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The Mathematical Society of Japan

2018 Autumn Meeting

Titles and Short Summaries of the Talks

September, 2018

at Okayama University

2018 The Mathematical Society of Japan

AUTUMN MEETING

Dates: September 24th (Mon)–27th (Thu), 2018

Venue: Tsushima Campus, Okayama University
2–1–1 Tsushima-naka, Kita-ku, Okayama-shi,
Okayama 700-8530 Japan

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Plenary Talks

September 25th (Tue) Kanemitsu Hall, 50th Anniversary Hall

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

Yuji Tachikawa (Univ. of Tokyo) Mathematics of the QFT, by the QFT, for the QFT ..... (16:45–17:45)

Summary: Quantum field theory (QFT) is a branch of theoretical physics where the quantum property of fields is studied, where a field stand for any physical entity extended through time and space. In this talk, I would like to illustrate three aspects of connections between QFT and mathematics though a number of examples:
- the first is to formulate QFT in a mathematical language, i.e. to find mathematics of QFT.
- the second is to obtain mathematical conjectures using the ideas of QFT, i.e. to derive mathematics by QFT,
- and the third is to apply existing mathematics in the analysis of QFT, i.e. to use mathematics for QFT.

Featured Invited Talks

September 24th (Mon)

Conference Room I

Hiroshige Shiga (Tokyo Tech) Complex analysis on Kleinian groups ····· (13:00–14:00)

Summary: A discrete subgroup of $\mathrm{PSL}(2,\mathbb{C})$ is called a Kleinian group. An element of $\mathrm{PSL}(2,\mathbb{C})$ is a conformal automorphism of the Riemann sphere and also it is a hyperbolic isometry on the hyperbolic 3-space. Hence, the theory of Kleinian makes significant contributions to complex analysis as well as to the hyperbolic geometry. In this talk, we discuss complex analytic properties related to Kleinian groups. In particular, we consider geometric function theoretic properties of regions of discontinuity of Kleinian groups and complex structures of deformation spaces of Kleinian groups.

Conference Room VIII

Guest Talk from Taiwan Mathematical Society

Shun-Jen Cheng (Academia Sinica) Representation theory of Lie superalgebras in the BGG category ····· (13:00–14:00)

September 26th (Wed)

Conference Room I

Tatsuo Suwa (Hokkaido Univ.*)$^{\flat}$ Relative Dolbeault cohomology and its application to the Sato hyperfunction theory ····· (13:00–14:00)

Summary: The Čech–de Rham cohomology together with its integration theory has been effectively used in various problems related to localization of characteristic classes. Likewise we may develop the Čech–Dolbeault cohomology theory and on the way we naturally come up with the relative Dolbeault cohomology. This cohomology turns out to be canonically isomorphic with the local (relative) cohomology of A. Grothendieck and M. Sato with coefficients in the sheaf of holomorphic forms so that it provides a handy way of representing the latter.

In this talk we present the theory of relative Dolbeault cohomology and give, as applications, simple explicit expressions of Sato hyperfunctions, some fundamental operations on them and related local duality theorems. Particularly noteworthy is that the integration of hyperfunctions in our framework, which is a descendant of the integration theory on the Čech–de Rham cohomology, is simply given as the usual integration of C^{∞} differential forms. Also the Thom class in relative de Rham cohomology plays an essential role in the scene of interaction between topology and analysis. This approach also yields a new insight into the theory of hyperfunctions and further leads to a number of results that cannot be achieved by the conventional way.

The talk includes a joint work with N. Honda and T. Izawa.

Conference Room IV

Shin Nayatani (Nagoya Univ.)$^{\flat}$ Maximization of the first eigenvalue of Laplacian and minimal surface ····· (13:00–14:00)

Summary: In this lecture, I will focus on recent progress on metrics that maximize the first eigenvalue of the Laplacian (under area normalization) on a closed surface. I first discuss Hersch–Yang–Yau's inequality (1970, 1980), which was the starting point of the above problem. This is an inequality indicating that the first eigenvalue (precisely, the product of it with the area) is bounded from above by a constant depending only on the genus of the surface. Then I overview the recent progress on the existence problem for maximizing metrics together with the relation with minimal surfaces in the sphere. Finally I will discuss Jacobson–Levitin–Nadirashvili–Nigam–Polterovich's conjecture, which explicitly predicts maximizing metrics in the case of genus two, and the affirmative resolution of it (joint work with Toshihiro Shoda).

Conference Room VIII

Yu Yasufuku (Nihon Univ.) Abelian varieties and arithmetic dynamics —Similarities and differences ····· (13:00–14:00)

Summary: In this talk, we survey some of the results in the field of arithmetic dynamics, focusing on problems which arise as analogs of theorems and conjectures for abelian varieties. More specifically, a central object of study in arithmetic dynamics is the orbit

$$\{P, \phi(P), \phi(\phi(P)), \phi(\phi(\phi(P))), \ldots\},$$

where $\phi : X \dashrightarrow X$ is a rational map of an algebraic variety X to itself defined over a number field k and P is a k-rational point of X. Because of the *formal* analogy between an orbit

$$P \mapsto \phi(P) \mapsto \phi(\phi(P)) \mapsto \phi(\phi(\phi(P))) \mapsto \cdots$$

(where each arrow is an application of ϕ) and the subgroup generated by a point in an abelian variety

$$O \mapsto P \mapsto 2P \mapsto 3P \mapsto \cdots$$

(where each arrow is an addition by P), one *could hope* that theorems and conjectures for abelian varieties over number fields hold when we restrict to a single orbit, even if the entire variety X does not have a group structure. We will explore this "hope" for questions concerning torsion points, Galois images, integral points, and intersections with subvarieties. We will find that sometimes the dynamical analog holds, sometimes the dynamical analog holds conditionally on deep conjectures, and sometimes the most natural dynamical analog fails completely and the revised analog remains open.

September 27th (Thu)

Conference Room I

Nakao Hayashi (Osaka Univ.) Inhomogeneous Dirichlet-boundary value problem for one dimensional nonlinear Schrödinger equations ····· (13:00–14:00)

Summary: We consider the inhomogeneous Dirichlet-boundary value problem for the cubic nonlinear Schrödinger equations on the half line. We present sufficient conditions of initial and boundary data which ensure asymptotic behavior of small solutions to the problem by using the classical energy method and factorization techniques.

Conference Room IX

Masanobu Taniguchi (Waseda Univ.) Introduction to time series analysis ····· (13:00–14:00)

Summary: There has been much demand for the statistical analysis of dependent observations in many fields, for example, economics, engineering and the natural sciences. A model that describes the probability structure of a series of dependent observations is called a stochastic process. The stochastic processes mentioned here are very widespread, e.g., non-Gaussian linear processes, long-memory processes, nonlinear processes and continuous time processes etc. For them we will develop not only the usual estimation and testing theory but also many other statistical methods and techniques, such as discriminant analysis, cluster analysis, nonparametric methods, higher order asymptotic theory etc. Optimality of various procedures is often shown by use of local asymptotic normality (LAN), which is due to LeCam. Applications of the theory are enormous.

Foundation of Mathematics and History of Mathematics

September 26th (Wed) Conference Room V

9:30–11:25

Summary: (1) Godel's L_α; continuum hypothesis is correct: one construction is presented
(2) $M == G/K$;; Homotopy equivalent ====> $M == G/K$;; homeomorphic:
(3) Some considerations on $L2(M)$ is presented:
(4) Derivation induces an auto-isomorphism:
(5) DIFF(H): H=======>H: DIFF(H)|U(H);H=====>H: DIFF(|U(H);SPEC(H)====>SPEC(H): U(H) ∂Ut;; unitary; $\supset$AUT(H)
(6) RVE: R<==========>SPEC(R)
↑ ↖↗
DIFF(R) AUT(R):G;G';G";

Summary: It is known that, under MA(σ-linked), a separable measure algebra forces MA(σ-linked). We extend it to MA for Todorcevic orderings $\mathbb{T}(X)$ for topological spaces X. If X is a second countable Hausdorff space, $\mathbb{T}(X)$ is a non-σ-linked ccc forcing. It is proved that, under MA, a separable measure algebra forces MA for all $\mathbb{T}(X)$ for second countable Hausdorff X.

Summary: Let $\mathbb{N}$ denote an infinite countable discrete space. Let $\mathbb{N}^\kappa$ denote the products of κ many copies of $\mathbb{N}$. We prove that it is undecidable in ZFC that there is an uncountable C^*-embedded discrete subset in $\mathbb{N}^{2^\omega}$. Moreover, we show that the existence of C^*-embedded discrete subset with cardinality κ in $\mathbb{N}^\kappa$ is depends on the choice of κ.

Summary: We show that if there is an extendible cardinal, then the mantle, the intersection of all ground models of the universe, must be the minimum ground model.

Summary: J. K. Truss showed that for all automorphism g on Rado graph, any other automorphisms can be described by product of just 3 conjugates of g in 2003. We call such number of products a width of automorphism groups. There is several result on width of automorphisms with some conditions obtained by using techniques of descriptive set theory. We talk on the way of the improvements of width of automorphisms of more general structures.

Summary: After introducing the notion of geometric isomorphism of quantum 2-tori and the notion of Morita equivalence of coordinate algebras of quantum 2-tori, we examine the relation between the two notions.

Summary: In 1988, Hrushovski constructed pseudoplanes to refute a conjecture by Lachlan. Given an irrational number α with $1/2 < \alpha < 2/3$, he defined a function f on the positive real numbers similar to log functions. He defined a class K of finite graphs using this function f, and constructed a generic structure M of K. His construction is valid for any real number α with $0 < \alpha < 1$. Our main result is the following: Suppose α is a rational number with $0 < \alpha < 1$. Let M be the generic structure described above. Then the theory of M is model complete. We are going to discuss also on the automorphism group of M.

Summary: In this talk, we want to explain some result which says that if Hrushovski's pseudoplane is model complete then there is a strictly stable generic structure whose theory is not omega-categorical and has finite closures.

14:15–16:15

Summary: In this presentation, we shall define a BCK-algebra with the condition (I), and prove some properties of this notion, and discuss the relationship between the existence of commutative elements and the existence of infomums in BCK-algebra. Then, we show the two characterizations; a BCK-algebra with Canonical Condition (I) are equivalent to a commutative BCK-algebra; and a BCK-algebra with Condition (I) are a lower semi-lattice with respect to the operation $\times$.

Summary: The disjunction and existence properties in intermediate predicate logics were revealed to be independent in our previous paper. In that paper, we introduced Z-normality, which is a weak variant of disjunction property in the setting of intermediate predicate logic. In this talk, we introduce another weak variant of disjunction property called sentential disjunction property, and report relations among disjunction property, sentential disjunction property, and Z-normality in intermediate predicate logics.

