Final: 2021/2/15

The Mathematical Society of Japan

2021 Annual Meeting

Titles and Short Summaries of the Talks

March, 2021

at Keio University

2021 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 15th (Mon)–18th (Thu), 2021

Venue: Yagami Campus, Keio University
and Live streaming

Contact to: E-mail `keio21mar@mathsoc.jp`

The Mathematical Society of Japan

	I	II	III	IV	V	VI	VII	VIII	IX
15th (Mon)	Found. of Math. & Hist. of Math. 9:30–10:35 14:15–15:15	Algebra 9:40–10:45 14:15–16:30	Geometry 9:30–12:00 14:15–15:15	Complex Analysis 15:30–16:40	Functional Equations 9:00–12:00 14:15–15:30		Statistics and Probability 10:00–12:00		Topology 10:00–11:00
	Featured Invited Talks 13:00–14:00								
	Invited Talk 10:45–11:45	Invited Talk 11:00–12:00	Invited Talk 15:30–16:30	Invited Talks 11:00–12:00 14:15–15:15	Invited Talk 15:40–16:40		Invited Talks 14:15–15:15 15:35–16:35		Invited Talk 14:15–15:15
16th (Tue)	Found. of Math. & Hist. of Math. 10:15–11:00	Algebra 10:00–12:00 Invited Talk 13:00–14:00	Geometry Invited Talks 10:30–11:30 13:00–14:00	Complex Analysis 13:00–14:10 Invited Talk 11:00–12:00	Functional Equations 9:00–12:00 Invited Talk 13:00–14:00	Functional Analysis 9:00–10:30 Invited Talks 11:00–12:00 13:00–14:00		Applied Mathematics 9:30–10:45 Invited Talk 11:00–12:00	Topology 10:00–11:00 Invited Talk 13:15–14:15
	MSJ Prizes Presentation (Multimedia Room) ····· (14:30–15:00) Plenary Talks (Multimedia Room) Spring Prize Winner ····· (15:15–16:15) Shigeru Mukai (Kyoto Univ.) ····· (16:30–17:30)								
17th (Wed)	Infinite Analysis 10:30–12:00 14:15–15:15	Algebra 9:30–12:00	Geometry 10:00–12:00 14:15–15:15	Real Analysis 10:30–11:50	Functional Equations 9:00–12:00 14:15–15:30	Functional Analysis 9:00–10:45	Statistics and Probability 10:00–10:35 14:15–15:00	Applied Mathematics 9:40–10:45 14:15–15:20	
	Featured Invited Talks 13:00–14:00								
		Invited Talks 14:15–15:15 15:30–16:30	Invited Talk 15:30–16:30	Invited Talk 14:30–15:30	Invited Talk 15:40–16:40	Invited Talks 11:00–12:00 14:30–15:30	Invited Talks 10:55–11:55 15:20–16:20	Invited Talk 11:00–12:00	
18th (Thu)	Infinite Analysis	Algebra 9:40–12:00 14:15–16:25		Real Analysis 10:00–11:45 14:15–14:45	Functional Equations 9:00–12:00 14:15–15:30			Applied Mathematics 9:40–10:45 14:15–15:05	
	Featured Invited Talks 13:00–14:00								
	Invited Talks 10:00–11:00 11:15–12:15			Invited Talk 15:00–16:00	Invited Talk 15:40–16:40			Invited Talk 11:00–12:00	

Contents

Plenary Talks

March 16th (Tue) Live streaming from Multimedia Room

Spring Prize Winner [Z] ..... (15:15–16:15)

Shigeru Mukai (Kyoto Univ.) [Z] Algebraic varieties and their symmetry with emphasis on K3 surfaces and their companions ..... (16:30–17:30)

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. The Mathieu group M24, one of the 26 sporadic finite simple groups, was a key in classifying finite groups acting symplectically on K3 surfaces. The Higman–Sims graph, which defines another sporadic group, was implicitly used in determining the (infinite) automorphism group of generic Jacobian Kummer surfaces (Kondo 1998). Besides these topics, I will also discuss some recent results on Enriques surfaces and the decomposition groups of certain plane curves if time permits.

Featured Invited Talks

March 15th (Mon)

Conference Room I

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

Summary: We will explain how Georg Cantor introduced transfinite 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.

Conference Room V

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Kazue Sako (Waseda Univ.) Z Cryptographic protocols brings transparency to digital process ····· (13:00–14:00)

Summary: Cryptography had been studied for thousand years to protect secret messages from eavesdroppers. With advancements of computing and network technologies, cryptography serves as not only to hide messages, but to ensure correct conduct of digital procedures. Cryptography prohibits malicious or unfair activities by setting a wall by some computationally difficult mathematical problems, such as factorization or computing discrete logarithms. In this presentation, some basic tools using cryptographic primitives are introduced, together with how they are used in real world applications, including cryptocurrencies such as Bitcoin.

Conference Room IX

Katsuhiko Kuribayashi (Shinshu Univ.) Z 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 17th (Wed)

Conference Room II

Shu Kawaguchi (Doshisha Univ.) Z Height functions in arithmetic dynamics ····· (13:00–14:00)

Summary: Height functions are means to measure how "complicated" algebraic points are from the arithmetical viewpoint. I would like to explain that height functions are useful in the study of the dynamics of polynomial and rational mappings on algebraic varieties, establishing sometimes properties of the dynamical system, or leading some conjectures. I would also like to explain some interactions of arithmetic and complex dynamics.

Conference Room IV

Kenichi Mitani (Okayama Pref. Univ.) Z Geometrical constants of Banach spaces · · · · · · · · · · · · · · · · · (13:00–14:00)

Summary: In this talk, we give recent results on geometrical constants of Banach spaces. In particular, we treat the von Neumann–Jordan and James constant, which are most widely studied constants. Some geometrical properties are characterized by means of them. We discuss some relations between them and other geometrical constants. Moreover, we determine geometrical constants of concrete Banach spaces.

March 18th (Thu)

Conference Room IV

Tomoki Nakanishi (Nagoya Univ.) Z Cluster algebras, root systems, and scattering diagrams · · · (13:00–14:00)

Summary: Cluster algebras are a class of commutative algebras introduced by Fomin and Zelevinsky around 2000. They are generalizations of the coordinate rings of some algebraic varieties in Lie theory such as Grassmannians in view of the Laurent phenomenon and the positivity property. It is remarkable that, almost around the same time and essentially independently, Fock and Goncharov also reached to the concept of cluster algebras from the study of Teichmüller theory. Since the introduction, it was gradually recognized that cluster algebras are relevant to several areas of mathematics, to name a few, representation theories of quivers, quantum groups, and Khovanov–Lauda–Rouquier algebras, Bridgeland stability conditions, Donaldson–Thomas invariants, Stasheff polytopes, Poisson–Lie structures, two and three dimensional hyperbolic geometries, skein relations, dilogarithm functions, exact WKB analysis and Stokes phenomenon, Somos sequences, KP hierarchy, Coxeter–Toda lattices, dimer models, conformal field theory, T-systems and Y-systems, Hitchin systems, discrete Painlevé equation, etc.
Despite these developments and the apparent importance of cluster algebras, I personally believe that the current definition of cluster algebras by Fomin and Zelevinsky is too explicit and specific, and a more intrinsic and/or axiomatic definition of cluster algebras should be given. In other words, we do not yet know what really are cluster algebras. Having this viewpoint in mind, I explain the relations among cluster algebras, root systems, and scattering diagrams by Gross–Hacking–Keel–Kontsevich, hoping that they are relevant to an intrinsic definition of cluster algebras in future.

Conference Room VIII

Yoshihisa Morita (Ryukoku Univ.) Z Reaction-diffusion systems and pattern formations —Emerging structure of solutions under constraint— · · · · · · · · · · · · · · · · (13:00–14:00)

Summary: In the fields of biology, chemistry and material science reaction-diffusion equations are employed as phenomenological models and various spatial patterns of the solutions are exhibited by numerical computations. For specific model equations, the existence and stability of solutions with spatial profile are mathematically well studied, but it is far from the complete understanding for the mechanism of pattern formations in the whole class of the equations. Since it is difficult to overview every class of the equations, we are involved in the simple question what equations or conditions allow the emergence of the pattern formation. In this lecture we quickly review the pioneering works on the pattern formation and then go to systems of reaction-diffusion equations with mass conservation. It turns out that the systems have rich mathematical structures even though the constraint of the conservation. We also briefly introduce the recent development of the study for the fast reaction limit and nonlocal problems in the reaction-diffusion equations.

Foundation of Mathematics and History of Mathematics

March 15th (Mon) Conference Room I

9:30–10:35

1 Katsumi Sasaki (Nanzan Univ.) Z Improper inference rules weaker than implication introduction rule ··· 15

Summary: In natural deduction system for classical propositional logic, there are some inference rules with temporal assumptions, e.g., implication introduction rule and disjunction elimination rule. D. Prawitz calls such inference rules improper inference rules, and the others proper inference rules. In MSJ Autumn Meeting 2020, we considered a sequent system for simple proofs, in which none of the improper inference rules, the implication right rule, the disjunction left rule, and the rule of contradiction, holds while proper ones hold. This system can be used to compare improper inference rules. For instance, we can observe that the above three improper inference rules are equivalent in the system. So, we also note that no improper inferences rules weaker than the above three rules is noticed. Here, we give improper inference rules weaker than three improper inference rules above.

2 Katsumi Sasaki (Nanzan Univ.) Z An interpretation of simple proofs by modal operators ····· 15

Summary: In natural deduction systems, there are some inference rules with temporal assumptions, e.g., implication introduction rule and disjunction elimination rule. D. Prawitz calls such inference rules improper inference rules, and the others proper inference rules. In MSJ Autumn Meeting 2020, we considered a sequent system for simple proofs, in which none of the improper inference rules: the implication right rule, the disjunction left rule,and the rule of contradiction, holds while proper ones hold. Here, we give an interpretation of the system for simple proofs by using modal operators.

3 Yuya Okawa (Chiba Univ.) Z
Sohei Iwata (Kobe Univ.)
Taishi Kurahashi (Kobe Univ.)
The Craig interpolation and fixed point properties for sublogics of interpretability logic IL ····· 15

Summary: De Jongh and Sambin's fixed point theorem for the modal propositional logic **GL** of provability is one of notable results of modal logical investigation of formalized provability. Smoryński pointed out that the fixed point theorem follows from the Craig interpolation theorem for **GL**. De Jongh and Visser proved that the interpretability logic **IL** that is an extension of **GL** with the binary modal operator $\triangleright$ also has the fixed point property (FPP). Also, Areces, Hoogland and de Jongh proved that **IL** has the Craig interpolation property (CIP).
We investigated FPP and CIP for twelve sublogics of **IL**, and completely clarified whether each of these twelve logics has FPP and CIP.

4 Ryo Kashima (Tokyo Tech) Z
Shinichi Tomaru (Tokyo Tech)
On the completeness of 2nd-order type assignment system for lambda calculus ····· 15

Summary: We consider how to define adequate semantics for the 2nd order type assignment system for lambda calculus such that $M : \tau$ is provable if and only if $M : \tau$ is valid in the semantics.

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

Takahiro Seki (Niigata Univ.) Substructural logics from the viewpoint of relevant logics

Summary: Substructural logics are those that restrict certain structural rules, such as weakening, contraction, and exchange in **LK** or **LJ**. Nonclassical logics, such as many-valued, relevant, and linear logics and Lambek calculus—in which the meanings of logical connectives differ somewhat from their definitions in classical logic—have been studied independently for a long lime, but they are now regarded as constituting a family of substructural logics. In particular, relevant logics are those that avoid the paradoxes of material implication and are understood to be substructural logics without weakening rules. We present some basic results related to substructural logics over **FL** and the relevant logic **R** and discuss their relationships and difficulties with Kripke-style semantics, algebraic semantics, and cut-free Gentzen-style formulations. Furthermore, we introduce non-associative substructural logics, which lack another structural rule (namely associativity). Our approach to non-associative substructural logics is based on the techniques of weaker relevant logics.

11:45–12:00 Research Section Assembly

14:15–15:15

5 Kohtaro Tadaki (Chubu Univ.) A refinement of quantum information theory by algorithmic randomness IV 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 stabilizer codes based on the principle of typicality, in order to demonstrate how properly our framework works in practical problems in quantum mechanics.

6 Toshimichi Usuba (Waseda Univ.) Variants of Strong Chang's Conjecture 15

Summary: Cox and Sakai introduced a variant of Strong Chang's Conjecture (SCC). We show that, under the negation of the continuum hypothesis, their SCC is equivalent to that Namba forcing being semi-proper.

7 Akito Tsuboi (Univ. of Tsukuba) On Fraïssé limit and coloring 10

Summary: We generalize some of the important results in Ramsey theory.

8 Koichiro Ikeda (Hosei Univ.) On holographic structures 15

Summary: We show that there exists a generic structure which is holographic but not !-categorical.

9 Hiroki Yagisita (Kyoto Sangyo Univ.) Semantics, formal deductive system and completeness theorem of structure (in a broad sense) with partial functions as interpretations of function symbols ..... ∗

Summary: For example, a ring is a structure of the language $\{+,-,\times,0,1\}$, and a ring is not a structure of the language $\{+,-,\times,\cdot^{-1},0,1\}$ because the domain of the operation $\cdot^{-1}$ of the multiplicative inverse is not the whole. In general, it is not officially possible to introduce a function symbol into a partial function. In this paper, we consider "a structure in a broad sense" that allows a partial function as the interpretation of a function symbol, we give its semantics and a Hilbert-style formal deductive system, and we prove the completeness theorem.

10 Hirotaka Kikyo (Kobe Univ.) On model completeness of Hrushovski's pseudoplanes ····· ∗

Summary: Hrushovski constructed generic graphs depending on a real number parameter α with $0 < \alpha < 1$. Given a parameter α he defined a real function f_α and a class K_α of finite graphs, and he proved that K_α has a generic structure M_α which can be seen as a pseudoplane. f_α is a concave increasing piecewise smooth function like log function. The right derivative of f_α tends to 0 if the argument tends to the infinity. We have shown the following: M_α has a model complete theory if f_α is rational. In this case, f_α is unbounded. If α is irrational, f_α can be bounded or unbounded. If f_α is bounded then the theory of M_α is not model complete. It is likely that M_α has a model complete theory if f_α is unbounded.

March 16th (Tue) Conference Room I

10:15–11:00

11 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) Z Differential equations and trancendent equations by Legendre and its application by Poisson ····· 15

Summary: Legendre issues Traité des fonctions elliptiques et des intégrales eulériennes etc. in 1825. in which he shows the many transcendent. In addition to that in the secondary volume, as the thertiay volume, in 1828, he deeps the study of the relation of differential equations and transcendent equations. We discuss the differential equations and transcendent equations by Legendre and Poisson's applications. These are necessary to discuss their theories of elliptic functions and its applications, which aim to develop and improve Eulerian integrals.

12 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) Z Echelons and transcendent equations of the elliptic functions by Legendre ····· 15

Summary: We discuss the spiral of echelon by Legendre. The researches of the elliptic functions are started from Landen. and progressed via Macraulin, d'Alembert, etc. Euler didn't reserved his results. If it had existed, Legendre had compared it with his method.

13 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) Z Particular values versus eigenvalues versus proper value and particular function versus eigenfunction ····· 15

Summary: We discuss the eigenvalue problem, especially, the coincidence between la valeur particulière and the eigenvalue. The eigenvalue problem is the model of the Schrödinger equations or the quantum equations, namely, the Sturm–Liouville type boundary value problem of heat diffusion is the model of the Schrödinger equations. Sturm and Liouville discuss la valeur particulière, without its corresponding eigenspace, and the definition of eigenvalue and eigenspace/eigenfunction are introduced by Hilbert. This handling of the value is traditionally relates to the studies of linear differential equations, such as by Lagrange, Laplace, Fourier, Legendre, Poisson, Cauchy, et al. After Wilkinson 1952, Chatelin 1988 use proper value of matrix. We discuss the particular value and particular functions, which are origin of the today's eigenvalues and eigen functions, in addition to include Legendre's examples.

11:00–11:15 Mathematics History Team Meeting

Algebra

March 15th (Mon) Conference Room II

9:40–10:45

1 Mawo Ito (Kyoto Univ.) Z
Shuhei Kamioka (Kyoto Univ.)
A product-type generating function for plane partitions derived from the Askey–Wilson polynomials ····· 10

Summary: A new product-type generating function for boxed plane partition is derived by using a relationship between plane partitions and the discrete two-dimensional Toda equation. A class of solutions of the discrete two-dimensional Toda equation is derived from the Christoffel and Geronimus transformation of Askey–Wilson polynomials. The new generating function generalizes the generating function by MacMahon and Stanley.

2 Ryotaro Koshio (Tokyo Univ. of Sci.) Z
Yuta Kozakai (Tokyo Univ. of Sci.)
On induced modules of support τ-tilting modules over group algebras ····· 10

Summary: Support τ-tilting modules over algebras have been actively studied in recent years, because these correspond bijectively to various classes of representation theoretical objects. In this talk, we will discuss support τ-tilting modules over certain group algebras. Let k be an algebraically closed field of characteristic p, G a finite group and $\widetilde{G}$ a finite group containing G as a normal subgroup of p-power index in $\widetilde{G}$. We provide a sufficient condition for the induced module of support τ-tilting module over the group algebra kG to be also a support τ-tilting module over the group algebra $k\widetilde{G}$. We also discuss the classification of the support τ-tilting modules over $k\widetilde{G}$.

3 Kenichiro Tanabe (Hokkaido Univ.) Z
The weak modules for the fixed point subalgebra of the vertex algebra associated to a non-degenerate even lattice ····· 15

Summary: Let V_L be the vertex algebra associated to a non-degenerate even lattice L, θ the automorphism of V_L induced from the -1-isometry of L, and V_L^+ the fixed point subalgebra of V_L under the action of θ. We show that every weak V_L^+-module is completely reducible.

4 Shoma Sugimoto (Kyoto Univ.) Z
On the logarithmic W-algebras ····· 15

Summary: First, along the preprint of [Feigin-Tipunin], we construct the type ADE logarithmic W-algebras $W(p)_Q$ and their modules $W(p,\lambda)_Q$ geometrically. After that, we show the simplicity, $W_k(g)$-module structure and character of $W(p,\lambda)_Q$ when $\sqrt{p}\bar{\lambda}$ is in the closure of the fundamental alcove. Finally, we show the C_2-cofiniteness of $W(p)_Q$ for some new cases.

5 Yasuhiro Omoda (Akashi Coll. of Tech.)
Kazunori Nakamoto (Univ. of Yamanashi)
Thick representations and tensor products ····· ∗

Summary: Let $\rho : G \to \mathrm{GL}(V)$ be an n-dimensional representation of a group G over a field k. We say that ρ is *thick* if there exists $g \in G$ such that $(\rho(g)V_1) \oplus V_2 = V$ for any subspaces $V_1, V_2 \subset V$ with $\dim V_1 + \dim V_2 = n$. We show that the tensor product $\rho \otimes \tau : G \to \mathrm{GL}(V \otimes_k W)$ is not a thick representation for $\rho : G \to \mathrm{GL}(V)$ and $\tau : G \to \mathrm{GL}(W)$ with $\dim_k V \geq 2$ and $\dim_k W \geq 2$.

6 Shotaro Kawata (Kobe Univ.)
Higher Capelli elements for classical Lie algebras ····· ∗

Summary: The generators of the center of universal enveloping algebra is called Capelli elements. We construct the higher Capelli elements which correspond to a partition lambda for type B, C, and D case. Firstly, we construct the Capelli elements of the lower degree which correspond to the factorial Schur function including parameter, then in order to construct the higher Capelli elements, we apply Jacobi–Trudi formula to the Capelli elements of the lower degree.

7 Toshiya Yurikusa (Tohoku Univ.) Tame algebras have dense g-vector fans ····· ∗

Summary: The g-vector fan of a finite dimensional algebra is a simplicial polyhedral fan whose rays are the g-vectors of the indecomposable 2-term presilting complexes. We prove that the g-vector fan of a tame algebra is dense. The main ingredients of the proof are the generic decomposition of g-vectors, and the asymptotic behavior of g-vectors under a variation of twist functors. This is a joint work with Pierre-Guy Plamondon.

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

Naoki Chigira (Kumamoto Univ.) Z Sporadic simple groups and combinatorial structure

Summary: Finite groups act some finite combinatorial structures such as graphs, designs and codes. Also we know some "good lattices" give some information for the group on which acts. We discuss about the conditions to exist a self-dual code on which a group acts. And we focus self-dual codes related to sporadic simple groups J_2 and Ru. To characterize these code, we use some combinatorial structures. Especially for Ru, a $\mathbb{Z}[i]$ lattice originally defined by Conway is considered. It contains some interesting combinatorial structures.

14:15–16:30

8 Yoshiharu Shibata (Yamaguchi Univ.) Z On lifting modules which do not satisfy the finite internal exchange property ····· 10

Summary: A module M is called *lifting* if, for any submodule N of M, there exists a direct summand X of M such that $X \subseteq N$ and $N/X \ll M/X$. A module M is said to satisfy *FIEP* if, for any direct summand X of M and any finite direct sum decomposition $M = \bigoplus_{i=1}^{n} M_i$, there exists a direct summand M_i' of M_i $(i = 1, 2, \ldots, n)$ such that $M = X \oplus (\bigoplus_{i=1}^{n} M_i')$. In this talk, we first give characterizations for the square of a hollow uniform module to be lifting, and make an example of a lifting module which does not satisfy FIEP.

9 Tsutomu Nakamura (Univ. of Tokyo) Z Ryo Kanda (Osaka City Univ.) Structure of flat cotorsion modules over noetherian algebras and elementary duality on Ziegler spectra ····· 15

Summary: A right module over an associative ring is said to be cotorsion if it belongs to the right Ext-orthogonal class to the flat right modules. In 1984, Enochs gave a structure theorem for flat cotorsion module over a commutative noetherian ring, emphasizing ideal-adic completions of free modules over local rings. In this talk, we extend Enochs' result to any noetherian algebra, i.e., a module-finite algebra over a commutative noetherian ring. As a consequence, we obtain a classification of indecomposable flat cotorsion modules in terms of the prime ideals of the noetherian algebra. This classification allows us to explicitly illustrate a homeomorphism, given by Herzog in 1993, between two closed subsets of the Ziegler spectra for left modules and right modules.

10 Ryo Kanda (Osaka City Univ.) Z Extension groups between atoms in abelian categories ····· 15

Summary: We introduce the extension groups between atoms in an abelian category. For a locally noetherian Grothendieck category, we determine which localizing subcategories are closed under injective envelopes, in terms of those extension groups.

11 Ayako Itaba (Tokyo Univ. of Sci.) Z Izuru Mori (Shizuoka Univ.) Characterization of the quantum projective planes finite over their centers ····· 15

Summary: For a 3-dimensional quantum polynomial algebra $A = \mathcal{A}(E, \sigma)$, Artin–Tate–Van den Bergh showed that A is finite over its center if and only if $|\sigma| < \infty$. Moreover, Artin showed that if A is finite over its center and $E \neq \mathbb{P}^2$, then A has a fat point module, which plays an important role in noncommutative algebraic geometry, however, the converse is not true in general. In this talk, we show that, if $E \neq \mathbb{P}^2$, then A has a fat point module if and only if the quantum projective plane $\mathsf{Proj}_{\mathrm{nc}} A$ is finite over its center if and only if $|\nu^*\sigma^3| < \infty$ where ν is the Nakayama automorphism of A. As a byproduct, we show that $|\nu^*\sigma^3| = 1$ or ∞ if and only if the isomorphism classes of simple 2-regular modules over ∇A are parameterized by $E \subset \mathbb{P}^2$.

Summary: Let S be a 3-dimensional Calabi–Yau quantum polynomial algebra, and $f \in S_2$ a regular central element. We say that $A = S/(f)$ is a noncommutative conic. For a noncommutative conic A, there is an associated finite dimensional algebra $C(A)$ which plays an important role to study A. As a main result, we give a complete list of $C(A)$ and give some corresponding examples of A.

Summary: We investigate the problems of liftings and weak liftings of DG modules. In our research, j-operators which we introduced are key objects. In our talk, we will explain the precise definition of j-operators and their properties. In addition, we will also present a new characterization of the weak lifting property of DG modules along simple extensions of DG algebras.

Summary: The first goal of this talk is to study the class groups of the edge rings of complete multipartite graphs, denoted by $\mathbb{K}[K_{r_1,\dots,r_n}]$, where $1 \leq r_1 \leq \cdots \leq r_n$. The second goal is to investigate the special class of divisorial ideals of $\mathbb{K}[K_{r_1,\dots,r_n}]$, called conic divisorial ideals. We describe conic divisorial ideals for certain $K_{r_1,\dots,r_n}$ including all cases where $\mathbb{K}[K_{r_1,\dots,r_n}]$ is Gorenstein. Finally, we give a non-commutative crepant resolution (NCCR) of $\mathbb{K}[K_{r_1,\dots,r_n}]$ in the case where it is Gorenstein.

Summary: In this talk, we prove that the toric ideals of certain s-block diagonal matching fields have quadratic Gröbner bases. Thus, in particular, those are quadratically generated. By using this result, we provide a new family of toric degenerations of Grassmannians.

Summary: Harada ring is an important artinian ring which characterize Nakayama rings and Quasi-Frobenius rings from a new point of view. In this talk, we give the matrix representation of non-Nakayama two-sided Harada rings.

Summary: Aghapournahr and Melkersson introduced the notion of Melkersson condition on a Serre subcategory of the category of modules over a commutative Noetherian ring. The Melkersson condition is a suitable condition in local cohomology theory. We investigate prime ideals satisfying the Melkersson condition on a Serre subcategory.

Summary: The almost purity theorem is one of the most important theorems to study commutative rings in mixed characteristic. We will explain a new proof for perfectoid valuation rings by using the normalized length which was defined by Faltings.

March 16th (Tue) Conference Room II

10:00–12:00

19 Shuhei Tsujie (Hokkaido Univ. of Edu.) Z
Takuro Abe (Kyushu Univ.)
Tan Nhat Tran (Hokkaido Univ.)
Deformation preserving freeness from the Shi arrangement to the Ish arrangement, and its generalization. ····· 15

Summary: The Shi arrangement and the Ish arrangement are known to be free and have the same characteristic polynomial although they are not combinatorially equivalent. The proofs were independent and did not explain the coincidence. Recently Duarte and Guedes de Oliveira introduced family of hyperplane arrangements between the Shi and Ish arrangements and give a reason why their characteristic polynomials coincide. The Shi and Ish arrangements can be represented by digraphs. We introduce deformation of digraphs and give a reason why the both Shi and Ish arrangements are free.

