangian torus fibration on a compact, complete base with prequantum line bundle and a compatible almost complex structure invariant along the fiber, we show that the Spin^c quantization converges to the real quantization by the adiabatic(-type) limit. This talk is based on arXiv:1904.04076.

2 Ken Kuwata (Hokkaido Univ.) Holomorphic vector field and topological sigma model on $\mathbb{P}^1$ world sheet
Masao Jinzenji (Hokkaido Univ.) ····· 15

Summary: Witten suggested that fixed-point theorems can be derived by the supersymmetric sigma model on a Riemann manifold M with potential term induced from Killing vector on M. One of the well-known fixed-point theorem is the Bott residue formula which represents intersection number of Chern classes of holomorphic vector bundles on a Kähler manifold M as sum of contributions from fixed point sets of a holomorphic vector field K on M. We derived the Bott residue formula by using topological sigma model (A-model) that describes dynamics of maps from CP^1 to M, with potential term induced from the vector field K.

3 Natsuo Miyatake (Osaka Univ.)[b] A direct proof of Hitchin–Kobayashi type correspondences for abelian vortex equations ····· 15

Summary: We discuss Hitchin–Kobayashi type correspondences for the abelian vortex equations, i.e., a certain kind of gauge theoretic equations on compact Kähler manifolds associated with linear actions of tori on complex vector spaces. The correspondence itself had already established for further general settings. Further for the abelian gauge group and linear fiber cases it is known that there exists a very simple characterization of the stability condition. We give a direct proof of the correspondences using such a simple characterization of the stability condition. The problem reduces to show the existence and the uniqueness of Kazdan–Warner type equations associated with linear actions of tori on complex vector spaces.

4 Yasufumi Nitta (Tokyo Univ. of Sci.) A uniform version of the Yau–Tian–Donaldson correspondence for polarized toric manifolds ····· 15
Shunsuke Saito (RIKEN/Kyoto Univ.)

Summary: We solve a uniform version of the Yau–Tian–Donaldson conjecture for polarized toric manifolds.

5 Kazuyuki Hasegawa (Kanazawa Univ.) A construction of a hypercomplex manifold from a quaternionnic manifold —the quaternionic/hypercomplex-correspondence— ····· 15
Vicente Cortés (University of Hamburg)

Summary: Given a quaternionic manifold M with a certain U(1)-symmetry, we construct a hypercomplex manifold M' of the same dimension. This construction generalizes the quaternionic Kähler/hyper-Kähler-correspondence. As an example of this construction, we obtain a compact homogeneous hypercomplex manifold which does not admit any hyper-Kähler structure.

6 Yoshinori Hashimoto (Tokyo Tech) Kobayashi–Hitchin correspondence and the Quot-scheme limit of Fubini–Study metrics ····· 15
Julien Keller (Aix-Marseille Univ.)

Summary: We use the Quot-schemes in algebraic geometry to identify the asymptotic slope of Donaldson's functional, whose critical point is a Hermitian–Einstein metric on a holomorphic vector bundle. This result, together with an extra technical assumption, provides an alternative proof of the Kobayashi–Hitchin correspondence relating the Hermitian–Einstein metrics and stability of vector bundles.

Summary: The existence of constant scalar curvature Kähler metric is a fundamental problem in Kähler geometry. Let (X, L_X) be an n-dimensional polarized manifold and D be a smooth hypersurface defined by a holomorphic section of L_X. I will talk about the following result: if D has a constant positive scalar curvature Kähler metric, $X \setminus D$ admits a complete scalar-flat Kähler metric, under the following three conditions, (i) $n \geq 6$ and there is no nonzero holomorphic vector field on X vanishing on D, (ii) an average of a scalar curvature on D denoted by $\hat{S}_D$ satisfies the inequality $0 < 3\hat{S}_D < n(n-1)$, (iii) there are positive integers $l(> n), m$ such that the line bundle $K_X^{-l} \otimes L_X^m$ is very ample and the ratio m/l is sufficiently small.

14:20–15:45

Summary: A Dirac pair on a Jacobi bialgebroid is a pair of two Dirac structures constructing a Nijenhuis relation on a Jacobi bialgebroid and is a generalization of it on a Lie bialgebroid. In this talk, we prove a relation between Dirac pairs on Jacobi and Lie bialgebroids and show examples of Dirac pairs on Jacobi bialgebroids.

Summary: In the talk, we deal with fibers of classical Liouville integrable systems containing the Lagrangian top and the Kovalevskaya top. Especially, we find a non-displaceable fiber for each of them. To prove these results, we use the notion of superheaviness introduced by Entov and Polterovich. This is a joint work with Morimichi Kawasaki (RIMS).

Summary: Let M be a compact Riemannian symmetric space and denote the geodesic symmetry at $x \in M$ by s_x. We say that $x, y \in M$ are antipodal if $s_x(y) = y$. A subset S of M is an antipodal set if any two points of S are antipodal. An antipodal set T is called maximal if there are no antipodal sets including T properly. In this talk, we introduce a concept of connectedness of two antipodal points and antipodal sets. Using this connectedness, we construct a method to make a bigger antipodal set from a given antipodal set. Also, we construct a method to decide whether a given maximal antipodal set is homogeneous.

Summary: We study local rigidity of certain actions of a solvable group on the boundary of a rank-one symmetric space of non-compact type, which is diffeomorphic to a sphere. When the symmetric space is a quaternionic hyperbolic space or the Cayley plane, the action we constructed is locally rigid.

Summary: We classify R-spaces that admit a certain natural Γ-symmetric structure. We further determine the maximal antipodal sets of these structures.

16:00–17:00 Talk Invited by Geometry Section

Hikaru Yamamoto (Tokyo Univ. of Sci.) Special Lagrangian submanifolds, mean curvature flows and their mirror

Summary: A special Lagrangian submanifold was defined by Harvey and Lawson in 1982 as a volume-minimizing Lagrangian submanifold in a Calabi–Yau manifold. Since Strominger, Yau and Zaslow in 1996 gave physical importance to special Lagrangian submanifolds in the context of mirror symmetry, special Lagrangian submanifolds have acquired much attention from both mathematicians and physicists. In 2002, Thomas and Yau conjectured that if a given Lagrangian submanifold is stable (in the sense of their paper) then the mean curvature flow starting from it exists for all time and converges to a special Lagrangian submanifold in its Hamiltonian deformation class. This is the so-called Thomas–Yau conjecture. In 2015, Joyce updated Thomas–Yau conjecture to make the statement more careful, and it is still widely open. Actually, this story is in A-side of mirror symmetry, and there is a corresponding story in B-side. The special object is a deformed Hermitian–Yang Mills connection and a way to get it is a line bundle mean curvature flow. In the former part of this talk, I would like to give an overview of recent development related to Thomas–Yau conjecture, and in the latter part, give that of studies in B-side which are rapidly developed in these several years.

March 17th (Tue) Conference Room II

9:40–11:50

13 Yufeng Lu (Osaka Univ.) Singularity theorems on Lorentz–Finsler manifolds ····· 10
Ettore Minguzzi (Univ. Stud. Firenze)
Shin-ichi Ohta (Osaka Univ./RIKEN)

Summary: Motivated by recent works on singularity theorems by Case for weighted Lorentzian manifolds and by Minguzzi for Finsler spacetimes, we established the theory for most singularity theorems, including Penrose's, Hawking's and Hawking and Penrose's, in the framework of weighted Lorentz-Finsler manifolds. Our results cover Case's case ($N \in [n, \infty]$) and Woolgar–Wylie's case ($N \in (-\infty, 0)$) as special cases.

14 Atsufumi Honda (Yokohama Nat. Univ.) Duality on generalized cuspidal edges preserving singular set images and first fundamental forms ····· 15
Kosuke Naokawa (Hiroshima Inst. of Tech.)
Kentaro Saji (Kobe Univ.)
Masaaki Umehara (Tokyo Tech)
Kotaro Yamada (Tokyo Tech)

Summary: In the second, fourth and fifth authors' previous work, a duality on generic real analytic cuspidal edges in the Euclidean 3-space preserving their singular set images and first fundamental forms, was given. Here, we call this an isometric duality. In this paper, we show that this duality extends to generalized cuspidal edges, including cuspidal cross caps, and 5/2-cuspidal edges. When the singular set image has no symmetries and does not lie in a plane, the dual cuspidal edge is not congruent to the original one.

15 Yoshito Ishiki (Univ. of Tsukuba) On the Assouad dimension and convergence of metric spaces ····· 15

Summary: We introduce the notion of pseudo-cones of metric spaces as a generalization of both of the tangent cones and the asymptotic cones. We prove that the Assouad dimension of a metric space is bounded from below by that of any pseudo-cone of it. We exhibit a example containing all compact metric spaces as pseudo-cones, and examples containing all proper length spaces as tangent cones or asymptotic cones.

Summary: We introduce the notion of tiling spaces for metric space. The class of tiling spaces includes the Euclidean spaces, the middle-third Cantor spaces, and various self-similar spaces appeared in fractal geometry. On a tiling space, we characterize a metric subspace whose Assouad dimension coincides with that of the whole space.

Summary: Let (M, F) be a geodesically forward complete Finsler manifold and $p \in M$. We observe how the preimage of a curve in M under exponential map at p can behave in the tangent space T_pM at p, when the curve approaches a conjugate cut point of p without crossing the cut locus of p.

Summary: We introduce an embedding optimization problem for a finite graph. This problem is related to an optimization problem concerning the smallest nonzero eigenvalue of the graph Laplacian. Goering–Helmberg–Wappler introduced a different embedding problem as a dual of the eigenvalue optimization problem. We establish a relation between the optimal values of the two embedding problems. It then follows that the optimal value of our embedding problem is obtained by the optimal value of the eigenvalue optimization problem. Further, we show that our embedding problem is also a dual of the eigenvalue optimization problem. We present examples of graphs for which these optimization problems can be explicitly solved.

Summary: Sectional curvature is one of the most important notions in differential geometry. Statistical sectional curvature can be introduced on a statistical manifold by using the statistical curvature tensor field, which is defined as the arithmetic mean of curvature tensor fields with respect to the pair of dual connections. For a submanifold in a statistical manifold, the Euler inequality, which presents a relation between the mean curvature and the Gaussian curvature in Euclidean geometry, is generalized in terms of the statistical sectional curvature. A doubly umbilical statistical submanifold is characterized as a submanifold such that the equality holds at each point. In particular, we describe the inequality in the case where the ambient space is a standard warped product statistical manifold.

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 conclude several geometric and spectral properties of directed graphs under lower Ricci curvature bound extending previous results in the undirected case.

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

Ulrich Pinkall (TU Berlin) Discretizing fluids into filaments and sheets

Summary: In differential geometry and in mathematical physics "discretization" means replacing a continuum system (like for example a smooth surface in three-space) by a discrete collection of lower-dimensional objects (like curves or even isolated points). It is often possible to capture many important properties of the original continuum system in its discrete equivalent. In many situations relevant for physics simulation the relevant fields (vorticity of a fluid, current or magnetic field in a plasma) exhibit on their own a strong tendency to become concentrated in one-dimensional filaments or two-dimensional sheets. "Decomposing" a given continuous field into its "constituent" filaments or sheets is important for understanding and visualizing a given field. Moreover, simulation algorithms that take into account the natural tendency of the fields to become "discretized" into filaments or sheets can be highly efficient.

March 18th (Wed) Conference Room II

9:40–11:35

21 Ayato Mitsuishi (Fukuoka Univ.) Certain mini-max values of the p-energy and packing radii ····· 15

Summary: Grosjean proved that the $(1/p)$-th power of the first non-zero eigenvalue of the p-Laplacin on a closed Riemannian manifold converges to the twice of the inverse of the diameter of the space, when p goes to infinity. Before this being proved, Juutinen, Lindqvist and Manfredi proved a corresponding result for the Dirichlet eigenvalues. The speaker extends their results to "k-th values". More presicely, we consider "k-th diameter" as the $(k+1)$-th packing radius introduced by Grove–Markvorsen. Furthermore, we introduce certain min-max value related to the p-energy as a counter-part of "k-th eigenvalue." Here, please note that our min-max values are not known whether they are real eigenvalues.

22 Cong Hung Mai (Kyoto Univ.)
Shin-ichi Ohta (Osaka Univ./RIKEN) Quantitative estimates for the Bakry–Ledoux isoperimetric inequality ····· 10

Summary: We establish a quantitative isoperimetric inequality for weighted Riemannian manifolds with lower weighted Ricci curvature bound. Precisely, we give an upper bound of the volume of the symmetric difference between a Borel set and a sub-level (or super-level) set of the associated guiding function (arising from the needle decomposition), in terms of the deficit in Bakry–Ledoux's Gaussian isoperimetric inequality. This is the first quantitative isoperimetric inequality on noncompact spaces besides Euclidean and Gaussian spaces. Our argument makes use of Klartag's needle decomposition (also called localization), and is inspired by the recent work of Cavalletti, Maggi and Mondino on compact spaces.

23 Shintaro Akamine (Nagoya Univ.)
Atsufumi Honda (Yokohama Nat. Univ.)
Masaaki Umehara (Tokyo Tech)
Kotaro Yamada (Tokyo Tech) Bernstein-type theorem for zero mean curvature hypersurfaces admitting lightlike points ····· 15

Summary: Calabi and Cheng–Yau's Bernstein-type theorem asserts that an entire zero mean curvature graph in Lorentz–Minkowski (n+1)-space which admits only space-like points is a hyperplane. We give an improvement of the Bernstein-type theorem and show that an entire zero mean curvature graph in consisting only of space-like or light-like points is a hyperplane.

Summary: The Atiyah–Singer index theorem states, on a closed manifold, that the analytic index of the Dirac operator, is determined by topological data. Many mathematicians have generalized this theorem, for example Kasparov proved the version of non-compact manifolds equipped with proper and cocompact group actions, in terms of non-commutative geometry. The overall goal of my research is to formulate and prove an infinite-dimensional version of this index theorem. In other words, I would like to give an equivariant index theorem for infinite-dimensional manifolds equipped with proper and cocompact actions of infinite-dimensional Lie groups, in terms of non-commutative geometry. In this talk, I will explain the results so far, focusing on the non-commutative geometrical side. Time permitting, I will mention my ongoing work which connects the results so far and some topological invariants.

Summary: We give generalization of the Willmore energy for an even-dimensional closed submanifold in the Euclidean space as a residue of a meromorphic function obtained from the Riesz energy. We show that it is independent from the Graham–Witten energy when the dimension is 4.

Summary: We study power concavity of solutions to elliptic and parabolic boundary value problems on rotationally symmetric, strongly convex open metric balls in a Riemannian manifold. Our results provide a first step to the study of power concavity for Riemannian manifolds, and improve the known results for Euclidean spaces.

Summary: The space of geodesic currents on a hyperbolic surface were introduced by Bonahon as a generalization of measured geodesic laminations and have been successfully studied in the case that the surface is closed or compact (possibly with boundary). One of useful properties is that the space of geodesic currents on a closed hyperbolic surface can be considered as the measure-theoretic completion of the set of weighted closed geodesics on the surface, but such a property is not shown in the case that the surface has cusps due to infinite geodesics connecting two cusps on the surface. We have proved that the space of geodesic currents on a cusped hyperbolic surface with finite area also has the same denseness property.

14:20–15:40

Summary: A nondegenerate centoroaffine surface of cohomogeneity one can be considered as a corresponding object to a surface of revolution in Euclidean geometry. We obtain a normal form for such a surface to classify such centroaffine minimal surfaces with centroaffine metrics of constant curvature. We also study proper affine spheres from this viewpoint.

29 Masashi Yasumoto (Osaka City Univ.) Discrete Weierstrass-type representations ····· 15

Summary: Over the last three decades, structure-preserving discretizations of differential geometry are rapidly developing. In particular, discretizations of surfaces are highly related to differential geometry itself, integrable systems, complex analysis, discrete differential geometry, and so on. Bobenko–Pinkall showed that there exists a Weierstrass-type representation for discrete minimal surfaces in terms of discrete holomophic functions. Afetrwards other Weierstrass-type representations were discovered. In this talk we introduce Weierstrass representations for discrete surfaces. A common feature of Weierstrass-type representations for discrete surfaces is that they are described by discrete holomorphic functions. We give a unified description for these representation formulae in terms of transformations for Omega-sufaces. This talk is based on joint work with Mason Pember (Politecnico di Torino) and Denis Polly (Technische Universitaet Wien).

30 Masahiro Morimoto (Osaka City Univ.) Austere and arid properties for PF submanifolds in Hilbert spaces ···· 15

Summary: Austere submanifolds and arid submanifolds constitute respectively two different classes of minimal submanifolds in finite dimensional Riemannian manifolds. In this talk we introduce these two notions into a class of proper Fredholm (PF) submanifolds in Hilbert spaces, discuss their relation and show many examples of infinite dimensional austere PF submanifolds and arid PF submanifolds in Hilbert spaces.

31 Yuichiro Sato (Tokyo Metro. Univ.) Totally umbilical submanifolds in pseudo-Riemannian space form ···· 15

Summary: Totally umbilical submanifolds in pseudo-Riemannian manifolds are defined by the traceless part of the second fundamental form vanishing identically. They are fundamental submanifolds next to totally geodesic submanifolds. In this talk, we classify the congruent class of full totally umbilical submanifolds in non-flat pseudo-Riemannian space forms, and consider its moduli spaces. As a consequence, we obtain that some moduli spaces of isometric immersions between space forms which are of the same constant curvature are non-Hausdorff.

32 Kazuhiro Okumura (Asahikawa Nat. Coll. of Tech.) The curvature tensor of ruled real hypersurfaces in a nonflat complex space form ····· 10

Summary: In this talk, we consider ruled real hypersurfaces in a nonflat complex space form from the viewpoint of ϕ-invariances of curvature tensors of real hypersurfaces. Furthermore we give a new characterization of these real hypersurfaces.

16:00–17:00 Talk Invited by Geometry Section

Atsushi Kanazawa (Kyoto Univ.) Kähler moduli spaces and stability conditions of triangulated categories

Summary: For a Kähler manifold, we can consider two moduli spaces, namely the complex moduli space and the Kähler moduli space. The former has been one of the most important subjects in modern mathematics (studied by Riemann, Kodaira–Spencer, Kuranishi and others), and beautiful theories have been developed in a variety of cases. In light of mirror symmetry, we expect that there are equivalently rich theories for the Kähler moduli spaces. However, it turns out that the Kähler structures are much more delicate than the complex structures. In this talk, I will introduce our program to investigate the Kähler moduli spaces via stability conditions of triangulated categories. Roughly speaking, we will consider a Kähler analogue of the Hodge theory.

Complex Analysis

March 16th (Mon) Conference Room VIII

9:30–11:50

1 Saburou Saitoh (Gunma Univ.*/Inst. of Reproducing Kernels) — Okumura's disc series can beyond the crucial point of Däumler–Puha's horn torus models for the Riemann sphere ····· 15

Summary: For the statement of the conclusion, we will first recall the basic related backgrounds; division by zero calculus, examples and horn torus models.

2 Toshiyuki Sugawa (Tohoku Univ.), Mark Elin (ORT Braude Coll.), David Shoikhet (Holon Inst. of Tech.) — Geometric properties of the nonlinear resolvent for a continuous semigroup of holomorphic self-maps of the unit disk ····· 15

Summary: Let f be the infinitesimal generator of a one-parameter semigroup of holomorphic self-mappings of the open unit disk $\mathbb{D}$. Our main purpose is to study properties of the family $\mathcal{R}$ of nonlinear resolvents $(I+rf)^{-1}:\mathbb{D}\to\mathbb{D}$, $r\geq 0$, in the spirit of classical geometric function theory. To make a connection with this theory, we mostly consider the case where $f(0)=0$ and $f'(0)>0$. We found, in particular, that $\mathcal{R}$ forms an inverse Löwner chain of hyperbolically convex functions. Moreover, each element of $\mathcal{R}$ satisfies the Noshiro–Warschawskii condition. This, in turn, implies that each element of $\mathcal{R}$ is also an infinitesimal generator of a one-parameter semigroup on $\mathbb{D}$. We mention also quasiconformal extension of elements of $\mathcal{R}$.

3 Hideaki Izumi (Chiba Inst. of Tech.) — Dimensioned number solutions to iterative functional equations ····· 15

Summary: We will obtain formal solutions to iterative functional equation $f(f(x))=x$ by using extended dimensioned numbers.

4 Akira Ushijima (Kanazawa Univ.), Toshihiro Nakanishi (Shimane Univ.) — Existence of exceptional points for cofinite Fuchsian groups ····· 15

Summary: It is shown by Fera that there exist uncountably many exceptional points for cocompact Fuchsian groups. We generalize this result to the case that the Fuchsian group is cofinite.

5 Takayuki Watanabe (Kyoto Univ.), Hiroki Sumi (Kyoto Univ.) — Dichotomy of Markov random dynamical systems of rational maps ··· 15

Summary: We consider random holomorphic dynamical systems on the Riemann sphere whose choices of maps are related to "Markovian" noise. Our motivation is generalizing the theory of i.i.d. random dynamical systems to our setting. We show that a generic such system is either stable on average or chaotic with full Julia set. We also talk about difference between i.i.d. and non-i.i.d. random dynamical systems.

6 Masashi Kisaka (Kyoto Univ.) — Fatou–Shishikura inequality for transcendental entire functions in class $\mathcal{S}$ ····· 15

Summary: We discuss the following realizability problem: For given numbers which satisfy the Fatou–Shishikura inequality, is there a transcendental entire functions in class $\mathcal{S}$ with the given numbers of Fatou components?

7 Joe Kamimoto (Kyushu Univ.), Toshihiro Nose (Fukuoka Inst. of Tech.) — On the maximal region to which local zeta functions can be meromorphically extended ····· 15

Summary: It is known that local zeta functions associated with real analytic functions can be analytically continued as meromorphic functions to the whole complex plane. But, in the case of general smooth functions, it has been recently shown that there exist specific smooth functions whose local zeta functions have singularities different from poles. In order to understand the situation of the meromorphic extension in the smooth case, we investigate a simple but essentially important case, in which the respective function is expressed as $u(x,y)x^ay^b+$ flat function, where $u(0,0)\neq 0$ and a,b are nonnegative integers.

8 Toshihiro Nose (Fukuoka Inst. of Tech.)
Joe Kamimoto (Kyushu Univ.)
On non-polar singularities of local zeta functions 15

Summary: In this talk, we investigate asymptotic limits of local zeta functions associated with specific (non-real analytic) smooth functions at some singularities along one direction. It follows from these behaviors that these local zeta functions have singularities different from poles, which gives the optimality of the lower estimates of an invariant concerning with meromorphic continuation of local zeta functions in the case of smooth functions of the form investigated in the previous talk.