Summary: We prove that there exists a Rosser provability predicate whose provability logic is the modal logic **KD**. Also we prove that there exists a Rosser provability predicate whose provability logic includes the logic $\mathbf{KD} + (\Box p \to \Box\Diamond p)$ which is a proper extension of **KD**.

Summary: The Frege–Hilbert controversy over the foundations of geometry reveals the difference between Frege's philosophical standpoints and the basic assumptions of first-order logic, rather than the variance in their views about geometry. I will review the controversy and discuss the relationship between Frege's philosophical standpoints and some proposals of extensions and modifications of the first-order logic.

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 alternative rule to the Born rule for specifying the property of results of measurements in an operational way. In this talk, we investigate the consequences of our alternative rule from a physical point of view.

14 Kazuyuki Tanaka (Tohoku Univ.)
Li Wenjuan (Nanyang Tech. Univ.)
Modal μ-calculus and its one-variable hierarchy 15

Summary: Modal μ-calculus, introduced by Kozen, is an extension of propositional modal logic by adding the least and greatest fixpoint operators. In this talk, we review the historical and latest studies on the (semantical) strictness of several alternation hierarchies with respect to various transition systems, and then investigate the variable hierarchies. Among others, we show that the simple alternation hierarchy of the one-variable fragments of modal μ-calculus is strict over finitely branching transition systems.

15 Satoru Kuroda (Gunma Pref. Women's Univ.)
Forcing in bounded arithmetic for small complexity classes 15

Summary: We present Takeuti–Yasumoto style generic models of theories for classes ALOGTIME, LOGSPACE and NLOGSPACE.

16 Mika Shigemizu (Tokyo Metro. Univ.)
Toshio Suzuki (Tokyo Metro. Univ.)
Koki Usami (Tokyo Metro. Univ.)
Independent distributions on a multi-branching AND-OR tree of height 2 15

Summary: We investigate an AND-OR tree T and a probability distribution d on the truth assignments to the leaves. Tarsi (1983) showed that if d is an independent and identical distribution (IID) such that probability of a leaf having value 0 is neither 0 nor 1 then there exists an optimal algorithm that is depth-first. We investigate the case where d is an independent distribution (ID) and probability depends on each leaf. It is known that in this general case, if height is greater than or equal to 3, Tarsi-type result does not hold. It is also known that for a complete binary tree of height 2, Tarsi-type result certainly holds. We ask whether Tarsi-type result holds for an AND-OR tree of height 2.

16:30–17:30 Talk Invited by Section on Foundation and History of Mathematics

Kojiro Higuchi (Nihon Univ.) Computable prestructures

September 27th (Thu) Conference Room V

9:00–10:50

17 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics)
Poisson' "sloughs" in his final works in life, "A Study of Mathematical Physics" 15

Summary: We discuss the "sloughs" in A Study of Mathematical Physics by Poisson. In his books, he explodes the established theories in rivalry to Lagrange, Laplace, Fourier, Gauss, etc. who are the trailblazers of each arena and the leading scholars of mathematical physics. We think, these trials are "sloughs", and look for Poisson's thinking for newness of learning.

18 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics)
The celestial mechanics in conformity to the mathematical physics by Poisson 15

Summary: We discuss the verification of scientific newness on A Study of Mathematical Physics by Poisson. He belongs to the Laboratory of Longitude, and discusses the universal mechanics of about two hundred years ago, in which he emphasizes his standing arena not on the astronomy but on the mathematical physics. We introduce the then scientific-common-sense on some topics comparing with today's data.

19 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics)
The Poisson's integral owing to Legendre's formulae and his own 15

Summary: We discuss Poisson's integral of ellipsoid using the Legendre's formulae in his works. He tries his method of integral beginning with the paper 1802, and until at the last work, he appreciates fully Legendre's method. Without his method, Poisson says, he couldn't have succeeded in these sort of integrals, although he tries his own of ellipsoid. He adopts Lagrange's formulae only after five years since Legendre's table 1826.

20 Shotaro Tanaka * To express fractions into power series by Suida expansion ····· 15

Summary: The fraction $1/(z^2+1)$ has two singularities $z=i,-i$. Expand in $z=2i$. (1) Devide the domain into A: $0 \le |z-2i| < 1$, B: $1 < |z-2i| < 3$, C: $3 < |z-2i|$. (2) Decomposite it into partials: $(i/2)\{1/(z+i) - 1/(z-i)\}$. Ex. $1/(z+i) = 1/\{(z-2i)+3i\}$. Wada's formula: $1/(\Box - \triangle)^{p+1} = \Sigma(k = 1 \to \infty) d_p(k) \Box^{-p-k} \triangle^{k-1} (0 < |\triangle/\Box| < 1)$, where integers $p \ge 0$; $k \ge 1$; $d_p(k) \equiv (k+p-1)!/p!(k-1)!$, named Suida expansion. If $1/\{(z-2i)+3i\} = 1/\{(z-2i)-(-3i)\}^{0+1} = \Sigma(k=1\to\infty) d_0(k)(z-2i)^{-0-k}(-3i)^{k-1} (0 < |-3i/(z-2i)| < 1)$, then we have $\Sigma(k=1\to\infty)\ (-3i)^{k-1}(z-2i)^{-k} (3 < |z-2i|)$. If $1/\{3i-(-(z-2i))\}^{0+1} = \Sigma(k=1\to\infty) d_0(k)(3i)^{-0-k}(-(z-2i))^{k-1} (0 < |-(z-2i)/3i| < 1)$, then we have $\Sigma(k=1\to\infty) d_0(k)(-1)^{k-1}(1/3i)^k (z-2i)^{k-1}$ $(0 < |z-2i| < 3)$.

21 Ken Saito (Yokkaichi Univ.) Syntactic analysis of the whole text of Euclid's Elements (progress report) ····· 15

Summary: This is a progress report of the research presented in September 2016. Though the text of the *Elements* is extremely simple and monotonous Greek prose, it is not easy to provide all the necessary grammatical rules so that the syntactic tree of all the sentences can be constructed. We will show the results hitherto obtained.

22 Mitsuo Morimoto (Yokkaichi Univ./Sophia Univ.*) ♭ Preliminary Volume, and Volumes 1, 2 and 3 of the Taisei Sankei ···· 15

Summary: The Taisei Sankei (1683–1711) is a monograph of 20 volumes written by Seki Takakazu, Takebe Kata'akira and Takebe Katahiro. Volume 1, called Five Techniques, treats five fundamental operations on numbers, that is, addition, subtraction, multiplication, division and extraction of root. Both Volumes 2 called Miscellaneous Techniques and 3 called Various Techniques treat numbers and their calculations. Besides, Preparatory Volume which is placed in front of Volume 1, considers, among others, numbers. Because of elementary character, these volumes have been overlooked by many scholars. We shall discuss the inter-dependence among these volumes.

23 Toshio Harikae (Osaka Sangyo Univ.) On proportionality in "The Sea Island Mathematical Manual" ····· 15

Summary: In this talk, we will give some equations in "The Sea Island Mathematical Manual" by the calculation of rectangles instead of the similarity of triangles.

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

Kenichi Sato (Univ. of Electro-Comm.) SEKI Takakazu and his contemporary mathematicians

Summary: This paper introduces some Japanese mathematicians' connections in 17th century who were known as disciples of SEKI Takakazu. One of them, KURU Shigezane, was the first manuscript writer of SEKI's Kaihohnpen no Ho, 1683. The author points out that KURU was not only SEKI's disciple, but that of HASHIMOTO Masakazu in Kamigata area (i.e. Kyoto and Osaka). This relation suggests us that KURU should be a candidate who bridged the gap between the both schools of SEKI and HASHIMOTO, giving us the reason of the similarity of their mathematical works. On the other hand, we could identify KURU was a distant relative of TAKEBE Katahiro, referring the description of Kansei Choshu Shokafu, 1812. (TAKEBE's cousin married with KURU's older brother.) As a conclusion, these connections could clarify their circulations of mathematical works were relatively narrow than we thought.

12:00–12:30 Research Section Assembly

12:30–13:00 Mathematics History Team Meeting

Algebra

September 24th (Mon) Conference Room VIII

9:15–11:45

1 Shinya Kumashiro (Chiba Univ.)
Shiro Goto (Meiji Univ.*)
Ryotaro Isobe (Chiba Univ.)
The Gorenstein property and correspondences between trace ideals and birational finite extensions 10

Summary: The behavior of trace ideals and modules is explored in connection with the structure of the base ring and the ambient module. Firstly, over a commutative Noetherian ring, a characterization of a module for which every submodule is a trace module is given. Secondly, over an arbitrary commutative ring, correspondences between three sets, the set of trace ideals, the set of certain stable ideals, and the set of certain birational extensions of the base ring, are studied. The correspondences work very well, if the base ring is a Gorenstein ring of dimension one. As a conclusion, it is shown that with one extremal exception, the surjectivity of some correspondence characterizes the Gorenstein property of the base ring, provided the base ring is a Cohen–Macaulay local ring of dimension one.

2 Ryotaro Isobe (Chiba Univ.)
Shiro Goto (Meiji Univ.*)
Shinya Kumashiro (Chiba Univ.)
The structure of chains of Ulrich ideals in Cohen–Macaulay local rings of dimension one 10

Summary: The purpose of this talk is to investigate the behavior of chains of Ulrich ideals, in a one-dimensional Cohen–Macaulay local ring, in connection with the structure of birational finite extensions of the base ring. The notion of Ulrich ideals is a generalization of stable maximal ideals, which J. Lipman started to analyze in 1971. Because Ulrich ideals are a very special kind of ideals, it seems natural to expect that, in the behavior of Ulrich ideals, there might be contained ample information on base rings, once they exist. We focus our attention on the one-dimensional case, clarifying the relationship between Ulrich ideals and the birational finite extensions of the base ring.

3 Hiroki Matsui (Nagoya Univ.)
Remarks on a conjecture of Huneke and Wiegand 10

Summary: Huneke-Wiegand conjecture is, raughly saying, $M \otimes_R \mathsf{Hom}_R(M, R)$ has torsion for any non-free torsion-free finitely generated module M over a commutative Noetherian ring R. This conjecture is proved for hypersurface rings by Huneke and Wiegand and it is thought to be true for complete intersection rings. However, the conjecture is very much open and not known even in the case where M is an ideal. In this talk, I will give some equivalent statements of the conjecture and give another proof of Huneke–Wiegand theorem.

4 Akiyoshi Tsuchiya (Osaka Univ.)
Takayuki Hibi (Osaka Univ.)
Kazunori Matsuda (Kitami Inst. of Tech.)
Edge rings with 3-linear resolutions 10

Summary: In this talk, it is shown that the edge ring of a finite connected simple graph with a 3-linear resolution is a hypersurface.