20 Kenta Mori (Kwansei Gakuin Univ.) Z
Hidefumi Ohsugi (Kwansei Gakuin Univ.)
Akiyoshi Tsuchiya (Univ. of Tokyo)
Edge rings with q-linear resolutions ····· 10

Summary: Let K be a field and $K[\mathbf{x}] := K[x_1, \ldots, x_n]$ the polynomial ring with n variables over K. For a finite simple graph G on the vertex set $[n] := \{1, \ldots, n\}$, the *edge ring* $K[G]$ of G is the K-subalgebra of $K[\mathbf{x}]$ generated by the quadratic monomials $x_i x_j$ corresponding to the edges $\{i, j\}$ of G. Recently, edge rings and the associated lattice polytopes, which are called *edge polytopes*, have been studied from the viewpoints of combinatorics, graph theory, geometric algebra, and commutative algebra. We give a complete classification of connected simple graphs whose edge rings have a q-linear resolution with $q \geq 2$. In particular, we show that the edge ring of a finite connected simple graph with a q-linear resolution, where $q \geq 3$, is a hypersurface, which was conjectured by Hibi, Matsuda, and Tsuchiya.

21 Akiko Yazawa (Shinshu Univ.) Z
On Artinian Gorenstein algebras associated to the face posets of regular polyhedra ····· 15

Summary: We introduce the Artinian Gorenstein algebras defined by the face posets of regular polyhedra. We consider the strong Lefschetz property and Hodge–Riemann relation for the algebras. We show the strong Lefschetz property of the algebras for all Platonic solids. On the other hand, for some polyhedra, we show that the algebras do not satisfy the Hodge–Riemann relation with respect to some strong Lefschetz elements.

22 Kosuke Shibata (Okayama Univ.) Z
Naoki Terai (Okayama Univ.)
The CM_t property of general monomial ideals ····· 10

Summary: In this talk, we introduce the notion of CM_t monomial ideals. We give an explicit relation of the CM_t property to a monomial ideal and its polarization. Further, we characterize the CM_t property of the ordinary as well as the symbolic third or more powers of squarefree monomial ideals.

23 Olgur Celikbas (West Virginia Univ.) Z
Uyen Le (West Virginia Univ.)
Hiroki Matsui (Univ. of Tokyo)
On a depth inequality and the second rigidity theorem ····· 15

Summary: Auslander's zero divisor conjecture states that for a noetherian local ring R and a non-zero finitely generated R-module M with finite projective dimension, every M-regular sequence is R-regular. This conjecture is solved for regular local rings by Auslander and Lichtenbaum in the 1960s by showing every module over a regular local ring is Tor-rigid (and completely solved by Roberts as a consequence of the new intersection theorem). The aim of this talk is to generalize Auslander's zero divisor conjecture for regular local rings to complete intersection local rings. The key role is played by n-Tor-rigid modules. Moreover, I will explain the connection with Huneke–Wiegand's second rigidity theorem.

24 Shinya Kumashiro (Chiba Univ.) Z Hilbert function of ideals of reduction number two 15

Summary: In a Cohen–Macaulay local ring (A, m), we study the Hilbert function of an m-primary ideal I to analyze the structures of the Rees algebra and the associated graded ring. The study in this direction has been developed in the papers of Northcott, Huneke, Ooishi, Sally, Goto–Nishida–Ozeki, and others. In this talk we focus on ideals of reduction number two with an additional condition, then the inequality $\ell_A(A/I) \geq \mathrm{e}_0(I) - \mathrm{e}_1(I) + \mathrm{e}_2(I)$ of the Hilbert coefficients holds. The inequality is the inverse inequality of Sally and Itoh on integrally closed ideals. We also study the relation between the Hilbert coefficients and the depth of the associated graded rings.

25 Ken-ichi Yoshida (Nihon Univ.) Z Two different normal reduction numbers 10
Tomohiro Okuma (Yamagata Univ.)
Kei-ichi Watanabe (Nihon Univ.)

Summary: We give an example of an integrally closed ideal I which has different two normal reduction numbers.

26 Ken-ichi Yoshida (Nihon Univ.) Z Strongly elliptic ideal 10
Tomohiro Okuma (Yamagata Univ.)
Kei-ichi Watanabe (Nihon Univ.)

Summary: We introduce the notion of strongly elliptic ideals.

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

Hiroyuki Nakaoka (Nagoya Univ.) Z External triangulation of the homotopy category of exact quasi-category

Summary: This is a joint work with Yann Palu, Universite de Picardie Jules Verne.
In our previous work, we have introduced the notion of an externally triangulated category (= extriangulated category for short). It gives a common generalization of exact categories and triangulated categopries, which is closed by taking extension-closed subcategories, relative theories and ideal quotients. Hence it can be regarded as an axiomatization of extension-closed subcategories of triangulated categories.
In this talk, after a brief review of its definition, basic properties, and some of related results, I would like to introduce our recent result which shows that the homotopy category of an exact quasi-category in the sense of Barwick can be equipped with a natural extriangulated structure.

March 17th (Wed) Conference Room II

9:30–12:00

27 Kotaro Kawatani Z Stability conditions on affine Noetherian schemes 15
(Yamato Univ. / Osaka Pref. Univ.)

Summary: Let R be a Noetherian ring and $D(R)$ the bounded derived category of the affine scheme $\operatorname{Spec} R$. We show that the existence of Bridgeland's stability condition on $D(R)$ is equivalent to $\dim R = 0$. Furthermore we discuss the space of stability conditions on the triangulated category of morphisms in $D(R)$.

28 Ryota Mikami (Kyoto Univ.) Z A tropical analog of the Hodge conjecture for smooth complex algebraic varieties 15

Summary: Tropical geometry reduces some problems of algebraic subvarieties to combinatorial problems. We propose a tropical approach to the Hodge conjecture. In this talk, I will explain a proof of a tropical analog of the Hodge conjecture for smooth complex algebraic varieties. The main ingredients are a theorem on cohomology theories (exactness of Gersten complexes), developed by many mathematicians, and computations of non-archimedean geometry, which is highly related to tropical geometry.

Summary: Let p be a prime number and K be a p-adic field with ring of integers V. In this talk, we will give a framework of coefficients of p-adic Hodge cohomology for semistable schemes over V. More precisely, we will introduce p-adic Hodge cohomology with syntomic coefficients as a p-adic analogue of Hodge cohomology with coefficients in a variation of mixed Hodge structures for complex algebraic varieties. The rigid analytic reconstruction of Hyodo–Kato theory studied by the speaker and V. Ertl plays important roles in the construction of p-adic Hodge cohomology and the formulation of functorial properties with respect to base extension.

Summary: In this talk, we classify the irreducible components of moduli stacks of torsion free sheaves of rank 2 on K3 surfaces of Picard number 1. For ruled surfaces, the components of moduli stacks of torsion free sheaves were classified by C. Walter. Moreover, by virtue of our result, we classify the irreducible components of Brill–Noether loci of Hilbert schemes of points on K3 surfaces.

Summary: Let X be a Del Pezzo Surface in a projective space $\mathbb{P}^n$ over an algebraically closed field and C be a curve on X. Since an ideal sheaf $\mathcal{I}_{C/X}$ is an invertible sheaf on X, we consider a classfication of line bundles with respect to Arithmetically Cohen Macaulay (ACM for short) or not. In this talk, we give a classfication of ACM line bundles on Del Pezzo surfaces and determine ACM curves which embedded by anti-canonical divisor $-K_X$ in $\mathbb{P}^n$.

Summary: Recently, I obtained a sufficient criterion for the hierachy strucuture stronger than higher uniruledness = lower unirationality, in terms of Fano generalized Bott towers. This sufficient criterion is expressed by many weally positive conditions described in terms of the intersection product. In this talk, I shall report an improvement of this criterion, by improving those most critical wealy positive conditions by nef conditions. For this, the crucial ingredients are the results of Casagrande and Casagrande–Druel, which relies on the "special Mori programs" for Fano manifols, made possible by Hu–Keel and Birkar–Cascini–Hacon–McKernan.

Summary: I shall introduce the natural, even a novice would come up with, hierachy interporationg the stable rationality and the stable ruledness. Then, I shall revisit the stable irrationality theorems of Totaro, Chatzistamatiou–Levine, and Schreieder, and upgrade their theorems as the nonexistence theorems for this natural hierachy structure.

Summary: We compute torus equivariant integrations over Grassmann manifolds. Our integrands are defined from symmetric polynomials of Chern roots of universal bundles. We prove residue formula for these integrals using wall-crossing formula by Takuro Mochizuki.

35 Makoto Sakurai (Kaichi Gakuen) Z Topological chiral conformal algebras related to Batalin–Vilkovisky algebras 15

Summary: The chiral algebra theory is an algebraic system which can be regarded as the sheaf of vertex algebras. By looking up Konishi–Minabe's paper, the author successfully generalized the toric chiral de Rham complex to non-toric del Pezzo surfaces of at most 6 generic blow-ups. I will deliver a report about the recent developments of topological chiral homology theory with a view towards L_∞-algebra theory and its string field theory. The author especially describes the local-to-global theory of curved beta-gamma CFT for string compactification of del Pezzo surfaces and Hirzebruch surfaces. As this chiral algebra theory is a generalization of chiral CFT, not only anomaly 2-form theory of Nekrasov's lecture, but also the chiral conformal blocks are generalized to BV-algebra-like homotopy algebra theory.

36 Yuji Sano (Fukuoka Univ.)
Hiroshi Sato (Fukuoka Univ.)
Yusuke Suyama (Osaka Univ.)
Chern characters of toric Fano varieties ..... ∗

Summary: We show that any ch_2-positive toric Fano variety of dimension at most eight is isomorphic to the projective space, and we give various examples of ch_k-positive toric Fano varieties for $k \geq 3$. In addition, we generalize this study to the case of singular toric Fano varieties.

37 Toru Tsukioka (Tokai Univ.) Examples of weak Fano manifolds with small contractions ..... ∗

Summary: We give some examples of weak Fano manifolds with small contractions. These are constructed by blowing up successively along two subvarieties intersecting transversally at one point in products of two projective spaces. We describe explicitly the nef cones of related projective varieties.

38 Taku Suzuki (Utsunomiya Univ.) Generalized Mukai conjecture for Fano 6-folds ..... ∗

Summary: Generalized Mukai conjecture says that $\rho(i-1) \leq n$ holds for any Fano n-fold with Picard number ρ and pseudo-index i, with equality if and only if it is isomorphic to the product of equidimensional projective spaces. In this talk, we consider this conjecture for $n = 6$, which is an open problem, and give a solution of this problem for some cases.

39 Tomohiro Iwami (Kyushu Inst. of Tech.) Periodically Higgs sheaves on an extended extremal neighborhood and the related Miyaoka–Yau type inequality with the associated 3rd Chern classes ..... ∗

Summary: In order to prove the existence of the 3-fold flips for semi-stable extremal neighborhood $(X, C) \subset \mathbb{C}^4$, 0-dimensional supports of the Du Val members of $|-K_X|$ have crucial role for the infinitesimal deformations (loca-to-global automorphisms) of the extremal curve C ([S. Mori 1988]). Based on this fact, the author reported: 1) charactrization of Mukai–Umemura 3-folds by introducing an extented extremal neighborhoods (X, C_s) ([I2019March]), 2) spliting criterion for the distinct types of extremal curves by introducing the associated Higgs sheaves $\mathscr{E}_s$ on (X, C_s) ([I2019Sep., I2020Sep.]) as an alternative criterion of [Bogomoolov-De Oliveira 2013]. As succeeding our works, in order to have new type of Miyaoka–Yau type inequality of c_3 on (X, C_s), the author will report: a) for ceratain sheaf $\mathscr{D}_{(2)}$ of diffrential operators corresponding to the endomorphism on $\mathscr{E}_s$, to make a permissible blow-ups for $\mathscr{D}_{(2)}$ in the sense of [Aroca-Hironaka-Vicente], and especially, b) to understand the 0-dimensional supports appearing in the the infinitesimal deformations of C by certain $\mathscr{R}$-module obtained by real monoidal transformation.

40 Ai Takahashi (Tokyo Metro. Univ.)
Hiro-o Tokunaga (Tokyo Metro. Univ.)
Representations of divisors on hyperelliptic curves and Gröbner basis ..... ∗

Summary: We give an interpretation in terms of Gröbner basis for the Mumford representation of semi-reduced divisors on hyperelliptic curves. We apply it to study quasi-toric curves of type $(2, n, 2)$.

41 Tetsuya Ando (Chiba Univ.) Extremal cubic homogeneous inequalities of three variables ····· ∗

Summary: We have classified all the extremal cubic homogeneous polynomials $f(x, y, z)$ which satisfy $f(x, y, z) \geq 0$ for all $x \geq 0$, $y \geq 0$ and $z \geq 0$.

14:15–15:15 Award Lecture for the 2021 MSJ Algebra Prize

Kazuhiko Yamaki (Kyoto Univ.)[Z] Progress in the geometric Bogomolov conjecture

Summary: In Diophantine geometry, the theory of height functions plays an important role. The height functions are real valued functions defined over the set of algebraic points of an algebraic variety over number fields or function fields, and they measure "arithmetic complexity" of algebraic points. We sometimes encounter interesting problems when we focus on points of small height on algebraic varieties. The geometric Bogomolov conjecture for abelian varieties, which generalizes a conjecture called Bogomolov conjecture for curves over function fields, is one of the problems concerning the distribution of points of small height. In this talk, we will explain how the geometric Bogomolov conjecture is formulated together with its background. Then we will talk about how we have been making contributions to the conjecture, possibly with an emphasis on the argument using nonarchimedean geometry. Our contribution to the geometric Bogomolov conjecture is still partial, but we will see that our contribution enables us to prove that the Bogomolov conjecture for curves over function fields is true in full generality.

15:30–16:30 Award Lecture for the 2021 MSJ Algebra Prize

Masanori Asakura (Hokkaido Univ.)[Z] Regulators and special values of L-functions

Summary: I will give a talk on regulators and special values of L-functions. The talk plan is
(1) survey on the Beilinson conjecture
(2) survey on the p-adic Beilinson conjecture (by Perrin-Riou)
(3) higher Ross symbols and regulators.
The last one is the speaker's recent work.

March 18th (Thu) Conference Room II

9:40–12:00

42 Satoshi Kumabe (Kyushu Univ.)[Z] Dwork hypersurfaces of degree six and Greene's hypergeometric function ····· 15

Summary: In this talk, we give a formula for the number of rational points on the Dwork hypersurfaces of degree six over finite fields by using Greene's finite-field hypergeometric function, which is a generalization of Goodson's formula for the Dwork hypersurfaces of degree four. Our formula is also a higher-dimensional and a finite field analogue of Matsumoto–Terasoma–Yamazaki's formula. Furthermore, we also explain the relation between our formula and Miyatani's formula.

43 Kazuhiro Ito (Kyoto Univ.)[Z] Uniform local constancy of étale cohomology of rigid analytic varieties ····· 15

Summary: In this talk, we discuss some ℓ-independence results on local constancy of étale cohomology of rigid analytic varieties. We prove that a closed subscheme of a proper scheme over an algebraically closed complete non-archimedean field has a small open neighborhood in the analytic topology such that, for every prime number ℓ different from the residue characteristic, the closed subscheme and the open neighborhood have the same mod ℓ étale cohomology. The existence of such an open neighborhood for each ℓ was proved by Huber. A key ingredient in the proof is a uniform refinement of a theorem of Orgogozo on the compatibility of the nearby cycles over general bases with base change.

Summary: Faltings proved the Shafarevich conjecture for proper hyperbolic curves. In this talk, we give a proof of the higher dimensional analogue of this conjecture, that is, the Shafarevich conjecture for proper hyperbolic polycurves. We prove this by using the good reduction criterion for proper hyperbolic polycurves established by Nagamachi. This is a joint work with Teppei Takamatsu.

Summary: Let K/k be an extension of number fields and $\mathcal{O}_K$, $\mathcal{O}_k$ be the rings of integers of K, k, respectively. It is said that $\alpha \in \mathcal{O}_K$ forms a relative power integral basis for K/k if $\mathcal{O}_K = \mathcal{O}_k[\alpha]$. In such a case, we say K/k is monogenic. In this talk, we introduce a sufficient condition for the monogenity of a cyclic extension of odd prime degree l over $\mathbb{Q}(\zeta_l + \zeta_l^{-1})$ defined by Rikuna's generic cyclic polynomial. Furthermore, using the condition, we consider that there exist infinitely many monogenic extensions among them.

Summary: We report a complete list of the imaginary multiquadratic fields with ideal class groups of exponent 3 and 5 under the extended Riemann hypothesis.

Summary: Let p be an odd prime number and k an imaginary quadratic field in which p splits. In this talk, we consider a weak form of Greenberg's generalized conjecture for p and k, which states that the non-trivial Iwasawa module of the maximal multiple $\mathbb{Z}_p$-extension field over k has a non-trivial pseudo-null submodule. We prove this conjecture for p and k under the assumption that the Iwasawa λ-invariant for a certain $\mathbb{Z}_p$-extension over a finite abelian extension of k vanishes and that the characteristic ideal of the Iwasawa module associated to the cyclotomic $\mathbb{Z}_p$-extension over k has a square-free generator.

Summary: In this talk, we discuss equivariant Iwasawa theory for two-variable abelian extensions of an imaginary quadratic field. One of the main goals is to describe the Fitting ideals of Iwasawa modules using p-adic L-functions. We also provide an application to Selmer groups of elliptic curves with complex multiplication.

Summary: The theory of Stark systems due to Burns, Sakamoto, and Sano is an important tool toward main conjectures in Iwasawa theory. In this talk, we propose a new perspective of their results, which produces more refined consequences. As a principal application, we prove one divisibility of the equivariant main conjecture for elliptic curves, under certain conditions without $\mu = 0$ hypothesis.

Summary: We determine the sets of rational points on infinite families $C^{(p;i,j)}$ of hyperelliptic curves parametrized by prime numbers p satisfying some congruent conditions and integers i, j. In the proof, we use the 2-descent and the Lutz–Nagell type theorem which was proven by Grant. This is a joint work with Yoshinosuke Hirakawa (arXiv:1904.00215v2).

51 Hideki Matsumura (Keio Univ.) Z — A unique pair of triangles 10

Summary: A triangle is called rational if the lengths of its sides are rational numbers. In this talk, we prove that up to similitude, there exists a unique pair of a rational right triangle and a rational isosceles triangle which have the same perimeter and the same area. The proof is reduced to determine the set of rational points on a certain hyperelliptic curve. We carry out this task by the Chabauty–Coleman's method and the 2-descent on the Jacobian variety of a hyperelliptic curve. This is a joint work with Yoshinosuke Hirakawa (JNT2019).

52 Masakazu Yamagishi (Nagoya Inst. of Tech.) — On rational formal groups ..... *

Summary: We report on two topics concerning rational formal groups, i.e., formal groups that are rational functions: (1) congruences for Lucas sequences and, (2) Rikuna polynomials as the multiplication-by-n maps on a certain rational formal group.

53 Masakazu Yamagishi (Nagoya Inst. of Tech.) — Formal weight enumerators and Chebyshev polynomials ..... *

Summary: A formal weight enumerator is a homogeneous polynomial in two variables which behaves like the Hamming weight enumerator of a self-dual linear code except that the coefficients are not necessarily nonnegative integers. A systematic investigation of formal weight enumerators has been conducted by Chinen in connection with zeta functions and Riemann hypothesis for linear codes. We establish a relation between formal weight enumerators and Chebyshev polynomials.

54 Abdelaziz El Habibi (Mohammed First Univ.)
Yasushi Mizusawa (Nagoya Inst. of Tech.) — On pro-p-extensions of a number field which are tamely ramified over an intermediate $\mathbb{Z}_p$-extension ..... *

Summary: For the maximal pro-p-extension of a number field which is unramified outside some prescribed primes and tamely ramified over an intermediate $\mathbb{Z}_p$-extension, we give a Koch type presentation of the Galois group with some applications.

55 Ryoto Tange (Waseda Univ.)
Jun Ueki (Tokyo Denki Univ.) — On the Iwasawa λ-invariants of twisted knot modules for holonomy representations of 2-bridge knots ..... *

Summary: We consider the Iwasawa λ-invariants of twisted knot modules for holonomy representations of 2-bridge knots.

14:15–16:25

56 Iwao Kimura (Univ. of Toyama) Z
Yoshifumi Tomioka (Univ. of Toyama) — On an asymptotic behaviour of relative class numbers of imaginary Abelian function fields 15

Summary: We give an asymptotic estimate of relative class numbers of imaginary Abelian function fields of prime power conductors. We also give some computational examples of relative class numbers of some imaginary Abelian function fields.

57 Daisuke Shiomi (Yamagata Univ.) Z — A construction of cyclotomic function fields whose zeta polynomials have a given irreducible factor. 10

Summary: In the 80s, Feng showed that there are infinitely many cyclotomic function fields whose class numbers are divided by p. In this talk, we generalize Feng's results from the view points of zeta function. Our goal is to give an explicit construction of cyclotomic function fields whose zeta polynomials have a given irreducible factor.

Summary: In 2005, J. Lagarias suggested using canonical systems for the study of L-functions, and asked about the concrete form of Hamiltonians of canonical systems arising from L-functions. For this, an explicit method of constructing the Hamiltonian arising from self-dual L-functions is known. In this talk, I would like to talk about how to remove this "self-dual" condition.

Summary: For every non-integral $\alpha > 1$, the sequence of the integer parts of n^α $(n = 1, 2, \ldots)$ is called a Piatetski–Shapiro sequence, and let $\mathrm{PS}(\alpha)$ denote the set of all those terms. Let $a, b \in \mathbb{R}$ with $a \neq 1$ and $0 \leq b < a$, and suppose that the equation $y = ax + b$ has infinitely many solutions of distinct pairs $(x, y) \in \mathbb{N}^2$. In this talk, we investigate the set of $\alpha \in (s, t)$ so that the equation $y = ax + b$ has infinitely many solutions of distinct pairs $(x, y) \in \mathrm{PS}(\alpha)^2$ where $2 < s < t$. We show the Hausdorff dimension of the set is coincident with $2/s$.

Summary: Let $d, r \geq 1$ and $k \geq d + 2$ be integers. For a real-valued function f of a real variable, we consider integers $n \geq 1$ such that the sequence $(\lfloor f(n + rj) \rfloor)_{j=0}^{k-1}$ is represented as $\lfloor f(n + rj) \rfloor = p(j)$, $j = 0, 1, \ldots, k - 1$, by using some polynomial $p(x) \in \mathbb{Q}[x]$ of degree at most d. Roughly speaking, we show the asymptotic density of such numbers n when f belongs to a Hardy field and the growth rate of $f(x)$ is between $x^d \log x$ and x^{d+1}. When $d = 1$, the above sequence is an arithmetic progression, and the asymptotic density is equal to $1/(k - 1)$.

Summary: For a nonnegative integer n, we denote the sum of digits in binary expansion of n by $s(n)$. In this talk we will consider the Diophantine system with odd positive integer variables a and b denoted by $s(ab) = k$, $s(a) = m$, $s(b) = n$, where k, m, n are fixed integers greater than 1. In particular, we discuss the finiteness of the solution in the case of $k \in \{2, 3, 4\}$.

Summary: We propose an equivalent condition for the Markov triples, which was mentioned by H. Rademacher essentially. As an application, we mention the solvability of the Diophantine equation $a^2 + b^2 + c^2 = abcf(a, b, c)$.

Summary: Given a prime P and an integer m, a natural number α is said to be hyperperfect numbers of hybrid type with traslation parameter m
if $\overline{P}\sigma(\alpha) = P\alpha + P - 2 - m$.
Here, $\overline{P} = P - 1, \sigma(\alpha)$ means the sum of factors of α.

Summary: We give transcendence results involving Cahen's constant using a variant of Mahler's method.

65 Shin-ya Koyama (Toyo Univ.) Functional equations for Selberg zeta functions with Tate motives ···· ∗
Nobushige Kurokawa (Tokyo Tech*)

Summary: For a compact Riemann surface M of genus $g \geq 2$, we study the functional equations of the Selberg zeta functions attached with the Tate motives f. We prove that certain functional equations hold if and only if f has the absolute automorphy.

66 Hidenori Tanaka (Toyo Univ.) The Euler product expressions of the absolute tensor products of the Dirichlet L-functions ····· ∗

Summary: In 1992 Kurokawa defined the absolute tensor product $(Z_1 \otimes_{\mathbb{F}_1} \cdots \otimes_{\mathbb{F}_1} Z_r)(s)$ of some zeta functions $Z_j(s)\,(j = 1, \cdots, r)$ as a function which had zeros or poles only at $s = \rho_1 + \cdots + \rho_r$ where $\rho_j \in \mathbb{C}$ with $Z_j(\rho_j) = 0$ or ∞ and predicted it to have the expression by the Euler product over r-tuples of primes if $Z_j(s)$ was represented by the Euler product over primes for each $j \in \{1, \cdots, r\}$. The validity of Kurokawa's prediction has been confirmed in some cases, especially, the case of the Riemann zeta function for $r = 2$ was proved by Akatsuka.
In this study, I construct the Euler product expression of the absolute tensor product of the Dirichlet L-functions $L(s, \chi_j)\,(j = 1, \cdots, r)$ by generalizing Akatsuka's method for the Riemann zeta function and show that Kurokawa's prediction is valid in the case of the Dirichlet L-functions for $r = 2$.

67 Masatoshi Nakano (Kesennuma Coll. of Tech.) Some conjectures on the divisor function ····· ∗

Summary: We propose the following conjecture on $\sigma(n)$, the sum-of-divisors function: $\dfrac{\log(e^\gamma n \log\log n - \sigma(n))}{\log(e^\gamma n \log\log n)}$ will increase strictly and converge to 1 when n runs from the colossally abundant numbers to infinity. This conjecture is a sufficient condition for the Riemann hypothesis by Robin's theorem, and it is confirmed for n from 10^4 up to 10^{103078}.

68 Miyu Nakano (Yamaguchi Univ.) On an error term for the mean square of $\delta_k(n)$ ····· ∗
Tadaaki Igawa
Makoto Minamide (Yamaguchi Univ.)

Summary: Set $\delta_k(n) = \max\{d : d|n,\ (d,k) = 1\}$, where $k \geq 2$ is a fixed square-free integer. We study the error term $E_k^{(2)}(x) = \sum_{n \leq x} \delta_k^2(n) - \frac{k^2}{3\sigma(k^2)}x^3$ $(\sigma(n) = \sum_{d|n} d)$ for the mean square of $\delta_k(n)$, and deduce $\sum_{n \leq x} E_k^{(2)}(n) \sim \frac{k^2}{6\sigma(k^2)}x^3$ (as $x \to \infty$) and $\int_1^\infty \frac{E_k^{(2)}(t)}{t^3}dt = \frac{k^2}{3\sigma(k^2)}$.

Geometry

March 15th (Mon) Conference Room III

9:30–12:00

1 Shintaro Akamine (Nihon Univ.) Z
Hiroki Fujino (Nagoya Univ./Nagoya Univ.)
Reflection principle for lightlike line segments on maximal surfaces ··· 15

Summary: As in the case of minimal surfaces in the Euclidean 3-space, the reflection principle for maximal surfaces in the Minkowski 3-space asserts that if a maximal surface has a spacelike line segment L, the surface is invariant under the 180 degree rotation with respect to L. However, such a reflection property does not hold for lightlike line segments on the boundaries of maximal surfaces in general. In this talk, we show some kind of reflection principle for lightlike line segments on the boundaries of maximal surfaces when lightlike line segments are connecting shrinking singularities.