14:15–15:20

9 Takanori Ayano (Osaka City Univ.)
Victor M. Buchstaber (Steklov Inst. of Math.)
Series expansion of two-dimensional sigma function based on the heat equations 15

Summary: Weierstrass gave the heat equations which characterize the elliptic sigma function. Buchstaber and Leykin succeeded in generalizing the theory of the heat equations to the sigma functions of higher genus curves. Eilbeck, Gibbons, Onishi, and Yasuda gave the detailed proof of their theory. They also gave the recurrence relations of the coefficients of series expansion of the two-dimensional sigma function. In this talk, we derive new recurrence relations of series expansion of the two-dimensional sigma function based on the heat equations. Our recurrence relations take the form in which all the parameters of the curve are included. As a corollary, we can find that the two-dimensional sigma function is characterized by a part of the heat equations.

10 Atsushi Hayashimoto (Nagano Nat. Coll. of Tech.)
Automorphism group and isometry group of Hua domains 15

Summary: For proper holomorphic polynomial mappings between Hua domains, we show that two such mappings are isotropic equivalence if and only if they are automorphic equivalence.

11 Hidetaka Hamada (Kyushu Sangyo Univ.)
Distortion theorems, Lipschitz continuity and their applications for Bloch type mappings on bounded symmetric domains in $\mathbb{C}^n$ 15

Summary: Let $\mathbb{B}_X$ be a bounded symmetric domain realized as the unit ball of an n-dimensional JB*-triple $X = (\mathbb{C}^n, \|\cdot\|_X)$. In this talk, we give a new definition of Bloch type mappings on $\mathbb{B}_X$ and give distortion theorems for Bloch type mappings on $\mathbb{B}_X$. As a corollary of the distortion theorem, we obtain the lower estimate for the radius of the largest schlicht ball in the image of f centered at $f(0)$ for α-Bloch mappings f on $\mathbb{B}_X$. Next, as another corollary of the distortion theorem, we show the Lipschitz continuity of $(\det B(z,z))^{1/2n}|\det Df(z)|^{1/n}$ for Bloch type mappings f on $\mathbb{B}_X$ with respect to the Kobayashi metric, where $B(z,z)$ is the Bergman operator on X, and use it to give a sufficient condition for the composition operator C_φ to be bounded from below on the Bloch type space on $\mathbb{B}_X$, where φ is a holomorphic self mapping of $\mathbb{B}_X$.

12 Ian Graham (Univ. of Toronto)
Hidetaka Hamada (Kyushu Sangyo Univ.)
Gabriela Kohr (Babeş-Bolyai Univ.)
Loewner chains, Bloch mappings and Pfaltzgraff–Suffridge extension operators on bounded symmetric domains 15

Summary: Let Y be a complex Banach space and let $\mathbb{B}_Y$ be the open unit ball of Y. In this talk, we consider a generalization of the Pfaltzgraff–Suffridge extension operator on bounded symmetric domains $\mathbb{B}_X$ in $\mathbb{C}^n$, and show that this operator extends the first elements of Loewner chains from $\mathbb{B}_X$ to the first elements of Loewner chains on $\mathbb{D}_\alpha$, when $\alpha \geq n/(2c(\mathbb{B}_X))$, where $\mathbb{D}_\alpha \subset \mathbb{B}_X \times \mathbb{B}_Y$ is a certain domain with $\mathbb{B}_X \times \{0\} \subset \mathbb{D}_\alpha$ and $c(\mathbb{B}_X)$ is a constant defined by the Bergman metric on X. Next, we also show that normalized locally univalent I-Bloch mappings, which have finite trace order on $\mathbb{B}_X$, are mapped into R-Bloch mappings on Ω_α by this extension operator when $\alpha \geq 1/2$, where $\Omega_\alpha \subset X \times Y$ is a bounded balanced convex domain such that $\mathbb{B}_X \times \{0\} \subset \Omega_\alpha \subset \mathbb{D}_\alpha$.

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

Yohei Komori (Waseda Univ.) Growth of hyperbolic Coxeter groups

Summary: In this talk I will give an overview of recent progress on arithmetic aspects of growth related to hyperbolic Coxeter groups.

16:50–17:50 Award Lecture for the 2019 MSJ Analysis Prize

Hiroki Sumi (Kyoto Univ.) Various randomness-induced phenomena and their mechanisms in random holomorphic dynamical systems

Summary: We consider random holomorphic dynamical systems. In particular, we see various randomness-induced phenomena in random holomorphic dynamical systems which cannot hold in the deterministic random holomorphic dynamical systems.

March 17th (Tue) Conference Room VIII

9:15–11:45

13 Shinichi Tajima (Niigata Univ.*)
Takafumi Shibuta (Kyushu Sangyo Univ.)
Katsusuke Nabeshima (Tokushima Univ.)
A computation method of logarithmic vector fields associated to isolated complete intersection singularities 15

Summary: Logarithmic vector fields of a complete intersection are important objects with many applications. However, its computation is hard, as a number of open questions and challenges indicate. In this talk logarithmic vector fields associated to isolated complete intersection singularities are considered. A computation method for computing the logarithmic vector fields is introduced.

14 Tomoko Shinohara (Tokyo Metro. Coll. of Ind. Tech.) Local stable set of an indeterminate point of rational mappings of two complex variables 15

Summary: In this talk, we study local dynamics of a rational mapping of two complex variables at an indeterminate point. It is known that for some Newton's method of two variables there exist a Cantor bouquet and a local stable set at an indeterminate point. We define the order of a rational mapping at an indeterminate point and give a sufficient condition that the rational mapping becomes to be a horizontal-like mapping. By using this order, we construct a local stable set of an indeterminate point for general rational mappings.

15 Yukitaka Abe (Univ. of Toyama) Isogenies between commutative complex Lie groups 10

Summary: We study isogenies between connected commutative complex Lie groups.

16 Yukitaka Abe (Univ. of Toyama) Meromorphic function fields closed by partial derivatives 15

Summary: We characterize meromorphic function fields closed by partial derivatives in n variables.

17 Takayuki Koike (Osaka City Univ.) Hermitian metrics on the anti-canonical bundle of the blow-up of the projective plane at nine points 15

Summary: We investigate Hermitian metrics on the anti-canonical bundle of a rational surface obtained by blowing up the projective plane at nine points. For that purpose, we pose a modified variant of an argument made by Ueda on the complex analytic structure of a neighborhood of a subvariety by considering the deformation of the complex structure.

Summary: The Diederich–Fornæss and Steinness indices are estimated for weakly pseudoconvex domains in complex manifolds by using the D'Angelo 1-form of the boundary. In particular, CR invariance of these indices is shown when the domain is Takeuchi 1-convex.

Summary: We investigate Stein morphisms and the pseudonorms on direct images of pluricanonical bundles. Our main goal in this talk is to show that the pseudonorms determine holomorphic structures of Stein morphisms. One important technique is an $L^{2/m}$ variant of the Ohsawa–Takegoshi extension theorem.

Summary: I will give a simplified proof of an optimal version of the Ohsawa–Takegoshi L^2-extension theorem. In the proof, I use a method of Berndtsson–Lempert and skip some argument by the method of McNeal–Varolin. As an application, I will explain a result on extensions from possibly non-reduced varieties.

Summary: L^2 methods for extending holomorphic sections of semipositive bundles are applied to show the holomorphic convexity of complex spaces under several conditions.

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

Summary: The study of certain positively curved varieties, which are often formulated with positivity of bisectional curvatures, tangent bundles, or anti-canonical divisors, occupies an important place in the theory of classification of varieties. One of the central problems in this study is to determine the structure of semi-positively curved varieties in terms of naturally associated fibrations such as Albanese maps, Iitaka fibrations, or maximally rationally connected fibrations. In this talk, I would like to discuss structure theorems for projective varieties (more generally compact Kähler manifolds) satisfying various positivity conditions. More specifically, I will explain structure theorems of maximally rationally connected fibrations for varieties satisfying the following conditions: (1) Projective manifolds with tangent bundle admitting positively curved singular hermitian metrics. (2) Projective manifolds with semi-positive holomorphic sectional curvature. (3) Projective KLT pairs with nef anti-canonical bundle. The proof is based on singular hermitian metrics on vector bundles, analytic positivity of direct image sheaves, the theory of foliations, and so on. A part of this talk is a joint work with F. Campana (Lorraine), J. Cao (Jussieu), M. Iwai (Tokyo), G. Hosono (Tohoku).

Functional Equations

March 16th (Mon) Conference Room III

9:00–12:00

1 Hiroto Inoue (Kyushu Univ.) The exponential matrix solution and power series solution of the matrix-valued Bratu equation · · · · · 10

Summary: The Bratu equation is a nonlinear ordinary differential equation arising originally from the Frank–Kamenetskii's combustion theory. In a mathematical contexts, the Bratu equation appears as the simplest case of the finite Toda lattice, whose an elaborate theory for the initial value problem exists. It also appears as the radial part of the 2-dimensional Liouville equation. The boundary value problem of the Liouville equation is called the Liouville–Bratu–Gelfand problem and its interesting solution structures are widely studied. In this talk, we define a matrix-valued extension of the Bratu equation and give its power series solution.

2 Daichi Komori (Hokkaido Univ.) The construction of the morphism of sheaves from pseudodifferential operators to their symbols via Čech–Dolbeault cohomology · · · · · 10

Summary: For the study of the sheaf $\mathscr{E}_X^{\mathbb{R}}$ of pseudodifferential operators, Kataoka and Aoki established the symbol theory $\mathfrak{S}/\mathfrak{N}$ of $\mathscr{E}_X^{\mathbb{R}}$ by the aid of the Radon transformations. They constructed the isomorphism $\sigma : \mathscr{E}_{X,z^*}^{\mathbb{R}} \to \mathfrak{S}_{z^*}/\mathfrak{N}_{z^*}$ of stalks. However, they hadn't shown the equivalence of $\mathscr{E}_X^{\mathbb{R}}$ and its symbol class, since the morphism of stalks constructed by them cannot be directly extended to the one of sheaves. In this talk we construct the morphism of sheaves from $\mathscr{E}_X^{\mathbb{R}}$ to $\mathfrak{S}/\mathfrak{N}$, which is an isomorphism of sheaves, by using the theory of Čech–Dolbeault cohomology introduced by Honda, Izawa and Suwa.

3 Masatoshi Suzuki (Tokyo Tech) On a system of partial differential equations and entire functions of Hermite–Biehler class · · · · · 10

Summary: We present an initial value problem for a system of first-order partial differential equations in two variables and explain the relationship with entire functions of Hermite–Biehler class.

4 Hidetoshi Tahara (Sophia Univ.) Uniqueness of the solution of nonlinear singular first order partial differential equations · · · · · 10

Summary: In this talk, I will consider a class of nonlinear singular first order partial differential equations, and show the uniqueness of the solution under a very weak assumption.

5 Yukihide Tadano (Univ. of Tokyo)
Shu Nakamura (Gakushuin Univ.) On a continuum limit of discrete Schrödinger operators on square lattices · · · · · 10

Summary: We consider a continuum limit problem of Schrödinger operators. The motivation comes from the two questions: How to formulate the continuum limit problem from the view point of spectral theory, and whether the formulated problem is solved. In this talk, we obtain positive answers to both questions, and we see that the continuum limit holds for a large class of potentials including uniformly continuous bounded potentials and the harmonic potentials.

6 Kenichi Ito (Univ. of Tokyo)
Arne Jensen (Aalborg Univ.) Hypergeometric expression for resolvent of the discrete Laplacian in low dimension · · · · · 10

Summary: We discuss an explicit formula for resolvent of the discrete Laplacian on the square lattice, and compute its asymptotic expansions around thresholds in low dimensions. We obtain an expression of the resolvent in a general dimension employing the Appell–Lauricella hypergeometric function of type C outside a disk encircling the spectrum. In low dimensions it reduces to a generalized hypergeometric function, for which certain transformation formulas are available.

Summary: We define a monodromy preserving deformation which has a special solution in terms of a generalization of q-hypergeometric functions. Also, we obtain its affine Weyl group symmetry. In this talk, we introduce the monodromy preserving deformation and give its symmetry.

Summary: In this talk, we consider the WKB theoretic transformation of a certain Schrödinger equation to the boosted Airy equation. As a result, we find that the transformation series can be constructed and that the relation between their WKB solutions formally holds.

Summary: The Voros coefficients at the origin and at the infinity are defined and their explicit forms are given for the generalized hypergeometric differential equation of ${}_pF_q$ with a large parameter.

Summary: We solve the Cauchy problem for the μ-Camassa–Holm integro-partial differential equation introduced by Khesin–Lenells–Misiołek in the analytic category. We show the existence of a unique global-in-time analytic solution.

Summary: In this talk, we consider the half-linear difference equation $\Delta(r_n\Phi_p(\Delta x_n)) + c_n\Phi_p(x_{n+1}) = 0$, where r_n, c_n are real-valued sequences, $r_n > 0$ for $n \in \mathbb{N}\cup\{0\}$, and $\Phi_p(x) = |x|^{p-2}x$ with $p > 1$ and $\mathbb{N}$ is the set of natural numbers. The purpose of this talk is to give new criteria which guarantee that all non-trivial solutions of the half-linear difference equation are nonoscillatory. We obtain the desired results by using the method of Riccati technique.

Summary: In this talk an attempt is made to depict a clear picture of the overall structure of nonoscillatory solutions of the second order half-linear differential equation (E) $(p(t)\varphi_\alpha(x'))' + q(t)\varphi_\alpha(x) = 0$, where $\alpha > 0$ is a constant, $p(t)$ and $q(t)$ are positive continuous functions on $[0,\infty)$, and $\varphi_\gamma(u) = |u|^\gamma \operatorname{sgn} u$, $u \in \mathbb{R}$, $\gamma > 0$. A special mention should be made of the fact that all possible types of nonoscillatory solutions of (E) can be constructed by solving the Riccati type differential equaitons associated with (E).

Summary: We consider the global and local behavior of bifurcation curves of semilinear eigenvalue problems, in which some special oscillatory nonlinearities and bifurcation parameter λ are included. Let $\alpha = \|u_\lambda\|_\infty$ be the maximum norm of the solution u_λ associated with λ. Then in our situation, λ is a continuous function of $\alpha > 0$. Therefore, we write $\lambda = \lambda(\alpha)$. The goal of this talk is to establish the precise asymptotic formulas for $\lambda(\alpha)$ as $\alpha \to \infty$ and $\alpha \to 0$ with the exact second and third terms by using time-map method and stationary phase method.

14 Yutaka Kamimura (Tokyo Univ. of Marine Sci. and Tech.) — Energy dependent reflectionless inverse theory and method ····· 10

Summary: We give a reflectionless inverse scattering theory on an energy dependent Schrödinger equation and, based on it, develop an inverse scattering method for an isospectral flow for the equation.

14:15–16:15

15 Shingo Takeuchi (Shibaura Inst. of Tech.), Kohtaro Watanabe (Nat. Defense Acad. of Japan) — Lyapunov-type inequalities for a Sturm–Liouville problem of the one-dimensional p-Laplacian ····· 10

Summary: We will give Lyapunov-type inequalities for a Sturm–Liouville problem of the one-dimensional p-Laplacian. In the linear case of $p = 2$, Borg and Ha showed the Lyapunov-type inequalities by the self-adjoint property of an operator and the Green function for a boundary value problem. However, no one has ever extended those inequalities to the nonlinear case $p \neq 2$. Using another approach and the generalized trigonometric functions, we will establish those inequalities. Moreover, an inequality we obtained yields the best constant for the Sobolev embedding $W_0^{1,p} \hookrightarrow L^\infty$.

16 Tatsuki Mori (Musashino Univ.), Kousuke Kuto (Waseda Univ.), Yasuhito Miyamoto (Univ. of Tokyo), Tohru tsujikawa (Univ. of Miyazaki), Shoji Yotsutani (Ryukoku Univ.*) — Parametric representation of a sheet constructed by all solution to a nonlocal Allen–Cahn equation ····· 10

Summary: We are interested in the Neumann problem of a 1D stationary Allen–Cahn equation with a nonlocal term. We have obtained the global bifurcation diagram of stationary solutions, which includes the secondary bifurcation from the odd symmetric solution due to the symmetric breaking effect. Furthermore, we derives the stability/instability of all symmetric solutions. However, stability/instability of asymmetric solutions is not clarified. In this talk, we give new representation formula of a sheet consisted of all solutions to investigate stability/instability of asymmetric solutions.

17 Kenichiro Umezu (Ibaraki Univ.), Uriel Kaufmann (Univ. Nacional de Córdoba), Humberto Ramos Quoirin (Univ. de Santiago de Chile) — Global exact multiplicity of positive solutions for an indefinite sublinear Robin problem ····· 10

Summary: In this talk we consider an indefinite sublinear elliptic problem with a Robin boundary condition. We aim to provide a precise description of the positive solutions set for this problem, especially proving a global exact multiplicity result for positive solutions. Our methods rely on a priori bounds for positive solutions, the linear stability argument, bifurcation approach, and sub and supersolutions.

18 Yohei Sato (Saitama Univ.), Xiaojun Chang (Northeast Normal Univ.) — Localized solutions of nonlinear Schrödinger systems with critical frequency for infinite attractive case ····· 10

Summary: We consider the singular perturbation problem of the nonlinear Schrödinger system for infinite attractive case. We construct localized solutions concentrating around a local minimun of some function $b(V_1(x), V_2(x))$ which depends on the two potential functions V_i $(i = 1, 2)$. In particular we also consider the case where local minimum value of $b(V_1(x), V_2(x))$ is 0. We make clear that, when dimension $N = 1, 2$, $b(V_1(x), V_2(x)) = 0$ if and only if $V_1(x) = 0$ and $V_2(x) = 0$, when $N = 3$, $b(V_1(x), V_2(x)) = 0$ if and only if $V_1(x) = 0$ or $V_2(x) = 0$.

19 Lorenzo Cavallina (Tohoku Univ.) On the two-phase isoperimetric problem 10
Antoine Henrot
(Inst. Elie Cartan de Lorraine/Univ. de Lorraine)
Shigeru Sakaguchi (Tohoku Univ.)

Summary: In this talk, we will deal with a variation of the classical isoperimetric problem in dimension $N \geq 2$ for a two-phase piecewise continuous density whose discontinuity interface is a given hyperplane. We consider a weighted perimeter functional with three different weights, one for the hyperplane and one for each of the two open half-spaces in which $\mathbb{R}^N$ gets partitioned. We then consider the problem of characterizing the sets Ω that minimize this weighted perimeter functional under the additional constraint that the volumes of the portions of Ω in the two half-spaces are given. We will provide a complete classification of the minimizers depending on the various parameters of the problem.

20 Shigeru Sakaguchi (Tohoku Univ.) A characterization of the interface with constant temperature in two-phase heat conductors 10
Lorenzo Cavallina (Tohoku Univ.)
Seiichi Udagawa (Nihon Univ.)

Summary: We consider the Cauchy problem for the heat diffusion equation in the whole Euclidean space consisting of two media with different constant conductivities, where initially one has temperature 0 and the other has temperature 1. Suppose that the interface is connected and uniformly of class C^6. We show that if the interface has a time-invariant constant temperature, then it must be a hyperplane.

21 Yuki Tsukamoto (Tokyo Tech) Existence of a prescribed anisotropic mean curvature problem 10

Summary: We consider a prescribed mean curvature problem. In particular, we want to construct a surface whose mean curvature vector coincides with the normal component of a given vector field. We show that the problem has a solution near a graphical minimal surface if the prescribed vector field is sufficiently small in a dimensionally sharp Sobolev norm.

22 Kensuke Yoshizawa (Tohoku Univ.)$^{\flat}$ Existence and non-existence of elastic graphs with the symmetric cone obstacle 10

Summary: This talk is concerned with the variational problem for the bending energy defined on symmetric graphs under the unilateral constraint. In this talk, assuming that the obstacle function satisfies the symmetric cone condition, we prove (i) uniqueness of minimizers, (ii) loss of regularity of minimizers, and give (iii) complete classification of existence and non-existence of minimizers in terms of the size of obstacle.

16:30–17:30 Award Lecture for the 2019 MSJ Analysis Prize

Hidetaka Sakai (Univ. of Tokyo) The world of the Painlevé equations

Summary: More than a century has passed since the Painlevé equations appeared as equations that defines the special functions next to elliptic functions and hypergeometric functions. I have been studying the extension of the Painlevé equations to discrete dynamical systems or higher dimensional cases. In this talk we will see the extended world of the Painleé equations.

March 17th (Tue) Conference Room III

9:00–12:00

23 Naoki Hamamoto (Osaka City Univ.) Sharp Rellich inequality for vector-valued functions under the solenoidal condition · · · · · 10

Summary: We show Rellich inequality with sharp constant for vector valued function under solenoidal (namely divergence-free) condition. This is a continuation of the preceding work by N. Hamamoto on sharp Rellich–Leray inequality for axisymmetric divergence-free vector fields. Our main result asserts that the sharp constant can be derived without the axisymmetry condition which was used in the preceding work for technical reason. We remove such a symmetry condition and compute the best constant. Our technique is based on an appropriate $L^2(\mathbb{S}^{N-1})$ decomposition of solenoidal fields into radial and spherical directions, which does not depend on the choice of polar angular coordinates.

24 Megumi Sano (Hiroshima Univ.) Minimization problem associated with an improved Hardy–Sobolev type inequality · · · · · 10

Summary: We consider the existence and the non-existence of a minimizer of minimization problems associated with an improved Hardy–Sobolev type inequality. Only for radial functions, the improved Hardy–Sobolev inequality is equivalent to the classical Hardy–Sobolev inequality via some transformation. Therefore we completely know the existence and the non-existence of a minimizer of our minimization problem only for radial functions via the transformation. In this talk, we consider it for all functions without the transformation. Especially, in contrast to the classical results, we show the existence of a minimizer for our minimization problem with the Hardy–Sobolev critical exponent on a bounded domain.

25 Takeshi Suguro (Tohoku Univ.) ♭ Shannon's inequality for a generalized entropy and an application to the uncertainty principle · · · · · 10

Summary: We consider Shannon's inequality for the Rényi entropy, which is a generalization of the Boltzmann–Shannon entropy. By using some relative entropies, we identify the sharp constant and the extremal of this inequality. Moreover, we derive an extension of the Heisenberg uncertainty principle.