Summary: It is known that every lattice polytope is unimodularly equivalent to a face of some reflexive polytope. A stronger question is to ask whether every $(0,1)$-polytope is unimodularly equivalent to a facet of some reflexive polytope. A large family of $(0,1)$-polytopes are the edge polytopes of finite simple graphs. In this talk, it is shown that, by giving a new class of reflexive polytopes, each edge polytope is unimodularly equivalent to a facet of some reflexive polytope. Furthermore, we extend the characterization of normal edge polytopes to a characterization of normality for these new reflexive polytopes.

Summary: In this talk, given arbitrary integers d and r with $d \geq 4$ and $1 \leq r \leq d+1$, a reflexive polytope $\mathcal{P} \subset \mathbb{R}^d$ of dimension d with depth $K[\mathcal{P}] = r$ for which its dual polytope $\mathcal{P}^\vee$ is normal will be constructed, where $K[\mathcal{P}]$ is the toric ring of $\mathcal{P}$.

Summary: Let S be the polynomial ring in n variables over a field K and H a bipartite graph with n vertices. We denote by $I(H)$ the edge ideal of H. We are interested in the structure of H when $S/I(H)$ is a "good" ring. In 2005, Hezrog and Hibi characterized Cohen–Macaulay bipartite graphs in terms of partially ordered sets. In 2007, Villarreal characterized unmixed bipartite graphs in terms of quasi-ordered sets.
In this talk, we introduce the notion of semi-unmixed graphs and investigate semi-unmixed bipartite graphs in terms of partially ordered sets. As a application, we investigate sequentially Cohen–Macaulay bipartite graphs. Moreover, we calculate the regularity of semi-unmixed bipartite graphs.

Summary: Let K be a field, H a finite distributive lattice, $\mathcal{R}_K[H]$ the Hibi ring defined over K on H and ω the canonical ideal of $\mathcal{R}_K[H]$. Since $\mathcal{R}_K[H]$ is a Noetherian normal domain, and ω is a divisorial ideal of $\mathcal{R}_K[H]$, we can consider the n-the power $\omega^{(n)}$ of ω in $D(\mathcal{R}_K[H])$ for each $n \in Z$. We call $\omega^{(-1)}$ the anticanonical ideal of $\mathcal{R}_K[H]$. In this talk, we introduce the notion "$q^{(n)}$-reduced sequence with condition N" and define a convex polytope for each $q^{(\pm 1)}$-reduced sequence with condition N. We show that the fiber cone of ω (resp. $\omega^{(-1)}$) is the sum of the Ehrhart rings defined by these convex polytopes and describe the analytic spread of ω (resp. $\omega^{(-1)}$) by the words of posets.

Summary: Lyubeznik and Smith introduced for a commutative ring R with prime characteristic and an R-module M the notion of a ring of Frobenius operators $\mathcal{F}(M)$ which is a noncommutative graded ring. Enescu and Yau noticed that the complexity of $\mathcal{F}(E)$ is an important object to study, where E is the injective hull of the residue field of R. They showed that the Frobenius complexities of the Segre product of polynomial rings with m and n variables over a field with characteristic p have limit $m-1$ as $p \to \infty$ if $m > n \geq 2$. Page generalized this result that if a Hibi ring is anticanonical level and is not Gorenstein, then the limit of the Frobenius complexity of the Hibi rings (base field changed) converges to the analytic spread of the anticanonical module minus 1. In this talk, we report that this fact hold true for arbitrary Hibi rings which is not Gorenstein and the answer the question of Page affirmatively.

10 Kohsuke Shibata (Okayama Univ.)
Kohji Yanagawa (Kansai Univ.)
Alternative polarizations of strongly stable ideals, and their Alexander duals · · · · · 10

Summary: Let $I \subset S = K[x_1, \ldots, x_n]$ be a strongly stable ideal whose generators have degree at most d. It is known that I admits the *alternative polarization* b-pol$(I) \subset K[x_{i,j} \mid 1 \leq i \leq n, 1 \leq j \leq d]$. We show that the Alexander dual ideal of b-pol(I) is b-pol(I^*) of some strongly stable ideal $I^* \subset K[x_1, \ldots, x_d]$, after switching the variable $x_{i,j} \longmapsto x_{j,i}$. This duality between I and I^* is in some sense known, but our construction has some advantage. We can described the Hilbert series of $H^i_{\mathfrak{m}}(S/I)$ by the graded Betti numbers of I^*. We also show that if S/I is Cohen–Macaulay then b-pol(I) is a *letterplace ideal* in the sense of Fløystad.

11 Akiko Yazawa (Shinshu Univ.)
The Lefschetz property for an algebra constructed from a graph · · · · · 10

Summary: Let $A = \bigoplus_{i=0}^{c} A_i$, $A_c \neq 0$, be a graded Artinian algebra. We say that A has the strong Lefschetz property if there exists an element $L \in A_1$ such that the multiplication map $\times L^{c-2i} : A_i \to A_{c-i}$ is bijective for each $i \in \{0, 1, \ldots, \lfloor \frac{c}{2} \rfloor\}$. In this presentation, we consider an algebra constructed from a graph. The algebra is defined to be the quotient algebra of the ring of the differential polynomials by the annihilator of F_Γ, where F_Γ is the weighted generating function for the spanning trees in Γ. For $n \leq 5$, we show the strong Lefschetz property for the algebra corresponding to the complete graph with n vertices.

12 Tadahito Harima (Niigata Univ.)*
Akihit Wachi (Hokkaido Univ. of Edu.)
Junzo Watanabe (Tokai Univ.*)
The strong Lefschetz property for complete intersections defined by products of linear forms · · · · · 10

Summary: We prove the strong Lefschetz property for certain complete intersections defined by products of linear forms, using a characterization of the strong Lefschetz property in terms of central simple modules.

13 Maiko Ono (Okayama Univ.)
Yuji Yoshino (Okayama Univ.)
On liftings of DG modules · · · · · 10

Summary: Let A be a non-negatively graded differential (DG) algebra over a commutative ring R, and $B = A\langle X | dX = t\rangle$ be an extended DG algebra by the adjunction of a variable X of positive even variable n which kills a cycle t in A. Let N be a semi-free DG B-module. The aim of this talk is to explain the following our results; (1) If N is bounded below and $\mathrm{Ext}^{n+1}_B(N, N) = 0$, then N is liftable to A, i.e., there is a DG A-module M such that $N \cong B \otimes_A M$. (2) If N is liftable to A and $\mathrm{Ext}^{n}_B(N, N) = 0$, then the lifting of N is unique up to DG A-isomorphisms.

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

Hideto Asashiba (Shizuoka Univ.)
2-categorical covering theory and derived equivalences

Summary: Let G be a group and $\Bbbk$ a commutative ring. A small category with a weak G-action is a pair $(\mathcal{C}, X)$ of a small category $\mathcal{C}$ and a pseudofunctor X from G as a groupoid with one object $*$ to the 2-cateory $\Bbbk$-Cat of small $\Bbbk$-categories sending $*$ to $\mathcal{C}$. We will explain the facts that equivalences between the 2-category of small $\Bbbk$-categories with weak G-actions the 1-morphism (resp. the 2-morphisms) of which are G-equivariant functors (resp. natural transformations compatible with G-equivariances) and the 2-category of G-graded $\Bbbk$-categories the 1-morphisms (resp. 2-morphisms) of which are weakly degree-preserving functors (resp. natural transformations compatible with degree-preserving structures) are given by 2-functors defined by orbit category constructions and by smash product constructions that are mutually quasi-inverses and that (when $\Bbbk$ is a field) the derived equivalences defined on each 2-category are preserved under these constructions. We will also talk about some generalizations of these facts.

15:30–17:10

Summary: R. Ware gave the following problem in his paper;
Endomorphism rings of projective modules, Trans. Amer. Math. Soc. **155** (1971), 233–256.
Let R be a ring and P a projective right R-module with unique maximal submodule L, then L is the largest submodule of P.
We give the affirmative answer to this Ware's problem.
To solve this problem, we generalize Nakayama–Azumaya Lemma for any projective modules.

Summary: We treat a certain class of basic algebras which contains preprojective algebras of type A, Nakayama algebras, and generalized Brauer tree algebras. We provide a necessary condition for that an algebra share the same support τ-tilting poset with a given algebra A in this class. Furthermore, we see that this necessary condition is also a sufficient condition if A is either a preprojective algebra of type A, a Nakayama algebra, or a generalized Brauer tree algebra.

Summary: Cluster algebras are commutative algebras with a distinguished set of generators, which are called cluster variables. By Laurent phenomenon, any cluster variable is expressed by a Laurent polynomial of the initial cluster variable. An explicit formula for the Laurent polynomials of cluster variables is called a cluster expansion formula. We give a cluster expansion formula for cluster algebras defined from triangulated surfaces by using perfect matchings of angles. Moreover, they correspond bijectively with perfect matchings of snake graphs, perfect matchings of bipartite graphs, and minimal cuts of quivers with potential.

Summary: Path algebras are one of the most classical and important classes of algebras. In this talk, we discuss torsion pairs for path algebras. In particular, we review a close relationship with some elements of the Coxeter group, called sortable elements, and explain how to parametrize the torsion pairs by these objects via preprojective algebras.

Summary: In this talk, we study a relationship between silting objects and bounded t-structures. Let A be a finite dimensional algebra over a field. Then there exists an injective map from silting objects of the bounded homotopy category of finitely generated projective A-modules to bounded t-structures on the bounded derived category of finitely generated A-modules. However, the map is not necessarily bijective (e.g., A is the path algebra of the Kronecker quiver). We give a characterization of the injective map being bijective.

Summary: Let A be an algebra over a field K. For the real-valued Grothendieck group $K_0(\mathsf{proj}\,A)_{\mathbb{R}}$ of the projective module category $\mathsf{proj}\,A$ and the real-valued Grothendieck group $K_0(\mathsf{mod}\,A)_{\mathbb{R}}$ of the module category $\mathsf{mod}\,A$, there exists a non-degenerate $\mathbb{R}$-bilinear form called Euler form. Each $\theta \in K_0(\mathsf{proj}\,A)_{\mathbb{R}}$ gives a semistable subcategory $\mathcal{W}_\theta$ of $\mathsf{mod}\,A$. $\mathcal{W}_\theta$ is an abelian subcategory of $\mathsf{mod}\,A$, so its simple objects are bricks. In this talk, I set $\Theta_S := \{\theta \in K_0(\mathsf{proj}\,A)_{\mathbb{R}} \mid S \in \mathcal{W}_\theta\}$ for each brick S, and consider the chamber structure of an Euclidean space $K_0(\mathsf{proj}\,A)_{\mathbb{R}}$ with the walls given by Θ_S for all bricks S.