2 Atsufumi Honda (Yokohama Nat. Univ.) Z
Himemi Sato (Yokohama Nat. Univ.)
Duality of singularities for spacelike mean curvature one surfaces in de Sitter space ····· 15

Summary: In this talk, we show that CMC1 faces in the de Sitter 3-space S^3_1 do not admit any fold singular points. Moreover, we obtain the duality between generalized conelike singular points and 5/2 cuspidal edges on CMC1 faces. Other singularities, such as the cuspidal butterfly and the cuspidal $S^{\pm}_1$ singularity, will also be discussed.

3 Kazuhiro Okumura (Asahikawa Nat. Coll. of Tech.) Z
Real hypersurfaces in a nonflat complex space form whose a certain tensor h is recurrent ····· 15

Summary: In this talk, we consider real hypersurfaces in a nonflat complex space form from the viewpoint of the recurrence of the tensor field $h(=(1/2)\mathcal{L}_\xi\phi)$. We give a new classification which includes a special class of 3-dimensional ruled real hypersurfaces in a complex hyperbolic plane $\mathbb{C}H^2(c)$.

4 Shun Maeta (Shimane Univ.) Z
3-dimensional complete gradient Yamabe solitons with divergence-free Cotton tensor ····· 10

Summary: In 1980's, R. S. Hamilton introduced the Yamabe flow. Yamabe solitons are special solutions of it. In this talk, we classify 3-dimensional complete gradient Yamabe solitons with divergence-free Cotton tensor.

5 Kyoji Sugimoto (Tokyo Univ. of Sci.) Z
Takuya Shimokawa
Classification of para-real forms of absolutely simple para-Hermitian symmetric spaces ····· 15

Summary: We introduce the notion of para-real forms of para-Hermitian symmetric spaces and classify para-real forms of absolutely simple para-Hermitian symmetric spaces of hyperbolic orbit type.

6 Toru Kajigaya (Tokyo Denki Univ.) Z
Takahiro Hashinaga (Kitakyushu Nat. Coll. of Tech.)
Equivariant realizations of Hermitian symmetric space of noncompact type ····· 15

Summary: Let $M = G/K$ be a Hermitian symmetric space of noncompact type. We provide a way of constructing K-equivariant embeddings from M to its tangent space at the origin by using the polarity of the K-action. As an application, we reconstruct the K-equivariant holomorphic embedding so called the Harish-Chandra realization and the K-equivariant symplectomorphism constructed by Di Scala–Loi and Roos under appropriate identifications of spaces. Moreover, we characterize the holomorphic/symplectic embedding of M by means of the polarity of the K-action. Furthermore, we discuss some properties of the equivariant realizations.

Summary: In locally conformal Kähler geometry, it is said to be Vaisman structure, if Lee form is parallel with respect to Levi–Civita connection. The main example of a Vaisman manifold is Hopf manifold $S^2 \times S^{2n+1}$. The Vaisman metric on Hopf manifold $S^2 \times S^{2n+1}$ is given by the product metric, and its curvatures were investigated by Vaisman ('79, '80). In this talk, we consider curvatures on Vaisman solvmanifolds, and introduce the difference from Hopf manifold.

Summary: We give all the Weitzenböck-type formulas among the geometric first order differential operators on the spinor fields with spin $j + 1/2$ over Riemannian spin manifolds of constant curvature. Then we find an explicit factorization formula of the Laplace operator raised to the power $j + 1$ and understand how the spinor fields with spin $j + 1/2$ are related to the spinors with lower spin. As an application, we calculate the spectra of the operators on the standard sphere and clarify the relation among the spinors from the viewpoint of representation theory. Next we study the case of trace-free symmetric tensor fields with an application to Killing tensor fields. Lastly we discuss the spinor fields coupled with differential forms and give a kind of Hodge–de Rham decomposition on spaces of constant curvature.

Summary: A compact Lie group has a biinvariant Riemannian metric, with respect to which it is a Riemannian symmetric space. Chen–Nagano introduced the notion of a polar and investigated polars of connected Riemannian symmetric spaces. We investigate polars of disconnected compact Lie groups, which is useful for the study of antipodal sets.

Summary: In this talk, I introduce some results about a solution to the almost Hermitian curvature flow (AHCF) (equivalently, the almost Hermitian flow (AHF)) on a compact almost Hermitian manifold. First, I introduce the regularity result and the long-time existence obstruction for (AHCF) (or (AHF)). Second, I introduce the uniform equivalence between almost Hermitian metrics and a solution to (AHF) (that is, a solution to (AHCF)). I will also talk about future prospects of this research.

Summary: In this talk, we determine stability of minimal Cartan embeddings of order 4 and austere Cartan embeddings.

Summary: We will talk the role played by the Higgs algebra in the generalization of classical harmonic analysis from the sphere S^{m-1} to the (oriented) Grassmann manifold $\mathrm{Gr}_o(m, 2)$ of 2-planes. This algebra is identified as the dual partner (in the sense of Howe duality) of the orthogonal group $\mathrm{SO}(m)$ acting on functions on the Grassmannian. This is then used to obtain a Pizzetti formula for integration over this manifold.

14:15–15:15

13 Noriaki Ikeda (Ritsumeikan Univ.) Z Momentum sections on pre-symplectic and pre-multisymplectic manifold 15

Summary: A momentum section and a Hamiltonian Lie algebroid theory have been recently introduced by Blohmann and Weinstein. We show a constrained Hamiltonian system and a gauged sigma model have these structures. We propose a generalization of a momentum section on a pre-multisymplectic manifold by generalizing gauged sigma models to higher dimensional manifolds.

14 Yoshiki Kaneko (Waseda Univ.) Z Solutions of the tt*-Toda equations and quantum cohomology of flag manifolds 15

Summary: We relate the quantum cohomology of minuscule flag manifolds to the tt*-Toda equations, a special case of the topological- antitopological fusion equations which were introduced by Cecotti and Vafa in their study of supersymmetric quantum field theories. To do this, we combine the Lie-theoretic treatment of the tt*- Toda equations of Guest–Ho with the Lie-theoretic description of the quantum cohomology of minuscule flag manifolds from Chaput– Manivel–Perrin and Golyshev–Manivel.

15 Masahiro Futaki (Chiba Univ.) Z Homological mirror symmetry for projective spaces via Morse homotopy
Hiroshige Kajiura (Chiba Univ.) 15

Summary: We propose a way of understanding homological mirror symmetry for smooth compact toric manifolds and their Landau–Ginzburg mirrors via Strominger–Yau–Zaslow fibration. Fukaya and Fukaya–Oh introduced Morse homotopy as a kind of limit of the Fukaya category of the cotangent bundle of closed manifolds. Kontsevich–Soibelman used Morse homotopy to develop a framework to prove HMS. We extend their construction to the case when the base manifold is the moment polytope and proved a version of HMS for the projective spaces and their products.

16 Yuuki Sasaki (Univ. of Tsukuba) Maximal antipodal sets and Morse functions of $G_2/SO(4)$ ..... *

Summary: We construct $\mathbb{Z}_2$-perfect Morse functions of $G_2/SO(4)$ whose set of all critical points is a great antipodal set of $G_2/SO(4)$. In particular, we give the reason why the 2-number $\#_2(G_2/SO(4))$ matches the Betti number of the $\mathbb{Z}_2$-coefficient homology group of $G_2/SO(4)$.

17 Masahiro Morimoto (Osaka City Univ.) On weakly reflective submanifolds in compact isotropy irreducible Riemannian homogeneous spaces ..... *

Summary: We show that for any weakly reflective submanifold of a compact isotropy irreducible Riemannian homogeneous space its inverse image under the parallel transport map is an infinite dimensional weakly reflective PF submanifold of a Hilbert space. This is an extension of the author's previous result in the case of compact irreducible Riemannian symmetric spaces. We also give a characterization of so obtained weakly reflective PF submanifolds.

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

Hisashi Naito (Nagoya Univ.) Z Trivalent discrete surfaces and carbon structures

Summary: Fullerens, carbon nanotubes, and graphenes are typical examples of sp^2 carbon structures, and can be considered as trivalent discrete surfaces from a mathematical point of view. In this talk, we focus on constructions of negatively curved fullerens by using mathemtical method, and curvatures of trivalent discrete surfaces. We also discuss subdivisions of trivalent graphs and discrete surfaces.

March 16th (Tue) Conference Room III

10:30–11:30 Talk Invited by Geometry Section

Ryosuke Takahashi (Kyushu Univ.) Z Some geometric flow approaches for deformed Hermitian–Yang–Mills equation

Summary: On SYZ mirror symmetry, a deformed Hermitian–Yang–Mills (dHYM) metric is a fiber metric on a holomorphic line bundle, which is the mirror object to a special Lagrangian section of the dual torus fibration. As a parabolic analogue, Jacob–Yau'17 introduced the Line Bundle Mean Curvature Flow (LBMCF) as the mirror of the Lagrangian Mean Curvature Flow (LMCF) for graphs. The LBMCF has many similar properties to the LMCF, however the long time existence and convergence of these flows is a subtle matter. For example, Neves'13 showed that the LMCF forms finite time singularities even if there exists a special Lagrangian. In this talk, we explore some geometric flow approaches from the following different view points:
(A) On Kähler surfaces, it is known that the existence of dHYM metrics is equivalent to a certain positivity condition for a cohomology class. We relax this positivity to semipositivity and study how the LBMCF blows up.
(B) Recently, Collins–Yau'18 discovered a GIT/moment map interpretation for dHYM metrics based on the earlier works of Solomon'13 and Thomas'01 in the mirror side. Motivated by this, we introduce a new geometric flow which is designed to deform a given metric to a dHYM one. Then we show that this new flow potentially has more global existence and convergence properties compared to the LBMCF.

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

Yosuke Kubota (Shinshu Univ./RIKEN) Z Higher index theory in geometry and physics

Summary: Higher index theory is a theoretical framework to extract topological information from an operator with the help of C*-algebra theory. Applying it to elliptic differential operators associated to manifolds, nontrivial applications such as the proof of Novikov and Gromov–Lawson–Rosenberg conjectures are derived. With regard to the latter, it is well-understood that the higher index is a very efficient but not complete obstruction to metrics with positive scalar curvature (psc) on a closed spin manifold. Hence it has been an important issue to compare the efficiency of obstructions to psc metrics.
In this talk I summarize my works on higher index theory and its application to geometry and physics. A central issue is the codimension 2 obstruction initially considered by Gromov–Lawson and Hanke–Pape–Schick. Here the higher index of a codimension 2 submanifold (with a certain condition on homotopy groups) N of M obstructs to a psc metric on M. I prove that the non-vanishing of the higher index of N implies that of M, namely the codimension 2 obstruction does not overcome the higher index. The proof is refined in my joint work with T. Schick and is related to the existence of the 'codimension 2 transfer' map between C*-algebra K-groups. This construction is extended to secondary higher index invariants in my recent research. Moreover, I also observe that the simplest case of this codimension 2 transfer map is related to a problem on the topology of operators arising in condensed-matter physics, called the 'bulk-dislocation correspondence'.

March 17th (Wed) Conference Room III

10:00–12:00

18 Yoshinori Hashimoto (Tokyo Tech) Z Expected centre of mass of the random Kodaira embedding ····· 15

Summary: Let $X \subset \mathbb{P}^{N-1}$ be a smooth projective variety. To each $g \in SL(N, \mathbb{C})$ which induces the embedding $g \cdot X \subset \mathbb{P}^{N-1}$ given by the ambient linear action we can associate a matrix $\bar{\mu}_X(g)$ called the centre of mass, which depends nonlinearly on g. With respect to the probability measure on $SL(N, \mathbb{C})$ induced by the Haar measure and the Gaussian unitary ensemble, we prove that the expectation of the centre of mass is a constant multiple of the identity matrix for any smooth projective variety.

19 Shinichiro Kobayashi (Tohoku Univ.) Z A universal inequality for Laplace eigenvalues of arc-transitive graphs ····· 15

Summary: In this talk, I explain the results on the constraints on the Laplace eigenvalues for arc-transitive graphs. A graph is said to be arc-transitive if the automorphism group acts transitively on the entire set of arcs of length 1 of the graph. For such graphs, we show that Laplace eigenvalues satisfy Cheng–Yang type inequality, which states that higher order eigenvalues are bounded above by the information of lower order ones. I will also give a family of counterexamples for vertex-transitive graphs.

20 Jesus A. Álvarez López (Univ. of Santiago de Compostela) Z
Ramón Barral Lijó (Ritsumeikan Univ.)
John Hunton (Durham Univ.)
Hiraku Nozawa (Ritsumeikan Univ.)
John R. Parker (Durham Univ.)
From hyperbolic surfaces to chaotic Delone sets ····· 15

Summary: Using the well-known chaotic properties of the geodesic flow on hyperbolic closed surfaces, we construct Delone sets that satisfy Devaney's definition of chaos.

21 Jesus A. Álvarez López (Univ. of Santiago de Compostela) Z
Ramón Barral Lijó (Ritsumeikan Univ.)
Hiraku Nozawa (Ritsumeikan Univ.)
Symmetry-breaking of the large-scale geometry of graphs ····· 15

Summary: One of the most important open questions in the field of symmetry breaking in graphs is the infinite motion conjecture, which asks whether every connected and locally finite graph with infinite motion admits a 2-coloring that breaks every automorphism of the graph. In this talk we will introduce a large-scale geometric version of this problem and provide a solution for graphs of symmetric growth.

22 Daisuke Kazukawa (Osaka Univ.) Z Convergence of metric transformed spaces ····· 15

Summary: In this talk, we consider the metric transformation of metric measure spaces/pyramids. We clarify the conditions to obtain the convergence of the sequence of transformed spaces from that of the original sequence, and, conversely, to obtain the convergence of the original sequence from that of the transformed sequence, respectively. As an application, we prove that spheres with standard Riemannian distance converge to a Gaussian space as the dimension diverges to infinity.

23 Yoshito Ishiki (Univ. of Tsukuba) Z An embedding, an extension, and an interpolation of ultrametrics ···· 15

Summary: The notion of ultrametrics can be considered as a zero-dimensional analogue of ordinary metrics, and it is expected to prove ultrametric versions of theorems on metric spaces. In this talk, we provide ultrametric versions of the Arens–Eells isometric embedding theorem of metric spaces, the Hausdorff extension theorem of metrics, the Niemytzki–Tychonoff characterization theorem of the compactness, and the author's interpolation theorem of metrics and theorems on dense subsets of spaces of metrics.

24 Masayuki Igarashi (Tokyo Univ. of Sci.) On a one-parameter deformation of the metrics which are constituents of the Hermite–Liouville structures on Hopf surface and the property that these metrics are non-isometric each other ····· ∗

Summary: In this talk, we first construct a one-parameter volume-invariant deformation of the metrics which are constituents of the Hermite–Liouville structures on Hopf surface. We secondly verify the property that these metrics are non-isometric each other. The argument in this talk is in relation to the previous talk given by the speaker at the MSJ Autumn Meeting 2019.

25 Saburou Saitoh (Gunma Univ.*/Inst. of Reproducing Kernels) Hiroshi Okumura Division by zero calculus and Euclidean geometry—Revolution in Euclidean geometry— ····· ∗

Summary: We will discuss Euclidean geometry from the viewpoint of the division by zero calculus with typical examples. Where is the point at infinity? It seems that the point is vague in Euclidean geometry in a sense. Certainly we can see the point at infinity with the classical Riemann sphere. However, by the division by zero and division by zero calculus, we found that the Riemann sphere is not suitable, but Däumler's horn torus model is suitable that shows the coincidence of the zero point and the point at infinity. Therefore, Euclidean geometry is extended globally to the point at infinity. This will give a great revolution of Euclidean geometry. The impacts are wide and therefore, we will show their essence with several typical examples.

14:15–15:15

26 Tadashi Fujioka (Kyoto Univ.) Z Serre fibration structure of collapsing Alexandrov spaces ····· 15

Summary: Let M be an Alexandrov space sufficiently close to an Alexandrov space X of lower dimension in the Gromov–Hausdorff distance. Perelman proved that if X has no singular strata called extremal subsets, then M admits a Serre fibration structure over X in a weak sense. In particular, he constructed a finitely long exact sequence of homotopy groups. We improve his result to construct an infinitely long exact sequence of homotopy groups and a spectral sequence of cohomology groups. We also extend these results to each extremal subset of X.

27 Yuya Kodama (Tokyo Metro. Univ.) Z Divergence function of the braided Thompson group ····· 15

Summary: Golan and Sapir showed that Thompson groups F, T, V have linear divergence functions. Using their method, we prove that the "braided version" of Thompson group V, denoted by BV has a linear divergence function. Roughly speaking, the divergence function of a finitely generated group G is the function that is the length of the path connecting two points at the same distance from the origin while avoiding a small ball with the center at the origin in the Cayley graph. This function represents a "degree of connectedness at the infinity" of the Cayley graph. After I give a short definitions of BV and divergence functions, I will state a part of the idea of the proof.

28 Tomoshige Yukita (Waseda Univ.) Z Continuity of the growth rates of Coxeter groups ····· 15

Summary: For a group G and an ordered generating set $S = (s_1, \cdots, s_n)$, the pair (G, S) is called a marked group. The space of marked groups $\mathcal{G}_n$ is the set of all isomorphism classes of marked groups, where we identify two marked groups if they are isomorphic in the natural sense for marked groups. We consider the subspace $\mathcal{C}_n$ of the space of marked groups consists of Coxeter groups, and show that the growth rate is a continuous function on $\mathcal{C}_n$.

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

Yohei Sakurai (Tohoku Univ.)[Z] Recent development of geometric analysis on weighted Ricci curvature

Summary: In this talk, I introduce recent development of geometric analysis on weighted Ricci curvature. I will work on a lower N-weighted Ricci curvature bound with ε-range introduced by Lu–Minguzzi–Ohta, which interpolates the classical curvature-dimension condition and a Wylie–Yeroshkin type Ricci curvature bound induced from projectively equivalent affine connections. Under such a curvature bound, I present comparison geometry of manifolds with or without boundary, and a characterization by displacement convexity of entropies.

Complex Analysis

March 15th (Mon) Conference Room IV

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

Tetsu Shimomura (Hiroshima Univ.) Z Sobolev's inequality on Musielak–Orlicz–Morrey spaces

Summary: In this talk we study Sobolev's inequality for Riesz potentials of functions in Musielak–Orlicz–Morrey spaces. As a corollary we obtain Sobolev's inequality for double phase functionals with variable exponents. This is based on joint work with Fumi-Yuki Maeda, Yoshihiro Mizuta and Takao Ohno.

14:15–15:15 Award Lecture for the 2020 MSJ Analysis Prize

Hideki Miyachi (Kanazawa Univ.) Z Complex analysis on Teichmüller space

Summary: In this talk, we will give a recent progress on my research of Complex analysis on finite dimensional Teichmüller spaces. We will discuss mainly with the Teichmüller space of genus g. The Teichmüller space of genus g is the moduli space of marked compact Riemann surfaces of genus g, and has a natural complex structure which allows us to recognize the Teichmüller space as the universal space of holomorphic families of compact Riemann surfaces of genus g. The Teichmüller space of genus g is realized as a hyperconvex bounded domain in the complex Euclidean space of dimension $3g-3$ via the Bers embedding.
Our naive idea for developments of the complex analytic theory of Teichmüller space is to make a dictionary for interacting with several fields (the theory of Riemann surfaces, the function theory of several complex variables, the low dimensinal topology, etc.). For instance, in 1978, Royden observed that the Kobayashi distance coincides with the Teichmüller distance, and hence the counter part of the Kobayashi distance in our dictionary is the Teichmüller distance (a conformal invariant for marked Riemann surfaces). We will see that the Poisson kernel in the sense of Demailly corresponds to the ratio of the extremal lengths (a conformal invariant for marked Riemann surfaces), and the pluriharmonic measure corresponds to the Thurston measure (an invariant in the topological aspect) in the dictionary. If time permits, we also discuss other results on the function theory of several complex variables on the Teichmüller spaces.

15:30–16:40

1 Yôsuke Hishikawa (Gifu Univ.) Z Function spaces induced by two parabolic Bloch spaces ····· 15
Masaharu Nishio (Osaka City Univ.)
Katsunori Shimomura (Ibaraki Univ.)
Masahiro Yamada (Gifu Univ.)

Summary: We consider function spaces which consist of two parabolic Bloch spaces, and present reproducing formulas. As an application, we introduce Bloch type spaces which consist of solutions of a partial differential equation $(L^{(\alpha)})^2 u = 0$, and investigate several properties.

2 Kentarou Itou (Osaka City Univ.) Z Lagrange interpolation for Laguerre-type weights ····· 15
Ryozi Sakai (Meijo Univ.)

Summary: We consider the Laguerre weight $w(x) = e^{-x}$ on $\mathbb{R}^+ = [0, \infty)$. We denote the orthonormal polynomials $\{p_n(x)\}_{n=0}^{\infty}$ for the weight $w(t)$ and the zeros of $p_n(x)$ by $\{x_{k,n}\}_{k=1}^{n}$. Let $L_n^*(f,x)$ be the Lagrange interpolation polynomial with nodes $\{x_{k,n}\}_{k=1}^{n}$ for a continuous function f on $\mathbb{R}^+$. We show the approximation theory for $L_n^*(f,x)$ on $\mathbb{R}^+$, that is, we get the condition that $L_n^*(f,x)$ converges to f on $\mathbb{R}^+$ with weight $w(x)$. Our method is to extend $\mathbb{R}^+$ to whole $\mathbb{R}$ by transform $x =: t^2$ and $f(t^2) =: F(t)$.

Summary: We investigate a variant of the Beurling–Ahlfors extension of quasisymmetric homeomorphisms of the real line that is given by the convolution of the heat kernel, and prove that the complex dilatation of such a quasiconformal extension of a strongly symmetric homeomorphism (i.e. its derivative is an A_∞-weight whose logarithm is in VMO) induces a vanishing Carleson measure on the upper half-plane.

Summary: A discrete subgroup Γ of $\mathrm{Isom}(\mathbb{H}^d)$ is said to be locally rigid if any representation of Γ into $\mathrm{Isom}(\mathbb{H}^d)$ nearby the inclusion map is obtained by conjugation. If the quotient space $\mathbb{H}^d/\Gamma$ is finite volume, then Γ is locally rigid for $d \geq 4$ by the result due to Garland and Raghunathan. We give explicit examples of locally rigid hyperbolic reflection groups of infinite covolume.

Summary: Our aim in this paper is to establish Trudinger's inequality on Musielak–Orlicz–Morrey spaces $L^{\Phi,\kappa}(G)$ under conditions on Φ which are essentially weaker than those considered in a former paper. As an application and example, we show Trudinger's inequality for double phase functionals $\Phi(x,t) = t^{p(x)} + a(x)t^{q(x)}$, where $p(\cdot)$ and $q(\cdot)$ satisfy log-Hölder conditions and $a(\cdot)$ is non-negative, bounded and Hölder continuous.

Summary: In this talk, a variant of Schwarz–Pick inequality for analytic self-maps of the bidisk is given. In particular, our inequality is indefinite in a certain sense, and is obtained as an application of spectral theory on analytic Hilbert modules.

Summary: We extend the function f(z)=z*z+c of Mandelbrot set. Let the extended function be f2(z). Let h(z) be Moebius transformation. We do the conjugate transformation by h(z) to f2(z). Then we get 3 types of functions which are conjugation with f2(z) (Theorem 1.3, 1.5, 1.7). And we get the basic functions which are conjugate with f(z)(resp. 1/f(z)) from the corollaries of the Theorem 1.3,1.5 and 1.7. Next we give the figures of the extended Mandelbrot sets of the functions of the corollaries and f2(z).

Summary: We consider two commuting entire functions f and g with a common fixed point. Under some conditions we will show that f and g share the same Julia set.

March 16th (Tue) Conference Room IV

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

Yuta Kusakabe (Kyoto Univ.)Z Oka manifolds and ellipticity

Summary: A complex manifold is called an Oka manifold if the Oka principle for maps from Stein spaces holds. On the other hand, ellipticity is opposite to Kobayashi–Eisenman–Brody hyperbolicity, and it means the existence of many dominating holomorphic maps from complex Euclidean spaces. In this talk, we investigate the relationship between these notions. We first establish the characterization of Oka manifolds by convex ellipticity which implies Gromov's conjecture. As an application, the localization principle for Oka manifolds is proved. By using this principle, we show that there exists a nonelliptic Oka manifold which negatively answers a long-standing question of Gromov.

13:00–14:10

9 Takanori Ayano (Osaka City Univ.)Z
Victor M. Buchstaber (Steklov Inst. of Math.)
Relationships between Abelian functions of genus 2 and elliptic functions ····· 15

Summary: Curves whose Jacobians split into elliptic curves up to isogeny have been studied in many different contexts. Let V be the hyperelliptic curve of genus 2 defined by $y^2 = x^6 - \mu^6$, where $\mu \in \mathbb{C}\backslash\{0\}$. The Jacobian of the curve V is isogenous to the direct product of two elliptic curves E_1 and E_2. In this talk, we will give formulae which connect Abelian functions of V with elliptic functions of E_1 and E_2. As corollaries, we will give addition formulae of the Abelian functions of V and differential equations satisfied by the Abelian functions of V.

10 Takayuki Koike (Osaka City Univ.)Z
Linearization of transition functions of a semi-positive line bundle along a certain submanifold ····· 15

Summary: Let X be a complex manifold and L be a holomorphic line bundle on X. Assume that L is semi-positive, namely L admits a smooth Hermitian metric with semi-positive Chern curvature. Let Y be a compact Kähler submanifold of X such that the restriction of L to Y is topologically trivial. We investigate the obstruction for L to be unitary flat on a neighborhood of Y in X. As an application, for example, we show the existence of nef, big, and non semi-positive line bundle on a non-singular projective surface.

11 Masanori Adachi (Shizuoka Univ.)Z
Séverine Biard (Univ. Polytechnique Hauts-de-France)
On Levi flat hypersurfaces with transversely affine foliation ····· 15

Summary: We prove the non-existence of real analytic Levi flat hypersurface whose complement is 1-convex and Levi foliation is transversely affine in a compact Kähler surface.

12 Takeo Ohsawa (Nagoya Univ.)Z
Variants of Hörmander's theorem on q-convex manifolds by a technique of infinitely many weights ····· 15

Summary: By introducing a new approximation technique in the L^2 theory of the $\overline{\partial}$-operator, Hörmander's L^2 variant of Andreotti–Grauert's finiteness theorem is extended and refined on q-convex manifolds and weakly 1-complete manifolds. As an application, a question on the L^2 cohomology suggested by a theory of Ueda is solved.