26 Shoya Kawakami (Saitama Univ.)
Takeyuki Nagasawa (Saitama Univ.) Estimates on variational formulae of O'Hara's energies · · · · · 10

Summary: O'Hara's energies, introduced by O'Hara, were proposed to answer the question, "What is the canonical knot in a given knot class?". One of O'Hara's energies is named the Möbius energy as a result of its Möbius invariance. Several researchers have derived the first variational formula of O'Hara's energies in the terms of Cauchy's principal value integral. Subsequently, for a certain family of O'Hara's energies which includes the Möbius energy, Ishizeki–Nagasawa found expressions for the first and second variational formulae in terms of absolutely convergent integrals. Their argument was based on an appropriate decomposition of the energies; however, such an approach is not applicable for all of O'Hara's energies. In this talk, we present an alternative method for deriving variational formulae enabling us to handle all of O'Hara's energies.

27 Aya Ishizeki (Chiba Univ.)
Takeyuki Nagasawa (Saitama Univ.) Upper and lower bounds and modulus of continuity of decomposed Möbius energies · · · · · 10

Summary: The Möbius energy is one of knot energies, and is named after its Möbius invariant property. It is known that the energy has several different expressions. One is in terms of the cosine of conformal angle, and this expression is called the cosine formula. Another is the decomposition into Möbius invariant parts, called the decomposed Möbius energy, which was proved by the authors. Hence the cosine formula is sum of the decomposed energies. There is a question. Can each of decomposed energy be estimated by the cosine formula ? Here we give an affricative answer: upper and lower bound, and modulus of continuity of decomposed parts can be evaluated in terms of the cosine formula.

Summary: Several non-local curvature flows for plane curve with general rotation number are considered here. The flows include the are-preserving flow and the length-preserving flow. The research for the curve with the rotation number one has been well studied. In particular, when the initial curve is strictly convex, the flow converges to a circle as time to infinity. Even if the initial curve is not strictly convex, a global solution, if exists, converges to a circle. Here we deal with curves with general rotation number, and show not only a similar result for global solutions but also a blow-up criteria, estimates of the blow-up time and blow-up rate from below. We use a geometric quantity which has never been considered before.

Summary: In this talk, we give a sufficient condition for the solvability of higher-order elliptic equations in maximal L^p-L^q regularity settings. First, conditions for coefficients and so-called Lopatinskii–Shapiro conditions are introduced. Furthermore, the asymptotic Lopatinskii–Shapiro condition is required to deal with the boundedness of the symbol operators. Next, we show our method to solve our problem.

Summary: This study aims to discuss the global existence of a target detection model with a moving target. We formulate the problem of a target detection model in drug delivery, which describes the behavior of bio-nanomachines, attractant, and repellent in a spatially 2-dimensional domain. Then, we consider the linear problem and provide the global solution under the smallness condition on the initial data. Furthermore, we obtain the strong solution in anisotropic Sobolev–Slobodetskii spaces.

Summary: We discuss a stationary diffusive logistic equation on a ball. This talk focuses on an open question that showing the upper bound of the ratio of a total population to total resources. In one-dimensional case, Bai–He–Li (2015) settled that the supremum is equal to 3 by finding a special sequence of diffusion coefficients and carrying functions, and moreover, the first speaker recently obtained profiles of solutions corresponding to the maximizing sequence. A new question is the following: What happens in higher-dimensional cases? This talk shows that the supremum is infinite on the spherical symmetry domain.

Summary: We consider the dynamical behaviors of a singular predator-prey model and give some new results on the spreading speed of the predator.

Summary: We give some results on the existence vs non-existence of traveling waves connecting the predator-free state to the co-existence state, and the existence vs non-existence of spatially periodic traveling waves to the singular predator-prey reaction diffusion system.

34 Tomoyuki Oka (Tohoku Univ.)
Goro Akagi (Tohoku Univ.)
Space-time homogenization for the fast diffusion equation 10

Summary: In this talk, we shall discuss a space-time homogenization problem for the fast diffusion equation with periodically oscillating (in space and time) coefficients. Main results consist of a homogenization theorem, i.e., convergence of solutions as the period of coefficients goes to zero, and a characterization of the homogenized equation. In particular, homogenized matrices are described in terms of solutions to cell-problems and depend on the log-ratio of spatial and temporal periods of the coefficients.

35 Kenta Nakamura (Tohoku Univ.)
Masashi Misawa (Kumamoto Univ.)
Tuomo Kuusi (Univ. of Helsinki)
Global existence for the p-Sobolev flow 10

Summary: In this talk, we study a doubly nonlinear parabolic equation arising from the gradient flow for p-Sobolev type inequality, referred as p-Sobolev flow from now on, which includes the classical Yamabe flow on a bounded domain in Euclidean space in the special case $p = 2$. We present the global existence of the p-Sobolev flow.

36 Mario Fuest (Paderborn Univ.)
Johannes Lankeit (Paderborn Univ.)
Masaaki Mizukami (Tokyo Univ. of Sci.)
Asymptotic behavior in a chemotaxis-consumption model with realistic boundary conditions for the oxygen 10

Summary: This talk considers global existence and asymptotic behavior in a chemotaxis-consumption system under realistic boundary conditions for the oxygen. In previous works a chemotaxis-consumption system under the Neumann boundary condition for the oxygen is mainly considered, and it is shown that solutions of the problem converge to constant steady states by Tao–Winkler (2012); however this result does not describe pattern formation of species. Thus it might be important to consider a chemotaxis-consumption system under realistic boundary conditions for the oxygen. This talk shows solutions of the problem converge to non-constant steady states.

37 Takashi Suzuki (Osaka Univ.)
A parabolic concavity maximum principle 5

Summary: Positive solutions to the parabolic equation on strictly convex domain preserve log concavity of the initial value.

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

Sohei Ashida (Gakushuin Univ.)
Accurate lower bounds for eigenvalues of electronic Hamiltonians

Summary: Electronic Hamiltonians are differential operators depending on relative positions of nuclei as parameters. When we regard an eigenvalue of an electronic Hamiltonian as a function of relative possitions of nuclei, minimum points corresponde to shapes of molecules. Upper bounds for eigenvalues are obtained by variational methods. However, since only relative energy is relevant to the physical information as minimum points, physical information can not be obtained by variational methods only. Therefore, lower bounds are helpful for physical information to be available. In this talk we discuss the various methods for lower bounds of eigenvalues. In particular, lower bounds for eigenvalues of sums of lower semibounded self-adjoint operators are introduced. Some computations for systems of one electron and several protons are shown.

March 18th (Wed) Conference Room III

9:00–12:00

38 Toshikazu Kuniya (Kobe Univ.) Threshold theorem for an SIR epidemic model with diffusion under the different boundary conditions · 10

Summary: In this study, we are concerned with a threshold theorem for an SIR epidemic model with diffusion. We consider two different boundary conditions: (homogeneous) Dirichlet and (homogeneous) Neumann boundary conditions. We show that if the basic reproduction number $\mathcal{R}_0$ satisfies $\mathcal{R}_0 < 1$, then the disease-free equilibrium E_0 of the model is globally asymptotically stable, whereas if $\mathcal{R}_0 > 1$, then E_0 is unstable and a positive endemic equilibrium E^* exists under an additional condition. We show that, under the Neumann boundary conditions, $\mathcal{R}_0$ does not depend on the shape of the spatial domain $\Omega \subset \mathbb{R}^2$, whereas, under the Dirichlet boundary conditions, $\mathcal{R}_0$ depends on the shape of Ω. More precisely, we show that such $\mathcal{R}_0$ can attain its maximum when Ω is a square domain.

39 Daesu Jeong (Nagoya Univ.) The role of forward self-similar solutions in the Cauchy problem for semi-linear heat equations with exponential nonlinearity · · · · · · · · · · · · 10

Summary: In this talk, we consider the Cauchy problem for semi-linear heat equations with exponential nonlinearity. The main purpose of this talk is to prove the existence of solutions lying on the borderline between global existence and blow-up infinite time. The existence has been shown for semi-linear heat equations with power type nonlinearity. We explain the main strategy to prove the existence. By using the definition of exponential function, we approximate the solution to exponential type equation by that to power type equation. Then we can use directly the knowledge for power type equation.

40 Kotaro Hisa (Tohoku Univ.)
Kazuhiro Ishige (Univ. of Tokyo)
Jin Takahashi (Tokyo Tech)
Existence of solutions for an inhomogeneous fractional semilinear heat equation · 10

Summary: We obtain necessary conditions and sufficient conditions on the existence of solutions to the Cauchy problem for a fractional semilinear heat equation with an inhomogeneous term. We identify the strongest spatial singularity of the inhomogeneous term for the solvability of the Cauchy problem.

41 Md Rabiul Haque (Tohoku Univ.)♭
Norisuke Ioku (Tohoku Univ.)
Takayoshi Ogawa (Tohoku Univ.)
Ryuichi Sato (Tohoku Univ.)
Critical existence to a convection-diffusion equation in a uniformly local lebesgue space · 10

Summary: We establish the local in time existence of classical solutions to the Cauchy problem of the convection-diffusion equations in uniformly local Lebesgue spaces. For the proof, we use uniformly local L^p–L^q estimate for some convolution operators and the Banach fixed point theorem.

42 Sachiko Ishida (Chiba Univ.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Weak stabilization in Keller–Segel systems with degenerate diffusion · 10

Summary: We focus on stabilization in Keller–Segel systems with degenerate diffusion. As to the known studies on the non-degenerate diffusion systems, Cao (2015) and Cieślak–Winkler (2017) obtained that $u(t) \to \overline{u_0} := \frac{1}{|\Omega|}\int_\Omega u_0$ in $L^\infty(\Omega)$ as $t \to \infty$ for small initial data. Moreover, for chemtaxis-Stokes systems with degenerate diffusion, Winkler (2015) found that $u(t) \to \overline{u_0}$ weakly* in $L^\infty(\Omega)$ as $t \to \infty$ by using a proof by contradiction. Although their argument by contradiction actually can be applied to our system, we present the same stabilization with direct proof. Moreover our proof can be applied to chemotaxis-Navier–Stokes systems, tumor invasion systems and generalized parabolic equations with L^1-conservation law.

Summary: We consider the initial value problem for the dispersive 2D quasi-geostrophic equation with critical and supercritical dissipation $(-\Delta)^{\alpha}\theta$ $(0 < \alpha \leqslant 1)$. We establish a unique global solution for a given initial data θ_0 which belongs to the scaling subcritical Sobolev space $H^s(\mathbb{R}^2)$ $(s > 2 - \alpha)$ if the size of dispersion parameter is sufficiently large. This phenomenon is so-called the global regularity. We also obtain the relationship between the initial data and the dispersion parameter, which ensures the existence of the global solution.

Summary: We consider a singular limit problem for the Cauchy problem of the Keller–Segel equation in a critical function space. We show that a solution to the Keller–Segel system in a scaling critical function space converges to a solution to the drift-diffusion system of parabolic-elliptic type (the simplified Keller–Segel model) in the critical space strongly as the relaxation time $\tau \to \infty$. For the proof of singular limit problem, we employ generalized maximal regularity for the heat equation and use it systematically with the sequence of embeddings between the interpolation spaces $\dot{B}^s_{q,\sigma}(\mathbb{R}^n)$ and $\dot{F}^s_{q,\sigma}(\mathbb{R}^n)$.

Summary: We introduce two structure-preserving finite difference schemes in two-dimensional space with the Voronoi mesh. By applying the energy method to these schemes, we show the unique existence of a solution for these and error estimates between these and strict solutions.

Summary: We consider the direct and inverse scattering problem of the local perturbation of an open periodic waveguide in the half plane. Our first aim is to show the well-posedness of the direct scattering problem under the suitable radiation condition for this setting. Our second aim is to solve the inverse scattering problem of determining the supprot of the perturbation function from scattering measurements.

Summary: Assuming initial data have small weighted $H^4 \times H^3$ norm, we show global existence of solutions to the Cauchy problem for systems of quasi-linear wave equations in 3D satisfying the null condition of Klainerman. Compared with the work of Christodoulou, our result assumes smallness of data with respect to $H^4 \times H^3$ norm having a lower weight. Our proof uses the ghost weight energy method due to Alinhac. In comparison with the proofs of Klainerman and Hörmander, we can limit the number of occurrences of the generators of hyperbolic rotations or dilations in the course of a priori estimates of solutions. This limitation allows us to obtain global solutions for radially symmetric data, when a certain norm with considerably low weight is small enough.

48 Tadahiro Oh (Univ. of Edinburgh)
Mamoru Okamoto (Shinshu Univ.)
On the well-posedness for the quadratic stochastic nonlinear wave equation with a rough noise in two dimensions ····· 10

Summary: We study the two-dimensional stochastic nonlinear wave equation (SNLW) with a quadratic nonlinearity, forced by a fractional derivative (of order $\alpha > 0$) of a space-time white noise. In particular, we show that the well-posedness theory breaks at $\alpha = \frac{1}{2}$ for SNLW, while the threshold is $\alpha = 1$ for the stochastic nonlinear heat equation (SNLH). This provides an example showing that SNLW behaves less favorably than SNLH.

49 Haruya Mizutani (Osaka Univ.)
Xiaohua Yao
(Central China Normal Univ.)
Resolvent and Strichartz estimates for fractional Schrödinger operators with Hardy potentials ····· 10

Summary: We discuss recent progress on uniform resolvent estimates of Kato–Yajima type and Strichartz estimates for fractional or higher-order Schrödinger operators with Hardy potentials involving subcritical coupling constants related to the best constant in the fractional Hardy inequality.

50 Tomoyuki Tanaka ♭
(Nagoya Univ./Chuo Univ./RIKEN/Keio Univ.)
Masahiro Ikeda (RIKEN/Keio Univ.)
Kyouhei Wakasa
(Kushiro Nat. Coll. of Tech.)
Global well-posedness for the wave equation with a time-dependent scale invariant damping and a cubic convolution ····· 10

Summary: In this talk, we consider global well-posedness for the wave equation with a time-dependent scale invariant damping, i.e., $\frac{2}{1+t}\partial_t u$ and a cubic convolution $(|x|^{-\gamma} * u^2)u$, where $0 < \gamma < n$. For a power type nonlinearity, the work of D'Abbicco, Lucente and Reissig shows that a critical exponent, which divides global existence and blow-up for small solutions, is shifted because of the presence of the damping term. Our aim of this work is to determine two types of critical exponents of the problem with the cubic convolution. The one is for compactly supported initial data. The second is a critical exponent about the spatial decay condition on the data.

51 Yoshiyuki Kagei (Tokyo Tech)
Hiroshi Takeda (Fukuoka Inst. of Tech.)
Large time behavior of global solutions to nonlinear elastic wave equations with strong damping term ····· 10

Summary: In this talk we consider the Cauchy problem of quasi-linear elastic wave equations with the strong damping term. We prove the existence of the global solution with decay property and its asymptotic profile is given by the diffusion waves as time tends to infinity. Our proof is based on the combination of the semi-group theory and the energy method.

14:15–16:15

52 Isao Kato (Kyoto Univ.)
Shinya Kinoshita (Univ. Bielefeld)
On the 3D Zakharov system with radial initial data ····· 10

Summary: We study the Cauchy problem for the Zakharov system in three spatial dimensions. We prove the global well-posedness at the critical space with radially symmetric and small initial data by U^2, V^2 method introduced by Koch and Tataru. We follow the argument by Kato and Tsugawa, which was proved small data G.W.P. at the critical space for four and higher spatial dimensions. However, we need spherically symmetric data to obtain well-posedness at the critical space.

Summary: We consider the initial-value problem for Schrödinger maps with helicity terms. We prove the local well-posedness in two different settings: the general case and the topologically-free case. In the former case, we establish local well-posedness by applying the energy method of McGahagan with improving her argument. In the later case, we show additional properties for solutions, such as blow-up criterion, quantitative bounds and difference estimates. The key idea is the reduction of the problem to a kind of nonlinear Schrödinger equation, so-called the modified Schrödinger map equation. For its analysis, the treatment for magnetic potentials is required.

Summary: We consider a two-component system of cubic nonlinear Schrödinger equations in one space dimension. We show that each component of the solutions to this system behaves like a free solution in the large time, but there is a crucial restriction between the profiles of them. This turns out to be a possible consequence of non-trivial long-range nonlinear interactions.

Summary: We consider the Cauchy problem for nonlinear Schrödinger equations with anisotropic fourth-order dispersion. In this talk, we give sufficient conditions for the existence of blow-up solutions. In the proof, we use the localized virial identity which was introduced by T. Ogawa and Y. Tsutsumi (1991) to prove the existence of blow-up solutions to NLS with radial data. Since in our problem, equations have no radially symmetric structure in full spatial dimensions because of the anisotropic fourth-order term, we need to modify the argument.

Summary: We consider the Cauchy problem for the dissipative nonlinear Schrödinger equation with cubic nonlinearities in one space dimension. For the dissipative nonlinear term, the cubic nonlinearity in one space dimension is the threshold to exhibit the L^2-decay of solutions. We prove the existence for the global analytic solution and show the L^2-decay of the solution in the critical exponent.

Summary: We consider the Cauchy problems for nonlinear Schrödinger equations with an inverse-square potential $a|x|^{-2}$ and a repulsive harmonic oscillator $-\omega^2|x|^2$. Carles (2003) proved the well-posedness and solve the scattering problems for $a = 0$. We consider these problems for $a \neq 0$ by applying the pseudo-conformal type transform.

Summary: We deal with the nonlinear Schrödinger equation with a linear potential term. First, we consider a minimization problem with respect to the elliptic equation corresponding to the NLS. In order to apply to time behavior of solutions to the NLS, the minimization problem is not characterized by the Nehari functional but the virial functional. We prove existence of a minimizer of the problem in mass-supercritical and energy-subcritical case. Then, we consider time behavior of solutions to the NLS with initial data, whose action is less than the minimum value.

59 Noriyoshi Fukaya (Tokyo Univ. of Sci.)
Masayuki Hayashi (Kyoto Univ.)
Instability of algebraic standing waves for nonlinear Schrödinger equations with double power nonlinearities 10

Summary: We consider nonlinear Schrödinger equations with double power nonlinearities. This equation has two types of standing waves. One decays exponentially, and the other only decays algebraically. In this talk, we prove instability and strong instability of standing waves including algebraic standing waves. Our results extend previous results by Ohta (1995). He studied stability/instability of standing waves with exponential decay in one-dimensional case. We improve the instability results in previous works in one-dimensional case, and moreover establish new instability results in multi-dimensional cases. The key point in our approach is to take advantage of variational characterization of algebraic standing waves.

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

Kousuke Kuto (Waseda Univ.) Cross-diffusion limit in the stationary SKT model

Summary: This talk is concerned with the global bifurcation structure of coexistence steady-states to the Shigesada–Kawasaki–Teramoto model with cross-diffusion (so-called the SKT model). In 1999, Lou–Ni showed that the asymptotic behavior of coexistence steady-states as one of the cross-diffusion terms tends to infinity can be classified into two types (the segregation type and the shrink type). For the segregation type, the set of solutions to the corresponding limiting system (the 1st limiting system) has been revealed mainly by Lou–Ni–Yotsutani. This talk focuses on the shrink type and study the corresponding limiting system (the 2nd limiting system). We obtain the global bifurcation structure of positive solutions to the 2nd limiting system. Furthermore, by the perturbation of solutions of two limiting systems, we construct the bifurcation branch of coexistence steady-states to the SKT model in a case when one of the cross-diffusion terms is sufficiently large.

March 19th (Thu) Conference Room III

9:00–12:00

60 Shota Sakamoto (Tohoku Univ.)
Renjun Duan (Chinese Univ. of Hong Kong)
Shuangqian Liu (Central China Normal Univ./Jinan Univ.)
Robert M. Strain (Univ. Pennsylvania)
Solutions to initial and initial-boundary value problems of the non-cutoff Boltzmann equation near an equilibrium 10

Summary: We consider initial and initial-boundary value problems of the non-cutoff Boltzmann equation near the Maxwellian equilibrium on the three-dimensional torus. Especially we considered the specular boundary reflection condition and the inflow boundary condition for the IBVP. Using the Wiener space, we have succeeded in proving the unique global existence of solutions to these problems with energy estimates. Moreover, decay rates of these solutions are also shown.

61 Hirokazu Saito (Tokyo Univ. of Sci.)
Xin Zhang (Waseda Univ.)
On elliptic problems associated with two-phase incompressible flows in unbounded domains 10

Summary: In this talk, we consider elliptic problems associated with two-phase incompressible flows in unbounded domains. First, we prove the unique solvability of the strong elliptic problem (SEP). Next, by means of the solutions of (SEP), we prove the unique solvability of the weak elliptic problem (WEP). The result for (WEP) enables us to show the maximal regularity for a linearized system of the two-phase Navier–Stokes equations and some decomposition of Lebesgue spaces similar to the Helmholtz–Weyl decomposition.

Summary: This talk is concerned with a regularity criterion based on vorticity direction for the Navier–Stokes equations in a three-dimensional bounded domain under the no-slip boundary condition. It asserts that if the vorticity direction is uniformly continuous in space uniformly in time, then there is no type I blow-up. A similar result has been proved for a half space by Y. Giga, P.-Y. Hsu and Y. Maekawa (2014). The difficulty of extending this result to bounded domains lies in establishing a good L^∞ theory for the Navier–Stokes equations in a domain with curved boundary. This is achieved based on the L^∞ theory developed by K. Abe and Y. Giga (2013).

Summary: In this talk, we show the local-in-time unique existence of the linearized problem of the hyperbolic type Navier–Stokes equations in the three dimensional half-spaces under Dirichlet boundary condition. To do this, we add perturbation to the problem and show the unique existence of the solution to the perturbed equations. Then, by using a priori estimates, we can pass to the limit and thus we obtain the solution to the original equations.

Summary: In this talk, we consider the large time behavior of a viscous incompressible flow around a rotating rigid body. In particular, assume that both a compact rigid body in $\mathbb{R}^3$ and a viscous incompressible fluid that occupies the outside are at rest, and that the rigid body gradually increases the angular velocity and moves at a constant angular velocity after a certain time. Then we show that the fluid motion converges to the steady solution obtained by Galdi (2003) at time $t \to \infty$.

Summary: Consider the Cauchy problem of the Navier–Stokes equations with initial data in the Besov space. We construct the local solution in the Serrin class with the initial data in the Besov space. Conversely, if the local solution belongs to the Serrin class, the initial data necessarily belongs to the Beosv space. As a result, we are successful to determine the necessary and sufficient condition for the local existence of solution in the Serrin class.