20 Mayu Tsukamoto (Osaka City Univ.) On upper bound for global dimension of Auslander–Dlab–Ringel algebras · · · · · 10

Summary: Lin and Xi introduced Auslander–Dlab–Ringel (ADR) algebras of semilocal modules as a generalization of original ADR algebras. In this talk, we prove that ADR algebras of semilocal modules are left-strongly quasi-hereditary algebras. As an application, we give a tightly upper bound for global dimension of an ADR algebra. Moreover, we describe characterizations of original ADR algebras to be strongly quasi-hereditary algebras which are a special class of left-strongly quasi-hereditary algebras.

21 Yoshitomo Baba (Osaka Kyoiku Univ.) On Harada rings and weak co-H-sequences · · · · · 10

Summary: We give complete characterization of two-sided Harada rings using weak co-H-sequences.

22 Ayako Itaba (Tokyo Univ. of Sci.)
Masaki Matsuno (Shizuoka Univ.) Classifications of geometric algebras whose point schemes are elliptic curves · · · · · 10

Summary: Classification of AS-regular algebras is one of the main interests in non-commutative algebraic geometry. Recently, a complete list of superpotentials (defining relations) of all 3-dimensional AS-regular algebras which are Calabi–Yau was given by Mori–Smith (the quadratic case) and Mori–Ueyama (the cubic case), however, no complete list of defining relations of all 3-dimensional AS-regular algebras has not appeared in the literature. So the purpose of this research is to give a complete list of defining relations of all 3-dimensional quadratic AS-regular algebras, to classify them up to isomorphism, and up to graded Morita equivalence in terms of their defining relations. In this talk, for the case that the point scheme is an elliptic curve, we give classifications up to isomorphism, and up to graded Morita equivalence in terms of their defining relations.

September 25th (Tue) Conference Room VIII

9:30–12:00

23 Shuhei Tsujie (Hiroshima Kokusai Gakuin Univ.) On chromatic symmetric functions of trivially perfect graphs and cographs · · · · · 10

Summary: Richard P. Stanley has conjectured that chromatic symmetric functions are complete invariants for trees. Vesselin Gasharov has conjectured that chromatic symmetric functions of claw-free graphs are s-positive. In this talk, we consider the analog for trivially perfect graphs and cographs.

24 Tomoo Matsumura (Okayama Univ. of Sci.) A tableau formula of the double Grothendieck polynomials associated to 321 avoiding permutations · · · · · 10

Summary: The double Grothendieck polynomials introduced by Lascoux–Schützenberger represent the equivariant K-theory Schubert classes for the type A flag varieties. Their explicit formulas have been known for vexillary (2143 avoiding) permutations in the form of determinants or set-valued tableaux. Recently Anderson–Chen–Tarasca (2017) obtained the determinant formula in the case of 321 avoiding permutations. Motivated by this result, we obtained their tableau formula too. I will report on this new formula with its combinatorial proof.

25 Tatsuya Horiguchi (Osaka Univ.) The cohomology rings of regular nilpotent Hessenberg varieties and Schubert polynomials · · · · · 10

Summary: Hessenberg varieties are subvarieties of a full flag variety. Its topology makes connection with other research areas such as geometric representation of Weyl groups, the quantum cohomology of flag varieties, hyperplane arrangements, and the chromatic quasisymmetric functions in graph theory. In this talk, we consider polynomials which determine the fundamental relation in the cohomology of a regular nilpotent Hessenberg variety, and I will explain that each of the polynomials can be written as an alternating sum of certain Schubert polynomials.

Summary: We construct all relative invariants of prehomogeneous vector spaces associated with valued quivers of type $\mathbb{B}$.

Summary: We obtain a summation formula of a generalization of the Fibonacci numbers which is special values of the homogenous complete symmetric polynomials. We also give an expression formula of our Fibonacci numbers.

Summary: It is well-known that the center of a Chevalley groups (or a split and connected reductive algebraic group) can be described in terms of its root datum. In this talk, we generalize the result to the super situation. We give an explicit description of centers of Chevalley supergroups.

Summary: Categorifying the symmetric or skew Howe representation of $U_q(\mathfrak{gl}_m)$, we construct a 2-representation of the quiver Hecke (KLR) algebra of $U_q(\mathfrak{gl}_m)$. In the skew case, the 2-representation is realized in a category of matrix factorizations (a joint work with Mackaay). In the symmetric case, the 2-representation is realized in a bimodule category over a deformation of Webster algebra of type A_1 (a joint work with Khovanov, Lauda, and Sussan). As a consequence, we obtain a braid group action on the homotopy category of each of the above categories.

Summary: In this talk I will give a candidate notion to unify exact categories and triangulated categories. This talk is partly based on a joint work with Yann Palu. If the time permits, I will also introduce recent developments on this class of categories.

Summary: We determine the ring structure of the Hochschild cohomology $HH^*(\mathbb{Z}G)$ of the integral group ring of the semidihedral group G of order 8ℓ for arbitrary integer $\ell \geq 2$ by giving the precise description of the integral cohomology ring $H^*(G, \mathbb{Z})$.

Summary: In this talk, I give a generalization of Matsuda's theorem and some results. In particular, I give isomorphism between partial Burnside rings of different groups. Moreover, I consider the relationship between an image of Frobenius–Wielandt homomorphism, a partial Burnside ring, and a structure of a group.

Summary: Let k be a field of prime characteristic p and G a finite group. We shall give a theorem on direct summands of a source algebra of a block ideal of the group algebra kG. Let b be a block ideal of kG with P as a defect group. If an element x in G satisfies some conditions, which cannot be written down here although, then the (kP, kP)-bimodule $k[PxP]$ is isomorphic with a direct summand of the source algebra of the block ideal with the multiplicity congruent to 1 modulo p.

34 Masanori Sawa (Kobe Univ.)
Yukihiro Uchida (Tokyo Metro. Univ.)
Compact formulas for discriminants of classical quasi-orthogonal polynomials, with their applictaions 10

Summary: We derive explicit formulas for the discriminants of classical quasi-orthogonal polynomials, as a full generalization of the result of Dilcher and Stolarsky (2005). We consider a certain system of Diophantine equations, originally designed by Hausdorff (1909) as a simplification of Hilbert's solution (1909) of Waring's problem, and then create the relationship to quadrature formulas and quasi-Hermite polynomials. We reduce these equations to the existence problem of rational points on a hyperelliptic curve associated with discriminants of quasi-Hermite polynomials, and thereby show a nonexistence theorem for solutions of Hausdorff-type equations.

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

Yoshinori Yamasaki (Ehime Univ.) On Schur multiple zeta functions

Summary: In this talk, we introduce what we call a Schur multiple zeta function. This is a zeta-function analogue of Schur function and interpolates both the multiple zeta and multiple zeta-star functions of Euler–Zagier type. We first show some combinatorial relations among Schur multiple zeta functions coming from theory of Schur functions such as Jacobi–Trudi and Giambelli formulas and then give some explicit formulas for special values at positive integers of them such as 1–3 formulas, which are analogues of those for above-mentioned multiple zeta functions. The former is a joint work with Maki Nakasuji and Ouamporn Phuksuwan and the latter is with Henrik Bachmann.

September 26th (Wed) Conference Room VIII

9:15–11:25

35 Tabane Yashiro (Tokyo Denki Univ.)
Ayane Minami (Tokyo Denki Univ.)
Discrete tomography for the L-shaped window 10

Summary: Tomography is the field that reconstructs a three-dimensional object from its two-dimensional cuts. Let f be a function on $\mathbb{Z}^n$, and $\mathbf{w}$ be a finite subset of $\mathbb{Z}^n$. Discrete tomography reconstructs the function f from the data $f_{\mathbf{w}+p} = \sum_{x\in\mathbf{w}+p} f(x), p \in \mathbb{Z}^n$. This problem is proved by F. Hazama to be described completely by the zero locus of a certain polynomial in n variable associated with $\mathbf{w}$. The purpose of this talk is to apply his result to the zero-sum arrays when the window $\mathbf{w}$ has the form $\mathbf{w} = \{(0,1),(0,0),(1,0),\cdots,(n-2,0),(n-1,0)\}$. Furthermore we describe the way how one can find the rational zero-sum arrays for $\mathbf{w}$.

36 Kazuhito Kozuka * (Miyakonojo Nat. Coll. of Tech.)
Reciprocity relations for p-adic Dedekind sums related to modular matrices 10

Summary: In this talk, by making use of a modular matrix, we consider a generalization of the p-adic reciprocity formula for p-adic Dedekind sums due to Snyder.

37 Debika Banerjee (IISER) *
Makoto Minamide (Yamaguchi Univ.)
Yoshio Tanigawa
Mean square of the double zeta function 10

Summary: We show mean square theorems of the double zeta function.

38 Shota Inoue (Nagoya Univ.)
A relation between the estimate of $S(t)$ and the zero density estimate in short intervals 10

Summary: The speaker studied on a function $S(t)$ which is related to the zero distribution of the Riemann zeta-function. This function has a well-known estimate under the assumption of the Riemann Hypothesis. The speaker has proved that this assumption can be weaken and is going to report the result in this talk.

Summary: The poly-Bernoulli numbers and its relative are defined by the generating series using the polylogarithm series, and we call them type B and C, respectively. As a generalization of these poly-Bernoulli numbers, we introduce hook Schur type Bernoulli numbers, which has relation with Schur multiple zeta functions of hook type. We obtain the relation between hook Schur type poly-Bernoulli numbers of type B and that of type C. Furthermore, we define a generalization of Arakawa–Kaneko multiple zeta functions and Kaneko–Tsumura type multiple zeta functions to hook Schur type, and obtain their expression using hook Schur type Bernoulli numbers.

Summary: Ihara, Kaneko, and Zagier defined two regularizations of multiple zeta values and proved the regularization theorem that describes the relation between those regularizations. We show that the regularization theorem can be generalized to polynomials whose coefficients are regularizations of multiple zeta values and that specialize to symmetric multiple zeta values defined by Kaneko and Zagier.

Summary: In 2001, J. M. Borwein, D. J. Broadhurst and J. Kamnitzer proved a formula including one multiple zeta value and values of multiple polylogarithms at $e^{\frac{\pi}{3}i}$. We show that this formula can be regarded as the formula including one multiple zeta value and values of log-sine integrals at $\pi/3$. Moreover, we introduce some applications of this formula to the theory of multiple zeta values.

Summary: Here, given an integer m, a is said to be a super perfect number with translation parameter m, if $\sigma(\sigma(a)+m)=2a+m$. For $m=-28,-18,-14$, structure of super perfect numbers with translation parameters m are investigated in detail.

Summary: We shall consider the radii of circles which are tangental to each othe and to the quadratic curves. These radii are derived from 'the symmetric recurrent formula'. The solutions of Pell's equation and every other Fibonacci sequence are also derived from the symmetric recurrent formula. We shall research the characters of the symmetric recurrent formula and express the radii of circles in the quadratic curves by the symmetric recurrent formula uniformly. And more we shall express the solutions of Pell's equation and the every other Fibonacci sequence as the radii of the circles in the hyperbola.