13 Masataka Iwai (Osaka City Univ.)
On projective manifolds whose tangent bundles contain positive subbundles ····· *

Summary: If the tangent bundles of projective varieties are "positive"(such as ample, nef, and so on), we have the structure theorems of the projective varieties. On the other hand, Peternell proposed problems on the structures of projective manifolds whose tangent bundles contain "positive" subbundles. In this talk, I will talk about the related researches and my results on Peternell's problems.

14 Makoto Abe (Hiroshima Univ.)
Tadashi Shima (Hiroshima Univ.)
Shun Sugiyama
(NEC Comm. Systems, Ltd.)

A generalization of a theorem of Kühnel on globally defined analytic sets ..... *

Summary: Let X be a connected K-complete normal complex space. If for every closed discrete set A in X there exists a family $\mathcal{F}$ of holomorphic functions on X such that $N(\mathcal{F}) = A$, then the K-envelope $H(X)$ of holomorphy of X in the sense of Kerner (Math. Ann. 138: 316–328, 1959) coincides with X.

15 Katsusuke Nabeshima
(Univ. of Tokushima)
Shinichi Tajima (Niigata Univ.*)

Computing κ-invariants of isolated hypersurface singularities ..... *

Summary: A new framework for treating several genericities of parametric systems is proposed. A computation method of comprehensive standard system over a field of rational functions is introduced as a basic tool. As application to singularity theory, algorithms of computing parameter dependency of κ-invariants and are given. Furthermore, κ-invariants associated to μ-constant deformations are given by using the resulting algorithm.

16 Shinichi Tajima (Niigata Univ.*)
Katsusuke Nabeshima
(Univ. of Tokushima)

Logarithmic vector fields along singular plane curves and Camacho–Sad–Suwa indices ..... *

Summary: Logarithmic vector fields along singular plane curves are considered for computing Camacho–Sad–Suwa indices. A computation method of Camacho–Sad–Suwa indices is introduced and the examples are given.

17 Hidetaka Hamada
(Kyushu Sangyo Univ.)
Gabriela Kohr (Babeş-Bolyai Univ.)

A boundary Schwarz lemma for mappings from the unit polydisc to irreducible bounded symmetric domains ..... *

Summary: In this talk, we obtain a boundary Schwarz lemma for C^1 (pluriharmonic, holomorphic) mappings from the unit polydisc $\mathbb{U}^n$ in $\mathbb{C}^n$ to irreducible bounded symmetric domains realized as the unit ball $\mathbb{B}_X$ of an N-dimensional simple JB*-triple X. In particular, we obtain a version of the boundary Schwarz lemma for C^1 (pluriharmonic, holomorphic) mappings from $\mathbb{U}^n$ into the Euclidean unit ball $\mathbb{B}^N$ in $\mathbb{C}^N$. These results are generalizations of recent results regarding boundary Schwarz lemma in higher dimensions.

Functional Equations

March 15th (Mon) Conference Room V

9:00–12:00

1 Masakazu Onitsuka (Okayama Univ. of Sci.) Satoshi Tanaka (Tohoku Univ.) Z Rectifiability and attractivity for two-dimensional nonautonomous differential systems ····· 15

Summary: The main purpose of this talk is to classify whether the orbital length of the solution on the phase plane is finite (rectifiable) or infinite (nonrectifiable) under the assumption that the zero solution of two-dimensional differential systems is the globally attractive (asymptotically stable). We obtain some theorems that make a beautiful contrast between the conditions for rectifiable and nonrectifiable. In addition, a necessary and sufficient condition is established for the linear case.

2 Satoshi Tanaka (Tohoku Univ.) Masakazu Onitsuka (Okayama Univ. of Sci.) Kenta Itakura (Matsue Yamamoto Metal Co. Ltd.) Z On a perturbation theory for the planar quasilinear differential system and its application ····· 15

Summary: The quasilinear differential system $x' = ax + b|y|^{p^*-2}y + k(t,x,y)$, $y' = c|x|^{p-2}x + dy + l(t,x,y)$ is considered, where a, b, c and d are real constants with $b^2 + c^2 > 0$, p and p^* are positive numbers with $(1/p) + (1/p^*) = 1$, and k and l are continuous for $t \geq t_0$ and small $x^2 + y^2$. It is shown that the behavior of solutions near the origin $(0,0)$ is very similar to the behavior of solutions to the unperturbed system. Our result will be applicable to study radial solutions of the quasilinear elliptic equation $\mathrm{div}(|x|^{\alpha}|\nabla u|^{p-2}\nabla u) + \frac{c}{|x|^{p-\alpha}}|u|^{p-2}u + |x|^{\beta}|u|^{q-2}u = 0$.

3 Sohei Ashida (Gakushuin Univ.) Z Structures of the sets of critical values less than the first energy threshold and associated critical points of the Hartree–Fock functional ····· 15

Summary: We study the Hartree–Fock functional used in many-electron problems. We prove that the set of all critical values of the Hartree–Fock energy functional less than a constant smaller than the first energy threshold is finite. We also prove that the set of associated critical points is a union of real-analytic subsets of a finite number of finite dimensional compact real-analytic manifolds. Since the Hartree–Fock equation which is the corresponding Euler–Lagrange equation is a system of nonlinear eigenvalue problems, the spectral theory for linear operators is not applicable. The main ingredients are the proof of convergence of a sequence of solutions and the analysis of the Fréchet second derivative of the functional at the limit point.

4 Haruya Mizutani (Osaka Univ.) Z Scattering theory for wave equations with singular potentials ····· 15

Summary: We consider scattering theory for wave equations with strongly singular potentials in more than two space dimensions and prove the existence and asymptotic completeness of wave operators. Our class of singular potentials includes an inverse-square potential with a subcritical coupling constant and rough potentials in a scaling-critical Lebesgue space.

5 Takanobu Hara (Hokkaido Univ.) Z Trace inequalities of the Sobolev type and nonlinear Dirichlet problems ····· 10

Summary: We discuss the solvability of Dirichlet problems of the type $-\Delta_{p,w}u = \sigma$ in Ω; $u = 0$ on $\partial\Omega$, where Ω is a bounded domain in $\mathbf{R}^n$, $\Delta_{p,w}$ is a weighted (p,w)-Laplace operator and σ is a nonnegative locally finite Radon measure on Ω. We do not assume the finiteness of $\sigma(\Omega)$. We revisit this problem from a potential theoretic perspective and provide the sufficient conditions for the existence of solutions. Our main ingredients are $L^p(w)$-$L^q(\sigma)$ trace inequalities and capacitary conditions. Additionally, we derive the trace inequalities using solutions conversely. These results are new even for Poisson's equation.

6 Takeshi Suguro (Tohoku Univ.) Z Shannon's inequality for a generalized entropy and an application to the uncertainty principle 15

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

7 Naoki Hamamoto (Osaka City Univ.) Z Non-attainability of the best constant in weighted Hardy inequality for solenoidal fields 12

Summary: Weighted Hardy inequality for solenoidal vector fields was found by Costin–Maz'ya with an improved constant number, under an additional assumption of axisymmetry. In the preceding research, we successfully removed the axisymmetry assumption to derive the the same sharp Hardy inequality for solenoidal fields. This time, we further prove the non-attainability of the best constant, by showing its simpler expression.

8 Kensuke Yoshizawa (Tohoku Univ.) Z Existence and non-existence of elastic graphs with the symmetric cone obstacle 15

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.

9 Kousuke Kuto (Waseda Univ.) Z Full cross-diffusion limit in the stationary Shigesada–Kawasaki–Teramoto model 15

Summary: This talk exhibits a couple of limiting (shadow) systems of the stationary Shigesada–Kawasaki–Teramoto model as both cross-diffusion terms tend to infinity with the same order. As a key step to derive the limiting systems, this talk also shows a uniform L^∞ bound for all positive solutions.

10 Yasuhito Miyamoto (Univ. of Tokyo) Z Existence and uniqueness of singular solutions for supercritical semilinear elliptic equations 10
Yūki Naito (Hiroshima Univ.)

Summary: We study singular radial solutions of the semilinear elliptic equation on finite balls. We provide the existence and uniqueness of the singular radial solution, and show the convergence of regular radial solutions to the singular solution. Some applications to the bifurcation diagram of an elliptic Dirichlet problem are also given. Our results generalize and improve some known results in the literature.

14:15–15:30

11 Tomoyuki Oka (Tohoku Univ.) Z Qualitative space-time homogenization for the porous medium equation 15
Goro Akagi (Tohoku Univ.)

Summary: In this talk, we shall discuss a space-time homogenization problem for the porous medium equation with periodically oscillating (in space and time) coefficients. Main results consist of characterization and qualitative properties of the homogenized matrices, which are decisively different from ones of the fast diffusion equation under a certain critical case in terms of the log-ratio of spatial and temporal periods of the coefficients.

12 Tomoyuki Oka (Tohoku Univ.) Z Corrector results for space-time homogenization of nonlinear diffusion 10
Goro Akagi (Tohoku Univ.)

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

Summary: We consider reaction-diffusion equations on topological tori. Stable nonconstant stationary solutions are often called patterns. Initially, we prove that patterns exist on standard tori T^2. Then, we slightly perturb T^2 by simply changing the radius of the tube from a constant into a periodic function to obtain new topological tori T^2_ϵ with a small parameter ϵ. By using the patterns on T^2 together with the implicit function theorem, we find patterns on T^2_ϵ with prescribed numbers of critical points whose locations are explicit.

Summary: We show convergence to a stationary state u_* of the solution $u = u(x,t)$ to a parabolic equation on compact Riemann manifold Ω with logarithmic diffusion. This equation coincides with Hamilton's normalized Ricci flow if Ω is a sphere. The decay rate is of polynomial order generally, and is exponential if u_* is non-degenerate in a sense of variational functional associated with thermodynamics.

Summary: We study the existence of symmetric and asymmetric nodal solutions for the sublinear Moore–Nehari equation. Here we call a solution symmetric if it is even or odd. We shall prove the existence of a solution which has exactly m zeros in the interval $(-1,0)$ and exactly n zeros in $(0,1)$ for given nonnegative integers m and n.

Summary: We consider the asymptotic behavior of bifurcation curve of nonlinear ODEs with logarithmic nonlinear term. It is known that the bifurcation curve λ is a continuous function of the maximum norm $\alpha = \|u_\lambda\|_\infty$ of the solution u_λ associated with λ, and is written as $\lambda = \lambda(\alpha)$. We establish the asymptotic expansion formula for $\lambda(\alpha)$ as $\alpha \to \infty$ up to the third term with optimal remainder estimate.

Summary: Referring to the author's paper published in 1997, we consider the boundary value problem of the equation written in the title, and discuss the existence of its solution and behaviour of this solution at the x axis in the tx plane, from which we conclude the unique existence of the solution of the one dimensional Hénon equation.

Summary: We consider a class of singular nonlinear first order partial differential equations $t(\partial u/\partial t) = F(t,x,u,\partial u/\partial x)$ with $(t,x) \in \mathbb{R} \times \mathbb{C}$ under the assumption that $F(t,x,z_1,z_2)$ is a function which is continuous in t and holomorphic in the other variables. Under suitable conditions, we determine all the solutions of this equation in a neighborhood of the origin.

Summary: We consider 2×2 system of 1D semiclassical differential operators with two Schrödinger operators in the diagonal part and small interactions of order h^ν in the off-diagonal part, where h is a semiclassical parameter and ν is a constant larger than $1/2$. We study the absence of resonance near a non-trapping energy for both Schrödinger operators in the presence of crossings of their potentials. The width of resonances is estimated from below by $Mh\log(1/h)$ and the coefficient M is given in terms of the directed cycles of the generalized bicharacteristics induced by two Hamiltonians.

20 Kengo Terai (Univ. of Tokyo) Remarks on the vanishing discount problem for infinite systems of Hamilton–Jacobi–Bellman equations ..... *

Summary: We consider the asymptotic analysis of infinite systems of weakly coupled stationary Hamilton–Jacobi–Bellman equations as the discount factor tends to zero. With a specific Hamiltonian, we obtain the convergence of the solution and prove the solvability of the corresponding ergodic problem.

15:40–16:40 Talk Invited by Functional Equations Section

Akihito Ebisu (Chiba Inst. of Tech.) Z Hypergeometric functions and difference equations

Summary: In this talk, we see a connection between the theory of hypergeometric functions (HGF) and difference equations. Firstly, we propose two methods employing the theory of difference equations to derive formulae of HGF, like transformation formulae and special values of HGF. Thus, some of the formulae for HGF are able to be treated from the point of view of difference equations. On the other hand, we can solve some kind of linear difference equations in terms of HGF. So, part of difference equations are able to be understood by HGF. Contiguity relations for HGF and invariant of difference equations link these two theories.

March 16th (Tue) Conference Room V

9:00–12:00

21 Erbol Zhanpeisov (Univ. of Tokyo) Z Blow-up rate of sign-changing solutions to nonlinear parabolic systems 15

Summary: We present a blow-up rate estimate for a solution to the parabolic Gross–Pitaevskii and related systems on entire space or a bounded convex domain with Sobolev subcritical nonlinearity. We extend the results of [Y. Giga, S. Matsui and S. Sasayama, Indiana Univ. Math. J. 53 (2004), 483–514] to the parabolic systems. We also obtain a blow-up rate estimate on a nonconvex domain with some additional assumptions on the behavior of the solution on the boundary.

22 Piotr Biler (Univ. of Wrocław) Z
Grzegorz Karch (Univ. of Wrocław)
Hiroshi Wakui (Tokyo Univ. of Sci.)
Existence of a forward self-similar solution to a drift-diffusion equation 15

Summary: We construct radial self-similar solutions of the, so called, minimal parabolicelliptic Keller–Segel model in several space dimensions with radial, nonnegative initial conditions with are below the Chandrasekhar solution—the singular stationary solution of this system.

23 Shota Tateyama (Univ. of Tokyo) Z Hölder gradient estimates on L^p-viscosity solutions of fully nonlinear parabolic equations with VMO coefficients 10

Summary: We discuss fully nonlinear second-order uniformly parabolic equations, including parabolic Isaacs equations. In 2014, N.V. Krylov proved the existence of L^p-viscosity solutions of boundary value problems for equations with VMO (vanishing mean oscillation) coefficients when $p > n+2$. Furthermore, the solutions were in the parabolic Hölder space $C^{1,\alpha}$ for $0 < \alpha < 1$. Our purpose is to show $C^{1,\alpha}$ estimates on L^p-viscosity solutions of fully nonlinear parabolic equations under the same conditions as in Krylov's result.

24 Nobuhito Miyake (Tohoku Univ.) Z
Hans-Christoph Grunau (Univ. of Magdeburg)
Shinya Okabe (Tohoku Univ.)
Positivity of solutions to the Cauchy problem for linear and semilinear biharmonic heat equations 15

Summary: In this talk, we first consider whether, the solution to the Cauchy problem for the linear biharmonic heat equation with the initial data $u_0(x) := |x|^{-\beta}$, is positive on the whole space-time or not. We show that, there exist intervals I_1 and I_2 such that the solution is positive if $\beta \in I_1$ and changes its sign if $\beta \in I_2$. Moreover, we also consider the existence of the global-in-time positive solution to the Cauchy problem for a semilinear biharmonic heat equation.

Summary: We are interested in characteristic behavior of a time global solution of a certain nonlinear parabolic PDE. This is a kind of toy model where, for instance, we see a mathematical system judging the right and wrong of external stimulation carefully. We make a rigorous analysis to the nonlinear parabolic PDE to get a theorem in which how a time global solution behave, and explain some connotation of this system's typical behavior.

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.

Summary: We consider the singular limit problem for the Keller–Segel system in 2-dimensional Eucridean space. By passing the relaxation time infinity, the solution of the system can be shown to converge the soltuion to the corresponding drift-diffusion equation (simplified Keller–Segel equations) in the scaling critical Bochner space that maintains the mass conservation law. For the proof, we employ generalized maximal regularity in the homogeneous Besov spaces.

Summary: This talk deals with finite-time blow-up in a fully parabolic attraction-repulsion chemotaxis system. Finite-time blow-up in a parabolic–elliptic–elliptic version of the attraction-repulsion chemotaxis system has already proved by e.g., Tao–Wang (2013), Li–Li (2016) and Yu–Guo–Zheng (2017). Also, when $w = 0$, finite-time blow-up was obtained by Winkler (2013). However, finite-time blow-up in a fully parabolic attraction-repulsion chemotaxis system has not yet been established. The purpose of this talk is to show that Winkler's method is also applicable to the discussion deriving to finite-time blow-up in the system.

Summary: This talk deals with blow-up of solutions to a quasilinear parabolic–elliptic Keller–Segel system with logistic source. Winkler (Z. Angew. Math. Phys.; 2018; 69; Art. 69, 40) found the conditions such that solutions blow up in finite time in a special setting. Moreover, a previous paper (Math. Methods Appl. Sci.; 2020; 43; 7372–7396) gave the conditions such that blow-up occurs in the case of weak chemotactic sensitivity. Black–Fuest–Lankeit (arXiv:2005.12089[math.AP]) showed existence of initial data such that the solution blows up under the conditions in the case of nonlinear diffusion. The purpose of this talk is to give conditions such that solutions blow up in finite time in a quasilinear parabolic–elliptic Keller–Segel system with logistic source.

30 Mario Fuest (Paderborn Univ.) Z
Johannes Lankeit (Paderborn Univ.)
Masaaki Mizukami
(Tokyo Univ. of Sci.)
Asymptotic behavior in a chemotaxis-consumption model with realistic boundary conditions for the oxygen 15

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.

31 Mikihiro Fujii (Kyushu Univ.) Time periodic solutions to the 2D quasi-geostrophic equation with the supercritical dissipation ..... *

Summary: We consider the 2D dissipative quasi-geostrophic equation with the time periodic external force and prove the existence of a unique time periodic solution in the case of the supercritical dissipation. In this case, the smoothing effect of the semigroup generated by the dissipation term is too weak to control the nonlinearity in the Duhamel term of the corresponding integral equation. In this talk, we give a new approach which does not depend on the contraction mapping principle for the integral equation.

32 Kazuhiro Takimoto (Hiroshima Univ.) The exterior Dirichlet problem for the generalized parabolic k-Hessian equations ..... *

Summary: We deal with the exterior Dirichlet problem for the generalized parabolic k-Hessian equation of the form $u_t = \mu(F_k(D^2u)^{1/k})$ in $\left(\mathbb{R}^n \times (-\infty, 0]\right) \setminus D$. We prove the existence and uniqueness of viscosity solution to the exterior Dirichlet problem with prescribed asymptotic behavior as $|x|^2 - t \to \infty$.

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

Norisuke Ioku (Tohoku Univ.) Z The best constant of the Sobolev type inequality

Summary: The best constant in the Sobolev inequality in the whole space is attained by the Aubin–Talenti function; however, this does not happen in bounded domains because of the break down of the dilation invariance. In this talk, we study a new scale invariant form of the Sobolev inequality in a ball and show that its best constant is attained by functions of the Aubin–Talenti type.

March 17th (Wed) Conference Room V

9:00–12:00

33 Ikkei Shimizu (Kyoto Univ.) Z Local well-posedness for the Landau–Lifshitz equation with helicity term 15

Summary: We consider the initial value problem for the Landau-Lifshitz equation with helicity term, arising from the Dzyaloshinskii–Moriya interaction. We prove that the equation is locally well-posed in the space $\vec{k} + H^s$ for integer $s \geq 3$ and $\vec{k} = {}^t(0, 0, 1)$. We also show that if we further assume that the solution is zero-homotopic, then the class of well-posedness can be extended to real number $s > 2$. Our proof is based on the analysis via the modified Schrödinger map equation.

34 Koichi Komada (Tohoku Univ.) Z Existence of blow-up solutions for quantum Zakharov system 15

Summary: We consider the quantum Zakharov system, which models the propagation of Langmuir waves in an ionized plasma. We show the existence of radially symmetric blow-up solutions with a negative energy. To prove a blow-up result we establish a localized virial identity.

35 Takuya Sato (Tohoku Univ.) Z L^2-decay for the one dimensional dissipative nonlinear Schrödinger equation in the Gevrey class 15

Summary: We consider the Cauchy problem for the nonlinear Schrödinger equation with a dissipative cubic nonlinear term. We prove the global existence of a unique solution and obtain the uniform estimate in the Gevrey class. Using the uniform regularity estimate, we show the L^2-decay rate for the solution which has the Gevrey regularity.

36 Yuki Osada (Tokyo Metro. Univ.) Z Energy asymptotic expansion of a nonlinear Schrödinger equations with three wave interaction 10

Summary: In this talk, we consider an asymptotic expansion of an energy $I^\beta(\gamma, \mu, s)$ as $\beta \to \infty$ related to a nonlinear Schrödinger equations with three wave interaction, where β is a coefficient of a self-attractive nonlinear term. Also, we consider an asymptotic behavior of a minimizing sequence for $I^{\beta_n}(\gamma, \mu, s)$ with $\beta_n \to \infty$. The key points of the proofs are the suitable scaling transform of minimizing sequence, characterization of the several limiting problems and the three wave interaction effect.

37 Kazuki Aoki Z
Takahisa Inui (Osaka Univ.)
Hayato Miyazaki (Kagawa Univ.)
Haruya Mizutani (Osaka Univ.)
Kota Uriya (Okayama Univ. of Sci.)
Asymptotic behavior of solutions to the nonlinear Schrödinger equation on the star graph with the Kirchhoff boundary condition 15

Summary: We consider the cubic nonlinear Schrödinger equation on the star graph with the Kirchhoff boundary condition. The long-range scattering for the final state problem and the initial value problem are proven. Moreover, we also consider the failure of scattering for the Schrödinger equation with power-type long-range nonlinearities. These results are extension of the results for NLS on the one dimensional Euclidean space. A new ingredient is a factorization property of the Schrödinger operator on the star graph with the Kirchhoff boundary condition. To give the factorization property, we employ a Fourier transform with respect to the Laplacian with the Kirchhoff boundary condition developed by Weder (2015).

38 Hiroyuki Hirayama (Univ. of Miyazaki) Z
Shinya Kinoshita (Univ. Bielefeld)
Mamoru Okamoto (Osaka Univ.)
Optimal Sobolev index for well-posedness of the system of derivative nonlinear Schrödinger equations 15

Summary: We consider the Cauchy problem of the system of quadratic derivative nonlinear Schrödinger equations. This system was introduced by M. Colin and T. Colin as a model of laser-plasma interaction. We determine an optimal Sobolev index where the smooth flow map of the Cauchy problem exists, except for the scaling critical case. In particular, to prove the well-posedness, we use the angular decomposition in the frequency space. Under the transversality condition, we can use the nonlinear Loomis–Whitney inequality. For the case that the transversality condition does not hold, we construct the refined bilinear Strichartz estimate and use it to obtain the estimates for nonlinear terms.

39 Haruya Mizutani (Osaka Univ.) Z
Xiaohua Yao (Central China Normal Univ.)
Resolvent and Strichartz estimates for fractional Schrödinger operators with Hardy potentials 15

Summary: We discuss a recent progress on resolvent and Strichartz estimates for both fractional and higher-order Schrödinger operators with the Hardy potential. This extends a seminal result by Burq et al (2003) for the second-order case to the fractional and higher-order cases.

40 Ryo Muramatsu (Tokyo Univ. of Sci.) Z Estimates on modulation spaces for solutions to Schrödinger equations with vector potentials 10

Summary: We study the initial value problem for the Schrödinger equations with vector potentials. We gave estimates for the solutions to the equations in modulation spaces by initial data when the vector potentials denoted by first-degree polynomial respect to x by using representation of the solutions to the equations by wave packet transform obtained by K. Kato, M. Kobayashi and S. Ito in 2014.

41 Satoshi Masaki (Osaka Univ.) Z
Koki Sugiyama (Osaka Univ.)
Optimal decay rate of solutions to nonlinear Klein–Gordon systems 15

Summary: We consider the decay rate of solutions to a class of nonlinear Klein–Gordon system of critical order. It is known that there are several possibilities for the decay rate of the solutions. Our aim here is to confirm that the so-called nonlinear dissipation rate is the optimal decay rate among a class of nonlinear Klein–Gordon systems.

42 Hiroshi Takase (Univ. of Tokyo) Z
Inverse source problem for a system of wave equations on Lorentzian manifolds 15

Summary: A quasilinear system of wave equations on Lorentzian manifolds can be derived from the Einstein equation in general relativity. We consider inverse source problem for the linearized system in this talk. Having established Carleman estimates for the Laplace–Beltrami operator on Lorentzian manifolds, we prove conditional Hölder stability and uniqueness theorem near the partial boundary where some data regarding a solution to the system are given.

14:15–15:30

43 Kimitoshi Tsutaya (Hirosaki Univ.) Z
Yuta Wakasugi (Hiroshima Univ.)
On heatlike lifespan of solutions of semilinear wave equations in Friedmann–Lemaître–Robertson–Walker spacetime 15

Summary: Consider a nonlinear wave equation for a massless scalar field with self-interaction in the spatially flat Friedmann–Lemaître–Robertson–Walker spacetimes. We treat the so-called heatlike case where the critical exponent is affected by the Fujita exponent. We show upper bounds of the lifespan of blow-up solutions by distinguishing subcritical and critical cases.

44 Kimitoshi Tsutaya (Hirosaki Univ.) Z
Yuta Wakasugi (Hiroshima Univ.)
Blow up of solutions of semilinear wave equations related to nonlinear waves in accelerated expanding FLRW spacetime 15

Summary: Consider a nonlinear wave equation for a massless scalar field with self-interaction in the spatially flat Friedmann–Lemaître–Robertson–Walker spacetimes. For the case of accelerated expansion, we show that blow-up in a finite time occurs for the equation with arbitrary power nonlinearity as well as upper bounds of the lifespan of blow-up solutions.

45 Mamoru Okamoto (Osaka Univ.) Z
Tadahiro Oh (Univ. of Edinburgh)
Leonardo Tolomeo (Univ. Bonn)
Almost sure global well-posedness for the focusing nonlinear wave equation with a Hartree-type nonlinearity 15

Summary: We consider the invariant Gibbs dynamics for the nonlinear wave equation with a Hartree-type cubic focusing nonlinearity on the three-dimensional torus. Using ideas from paracontrolled calculus, in particular from the recent work by Gubinelli, Koch, and Oh, we prove local well-posedness of the Cauchy problem. In order to handle a nonlinear term in the Hartree-type nonlinearity, we need to exploit the dispersive nature of paracontrolled operators. We establish almost sure global well-posedness and invariance of the focusing Hartree Φ^4_3-measure via Bourgain's invariant measure argument ('96).