Summary: We consider the Navier–Stokes equations on the whole space R^n. We discuss for any small initial data there exists an external force f which generates a rapid energy decay $\|u(t)\|_2 = o(t^{-\frac{n+2}{4}})$ as $t \to \infty$.

Summary: We consider the stationary Navier–Stokes equations in the two-dimensional torus. For every $\varepsilon > 0$ and $(p, q) \in ([1, 2) \times [1, \infty]) \cup (\{2\} \times [1, 2])$, we show the existence, uniqueness, and continuous dependence of solutions in homogeneous toroidal Besov spaces $\dot{B}^{-1+\frac{2}{p}}_{p+\varepsilon,q}(\mathbb{T}^2)$ (if $p = 2$, in $L^{2+\varepsilon}(\mathbb{T}^2)$) for given small external forces in $\dot{B}^{-3+\frac{2}{p}}_{p+\varepsilon,q}(\mathbb{T}^2)$. In addition, for the rest case of p and q, we show the ill-posedness caused by the discontinuity of the solution map.

Summary: The time periodic problem of the Navier–Stokes equations on a non-cylindrical space-time domain is studied. Motivated by a recent result by J. Saal (2006) on maximal regularity for this kind of system we construct time periodic solutions in L^q-spaces provided the bounded domain moves periodically with small amplitude and the given periodic external force is small. The proof is based on new decay estimates for the solution operator of parabolic evolution equations corresponding to the non-cylindrical space-time domain problem.

Summary: I would like to talk about the second Helmholtz decomposition in an exterior domain Ω in the N dimensional Euclidean space R^N. This decomposition is the based on the unique existence theorem for the weak Dirichlet problem. To obtain the unique existence theorem, the key is to definition of the underlying space $\hat{H}^1_{q,0}(\Omega)$.

Summary: I will talk about the local wellposedness of the isothermal compressible multi-component mixture flow in the L_p-L_q maximal regularity class. The equations are derived by the Maxwell–Stefan–Navier–Stokes theory, and the equations consist of the Navier–Stokes equations describing the compressible viscous fluid flow and diffusion equations. Since the diffusion part has 1 more unknown functions, we use the transformation of unknown functions introduced by V. Giovangigli to derive the Navier–Stokes equations coupled with a system of reaction diffusion equations. I consider the equations in a bounded domain with non-slip condition for the velocity field and homogeneous Neumann condition for the diffusion part. The proof is based on the maximal L_p-L_q regularity theorem for the linearized equations.

Summary: I will talk about the L_p-L_q maximal regularity theorem for a general linear parabolic system with Neumann type boundary conditions in a uniform C^2 domain. This equations arise in a mathematical study of isothermal compressible multi-component mixture flow based on the Maxwell–Stefan theory. The proof is based on the $\mathcal{R}$-solver for the corresponding generalized resolvent problem and Weis' operator valued Fourier multiplier theorem.

Summary: I introduce the notion of $\mathcal{R}$ solver for the generalized resolvent problem and explain how to prove the maximal regularity theorem for the high frequency part of the periodic solutions of the system of the parabolic equations with non-homogeneous boundary conditions, which includes Stokes system with the help of the transference theorem.

Summary: I would like to talk about the existence of periodic solutions for free boundary problem of the Navier–Stokes equations. We consider the case where unknown time dependent domain is bounded close to a ball and the support of time periodic external force is in this ball.

14:15–16:15

74 Senjo Shimizu (Kyoto Univ.) Takayoshi Ogawa (Tohoku Univ.) Maximal L^1-regularity for the parabolic initial-boundary value problem in the half-space 10

Summary: End-point maximal L^1-regularity for the parabolic initial-boundary value problem is considered in the half-space. For the inhomogeneous boundary data of both the Dirichlet and the Neumann type, maximal L^1-regularity for the initial-boundary value problem of parabolic equation is established in time end-point case upon the Besov space as well as the optimal trace estimates. We derive the almost orthogonal properties between the boundary potentials of the Dirichlet and the Neumann boundary data and the Littlewood–Paley dyadic decomposition of unity.

75 Tsukasa Iwabuchi (Tohoku Univ.) Pierre Germain (New York Univ.) Forward self-similar solutions for compressible Navier–Stokes equations 10

Summary: We construct forward self-similar solutions for compressible Navier–Stokes equations with radial symmetry. Some of these solutions are smooth, and the others exhibit a singularity due to vacuum.

76 Ryosuke Nakasato (Tohoku Univ.) Shuichi Kawashima (Waseda Univ.) Takayoshi Ogawa (Tohoku Univ.) Global well-posedness and time-decay estimates for the compressible Hall-magnetohydrodynamic system 10

Summary: We study the initial value problem for the compressible hall-magnetohydrodynamic system (hereinafter referred to hall-MHD) in the whole space. We first focus on the solution of the linearized system that are close to some constant state $(\bar{\rho}, 0, \bar{B})$ with a positive constant $\bar{\rho}$ and nonzero vector $\bar{B}$ at infinity. For general systems which include the standard linearized compressible magnetohydrodynamic system, Umeda–Kawashima–Shizuta (1984) obtained the pointwise estimates of solutions in the Fourier space. In this talk, we shall explain the results on global well-posedness and time-decay estimates for the hall-MHD around $(\bar{\rho}, 0, \bar{B})$. Furthermore, we shall show the pointwise estimate for the linearized hall-MHD that is the same as the result of Umeda–Kawashima–Shizuta. This is based on the joint work with Profs. Shuichi Kawashima and Takayoshi Ogawa.

77 Kai Koike (Keio Univ. / RIKEN) Long-time behavior of a pendulum in a 1D viscous compressible fluid 10

Summary: We consider the motion of a pendulum in a 1D viscous compressible fluid. The main theorem states that the displacement $X(t)$ of the pendulum from the equilibrium position decays with the power law $t^{-3/2}$. This partially explains the numerically observed long-time behavior of a pendulum in the BGK gas [Tsuji and Aoki, *J. Comput. Phys.*, 250: 574–600, 2013]. The basic tool for the analysis is the pointwise estimates of Green's function as in the case of a freely moving point mass [Koike, arXiv:1904.00992, 2019]. We also need to take into account a cancellation effect due to the oscillatory nature of the problem to obtain the presumably optimal decay rate.

78 Keiichi Watanabe (Waseda Univ.) Global solvability of the Navier–Stokes–Korteweg equations with a non-decreasing pressure in L^p-framework 10

Summary: In this talk, we consider the isentropic Navier–Stokes–Korteweg equations with a non-decreasing pressure on the whole space $\mathbb{R}^d$, $d \geq 2$, where the system describes the motion of compressible fluids such as liquid-vapor mixtures with phase transitions including a variable internal capillarity effect. We prove the global well-posedness of the system for small initial data belonging to $H^{s+1,q}(\mathbb{R}^d) \times H^{s,q}(\mathbb{R}^d)^d$ supposing that $s > d/q$ if $1 < q \leq d$ and that $s \geq 1$ if $d < q < \infty$. The proof relies on the maximal regularity property for the negative of the Laplace operator.

79 Masahiro Suzuki (Nagoya Inst. of Tech.) The Morrow model of gas discharge I: Stability analysis · · · · · · · · · · · · · 10
Atusi Tani (Keio Univ.*)

Summary: We study an initial boundary value problem to the Morrow model over a bounded interval. This problem has a trivial stationary solution for any voltage, which is adopted as a boundary condition. We show that there exists a threshold of voltage at which the trivial solution becomes from stable to unstable. This threshold can be understood as a sparking voltage for the happening of gas discharge.

80 Masahiro Suzuki (Nagoya Inst. of Tech.) The Morrow model of gas discharge II: Global bifurcation · · · · · · · · · · · 10
Walter Strauss (Brown Univ.)

Summary: We consider the steady states of a gas between two parallel plates that is ionized by a strong electric field so as to create a plasma. We use global bifurcation theory to prove that there is a curve of such states with the following property. The curve begins at the sparking voltage and either the particle density becomes unbounded or the curve ends at the anti-sparking voltage.

81 Masahiro Suzuki (Nagoya Inst. of Tech.) Justification of the Boltzmann relation · 10
Emmanuel Grenier (ENS de Lyon)
Yan Guo (Brown Univ.)
Benoit Pausader (Brown Univ.)

Summary: The classical Euler–Poisson system for electrons and ions, interacting through an electrostatic field, describes the motion of plasma. In a certain situation, physicists use a simpler system only for ions by assuming the Boltzmann relation. The simpler system can be derived by letting the mass ratio of an electron and an ion tend to zero. We justify this limit rigorously.

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

Jun-ichi Segata (Kyushu Univ.) Long time behavior of solution to the nonlinear Schrödinger equation with delta potential

Summary: We summarize recent progress on long time behavior of solution to the initial-value problem for the one dimensional nonlinear Schrödinger equation with a delta potential. We first consider the case where potential is repulsive and prove that small global solutions decay in L^∞ and exhibit (modified) scattering. Next we mention the case where potential is attractive and prove that for sufficiently small initial data, the corresponding global solution decomposes into a small solitary wave plus a radiation term that decays and scatters as $t \to \infty$. In particular, we establish the asymptotic stability of the family of small solitary waves.

Real Analysis

March 18th (Wed) Conference Room VIII

9:00–11:50

1 Toshiharu Kawasaki (Nihon Univ.)
Hiroko Manaka (Nihon Univ.)
The split feasibility problem with some projections in Banach spaces 15

Summary: In this talk, we treat with the split feasibility problem in some Banach spaces. We show that a solution of this problem is a solution of the equivalent equation defined by using some kinds of projections. Then we show a strong convergence theorem using the method in mathematical programing, in order to find a solution of the split feasibility problem in some Banach spaces.

2 Yukino Tomizawa (Niigata Inst. of Tech.)
Uniform convexity in distance spaces 15

Summary: It is thought that some distance space which are not linear spaces have properties such that the generalization of properties in linear spaces. However, it remains to be elucidated what geometrical properties exist in the spaces. Here we report the characterization of uniform convexity in Busemann spaces.

3 Hiroyasu Mizuguchi (Kansai Univ.)
A certain geometric constant and von Neumann–Jordan constant in Radon planes 15

Summary: The orthogonality relation in inner product spaces is interesting and investigated by a lot of mathematicians. Moving general normed spaces, there exist many generalized notions of orthogonality. Among these, we treat Birkhoff orthogonality. The orthogonality in inner product spaces is symmetric. However Birkhoff orthogonality in normed spaces is not so in general. If Birkhoff orthogonality is symmetric in a normed space whose dimension is at least three, then the space has a inner product. A two dimensional space in which Birkhoff orthogonality is symmetric is called Radon plane. We study the upper bound of a geometric constant in Radon plane. In addition, using this result, we estimate the von Neuamnn–Jordan constant in Radon plane.

4 Kichi-Suke Saito (Niigata Univ.)
Naoto Komuro (Hokkaido Univ. of Edu.)
Ryotaro Tanaka (Tokyo Univ. of Sci.)
A note on the structure of Radon spaces 15

Summary: Radon spaces are two-dimensional real normed spaces in which Birkhoff orthogonality is symmetric. We present a new characterization of Radon spaces, that is, every Radon space is isometrically isomorphic to special Day–James spaces generated by a pair of an absolute norm and its dual norm.

5 Toshiharu Kawasaki (Nihon Univ./Tamagawa Univ.)
Integrable functions for extended integration 15

Summary: In this talk, we describe the properties of a family of integrable functions for extended integration.

6 Ryoji Fukuda (Oita Univ.)
Aoi Honda (Kyushu Inst. of Tech.)
Yoshiaki Okazaki (Fuzzy Logic Systems Inst.)
Two non-discretizations for k-additivity of a monotone measure 15

Summary: The concept of the k-additive measure is originally defined for a non-additive measure on a finite set. We propose two types of non-discretization for the definition of k-additive measure: "Constructive k-additive measure" and "Formulaic k-additive measure". We found some their properties and relations.

7 Shohei Nakamura (Tokyo Metro. Univ.)
Jonathan Bennett (Univ. of Birmingham)
The tomography approach to the Fourier restriction theory 15

Summary: This talk is based on the joint work with Prof. Jonathan Bennett in University of Birmingham. In this talk, we will explain our new approach to the Fourier restriction theory by using the idea of the tomography. This approach leads us to several problems including one sitting between the restriction conjecture and the Kakeya conjecture, and another one which unifies the restriction conjecture and the Mizohata–Takeuchi conjecture (when dimension 2). We also give some applications of our approach to the weight theory for the Fourier extension operator.

8 Takeshi Iida (Fukushima Nat. Coll. of Tech.)
Weighted norm inequalities on Morrey spaces for the Orlicz-fractional maximal operators 15

Summary: In this talk, we discuss the weighted norm inequalities on Morrey spaces for the Orlicz-fractional maximal operators. We have investigated the boundedness of the weighted Lebesgue spaces and Morrey spaces for the Orlicz-fractional maximal operators and weighted estimates for the fractional integral and maximal operators in Morrey spaces. the main results which are based on these investigations give the estimates for the Orlicz-fractional maximal operators in Morrey spaces.

9 Ryota Kawasumi
Eiichi Nakai (Ibaraki Univ.)
Generalized fractional integral operators on weak Orlicz spaces 15

Summary: We consider the boundedness of the generalized fractional integral operator from a weak Orlicz space to another weak Orlicz space. We also consider some other operators.

10 Minglei Shi (Ibaraki Univ.)
Ryutaro Arai (Ibaraki Univ.)
Eiichi Nakai (Ibaraki Univ.)
Commutators of Calderón–Zygmund and generalized fractional integral operators with functions in generalized Campanato spaces on Orlicz–Morrey spaces 15

Summary: Let $\mathbb{R}^n$ be the n-dimensional Euclidean space. Let $b \in \mathrm{BMO}(\mathbb{R}^n)$ and T be a Calderón–Zygmund singular integral operator. In 1976 Coifman, Rochberg and Weiss proved that the commutator $[b,T] = bT - Tb$ is bounded on $L^p(\mathbb{R}^n)$ $(1 < p < \infty)$, that is, $\|[b,T]f\|_{L^p} = \|bTf - T(bf)\|_{L^p} \le C\|b\|_{\mathrm{BMO}}\|f\|_{L^p}$, where C is a positive constant independent of b and f. For the fractional integral operator I_α, Chanillo proved the boundedness of $[b, I_\alpha]$ in 1982. These results were extended to Orlicz spaces by Fu, Yang and Yuan (2012, 2014). In this talk we discuss the boundedness of the commutator $[b, I_\rho], [b, I_T]$ on Orlicz–Morrey spaces, where T is a Calderón–Zygmund operator, I_ρ is a generalized fractional integral operator and b is a function in generalized Campanato spaces.

14:15–15:55

11 Tsukasa Iwabuchi (Tohoku Univ.)
Bilinear estimates in Sobolev spaces associated with Dirichlet and Neumann Laplacian 15

Summary: We study the bilinear estimates in the Sobolev spaces with the Dirichlet and the Neumann condition. The optimal regularity will be revealed to obtain such estimates in the half space case.

12 Ryoichi Kunisada (Waseda Univ.)
On a continuous version of Banach limits 15

Summary: Banach limits are normalized positive bounded linear functionals on l_∞ of the set of bounded functions on natural numbers. We consider a cotinuous analogue of Banach limits defined on $L^\infty(\mathbb{R})$ and give a characterization of them in terms of invariance with respcet to convolution operators. We also discuss some applications.

13 Toru Nogayama (Tokyo Metro. Univ.) Yoshihiro Sawano (Tokyo Metro. Univ.) Local Muckenhoupt class for variable exponents ····· 15

Summary: In this paper, we define $A^{loc}_{p(\cdot)}$ and show that the weighted inequality for local Hardy–Littlewood maximal operator on the Lebesgue spaces with variable exponent. This work will extend the theory of Rychkov, who developed the theory of A^{loc}_{p} weights. Due to the setting of variable exponents, a new method of extension of weights will be needed; the extension method is different from the one by Rychkov.

14 Yoshihiro Sawano (Tokyo Metro. Univ.)$^{\flat}$ Cantor functions associated with generalized expansions ····· 15

Summary: The goal of this talk is to consider expansions generated by a sequence $\{h_n\}_{n=1}^{\infty}$, where $h_n \in \mathbb{N} \cap [2, \infty)$ for each n. We consider the generalized Cantor function and discuss its non-differentiable points.

15 Yoshihiro Sawano (Tokyo Metro. Univ.)$^{\flat}$ Sparse non-smooth atomic decomposition of Morrey spaces ····· 15

Summary: The goal of this talk is to refine the existing result on the decomposition of functions in Morrey spaces. As an application, we revisit the equivalence obtained by Adams.

16 Yoshihiro Sawano (Tokyo Metro. Univ.)$^{\flat}$ Tetsu Shimomura (Hiroshima Univ.) Modified Hardy–Littlewood maximal operator and modified fractional integral operator on metric measure spaces ····· 15

Summary: The goal of this talk is to simplify the example given by the first author in 2005. Recently Stempak constructed a simpler example showing that many results in a metric measure spaces fails unless they are modified suitably. Based on the idea of Stempak, we provide some further examples.

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

Gaku Sadasue (Osaka Kyoiku Univ.) Some martingale spaces and fractional integrals for martingale

Summary: In recent years, various new martingale spaces are introduced and structures of these spaces are studied. In this talk, we give some recent results on several martingale spaces. We also give some results on the boundedness of martingale transforms on these spaces. We especially study a special class of martingale transforms called fractional integrals.

March 19th (Thu) Conference Room VIII

9:00–12:00

17 Masaaki Mizukami (Tokyo Univ. of Sci.) Uniform-in-time convergence of solutions for a chemotaxis-competition model to those for the Lotka–Volterra competition model ····· 15

Summary: This work is concerned with the question that "how far does small chemotactic interaction perturb the Lotka–Volterra competition dynamics?". A two-species chemotaxis-competition model was studied by e.g., Bai–Winkler (2016) and Lin–Mu–Wang (2015). However, there are still many open problems about the two-species chemotaxis-competition model. On the other hand, the Lotka–Volterra competition model has been studied extensively. Thus the development of this work will enable us to see new properties of solutions for the chemotaxis system. The main result of this talk gives uniform-in-time convergence of solutions for the two-species chemotaxis-competition system to those for the Lotka–Volterra competition model.

18 Pierluigi Colli (Univ. of Pavia) Shunsuke Kurima (Tokyo Univ. of Sci.) Existence for a phase separation system deduced from the entropy balance ····· 15

Summary: This talk is concerned with a phase separation system deduced from the entropy balance. Both the viscous and the non-viscous cases are considered in the Cahn–Hilliard relations characterizing the phase dynamics. The entropy balance is written in terms of the absolute temperature and of its logarithm, appearing under time derivative. The initial and boundary value problem is considered for the system of partial differential equations. The existence of a global solution is proved via some approximations involving Yosida regularizations and a suitable time discretization.

19 Shunsuke Kurima (Tokyo Univ. of Sci.) A Cahn–Hilliard approach to a nonlinear diffusion chemotaxis system 15

Summary: This talk deals with a nonlinear diffusion chemotaxis system. Colli–Fukao (2015) proved existence of solutions to a Cahn–Hilliard system as an approximation of a nonlinear diffusion equation by applying the abstract theory by Colli–Visintin (1990) for doubly nonlinear evolution inclusions with some bounded monotone operator and some proper lower semicontinuous convex function. Moreover, Colli–Fukao (2016) established existence of solutions to the nonlinear diffusion equation by passing to the limit in the Cahn–Hilliard equation. However, Cahn–Hilliard approaches to nonlinear diffusion chemotaxis systems seem not to be studied. This talk will try to derive existence of solutions to a nonlinear diffusion chemotaxis system by passing to the limit in a Cahn–Hilliard type chemotaxis system.

20 Keiichiro Kagawa (Waseda Univ.), Mitsuharu Ôtani (Waseda Univ.) Asymptotic limits of the time-periodic problem for the viscous Cahn–Hilliard equation 10

Summary: We consider the asymptotic limits of the time-periodic problem for the viscous Cahn–Hilliard equation with the homogeneous Dirichlet boundary condition. We already reported about the asymptotic limits of the initial value problem for the viscous Cahn–Hilliard equation. It is shown that the Cahn–Hilliard equation and the Allen–Cahn equation are derived as the asymptotic limit of the viscous Cahn–Hilliard equation and hence we show the existence of the time-periodic solutions of their equations.

21 Chiharu Kosugi (Japan Women's Univ.), Toyohiko Aiki (Japan Women's Univ.) Existence of weak solutions to initial boundary value problems describing shrinking motion of elastic materials 15

Summary: In this talk we consider existence of weak solutions to an initial boundary value problem for beam equations. This problem describes a shrinking motion of elastic materials whose examples are rubber bands. The aims of this talk are to show an existence theorem of its weak solution and to present some numerical results for the approximation problems given as systems of ordinary differential equations. Also, we establish existence and unique of a solution to the system of ODE's by the fixed point theorem and convergence of numerical solutions.

22 Takahiro Kishida (Meijo Univ.), Yusuke Murase (Meijo Univ.) FEM analysis for mathematical model of adsorption phenomena in 1D domain 15

Summary: We study a mathematical model of adsorption phenomena in 1D domain. The model is free boundary problem which represent moisture adsorption phenomena in porous medium like a concrete. From recently researches, we got existence of unique time-local and global solution, existence of periodic solutions, large time behavior of solutions, and some numerical simulations. However, these numerical simulations are done with experimentally technics. So now we simulate and analyze this model by Free Element Method with Adaptive Moving Mesh Method. In this talk, we show some new numerical experiments and mathematical results.

23 Kazuki Shimura (Oita Univ.), Shuji Yosikawa (Oita Univ.) Structure-preserving finite difference schemes for a Cahn–Hilliard system coupled with elasticity 15

Summary: This study was made to observe the behavior of the solution by numerical analysis on the Cahn–Hilliard system coupled with elasticity (CHE), which is one of nonlinear partial differential equations, and summarizes the results obtained by the solution and error estimate includes the case where the viscosity coefficient is zero. CHE is a system of 4th order evolution equations for two unknowns describing a phenomenon in which a substance having a elastic property such as a phase separation. Although mathematical proofs of the existence and uniqueness of the solution are given, it has not been clarified the behavior of solution yet. Therefore, in this study, we demonstrate numerical simulations and error estimate. For the purpose, we use structure-preserving numerical methods that is expected to be stable and accurate.