Summary: This short talk gives that the graph of an increasing positive integer sequence approximated by a function whose second derivative goes to zero faster than or equal to $1/x^{\alpha}$ for some $\alpha > 0$, contains arbitrarily long arithmetic progressions. As a corollary, it follows that the graph of the sequence of the integer parts of $\{n^a\}_{n=1}^{\infty}$ contains arbitrarily long arithmetic progressions for every $1 \leq a < 2$. We also prove that the graph of the same form sequence does not contain any arithmetic progressions of length 3 for every $a \geq 2$.

45 Fumitsuna Maruyama ♭ On the cardinality of subsets of the matrix ring over certain residue ring · · · · · 10
Yozo Deguchi
Masao Toyoizumi (Toyo Univ.)

Summary: We investigate the cardinality of subsets of the matrix ring over certain residue ring.

11:30–12:00 Research Section Assembly

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

Takao Yamazaki (Tohoku Univ.) Motives and mixed Hodge structures with modulus

Summary: We shall overview how the notion of modulus enables us to generalize many aspects of motive theory. One of the earliest examples can be seen in Laumon's generalization of the theory of Deligne 1-motives. Another example is given by our work with Kahn and Saito on a modulus version of Voevodsky's triangulated category of motives. Recently, in our joint work with Ivorra, we have introduced a Hodge theoretic counterpart that generalizes the classical notion of mixed Hodge structures. As an application, we generalize Kato–Russell's construction of Albanese varieties with modulus to 1-motives.

15:30–17:40

46 Humihiko Watanabe * Fundamental group of the complement of theta divisors · · · · · 10
(Nat. Defense Acad. of Japan)

Summary: Let X be an abelian surface, and $D^{(n)}$ be the sum of n distinct theta divisors having normal crossings. A set of defining relations of the fundamental group of $X - D^{(n)}$ is determined.

47 Wataru Takeda (Nagoya Univ.) The finiteness of solutions of Diophantine equation over number fields · · · · · 10

Summary: We consider a Diophantine equation about the factorial function over number fields. It is not known whether or not there exist infinitely many solutions of it. We give a necessary and sufficient condition for the existence of trivial solution and show the finiteness of trivial solutions. In addition we give an explicit upper bound for trivial solutions.

48 Yoshiyasu Ozeki (Kanagawa Univ.) Torsion of abelian varieties and Lubin–Tate extensions · · · · · 10

Summary: We show that, for an abelian variety defined over a p-adic field K which has potential good reduction, its torsion subgroup with values in the composite field of K and a certain Lubin–Tate extension over a p-adic field is finite.

49 Hirotaka Kodama (Kogakuin Univ.) A note on the Sturm bound for Siegel modular forms of type $(k, 2)$ · · · · · 10

Summary: We consider a question about congruences for the Fourier coefficients of vector valued Siegel modular forms of type $(k, 2)$, which was answered by Sturm in the case of an elliptic modular form and by Choi–Choie–Kikuta, Poor–Yuen and Raum–Richter in the case of scalar valued Siegel modular form.

50 Yuichi Sakai (Kyushu Univ.) Modular linear differential equations in general form · · · · · 10

Summary: It is well known that modular linear differential equations (MLDEs) appear as one of tools in studies related to supersingular elliptic curves and classifications of characters of vertex operator algebras (VOAs). In some cases, MLDEs give a certain correspondence between modular forms and characters of VOAs. In this talk, we determine the properties of coefficients of MLDEs of any order. Furthermore, we give a general expression of MLDEs under the natural assumption for the ring structure of (quasi)modular forms.

Summary: For an even positive integer ℓ, d'_ℓ denotes the smallest integer d such that the minimal period of the simple continued fraction expansion of $\sqrt{d}$ is equal to ℓ, where d runs through non-square positive integers with d congruent to 2 or 3 modulo 4. We can observe some characteristic phenomena from numerical data; especially, for each even positive integer ℓ less than or equal to 83552, the class number of a real quadratic field $\mathbb{Q}(\sqrt{d'_\ell})$ is equal to 1. In this talk, we investigate partial quotients of the continued fraction expansions of $\sqrt{d}$, and then consider some properties of that of $\sqrt{d'_\ell}$.

Summary: The aim of this talk is to give a lower bound for the class number of real quadratic fields $\mathbb{Q}(\sqrt{d})$ of minimal type such that the primary symmetric part of the simple continued fraction expansion of $\sqrt{d}$ is of ELE type. By applying this lower bound to a sequence $\langle 2, \ldots, 2, 2, 1\rangle$ of pre-ELE type, we get an infinite family of real quadratic fields with non-trivial class number.

Summary: Let $\mathbb{F}_q$ be the finite field with q elements. For a monic $m \in \mathbb{F}_q[T]$, let h_m be the class number of the mth cyclotomic function field. The goal of this talk is to determine the p-divisibility of h_m when $\deg m = 2$.

Summary: A post-critically finite rational map ϕ of prime degree p yields a sequence of finitely ramified iterated extensions of number fields, and sometimes provides an arboreal Galois representation with a p-adic Lie image. In this talk, regarding such sequences by $\phi(x) = x^2 - 2$ as analogues of $\mathbb{Z}_2$-extensions, we study the size of 2-part of ideal class groups along the sequences or 2-adic Lie extensions.

Summary: Quantization is studied from a viewpoint of Galois theory, in which the field in mathematics to which a partition function or a wave function in physics belongs, be the algebraic extension of the field in mathematics to which an action and fields of a system in physics belong. This viewpoint was proposed by Y. Nambu three decades ago. Here, choosing quantum mechanics (one dimensional field theory) as an example, it is shown that the different Galois extension corresponds to the different quantization scheme in physics. Although one type of Galois' extension reproduces the usual quantization scheme, there exist other schemes of quantization, if we follow Galois and Nambu.

Summary: Many mathematicians have researched the transcendence of the values of power series at algebraic point α. In particular, Bailey, Borwein, Crandall, and Pomerance gave remarkable criterion for transcendence in the case where $\alpha = 1/2$. Consequently, we deduce that $\sum_{n=1}^{\infty} 2^{-\lfloor n^{\log n} \rfloor}$ is transcendental, which cannot be proved by early methods. Their result was generalized for the case of $\alpha = \beta^{-1}$, where β is a Pisot or Salem number. In this talk, we investigate partial results on the transcendence of the values of power series in the case where β is a more general algebraic integer.

September 27th (Thu) Conference Room VIII

9:15–12:00

Summary: We describe the moduli of 3-dimensional subalgebras of the full matrix ring of degree 3.

Summary: Let $\mathrm{Mold}_{n,d}$ be the moduli of d-dimensional subalgebras of the full matrix ring of degree n over $\mathbb{Z}$. We describe the dimension of the Zariski tangent space $T_x\mathrm{Mold}_{n,d}$ and the smoothness of $\mathrm{Mold}_{n,d} \to \mathbb{Z}$ at x by using Hochschild cohomology.

Summary: Let G be a finite subgroup of $\mathrm{SL}(n,\mathbb{C})$, then the quotient $\mathbb{C}^n/G$ has a singularity. $\mathrm{Hilb}^G(\mathbb{C}^n)$ is known to be related to crepant resolutions of the quotient singularity. If $n = 2$ or 3, $\mathrm{Hilb}^G(\mathbb{C}^n)$ is crepant resolutions. But when n is greater than or equal to four, it is not in generally cases. We will show the existence of a crepant resolutions for series of finite abelian subgroup of $\mathrm{SL}(4,\mathbb{C})$ via $\mathrm{Hilb}^G(\mathbb{C}^4)$.

Summary: Let $R = \oplus_{k \geq 0} R_k$ be a n-dimensional normal graded ring with an algebraically closed field R_0, and $x_1, \ldots, x_s$ be a minimal homogeneous generator $x_1, \ldots, x_s$ of the homogeneous maximal ideal R_+. We will discuss a condition on the reducedness of x_i in terms of $\deg(x_i)$.
Theorem. (1) Let $i \in \{1, \ldots, s\}$. If $c_i := \gcd(\deg(x_1), \ldots, \overset{i}{\wedge}, \ldots, \deg(x_s)) \geq 2$, then R/x_iR is reduced. (2)Let $i, j \in \{1, \ldots, s\}$ and $i \neq j$. If $c_i \geq 2$ and $c_j \geq 2$, then x_i, x_j is a part of parameter system.

Summary: Given a smooth projective variety on a number field and an endomorphism on it, we would like to know how the height of a point grows by iteration of the action of the endomorphism. When the endomorphism is polarized, Call and Silverman construct the canonical height, which is an important tool for the calculation of growth of heights. In this talk, we will give a generalization of the Call–Silverman canonical heights for not necessarily polarized endomorphisms, ample canonical heights, and propose an analogue of the Northcott finiteness theorem as a conjecture. We will see that the conjecture holds when the variety is an abelian variety or a surface.

Summary: Hyperplane arrangement i.e., a finite set of hyperplanes relates to many mathematics and is studied widely. Representative example is the braid arrangement and a fundamental group of its complement coincides with the pure braid group. In 1989 Manin and Schechtman defined the discriminantal arrangement which is a generalization of braid arrangement. So far its combinatorial structure is studied mainly when original arrangement is in a Zariski open set in the space of general position arrangements. In this talk the speaker would talk about study of combinatorics of discriminantal arrangement when the original arrangement is not in the Zariski open set, and a related topic, Pappus's theorem.

Summary: Generalized Zariski Cancellation Problem asks when $V \times_k \mathbb{A}^1 \simeq W \times_k \mathbb{A}^1$ implies $V \simeq W$. In general, this is not true, and many of conunterexamples for this problem are constructed as principal $\mathbb{G}_a$-bundles over integral schemes of finite type over $\mathbb{C}$, so-called "prevariety". In this talk, we show that for varieties V, W which has a principal $\mathbb{G}_a$-bundle structure over a prevariety X, Y, respectively, if a prevariety Y has a dominant morphism to a variety with nonnegative logarithmic kodaira dimension, then $V \times \mathbb{A}^1 \simeq W \times \mathbb{A}^1$ if and only if $X \simeq Y$. To prove this, We slightly generalize Fujita–Iitaka's cancellation theorem (1977) and a generalized version of it by T. Nishimura (2017).

Summary: A non-hyperelliptic fibered surface $f\colon S \to B$ of genus 4 is called Eisenbud–Harris special (resp. Eisenbud–Harris general) if the general fiber of f has a unique trigonal pencil (resp. exactly two trigonal pencils). It is known that the slope equality holds for Eisenbud–Harris general fibrations of genus 4. In this talk, I will explain that the slope equality also holds for relatively minimal Eisenbud–Harris special fibrations of genus 4.