46 Tomoyuki Tanaka (Nagoya Univ.) Z
Kyouhei Wakasa (Kushiro Nat. Coll. of Tech.)
On the critical decay for the wave equation with a cubic convolution in 3D ····· 10

Summary: We consider the wave equation with a cubic convolution $\partial_t^2 u - \Delta u = (|x|^{-\gamma} * u^2)u$ in three space dimensions. Here, $0 < \gamma < 3$ and $*$ stands for the convolution in the space variables. It is well known that if initial data are smooth, small and compactly supported, then $\gamma \geq 2$ assures unique global existence of solutions. On the other hand, it is also well known that solutions blow up in finite time for initial data whose decay rate is not rapid enough even when $2 \leq \gamma < 3$. In this paper, we consider the Cauchy problem for $2 \leq \gamma < 3$ in the space-time weighted L^∞ space in which functions have critical decay rate. When $\gamma = 2$, we give an optimal estimate of the lifespan. This gives an affirmative answer to the Kubo conjecture (Remark right after Theorem 2.1 in Kubo (2004)). When $2 < \gamma < 3$, we also prove unique global existence of solutions for small data.

47 Tomoyuki Tanaka (Nagoya Univ.)
Kotaro Tsugawa (Chuo Univ.)
Well-posedness and parabolic smoothing effect for higher order Schrödinger type equations with constant coefficients ····· ∗

Summary: We consider the Cauchy problem of a class of higher order Schrödinger type equations with constant coefficients. By employing the energy inequality, we show the L^2 well-posedness, the parabolic smoothing and a breakdown of the persistence of regularity. We classify this class of equations into three types on the basis of their smoothing property.

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

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

49 Hironobu Sasaki (Chiba Univ.)
The scattering problem for the three-dimensional cubic nonlinear Klein–Gordon equation with rapidly decreasing input data ····· ∗

Summary: The scattering problem for the three-dimensional cubic nonlinear Klein–Gordon equation is studied. It has been shown that the scattering operator $\boldsymbol{S}$ is well-defined on a neighborhood in the critical space $H^{1/2}(\mathbb{R}^3) \oplus H^{-1/2}(\mathbb{R}^3)$ of 0. We prove that if functions f_- and g_- are in the Schwartz space $\mathcal{S}(\mathbb{R}^3)$ and small in the sense of the critical space, then the corresponding output data $(f_+, g_+) := \boldsymbol{S}(f_-, g_-)$ also belongs to $\mathcal{S}(\mathbb{R}^3) \oplus \mathcal{S}(\mathbb{R}^3)$. Furthermore, we give sufficient conditions for (f_-, g_-) such that all order partial derivatives of f_+ and g_+ decay more rapidly than a same exponential function.

50 Masaru Hamano (Saitama Univ.)
Masahiro Ikeda (RIKEN/Keio Univ.)
Instability of standing waves to nonlinear Klein–Gordon equation with an inverse-square potential ····· ∗

Summary: In this talk, we consider nonlinear Klein–Gordon (NLKG) equation with an inverse-square potential. Killip–Murphy–Visan–Zheng '17 and Dinh '18 showed existence of a radial ground state to the stationary problem for the NLKG equation. We investigate instability of standing waves to the NLKG equation with the radial ground state as initial data. Here, instability implies that there exists a solution to the NLKG equation such that it blows up in finite time and its initial data is close to the radial ground state. The proof is based on the argument in Ohta–Todorova '07.

51 Takashi Furuya (Nagoya Univ.) The monotonicity method for the inverse crack scattering problem ··· ∗

Summary: The monotonicity method for the inverse acoustic scattering problem is to understand the inclusion relation between an unknown target and artificial object by comparing the far field operator with the artificial operator. In this talk, we present recent developments of this method to the inverse crack scattering problem, in which case the unknow target is the open arc (target does not have the volume). We give the indicator to determine whether an artificial small arc is contained in the unknown arc or not. We also give numerical examples for this method.

52 Gen Nakamura (Hokkaido Univ.) Sampling methods for inverse boundary value problems ····· ∗

Summary: We are concern with reconstructing an unknown obstacle by single measurement for the inverse boundary value problem for the Laplace equation. As for the reconstruction methods, we consider two sampling methods called the range test (RT) and the no-response test (NRT). Our main results are the duality between these two methods and convergence of each of these methods without using the duality.

53 Gen Nakamura (Hokkaido Univ.) An inverse boundary value problem for anisotropic elastic equation ··· ∗

Summary: We consider the inverse boundary value problem of recovering a piecewise homogeneous elastic tensor and a piecewise homogeneous mass density from a localized lateral Neuman-to-Dirichlet map, for the anisotropic elasticity equation in the space-time domain. We derive uniqueness for identifying these tensor and density on all domains of homogeneity that may be reached from the part of the boundary where the measurements are taken by a chain of subdomains whose successive interfaces contain a curved portion. This uniqueness result gives a foundation of the vibroseis exploration technique in the reflection seismology.

15:40–16:40 Award Lecture for the 2020 MSJ Analysis Prize

Hirokazu Ninomiya (Meiji Univ.) [Z] The world of reaction-diffusion systems

Summary: A reaction-diffusion system is a type of parabolic differential equations is often used to describe various phenomena in Chemistry, Physics and Biology. This only consists of diffusion and kinetics. However, the dynamics of a reaction-diffusion system is not simple even if the number of components is small. In this talk, I will illustrate the complexity of dynamics by taking the ventricular fibrillation as an example. To understand the dynamics, an entire solution is introduced, which is a solution existing for all positive and negative time. This includes a traveling wave solution and a stationary solution. I will begin with the scalar case. Then the singular limit problem is considered to understand the dynamics of two-component reaction-diffusion systems. By using the dynamics of the singular limit problem and the scalar reaction-diffusion equation, I will explain the dynamics.

March 18th (Thu) Conference Room V

9:00–12:00

54 Tomoki Takahashi (Nagoya Univ.) [Z] Existence of a stationary Navier–Stokes flow past a rigid body, with application to starting problem in higher dimensions ····· 15

Summary: We consider the large time behavior of the Navier–Stokes flow past a rigid body in $\mathbb{R}^n$ with $n \geq 3$. We first construct a small stationary solution possessing the optimal summability at spatial infinity, which is the same as that of the Oseen fundamental solution. When the translational velocity of the body gradually increases and is maintained after a certain finite time, we then show that the nonstationary fluid motion converges to the stationary solution corresponding to a small terminal velocity of the body as time $t \to \infty$ in L^q with $q \in [n, \infty]$. This is called Finn's starting problem and the three-dimensional case was affirmatively solved by Galdi, Heywood and Shibata (1997). We extend it to the case of higher dimensions. Even for the three-dimensional case, our theorem provides new convergence rate.

55 Motofumi Aoki (Tohoku Univ.) Z
Tsukasa Iwabuchi (Tohoku Univ.)
Remark on smoothing property of weak solutions for the Navier–Stokes equations 10

Summary: We consider a sufficient condition for the regularity of weak solutions for the incompressible Navier–Stokes equations on $\mathbb{R}^3$. We prove a smoothing property of the weak solution near the initial time under the condition that a scale invariant norm written by BMO is finite.

56 Hideo Kozono (Waseda Univ. / Tohoku Univ.) Z
Yutaka Terasawa (Nagoya Univ.)
Yuta Wakasugi (Hiroshima Univ.)
Asymptotic behavior of solutions to elliptic equations with unbounded coefficients of the second order in unbounded domains 15

Summary: We study an asymptotic behavior of solutions to elliptic equations of the second order in a two dimensional exterior domain. Under the assumption that the solution belongs to L^q with $q \in [2, \infty)$, we prove a pointwise asymptotic estimate of the solution at the spatial infinity in terms of the behavior of the coefficients.

57 Hideo Kozono (Waseda Univ. / Tohoku Univ.) Z
Yutaka Terasawa (Nagoya Univ.)
Yuta Wakasugi (Hiroshima Univ.)
Asymptotic properties of steady solutions to the 3D axisymmetric Navier–Stokes equations with no swirl 15

Summary: We study the asymptotic behavior of axisymmetric solutions with no swirl to the steady Navier–Stokes equations in the outside of the cylinder. We prove an a priori decay estimate of the vorticity under the assumption that the velocity has generalized finite Dirichlet integral.

58 Hideo Kozono (Waseda Univ. / Tohoku Univ.) Z
Erika Ushikoshi (Yokohama Nat. Univ.)
Fumitaka Wakabayashi (Waseda Univ.)
Removability of time-dependent singularities of the Stokes equations 15

Summary: Let $\Omega \subset \mathbb{R}^N$ and let $\xi \in C^\alpha([0,T];\Omega)$ for $0 < \alpha \le \frac{1}{2}$. We consider the situation that $u = u(x,t)$ is a classical solution of the Stokes equations in $\bigcup_{0<t<T}\{\Omega \setminus \{\xi(t)\}\} \times \{t\}$, that is, $\{\xi(t)\}_{0<t<T}$ is regarded as the time-dependent singularities of u in $\Omega \times (0,T)$. If u behaves around $\xi(t)$ like $|u(x,t)| = o(|x-\xi(t)|^{2-N+(1/\alpha-2)})$ as $x \to \xi(t)$ uniformly in $t \in (0,T)$, then $\{\xi(t)\}_{0<t<T}$ is a family of removable singularities of u, which implies that u can be extended as a smooth solution in the whole space and time $\Omega \times (0,T)$.

59 Tatsu-Hiko Miura (Kyoto Univ.) Z
Global existence of a strong solution to the Navier–Stokes equations in a curved thin domain 15

Summary: We consider the Navier–Stokes equations with Navier's slip boundary conditions in a three-dimensional curved thin domain which is defined as a thin tubular neighborhood of a given two-dimensional closed surface. When the thickness of the thin domain is sufficiently small, we establish the global existence of a strong solution for large data. Moreover, we derive several estimates for the strong solution with constants explicitly depending on the thickness of the thin domain.

60 Tatsu-Hiko Miura (Kyoto Univ.) Z
Singular limit problem for the Navier–Stokes equations in a curved thin domain 15

Summary: As in the previous talk, we consider the Navier–Stokes equations with Navier's slip boundary conditions in a three-dimensional curved thin domain around a given two-dimensional closed surface. Under suitable assumptions, we show that the average in the thin direction of a strong solution to the bulk Navier–Stokes equations weakly on the limit surface as the thickness of the thin domain tends to zero. Moreover, we characterize the weak limit as a unique weak solution to limit equations, which are the damped Navier–Stokes equations on the limit surface. In some special case, our limit equations agree with the Navier–Stokes equations on an abstract Riemannian manifold in which the viscous term contains the Ricci curvature.

61 Miho Murata (Shizuoka Univ.) Z
Takayuki Kobayashi (Osaka Univ.)
The global well-posedness of the compressible fluid model of Korteweg type for the critical case 10

Summary: We consider the compressible fluid model of Korteweg type in a critical case where the derivative of pressure equals to 0 at the given constant state. It is shown that the system admits a unique, global strong solution for small initial data in the maximal L_p-L_q regularity class. As a result, we also prove the decay estimates of the solutions to the nonlinear problem. In order to obtain the global well-posedness for the critical case, we show L_p-L_q decay properties of solutions to the linearized equations under an additional assumption for a low frequencies.

62 Kai Koike (Kyoto Univ.) Z
Refined pointwise estimates for the solutions to the one-dimensional compressible Navier–Stokes equations and the long-time behavior of a moving point mass 15

Summary: We present a result on refined pointwise estimates for the solutions to a coupled system of a 1D barotropic viscous compressible fluid and a moving point mass. In a previous work of the author, we obtained a power law decay estimate for the velocity $V(t)$ of the point mass: $V(t) = O(t^{-3/2})$. This time, as a corollary to the main result, we obtain a sufficient and necessary condition on the initial data for a corresponding lower bound $|V(t)| \geq C^{-1}(t+1)^{-3/2}$ $(t \gg 1)$ to hold.

63 Ryosuke Nakasato (Tohoku Univ.) Z
Shuichi Kawashima (Waseda Univ.)
Takayoshi Ogawa (Tohoku Univ.)
Global well-posedness for the Hall-magnetohydrodynamic system in the critical Besov space 15

Summary: We consider the global existence of solution for the initial value problem for the compressible Hall-magnetohydrodynamic system in the whole space. The system consists of a hyperbolic-parabolic system of partial differential equations of the conservation laws type with non-symmetric diffusion. We show the existence of solution as a perturbation from a constant equilibrium state. The time-decay of the solution in the Besov spaces is also established. Our results show the pointwise estimate of the solution in the Fourier space for the linearized Hall-MHD system that related to the result obtained by Umeda–Kawashima–Shizuta for a general class of linear symmetric hyperbolic-parabolic systems with symmetric diffusion. We utilize a systematic use of the product estimates in the Chemin–Lerner spaces and apply the energy method due to Matsumura–Nishida.

14:15–15:30

64 Masahiro Suzuki (Nagoya Inst. of Tech.) Z
Masashi Ohnawa
(Tokyo Univ. of Marine Sci. and Tech.)
Time-periodic solutions of symmetric hyperbolic systems 15

Summary: We prove the unique existence of time-periodic solutions to general hyperbolic equations with periodic external forces autonomous or nonautonomous over a domain bounded by two parallel planes, provided that all the characteristics with respect to the direction normal to the planes have the same sign. It is also shown that global-in-time solutions to initial-boundary value problems coincide with the solutions to corresponding time-periodic problems after a finite time. Furthermore, we introduce applications of our theorems to several realistic problems.

65 Masahiro Suzuki (Nagoya Inst. of Tech.) Z
Walter Strauss (Brown Univ.)
Global bifurcation analysis of an equation of gas discharge 15

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. There can be a cascade of electrons due both to the electrons colliding with the gas molecules and to the ions colliding with the cathode (secondary emission). We use global bifurcation theory to prove that there is a curve of such steady states with the following property. The curve begins at the sparking voltage and either the particle density becomes unbounded or the curve ends at an anti-sparking voltage. These critical voltages are characterized explicitly.

66 Shota Sakamoto (Tokyo Tech) Z
Suzuki Masahiro (Nagoya Inst. of Tech.)
Katherine Zhiyuan Zhang
(Courant Inst. of Math. Sci.)
Asymptotic stability of an initial-boundary value problem of the Boltzmann equation in 3D half-space 15

Summary: We consider an initial-boundary value problem of the Boltzmann equation in three-dimensional half-space. We will prove that a solution to this problem exponentially converges to a solution to the corresponding time-independent problem. It is known that, when we assume that the unknown only depends on one spatial variable, this claim is true. However, in our case it is hard to find a time-independent solution by the same proof because it only works for an ODE. To overcome this difficulty, we first find a time-periodic solution to the problem, and if a boundary data does not depend on time, the solution should have arbitrary large period. We can construct a stationary solution by this time-periodic solution. Stability is proved by using the energy method.

67 Tetu Makino (Yamaguchi Univ.*) Z
Asymptotically flat axisymmetric metric generated by rotating compact fluid mass 15

Summary: We consider axially symmetric metrics governed by the Einstein equations with the energy-momentum tensor of slowly rotating compact gaseous masses with physical vacuum boundary. The equation of state is a barotropic one which is near to the usual gamma-law at the vacuum. Applying the classical potential theory of 3,4,5-dimensional spaces, we can construct asymptotically flat global metric with compactly supported density distribution, provided that the central density and the angular velocity, which is supposed to be constant on the support of the density, are sufficiently small. This is an alternative approach to the so-called matter-vacuum matching problem.

68 Takeshi Gotoda (Nagoya Univ.)
A sufficient condition for the enstrophy conservation in 2D inviscid flows ..... *

Summary: In this talk, we consider weak solutions of the 2D filtered-Euler equations, which are a regularization of the 2D Euler equations, and give a sufficient condition for the conservation of the enstrophy. The enstrophy is defined by the L^2 norm of the vorticity and the dissipation of it is one of the remarkable features appearing in the turbulent flows. We show that if initial vorticity belongs to the L^p space with $3 < p \leq \infty$, then the enstrophy of the weak solution of the 2D filtered-Euler equations is conserved in the limit of the regularization parameter.

69 Kazuyuki Tsuda (Kyushu Sangyo Univ.)
Reinhard Farwig (TU Darmstadt)
Uniform estimates for fractional operators ..... *

Summary: Given a family of closed operators, $\{A(t)\}$, on a Banach space X of class $\mathcal{HT}$ we consider the question whether the domain of the fractional operators $\mathcal{D}(A(t)^\theta)$, $0 < \theta < 1$, coincides with the complex interpolation space $[X, \mathcal{D}(A(t))]_\theta$ such that the embeddings constants do not depend on the parameter t. Controlling constants in several fundamental theorems on operators with the property of bounded purely imaginary powers, operators admitting an H^∞calculus, and on complex interpolation theory we find conditions such that the above t-independence of embedding constants holds.

70 Natsumi Yoshida (Ritsumeikan Univ.)
Asymptotic behavior of solutions toward the rarefaction waves to the Cauchy problem for the scalar conservation law with nonlinear viscosity ..... *

Summary: We study the asymptotic behavior of solutions to the Cauchy problem for the one-dimensional scalar viscous conservation law where the far field states are prescribed. Especially, we deal with the case when the flux function is fully convex, and also the viscosity is a nonlinearly degenerate one. Then the Cauchy problem has a unique global in time solution which tends toward a rarefaction wave as time goes to infinity. The proof is given by using a technical weighted energy method associated with the nonlinearity of the flux and the viscosity.

71 Natsumi Yoshida (Ritsumeikan Univ.) Decay properties of solutions toward the rarefaction waves to the Cauchy problem for the scalar conservation law with nonlinear viscosity ..... *

Summary: We study the precise time-decay estimates of solutions toward the rarefaction wave to the Cauchy problem for the one-dimensional scalar viscous conservation law where the far field states are prescribed. Especially, we deal with the case when the flux function is fully convex, and also the viscosity is a nonlinearly degenerate one. Important is how to construct the time-weighted energy inequality associated with the nonlinearity of the flux and the viscosity.

72 Natsumi Yoshida (Ritsumeikan Univ.) Global asymptotic stability of rarefaction waves to the Cauchy problem for the scalar diffusive dispersive conservation law ..... *

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

73 Natsumi Yoshida (Ritsumeikan Univ.) Global asymptotic stability of a multiwave pattern for the generalized Korteweg–de Vries–Burgers equation ..... *

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

15:40–16:40 Talk Invited by Functional Equations Section

Takahiro Okabe (Osaka Univ.) Z Asymptotic analysis of the solution to the Navier–Stokes equations by external forces

Summary: We consider the incompressible Navier–Stokes equations on the whole space $\mathbb{R}^n$, $n \geq 2$. The aim is to derive an algorithm that, for any divergence-free small initial data, explicitly constructs a localised external force leading to a rapidly decaying solutions of the Navier–Stokes equations in $\mathbb{R}^n$: i.e., the energy decay rate of the flow will be forced to satisfy $\|u(t)\|_2^2 = o(t^{-(n+2)/2})$ as $t \to \infty$, which is faster than the usual optimal rate. An important feature of our construction is that this force can always be taken compactly supported in space-time, and its profile arbitrarily prescribed up to a spatial rescaling. Since the effect of the force vanishes after a finite time interval, our result suggests that nontrivial interactions between the linear and nonlinear parts may occur, annihilating all the slowly decaying terms contained in asymptotic profile derived by Fujigaki and Miyakawa.

Real Analysis

March 17th (Wed) Conference Room IV

10:30–11:50

1 Yukino Tomizawa (Niigata Inst. of Tech.) [Z] The modulus of convexity of Busemann spaces 15

Summary: The modulus of convexity is a function used to characterize the convexity of normed spaces. It is known that there is a generalization of it in geodesic spaces. We report properties of the modulus of convexity in Busemann spaces.

2 Ryota Kawasumi, Eiichi Nakai (Ibaraki Univ.) [Z] Calderón–Zygmund operators on Orlicz–Morrey and weak Orlicz–Morrey spaces 15

Summary: It is well known that the Calderón–Zygmund operators are bounded on $L^p(\mathbb{R}^n)$, $1 < p < \infty$. This boundedness was extended to several function spaces. In this talk we discuss the boundedness on Orlicz–Morrey and weak Orlicz–Morrey spaces. We also consider the weighted estimate.
The Orlicz–Morrey and weak Orlicz–Morrey spaces contain the L^p, Orlicz and generalized Morrey spaces and their weak versions, respectively, as special cases. Hence we get the boundedness of these function spaces as corollaries.

3 Naoya Hatano (Chuo Univ./RIKEN), Masahiro Ikeda (RIKEN), Isao Ishikawa (Ehime Univ.), Yoshihiro Sawano (Chuo Univ.) [Z] A global universality of two-layer neural networks with ReLU activations 15

Summary: In the present study, we investigate a universality of neural networks, which concerns a density of the set of two-layer neural networks in a function spaces. There are many works that handle the convergence over compact sets. In this talk, we provide a global convergence by introducing a norm suitably, so that our results will be uniform over any compact set.

4 Kojiro Higuchi (Nihon Univ.) [Z] The natural extensions of positive additive partial functionals 15

Summary: We discuss a general method of extending a given positive additive partial functional defined on a pre-ordered linear space or on a naturally pre-ordered commutative monoid. The method is called the *natural extension*. We investigate basic properties of natural extensions of positive additive partial functionals, and we characterize their domains. Finally, we give some useful characterizations of the derivatives and the integrals in terms of natural extensions.

5 Shin-ya Matsushita (Akita Pref. Univ.) [Z] On primal-dual splitting algorithms 15

Summary: The primal-dual splitting algorithms are existing algorithms that do solve convex optimization problems, and the generated sequences weak convergence to a solution. In general, the weak convergence results of these algorithms cannot be improved to strong convergence without additional hypotheses on the functions. In this talk, we introduce and investigate a strongly convergent primal-dual splitting algorithm without assuming restrictive properties for the involved functions.

6 Takeshi Iida (Fukushima Nat. Coll. of Tech.) Weighted norm inequalities on Morrey spaces for the Orlicz-fractional maximal opearators ..... ∗

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 give the weighted norm inequalities for the Orlicz-fractional maximal operators in Morrey spaces.

7 Takashi Miyamoto (Osaka Kyoiku Univ.)
Hiro-o Kita (Kagoshima Univ.*)
Naoko Ogata (Kobe Univ.)
On generalized weak Orlicz spaces and F-norms constructed by φ-functions ..... *

Summary: The properties of the generalized Orlicz spaces and the weak Orlicz spaces, with quasi-norms or F-norms constructed by φ-functions, are given.

8 Ryutaro Arai (Ibaraki Univ.) Boundedness of fractional integrals on martingale Orlicz–Morrey spaces ..... *

Summary: We consider generalized fractional integrals of martingales, which is based on the notion of martingale transform in the sense of Burkholder. Let I_γ be a generalized fractional integral. We show the boundedness of I_γ from martingale Orlicz–Morrey space $L_{(\Phi,\varphi)}$ to another martingale Orlicz–Morrey space $L_{(\Psi,\varphi)}$.

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

Summary: To describe the geometry of normed spaces, the geometric constants play important roles. Among them, the von Neumann–Jordan constant has been investigated widely. Meanwhile, the notion of orthogonality in inner product spaces is simple, fruitful and has been studied by a lot of mathematicians. The generalized orthogonality notions in normed spaces can be considered. Those have been investigated widely, too. Here we consider Birkhoff orthogonality. The usual orthogonality in inner product space is symmetric. However, Birkhoff orthogonality is not so in general. A two dimensional plane in which Birkhoff orthogonality is symmetric is called Radon plane. We estimate the von Neumann–Jordan constants in Radon planes.

10 Toshiharu Kawasaki (Nihon Univ. / Tamagawa Univ.) On the family of extended integrable functions ..... *

Summary: We consider an extended integral that incorporates the properties of the primitive into the indefinite integral. In this talk we will describe how wide the family of integrable functions for the extended integral is.

14:30–15:30 Talk Invited by Real Analysis Section

Koji Aoyama (Chiba Univ.) [Z] Strongly quasinonexpansive mappings and strongly quasinonexpansive sequences of mappings

Summary: This talk is devoted to the study of strongly quasinonexpansive mappings in a metric-like space and a Banach space. In particular, we give some characterizations of such mappings and show that the class of strongly quasinonexpansive mappings is closed under composition. We also deal with strongly quasinonexpansive sequences of mappings in a Hilbert space and a Banach space. We provide some properties of such sequences and apply them to obtain convergence theorems for a fixed point problem of quasinonexpansive mappings.

March 18th (Thu) Conference Room IV

10:00–11:45

11 Shodai Kubota (Chiba Univ.) Z
Ken Shirakawa (Chiba Univ.)
Noriaki Yamazaki (Kanagawa Univ.)
Optimal control problems for one dimensional Fix–Caginalp type systems including singular diffusions 15

Summary: We consider optimal control problems for state problems of one dimensional systems of Fix–Caginalp types which are based on the modeling method as a possible mathematical model of solid-liquid phase transitions in a mesoscopic length scale. Each state problem is denoted by $(S)_\varepsilon$, with $\varepsilon > 0$. In this regard, each optimal control problem is denoted by $(OP)_\varepsilon$, with $\varepsilon > 0$, and it is prescribed as a minimization problem of a cost function. Additionally, the problems $(S)_\varepsilon$ and $(OP)_\varepsilon$ 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.

12 Ken Shirakawa (Chiba Univ.) Z
Shodai Kubota (Chiba Univ.)
Ryota Nakayashiki (Salesian Polytech.)
Optimal temperature controls for 1D KWC type systems with dynamic boundary conditions 15

Summary: In this paper, we consider a class of optimal control problems governed by 1D parabolic state-systems of KWC types with dynamic boundary conditions. The state-systems are based on a phase-field model of grain boundary motion, proposed in [Kobayashi–Warren–Carter, Physica D, 140, 141–150, 2000], and in the context, the dynamic boundary conditions are supposed to reproduce the transmitted temperature controls between interior and boundary of a polycrystal body. Under suitable assumptions, the mathematical results concerned with: the well-posedness of state-systems; the solvability and parameter-dependence in the class of our optimal control problems; and the first order necessary optimality conditions in regular cases of problems and the limiting approach to the singular case; will be obtained in forms of three Main Theorems of this paper.

13 Takeshi Fukao (Kyoto Univ. of Edu.) Z
Pierluigi Colli (Univ. of Pavia)
Vanishing diffusion in a dynamic boundary equation for the Cahn–Hilliard system. 15

Summary: In this talk, we will discuss the interpretation of the boundary equation for the Cahn–Hilliard system with a 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. Under the suitable assumption of the growth condition, the dynamic boundary condition can be interpreted as the equation almost everywhere sense.

14 Chiharu Kosugi (Japan Women's Univ.) Z
Toyohiko Aiki (Japan Women's Univ.)
Existence of weak solutions for the initial and boundary value problems representing stretching and shrinking motion of the compressible elastic material on the plane 15

Summary: In this talk we consider existence of weak solutions to an initial boundary value problem for beam equations with a viscosity term. This problem represents stretching and shrinking motion of the compressible elastic material, like a rubber ring, and is to find a closed curve defined on the closed interval [0, 1]. We note that the strain is given by a nonlinear function having a singular point to deal with large deformations. The aim of this talk is to prove the existence of weak solutions, by applying Banach's fixed point theorem and Aubin's compact theorem.