24 Makoto Okumura (Osaka Univ.) A structure-preserving scheme for the Cahn–Hilliard equation with dynamic boundary conditions which has the total mass conservation 15

Summary: We propose a structure-preserving scheme for the GMS model by using the discrete variational derivative method (DVDM). In the model, two characteristic properties hold. One is the total mass conservation, which means that the sum of the mass in bulk and on the boundary is conserved. The other is the total energy dissipation, which represents the sum of energy in bulk and on the boundary decrease. In this study, we design a finite difference scheme for the GMS model so that the scheme inherits the properties from the original problem in a discrete sense. In this talk, we focus on the existence and uniqueness of the solution for the scheme.

25 Yoshimasa Sasaki (Niigata Univ.)
Ohwa Hiroki (Niigata Univ.) Existence and uniqueness of solutions to conservation laws with spatially discontinuous flux 15

Summary: We study the existence and uniqueness of solutions to conservation laws with spatially discontinuous flux functions.

26 Hiroshi Watanabe (Oita Univ.) Construction of traveling waves and asymptotic behavior of entropy solutions to scalar parabolic-hyperbolic conservation laws 15

Summary: We consider one-dimensional Cauchy problems (CP) for scalar parabolic-hyperbolic conservation laws. The equation is regarded as a linear combination of the hyperbolic conservation laws and the porous medium type equations. Thus, this equation has both properties of hyperbolic equations and those of parabolic equations. Accordingly, it is difficult to investigate the behavior of solutions to (CP). In this talk, we construct discontinuous traveling waves and discuss the properties of them. Moreover, we show the asymptotic behavior of entropy solutions to (CP) using the constructed traveling waves.

27 Yutaka Tsuzuki (Hiroshima Shudo Univ.) Existence for Initial-boundary value problems for Vlasov–Poisson equations with angle error in magnetic field 15

Summary: We deal with initial-boundary problems for Vlasov–Poisson systems in a half-space. In 2013, Skubachevskii provides local-in-time solvability to the system. Furthermore, in 2017, existence result with weaker condition were also obtained where the magnetic force is horizontal to the wall. This talk provides another result for the equation where the magnetic force has angle error in the vertical direction and depending on the first element of the spatial variable.

14:15–15:55

28 Noriaki Yamazaki (Kanagawa Univ.)
Nobuyuki Kenmochi (Chiba Univ.*)
Ken Shirakawa (Chiba Univ.) Control of parameter-dependent evolution equations governed by time-dependent subdifferentials 15

Summary: We consider nonlinear parameter-dependent evolution equations governed by double time-dependent subdifferentils in uniformly convex Banach spaces. In this talk, we investigate singular optimal control problems for doubly nonlinear parameter-dependent evolution state equations. Then, we show the existence of an optimal control for our problem.

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

Summary: In this talk, we consider a one-dimensional Kobayashi–Warren–Carter type system, which is based on a phase-field model of grain boundary motion. This talk corresponds to a continuation of the last presentation at MSJ Spring Meeting 2019 (Tokyo), which was concerned with the uniqueness of special kind of solution, named "crystalline solution". On this basis, we here focus on the existence issue of crystalline solution. Through the precise observations for solutions to a time-discretization scheme, a class of structural conditions for the initial data will be presented as the sufficient condition for the existence of crystalline solution.

Summary: In cold regions, buildings that are exposed to extremely low temperatures undergo freezing and build microscopic ice lenses that lead to the mechanical damage of the material. In this talk, we consider a mathematical model describing swelling of a pocket of water to understand the formation of ice lenses growing inside of porous materials. Our problem is posed on a halfline with a moving boundary at one of the ends, and the moving boundary conditions encode the swelling mechanism, while a diffusion equation is responsible for providing water content for the swelling to take place. In this talk, we discuss the existence and uniqueness, large time behavior of a solution to our problem.

Summary: In this talk, we will treat the Cahn–Hilliard equation with a dynamic boundary condition of Allen–Cahn type. We focus on the analysis of the surface diffusion on the dynamic boundary condition. By the asymptotic analysis, we can expect that the solution with the surface diffusion converges to the one of without the surface diffusion in a sense. The role of the surface diffusion will be expressed by means of the classes of the solutions.

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

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

Keisuke Takasao ♭ (Kyoto Univ./Kyoto Univ.)

On the existence of the weak solution for the mean curvature flow with forcing term via the phase field method

Summary: We study the mean curvature flow with given non-smooth forcing term g. In 1993, Ilmanen proved the existence of the Brakke flow with $g \equiv 0$, by using the phase field method. Generally, the most difficult part of the proof of the existence theorem is the estimate of the positive part of the discrepancy measure. To solve the problem, Ilmanen showed the non-positivity of the discrepancy measure via the maximum principle. However, in the case of $g \not\equiv 0$, the property does not hold for the usual phase field method of the problem. In this talk, we explain a new modified Allen–Cahn equation which satisfies the non-positivity of the discrepancy measure, and we prove the existence of the weak solution for the mean curvature flow with forcing term in suitable Sobolev spaces.

Functional Analysis

March 16th (Mon) Conference Room VII

10:00–11:45

1 Amane Kiyose (Kobe Univ.) On the Mourre estimates for Floquet Hamiltonians ····· 15
Tadayoshi Adachi (Kyoto Univ.)

Summary: We introduce a new conjugate operator for a Floquet Hamiltonian associated with a Schrödinger operator with time-periodic potentials. Although Yokoyama (1998) already obtained a conjugate operator for the Floquet Hamiltonian, there was a difficulty that it won't afford extensions to the many-body systems. Here we introduce our new conjugate operator which suggests such extensions. Actually, combining our results and Yokoyama's, Adachi recently constructed a conjugate operator for three-body systems.

2 Daisuke Kawagoe (Kyoto Univ.) Surface Riesz transforms and spectral property of the elastic Neumann–
Hyeonbae Kang (Inha Univ.) Poincaré operator on less smooth domains in three dimensions ····· 15

Summary: It was proved that the elastic Neumann–Poincaré operator, which is a boundary integral operator related to the Lamé system, is polynomially compact and, as a consequence, that its spectrum consists of three non-empty sequences of eigenvalues accumulating to certain numbers determined by Lamé constants, if the boundary of the domain where the operator is defined is C^∞-smooth. We extend this result to less smooth boundaries, namely, $C^{1,\alpha}$-smooth boundaries for some $\alpha > 0$. The results are obtained by proving certain identities for surface Riesz transforms, which are singular integral operators of non-convolution type, defined by the metric tensor on a given surface.

3 Daisuke Kawagoe (Kyoto Univ.) The essential spectrum of the elastic Neumann–Poincaré operator on a
Eric Bonnetier (Univ. Grenoble-Alpes) planar domain with a corner ····· 15
Charles Dapogny
(Univ. Grenoble-Alpes)
Hyeonbae Kang (Inha Univ.)

Summary: Main results of this talk is a contribution to the study of the spectrum of the elastic Neumann–Poincaré operator, which is a boundary integral operator involved in the resolution of the Lamé system in a domain. Previous studies have shown that when the domain is smooth in two dimensions, the spectrum of the operator consists of two sequences of eigenvalues with accumulation points $\pm\kappa_0$, where the constant κ_0 is explicitly determined by the Lamé constants. In this talk, we focus on the situation where the planar domain is smooth except at a corner; we then prove that the elastic Neumann–Poincaré operator has essential spectrum, which contains at least two intervals around the values κ_0 and $-\kappa_0$ respectively.

4 Hiroshi Inoue (Daiichi Univ. of Pharm.) Quantum dynamics based on non-self-adjoint hamiltonians ····· 15

Summary: This presentation introduces a study of quantum dynamics generated from non-self-adjoint hamiltonian based on biorthogonal sequences in Hilbert space. In this study, the notion of generalized Riesz systems plays an important role. We investigate under what conditions standard self-adjoint hamiltonian and non-self-adjoint hamiltonian defined by generalized Riesz systems construct quantum dynamics. Furthermore, we investigate under what conditions generalized Riesz systems define gibbs states on a $*$-algebra of unbounded operators.

5 Yoritaka Iwata (Kansai Univ.) Abstract Miura transform based on the logarithmic representation of operators 15

Summary: Miura transform is known as the transformation between Korteweg–de Vries(KdV) and modified KdV (mKdV) equations. In this talk, based on the logarithmic representation of operators in Banach spaces, a structure common to both Miura and Cole–Hopf transforms is studied in an abstract manner. In conclusion, by means of the abstract version of the Miura transform in Banach spaces, an integrable class of nonlinear semigroup theory is clarified. It is the first step to pin down the correspondence of Backland transform in semigroup theory of operators.

6 Shuji Watanabe (Gunma Univ.) An operator-theoretical treatment of the specific heat of a superconductor in the BCS-Bogoliubov model of superconductivity 15

Summary: In this talk we study the temperature dependence of the specific heat in the BCS-Bogoliubov model of superconductivity from the viewpoint of operator theory. We give the exact and explicit expression for $\Delta C_V(T_c)/C_V^N(T_c)$. Here, $C_V^N(T_c)$ denotes the specific heat at constant volume at the transition temperature T_c, and $\Delta C_V(T_c)$ its gap at T_c. We then show that $\Delta C_V(T_c)/C_V^N(T_c)$ does not depend on superconductors and is a universal constant.

14:15–15:15 Award Lecture for the 2019 MSJ Analysis Prize

Fumio Hiroshima (Kyushu Univ.) Renormalization theory and non-perturbative analysis of ground states by functional integrations

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

Fumihiko Nakano (Gakushuin Univ.) Scaling limit of the eigenvalues and eigenfunctions of 1-dimensional random Schrödinger operators

Summary: 1-dimensional random Schrödinger operators have various spectral properties, and level statistics depending on the decay rate of the potential at infinity. Especially, the level statistics at the critical order is intimately related to the scaling limit of the Gaussian beta ensemble in the random matrix theory. In this talk, we discuss the joint scaling limit of the eigenvalues and eigenfunctions.

March 17th (Tue) Conference Room VII

10:30–11:45

7 Koei Kawamura (Kyoto Univ.)[♭] Decomposition of spherical representations and an addition theorem for multivariate hypergeometric polynomials 15

Summary: Harmonic analysis on groups is useful to study properties of special functions which arise as zonal spherical functions. Dunkl (1976) induced an addition theorem for the Krawtchouk polynomials, which are discrete orthogonal polynomials of hypergeometric type, by decomposing spherical representations of wreath produnts of symmetric groups. We apply his method to multivariate case, that is, we use harmonic analysis on a non-Archimedean local field with a wreath products action. Then we have an addition theorem for multivariate Krawtchouk polynomials with coefficients in multivariate Hahn polynomials.

8 Koichi Arashi (Nagoya Univ.) Holomorphic multiplier representations for bounded homogeneous domains 15

Summary: We consider the unitarizations in the spaces of holomorphic sections of equivariant holomorphic line bundles over a bounded homogeneous domain under the action of the identity component of an algebraic group acting transitively on the domain. We give a complete classification of unitary representations arising from such unitarizations.

9 Taito Tauchi (Univ. of Tokyo) A generalization of the uniformly bounded multiplicity theorem ····· 15

Summary: Let H be a closed subgroup of a real reductive Lie group G and $G_{\mathbb{C}}, H_{\mathbb{C}}$ their complexifications. It was proved by T. Kobayashi and T. Oshima that the multiplicities of irreducible representations of G in the regular representation $C^{\infty}(G/H)$ are uniformly bounded iff $H_{\mathbb{C}}$ acts on the full flag variety $G_{\mathbb{C}}/B$ with finitely many orbits. In this talk, we prove that the multiplicities of the irreducible representations of G induced from a parabolic subgroup Q in $C^{\infty}(G/H)$ are uniformly bounded if $H_{\mathbb{C}}$ acts on $G_{\mathbb{C}}/Q_{\mathbb{C}}$ with finitely many orbits using the theory of holonomic $\mathcal{D}_X$-modules.

10 Toshihisa Kubo (Ryukoku Univ.) The K-type formulas for Kable's differential operators of type A_3 and Bent Ørsted (Aarhus Univ.) Heun polynomials ····· 15

Summary: In 2012, Kable introduced a one-parameter family $\mathcal{D}_n(s)$ with $s \in \mathbb{C}$ of differential operators for $\mathfrak{sl}(n,\mathbb{C})$. The operators $\mathcal{D}_n(s)$ can be thought of as $\widetilde{SL}(n,\mathbb{R})$-intertwining differential operators between parabolically induced representations; thus, the space $\mathcal{S}ol_n(s)$ of smooth solutions for $\mathcal{D}_n(s)$ is naturally a representation space of $\widetilde{SL}(n,\mathbb{R})$. To date, the representations realized on $\mathcal{S}ol_n(s)$ are determined only for the case $(n,s) = (3,0)$, for which the realized representations are precisely all minimal unitary representations of $\widetilde{SL}(n,\mathbb{R})$ ([Kubo–Ørsted, 2019]). In this talk we then consider the case $(n,s) = (3, \text{general})$. We first classify the complex parameters $s \in \mathbb{C}$ with $\mathcal{S}ol_3(s) \neq \{0\}$. We then determine the K-type formulas for the space $\mathcal{S}ol_3(s)_K$ of K-finite solutions for $\mathcal{D}_3(s)$ by using Heun polynomials.

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

Ryosuke Nakahama (Univ. of Tokyo) Construction of intertwining operators for restriction of holomorphic discrete series representations

Summary: Let G be a Lie group, $G' \subset G$ be a closed subgroup, and we consider a unitary representation $\mathcal{H}$ of G. Then in general, the restriction $\mathcal{H}|_{G'}$ decomposes into a direct integral of irreducible representations of G'. Especially, if $\mathcal{H}$ is in a nice class of representations called "holomorphic discrete series representations" and (G,G') is a "symmetric pair of holomorphic type", then $\mathcal{H}|_{G'}$ decomposes discretely, and there exist G'-intertwining operators between $\mathcal{H}|_{G'}$ and a representation $\mathcal{H}'$ of the subgroup G' of both directions. The projection operator $\mathcal{H}|_{G'} \to \mathcal{H}'$ (the symmetry breaking operator) is always given by a differential operator, and the embedding operator $\mathcal{H}' \to \mathcal{H}|_{G'}$ (the holographic operator) is given by an infinite-order differential operator. In this talk the speaker gives some results on explicit construction of these intertwining operators in some examples.

March 18th (Wed) Conference Room VII

9:45–12:00

11 Hiroshi Isa (Maebashi Inst. of Tech.)
Eizaburo Kamei
Hiroaki Tohyama (Maebashi Inst. of Tech.)
Masayuki Watanabe (Maebashi Inst. of Tech.)
The n-th Petz–Bregman divergence and the n-th residual relative operator entropy ····· 15

Summary: Let A and B be strictly positive operators on a Hilbert space, $n \in \mathbb{N}$ and $x, y \in \mathbb{R}$. We have defined the n-th residual relative operator entropy $\mathfrak{R}^{[n]}_{x,y}(A|B) \equiv A^{\frac{1}{2}}\Psi^{[n]}(A^{-\frac{1}{2}}BA^{-\frac{1}{2}}, x, y)A^{\frac{1}{2}}$, where $\Psi^{[n]}(a,x,y) = \dfrac{a^y(\log a)^n}{(n-1)!}\displaystyle\int_0^1 (1-t)^{n-1}a^{t(x-y)}dt$ $(a>0)$ is the residual term of the Taylor expansion of a^x around y divided by $(x-y)^n$. By using $\mathfrak{R}^{[n]}_{x,y}(A|B)$, we can show the relations among the n-th relative operator entropies or more precise properties of them.

Summary: Recently, Kian and Seo had shown the Ando–Hiai type inequality with negative powers, and also Fujii and Nakamoto have given the Furuta type inequality with negative powers and its generalizations. In this talk, we show some improvement forms of their Furuta type inequalities based on properties of Furuta inequality.

Summary: In this talk, by virtue of an expression of matrix geometric means for positive semidefinite matrices via the Moore–Penrose inverse, we show matrix versions of the Hölder–McCarthy inequality and quasi-arithmetic power means via matrix geometric means.

Summary: In this talk, by virtue of an expression of matrix geometric means for positive semidefinite matrices via the Moore–Penrose inverse, we show matrix versions of the Hölder–McCarthy inequality, the Holder inequality and quasi-arithmetic power means via the matrix geometric means, and their reverses for positive definite matrices via the generalized Kantorovich constant

Summary: In this talk, for an n-tuple of positive invertible operators on a Hilbert space, we investigate the monotonicity of the power mean from the deformed operator mean from an n-variable operator mean by an operator mean in terms of the generalized Kantorovich constants under the operator order. Moreover, we improve the norm inequality for the operator power means related to the Log-Euclidean mean in terms of the Specht ratio.

Summary: The set of the positive operators on a Hilbert space forms a Riemannian (or Finsler) manifold where its geodesic is the geometric mean in the sense of Pusz–Woronowicz–Kubo–Ando. The Kubo–Ando operator mean for the non-invertible case is defined as the limit for the invertible case. But it is no longer within the geometric consideration. On the other hand, based on the geodesic of the Grassmannian, Bonnabel–Sepulchure (and Batzies–Huper–Machado–Leitesection) introduces a path of geometric means for positive semi-definite matrices with a fixed rank that coincides with the Kubo–Ando one for the invertible case (We call it BS-mean shortly). We extend any (differentiable) path of Kubo–Ando means to that of the corresponding BS means.

Summary: It is well-known that $f(t)$ defined on a right half line is operator monotone if and only if $f(t)$ is operator concave and $f(\infty) > -\infty$. This characterization does not hold if the domain of $f(t)$ is a finite interval; for instance, an operator monotone function $\tan t$ on $(0, \pi/2)$ is not even numerically concave. We will show that $f(t) > 0$ is operator monotone if and only if $f(A!B) \leq f(A)!f(B) \quad (\forall A, B)$, where $!$ represents the operator harmonic mean.

18 Takeaki Yamazaki (Toyo Univ.) A generalization of the Aluthge transformation in the viewpoint of operator means ····· 15

Summary: The Aluthge transformation is a very famous operator transformation. It can be considered as a geometric mean of left and right multiplication operators in the finite dimensional case. In this talk, we will extend the Aluthge transformation by considering other operator means via double operator integrals.

14:15–15:10

19 Chris Bruce (Univ. of Victoria)
Marcelo Laca (Univ. of Victoria)
Takuya Takeishi (Kyoto Inst. Tech.)
Partition functions as C*-dynamical invariants and actions of congruence monoids ····· 15

Summary: We study the phase transition of KMS states for the C*-algebras of ax+b-semigroups of algebraic integers in which the multiplicative part is restricted to a congruence monoid, as in recent work of Bruce generalizing earlier work of Cuntz, Deninger, and Laca. Here we realize the extremal low-temperature KMS states as generalized Gibbs states by constructing concrete representations induced from extremal traces of certain group C*-algebras. We use these representations to compute the Murray–von Neumann type of extremal KMS states and we determine explicit partition functions for the type I factor states. The collection of partition functions that arise this way is an invariant under R-equivariant isomorphism of C*-dynamical systems, which produces further invariants through the analysis of the topological structure of the KMS state space. As an application we characterize several features of the underlying number field and congruence monoid in terms of these invariants.

20 Tsuyoshi Kajiwara (Okayama Univ.)
Yasuo Watatani (Kyushu Univ.*)
Dimension group of the C*-algebras associated with self-similar maps with higher dimensional branched points set ····· 15

Summary: In this talk, we present a method to represent the dimension group of the core of the C*-algebra associated with self-similar maps with higher dimensional branched points set, and to get information of dimension groups of them.

21 Hiroyasu Hamada (Sasebo Nat. Coll. of Tech.)
C*-algebras generated by multiplication operators and composition operators by functions with self-similar branches ····· 15

Summary: Let K be a compact metric space and let $\varphi : K \to K$ be continuous. We study C*-algebra $\mathcal{MC}_\varphi$ generated by all multiplication operators by continuous functions on K and a composition operator C_φ induced by φ on a certain L^2 space. Let $\gamma = (\gamma_1, \ldots, \gamma_n)$ be a system of proper contractions on K. Suppose that $\gamma_1, \ldots, \gamma_n$ are inverse branches of φ and K is self-similar. We consider the Hutchinson measure μ^H of γ and the L^2 space $L^2(K, \mu^H)$. Then we show that the C*-algebra $\mathcal{MC}_\varphi$ is isomorphic to the C*-algebra $\mathcal{O}_\gamma(K)$ associated with γ under some conditions.

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

Keiichi Watanabe (Niigata Univ.)
On Möbius gyrovector spaces and a class of continuous mappings between them

Summary: We study some aspects of Möbius gyrovector spaces from viewpoints of basic theory of functional analysis. First of all, I introduce the notion of gyrocommutative gyrogroups, gyrovector spaces and Möbius gyrovector spaces due to A. A. Ungar. Then I present some fundamental results such as the structure of finitely generated gyrovector subspaces, orthogonal gyrodecomposition and gyroexpansion, Cauchy–Bunyakovsky–Schwarz type inequalities, continuous quasi gyrolinear functionals and a class of continuous mappings between Möbius gyrovector spaces corresponding Hilbert space operators.

Statistics and Probability

March 16th (Mon) Conference Room VI

9:20–11:55

1 Kiyoiki Hoshino (Osaka Pref. Univ.) On a Riemann approximation of the stochastic integral ····· 15

Summary: We introduce a Riemann-type sum regarded as generalizations of the sums which define the Nualart–Pardoux–Stratonovich integral and the Ogawa integral with respect to the Haar system, and discuss the approximation of some stochastic integrals by this sum. We attempt to characterize some stochastic integrabilities by conditions on the Riemann sum, by which we also introduce a variation of the stochastic k-integral and give an application example of this related to the volatility estimation.

2 Shigeyoshi Ogawa (Ritsumeikan Univ.) A noncausal counterpart of Girsanov's theorem ····· 10

Summary: We are concerned with an application of the theory of BPE (Brownian particle equation). More precisely, in the framework of the nonccausal stochastic calculs, we intend to show a very simple derivation of noncausal counterpart of Girsanov's theorem on the drift shift of Brownian motion.

3 Yuki Ueda (Hokkaido Univ.) Free max-probability theory ····· 15

Summary: In 2006, Ben Arous and Voiculescu introduced free max-convolution and free extreme values. They are analogue of classical max-convolution and classical extreme values, respectively. We expect that there is a relation between free max-probability and asymptotically eigenvalue distributions of spectral maximum of random matrices. In additive case, Bercovici and Pata in 1999 proved the equivalence of limit theorems for classical and freely (additive) infinitely divisible distributions. Based on this result, we studied limit theorems for classical and freely max-infinitely divisible distributions. In this talk, we explain a relation between classical-max and free-max.