Summary: We study the several properties on indecomposable vector bundles of rank two on a weighted projective line $\mathbb{X}$ of type (2, 2, 2, 2, 2; λ_1, λ_2). Since $\mathbb{X}$ has the negative Euler characteristic, all vector bundles are not necessarily semi-stable. First, we check the stability of indecomposable vector bundles of rank two. Next, we check the exceptionality of all of them in the category of coherent sheaves $\mathrm{coh}(\mathbb{X})$ and the exceptionality of some of them in the stable category of vector bundles $\underline{\mathrm{vect}}(\mathbb{X})$.

Summary: Let E be an obstructed stable sheaf on some elliptic surfaces with Kodaira dimension one, and we consider its deformation space over Artin rings. Suppose the number of multiple fibers is relatively few. If E_η has no sub line bundle with fiber degree zero (Case I), then E is a canonical singularity of moduli of stable sheaves.

Summary: Let E be an obstructed stable sheaf on some elliptic surfaces with Kodaira dimension one, and we consider its deformation space over Artin rings. Suppose the number of multiple fibers is relatively few. If E_η has a sub line bundle with fiber degree zero, but not decomposable (Case II), then the defining equation of the deformation space of E is not always determined by degree-two terms.

Summary: We give a necessary and sufficient condition for the nonsingular projective toric variety associated to a building set to be Fano or weak Fano in terms of the building set.

Summary: We give a necessary and sufficient condition for the nonsingular projective toric variety associated to the graph cubeahedron of a finite simple graph to be Fano or weak Fano in terms of the graph.

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

Takuro Abe (Kyushu Univ.) Logarithmic vector fields and freeness of hyperplane arrangements

Summary: A hyperplane arrangement $\mathcal{A}$ is a finite set of linear hyperplanes in a fixed vector space. We may associate to an arrangement, the module of logarithmic vector fields $D(\mathcal{A})$ which is a graded reflexive module. We say that an arrangement is free if $D(\mathcal{A})$ is a free module. Free arrangements and logarithmic vector fields relates its algebraic structure with the topological and combinatorial aspects of arrangements. In particular, when $\mathcal{A}$ is free, we can describe the topological Poincaré polynomial of the complement of $\mathcal{A}$ in terms of the splitting type of $D(\mathcal{A})$ by Terao's factorization. However, to determine the freeness is difficult in general, and whether the freeness depends only on the combinatorial structure of an arrangement is an open problem, called the conjecture of Terao. We explain recent developments on this problem, mainly from the combinatorial point of view. Also, we will describe a recently found relation with logarithmic derivation modules and the cohomology ring of a regular nilpotent Hessenberg variety.

15:30–16:40

Summary: The closure of a torus orbit in the flag variety of type A is known to be normal, so that it is a toric variety. When the orbit is generic, its closure is known to be a permutohedral variety which is smooth. In this talk we introduce the notion of a generic orbit in a Schubert variety and give a criterion of the smoothness of its closure in terms of graphs associated to permutations.

Summary: For the geometrical sectional genus $g(X, L)$ of a polarized variety (X, L) has the well-known upper bound established by Fujita. Polarized varieties are called Castelnuovo varieties if $g(X, L)$ attains the upper bound, which are a higher-dimensional extension of extremal curves. In this talk, we consider polarized toric varieties, and provide some properties of toric Castelnuovo varieties. From the viewpoint of the theory of polytopes, these properties give the formulae for the volume and the boundary volume of the polytope associated to a Castelnuovo variety.

Summary: We shall report k-Fano varieties, as was studied by de Jong–Starr and Araujo–Castravet, with appropriately large peudo-index are covered by rational k-folds. We shall also report a similar claim for weak k-Fano varieties, as was studied by Taku Suzuki, with slightly larger pseudo-index.

Summary: For an embedded Fano manifold X, we introduce chains of higher order families of lines and define a new invariant S_X as the maximal length of such chains. This invariant S_X is related to the dimension of covering linear spaces. Our goal is to classify Fano manifolds X which have large S_X.

Summary: This talk is a sequel to the previous one at the MSJ annual meeting (March, 2018), in which the author gave an analogue of Miyaoka–Yau type inequality for three-dimesnional extremal contraction $(X, C) \to (Z, o)$ of type (IIA) with regading to the associated third Chen class, and also showed that the existence of a kind of Harder–Narasimhan (HN) filtrarion about c_2, c_3 appearing in (X, C), is a condition for such a analogous inequality with the third Chern class to be held. In this talk, the author will talk about an explicit formulation about such HN-filtrarion, and moreover, will give a realization about the pencil structure associated to (X, C) by the moduli space of a coherent system (Le Potier, Trautmann) associated to (X, C) based on such filtration.

Summary: We define non-commutative Kähler projective varieties. Some cohomological features are examined.

Geometry

September 24th (Mon) Conference Room VII

9:40–11:40

1 Saburou Saitoh * (Gunma Univ.*/Inst. of Reproducing Kernels)
Hiroshi Okumura
Division by zero calculus in figures —Our new space since Euclid— (Draft) ····· 10

Summary: In this talk, we will introduce new space results from the viewpoint of geometry from the book manuscript of division by zero calculus in figures —Our new space since Euclid— (Draft).

2 Saburou Saitoh * (Gunma Univ.*/Inst. of Reproducing Kernels)
Hiroshi Okumura
Applications of the division by zero calculus to Wasan geometry ····· 10

Summary: From the viewpoint of the division by zero (0/0=1/0=z/0=0) and the division by zero calculus, we will show interesting applications to Wasan geometry that show unexpected new discovery for some extreme cases. As a typical example, we will show a typical result for the old Japanese geometry, clearly.

3 Hajime Koba (Osaka Univ.)
Mathematical modeling of diffusion system on an evolving double bubble ····· 12

Summary: We consider the diffusion system on an evolving double bubble from an energetic point of view. We employ an energetic variational approach to make a mathematical model of the diffusion system on the double bubble. Moreover, we study the boundary conditions for our system to investigate both conservation and energy laws of the system.

4 Yuichiro Sato (Tokyo Metro. Univ.)
d-minimal surfaces in three-dimensional singular semi-Euclidean space $\mathbb{R}^{0,2,1}$ ····· 15

Summary: In this talk, we investigate surfaces in singular semi-Euclidean space $\mathbb{R}^{0,2,1}$ endowed with a degenerate metric. We define d-minimal surfaces, and give a representation formula of Weierstrass type. Moreover, we show that d-minimal surfaces in $\mathbb{R}^{0,2,1}$ and spacelike flat zero mean curvature (ZMC) surfaces in four-dimensional Minkowski space are in one-to-one correspondence.

5 Joseph Cho (Kobe Univ.)
Yuta Ogata
(Okinawa Nat. Coll. of Tech.)
Constant mean curvature surfaces and positon-like solutions ····· 15

Summary: The classical Bianchi–Bäcklund transformation for constant mean curvature surfaces in Euclidean 3-space has been studied by many researchers. In this talk, we introduce the method to construct positon-like solution of elliptic sinh-Gordon equation via successive Bianchi–Bäcklund transformations with a single spectral parameter. We also show the recipe of the corresponding constant mean curvature surfaces of positon-like solutions.

6 Shintaro Akamine (Nagoya Univ.)
Joseph Cho (Kobe Univ.)
Yuta Ogata
(Okinawa Nat. Coll. of Tech.)
Classification of timelike Thomsen surfaces and their deformations ····· 15

Summary: Minimal surfaces with planar curvature lines and minimal surfaces which are also affine minimal in the Euclidean space have been studied since the late 19th century and early 20th century. In this talk, we reveal that timelike minimal surfaces in the Minkowski space which are also affine minimal consist of timelike minimal surfaces with planar curvature lines and their conjugates, and they are generated by null curves with constant lightlike curvature. We also give a classification, including results of deformations and singularities, of such surfaces.

Summary: We compute principal curvatures of homogeneous hypersurfaces in a Grassmann manifold $\widetilde{\mathrm{Gr}}_3(\mathrm{Im}\mathbb{O})$ by the G_2-action. As applications, we find an orbit which is an austere submanifold and orbits which are proper biharmonic homogeneous hypersurfaces. We also show that an orbit is a weakly reflective submanifold.

Summary: We consider the Grassmann manifold of associative subspaces in the space of imaginary octonions, which we call the associative Grassmann manifold. It is known that the associative Grassmann manifold is an eight-dimensional compact symmetric quaternionic Kähler manifold. We construct interesting examples of four-dimensional complex submanifolds of the associative Grassmann manifold.

14:15–16:15

Summary: Real special linear group $SL(2,\mathbb{R})$ is embedded into the three-dimensional sphere. We can see the three-dimensional sphere by the stereographic projection. Through this visualization, every matrix in $SL(2,\mathbb{R})$ is realized as a point in the three-dimensional Euclidean space. The set of symmetric matrices is on a Euclidean plane, and on this plane $SL(2,\mathbb{Z})$ makes a certain hyperbolic pattern.

Summary: Let G be a reductive group, P be its parabolic subgroup, and H be a closed subgroup of G. There are several studies on the orbit decomposition of the flag variety G/P by the H-action, and these studies are expected to play an important role in various problems such as branching problem of G with respect to H. These studies were mostly based on the cases where H has only finitely many orbits on the flag variety. We focus on explicit descriptions of the orbit decomposition of a multiple flag variety $(G\times G\times\cdots\times G)/(P_1\times P_2\times\cdots\times P_m)$ by the diagonal action of G with infinitely many orbits.

Summary: I will talk about the existence problem of compact Clifford–Klein forms for pseudo Riemannian symmetric spaces. I will show that in the class of indecomposable pseudo Riemannian symmetric space with signature $(2,2)$, only one space up to isomorphism admits compact Clifford–Klein froms. To elucidate that, I have divided this problem into two cases – the first case in which the symmetric space G/H is completely solvable type and the second case is not. In the first case, for a compact Clifford–Klein form $\Gamma\backslash G/H$, there exists a connected and closed subgroup L which includes Γ cocompactly. Therefore, we can give the existence condition by using Lie algebra. In the second case, there is not necessarily such subgroup, I define a non-conneted but 'almost' connected subgroup, and simplify the existence problem of compact Clifford–Klein forms into that of the subgroup.

Summary: Cohomogeneity one actions of connected Lie groups on irreducible symmetric spaces of noncompact type have been classified into three types. In this talk, we study cohomogeneity one actions of disconnected Lie groups, and extend the above classification. We also study some relationships between the conditions for existence of such actions and geometry of their orbits.

13 Shinji Ohno (Nihon Univ.) Homegeneous biharmonic submanifolds in spheres ····· 15

Summary: In this talk, we give a necessarily and sufficient condition for orbits of linear isotropy representations of Riemannian symmetric spaces are biharmonic submanifords in hyperspheres. In particular, we obtain examples of biharmonic submanifolds in hyperspheres whose co-dimension is greater than one.