15 Shunsuke Kurima (Tokyo Univ. of Sci.) Z Employing a time discretization scheme for a parabolic-hyperbolic phase-field system with nonlocal term 15

Summary: Time discretizations of phase-field systems have been studied. For example, a time discretization and error estimate for a parabolic-parabolic phase-field system have been studied (see e.g., Colli–K. [Commun. Pure Appl. Anal. 18 (2019)]). Also, a time discretization and error estimate for a simultaneous abstract evolution equation applying parabolic-hyperbolic phase-field systems have been studied (see K. [ESAIM Math. Model. Numer. Anal. 54 (2020), Electron. J. Differential Equations 2020, Paper No. 96]). On the other hand, although existence of solutions to parabolic-hyperbolic phase-field systems with nonlocal terms have been studied (see e.g., Grasselli–Petzeltová–Schimperna [Quart. Appl. Math. 65 (2007)]), time discretizations of these systems seem to be not studied yet. This talk will focus on employing a time discretization scheme for a parabolic-hyperbolic phase-field system with nonlocal term.

16 Masaaki Mizukami (Tokyo Univ. of Sci.) Z Uniform-in-time convergence of solutions for a chemotaxis-competition model on the weakly competitive case 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 on the weakly competitive case.

14:15–14:45

17 Hiroshi Watanabe (Oita Univ.) Z Asymptotic behavior of entropy solutions to one-dimensional Cauchy problems for scalar parabolic-hyperbolic conservation laws 15

Summary: We consider one-dimensional Cauchy problems (CP) for scalar parabolic-hyperbolic conservation laws. The equation has both properties of hyperbolic equations and those of parabolic equations. Accordingly, it is difficult to investigate the behavior of solutions to (CP). In this talk, we prove the asymptotic behavior of entropy solutions to (CP) around some traveling waves. Moreover, we also discuss the rarefaction waves which are weak solutions to the Riemann problem for scalar hyperbolic conservation laws.

18 Kota Kumazaki (Nagasaki Univ.) Z Well-posedness of a one-dimensional free boundary problem describing water swelling within thin-elongated pores 15

Summary: In this talk, we consider a free boundary problem describing water swelling within thin-elongated pores. Our problem is posed on a halfline with a moving boundary at one of the ends and consists of a diffusion equation for water content and an ordinary differential equation describing the growth rate of the moving interface of the water region. Recently, we obtained that the moving interface grows finite if the production term by Henry's law has a certain decay in time, and grows infinitely otherwise. In this talk, we discuss the global existence of a unique solution and the dichotomy result of the large time behavior of a solution to our problem.

19 Noriaki Yamazaki (Kanagawa Univ.)
Nobuyuki Kenmochi (Chiba Univ.*)
Ken Shirakawa (Chiba Univ.)
Solvability of quasi-variational evolution inclusions via optimal control problems ..... *

Summary: We consider doubly nonlinear quasi-variational evolution inclusions. In this talk, we study singular optimal control problems of nonlinear evolution inclusions. Then, we show the solvability of our original problem via optimal control problems of parameter-dependent evolution inclusions.

20 Makoto Nakamura (Yamagata Univ.)
Haruki Takashima (Yamagata Univ.)
On the Klein–Gordon equation with the Hartree type semilinear term in the de Sitter spacetime ..... *

Summary: The Cauchy problem for the the Klein–Gordon equation with the Hartree type semilinear term is considered in the de Sitter spacetime. The effects of the spatial expansion and contraction on the existence of the solution of the equation are considered.

15:00–16:00 Talk Invited by Real Analysis Section

Kentarou Fujie (Tohoku Univ.)[z] Global solvability of some quasilinear chemotaxis systems

Summary: We will consider the initial-boundary value problems for some quasilinear chemotaxis systems in a bounded smooth domain. We first deal with the fully parabolic one dimensional chemotaxis system with logarithmic diffusion. We prove that for such a diffusion any initial condition, independently on the magnitude of mass, generates global-in-time solution. In order to prove global existence, we establish a new Lyapunov-like functional associated to the system. In the latter half of the talk, we will deal with a chemotaxis model which describes a density-suppressed motility in process of stripe pattern formation through self-trapping mechanism. The system shares the same set of equilibria as well as the Lyapunov functional with the classical Keller–Segel model. A novel critical phenomenon in the two-dimensional setting is observed that with any initial datum of subcritical mass, the global solution is proved to be uniform-in-time bounded, while with certain initial datum of supercritical mass, the global solution will become unbounded as time goes to infinity. Namely, blowup takes place in infinite time rather than finite time in our model which is distinct from the well-known fact that certain initial data of supercritical mass will enforce a finite-time blowup for the classical Keller–Segel system.

Functional Analysis

March 16th (Tue) Conference Room VI

9:00–10:30

1 Yoritaka Iwata (Kansai Univ.) Z Unbounded generalization of logarithmic representation of infinitesimal generators by means of the resolvent operator ····· 15

Summary: There are several logarithmic type transforms between the solutions of partial differential equations. Among them, the Cole–Hopf transform and the Miura transform are represented by the logarithmic differentiation. In those transformations, logarithmic differential of evolution operators are identified by unbounded infinitesimal generators. On the other hand evolution operators are assumed to be bounded in the standard semigroup theory of operators, although the infinitesimal generator is generally unbounded. In this paper, by means of the simultaneously-introduced double resolvent approximation, the logarithmic representations for bounded operators in Banach spaces are generalized to those for unbounded operators.

2 Kouichi Taira (Ritsumeikan Univ.) Z Uniform Sobolev estimates for discrete Schrödinger operator in dimension three ····· 15

Summary: In this talk, we prove the uniform Sobolev estimate of the discrete Schrödinger operator with dimension three. To do this, we show a Fourier decay of the surface measure on the Fermi surface.

3 Yuuya Yoshida (Nagoya Univ.) Z Maximum dimension of subspaces with no product basis ····· 15

Summary: Let $n \geq 2$ and $d_1, \ldots, d_n \geq 2$ be integers, and $\mathcal{F}$ be a field. A vector $u \in \mathcal{F}^{d_1} \otimes \cdots \otimes \mathcal{F}^{d_n}$ is called a product vector if $u = u^{[1]} \otimes \cdots \otimes u^{[n]}$ for some $u^{[1]} \in \mathcal{F}^{d_1}, \ldots, u^{[n]} \in \mathcal{F}^{d_n}$. A basis composed of product vectors is called a product basis. In this talk, we show that the maximum dimension of subspaces of $\mathcal{F}^{d_1} \otimes \cdots \otimes \mathcal{F}^{d_n}$ with no product basis is equal to $d_1 d_2 \cdots d_n - 2$ if either (i) $n = 2$ or (ii) $n \geq 3$ and $\#\mathcal{F} > \max\{d_i : i \neq n_1, n_2\}$ for some n_1 and n_2. Since this result is related to the maximum number of simultaneously distinguishable states in general probabilistic theories (GPTs), we introduce this relation for mathematicians.

4 Takashi Satomi (Univ. of Tokyo) Z The optimal constant of Young–Beckner–Fournier's convolution inequality on unimodular locally compact groups ····· 15

Summary: Young's convolution inequality holds for any unimodular locally compact group G. Fournier proved that the optimal constant $c(G)$ of Young's inequality is less than 1 if and only if G has no open compact subgroup, and found a uniform constant $C < 1$ that is not less than $c(G)$ in this case. Furthermore, Beckner obtained $c(G)$ explicitly when $G = \mathbb{R}^n$. In this talk, I report that the optimal constant of C is $c(\mathbb{R})$.

5 Toshihisa Kubo (Ryukoku Univ.) Z Palindromic property of Cayley continuants $\{\mathrm{Cay}_k(x;n)\}_{k=0}^{\infty}$ ····· 15

Summary: In 1858, Cayley considered a family $\{\mathrm{Cay}_k(x;y)\}_{k=0}^{\infty}$ of certain continuants $\mathrm{Cay}_k(x;y)$. In this talk, for $y = n \in \mathbb{Z}_{\geq 0}$, we show that the values of a finite sequence $\{\mathrm{Cay}_k(s;n)/k!\}_{k=0}^{n}$ is palindromic or antipalindromic at $s \in \mathbb{C}$, for which $\mathrm{Cay}_{n+1}(s;n) = 0$. If time permits, we also provide other families $\{P_k(x;n)\}_{k=0}^{\infty}$ and $\{Q_k(x;n)\}_{k=0}^{\infty}$ of tridiagonal determinants of this property, which arise from a study of representations on the space of K-finite solutions to the Heisenberg ultrahyperbolic operator in connection with Heun polynomials.

6 Shuji Watanabe (Gunma Univ.) An operator-theoretical treatment of the critical magnetic field of a superconductor in the BCS-Bogoliubov model of superconductivity ··· ∗

Summary: We study the temperature dependence of the critical magnetic field in the BCS-Bogoliubov model of superconductivity. Moreover, we show that the critical magnetic field is smooth with respect to the temperature, and point out the behavior of both the critical magnetic field and its derivative.

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

Takuya Mine (Kyoto Inst. Tech.) Z Schrödinger operators with point interactions

Summary: Schrödinger operators with point interactions are typical examples of solvable models, in the sense that the spectrum, the resonance, and the resolvent etc. can be explicitly calculated. In this talk, we will give a brief historical review of mathematical results about Schrödinger operators with point interactions. In particular, we will explain a recent result about Schrödinger operators with random point interactions of Poisson–Anderson type.

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

Toshiyuki Kobayashi (Univ. of Tokyo) Z Tempered homogeneous spaces

Summary: Let G be a reductive Lie groups, H an algebraic subgroup, and $X = G/H$.
Joint with Y. Benoist, we have established a geometric criterion which detects whether the regular representation of G in $L^2(X)$ is tempered. The proof employs analytic and dynamical approaches.
Moreover, we have given a complete description for which $L^2(X)$ is tempered by algebraic and combinatorial method.
If time permits, I would like to discuss also its relations with deformation of Lie algebras, and with geometric quantization from the orbit philosophy.
Reference:
Y. Benoist and T. Kobayashi, Tempered Homogeneous Spaces I (J. Euro. Math, 17 (2015), 3015–3036); II (Margulis Festschrift, Univ Chicago Press, to appear, available also at arXiv 1706.10131); III (preprint 2020, arXiv 2009.10389); IV (preprint 2020, arXiv 2009.10391).

March 17th (Wed) Conference Room VI

9:00–10:45

7 Yuta Enami (Niigata Univ.) Z Range preserving maps between spaces of vector-valued continuous functions · · · · · 15

Summary: Let X, Y be compact Hausdorff spaces, and let E be a locally convex topological space. The spaces of all continuous function on X and Y with values in E are denoted by $C(X, E)$ and $C(Y, E)$, respectively. We give a characterization of maps $T : C(X, E) \to C(Y, E)$ satisfying $\mathrm{Ran}(TF - TG) \subset \mathrm{Ran}(F - G)$ for every $F, G \in C(X, E)$.

8 Shiho Oi (Niigata Univ.) Z 2-local isometries on commutative Banach algebras · · · · · 15

Summary: In this talk, we consider 2-local isometries (without assuming linearity) on Banach algebras. Firstly we generalize the Kowalski–Słodkowski theorem. Then as a corollary, we conclude that every 2-local map in the set of all surjective isometries on a certain function space is in fact a surjective isometry. This gives an affirmative answer to a problem on 2-local isometries posed by Molnár.

9 Norio Niwa (Nihon Univ.) Z
Takeshi Miura (Niigata Univ.) Surjective isometries on a Lipschitz space of analytic functions on the open unit disc · · · · · 15

Summary: We will talk about surjective isometries on a Lipschitz space of analytic functions on the open unit disc.

10 Keiichi Watanabe (Niigata Univ.) Z On mappings between Möbius gyrovector spaces induced from bounded linear operators · · · · · 15

Summary: I would like to mention here that bounded linear operators naturally raise mappings between Möbius gyrovector spaces.

11 Yuki Seo (Osaka Kyoiku Univ.) Z Ando–Hiai type inequalities for deformed means 15

Summary: In this talk, for an n-tuple of positive invertible operators on a Hilbert space, we present Ando–Hiai type inequalities for deformed means from an n-variable operator mean by an operator mean. As an application, we show Ando–Hiai type inequalities for the operator power mean in terms of the generalized Kantorovich constants under the operator order.

12 György Pál Gehér (Univ. of Reading) Z
Michiya Mori (Univ. of Tokyo)
The structure of maps on the space of all quantum pure states that preserve a fixed quantum angle 15

Summary: Let H be a Hilbert space and $P(H)$ be the space of all quantum pure states, that is, the collection of all rank-one projections. Wigner's theorem states that every surjective isometry $\phi\colon P(H) \to P(H)$ is automatically induced by either a unitary or an antiunitary operator $U\colon H \to H$. Uhlhorn's theorem generalises this result for bijective maps ϕ that are only assumed to preserve the distance 1 (orthogonality) in both directions. In this talk we explain the general form of bijections $\phi\colon P(H) \to P(H)$ that preserves a fixed distance $0 < c \leq 1$ in both directions, in full generality.

13 Saburou Saitoh (Gunma Univ.*/Inst. of Reproducing Kernels)
Hiroshi Okumura
Some new type Laurent expansions and division by zero calculus; Spectral theory ..... *

Summary: In this talk we introduce a very interesting property of the Laurent expansion in connection with the division by zero calculus and Euclid geometry by H. Okumura. The content may be related to analytic motion of figures. We will refer to some similar problems in the spectral theory of closed operators.

14 Takashi Shimomura (Nagoya Univ. of Economics) Bratteli–Vershik model from basic set ..... *

Summary: Bratteli diagrams are studied as Bratteli–Vershik models in zero-dimensional dynamical systems study. Herman, Putnam and Skau (1992) established this work in Cantor minimal case. Medynets (2006) extended the work to aperiodic zero-dimensional systems. restricting to topological dynamics and following Downarowicz and Karpel (2019), we extended to all zero-dimensional cases. For this, we introduce 'quasi-section', in place of basic sets. We have shown that there exists one-to-one correspondence between certain essential equivalence classes of decisive Bratteli diagrams and certain topological conjugacy classes of triples of zero-dimensional systems with quasi-sections. Furthermore, there exists one-to-one correspondence between certain essential equivalence classes of decisive Bratteli diagrams with closing property and certain topological conjugacy classes of triples of zero-dimensional systems with basic sets.

15 Yusuke Isono (Kyoto Univ.) Boundary and rigidity of nonsingular Bernoulli actions ..... *

Summary: Let G be a countable discrete group and consider a nonsingular Bernoulli shift action $G \curvearrowright \prod_{g\in G}(\{0,1\},\mu_g)$ with two base points. When G is exact, under a certain finiteness assumption on the measures $\{\mu_g\}_{g\in G}$, we construct a boundary for the Bernoulli crossed product C*-algebra that admits some commutativity and amenability in the sense of Ozawa's bi-exactness. As a consequence, we obtain that any such Bernoulli action is solid. This is joint work with Kei Hasegawa and Tomohiro Kanda.

16 Taro Sogabe (Kyoto Univ.) A topological invariant for continuous fields of Cuntz algebras ..... *

Summary: We introduce a topological invariant of the bundles of the Cuntz algebras. The Cuntz algebra with n+1 generators is an example of the Kirchberg algebra, and their bundles are classified by 2nd cohomology with Z/nZ coefficient when the base space of the bundles is a CW-complex whose dimension is less than 3. In general, we can construct a topological invariant of the bundles using Dadarlat–Pennig's generalized cohomology group. In this talk, we give a characterization of the invariant using the bundles of another C*-algebra which is the tensor product of the infinite Cuntz algebra and the n by n matrix algebra.

17 Yasuo Iida (Kanazawa Med. Univ.) The Zygmund F-algebra on the upper half plane ····· ∗

Summary: For $\alpha > 0$, the class $N\log^{\alpha} N(U)$ is the set of all holomorphic functions f on the unit disk U satisfying

$$\sup_{0\le r<1}\int_T \varphi_\alpha\left(\log(1+|f(r\zeta)|)\right)\,d\sigma(\zeta) < +\infty,$$

where $\varphi_\alpha(t) = t\{\log(c_\alpha + t)\}^\alpha$ for $t \ge 0$ and $c_\alpha = \max(e\,,\, e^\alpha)$. This class was introduced by A. Zygmund in his monograph and becomes an F-algebra with a natural metric on the class. Therefore this class is called *the Zygmund F-algebra*. In this talk we shall introduce the class $N\log^{\alpha} N(D)$ on the upper half plane $D = \{z \in \mathbf{C} \,|\, \mathrm{Im}\, z > 0\}$ and characterize some properties on this class.

11:00–12:00 Award Lecture for the 2020 MSJ Analysis Prize

Kengo Matsumoto (Joetsu Univ. of Edu.) Z Continuous orbit equivalence, topological conjugacy of symbolic dynamical systems and C*-algebras

Summary: We characterize three equivalence relations, continuous orbit equivalence, eventual conjugacy and topological conjugacy of one-sided topological Markov shifts, in terms of their Cuntz–Krieger C*-algebras, their gauge actions, their C*-subalgebras, and their continuous full groups. (Main ingredient is due to joint work with Hiroki Matui (Chiba University)). We also refer to characterizations of flow equivalence, topological conjugacy of two-sided topological Markov shifts in terms of C*-algebras. Finally we talk about generalization of theses results to some class of subshifts.

14:30–15:30 Talk Invited by Functional Analysis Section

Norio Nawata (Osaka Univ.) Z Simple stably projectionless C*-algebras

Summary: A C*-algebra A is said to be *stably projectionless* if $A \otimes M_n(\mathbb{C})$ has no non-zero projections for any $n \in \mathbb{N}$. Kishimoto and Kumjian showed that a large class of simple stably projectionless C*-algebras arises as continuous crossed products of Kirchberg algebras by $\mathbb{R}$. More generally, we see that many simple stably projectionless C*-algebras can be realized as continuous crossed products of stably finite C*-algebras by recent progress of the classification of nuclear C*-algebras. Hence we believe that simple stably projectionless C*-algebras will play important roles of the study of flows (or one-parameter automorphism groups) on C*-algebras in the future.

In this talk, we survey the study of simple stably projectionless C*-algebras. Also, we consider a characterization of the Razak–Jacelon algebra $\mathcal{W}$, which is an interesting example of simple stably projectionless C*-algebras and considered as a stably finite analog of the Cuntz algebra $\mathcal{O}_2$.

Statistics and Probability

March 15th (Mon) Conference Room VII

10:00–12:00

1 Yuki Ueda (Nat. Inst. of Tech., Ichinoseki Coll.) Z Free extreme value theory and its development ····· 15

Summary: In 2006, Ben Arous and Voiculescu investigated the maximum (in the Ando's sense) of freely independent selfadjoint operators. One of the most important concepts in free extreme value theory is the free extreme value distribution which is characterized by three type: Fréchet, Gumbel, Weibull. In this talk, we introduce free extreme value theory, related field and its development.

2 Ikkei Hotta (Yamaguchi Univ.) Z On freely quasi-infinitely divisible distributions ····· 15
Wojciech Młotkowski (Wrocław Univ.)
Noriyoshi Sakuma (Aichi Univ. of Edu.)
Yuki Ueda (Nat. Inst. of Tech., Ichinoseki Coll.)

Summary: We shall introduce freely quasi-infinitely divisible (for short, FQID) distributions on $\mathbb{R}$ inspired by classical quasi-infinitely divisible distributions. The FQID distributions are characterized by the free Lévy–Khintchine type representation with a signed Lévy measure. Based on the representation form, we obtain some examples and distributional properties of FQID distributions. Moreover, a few interesting facts are observed, which cannot hold in the classical setting; some FQID distribution admits a negative Gaussian part; total mass of the signed Lévy measure for some FQID distribution may be negative.

3 Johannes Jaerisch (Nagoya Univ.) Z Mixed Birkhoff spectra of one-dimensional Markov maps ····· 15
Hiroki Takahasi (Keio Univ.)

Summary: For Markov maps of the interval with countably many branches and finitely many neutral periodic points, we establish a conditional variational formula for the mixed multifractal spectrum of Birkhoff averages of countably many observables, in terms of the Hausdorff dimension of invariant probability measures.

4 Jean-Dominique Deuschel (Tech. Univ. Berlin) Z Quenched tail estimate for the random walk in random scenery II ···· 10
Ryoki Fukushima (Univ. of Tsukuba)

Summary: This is a continuation of our earlier work [Stochastic Processes and their Applications, 129(1), pp.102–128, 2019] on the random walk in random scenery. We complete the picture of upper deviation of the random walk in random scenery, and also prove a bound on lower deviation probability.

5 Naotaka Kajino (Kobe Univ.) Z An elementary proof of walk dimension being greater than two for Brownian motion on Sierpiński carpets ····· 15

Summary: The purpose of this talk is to present, on the basis of `arXiv:2005.02524`, the speaker's recent elementary self-contained proof of the fact that the walk dimension of the Brownian motion on an *arbitrary* generalized Sierpiński carpet is greater than two, no proof of which in this generality had been available in the literature. Our proof is based solely on the self-similarity and hypercubic symmetry of the associated Dirichlet form and on several very basic pieces of the theory of regular symmetric Dirichlet forms.

6 Makoto Nakashima (Nagoya Univ.) Z
Shuta Nakajima (Univ. of Basel)
Clément Cosco (Weizmann Inst. of Sci.)
Fluctuation in L^2-region for stochastic heat equation and KPZ equation in higher dimension 15

Summary: There have been recently several works studying the regularized stochastic heat equation (SHE) and Kardar–Parisi–Zhang (KPZ) equation in dimension $d \geq 3$ as the smoothing parameter is switched off. We prove that the fluctuations of the solutions of SHE and KPZ equation converge to the Edwards–Wilkinson in the full L^2-region, along with multidimensional convergence and general initial conditions.

7 Atsushi Takeuchi (Tokyo Woman's Christian Univ.) Z
Wasserstein distance of solutions to stochastic differential equations with jumps 15

Summary: Consider jump processes determined by stochastic differential equations with jumps. The goal in this talk is to study the estimate of the Wasserstein distance of the solutions. Moreover, the topics on the processes on the Riemannian manifold given by jump-type stochastic differential equations will be introduced as an application.

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

Dai Taguchi (Okayama Univ.) Z 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 field 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.

15:35–16:35 Talk Invited by Statistics and Probability Section

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

Summary: In Random Matrix Theory, historically, much of the focus is on the study of the set of eigenvalues in the limit of large dimension. Recently, there has also been substantial study of the behavior of other quantities related to matrices, such as eigenvector or their operator norm. This talk is about recent progress on the behavior of operator norm of multi matrix models in large dimension. Historically, the first results on the norm behavior of random matrices relied heavily on combinatorics and moment methods. However, these results worked only for single matrix models, and most results about the limiting behavior of the operator norm of random multi matrices required hard analysis, e.g. involving Stieltjes transform. Recently, together with Bordenave, we found a way to use moment techniques to study the operator norm of multi matrix models and obtained norm estimates for new classes of random matrices. I will review recent progress in this direction. This talk is based on work with Charles Bordenave.

March 16th (Tue) Conference Room VII

Morning

8 Saburou Saitoh (Gunma Univ.*/Inst. of Reproducing Kernels)
Tsutomu Matsuura (Gunma Univ.)
Hiroshi Okumura
Probability and stochastic analysis in reproducing kernels and division by zero calculus ..... *

Summary: Professor Rolin Zhang kindly invited in The 6th Int'l Conference on Probability and Stochastic Analysis (ICPSA 2021), January 5–7, 2021 in Sanya, China as a Keynote speaker and so, we will state the basic interrelations with reproducing kernels and division by zero from the viewpoint of the conference topics. The connection with reproducing kernels and Probability and Stochastic Analysis are already fundamental and well-known, and so, we will mainly refer to the basic relations with our new division by zero $1/0 = 0/0 = z/0 = \tan(\pi/2) = \log 0 = 0, [(z^n)/n]_{n=0} = \log z$, $[e^{(1/z)}]_{z=0} = 1$.

9 Yong Moo Chung (Hiroshima Univ.)
Multifractal formalism for multimodal maps ..... *

Summary: We consider a topologically exact smooth interval map with non-flat critical points and assume that the Lyapunov exponent is positive for each invariant probability measure. A formula is given which characterizes the Hausdorff dimension of the level set of time averages for a continuous function, and then the Birkhoff spectrum is continuous.

10 Toshihiro Uemura (Kansai Univ.)
Matsuyo Tomisaki (Nara Women's Univ.*)
Homogenization of symmetric Dirichlet forms ..... *

Summary: We consider a homogenization problem for symmetric jump-diffusion processes by using the Mosco convergence and the two-scale convergence of the corresponding Dirichlet forms. Moreover, we show the weak convergence of the processes.

11 Jian Ding (Univ. of Pennsylvania)
Ryoki Fukushima (Univ. of Tsukuba)
Ronfeng Sun (Nat. Univ. of Singapore)
Changji Xu (Harvard Univ.)
Geometry of the random walk range conditioned on survival among Bernoulli obstacles ..... *

Summary: Consider a discrete time random walk conditioned to avoid Bernoulli obstacles on the d-dimensional integer lattice. The random walk is known to localize in a ball of sub-diffusive size under the annealed law. Our result gives a more detailed geometric description of the range of the random walk. More precisely, we showed that it completely fills the ball where the walk is localized, and in addition we got a sharp estimate on the size of its boundary.

12 Jian Ding (Univ. of Pennsylvania)
Ryoki Fukushima (Univ. of Tsukuba)
Ronfeng Sun (Nat. Univ. of Singapore)
Changji Xu (Harvard Univ.)
Biased random walk conditioned on survival among Bernoulli obstacles: subcritical phase ..... *

Summary: Consider a discrete time biased random walk conditioned to avoid Bernoulli obstacles on the d-dimensional integer lattice. In the case of no bias, the random walk is known to localize in a ball of sub-diffusive size under the annealed law. If we give a bias to the random walk, then the model is known to undergo a phase transition: for a large bias, the walk is ballistic whereas for a small bias, it is sub-ballistic. This phase transition was proved by Sznitman and later, Ioffe and Velenik studied the ballistic phase in detail. In the sub-ballistic phase, physicists conjectured that the walk is localized in a sub-diffusive scale as in the unbiased case, but it has not been proved. We prove this conjecture with a precise information on the behavior of whole path.

13 Hiroshi Tsukada (Kagoshima Univ.) Pathwise uniqueness and non-contact property of SDEs driven by Cauchy processes with drift ····· *

Summary: Let us consider one-dimensional stochastic differential equations (SDEs) driven by Cauchy processes with drift. In this talk, we give non-Lipschitz conditions on the diffusion coefficient under which the pathwise uniqueness of the solution to the SDEs holds. We also give sufficient conditions for the non-contact property of the solutions to the SDEs.

14 Satoshi Suzuki (Shimane Univ.) Optimality conditions and constraint qualifications for quasiconvex programming ····· *

Summary: In this talk, we study optimality conditions and constraint qualifications for quasiconvex programming. We introduce necessary and sufficient optimality conditions in terms of Greenberg–Pierskalla subdifferential, Martínez–Legaz subdifferential and generators. We investigate necessary and/or sufficient constraint qualifications for these optimality conditions.