4 Shoto Osaka (Yokohama Nat. Univ.) On the rate of convergence for Takagi class functions ····· 15
Masato Takei (Yokohama Nat. Univ.)

Summary: We consider a generalized version of the Takagi function, which is one of the most famous example of nowhere differentiable continuous functions. We investigate a set of conditions to describe the rate of convergence of Takagi class functions from the probabilistic point of view: The law of large numbers, the central limit theorem, and the law of the iterated logarithm. On the other hand, we show that the Takagi function itself does not satisfy the law of large numbers in the usual sense.

5 Yuto Nakajima (Kyoto Univ.) Connectedness of connectedness locus for fractal n-gons and the remarkable subset ····· 15

Summary: We consider the closure of the set of zeros of polynomials with complex coefficients randomly chosen from a "good" compact subset of complex plane. We prove that the closure of the set of zeros is connected. Furthermore, we apply this result to the study of connectedness locus ($\mathcal{M}_n$) of fractal n-gons and the remarkable subset $\mathcal{M}_n^0$. Fractal n-gons and $\mathcal{M}_n$ are introduced by C. Bandt and N. V. Hung (2008). It is already known that $\mathcal{M}_2$, $\mathcal{M}_2^0$ and $\mathcal{M}_3$ are connected (T. Bousch (1988), Y. Himeki under supervision Y. Ishii (2018)). We prove that for each $n = 2, 3, 4, 5, 6$, $\mathcal{M}_n$ is connected and for all n $\mathcal{M}_n^0$ is connected.

6 Yu Ito (Kyoto Sangyo Univ.) Integration with respect to Hölder rough paths of order greater than 1/4: an approach via fractional calculus ····· 15

Summary: On the basis of fractional calculus, we introduce an integral of controlled paths with respect to Hölder rough paths of order $\beta \in (1/4, 1/3]$. Our definition of the integral is given explicitly in terms of Lebesgue integrals for fractional derivatives, without using any arguments from discrete approximation. We demonstrate that for suitable classes of β-Hölder rough paths and controlled paths, our definition of the integral is consistent with the usual definition given by the limit of the compensated Riemann–Stieltjes sum. This result also provides an approach to the integral of 1-forms against geometric β-Hölder rough paths.

7 Yosuke Kawamoto (Fukuoka Dental Coll.) Transitions of generalised Bessel kernels related to biorthogonal ensembles 15

Summary: Biorthogonal Laguerre ensembles are generalizations of classical Laguerre ensembles. Local fluctuation of these ensembles at the origin has been studied, and determinantal kernels in the limit are described in terms of the Wright generalised Bessel functions. The limit kernels are one parameter deformations of the Bessel kernel. I am going to talk about transitions from the generalised Bessel kernels to the sine kernel under appropriate scaling limits in common with the classical Bessel kernels.

8 Shota Osada (Kyushu Univ.) Isomorphism between determinantal point processes and Poisson point processes 15

Summary: The determinant point process is a point process for which the determinants of its kernel function give its correlation functions. It describes a repulsive particle system, and some of them have remarkable properties such as rigidity and small variance property. On the other hand, Poisson point processes do not have these properties because the particles are regionally independent. As above, these two classes of point processes have different properties in correlations among particles. However, we prove that they are isomorphic to each other in the sense of ergodic theory. Translation invariant determinant point processes on integer lattices are isomorphic to Bernoulli shifts. This Bernoulli property is a sufficient condition for tail triviality in the measure-preserving dynamical systems. This result, the Poisson property, is the continuous version of the Bernoulli property.

9 Yuta Arai (Chiba Univ.) The KPZ fixed point for discrete time TASEP 15

Summary: The totally asymmetric simple exclusion process (TASEP) is one of the simplest interacting stochastic particle system and can be interpreted as a stochastic growth model of an interface, which turns out to belong to the Kardar–Parisi–Zhang (KPZ) universality class. In this talk we consider a discrete time version of the TASEP with arbitrary right finite initial condition. We obtain a single Fredholm determinant representation for the joint distribution function of particle positions. Using this, we show that in the KPZ 1:2:3 scaling limit, the distribution function converges to the one describing the KPZ fixed point introduced by Matetski, Quastel and Remenik (2018).

14:15–15:00

10 Kouhei Matsuura (Kyoto Univ.) Hölder continuity of Neumann heat kernels on a class of planar domains 15

Summary: Gyrya and Saloff–Coste studied first-order Sobolev spaces on inner uniform domains with Neumann boundary condition. They proved the volume doubling property and the Poincaré inequality for the associated Dirichlet spaces. As a corollary, Neumann heat kernels on inner uniform domains are extended to continuous functions on appropriate completions of the domains and satisfy the two-sided Gaussian estimates. Moreover, the heat kernels are Hölder continuous on the complete metric spaces. However, in the result, it is difficult to calculate even the lower bounds of the indices of Hölder continuity of the heat kernels. In this talk, we give the lower bounds for Neumann heat kernels on a class of planar domains.

11 Toshihiro Uemura (Kansai Univ.) Haruna Okamura (Kansai Univ.) Global path properties of symmetric stable processes with singular/degenerate coefficients 15

Summary: We show some global path properties of symmetric stable processes with singular/degenerate coefficients in terms of Dirichlet form theory.

12 Atsushi Takeuchi (Tokyo Woman's Christian Univ.) Gradient formula for jump processes on manifolds 15

Summary: Let M be a connected and compact Riemannian manifold of dimension m, and $O(M)$ the bundle of orthonormal frames. Consider the $O(M)$-valued process $R = \{R_t\,;\, 0 \le t \le T\}$ determined by the Marcus-type stochastic differential equation with jumps, associated with the canonical horizontal vector fields on $O(M)$. The main goal in this talk is to construct the integration by parts formula on the M-valued process $X = \{X_t\,;\, 0 \le t \le T\}$ defined by $X_t = \pi(R_t)$, where $\pi : O(M) \to M$ is the canonical projection.

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

Dai Taguchi (Okayama Univ.) Numerical analysis of stochastic differential equations

Summary: The theory of stochastic calculus and stochastic differential equations (SDEs) introduced by Kiyosi Itô is used to model a random dynamical phenomena in many fields of applications, for example, mathematical finance, physics and biology. For instance, in the field of mathematical finance it has been actively studied from both sides of theory and practice. In particular, financial derivatives are priced by using expectations of a solution of stochastic differential equations, and it is required to accurately calculate their prices. However, since in general it is difficult to obtain explicit form of a solution of stochastic differential equation, it is necessary to approximate the solution by using "discretization". In this talk, I will talk about recent developments and future issues of numerical analysis for a solution of stochastic differential equations.

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

Benoît Collins (Kyoto Univ.)♭ On the operator norm of random matrices

Summary: I will review recent results on the operator norm of some random matrices.

March 17th (Tue) Conference Room VI

9:10–11:25

13 Hayato Takahashi (Random Data Lab.) Martin-Löf random sets and consistent theorem of posterior distributions 15

Summary: By the theorem of Doob (1948), if there is a consistent estimator for all parameters, the posterior distribution is consistent for almost all parameters. By the theorem of Breiman et.al (1964), posterior distributions are consistent if conditional probabilities given disjoint cylinder sets are orthogonal, which is much weaker than the existence of consistent estimator for all parameters such as Wald (1949). Frequentist may concern about for which parameter the posterior distribution will converge (Diaconis and Freedman pp. 4). In this presentation, we show that posterior distributions converge weakly to Martin-Löf random set on parameter space with oracle P of joint distribution iff posterior distribution is consistent for almost all parameters. We discuss random sets that satisfy consistent theorems of Bayes models and propose a definition of random sets with respect to conditional probabilities.

14 Naoyuki Ichihara (Aoyama Gakuin Univ.) Convergence of value functions for finite horizon Markov decision processes with boundary conditions 15

Summary: We are concerned with the convergence of value functions for some finite horizon Markov decision processes on a countable state space with boundary condition. We observe three different limiting behaviors of value functions depending on the generalized principal eigenvalue of the associated ergodic problem.

15 Masaaki Tsuchiya (Kanazawa Univ.*) ♭ Markov processes controlled by clocks with variable motion on a Euclidean space ····· 15

Summary: Given a bundle of generating triplets of natural additive processes on a Euclidean space, we consider its cumulant and the pseudo-differential operator with the cumulant as symbol, which is an operator-valued measure on the time axis. By using the arguments on Markov selections, we study the existence of a solution with strong Markov property to the martingale problem for the pseudo-differential operator.

16 Yuji Hibino (Saga Univ.) Construction of the canonical representation from a noncanonical representation ····· 10

Summary: A centered Gaussian process is determined by its covariance. However, the method to construct the canonical representation from the covariance has not been obtained. In this talk, we propose a new method to construct the canonical representation for a Gaussian process by using a noncanonical representation.

17 Yushi Hamaguchi (Kyoto Univ.) Time-inconsistent consumption-investment problems under general discount functions ····· 15

Summary: We study a time-inconsistent consumption-investment problem with random endowments in a possibly incomplete market under general discount functions. We provide a necessary condition and a verification theorem for an open-loop equilibrium consumption-investment pair in terms of a coupled forward-backward stochastic differential equation. Moreover, we prove the uniqueness of the open-loop equilibrium pair by showing that the original time-inconsistent problem is equivalent to an associated time-consistent one.

18 Noriyoshi Sakuma (Aichi Univ. of Edu.)
Ryoichi Suzuki (Keio Univ.) A Clark–Ocone–Haussmann type formula under change of measure for L^1-canonical additive processes and its applications ····· 10

Summary: In this talk, we show a Clark–Ocone–Haussmann type formula under change of measure for L^1-canonical additive processes by using a Malliavin–Skorohod calculus in L^0 and L^1 for additive processes developed by Di Nunno–Vives (2017, Stochastics). This is a generalization of Suzuki (2013, COSA). We also show some applications of the main theorem to finance.

19 Toru Sera (Kyoto Univ.)
Kouji Yano (Kyoto Univ.)
Yu Ito (Kyoto Sangyo Univ.) Resolution of sigma-fields for multiparticle finite-state action evolutions with infinite past ····· 15

Summary: For multiparticle finite-state action evolutions, we report that the observation sigma-fields are proven to have a resolution consisting of a reduced driving noise, the remote past noise and a third noise. The general theory of infinite convolutions on finite semigroups are utilized in our proofs.

20 Tomoki Inoue (Ehime Univ.) Invariant measures of random dynamical systems with indifferent fixed points ····· 15

Summary: We consider a family of transformations and study a random dynamical system such that one transformation is randomly selected from the family and then applied on each iteration. Especially, we study random dynamical systems with indifferent fixed points and show the existence of absolutely continuous σ-finite invariant measures under some conditions. Further, we research whether the invariant measures are finite or not under some conditions.

11:30–12:00 Research Section Assembly

March 18th (Wed) Conference Room VI

9:00–12:00

21 Yuichi Goto (Waseda Univ.) Estimation of trigonometric moments for circular distribution of MA(p) type by using binary series ····· 10

Summary: Directional statistics have received a great deal of interest in recent years, and a variety of distributions on the circle have been proposed. In this paper, we propose circular distributions of a moving average model of order p type which includes the cardioid distribution, and discuss the problem of estimation of trigonometric moments based on binary series. We give an explicit form of the root n consistent estimator based on clipped series, which enables us to construct an efficient estimator by the Newton–Raphson iterative method. We also show a robustness of the proposed estimator when the probability density function is contaminated with a noise term.

22 Akitoshi Kimura (Waseda Univ.) The asymptotic variance estimators of the correlation estimator between latent processes and their asymptotic properties ····· 15

Summary: In this talk, we treat a model in which the finite variation part of a two-dimensional semi-martingale is expressed by time-integration of latent processes. We propose a correlation estimator between the latent processes and show its consistency and asymptotic mixed normality. Moreover, we propose two types of estimators for asymptotic variance of the correlation estimator and show their asymptotic properties in a high frequency setting. We focus on the proof of the asymptotic properties. Our model includes doubly stochastic Poisson processes whose intensity processes are correlated Itô processes.

23 Fumiya Akashi (Univ. of Tokyo)
Holger Dette (Ruhr-Univ. Bochum) Robust regression on hyper-spheres with unspecified heteroscedastic errors ····· 15

Summary: Statistical treatment for a random vector on a hyper-spheres attracts a lot attention recently, and has various applications such as seismic wave analysis, analysis for orientation of wild fire, etc. In this talk the nonlinear regression model whose predictor is a random vector on a hyper-sphere is considered. It is well known that the classical method in "linear statistic" does not work for spherical random vectors. To construct a robust estimator for the nonlinear regression function, this talk employees L1-regression method and kernel-type objective function. The proposed local-linear estimator has asymptotic normality even if the error process has infinite variance, dependent structure or heteroscedasticity. Some simulation experiments illustrate desired finite sample properties of the proposed method.

24 Fumiya Akashi (Univ. of Tokyo)
Junichi Hirukawa (Niigata Univ.)
Konstantinos Fokianos (Lancaster Univ.) Inference for heavy-tailed time varying processes by self-weighting ···· 15

Summary: This talk considers a parameter estimation problem of time-varying autoregressive models under the presence of infinite variance. Although there is rich literature on locally stationary processes, the classical papers always assume the finite variance of the model. This talk constructs a robust estimator based on the self-weighting approach proposed by Ling (2005, Journal of Royal Statistical Society B) and least absolute deviations regression. The proposed estimator is show to be asymptotically normal regardless of whether the error term has infinite variance or not. Finite sample performance of the proposed method is also investigated by simulation experiments.

Summary: We propose a topological approach to statistically analyzing the Granger causality. Granger introduced his celebrated new measure of causality in the sense of prediction errors of multivariate time series 50 years ago. We localize his idea and construct a theory based on locally stationary processes for its alternative version, a natural refinement for stationary processes by Hosoya. To construct the theory, we provide a Gaussian approximation of the suprema of empirical spectral processes. Especially, the local extension of the theory serves for the statistical inference for the Granger causality curve. In addition, we provide a bootstrap procedure for the approximation to construct confidence bands. Finally, we discuss the persistence diagrams and persistence landscapes for the causality curves and numerically construct some examples of locally stationary processes for our simulations studies.

Summary: Necessary and sufficient conditions for the attainments of the Borovkov-Sakhanenko and the van Trees information bounds are given when the underlying distribution is an exponential family and the conjugate prior, and the estimand is a function of the parameter. Moreover, the attainments under the Jeffreys prior are also considered.

Summary: Under a problem setting of the Bayesian nonparametrics, the Pitman–Yor process, which has two parameters denoted by $\alpha(\in [0,1))$ and $\theta(> -\alpha)$, is a popular prior. In the literature, when the Pitman–Yor process is placed, the conditional weak convergence of the centered posterior process rescaled by the ordinary rate factor $n^{1/2}$ is provided, where n is the number of observations. Introducing a zero-mean process rescaled by the different rate factor $(\theta + n\alpha)^{1/2}$, we present a corresponding result under the asymptotic regime that θ and n simultaneously increase. This result reveals that the rate of convergence changes when $\theta/n \to \infty$.

Summary: For the data supported on $[0,\infty)$ or $[0,1]$ ($[0,\infty)^d$ or $[0,1]^d$), asymmetric kernel density estimation has been well-studied in the recent literature. In this talk, we consider two problems, on the basis of the AK method: one is the estimation of density ratio in the two-sample setting, and the other is the estimation of conditional density for the bivariate dataset.

Summary: We consider hypotheses of independence among groups of factors in a multi-way contingency table. Hypotheses include that of one factor independence from the other two in a 3-way contingency table and that of independence among three factors, one factor and one factor in a 5-way contingency table. In this report, we derive approximations of distribution of the test statistics for the hypotheses based on asymptotic expansion.

30 Kiyotaka Iki (Nihon Univ.) Parsimonious bivariate t-distribution type symmetry models for square contingency tables 15

Summary: For the analysis of square contingency tables with the same row and column ordinal classifications, this presentation proposes new models, which may be appropriate for a square ordinal table if it is reasonable to assume an underlying bivariate t-distribution having any degrees of freedom. The new models have stronger restriction than t-distribution type symmetry models (Iki et al., 2013; Iki et al., 2018). The simulation studies based on bivariate t-distribution are given.

31 Hiromu Yumiba (Int. Center for Academic Exchange)
Yoshifumi Hyodo (Okayama Univ. of Sci.)
E*-optimal balanced third-order designs of resolution R*({10, 01}) with $N < \nu(m)$ for 3^m factorials 15

Summary: We consider a balanced third-order (3^m-BTO) design T of resolution R*({10, 01}) derived from an SA(m; $\{\lambda_{xm-x-yy}\}$) with N assemblies and $m \geq 6$. Let $\sigma^2\lambda_{\max}(T)$ be the maximum eigenvalue of the variance-covariance matrix of the estimators concerning with all the main effects based on T. If $\lambda_{\max}(T_0) \leq \lambda_{\max}(T)$ for any T, then T_0 is said to be E*-optimal, where T_0 is a 3^m-BTO design of resolution R*({10, 01}) derived from an SA with N assemblies. In this talk, we give E*-optimal 3^m-BTO designs of resolution R*({10, 01}) derived from SA's for $6 \leq m \leq 8$, where $N < \nu(m)$. Here $\nu(m)(= 1 + 2m + \frac{1}{6}m(m-1)(m+7))$ is the number of non-negligible factorial effects.

14:15–15:05

32 Yoshihiko Konno (Japan Women's Univ.)
Satomi Seita (Japan Women's Univ.)
Shrinkage estimation of mean for complex multivariate normal distribution with unknown covariance when $p > n$ 15

Summary: We consider the problem of estimating the mean vector of the multivariate complex normal distribution with unknown covariance matrix under an invariant loss function when n, the sample size, is smaller than p, the dimension of the mean vector. Tne problem of difficulty lies in the fact that the sample covariance matrix becomes singular. Following the approach of Chételet and Wells (2012, Ann. Statist. vol. 40 p. 3137–3160), we show that a modification of Baranchik-like-tpye estimators beats the MLE if it satisfies certain conditions. Based on this result, we propose the James–Stein-like shrinkage and its positive-part estimators.

33 Kazuyoshi Yata (Univ. of Tsukuba)
Makoto Aoshima (Univ. of Tsukuba)
Singular value estimation for high-dimensional cross-covariance matrix 15

Summary: In this talk, we consider singular value estimations for a high-dimensional cross-covariance matrix. We first consider asymptotic properties of the conventional estimator of the singular values. We show that the estimator is affected by high-dimensional noise structures directly, so that it becomes inconsistent. In order to overcome the difficulty, we proposed a new singular value estimation method via the extended cross-data-matrix methodology. We show that the new method can enjoy consistency properties for the singular values in high-dimensional settings.

34 Aki Ishii (Tokyo Univ. of Sci.)
Kazuyoshi Yata (Univ. of Tsukuba)
Makoto Aoshima (Univ. of Tsukuba)
A test procedure for high-dimensional eigenvectors 15

Summary: In this talk, we consider testing high-dimensional eigenvectors. We produce a test statistic by using the extended cross-data-matrix (ECDM) methodology and show the unbiasedness of the ECDM test statistic even in a high-dimensional setting. We also show that the test statistic holds the asymptotic normality. We propose a new test procedure by using the asymptotic normality and evaluate its size and power asymptotically. We also give a real data analysis by using a microarray data set.

15:20–16:20 Talk Invited by Statistics and Probability Section

Rie Enomoto (Seikei Univ.) Consistency of some information criteria in high-dimensional growth curve models

Summary: In multivariate regression model, it is known that the AIC has no consistency and the BIC has consistency under large-sample framework. However, Fujikoshi et al. (2014) and Yanagihara et al. (2015) note that the AIC has consistency and the BIC has no consistency under a high-dimensional framework. The AIC and its modifications have been proposed for selecting the degree in the growth curve model under a large-sample framework and a high-dimensional framework by Satoh et al. (1997) and Fujikoshi et al. (2013), respectively. They note that the AIC and its modifications have no consistency property.

The purpose of this paper to discuss high-dimensional asymptotic distributions of the estimators and consistency property of some information criteria under a high-dimensional framework. Our results are checked numerically by conducting a Mote Carlo simulation.

16:35–17:35 Talk Invited by Statistics and Probability Section

Kou Fujimori (Waseda Univ.) The Dantzig selector for statistical models of stochastic processes in high-dimensional and sparse settings

Summary: The Dantzig selector, which was proposed by Candés and Tao in 2007, is an estimation procedure for regression models in high-dimensional and sparse settings. In this talk, the Dantzig selectors for some statistical models of stochastic processes are discussed. We apply this procedure to Cox's proportional hazards model and some specific models of diffusion processes and prove the consistencies and the variable selection consistencies of the estimators. Based on partial likelihood and quasi-likelihood methods which were studied intensively in low-dimensional settings, we study these statistical models of stochastic processes in high-dimensional and sparse settings, which need some mathematically challenging tasks. The consistencies of the estimators are derived from the stochastic maximal inequalities which are derived from Bernstein's inequalities for martingales and conditions, which are known to be similar to the restricted eigenvalue conditions, on Hessian matrices of log-(partial or quasi)-likelihood functions. We prove that consistencies of the estimators imply the variable selection consistencies which enable us to reduce the dimension. Using the dimension reduction, asymptotically normal estimators can be constructed.

Applied Mathematics

March 16th (Mon) Conference Room V

10:00–11:40

Summary: The following equality dates back to André in 1879: $\sum_{n=0}^{\infty} E_n \frac{x^n}{n!} = \sec x + \tan x$ where E_n is half the number of alternating permutations in S_n (with $E_0 = E_1 = 1$). Recently, Heneghan–Petersen in 2014 introduced the sequences $(F_n)_{n \geq 2}$, $(G_n)_{n \geq 2}$ as a refinement of E_n. In terms of formal power series, they proved $F_{2n} - G_{2n} = E_{2n-2}$ saying at the end: Is there a bijective explanation for this? In this talk, I will show you an answer to this question with constructing some bijection explicitly.

Summary: In this talk we consider a counting of rooted spanning forests of weighted graphs with fixed set of nodes. This counting problem has its origin in Kenyon–Wilson's formula, which gives a relation between counting of certain rooted spanning forests and minors of response matrix. We consider a family of weighted graphs which we call the n-gon graph. Our main result is an explicit formula of the counting for n-gon graph in terms of Chebyshev polynomials of the first kind.

Summary: We present weighted versions for the results of Li and Hou's on the partial derivatives of the determinant part in the determinant expression of the Bartholdi zeta function of a graph G. Furthermore, we give a formula for the weighted Kirchhoff index function of a regular covering of G in terms of that of G.