14 Shinji Ohno (Nihon Univ.) Antipodal sets of generalized s-manifolds ····· 15
Takashi Sakai (Tokyo Metro. Univ.)
Yasunori Tereuchi

Summary: In this talk, we give the definition of generalized s-manifolds as a generalization of symmetric spaces. Moreover, for a generalized s-manifolds, we introduce the notions of polars and antipodal sets, and define the antipodal number as the supremum of the cardinalities of antipodal sets.
We give s-structures on Flag manifolds, and determine maximal antipodal sets and the antipodal number.

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

Summary: In previous MSJ meetings we gave the classification of maximal antipodal subgroups of the quotient groups of classical compact Lie groups. Using this classification we show the classification of maximal antipodal sets of classical compact symmetric spaces.

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

Yosuke Morita (Kyoto Univ.) On the cohomology of compact quotients of non-Riemannian homogeneous spaces

Summary: If a discrete subgroup Γ of a Lie group G acts properly and freely on a homogeneous space G/H, the quotient space $\Gamma\backslash G/H$ becomes a manifold locally modelled on G/H, and is called a Clifford–Klein form. Since the initial work by T. Kobayashi (1989), the global geometry and topology of Clifford–Klein forms in the non-Riemannian case (i.e. the case when H is noncompact) has been studied by various methods. In this talk, I will explain some necessary conditions for the existence of compact Clifford–Klein forms obtained by comparing relative Lie algebra cohomology and de Rham cohomology. I will also discuss their reinterpretations in terms of invariant polynomials and Sullivan algebras.

September 25th (Tue) Conference Room VII

10:10–10:25 Presentation Ceremony for the 2018 MSJ Geometry Prize

10:30–11:30 Award Lecture for the 2018 MSJ Geometry Prize

Shouhei Honda (Tohoku Univ.) Geometric analysis on metric measure spaces with Ricci bounds from below

Summary: In this talk we will discuss the recent developments on the study of metric measure spaces with Ricci bounds from below and applications to Riemannian geometry. In particular it is explained how to construct nontrivial geometric/analytic quantities which are continuous with respect to measured Gromov–Hausdorff convergence.

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

Tomoyuki Hisamoto (Nagoya Univ.) A variational aspect of the Kähler–Einstein problem

Summary: A Fano manifold admits a Kähler–Einstein metric if and only if it is K-polystable. This theorem was established by Chen–Donaldson–Sun around 2012. Such a standard metric is characterized as the critical point of the canonical energy functional and in fact the existence is equivalent to the proper growth condition of the energy, which implies that the modulus of stability can be taken uniformly in test configurations of the manifold. The idea is also for the purpose of attacking general constant scalar curvature metric problem and even in the Kähler–Einstein case it leads Berman–Boucksom–Jonsson to a new simple proof of the existence. More recently the unstable case attracts people's interest and we expect the parabolic version of the theorem of Chen–Donaldson–Sun. Namely, the gradient flow of the energy functional should produce a unique test configuration which optimally destabilizes the manifold. In collaboration with T. Collins and R. Takahashi we showed the long-time existence of the flow. The relevant soliton metric and stability will be also discussed.

September 26th (Wed) Conference Room VII

10:00–11:40

16 Nobuhiko Otoba (Univ. Regensburg) * Jimmy Petean (CIMAT) Bifurcation for the constant scalar curvature equation and harmonic Riemannian submersions 15

Summary: We study bifurcation for the constant scalar curvature equation along a one-parameter family of Riemannian metrics on the total space of a harmonic Riemannian submersion. We provide an existence theorem for bifurcation points and a criterion to see that the conformal factors corresponding to the bifurcated metrics must be indeed constant along the fibers. In the case of the canonical variation of a Riemannian submersion with totally geodesic fibers, we characterize discreteness of the set of all degeneracy points along the family and give a sufficient condition to guarantee that bifurcation necessarily occurs at every point where the linearized equation has a nontrivial solution. In the model case of quaternionic Hopf fibrations, we show that symmetry-breaking bifurcation does not occur except at the round metric.

17 Nobuhiko Otoba (Univ. Regensburg) Saskia Roos (MPIM) Scalar curvature and the multiconformal class of a direct product Riemannian manifold 15

Summary: For a closed, connected direct product Riemannian manifold $(M, g) = (M_1 \times \cdots \times M_l, g_1 \oplus \cdots \oplus g_l)$, we define its multiconformal class $[\![g]\!]$ as the totality $\{f_1^2 g_1 \oplus \cdots \oplus f_l^2 g_l\}$ of all metrics obtained from multiplying each g_i by a function $f_i^2 > 0$ on the total space M. A multiconformal class $[\![g]\!]$ contains not only all warped product type deformations of g but also the whole conformal class $[\tilde{g}]$ of every $\tilde{g} \in [\![g]\!]$. We prove that $[\![g]\!]$ carries a metric of positive scalar curvature if and only if the conformal class of some factor (M_i, g_i) does, under the technical assumption $\dim M_i \geq 2$. We also show that, even in the case where every factor (M_i, g_i) has positive scalar curvature, $[\![g]\!]$ carries a metric of scalar curvature constantly equal to -1 and with arbitrarily large volume, provided $l \geq 2$ and $\dim M \geq 3$. In this case, we observe that such negative scalar curvature metrics within $[\![g]\!]$ cannot be of any warped product type, provided $l = 2$.

18 Kaoru Ikeda (Keio Univ.) ♭ The symplectic structures on the Heisenberg groups and real characteristic classes 15

Summary: We consider the quotient space of the Heisenberg group by its center. The Heisenberg group it self is the principal bundle of the quotient space. Thus one can define the line bundle over the quotient space by using the character of the center. The symplectic structure of the quotient space is defined by the curvature of the line bundle whose characterlistic class is integral. We consider the the symplectic structures of the quotient space of non integral classes and the relationship to the Stone–von Nuemann theorem.

19 Ryunosuke Ozawa (Osaka Univ.)
Takumi Yokota (Kyoto Univ.)
Stability of Riemannian curvature dimension condition under concentration topology 15

Summary: We talk about the stability of the Riemannian curvature dimension condition introduced by Ambrosio–Gigli–Savaré under the concentration of metric measure spaces introduced by Gromov. This is an analogue of the result of Funano–Shioya for the curvature dimension condition of Lott–Villani and Sturm. These conditions are synthetic lower Ricci curvature bound for metric measure spaces.

20 Asuka Takatsu (Tokyo Metro. Univ.)[♭]
Convergence of combinatorial Ricci flows on tori to degenerated circle patterns 15

Summary: We investigate the combinatorial Ricci flow on a torus when the necessary and sufficient condition for the convergence of the combinatorial Ricci flow is not valid. This observation addresses one of questions raised by B. Chow and F. Luo.

14:15–16:15

21 Yoshito Ishiki (Univ. of Tsukuba)
Quasi-symmetric invariant properties of Cantor metric spaces 15

Summary: For metric spaces, the doubling property, the uniform disconnectedness, and the uniform perfectness are known as quasi-symmetric invariant properties. The David–Semmes uniformization theorem states that if a compact metric space satisfies all the three properties, then it is quasi-symmetrically equivalent to the middle-third Cantor set. We say that a Cantor metric space is standard if it satisfies all the three properties; otherwise, it is exotic. In this talk, we conclude that for each of exotic types the class of all the conformal gauges of Cantor metric spaces exactly has continuum cardinality.

22 Shu Takeuchi (Tohoku Univ.)
Currents in metric spaces and flat distances 15

Summary: A triplet (X, d, T) is called an integral current space if (X, d) is a complete separable metric space and T is an integral current on (X, d). In 2011, Sormani and Wenger defined the intrinsic flat distance between two integral current spaces, and proved a compactness theorem with respect to that distance. We generalize these results to the setting of locally integral current spaces, which may have infinite mass, by introducing the pointed intrinsic flat distance.

23 Keita Kunikawa (Tohoku Univ.)
Shunsuke Saito (Tohoku Univ.)
Stability and topology of translating solitons 15

Summary: Translating solitons (translators for short) are hypersurfaces in Euclidean space defined as critical points of some weighted volume functional. The notion of stability for translators is naturally introduced with respect to the weighted measure.
In this talk, we show a topological result for stable translators. Roughly speaking, a stable translator must have simple shape. To be more precise, a complete stable translator admits no codimension one cycle which does not disconnect the translator. In particular, for a two dimensional surface case, this result means that a stable translator has no genus.

24 Homare Tadano (Tokyo Univ. of Sci.)
Some Cheeger–Gromov–Taylor type theorems for Finsler manifolds ... 15

Summary: We establish some Cheeger–Gromov–Taylor type theorems for forward complete Finsler manifolds via Bakry–Émery Ricci curvature. Our results generalize the Myers type theorem for forward complete Finsler manifolds due to S.-i. Ohta.

25 Hiroshi Sawai (Numazu Nat. Coll. of Tech.)
Vaisman structures and complex structures on LCK solvmanifolds ... 15

Summary: In this talk, we give a necessary and sufficient condition of a LCK structure on a solvmanifold is a Vaisman structure. Thus, we see that Inoue surfaces and O–T manifolds has no Vaisman structures.

Summary: Whether a constant scalar curvature Kähler (cscK) metric exists on a compact Kähler manifold is a question that attracted much attention in recent years. A continuity method for finding such metrics was proposed by X. X. Chen, which involves a twisted cscK metric that is an interesting object in its own right. We prove the openness for this continuity method, and quickly survey some relevant results.

Summary: We study the Rarita–Schwinger operator on compact Riemannian spin manifolds. In particular, we find examples of compact Einstein manifolds with positive scalar curvature where the Rarita–Schwinger operator has a non-trivial kernel. For positive quaternion Kähler manifolds and symmetric spaces with spin structure we give a complete classification of manifolds admitting Rarita–Schwinger fields. In the case of Calabi–Yau, hyperkähler, G_2 and $Spin(7)$ manifolds we find an identification of the kernel of the Rarita–Schwinger operator with certain spaces of harmonic forms. We also give a classification of compact irreducible spin manifolds admitting parallel Rarita–Schwinger fields.

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

Summary: In this talk I will talk about developments of index theory of Dirac-type operator on symplectic manifolds. In particular I will focus on localization phenomena of index and localization technique using perturbation by Dirac-type operator along fibers. I am planning to talk about the following contents.

1. A motivation: geometric quantization
2. Localization formula of index: perturbation by Dirac-type operator along fibers
3. Applications
4. Further developments

Complex Analysis

September 24th (Mon) Conference Room II

9:00–11:50

1 Saburou Saitoh * Division by zero calculus ····· 15
(Gunma Univ.*/Inst. of Reproducing Kernels)

Summary: In this talk, we will present the basic idea and results in connection with Complex Analysis from the book manuscript of division by zero calculus.