15 Toshiharu Fujita (Kyushu Inst. of Tech.) On subproblems for Markov decision process with converging branch system ····· *

Summary: We consider a Markov decision process model with a converging branch system which is one of the nonserial transition systems. We have introduced recursive equations by using dynamic programming technique. In this study, we reconsider our results and give another approach to constructing subproblems.

16 Kento Egashira (Univ. of Tsukuba)
Kazuyoshi Yata (Univ. of Tsukuba)
Makoto Aoshima (Univ. of Tsukuba) Asymptotic properties of distance weighted discrimination in high-dimensional settings ····· *

Summary: While distance weighted discrimination (DWD) was proposed to improve the support vector machine in high dimensional settings, it is known that the DWD is quite sensitive to imbalanced ratio of sample sizes. In this talk, we investigate the DWD theoretically in high-dimensional settings. We first show that the DWD includes a huge bias caused by heterogeneity of covariance matrices as well as sample imbalance. We propose a bias corrected-DWD (BC-DWD) and show that the BC-DWD can enjoy consistency properties about misclassification rates.

17 Yugo Nakayama (Kyoto Univ.)
Kazuyoshi Yata (Univ. of Tsukuba)
Makoto Aoshima (Univ. of Tsukuba) Asymptotic properties of kernel PCA for high-dimensional data and application to outlier detection ····· *

Summary: The Mahalanobis distance is a conventional method of outlier detection. However, the Mahalanobis distance with conventional estimators does not work well in the HDLSS context. In this talk, we consider outlier detection as an application of the kernel principal component analysis (KPCA). We investigate asymptotic properties of the KPCA with the typical kernel functions such as the linear kernel and the Gaussian kernel. We give theoretical reasons why the Gaussian kernel is effective for classifying high-dimensional data. We give asymptotic properties of the KPCA in a general framework of the kernel functions. Finally, we check the performance of outlier detection by using numerical simulations and microarray data sets.

18 Ayaka Yagi (Tokyo Univ. of Sci.)
Takashi Seo (Tokyo Univ. of Sci.)
A new test statistic for two mean vectors with monotone missing data ..... *

Summary: Testing problem for the equality of two mean vectors with k-step monotone missing data is considered. For this problem, Yu et al. (2006) proposed the T^2-type test statistic and gave the approximation to the upper percentiles of this statistic. Its approximate null distribution in the form of an asymptotic expansion is derived by Yagi et al. (2018). In this talk, replacing a part of the above statistic, we propose a new test statistic, which is an extension of Onozawa et al. (2020) to the case of k-step. Further, we derive an asymptotic expansion for the distribution of new test statistic. Finally, by a Monte Carlo simulation, we numerically investigate the accuracy and asymptotic behavior of the proposed approximation of new test statistic and its transformed test statistics.

19 Yan Liu (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
Hernando Ombao
(King Abdullah Univ. of Sci. and Tech.)
Hypothesis testing for local Granger causality ..... *

Summary: We consider the hypothesis testing problem for the local Granger causality. We localize the original idea of Granger causality and construct a new measure based on locally stationary processes. To test the hypotheses, we divide them into two cases because of the different asymptotic theory. We propose two test statistics in both cases and elucidate the asymptotic distributions of them. The numerical results are also given.

20 Koji Tsukuda (Kyushu Univ.)
Asymptotic evaluation for moments of length of Pitman partition .... *

Summary: The Pitman sampling formula has been intensively studied as a distribution of random partitions. One of the objects of interest is the length $K(= K_{n,\theta,\alpha})$ of a random partition that follows the Pitman sampling formula, where $n \in \mathbb{N}$, $\alpha \in (0, \infty)$ and $\theta > -\alpha$ are parameters. In this presentation, we provide asymptotic evaluations for $\mathsf{E}[K^r]$ $(r = 1, 2, \ldots)$ under two asymptotic regimes. In particular, the goals of this study are to provide a finer approximate evaluation of $\mathsf{E}[K^r]$ as $n \to \infty$ than has previously been developed and to provide an approximate evaluation of $\mathsf{E}[K^r]$ as the parameters n and θ simultaneously tend to infinity with $\theta/n \to 0$.

March 17th (Wed) Conference Room VII

10:00–10:35

21 Xiao-Nan Lu (Univ. of Yamanashi) Z
Enumeration and classification of two-level circulant almost orthogonal arrays with strength 2 and bandwidth 1 15

Summary: Circulant almost orthogonal arrays (CAOAs) are a class of circulant arrays introduced by Lin, Phoa, and Kao [Ann. Stat., 45(6), 2483–2510, 2017] as designs for fMRI experiments. Recently, focusing on the case $n \equiv 2 \pmod 4$, Lu, Mishima, Miyamoto, and Jimbo [to appear in J. Statist. Plann. Inference] intensively studied $k \times n$ two-level CAOAs with strength 2 and bandwidth 1 (simply, CAOA$(n, k, 2, 2, 1)$) and showed that such CAOAs with $k > n/2$ are equivalent to a special type of sequences proposed in information theory. I will talk about some results on the enumeration and classification of such CAOA$(n, k, 2, 2, 1)$ with $n \equiv 2 \pmod 4$ and $k > n/2$ for some small n.

22 Hiromu Yumiba (Int. Center for Academic Exchange) [Z] E_A^*-optimal balanced third-order designs of resolution $R^*(\{10,01\})$ with $N < \nu(m)$ for 3^m factorials 15
Eiji Taniguchi (Ikeda High School)
Yoshifumi Hyodo (Okayama Univ. of Sci.)

Summary: We consider a E^*-optimal 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 $\sigma^2 S_T$ be the total variance of the estimators concerning with all the main effects based on T. If $S_{T_0} \leq S_T$ for any T, then T_0 is said to be E_A^*-optimal, where T_0 is a E^*-optimal 3^m-BTO design of resolution $R^*(\{10,01\})$. In this talk, we give E_A^*-optimal 3^m-BTO designs of resolution $R^*(\{10,01\})$ derived from $SA(m;\{\lambda_{xm-x-yy}\})$'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.

10:55–11:55 Talk Invited by Statistics and Probability Section

Shoko Chisaki (Osaka Inst. of Tech.) [Z] Design of experiments and their application to deep learning

Summary: Dropout is a method of deep learning by invalidating nodes with randomly for each layer in the multi-layer neural network. And it deletes a random sample of activations (nodes) to zero during the training process. A random sampling of nodes causes more irregular frequency of dropout edges. There is a similar sampling concept in the area of design of experiments. In this talk, I will introduce a combinatorial design that drops out nodes from each layer. This design balances the edge frequencies. I will talk about analyze and construct such designs.

14:15–15:00

23 Yuichi Goto (Waseda Univ.) [Z] Likelihood ratio processes under non-standard settings 15
Takuya Kaneko (Waseda Univ.)
Soichiro Kojima (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)

Summary: In this talk, we investigate likelihood ratio (LR) processes under non-standard settings. First, A curved Gaussian family and a simultaneous equation system are discussed. We show that both models have the local asymptotic normal (LAN) property. Hence, we can construct optimal inference and testing methods based on LAN property. Second, one-way random ANOVA models are scrutinized. We elucidate that the LR process of this model has unusual limit distributions that depend on the contiguity orders. Consequently, the ordinary optimal theory based on LAN property is not available. By Neymann–Pearson framework, we show the test based on LR is asymptotically most powerful.

24 Yuta Koike (Univ. of Tokyo) [Z] High-dimensional central limit theorems for homogeneous sums 15

Summary: This study develops a quantitative version of de Jong's central limit theorem for homogeneous sums in a high-dimensional setting. More precisely, under appropriate moment assumptions, we establish an upper bound for the Kolmogorov distance between a multi-dimensional vector of homogeneous sums and a Gaussian vector so that the bound depends polynomially on the logarithm of the dimension and is governed by the fourth cumulants and the maximal influences of the components. As a corollary, we obtain high-dimensional versions of fourth moment theorems, universality results and Peccati–Tudor type theorems for homogeneous sums.

Summary: The least absolute shrinkage and selection operator (LASSO) is a popular technique for variable selection and estimation in linear regression models. Introduction of information criteria for LASSO can decrease the computational cost efficiently. So far the forms of some classic information criteria for LASSO are derived. In fact, there exists some regression matrix such that the ordinary LASSO may not select the correct model efficiently even by information criteria. In such situation, modified LASSO approach was introduced. In this talk, we introduce two forms of Akaike information criterion (AIC) based on modified LASSO estimation to help find the optimal tuning parameters for prediction and variable selection purposes respectively. The properties of those two forms are shown and a simulation study comparing these two forms is conducted.

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

Rie Enomoto (Seikei Univ.)[z] Consistency properties of some information criteria in the growth curve model under a high-dimensional framework

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.

Applied Mathematics

March 15th (Mon) Conference Room VIII

Morning

1 Ayaka Ishikawa (Yokohama Nat. Univ.) A family of graph quantum walks associated with the Sato zeta function ..... *

Summary: The spectrum of the transition matrix of a quantum walk is important to study the dynamics. Konno and Sato showed that the spectrum of the Grover transition matrix for a finite graph is given by the Sato zeta function. In this paper, we introduce a new family of quantum walks on a finite graph whose spectra are given by the Sato zeta function.

2 Iwao Sato (Oyama Nat. Coll. of Tech.)
Norio Konno (Yokohama Nat. Univ.)
Takashi Komatsu (Univ. of Tokyo)
Zeta functions with respect to general coined quantum walk of periodic graphs ..... *

Summary: We define a zeta function of a graph by using the time evolution matrix of a general coined quantum walk on it, and give a determinant expression for the zeta function of a finite graph. Furthermore, we present a determinant expression for the zeta function of an (inifinite) periodic graph.

3 Takashi Komatsu (Univ. of Tokyo)
Norio Konno (Yokohama Nat. Univ.)
Iwao Sato (Oyama Nat. Coll. of Tech.)
Relationship between the Grover walk and the generalized Ihara zeta function ..... *

Summary: In 2015, Chinta, Jorgenson and Karlsson gaved a generalized version of the determinant formula for the Ihara zeta function associated to finite or infinite regular graphs. On the other hand, Konno and Sato obtained a formula of the characteristic polynomial of the Grover matrix by using the determinant expression for the second weighted zeta function of a finite graph. In this talk, we consider a relationship between the Grover walk and the generalized Ihara zeta function. That is to say, we treat the generalized Ihara zeta function of the one-dimensional integer lattice as a limit of the Ihara zeta function of the cycle graph.

4 Sho Kubota (Yokohama Nat. Univ.)
Hiroto Sekido (Yokohama Nat. Univ.)
Harunobu Yata (Yokohama Nat. Univ.)
Periodicity of a quantum walk defined by mixed cycles ..... *

Summary: We study the periodicity of the quantum walk defined by mixed cycles using the model introduced by Kubota–Segawa–Taniguchi. This model is uniquely determined by a digraph and a parameter η. To study periodicity, we need to consider eigenvalues of the η-Hermitian adjacency matrices. First, we show that all mixed cycles are periodic if $\eta = \pi/2$. Next, we provide what we currently know on eigenvalues of the η-Hermitian adjacency matrices of mixed cycles for general η.

5 Chusei Kiumi (Yokohama Nat. Univ.)
Kei Saito (Kanagawa Univ.)
Time-averaged limit measures of two-phase quantum walks with one defect ..... *

Summary: Quantum walks, the quantum mechanical counterpart of classical random walks, have been actively studied since the 2000s, mainly in the field of quantum information. Quantum walks have an interesting property called localization, which is not found in classical random walks. In this study, we researched deeply about localization by analyzing their time-averaged limit measures on a one-dimensional line. In particular, we focus on a model called two-phase quantum walks with one defect, including both one-defect and two-phase quantum walks, which have been intensively studied From an applied mathematical perspective.

6 Takako Endo(Watanabe) (Yokohama Nat. Univ.) Eigenvalues of the discrete-time quantum walks in one dimension ···· ∗

Summary: Existence of the eigenvalues of the discrete-time quantum walks is deeply related to localization of the walks. We revealed the distributions of the eigenvalues of the discrete-time quantum walks in one dimension.

7 Akihiro Narimatsu (Yokohama Nat. Univ.), Masahiro Asano (Yokohama Nat. Univ.), Norio Konno (Yokohama Nat. Univ.) About the time-averaged limit measure of the Grover walk on the 2-dimensional lattice ····· ∗

Summary: The Grover walk is a model that has many applications, including the quantum search algorithm. In this study, we calculated the time-averaged limit measure of the Grover walk on the 2-dimensional lattice on the coordinate axis and revealed the order of the convergence.

8 Takuto Naito (Yokohama Nat. Univ.), Chusei Kiumi (Yokohama Nat. Univ.), Norio Konno (Yokohama Nat. Univ.), Sarato Takahashi (Yokohama Nat. Univ.) Recommendation models based on walks ····· ∗

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.

9 Ryota Hanaoka (Yokohama Nat. Univ.), Norio Konno (Yokohama Nat. Univ.) Return probability and evolution of the Riesz walk ····· ∗

Summary: We focus on the return probability of the Riesz walk, determined by the singular continuous measure. Furthermore, we present some conjectures on the self-similarity of the Riesz walk.

March 16th (Tue) Conference Room VIII

9:30–10:45

10 Shohei Satake (Kumamoto Univ.) [Z] On high-girth expander regular graphs of general degrees with localized eigenvectors ····· 15

Summary: The main aim of spectral graph theory is to study properties or structures of graphs using spectrum of their adjacency matrix. For regular graphs, Brooks and Lindenstrauss proved a bound for girth, the length of the shortest contained cycles, via localization of eigenvectors; later the bound was improved by Ganguly and Srivastava. Recently Alon, Ganguly and Srivastava (To appear in Israel J. Math.) gave an explicit construction of $(d+1)$-regular expander graphs for a prime d to show that the bound due to Ganguly and Srivastava is sharp.
In this talk, we extend their construction for general degrees, showing that the bound due to Ganguly and Srivastava is sharp for almost all degree cases.

11 Koji Imamura (Kumamoto Univ.) [Z], Keisuke Shiromoto (Kumamoto Univ.) Matroid representation over finite rings ····· 10

Summary: Matroids were introduced by H. Whitney to axiomatizing combinatorial properties of finite sets of vectors in a vector space. But it is known that there are many matroids which do not arise from vector space. The matoid representation theory is one of the most active areas of research in the subject. The purpose of our study is to give some representations of such matroids by using codes over finite rings. Using one of the generalizations of linearly independence, called modular independence, we actually show representations of matroids which are not representable over several finite fields.

Summary: Symmetric edge polytopes $\mathcal{A}_G$ are lattice polytopes arising from the root system A_n and finite simple graphs G. There is a connection between $\mathcal{A}_G$ and the Kuramoto synchronization model in physics. In particular, the normalized volume of $\mathcal{A}_G$ plays a central role. In this talk, we focus on a particular class of graphs. In fact, for any cactus graph G, we give a formula for the h^*-polynomial of $\mathcal{A}_{\widehat{G}}$ by using matching generating polynomials, where $\widehat{G}$ is the suspension of G. This gives also a formula for the normalized volume of $\mathcal{A}_{\widehat{G}}$. Moreover, via the chemical graph theory, we show that for any cactus graph G, the h^*-polynomial of $\mathcal{A}_{\widehat{G}}$ is real-rooted.

Summary: In this note, we show sharp upper bounds of the size of simple bipartite and tripartite 1-embeddable graphs on closed surfaces.

Summary: An edge of a 4-connected graph G is said to be 4-contractible if the contraction of it results in a 4-connected graph. Let x be a vertex of G having degree 4. An operation; (1) Delete x from G, and (2) Add a perfect matching on $N_G(x)$ is called "lifting". A vertex x is said to be 4-liftable if there is a lifting on x which results in a 4-connected graph. We denote $E_c(G)$ and $\mathcal{L}(G)$ the set of 4-contractible edges of G and the set of 4-liftable vertices of G, respectively. Let $W(G)$ denote the set of vertices of G having degree at least 5. We prove that if $|V(G)| \geq 6$, then $2|E_c(G)| + |\mathcal{L}(G)| \geq \max\{|V(G)| - |W(G)|, 2|W(G)|\}$.

Summary: It is always interesting to ask what a q-analog of something is. In studying the poset structure of alternating sign matrices, I came up with a series of three ideas as in the title. With the ideas of q-determinant and q-Vandermonde, I will show that the signed bigrassmannian polynomials of the symemtric group S_n is

$$\det_q(1) = \prod_{1 \leq i < j \leq n} (1 - q^{j-i})$$

as a q-analog of $\det(1) = 0$.

Summary: In this talk, we give an algebraic characterization of complete bipartite graphs, by using travel groupoid. Travel groupoid is an algebraic system introduced by Ladislav Nebeský as a generalization of an algebraic structure of geodetic graphs.

Summary: Let $\chi(F^2)$ be the Euler characteristic of a surface F^2. We characterize the set of graphs H of order at most 6 which satisfies the following: If G is a 5-connected graph embedded in a closed surface F^2 of face width at least $3|H| - 2\chi(F^2) - 5$ and H' is a subgraph of G isomorphic to H such that $G - H'$ has even order, then $G - H'$ has a perfect matching. An analogous result on near-perfect matching is given as well.

18 Shinya Fujita (Yokohama City Univ.)
Boram Park (Ajou Univ.)
The optimal proper connection number of a graph with given independence number ····· *

Summary: Some recent results concerning the optimal proper connection number in edge colored graphs will be reviewed.

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

Yoshio Sano (Univ. of Tsukuba) Z
Matroidal structures on partially ordered sets and related topics

Summary: A matroid is a combinatorial structure that abstracts the notion of independence. A *matroid* defined on a finite set E is a pair $(E, \mathcal{F})$ of the set E and a family $\mathcal{F}$ of subsets of E satisfying certain axioms. The notion of matroids is also important in the field of Combinatorial Optimization since matroid structure is closely related to efficient algorithms. There are several generalizations of matroids, like *supermatroids*, *pregeometries*, and *poset matroids*, each of which are matroidal structures defined on partially ordered sets. In this talk, we consider such matroidal structures defined on partially ordered sets. We present recent study on this topic and also show some relationships among such structures.

13:30–13:50 Presentation Ceremony for the 2020 MSJ Prize for Excellent Young Applied Mathematicians

March 17th (Wed) Conference Room VIII

9:40–10:45

19 Aoi Honda (Kyushu Inst. of Tech.) Z
Masayuki Itabashi (Kyushu Inst. of Tech.)
Simon James (Deakin Univ.)
Model interpretability of Moebius type inclusion-exclusion integral neural networks ····· 15

Summary: The Moebius type inclusion-exclusion integral is a representation of nonlinear integral with respect to nonadditive measures through the Moebius translation. We propose parameter estimation with backpropagation method of the Moebius type inclusion-exclusion integral mathematical model. Using this method, not only parameter determination but also data preprocessing can be performed automatically and the mathematical model can be interpreted. In this talk we show the performance of this method comparing with other neural network methods.

20 Hidenori Ogata (Univ. of Electro-Comm.) Z
Method of fundamental solutions for doubly-periodic potential flow and its invariance under unimodular transforms ····· 15

Summary: We propose a method of fundamental solutions for two-dimensional potential flow past a doubly-periodic array of obstacles. In our method, we approximate the solution by a linear combination of doubly-periodic potentials using the theta functions. Numerical examples show the effectiveness of our method. In addition, the approximation of our method is invariant under unimodular transforms, that is, the changes of basis of the doubly-periodic obstacle array.

21 Takuya Tsuchiya (Hachinohe Inst. of Tech.) Z
Ryosuke Urakawa
Gen Yoneda (Waseda Univ.)
Hi-precision numerical simulations of Einstein equations for gravitational collapse ····· 15

Summary: The Einstein equations are one of the governing equations of the general theory of relativity. These equations represent many phenomena in the universe. In particular, black holes are one of the most interesting phenomena. When the mass exceeds a certain threshold, the gravitational collapse occurs and a black hole is created. This time, we will simulate the process of gravitational collapse.

22 Hiroshi Fujiwara (Kyoto Univ.)[Z] Regularization for x-ray computerized tomography as the inverse source problem 15

Summary: In this talk we introduce a novel numerical approach to x-ray computerized tomography (x-ray CT) as the inverse source problem of the transport equation. The reconstruction procedure has been developed by A. L. Bukhigem et. al., and is involved with the Cauchy-type boundary integral representation. Because the problem is ill-posed in the sense of Hadamard, regularization is required in its numerical treatment. We introduce the natural regularization scheme for the procedure, and discuss the role of regularization parameters. Some numerical examples are also exhibit in the presentation. This work is based on the collaboration with Prof. A. Tamasan (University of Central Florida) and Prof. N. Oishi (Kyoto University).

23 Itsuki Watanabe (Waseda Univ.) Deterministic and stochastic models of nonlocal diffusion on inhomogeneous network ..... *

Summary: We discuss the difference of two mathematical models of nonlocal diffusion; the deterministic and stochastic models. The deterministic model is given by an integro-differential equation, and the stochastic model is given by a multi-dimensional jump Markov process. In this talk, we show two limit theorems. First, by the law of large numbers, we show that the difference between the deterministic and stochastic models converges to 0 in probability. Second, we consider the rescaled difference, and show it weakly converges to the Ornstein–Uhlenbeck process on the Skorokhod space.

24 Satoru Iwasaki (Osaka Univ.) Atsushi Yagi (Osaka Univ.*) Asymptotic convergence of solutions of Laplace reaction-diffusion equations ..... *

Summary: We study the initial-boundary value problem for a Laplace reaction-diffusion equation. After constructing local solutions by using the theory of abstract degenerate evolution equations of parabolic type, we show asymptotic convergence of bounded global solutions if they exist under the assumption that the reaction function is analytic in neighborhoods of their ω-limit sets. Reduction of degenerate evolution equation to multivalued evolution equation enables us to use the theory of the infinite-dimensional Łojasiewicz-Simon gradient inequality.

25 Hiroshi Ishii (Hokkaido Univ.) Shin-Ichiro Ei (Hokkaido Univ.) Interaction of front solutions for nonlocal reaction diffusion equation ..... *

Summary: We study the interaction of standing front solutions for scalar reaction diffusion equations with nonlocal effect in one space dimension. We consider the case that a nonlocal effect is given by the convolution with a suitable integral kernel. At first, we deduce the equation describing the movement of interacting front solutions in a mathematically rigorous way, assuming that there exists a linearly stable standing front solution. When the distances between localized patterns are sufficiently large, the motion of front solutions can be reduced to the equation for the distances between them. Finally, using this equation, we analyze the interaction of front solutions to some nonlocal scalar equation. We can show that the front solutions are interacting attractively for a large class of integral kernels.

26 Shin-Ichiro Ei (Hokkaido Univ.) Haruki Shimatani (Hokkaido Univ.) Ken Mitsuzono (Hokkaido Univ.) The dynamics of a pulse solution for reaction diffusion systems in multiple half-lines with a junction ..... *

Summary: We consider the dynamics of a pulse solution for generally reaction diffusion systems in Ω (we refer to Ω as Network-shaped domain) which is defined by $\Omega := \bigcup_{j=1}^{r} \Omega_j$ where $\Omega_j := \{x_j \in \boldsymbol{R};\, x_j > 0\}, j \in \boldsymbol{N}, 3 \leq r \in \boldsymbol{N}$. In this report, we show by using the theory of weakly interacting pulses and fronts for reaction diffusion systems by Ei (2002), Ei–Ishimoto (2013) that we could obtain several results of the above problem. Moreover we explain to the above dynamics holding Gray–Scott-model up as an example.

27 Takashi Teramoto (Asahikawa Medical Univ.)
Peter van Heijster (Queensland Univ. of Tech./Wageningen Univ. and Res.)
Traveling two pulse solutions in a three-component FitzHugh–Nagumo model ····· *

Summary: We use geometric singular perturbation techniques combined with an action functional approach to study traveling two-pulse solutions in a three-component FitzHugh–Nagumo model. First, we derive the profile of traveling 2-pulse solutions with undetermined widths and a propagating speed. Next, we compute the associated action functional for this profile from which we derive the explicit conditions for existence and a saddle-node bifurcation as the zeros of the action functional and its derivatives. From these we deduce a necessary condition for the existence of traveling 2-pulse solutions.

28 Yoshitaka Watanabe (Kyushu Univ.)
Takehiko Kinoshita (Saga Univ.)
Mitsuhiro T. Nakao (Waseda Univ.)
An improvement of constructive error estimation of approximate solution for biharmonic problems ····· *

Summary: This talk presents some improved constructive error estimations for two-dimensional biharmonic equations by using verified computational techniques. These estimations are expected to provide valuable information for computer-assisted proofs of nonlinear biharmonic problems. Several numerical examples that confirm the effectiveness are reported.

29 Syunsuke Kobayashi (Kyoto Univ./RIKEN)
Shigetoshi Yazaki (Meiji Univ.)
Finite difference discretization for the Kuramoto–Sivashinsky equation on expanding circle solution ····· *

Summary: We analyze a Crank–Nicolson type finite difference scheme for a Kuramoto–Sivashinsky equation on expanding circle solution. The exisetence, uniqueness and second-order error estimate of the numerical solution are shown. Furthermore, we also discuss linearization to the scheme by Newton's method, and prove second-order error estimates for this scheme as well.

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

Kohei Nakajima (Univ. of Tokyo) Z
Physical reservoir computing: pursuing the nature of information processing

Summary: Reservoir computing (RC) was first proposed as a framework to train recurrent neural networks. In this framework, a low-dimensional input is projected to high-dimensional dynamical systems, which are typically referred to as a reservoir. If the dynamics of the reservoir involve adequate nonlinearity and memory, emulating nonlinear dynamical systems only requires adding a linear, static readout from the high-dimensional state space of the reservoir. Because of its generic nature, RC is not limited to digital simulations of neural networks, and any high-dimensional dynamical system can serve as a reservoir if it has the appropriate properties. The approach using a physical entity rather than abstract computational units as a reservoir is called physical reservoir computing (PRC). Its various engineering applications have been proposed recently in all range of physics, from quantum and photonics to mechnaical scales. In this presentation, the focus will particularly be on how dynamical system aspects can provide a novel view of the RC/PRC framework. In addition, several platforms based on PRC are introduced using physical substrates and they illustrate the potentials of the framework through a number of experiments.

14:15–15:20

30 Ippei Obayashi (RIKEN/Kyoto Univ./Tohoku Univ.) [Z] Stable volumes for persistent homology 15

Summary: In this talk, I will discuss how to extract homological structures corresponding to birth-death pairs in a persistence diagram. In some previous works, the authors proposed the method to solve the problem by using optimization on homology algebra. However, these methods have the following two problems: (1) Sometimes the methods fail to capture minimal building blocks (2) The results are unstable against noises. In this talk, we will propose a new method, stable volumes, to improve the results.