Summary: The Mizuno–Sato zeta functions are generalized Ihara zeta functions, and the weights are complex numbers. The definitions of the quaternionic Mizuno–Sato zeta functions for finite symmetric digraphs were given by Konno, Mitsuhashi, and Sato. In this study, we re-define them for finite digraphs with loops and multi arcs and give the determinant expressions called Ihara expressions.

Summary: It is well known that when a graph is equitable, the characteristic polynomial of the quotient graph divides that of the original graph, but the remainder part is not well investigated. We define a deletion graph, and give a similarity transformation exchanging the adjacency matrix which is compatible with the equitable partition for a block triangular matrix whose diagonal blocks are the adjacency matrix of the quotient graph and the deletion graph, which gives the remainder part. We apply the result to the Ihara–Bartholdi zeta function.

6 Hideaki Morita (Muroran Inst. of Tech.) On the determinant expression for graph zeta functions ····· 15

Summary: Graph zeta functions naturally have the three expressions—the exponential expression, the Euler expression, and the determinant expression of Hashimoto type (the Hashimoto expression). In this talk, a new family of graph zetas is introduced, which does not have the Hashimoto expression.

14:20–16:05

7 Shinya Fujita (Yokohama City Univ.) Recent topics on rainbow connectivity in edge-colored graphs ····· 10

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

8 Michitaka Furuya (Kitasato Univ.) Bounds on self domination number and an edge-deletion operation in trees ····· 15

Summary: Let G be a graph, and let $c \in \mathbb{R}^+ \cup \{\infty\}$. A function $f : V(G) \to \{0, 1, c\}$ is called a *c-self dominating function* of G if for $x \in V(G)$ with $f(x) < c$, $\max\{f(y) : y \in N_G(x)\} \geq 1$. The minimum weight $w(f) := \sum_{x \in V(G)} f(x)$ of a c-self dominating function f of G is called the *c-self domination number* of G. In this talk, we give a sharp upper bound of a c-self domination number for all $c \in \mathbb{R}^+ \cup \{\infty\}$. To prove our main result, we focus on an edge-deletion operation for trees, and for $\mathcal{P} \subseteq \{P_n : n \in \mathbb{N}\}$, we characterize the trees T such that one of components of $T - e$ belongs to $\mathcal{P}$ for every $e \in E(T)$.

9 Kiyoshi Ando (Nat. Inst. of Information / JST ERATO)
Yoshimi Egawa (Tokyo Univ. of Sci.) Contractible edges and contractible triangles in a 3-connected graph ····· 15

Summary: Let G be a 3-connected graph. An edge (a triangle) of G is said to be a 3-contractible edge (a 3-contractible triangle) if the contraction of it results in a 3-connected graph. We denote $E_c(G)$ and $\mathcal{T}_c(G)$ the set of 3-contractible edges of G and the set of 3-contractible triangles of G, respectively. We prove that if $|V(G)| \geq 7$, then $|E_c(G)| + a|\mathcal{T}_c(G)| \geq \min\{\frac{1}{2} + \frac{a}{3}, \frac{6}{7}\}|V(G)|$ for every nonnegative real number a. As a corollary of this, if $|V(G)| \geq 7$, then $|E_c(G)| + \frac{15}{14}|\mathcal{T}_c(G)| \geq \frac{6}{7}|V(G)|$; and if G has no contractible triangles, then $|E_c(G)| \geq \frac{6}{7}|V(G)|$. We also determine the extremal graphs of these results.

10 Chie Nara (Meiji Univ.)
Jin-ichi Itoh (Sugiyama Jogakuen Univ.) Continuous flattening of the 2-skeletons of triangular faces in higher dimensional cross-polytopes ····· 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 higher dimensional regular cross-polytopes by considering the 2-dimensional skeleton of a polytope, corresponding to the surface of a three dimensional polyhedron.

11 Yasuhide Numata (Shinshu Univ.)
Akiko Yazawa (Shinshu Univ.) The eigenvalues of a matrix defined by the complete graph with selfloops ····· 15

Summary: We consider a matrix whose indices are the edge of the complete graph with selfloops. Assume that entries are the same if the indices are isomorphic as graphs. We compute the eigenvalues of this matrix. We also apply the main theorem to the eigenvalues of the second Hessian matrix with respect to divided power operators of the elementary symmetric polynomial $e_l(x_1^k, \ldots, x_n^k)$.

12 Sho Suda (Nat. Defense Acad. of Japan)
Alexander Gavrilyuk (Pusan Nat. Univ.) On the multiplicities of digraph eigenvalues ····· 10

Summary: We show an upper bound for the order of a digraph (or a mixed graph) whose Hermitian adjacency matrix has an eigenspace of prescribed codimension. This generalizes the so-called absolute bound for (simple) graphs first shown by Delsarte, Goethals, and Seidel (1977) and extended by Bell and Rowlinson (2003).

13 Ryoya Fukasaku (Kyushu Univ.)
Michitaka Furuya (Kitasato Univ.)
Akihiro Higashitani (Osaka Univ.)
Chromatic numbers of tensor products of graphs and Gröbner basis 15

Summary: For a graph G, let $\chi(G)$ denote the chromatic number. In graph theory, the following famous conjecture posed by Hedetniemi has been studied: For two graphs G and H, $\chi(G \times H) = \min\{\chi(G), \chi(H)\}$, where $G \times H$ is the tensor product of G and H. In this talk, we give a reduction of Hedetniemi's conjecture to an inclusion relation problem on ideals of polynomial rings, and we demonstrate computational experiments for partial solutions of Hedetniemi's conjecture along such a strategy using Gröbner basis.

16:20–17:20 Talk Invited by Applied Mathematics Section

Masanori Sawa (Kobe Univ.)
On the rationality of classical orthogonal polynomials, quadrature formulas and geometric designs

Summary: In this talk we first introduce a certain system of Diophantine equations, originally designed by Hausdorff (1909, Math. Ann.) as a simplification of Hilbert's solutions of Waring's problem, and then review a close relationship among classical orthogonal polynomials in special function theory, quadrature formulas in numerical analysis, and geometric designs in combinatorics, with particular emphasis on their 'rationality'. We also look at some recent results including, non-solvability results for our equations, an alternative proof of a theorem by Delsarte, Goethals and Seidel on tight spherical 6-designs (1977). This talk may moreover touch with a connection with optimal design problem in statistics. Some of the results given in this talk have been found as a joint work with Yukihiro Uchida.

March 17th (Tue) Conference Room V

9:50–11:15

14 Ryota Hanaoka (Yokohama Nat. Univ.)
Norio Konno (Yokohama Nat. Univ.)
Shohei Koyama (Yokohama Nat. Univ.)
A time-series analysis based on two-state quantum walk in one dimension 10

Summary: Konno introduced a time-series model via the quantum walk in 2019. We show some properties of the model based on two-state quantum walk in one dimension. Moreover we present results on an application of BTC/USD price data.

15 Masahiro Asano (Yokohama Nat. Univ.)
Norio Konno (Yokohama Nat. Univ.)
Akihiro Narimatsu (Yokohama Nat. Univ.)
Long-time behavior of the Grover walk on the two-dimensional lattice 15

Summary: The Grover walk has been investigated for many applications, such as quantum searching algorithms. Inui et al. (2005) got both limit measure and weak limit theorem as a long-time behavior of the 3-state Grover walk on the one-dimensional lattice. However, the 4-state Grover walk on the two-dimensional lattice was studied only for time-averaged limit measure at the starting point and weak limit theorem. We obtained the time-averaged limit measure on coordinate axes and analyzed the asymptotic behavior for the Grover walk in two dimensions.

Summary: These days, we use online sites to see news, SNS, and so on. There are various services using recommendation models. Recently, the quality of recommendation models influences on the earnings of merchandises very much. In this situation, we propose new models based on user's selection process as walks. Moreover, we analyze user's preference using random, correlated, and quantum walks, respectively.

Summary: The recommendation models are used in many online sites. We consider recommendation models proposed in Part 1 based on random, correlated, and quantum walks, respectively. Then we show the behaviors of these models by numerical simulations. The quantum-walk version model has a peculiar feature compared with random- and correlated-walk version models.

Summary: We obtain an explicit expression of the scattering matrix of a free quantum walk on one-dimensional lattice with finite impurities by using a path counting method. We show that this expression is essentially obtained by counting the escaping amplitude from the impurity's region; in other word, an analysis on the principal submatrix of this unitary time evolution operator with respect to the impurities. As a byproduct, we clarify that the reflection and transmission rates of the quantum walk model introduced by Matsue et al (2018), which is connected to the stationary Schrödinger equation on the double well potentials, can be expressed by this scattering matrix.

Summary: We consider relationships between orthonormal polynomial related to the limit distribution of discrete-time quantum walk on the line and corresponding random walk on the half line. In order to connect the orthonormal polynomial and the random walk, we use so-called Jacobi matrix for each objects. In this talk, we discuss about roles of the limit distribution in corresponding random walk and/or other induced processes.

11:30–11:50 Presentation Ceremony for the 2019 MSJ Prize for Excellent Young Applied Mathematicians

March 18th (Wed) Conference Room V

9:30–12:00

20 Ken Nakashima (Shizuoka Univ.)
Hideto Asashiba (Shizuoka Univ.)
Emerson Gaw Escolar (RIKEN / Kyoto Univ.)
Michio Yoshiwaki (RIKEN / Kyoto Univ. / Osaka City Univ.)
On approximation of 2D persistence modules by interval-decomposables 15

Summary: In this work, we propose a new invariant for 2D persistence modules called the compressed multiplicity and show that it generalizes the notions of the dimension vector and the rank invariant. In addition, we propose an "interval-decomposable approximation" $\delta^*(M)$ of a 2D persistence module M. In the case that M is interval-decomposable, we show that $\delta^*(M) = M$. Furthermore, even for representations M not necessarily interval-decomposable, $\delta^*(M)$ preserves the dimension vector and the rank invariant of M.

21 Emerson Gaw Escolar (RIKEN / Kyoto Univ.)
Killian F. Meehan (Kyoto Univ.)
Michio Yoshiwaki (RIKEN / Osaka City Univ. / Kyoto Univ.)
Every pair of Λ-interleavings is $\widetilde{\Lambda}$-interleaved 15

Summary: There is an isometry theorem relating the interleaving distance between 1D persistence modules and the bottleneck distance of their corresponding barcodes. The bottleneck distance is defined by matchings between the barcodes, and can be seen as a "diagonal" interleaving of the persistence modules. We wish to study how far arbitrary interleavings are from diagonal interleavings. To that end, we work in a more general setting of prosets. We introduce the concept of a shoelace of a proset and show that the representation category of the shoelace is isomorphic to the category of interleavings. Through this, we can formulate interleavings between interleavings in this new setting. Finally, we show that any two Λ-interleavings are $\widetilde{\Lambda}$-interleaved, where $\widetilde{\Lambda}$ is a "twisted" interleaving on the shoelace naturally induced from Λ.

22 Ippei Obayashi (RIKEN / Tohoku Univ.)
Michio Yoshiwaki (RIKEN / Osaka City Univ. / Kyoto Univ.)
Field choice problem on persistent homology 15

Summary: In this presentation, I will talk about the problem of the choice of a coefficient field on persistent homology. When we compute a persistence diagram, we need to select a coefficient field before computation. We should understand the dependency of the diagram on the coefficient field for the better computation and interpretation of the diagram. We give some sufficient and necessary conditions for the independence of the diagram to the coefficient field. We also give an efficient algorithm to determine whether a given input satisfies the condition or not. The algorithm is already implemented in HomCloud, our data analysis software based on persistent homology. The software will be helpful for data analysis using persistent homology. This is the joint work with Michio Yoshiwaki (RIKEN).

Summary: The time evolution version of the percolation model is called the first passage percolation model: each edge of the cubical lattice is assigned a random time, and consider the growth of the percolation region $B(t)$, which consists of the vertices that can be arrived from the origin within time $t > 0$. One of the most basic theorem is called shape theorem, saying that the normalized region $B(t)/t$ converges to some limit shape. In this study, a generalized FPP model, defined on a crystal lattice, is considered. In this setting, the generalized version of the shape theorem is obtained and the limit shape depends only on the graph structure and the period of the lattice.

Summary: Unlike the 1D case, there exists an algebraic difficulty in the decomposition theory of multi-parameter persistence modules. We try to solve this difficulty not purely algebraically, but stochastically by considering the appropriate scaling limit. We first show the existence of the scaling limit of some invariants: multiplicity of the interval representation and rank invariant.

Summary: Where do firms innovate? Locating and visualizing them in technological space is challenging, because it is high-dimensional and unstructured. We address this issue by using a method in topological data analysis called Mapper, which combines local clustering with global reconstruction. We apply this method to a panel of 333 major firms' patent portfolios in 1976–2005 in 430 technological areas and propose a definition of the characteristic "flares" that appear in the Mapper graph. Results suggest the Mapper graph captures salient patterns in firms' patenting histories, and the type and length of flares are correlated with firms' financial performances in a statistically and economically significant manner.

Summary: The gene regulatory network (GRN) is a directed graph model with annotated edges that shows the regulatory relationship of gene expressions. In this study, we develop a method that estimates GRN from gene expression data by utilizing a causal discovery method 'LiNGAM' and a dynamical system 'switching model'. We derive a linear model that is applicable in LiNGAM by discretizing the switching model and applying the multi-regression to it. As a result, GRN is constructed by superposing the adjacency matrices estimated by LiNGAM.

14:30–15:50

27 Takeshi Gotoda (Nagoya Univ.) Numerical study of initial configurations leading to collapse in the point-vortex system ····· 15

Summary: Self-similar collapse is a notable phenomena in the point vortex system. The structure of initial configurations leading to self-similar collapses has been made clear for the 3-point vortex problem and some examples of self-similar collapsing solutions for the 4 and 5-point vortex problem have been obtained. In this study, we investigate initial configurations leading to self-similar collapse for the N-point vortex problem by using numerical simulations and compare some properties of them by changing the number of N. We also show the existence of relative equilibria forming symmetrical configurations.

28 Taito Tauchi (Univ. of Tokyo)
Tsuyoshi Yoneda (Univ. of Tokyo) Existence of a conjugate point in the incompressible Euler flow on an ellipsoid ····· 15

Summary: Existence of a conjugate point in the incompressible Euler flow on a sphere and an ellipsoid is considered. Misiołek (1996) formulated a differential-geometric criterion (we call M-criterion) for the existence of a conjugate point in a fluid flow. In this talk, it is shown that no zonal flow (stationary Euler flow) satisfies M-criterion if the background manifold is a sphere, on the other hand, there are zonal flows satisfy M-criterion if the background manifold is an ellipsoid (even it is sufficiently close to the sphere). The conjugate point is created by the fully nonlinear effect of the inviscid fluid flow with differential geometric mechanism.

29 Takashi Teramoto
(Asahikawa Medical Univ.)
Peter van Heijster
(Queensland Univ. of Tech.) Pinned pulse solutions inside a bump type heterogeneity ····· 10

Summary: We analyse pinned front and pulse solutions in a singularly perturbed three-component FitzHugh–Nagumo model with a bump type heterogeneity. We derive explicit conditions for the existence and stability of pinned solutions by combining geometric singular perturbation techniques and an action functional approach. We show that the model in the 1 activator - 2 inhibitors framework only supports symmetric pinned pulse solutions that are pinned in the middle of the bump region.

30 Takayuki Kubo (Ochanomizu Univ.)
Yoshihiro Ueda (Kobe Univ.) On global in time solution to Burgers equation with a time delay ···· 15

Summary: We consider the Burgers equation with a time delay, which is considered to be a model of traffic flow. We show the existence theorem for global in time solution to Burgers equation with a time delay. The key lemma of the proof of main theorem is the existence theorem for local in time solution to our problem and its a priori estimates.

31 Itsuki Watanabe (Waseda Univ.)
Hiroshi Toyoizumi (Waseda Univ.) Central limit theorem for data-diffusion with linear reactions ····· 15

Summary: We compare two mathematical models of data-diffusion; (1) the deterministic model governed by a reaction-diffusion equation and (2) the stochastic model governed by a multi-dimensional jump Markov process, respectively. In this talk, by scaling the state and fluidizing data-pieces size, we show that the difference of two mathematical models weakly converges to the Ornstein–Uhlenbeck process on skorokhod space, i.e., it is proved that the central limit theorem holds for these models.

16:00–17:00 Talk Invited by Applied Mathematics Section

Sungrim Seirin Lee (Hiroshima Univ.) Reaction-diffusion equation, its infinite talent in pattern formation of life science

Summary: Since A. Turing′s landmark paper (1952), reaction-diffusion equations became a symbol of mathematical model for pattern formation in life science. A short-range self-activation and long-range inhibition have been considered as a fundamental mechanism by which a symmetry breaking is triggered and a pattern, namely, non-constant steady state, is formed in reaction-diffusion systems. And many mathematical models in pattern formation also have based on it. However, once we take a step back and look at the truly pure essence of reaction-diffusion equation(s), we can find more potential of reaction-diffusion equation(s) and see various patterning dynamics in a simple reaction-diffusion equation(s) without a basis of activation-inhibition chemical reactions. In this talk, I will introduce such an infinite potential of reaction-diffusion equation(s) as pattern forming system which has been done by myself during theses 10 years. I also would like to discuss how mathematical modeling (or mathematical modeler) in life science and pure mathematics (or pure mathematician) can be collaborated and open a new trail of applied mathematics.

March 19th (Thu) Conference Room V

9:15–10:50

32 Shunji Horiguchi Binomial expansions of Newton's method and comparison of convergence ····· 10

Summary: We give the binomial expansion of Newton method from the first term to m (natural number of more than 2) term, and show that the convergences become the quadratic and linearly (Theorem 1.7). Next in case of the quadratic convergence, we give the convergence comparison of the binomial expansion of Newton method from the first term to m term and Newton method (Theorem 1.8 (1.13), (1.14)). Next we give the convergence comparison of the binomial expansion of the Newton method from the first term to the second term and from the first term to more than three term (Theorem 1.8 (1.15)). And we give convergence comparisons of the binomial expansion of Newton method from the first term to m term and Newton method using the curvatures, and concaves and convexes of curves (Theorem 2.3–2.9).

33 Shunji Horiguchi Examples of numerical calculations of the binomial expansions of Newton's method ····· 10

Summary: We give ranges of x satisfying the formulas (1.13), (1.14) and (1.15) of the convergence comparisons of Theorem 1.8 for f(x)=(x-1)(x-2). Next in case of the quadratic convergence, we do numerical calculations of the binomial expansion of Newton method for f(x) from the first term to m (m=2,3,4) term, and we give the comparisons of convergences of them. These are the confirmations of formulas (1.13), (1.14) and (1.15) of Theorem 1.8. We give ranges of x satisfying the formulas of Theorem 2.3, 2.4, 2.5 of the convergence comparisons by the curvatures of the binomial expansions of Newton method for f(x). And we do numerical calculations of these formulas for confirmations.

34 Fuminori Sakaguchi (Univ. of Fukui) A possibility of wider application of an algorithm for solving ODEs by means only of four arithmetical operations among integers ····· 15

Summary: A kind of generalization was proposed by the author for an integer-type algorithm for solving higher-order linear ODEs, which was proposed by the author and M. Hayashi several years ago, by means of algebraic extensions of the field of rational functions. By this generalization, for example, we can solve the higher-order linear ODEs whose coefficient functions are general algebraic functions, by means only of four arithmetical operations among integers. In this study, we show that the range of application of this algorithm can be expanded into a spacial class of the cases where the coefficient functions of ODEs involve exponential, trigonometric and hyperbolic functions. Moreover, some successful numerical examples are given for ODEs whose coefficient functions involve, for example, sigmoid and tangent functions.

35 Koichi Anada (Waseda Univ. Senior High School)
Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Takeo Ushijima (Tokyo Univ. of Sci.)
A remark on asymptotic behavior of blow-up solutions to a quasi-linear parabolic equation for a curve shortening problem 15

Summary: In this talk, we consider asymptotic behavior of blow-up solutions to a quasi-linear parabolic equation $v_t = v^\delta(v_{\theta\theta} + v)$ for a curve shortening problem. It is known that solutions blow up regionally. Our purpose is to investigate a relation between behavior of solutions at the maximum point and ones on the boundary of the blow-up set.

36 Takehiko Kinoshita (Kyushu Univ.)
Watanabe Yoshitaka (Kyushu Univ.)
Mitsuhiro T. Nakao (Waseda Univ.)
On the strong convergence of some approximate operators for resolvents of bounded operators 15

Summary: We consider the convergence of some approximate operators for resolvents of bounded linear operators. We report that this approximate operators strong converge to resolvents under reasonable assumptions. Moreover, the operator norm of this approximate operators also converge to the operator norm of resolvents.

37 Akitoshi Takayasu (Univ. of Tsukuba)
Jean-Philippe Lessard (McGill Univ.)
Jonathan Jaquette (Brandeis Univ.)
Hisashi Okamoto (Gakushuin Univ.)
Rigorous numerics for nonlinear heat equations in the complex plane of time 15

Summary: In this talk, we give two computer-assisted proofs for Cauchy problems of nonlinear heat equations for complex time values. The proofs are obtained by rigorous numerics, via a careful blend of functional analysis, semi-group theory, numerical analysis, fixed point theory, the Lyapunov–Perron method and interval arithmetic.

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

Katsuhisa Ozaki (Shibaura Inst. of Tech.)
Error-free transformation for matrix multiplication: Basic, applications, and future

Summary: This talk concerns the numerical computations of matrix multiplication. Floating-point numbers and floating-point arithmetic defined in IEEE 754 are widely used in numerical computations. The performance of the numerical computation is very high. On the other hand, the problem of rounding errors is crucial. We proposed an error-free transformation of matrix multiplication. The matrix product is transformed into an unevaluated sum of floating-point matrices. This technique is useful for accurate numerical computations. Besides, the error-free transformation is applied to interval matrix multiplication and generation of test matrices in numerical linear algebra. Moreover, we can develop reproducible numerical algorithms and a fast algorithm for matrix multiplication using low precision arithmetic on GPGPU based on the error-free transformation.

Topology

March 16th (Mon) Conference Room IV

10:00–12:00

Summary: Taking the sphere spectrum as base instead of integers gives Hochschild homology a structure called cyclotomic structure. Using the structure we evaluate certain maps between algebraic K-groups of some truncated polynomial algebras in terms of de Rham–Witt complex.

Summary: We introduce a property of mutation loops, called the sign stability, with a focus on an asymptotic behavior of the iteration of the tropical $\mathcal{X}$-transformation. A sign-stable mutation loop has a numerical invariant which we call the cluster stretch factor, in analogy with that of a pseudo-Anosov mapping class on a marked surface. We compute the algebraic entropies of the cluster $\mathcal{A}$- and $\mathcal{X}$-transformations induced by a sign-stable mutation loop, and conclude that these two coincide with the logarithm of the cluster stretch factor.

Summary: We will discuss a criteria for finding Fatou sets of foliations.

Summary: In this talk, I would like to propose a purely geometric description of Bayesian estimation. We generalize the notion of relative entropy and Fisher information so that they become subjects of Lorentzian geometry and further those of the general relativity. In fact, we give an example of Ricci flat Lorentzian manifold appearing as an extended space of normal distributions.

Summary: We give an explicit formula of the twisted Alexander polynomial of the torus link and show that it is a locally constant function on the $SL(2;\mathbb{C})$-character variety. We also discuss the similar things for higher dimensional twisted Alexander polynomials.

Summary: We construct a homomorphism on the graded quotient of the Y-filtration of the homology cylinders. The homomorphism restricted to the lower central series of the Torelli group is non-trivial and different from the Johnson homomorphisms. As an application, we give an abelian quotient of the Johnson kernel which is not described by the Casson invariant, the second and third Johnson homomorphisms. This is the joint work with Masatoshi Sato and Masaaki Suzuki.

Summary: We study twisted Alexander polynomials of hyperbolic twist knots for non-abelian $\mathrm{SL}_2(\mathbb{C})$-representaions and discuss some relations with von Dyck groups.

8 Takefumi Nosaka (Tokyo Tech) K_1-Alexander twisted polynomials of knots ····· 15

Summary: Given a homomorphism from a knot group to a group,we introduce a K_1-class, which is a generalization of the 1-variable Alexander polynomial. We suggest several approached to the K_1-class. As a corollary, we show a relation to Reidemeister torsions of finite cyclic covering spaces, and show reciprocity in some senses.

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

Takayuki Morifuji (Keio Univ.) Twisted Alexander polynomials of hyperbolic knots and links

Summary: The twisted Alexander polynomial is defined for a pair of the group and its representation. It is a natural generalization of the Alexander polynomial and gives a powerful tool in the study of low-dimensional topology. Based on huge numerical calculations, Dunfield, Friedl and Jackson have proposed a conjecture that the twisted Alexander polynomial associated to the holonomy representation determines the genus and fiberedness of a hyperbolic knot. In this talk we will survey recent results on the conjecture and explain its generalization to hyperbolic links.

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

Naoki Fujita (Univ. of Tokyo) Toric degenerations arising from Newton–Okounkov bodies and cluster structures

Summary: The theory of toric varieties gives an elegant dictionary translating geometric and topological properties into combinatorial properties in terms of cones and polytopes. In order to apply this powerful dictionary to other projective varieties, we can use degenerations to toric varieties, called toric degenerations. In this talk, we study the following two systematic methods of constructing toric degenerations: Newton–Okounkov bodies and cluster algebras. In the first part of this talk, we survey the theory of Newton–Okounkov bodies and its applications in geometry, including Harada–Kaveh's construction of completely integrable systems. In the second part, we study Newton–Okounkov bodies from the theory of cluster algebras. We can realize Gross–Hacking–Keel–Kontsevich's toric degenerations of compactified cluster varieties as ones coming from Newton–Okounkov bodies. Throughout this talk, we especially focus on the case of flag varieties whose toric degenerations are closely related to representation theory.

March 17th (Tue) Conference Room IV

10:00–12:00

9 Atsushi Ishii (Univ. of Tsukuba)
Shosaku Matsuzaki (Takushoku Univ.)
Tomo Murao (Univ. of Tsukuba)
A multiple group rack and oriented spatial surfaces ····· 10

Summary: In this talk, we define a multiple group rack, which is an algebraic structure consisting of the disjoint union of groups. We introduce a coloring invariant for oriented spatial surfaces by using multiple group racks, and give some examples.

10 Atsushi Ishii (Univ. of Tsukuba) The fundamental multiple conjugation quandle of a handlebody-knot ····· 10

Summary: A multiple conjugation quandle is used to define a coloring invariant of a handlebody-knot. We introduce a presentation of a multiple conjugation quandle and define the fundamental multiple conjugation quandle of a handlebody-knot.

Summary: A finite presentation for the subgroup of the mapping class group of a compact non-orientable surface generated by all Dehn twists was given by Stukow. In this work, we give an infinite presentation for this group, mainly using the presentation given by Stukow and Birman exact sequences on mapping class groups of non-orientable surfaces. As an application, we give an infinite presentation for the mapping class group of a compact non-orientable surface.

Summary: Lickorish proved that any element of the mapping class group of a non-orientable is a product of Dehn twists and crosscap slides. We call the product Dehn twist-crosscap slide presentation for the element. In this talk, we give Dehn twist-crosscap slide presentations for all conjugacy classes of involutions on non-orientable surfaces of genus 4 and 5. The Dehn twist-crosscap slide presentations are constructed by products of Szepietowski's finite generating set.

Summary: We construct a genus zero PALF structure on each of plugs introduced by Akbulut and Yasui and describe the monodromy as a positive factorization in the mapping class group of a fiber. We also examine the monodromies of PALFs on a certain pair of compact Stein surfaces such that one is obtained by applying a plug twist to the other.

Summary: A trisection is a decomposition of a closed 4-manifold by 3 tuple of 4-dimensional 1-handlebodies, which was introduced by Gay and Kirby. They proved the existence of a trisection for any closed 4-manifold by using a stable map (called a trisection map) from the 4-manifold to $\mathbf{R}^2$. After their work, a simplified trisection was introduced by Baykur and Saeki. They proved the existence of a simplified trisection from a simplified broken Lefschetz fibration. In this talk, we will give a classification of 3-manifolds that can be obtained as the preimages of arcs on $\mathbf{R}^2$ by simplified genus 2 trisection maps, which we call vertical 3-manifolds.

Summary: In this talk, we treat oriented 2-knots: smooth embeddings from S^2 to S^4 equipped with orientations. For a given oriented 2-knot, we introduce a functional from the $SU(2)$-representation space of its knot group to $(0, 1]$. The image of the functional gives an isotopy invariant of an oriented 2-knot. We show several properties of the functional, including a connected sum formula, a relation between the functional and $SU(2)$-representation, and an orientation reversing formula. Moreover, we calculate the images of the functionals for ribbon 2-knots and twisted spun knots of torus knots, rational knots, and Montesinos knots. Using a refinement of instanton Floer theory and several properties of the functional, we relate the existence of a certain class of Seifert hypersurface with the existence of an irreducible $SU(2)$-representation of its knot group.

Summary: We define the regularzied self-inductances of a knot from Neumann formula and Weber formula of the mutual inductance of a pair of closed circuits. We show that they are different by twice the length. We also study the residues and related quantities.

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

Hokuto Konno (RIKEN) Gauge theory and diffeomorphism and homeomorphism groups

Summary: I will survey recent development of applications of gauge theory to the diffeomorphism and homeomorphism groups of 4-manifolds.
It is known that, for an arbitrary closed manifold of dimension less than 4, the inclusion map from the diffeomorphism group to the homeomorphism group is a weak homotopy equivalence. Therefore it is interesting to ask if there is a homotopical difference between the diffeomorphism and homeomorphism groups in other dimensions. Thanks to one of Donaldson's results, it turned out that 4 is the first dimension in which such a difference appears. But until recently, no one had have any systematic way to extract such differences in dimension 4. This talk is aimed at explaining that gauge theory for families gives a systematic way as follows.
After Donaldson's celebrated diagonalization theorem, gauge theory has given strong constraints on the topology of smooth 4-manifolds, such as Furuta's 10/8-inequality. Combining such constraints with Freedman's theory, one may find many non-smoothable topological 4-manifolds. Recently, a family version of this argument was started by T. Kato, N. Nakamura and myself, and soon later it was developed also by D. Baraglia and his collaborating work with myself. More precisely, considering gauge theory for smooth fiber bundles of 4-manifolds, they obtained some constraints on the topology of smooth fiber bundles of 4-manifolds. Moreover, it turned out that one may detect non-smoothable topological fiber bundles of smooth 4-manifolds using such constraints. The existence of such bundles implies that there are homotopical differences between the diffeomorphism and homeomorphism groups of the 4-manifolds given as the fibers of the non-smoothable bundles.

March 18th (Wed) Conference Room IV

10:00–12:00

17 Katsumi Ishikawa (Kyoto Univ.)
Kazuhiro Ichihara (Nihon Univ.)
Eri Matsudo (Nihon Univ.)
Minimal coloring numbers on minimal diagrams of torus links ····· 10

Summary: In this talk, we determine the minimal number of colors for non-trivial $\mathbb{Z}$-colorings on the standard minimal diagrams of $\mathbb{Z}$-colorable torus links. Also included are complete classifications of such $\mathbb{Z}$-colorings and of such $\mathbb{Z}$-colorings by only four colors.

18 Natsumi Oyamaguchi (Shumei Univ.)
Kanako Oshiro (Sophia Univ.)
Pallets of Dehn p-coloring for spatial graphs ····· 10

Summary: A Dehn p-coloring for a spatial graph diagram is an assignment of an element of $\mathbb{Z}_p = \{0, \ldots, p-1\}$ to each region. At each crossing, some coloring condition is satisfied. A region pallet of $\mathbb{Z}_p$ is a subset of $\bigcup_{n \in 2\mathbb{Z}_+} \mathbb{Z}_p^n$ which gives a coloring condition at each vertex for Dehn p-colorings. We classified the region pallets of $\mathbb{Z}_p$.

19 Mario Eudave-Muñoz ♭ (Univ. Nacional Autónoma de México)
Makoto Ozawa (Komazawa Univ.)
The maximum and minimum genus of a multibranched surface ····· 15

Summary: In this talk, we give a lower bound for the maximum and minimum genus of a multibranched surface by the first Betti number and the minimum and maximum genus of the boundary of the neighborhood of it respectively. As its application, we show that the maximum and minimum genus of $G \times S^1$ is equal to twice of the maximum and minimum genus of G for a graph G respectively. This is a joint work with Mario Eudave-Muñoz.

Summary: We show how to tabulate knot projections by listing tangles. In particular, we obtain the complete table of prime knot projections with their mirror images up to eight double points systematically thorough a finite procedure.

Summary: We show that two-bridge knots and alternating fibered knots admit no purely cosmetic surgeries, i.e., no pair of distinct Dehn surgeries on such a knot produce 3-manifolds that are homeomorphic as oriented manifolds. Our argument, based on a recent result by Hanselman, uses several invariants of knots or 3-manifolds; for knots, we study the signature and some finite type invariants, and for 3-manifolds, we deploy the $SL(2,\mathbb{C})$ Casson invariant.

Summary: We study Dehn surgeries along genus one fibered knots and which resultant manifolds have left-orderable fundamental groups. The 3-sphere has only two genus one fibered knots, the trefoil and the figure-eight knot. In contrast with the 3-sphere, some lens spaces have more genus one fibered knots. In 2014, Baker completely classified the number of genus one fibered knots in lens spaces. Along the classification, we show that, on some class of such knots in lens spaces, all integral surgeries yield 3-manifolds with left-orderable fundamental groups. In order to prove this theorem, we examine the existence of Anosov flow whose stable/unstable foliation is $\mathbb{R}$-covered in the resultant manifold.

Summary: A symmetric union in the 3-space is a knot, obtained from a knot and its mirror image, which are symmetric with respect to a 2-plane, by taking the connected sum of them and moreover by connecting them with some vertical twists along the plane. A symmetric union is an example of a ribbon knot. In this talk, we show that if a knot is a composite symmetric union with minimal twisting number one, then the knot has a non-trivial knot and its mirror image as connected summands. We also show that a satellite symmetric union with minimal twisting number one such that the order of the pattern is an odd number$\geq$3 has at least two disjoint non-parallel essential tori in the complement.

Summary: We give a table of knots which have annulus presentations up to 8-crossings.

Summary: We show that if a link L has a closed n-braid representative admitting a non-degenerate exchange move, an exchange move that does not obviously preserve the conjugacy class, L has infinitely many non-conjugate closed n-braid representatives.

Infinite Analysis

March 18th (Wed) Conference Room IX

14:15–16:15

1 Koichi Hiraide (Ehime Univ.)
Chihiro Matsuoka (Osaka City Univ.)
Stokes-like phenomena which appear in dynamics of complex Henon maps · · · · · 15

Summary: We consider invariant curves for complex Henon maps associated with an eigenvalue, with absolute value not equal to one, of the derivative at a fixed point. By the method of Borel–Laplace transform, we can construct pairs $(x_i(t), y_i(t))$ of functions, parameterizing the invariant curves. Such functions have forms of asymptotic expansions. In this talk, we give a relation with classical functions, due to Poincare, represented by Taylor series, and state a connection structure among functions' pairs $(x_i(t), y_i(t))$, which is like structures known as (nonlinear) Stokes phenomena in differential equations.

2 Nozomu Matsuura (Kurume Inst. of Tech.)
Explicit formula for planar discrete elasticae · · · · · 15

Summary: We give an explicit formula for the discrete elasticae in the Euclidean plane in terms of Jacobi's elliptic theta functions.

3 Yuuki Tadokoro (Nat. Inst. of Tech., Kisarazu Coll.)
Masayoshi Sekiguchi (Nat. Inst. of Tech., Kisarazu Coll.)
Masaru Kamata (Nat. Inst. of Tech., Kisarazu Coll.⋆)
Nonlinear $O(3)$ sigma model in discrete complex analysis · · · · · 15

Summary: We study a discrete version of the two-dimensional nonlinear $O(3)$ sigma model derived from discrete complex analysis. We show the discrete version of an equality for the energy of this model.

4 Yas-Hiro Quano (Suzuka Univ. of Med. Sci.)
Runge–Lenz like vectors for central force fields · · · · · 15

Summary: In this talk, two-body problems for classical central force fields will be discussed. As is well known, there exists a conserved Runge–Lenz vector in addition to conserved quantities, the energy and the angular momentum.
I conseder general central force problems, and show the existence of Runge–Lenz like vectors. In particular, I discuss a harmonic oscillator and a perturbed Kepler problem with a $1/r^2$ potential in detail.

5 Junichi Shiraishi (Univ. of Tokyo)
Non-stationary Ruijsenaars function · · · · · 15

Summary: We introduce the formal power series $f^{\widehat{\mathfrak{gl}}_N}(x, p|s, \kappa|q, t)$ which we call the non-stationary Ruijsenaars function. We present several theorems and conjectures concerning the non-stationary Ruijsenaars function.

6 Junichi Shiraishi (Univ. of Tokyo)
Non-stationary and stationary Ruijsenaars functions and eigenvalue problem associated with Ruijsenaars operator · · · · · 15

Summary: Based on the non-stationary and the stationary Ruijsenaars functions, we present a conjecture concerning the eigenvalue problem associated with the Ruijsenaars operator.

7 Yusuke Ohkubo (Univ. of Tokyo) Jun'ichi Shiraishi (Univ. of Tokyo) Masayuki Fukuda (Univ. of Tokyo) Non-stationary Ruijsenaars functions and intertwining operators of the Ding–Iohara–Miki algebra 15

Summary: In this talk, we realize the affine analogue of the Macdonald functions, which are referred to as the non-stationary Ruijsenaars functions, by the Ding–Iohara–Miki algebra. Moreover, we present various combinatorial expressions of the non-stationary Ruijsenaars functions by using a duality formula for the intertwining operators of the Ding–Iohara–Miki algebra.

16:30–17:30 Talk Invited by Infinite Analysis Special Session

Hideya Watanabe (Kyoto Univ.) $\imath$quantizations

Summary: $\imath$quantum groups are generalizations of quantum groups appearing as one-sided coideal subalgebras of quantum groups in the theory of quantum symmetric pairs. Recently, numerous results which we should call "$\imath$quantizations" have been reported. $\imath$quantizations have two meanings; (1) generalizing what is known for usual quantum groups to $\imath$quantum groups, (2) quantizing what is known for classical Lie algebras but cannot be quantized by usual quantum groups, by means of $\imath$quantum groups. In this talk, I introduce examples of $\imath$quantizations such as canonical basis, geometric construction, Hall algebraic construction, GT-basis of type B/D, Schur duality of type B/C/D, highest weight theory, and crystal basis.

March 19th (Thu) Conference Room IX

9:45–11:30

8 Sanefumi Moriyama (Osaka City Univ.) Quantum curves and Weyl groups 15

Summary: Quantum curves are helpful for studying the Painlevé equations or many other mathematical physics equations such as the correspondence between spectral theories and topological strings. We provide explicit expressions for the quantum curves of genus one and the actions of Weyl group. We further comment on the applications of these curves to the analysis of mirror maps.

9 Kanehisa Takasaki (Kindai Univ.) Equivariant Gromov–Witten theory of CP^1 and equivariant Toda hierarchy 15

Summary: Okounkov and Pandharipande constructed what they call "dressing operators" in their study on the integrable structure of the Gromov–Witten theory of CP^1. These operators are used to convert a generating function of the equivariant Gromov–Witten invariants to a tau function of the equivariant Toda hierarchy. We redefine these operators in the perspective of the Lax formalism of the 2D Toda hierarchy. This leads to yet another proof of the fact that the generating function of the equivariant Gromov–Witten invariants yields a special solution of the equivariant Toda hierarchy.

10 Hiroyuki Yamane (Univ. of Toyama) On typical irreducible characters of generalized quantum groups 15

Summary: In 1977, V. Kac gave the Weyl-type character formula of the typical finite dimensional irreducible modules of the basic classical Lie superalgebras. In the talk, we introduce an analogous character formula for the generalized quantum groups.

11 Ryo Fujita (Kyoto Univ.) Singularities of normalized R-matrices between fundamental modules over the affine quantum groups of type ADE 15

Summary: We present a simple unified formula expressing the denominators of the normalized R-matrices between the fundamental modules over the affine quantum groups of type ADE. It has an interpretation in terms of representations of Dynkin quivers and can be proved in a unified way using the geometry of graded quiver varieties. As a by-product, we obtain a geometric interpretation of Kang–Kashiwara–Kim's generalized quantum affine Schur–Weyl duality functor when it arises from a family of fundamental modules.

12 Yasuaki Gyoda (Nagoya Univ.) Relation between f-vectors and d-vectors in cluster algebras of finite type or rank 2 15

Summary: We study the f-vectors, which are the maximal degree vectors of F-polynomials in cluster algebra theory. When a cluster algebra is of finite type or rank 2, we find that the positive f-vectors correspond with the d-vectors, which are exponent vectors of denominators of cluster variables. Furthermore, using this correspondence and properties of d-vectors, we prove that cluster variables in a cluster are uniquely determined by their f-vectors when the cluster algebra is of finite type or rank 2.

13 Naoto Okubo (Aoyama Gakuin Univ.)
Tetsu Masuda (Aoyama Gakuin Univ.)
Teruhisa Tsuda (Hitotsubashi Univ.)
Cluster algebras and higher order q-Painlevé systems of type $A_7^{(1)}$ 15

Summary: In this talk, we present higher order q-Painelevé systems of type $A_7^{(1)}$ by using a cluster algebra.

14:15–16:00

14 Genki Shibukawa (Kobe Univ.) Another proof of difference equations for interpolation Jack polynomials 15

Summary: We give another proof of difference equations for interpolation Jack polynomials.

15 Ryuya Matsunawa (Chuo Univ.)
Tomoki Sato (Chuo Univ.)
Kouichi Takemura (Ochanomizu Univ.)
Variants of confluent q-hypergeometric equations 15

Summary: Variants of the q-hypergeometric equation were introduced in our paper jointly with Hatano. We consider degenerations of the variants of the q-hypergeometric equation, which is the q-analogue of confluence of singularities in the setting of the differential equation. We also consider degenerations of solutions to the q-difference equations.

16 Hiroshi Kawakami (Aoyama Gakuin Univ.) On four-dimensional Painlevé-type difference equations 15

Summary: We focus on Fuchsian equations with four accessory parameters and three singular points. We see that the Fuchsian equations admit a "degeneration scheme" in some sense, which is expected to give rise to a degeneration scheme of discrete isomonodromic deformation equations with four-dimensional phase space. We compute an example of discrete isomonodromic deformation equations of a certain Fuchsian equation.

17 Hiroshi Kawakami (Aoyama Gakuin Univ.) A q-analogue of the matrix sixth Painlevé system 15

Summary: We consider a connection-preserving deformation of a certain linear q-difference system. A system of non-linear q-difference equations thus obtained can be regarded as a q-analogue of the matrix sixth Painlevé system, or as a non-abelian analogue of the q-P_{VI}.

18 Masahiko Ito (Univ. of Ryukyus)
Masatoshi Noumi (Kobe Univ.)
q-Difference system for the elliptic hypergeometric integral of type G_2 with six parameters 15

Summary: We will present an explicit form of the q-difference system, which is satisfied by the elliptic hypergeometric integral of type G_2 with six parameters.

19 Hidehito Nagao (Akashi Coll. of Tech.)
Yasuhiko Yamada (Kobe Univ.)
Padé method and q-quadratic Garnier systems 15

Summary: We study a certain q-quadratic Garnier system. Choosing a suitable Padé problem on q-quadratic grid, we simultaneously construct the evolution equation, the Lax pair and determinant formulae of special solutions in terms of the very-well-poised balanced q-hypergeometric function. We discuss some specializations of the system.

16:15–17:15 Talk Invited by Infinite Analysis Special Session

Yoshihisa Saito (Rikkyo Univ.) On elliptic Artin groups

Summary: In the study of representation theory of Lie groups and Lie algebras, the regular Weyl group orbit spaces and their fundamental groups (called Artin groups or generalized braid groups) have quite important roles.

In the middle of 80's, motivated by the study of singularity theory, Kyoji Saito introduced the notion of elliptic root systems, and study their basic properties. Especially, he introduced an "elliptic analogue" of the regular Weyl group orbit spaces, so-called the elliptic regular orbit spaces, and study their detailed structure in algebraic and differential geometrical point of view.

In this talk, we study the fundamental groups of the regular elliptic Weyl group orbit spaces. These groups are presented by a generator system associated with the elliptic diagrams, and we call them the elliptic Artin groups. Furthermore, some basic properties of these groups will be also discussed. Especially, the elliptic regular orbit space is defined over the moduli space of elliptic curves. This fact leads us to the description of the elliptic modular group actions on elliptic Artin groups. This talk is based on a joint work with Kyoji Saito.