31 Jonathan Jaquette (Boston Univ.) [Z] Global dynamics in a quadratic nonlinear Schrödinger equation 15
Jean-Philippe Lessard (McGill Univ.)
Akitoshi Takayasu (Univ. of Tsukuba)

Summary: In this talk, we consider a quadratic nonlinear Schrödinger equation (NLS) under the periodic boundary condition. We discuss the global dynamics of solutions to NLS and show some results of the existence of homoclinic and heteroclinic orbits, blow-up of solutions in finite time, periodic solutions, and the existence of infinite families of nontrivial unstable equilibria.

32 Takashi Sakajo (Kyoto Univ.) [Z] On a family of rotating equilibria of vortex sheets 15
Bartosz Protas (McMaster Univ.)

Summary: Vortex sheets are defined mathematically as the curves of discontinuity of 2D incompressible and inviscid flows. The governing equation is known as the Birkhoff–Rott equation, which contains a singular integral operator. In this talk, we consider relative equilibrium solutions of the stationary Birkhoff–Rott equation consisting of finite-length vortex sheets. Using methods of the theory of the Riemann–Hilbert problem, we construct a family of rotating equilibria of p straight vortex sheets rotating about a common center of rotation and with endpoints at the vertices of a regular polygon. The family of equilibrium not only contains a single rotating vortex sheet, but it also converges to a hollow vortex bounded by a vortex sheet in the infinite limit of p, which is another well-known steady solution to the two-dimensional Euler equations.

33 Takaaki Nishida (Kyoto Univ.*) [Z] Routes to chaos in Rayleigh–Bénard heat convection 15
Chun-Hsiung Hsia (Nat. Taiwan Univ.)

Summary: Bénard heat convection is described by the Oberbeck–Boussinesq equations. Rayleigh formulated it for fluids heated from the bottom in the horizontal strip domain with stress-free boundary conditions. Rayleigh number $\mathcal{R}_a$ and Prandtl number $\mathcal{P}_r$ are important parameters. When $\mathcal{R}_a$ increases, the heat convection (roll-type solutions, hexagonal cells etc.) bifurcates from the heat conduction state, which can be shown analytically. It is not known to treat analytically the solutions when $\mathcal{R}_a$ increases further. We show numerical computations to see the behavior of solutions such as transition from stationary to periodic and to chaos when $\mathcal{R}_a$ increases further.

March 18th (Thu) Conference Room VIII

9:40–10:45

34 Hideki Murakawa (Ryukoku Univ.) [Z]
Rhudaina M. Mohammad (Univ. of the Philippines Diliman)
Karel Svadlenka (Kyoto Univ.)
Hideru Togashi (Kobe Univ.)
A mathemtical model and a numerical method for the formation of epithelial tissues 15

Summary: Here we present a simple mathematical model for tissue morphogenesis together with a level set-based numerical scheme for its solution as a tool to rigorously investigate evolving cellular patterns. This combined framework of a model and a numerical method features minimum possible number of physical parameters and guarantees reliability of simulation results, including correct handling of topology changes, such as cell intercalations. Thanks to its simplicity and reliability, the model is able to capture the essence of biological phenomena, and may give a strong helping hand in deciphering unsolved questions of morphology.

35 Masaharu Nagayama (Hokkaido Univ.) [Z]
Atsushi Mori (Hokkaido Univ.)
Mamoru Okamoto (Hokkaido Univ.)
On a mathematical modeling for a self-propelled material by volume conservation reaction-diffusion systems 15

Summary: In this study, we propose a self-propelled material model using a Phase-Field model that has a volume conservation effect. By taking the singular limit in the one-dimensional problem, we confirm that the mathematical model proposed matches the camphor motion model. Then, in the two-dimensional problem, a self-propelled model with a change in shape is derived by taking the singular limit from the proposed mathematical model.

36 Jumpei Inoue (Waseda Univ.) [Z]
Kousuke Kuto (Waseda Univ.)
Impact of regional differences of recovery rates on the total population of infected in an SIS reaction diffusion model 15

Summary: This talk is concerned with an SIS reaction-diffusion model. Our mathematical result asserts that an inhomogeneous effect of the recovery rate makes the L^1 norm of the endemic equilibrium (the total population of the infected) become as large as possible. The proof is based on an application of our result on the ratio of the total population of the species and the total mass of the resources in a diffusive logistic equation.

37 Hiroko Yamamoto (Univ. of Tokyo) [Z]
Ayuki Sekisaka (Meiji Univ.)
The Evans function for reaction-diffusion equations with nonlocal effects 15

Summary: The phenomena with nonlocal effects have attracted attention in various fields. In particular, it is important to study the stability of traveling waves for nonlocal equations, and the stability is a key point in understanding phenomena. To consider the stability problem for nonlocal equations, we construct the Evans function based on the infinite dimensional Evans function theory.

38 Hirotada Honda (Toyo Univ.)
Continuous limit of neural network-based multiclass classification .... *

Summary: Recently, attention on studies on the continuous limit of neural network (NN) has been increasing. In this talk, we will discuss the continuous limit of multi-layer NN applied to multiclass classification by using the graph limit theory and the dynamical system.

39 Keiichi Ueda (Univ. of Toyama)
Application of autonomous pathfinding system to kinematics problems ..... *

Summary: We propose a network model to solve kinematics problems for robot arm manipulation. In our model, the physical constraints, the target position are represented by excitatory link connections. The model finds a new solution automatically when perturbations such as a change in the target position.

40 Akane Kawaharada (Kyoto Univ. of Edu.) Singular function derived from Rule150 ····· ∗

Summary: In this talk, we give a singular function on the unit interval derived from the dynamic of the one-dimensional elementary cellular automaton Rule150. We describe properties of the resulting function, that is strictly increasing, uniformly continuous, and differentiable almost everywhere.

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

Yukihiko Nakata (Aoyama Gakuin Univ.) Z Dynamics of delay differential equations from epidemic models

Summary: I would like to present our studies on the dynamics of delay differential equations, which have been motivated by mathematcal modelling of disease transmission dynamics. First, we revisit an SIRS type epidemic model, which describes individuals' reinfection due to non-permanent immunity. It is shown that reinfection epidemic models, including SIRS type epidemic models, exhibit phenomena that are not observed in a standard SIR model, which may suggest an interpretation, in the spread of diseases, of a role of the individual's immunity. To understand periodic outbreaks observed in an SIRS model, we derive a logistic equation with distributed delay and study the existence of a periodic solution whose period is exactly twice as long as the maximum delay. This study is generalized to a class of distributed delay differential equations. For a class of distributed delay differential equations, it is shown that the existence of a periodic solution, whose period is exactly twice as long as the maximum delay, can be studied by a hamiltonian system of ordinary differential equations, following an idea of Kaplan and York (1974). We discuss an explicit form of the periodic solution and dynamics of a distributed delay differential equation with a particular nonlinearity. Finally, I would like to introduce our results concerning a blow-up phenomenon in delay differential equations.

14:15–15:05

41 Kei Nishi (Kyoto Sangyo Univ.) Z Pulse bifurcations in a three-component FitzHugh–Nagumo system ··· 15
Yasumasa Nishiura (Hokkaido Univ.)

Summary: The pulse dynamics in a three-component FitzHugh–Nagumo system is considered both numerically and analytically. The system admits a pulse solution of bistable type, which exhibits a variety of interface dynamics, not observed for the two-component analogue. In the talk, we focus on the parameter regime $\alpha > 0$, $\beta < 0$, where there appear two types of pulse solutions, whose profiles are mutually inverted. By numerical simulations, it is found that the two types of pulses coexist for some parameter regime, and that transitions between them are observed if initial conditions are appropriately set. In order to analytically investigate the mechanism for these pulse behavior, we apply the multiple scales method to the original reaction-diffusion system, and derive four-dimensional ordinary differential equations which describe the motions of the pulse interfaces. The reduced ODEs enable us to reveal the global bifurcation structures of the pulse solutions, and clarify the mechanism for the transition behavior from a view point of the bifurcation theory.

Summary: Let us consider the situation where an exotic species invades the native two-species system and discuss the occurrence of competitor-mediated coexistence between two competing species U and V due to the invasion of W. Since we already know the existence and stability of traveling wave solution connecting two stable constant states in 2-component strong competition reaction diffusion system, we consider a 3-component extended competition system. The original 2-component traveling wave with no third species is again a trivial solution for the 3-component system as well. We focus on the stability change of this trivial traveling wave solution with respect to the intrinsic growth rate for the third species and study the bifurcation structure around it.

Summary: We consider traveling waves connecting two stable states for a 3-component competition-diffusion system under the strong competition condition. By constructing suitable supersolutions and subsolutions, we determine the sign of the speed of the traveling wave.

Topology

March 15th (Mon) Conference Room IX

10:00–11:00

1 Eri Matsudo (Nihon Univ.) Z Coloring links by symmetric group of order 3 10
Kazuhiro Ichihara (Nihon Univ.)

Summary: In this talk, we consider a coloring by symmetric group S_3 for a link, which we call a S_3-coloring. An S_3-coloring with n colors is denoted by an (S_3, n)-coloring. We focus on whether an $(S_3, 5)$-colorable link has a diagram with an $(S_3, 4)$-coloring. We show that all the $(S_3, 5)$-colorable 2-bridge links are $(S_3, 4)$-colorable. This is joint works with Kazuhiro Ichihara, Nihon University.

2 Ryuji Higa (Kobe Univ.) Z The intersection polynomials of a virtual knot 10
Takuji Nakamura (Univ. of Yamanashi)
Yasutaka Nakanishi (Kobe Univ.)
Shin Satoh (Kobe Univ.)

Summary: We define two kinds of invariants of a virtual knot called the first and second intersection polynomials. The definition is based on the intersection number of a pair of curves on a closed surface. We study several properties of the polynomials. By introducing invariants of virtual tangles, we give connected sum formulae of the intersection polynomials, and prove that there are infinitely many connected sums of any two virtual knots as an application. Furthermore, by studying the behavior under a crossing change, we show that the intersection polynomials are finite type invariants of order two, and find an invariant of a flat virtual knot derived from the the intersection polynomials.

3 Motoo Tange (Univ. of Tsukuba) Z The third term in lens surgery polynomials 15

Summary: We show that if lens space knot K in S^3 admits $n_3 = g - 2$, then the Alexander polynomial K coincides with the Alexander polynomial of a $(2, 2g + 1)$-torus knot. Here n_3 is the exponent of the third highest non-zero term of the Alexander polynomial and g is the Seifert genus of K.

4 Nobutaka Asano (Tohoku Univ.) Z 4-manifolds admitting simplified (2, 0)-trisections with prescribed vertical 3-manifolds 15

Summary: A trisection of Gay–Kirby is a decomposition of a closed 4-manifold into three 4-dimesional 1-handlebodies. They proved the existence of a trisection for any closed 4-manifold by constructing a stable map from the 4-manifold to the real plane, called a trisection map. We focus on the 3-manifolds obtained as the preimages of arcs on the real plane for simplified (2,0)-trisection maps, called vertical 3-manifolds. Any vertical 3-manifold is given as a connected sum of finite copies of six basic vertical 3-manifolds and $S^2 \times S^1$. We show that the 6-tuple of vertical 3-manifolds determines the source 4-manifold uniquely up to orientation reversing diffeomorphisms.

5 Keiji Tagami (Nat. Fisheries Univ.) Naturality of the dualizable patterns obtained from annulus presentations of knots ..... *

Summary: The 0-trace of a knot is the 4-manifold obtained from the 4-ball by attaching a 2-handle along the knot with 0-framing. There are some techniques to construct distinct knots with the same 0-trace, for example, Gompf–Miyazaki's dualizable patterns and Abe–Jong–Omae–Takeuchi's annulus presentations. Miller–Piccirillo constructed dualizable patterns from Abe–Jong–Omae–Takeuchi's annulus presentations, and explained the annulus presentations in terms of dualizable patterns. In this talk, we draw the duals of Miller–Piccirillo's dualizable patterns concretely. Moreover, we explain that Miller–Piccirillo's construction is natural.

6 Masakazu Teragaito (Hiroshima Univ.) Generalized torsion elements and hyperbolic links ····· ∗

Summary: In a group, a generalized torsion element is a non-identity element whose some non-empty finite product of its conjugates yields the identity. Such an element is an obstruction for a group to be bi-orderable. We show that the Weeks manifold, the figure-eight sister manifold, and the complement of Whitehead sister link admit generalized torsion elements in their fundamental groups. In particular, the Whitehead sister link, which is the pretzel link of type $(-2, 3, 8)$, can be generalized to hyperbolic pretzel links of type $(-2, 3, 2n)$ $(n \geq 4)$. These give the first examples of hyperbolic links whose link groups admit generalized torsion elements.

7 Toshiyuki Akita (Hokkaido Univ.) The adjoint group of a Coxeter quandle ····· ∗

Summary: We give explicit descriptions of the adjoint group of the Coxeter quandle Q_W associated with an arbitrary Coxeter group W. The adjoint group turns out to be an intermediate group between W and the corresponding Artin group, and fits into a central extension of W by a finitely generated free abelian group. In case Q_W is connected, we construct a 2-cocycle of W corresponding to the central extension. In addition, we prove that the commutator subgroup of the adjoint group is isomorphic to the commutator subgroup of W. Finally, we prove homology stability for some families of adjoint groups.

8 Atsushi Ishii (Univ. of Tsukuba) Twisted derivatives for multiple conjugation quandles ····· ∗
Tomo Murao (Waseda Univ.)

Summary: A multiple conjugation quandle is an algebraic structure derived from handlebody-knot theory. In this presentation, we introduce the twisted derivatives for multiple conjugation quandles. By using this, we can construct MCQ twisted Alexander invariants for handlebody-knots.

9 Kanako Oshiro (Sophia Univ.) Goeritz matrices and Dehn colorings of spatial graphs ····· ∗
Natsumi Oyamaguchi (Shumei Univ.)

Summary: For spatial graphs whose vertices are of even valency, we introduce Goeritz matrices and Dehn colorings of their diagrams. Both of Goeritz matrices and Dehn colorings give invariants of spatial graphs. We also show a relationship between Goeritz matrices and Dehn colorings.

10 Takayuki Morifuji (Keio Univ.) On simple Hurwitz groups and eta invariant ····· ∗

Summary: A Hurwitz group is a conformal automorphism group of a compact Riemann surface with precisely $84(g-1)$ automorphisms, where g is the genus of the surface. Our starting point is a result on the smallest Hurwitz group $PSL(2, 7)$ which is the automorphism group of the Klein surface. In this talk we generalize it to various classes of simple Hurwitz groups and discuss a relationship between the surface symmetry and spectral asymmetry for compact Riemann surfaces. To be more precise, we show that the reducibility of an element of a simple Hurwitz group is equivalent to the vanishing of the η-invariant of the corresponding mapping torus.

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

Hokuto Konno (Univ. of Tokyo) Z Gauge theory and diffeomorphism and homeomorphism groups

Summary: I will explain my recent collaboration with several groups that develops gauge theory for families. The main application is detection of homotopical difference between the groups of diffeomorphisms and homeomorphisms of 4-manifolds. After Donaldson's celebrated diagonalization theorem, gauge theory has given strong constraints on the topology of smooth 4-manifolds. Combining such constraints with Freedman's theory, one may find many non-smoothable topological 4-manifolds. Last year, 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. As a consequence, they detected non-smoothable topological fiber bundles of smooth 4-manifolds. The existence of such bundles implies that there is homotopical difference between the diffeomorphism and homeomorphism groups of the 4-manifolds given as the fibers. Moreover, recently, M. Taniguchi and myself extended the above idea to 4-manifolds with boundary. I will summarize these new movements in this talk.

March 16th (Tue) Conference Room IX

10:00–11:00

11 Naoki Kitazawa (Kyushu Univ.) Z Special generic maps and products of cohomology classes of manifolds admitting them ····· 15

Summary: Special generic maps are higher dimensional versions of Morse functions on closed manifolds with exactly two singular points, characterizing spheres topologically except 4-dimensional cases and 4-dimensional standard spheres. Canonical projections of unit spheres are also special generic and suitable manifolds represented as connected sums of products of standard spheres admit special generic maps into suitable Euclidean spaces. Special generic maps also restrict the topologies and the differentiable structures strongly in considerable cases. For example, so-called exotic spheres admit no special generic map in considerable cases. In this talk, as a new study, we study products of cohomology classes of manifolds admitting special generic maps.

12 Ramón Barral Lijó (Ritsumeikan Univ.) Z Devaney's definition of chaos for foliated spaces ····· 15

Summary: Devaney characterized chaos for maps $f : X \to X$ of a metric space with the following three conditions: 1) topological transitivity, 2) density of periodic orbits, and 3) sensitivity to initial conditions. It is known that in very general situations, condition (3) follows from (1) and (2). In this talk we will present the case of foliated spaces and, more generally, pseudo(semi)groups. We will show with simple examples that, in several situations, (3) does not follow from (1) and (2).

13 Naohiko Kasuya (Kyoto Sangyo Univ.) Z
Daniele Zuddas (Univ. of Trieste)
Contact structure on the boundary of a strongly pseudoconcave complex surface ····· 15

Summary: We establish the method of holomorphic handle attaching to the strongly pseudoconcave boundary of a complex surface. As a consequence, we prove that every closed connected co-oriented contact 3-manifold can be filled as the strongly pseudoconcave boundary of a compact complex surface.

Summary: A germ of mixed polynomial f is called of strongly mixed weighted homogeneous face type if the face functions are strongly mixed weighted homogeneous polynomials for all compact faces of its Newton polyhedron. In this talk we especially consider Newton non-degenerate mixed polynomials f for which the face functions are strongly mixed weighted homogeneous polynomials for all compact faces and some of them are of polar degree 0. For some examples of such mixed polynomials f, we announce that the strict transforms of the germs of the zero-sets of f to the canonical toric modifications are smooth of class C^1 and real analytically smooth outside of their exceptional divisors.

Summary: This talk concerns construction of smooth functions with good properties inducing given graphs as Reeb graphs: Reeb graphs of smooth functions of suitable classes are defined as graphs consisting of all connected components of preimages such that the vertex sets are the sets of all connected components of preimages containing singular points of the functions. Such studies were essentially started by Sharko in 2006 as important problems of the singularity theory of differentiable maps and its applications to geometry of manifolds. In this talk we construct explicit smooth functions on closed or open manifolds inducing given graphs as Reeb graphs.

Summary: We begin the topological study of foliations by isochrones in order to generalize Mitsumatsu's construction of a leafwise symplectic foliation of the 5-sphere and the related construction of a family of contact structures by the author.

Summary: We will discuss a characteristic class for deformations of foliations called the Fuks–Lodder–Kotschick class (FLK class for short). It seems unknown if there is a real foliation with non-trivial FLK class. Indeed, we will give some conditions to assure the triviality of the FLK class. On the other hand, there are transversely holomorphic foliations with non-trivial FLK class. We present an example and give a construction which generalizes it.

Summary: In condensed matter physics, topology takes much interest. Topological insulators have gapped bulk though have (gapless) surface states reflecting some topology of bulk (known as the bulk-boundary correspondence). Recently, this bulk-boundary correspondence has much generalized to include corner states in its relation with higher-order topological insulators. In this talk, we propose a classification table for topological invariants related to corner states, which can be seen as a classification table for (extrinsic) higher-order topological insulators. Our table is based on three things: the definition of topological invariants, a proof of their relation with corner states and the construction of explicit examples.

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

Naoki Fujita (Univ. of Tokyo)[Z] Newton–Okounkov bodies arising from cluster structures and associated toric degenerations

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 discuss relations among the following three kinds of constructions of toric degenerations: representation theory, Newton–Okounkov bodies, and cluster algebras. In the first part of this talk, we survey the theory of Newton–Okounkov bodies and its applications to geometry. In the second part, we study Newton–Okounkov bodies from the theory of cluster algebras. We relate Gross–Hacking–Keel–Kontsevich's toric degenerations of compactified cluster varieties with Newton–Okounkov bodies. In the third part, we focus on the case of flag varieties whose toric degenerations are closely related to representation theory. We connect two kinds of representation-theoretic polytopes (string polytopes and Nakashima–Zelevinsky polytopes) by tropicalized cluster mutations. We also discuss relations with combinatorial mutations which was introduced in the context of mirror symmetry for Fano varieties.

Infinite Analysis

March 17th (Wed) Conference Room I

10:30–12:00

1 Takashi Imoto (Nat. Inst. of Adv. Industrial Sci. and Tech.) Jun Sato (Ochanomizu Univ.) Tetsuo Deguchi (Ochanomizu Univ.) [z] The Bethe solutions in the two down-spin sector of the spin-1/2 massive XXZ spin chain 15

Summary: We exactly show the number of solutions with two-down spin in the massive regime of the periodic spin 1/2 XXZ spin chain in N sites. Every solution of the Bethe ansatz equations is characterized by a set of integers or half-integers, which we call the Bethe quantum numbers. We exactly derive them for all the solutions in the sector with two down-spins. We show that in a region of N and anisotropic parameter the number of two-string solutions is by two larger than the number predicted by assuming the string hypothesis, i.e., an extra pair of two-strings appears. We call it extra two-string solutions. We determine it exactly and also such regions where m two-string solutions collapse for any given positive integer m. In addition, we prove the completeness in this sector through enumeration of the Bethe quantum numbers.

2 Shinsuke Iwao (Tokai Univ.) [z] Free-fermionic presentation of stable Grothendieck polynomials 15

Summary: The stable (symmetric) Grothendieck polynomial is a K-theoretic analog of a Schur polynomial, which represents a Schubert variety in the K-theory of the Grassmannian. In this talk, I explain how to construct the stable Grothendieck polynomials in terms of boson-fermion correspondence. This result gives a simple presentation and understanding of algebraic properties of these K-theory-based symmetric polynomials.

3 Tatsuki Kuwagaki (Osaka Univ.) [z] Sheaf quantization from exact WKB analysis 15

Summary: I'll explain how to construct sheaf quantizations by using exact WKB analysis. This construction explains some underlying geometries of exact WKB analysis and related cluster coordinates.

4 Taichiro Takagi (Nat. Defense Acad. of Japan) Takuma Yoshikawa (Nat. Defense Acad. of Japan) [z] Geometric lifting of the integrable cellular automata with periodic boundary conditions 15

Summary: G. Frieden recently presented explicit formulas for the affine type A geometric crystal and its intertwiner, the geometric R-matrix, by using Grassmannians. This is a geometric lifting of the crystal of the so-called Kirillov–Reshetikhin modules and the associated combinatorial R-matrix, represented by semi-standard Young tableaux with rectangular shapes. Inspired by his work, we present a method to construct geometric lifting of the integrable cellular automata with periodic boundary conditions, known as the periodic box-ball system and its generalizations. In terms of totally positive Grassmannians, our main theorem claims that there is a unique positive real solution to an algebraic equation related to Lax matrices of the system, satisfying a 'periodic boundary condition'. The proof is based on Perron–Frobenius Theorem.

5 Akihito Yoneyama (Univ. of Tokyo) [z] Tetrahedron and 3D reflection equation from PBW basis of the nilpotent subalgebra of quantum superalgebras 15

Summary: The tetrahedron equation and 3D reflection equation are the 3-dimensional analogs of the famous Yang–Baxter equation and reflection equation, respectively. We study the solutions of them associated with transition matrices of PBW basis of the nilpotent subalgebra of quantum superalgebras. By considering the case of type A, we show that the seminal solution to the tetrahedron equation given by Bazhanov–Sergeev is reproduced as the transition matrix of rank 2. Also, by considering the case of type B, we show that new solutions to the 3D reflection equation are obtained, which are the second nontrivial solutions to it.

14:15–15:15

6 Kouichi Takemura (Ochanomizu Univ.) Z
Shoko Sasaki (Chuo Univ.)
Shun Takagi (Chuo Univ.)
Initial-value space of q-Painlevé equation and q-Heun equation ····· 15

Summary: We obtain the q-Heun equation by considering a linear q-difference equation associated with the q-Painlevé VI equation and the exceptional curves in the initial-value space of q-PVI.

7 Kouichi Takemura (Ochanomizu Univ.) Z
Shoko Sasaki (Chuo Univ.)
Shun Takagi (Chuo Univ.)
q-middle convolution and q-Painlevé equation ····· 15

Summary: A q-deformation of the middle convolution was introduced by Sakai and Yamaguchi. We apply it to a linear q-difference equation associated with the q-Painlevé VI equation. We investigate the symmetry in terms of the affine Weyl group.

8 Ryo Okawa (Kobe Univ.) Z
Yutaka Yoshida (Univ. of Tokyo)
Wall-crossing for vortex partition function and handsaw quiver varierty ····· 15

Summary: We study $2d$ $\mathcal{N}=(4,4)$ and $(2,2)$ vortex partition functions and give functional equations. These partition functions are defined by integrals over handsaw quiver varieties of type A_1. From this point of view, our formula is obtained by wall-crossing formula by Mochizuki, and these can be viewed as finite type version of similar functional equations for Nekrasov functions.

9 Takeo Kojima (Yamagata Univ.) Quadratic relations of the deformed W-superalgebra $\mathcal{W}_{q,t}(\mathfrak{sl}(2|1))$ ···· ∗

Summary: We revisit the free field construction of the deformed W-superalgebras $\mathcal{W}_{q,t}(\mathfrak{sl}(2|1))$ by J. Ding and B. Feigin, *Contemp. Math.* **248**, 83–108 (1998), where the basic W-current and screening currents have been found. In this paper we introduce higher W-currents and obtain a closed set of quadratic relations among them. These relations are independent of the choice of Dynkin-diagrams for the superalgebra $\mathfrak{sl}(2|1)$, though the screening currents are not. This allows us to define $\mathcal{W}_{q,t}(\mathfrak{sl}(2|1))$ by generators and relations.

March 18th (Thu) Conference Room I

10:00–11:00 Talk Invited by Infinite Analysis Special Session

Genki Shibukawa (Kobe Univ.) Z
Let's play multivariate special functions!

Summary: I would like to talk about some multivariate special functions (e.g. Jack polynomials and their family) and how to play with "our friends" in relation to my recent research (Pieri type formulas for Jack polynomials and their applications, a multivariate analogue of some special functions). Throughout our talk, we hope ladies and gentlemen will become familiar with a multivariable analogue of special functions.

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

Tomoyuki Takenawa (Tokyo Univ. of Marine Sci. and Tech.) Z
Space of initial conditions and symmetries of higher-dimensional Painlevé systems

Summary: In recent years, research on higher-dimensional Painlevé systems have progressed mainly from the viewpoint of isomonodromy deformation of linear equations. In this talk we study the geometric aspects of higher-dimensional Painlevé systems by investigating the space of initial conditions in Okamoto–Sakai's sense, which was a powerful tool in the original two-dimensional case. Specifically, starting from known discrete symmetries, we construct the space of initial conditions for some four-dimensional Painlevé systems, and using the Néron–Severi bilattice, clarify the whole group of their discrete symmetries. This method is also valid in the q-discrte case.