2 Saburou Saitoh * The Descartes circles theorem and division by zero calculus ····· 15
(Gunma Univ.*/Inst. of Reproducing Kernels)
Hiroshi Okumura

Summary: From the viewpoint of the division by zero (0/0=1/0=z/0=0) and the division by zero calculus, we will show that the very beautiful theorem by descartes on three touching circles is valid for lines and points for circles except for one case. However, for the exceptional case, we can obtain interesting results from the division by zero calculus.

3 Toshiyuki Sugawa (Tohoku Univ.) On the length of the shortest closed geodesics in a hyperbolic punctured
Tanran Zhang (Soochow Univ.) sphere ····· 15

Summary: Let X be a hyperbolic punctured sphere with n punctures. We will show that the number of possible partitions of the set of punctures with certain modulus greater than a universal constant is at most $n-3$ and this number is the best possible. We also establish an analog of a collar lemma in hyperbolic geometry.

4 Fumio Maitani Spans of meromorpic differentials restricted by boundary behavior ··· 15

Summary: We consider some generalizations of span and period circles related to period matrix. They are characterized by behavior spaces. By variational formulas of these quantities, as those of Hamano, but in the view of holomorphic quasiconformal deformation, sup or sub harmonicity of varius spans are given.

5 Masakazu Shiba (Hiroshima Univ.*) Closings of an open Riemann surface —Hydrodynamic period matrices,
directional moduli and their applications ····· 15

Summary: Let R be an open Riemann surface of genus $g\,(0 < g < \infty)$ and $\chi = \{A_j, B_j\}_{j=1}^{g}$ be a fixed canonical homology basis of R modulo dividing cycles. Let $\Sigma^t(R)$ be the space of holomorphic hydorodynamic differentials on R, $t \in (-1, 1]$ being a parameter. The conventionally used subspace $\{\phi_j$ whose A_k-period is equal to $\delta_{jk}\,(j,k = 1,2,\ldots,g)\}$ of $\Sigma^t(R)$ is obviously incomplete, for $\dim_{\mathbb{R}} \Sigma^t(R) = 2g$. To get rid of this insufficiency we take, in addition to $\{\phi_j\}_{j=1}^{g}$ as above, $\phi_{g+j} \in \Sigma^t(R), j = 1,2,\ldots,g$ whose A_k-period is equal to $i\delta_{jk}$. The matrix formed by the B_k-periods of $\{\phi_j\}_{j=1}^{2g}$ is studied and some applications will be exhibited.

6 Katsuya Ishizaki (Open Univ. of Japan) Entire and meromorphic solutions of the functional equation $f^n + g^n +$
Naofumi Kimura (Open Univ. of Japan) $h^n = 1$ and differential equations ····· 15

Summary: The Fermat type functional equations $(*)$ $f^n + g^n + h^n = 1$ are considered in the complex plane. Alternative proofs for the known results for entire and meromorphic solutions to $(*)$ are given. Moreover, some conditions on degrees of polynomial solutions are given.

7 Katsuhiko Matsuzaki (Waseda Univ.) Myrberg limit set and horospheric limit set ····· 15
Kurt Falk
(Christian-Albrechts-Univ. zu Kiel)

Summary: It is proved that the Myrberg limit set of a non-elementary Kleinian group is contained in the horospheric limit set of any non-trivial normal subgroup.

Summary: In this talk, we give two sided estimates for positive solutions of a semilinear elliptic equation with zero Dirichlet boundary value.

Summary: It is known that local zeta functions associated with real analytic functions can be analytically continued as meromorphic functions to the whole complex plane. In this talk, the case of specific (non-real analytic) smooth functions is precisely investigated. Indeed, asymptotic limits of the respective local zeta functions at some singularities in one direction are explicitly computed. Surprisingly, it follows from these behaviors that these local zeta functions have singularities different from poles.

Summary: It has been announced in the previous talk that local zeta functions associated with some specific smooth functions have singularities different from poles. In connection with the investigation of such singularities, we consider the meromorphy of local zeta functions in the case of smooth models represented as the summation of a monomial term and some flat terms. Then we obtain certain regions depending only on the above monomial terms to which local zeta functions can be meromorphically continued, and their poles are contained in arithmetic progressions constructed of negative rational numbers. From the results of the previous talk, it is expected that our result relating to the above regions is optimal for the model cases in some sense.

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

Gou Nakamura (Aichi Inst. of Tech.) Closed Riemann surfaces admitting extremal disks

Summary: On the moduli space $\mathcal{M}_g$ of closed Riemann surfaces of genus $g \geqq 2$ we define the function $r_{\max}$ which maps each surface to its maximal injectivity radius. A surface attaining the maximum of $r_{\max}$ is called an extremal surface. There are finitely many extremal surfaces in $\mathcal{M}_g$ for every g. A Riemann surface is said to be symmetric if it admits an anti-conformal involution. It is known that the set of all symmetric Riemann surfaces in $\mathcal{M}_g$ is connected. A study of symmetric Riemann surfaces is related to that of Klein surfaces. Extremality is defined for closed Klein surfaces as well as for closed Riemann surfaces. In this talk we study some properties of extremal Riemann surfaces with respect to symmetricity and complex doubles of extremal Klein surfaces.

15:30–16:20

Summary: We investigate the behavior of fiber Julia sets for polynomial skew products with super-saddle fixed points. It turns out that the Lavaurs map is identically equal to zero. We will show that the fiber Julia sets converge to the fiber Julia–Lavaurs set defined by the zero Lavaurs map.

Summary: In this talk, we show the Jacobi inversion formulae of a compact Riemann surface X of genus g via the Weierstrass normal form (WNF). As a curve given by the WNF naturally appears in Weierstrass' elliptic function theory, its generalization to a general curve also behaves naturally, which was proposed by Weierstrass. Using the WNF, we give the explicit expressions of meromorphic functions of $S^k X$ $(k < g)$ in terms of theta function for the related Jacobi variety.

13 Shigeki Matsutani (Sasebo Nat. Coll. of Tech.)
Jiryo Komeda (Kanagawa Inst. of Tech.)
Emma Previato (Boston Univ.)
On σ function for the curve, $y^3 = x(x-s)(x-b_1)(x-b_2)$ and its limit of $s \to 0$ 15

Summary: In this talk, we show the behaviors of σ function and its related variables of an affine curve X_s given by $y^3 = x(x-s)(x-b_1)(x-b_2)$ for a limit $s \to 0$. Since X_0 is singular, its normalized curve $\widehat{X}_0$ naturally appears. We have investigated the σ functions of both X_s ($s \neq 0$) and $\widehat{X}_0$ for a decade. Using these results, we report the behaviors.

16:35–17:35 Talk Invited by Complex Analysis Section

Masataka Tomari (Nihon Univ.)* On recent studies on normal two-dimensional complex singularities via resolution process

Summary: We will report recent developments on the studies of normal two-dimensional complex singularities by means of resolution of singularities. According to special conditions, we can construct several resolution of singularites which reflects its own characteris properties.
Main Theme is the identification of the maximal ideal cycle by the Artin fundamental cycle.
This is one of famous and old theme in this field. Here, we will discuss the following special cases.
(1) Case with C^*-action, and more generally, normal two-dimensional singularities with star-shaped resolution
(2) About the condition of the normalized tangent cone; if it is reduced, this is a Kodaira singularity, we also general case in the relation with this class
(3) Case with star-shaped resolution where the central curve is a nonsingular rational curve. This is a spcical case of (1). We can talk about more precise characterization about Z=M
(4) Case of the form $z^2 - f(x,y) = 0$. We can characterize the situation with $Z^2 = -1$. As a ressult, we obatin the characterization of $f(x,y)$ with M = Z in terms of Puiseux pairs.
Here many parts are based on the joint work with Tadashi Tomaru.

September 25th (Tue) Conference Room II

9:00–11:45

14 Masataka Iwai (Univ. of Tokyo) On the global generation of direct images of pluri-adjoint line bundles 15

Summary: We study the Fujita-type conjecture proposed by Popa and Schnell. We obtain an effective bound on the global generation of direct images of pluri-adjoint line bundles on the regular locus. We also obtain an effective bound on the generic global generation for a Kawamata log canonical $\mathbb{Q}$-pair. We use analytic methods such as L^2 estimates, L^2 extensions and injective theorems of cohomology groups.

15 Masataka Iwai (Univ. of Tokyo) Vanishing theorems of vector bundles with singular Hermitian metrics 15

Summary: We study a singular Hermitian metric of a vector bundle. we prove the sheaf of locally square integrable holomorphic sections of a vector bundle with a singular Hermitian metric, which is a higher rank analogy of a multiplier ideal sheaf, is coherent under some assumptions. Moreover, we prove a Nadel–Nakano type vanishing theorem of a vector bundle with a singular Hermitian metric.

16 Masataka Iwai (Univ. of Tokyo) Characterization of weakly positive torsion-free coherent sheaves by singular Hermitian metrics 15

Summary: We give complex geometric descriptions of the notions of algebraic geometric positivity of torsion-free coherent sheaves, such as dd-ample at some point and weakly positive, by using singular Hermitian metrics.

17 Taiji Marugame (Academia Sinica) Self-dual Einstein ACH metric and CR GJMS operators in dimension three 15

Summary: Let M be a three dimensional strictly pseudoconvex CR manifold. By refining Matsumoto's construction, we construct a one parameter family of ACH metrics g^{λ}_{IJ} ($\lambda \in \mathbb{R}$) on $M \times [0,\infty)_{\rho}$, which solve the Einstein equation to infinite order. When $\lambda = 0$, the metric g^{0}_{IJ} is also self-dual to infinite order. As an application, we give another proof of the fact that a three dimensional CR manifold admits CR invariant powers of the sublaplacian of all orders, which was shown by Gover–Graham.

18 Masanori Adachi (Shizuoka Univ.) On a hyperconvex manifold without non-constant bounded holomorphic functions 10

Summary: An example is given of a hyperconvex manifold without non-constant bounded holomorphic functions, which is realized as a domain with real-analytic Levi-flat boundary in a projective surface.

19 Yusaku Tiba (Ochanomizu Univ.) Cohomology of non-pluriharmonic loci 15

Summary: Let D be a pseudoconvex domain in $\mathbb{C}^n$ for $n \geq 4$. Let φ be an exhaustive plurisubharmonic function on D. Our main theorem is the following: The direct limit of the cohomology of open sets which contain the support of $i\partial\overline{\partial}\varphi$ is equal to the cohomology of D in low degrees. This theorem may be regarded as a pseudoconvex counterpart of the Lefschetz hyperplane theorem.

20 Takeo Ohsawa (Nagoya Univ.)$^{\flat}$ L^2 proof of Nishino's rigidity theorem 15

Summary: Applying an L^2 extension theorem, an alternate proof of the following is given. Theorem (T. Nishino, 1969) Let X be a two dimensional Stein manifold and let π be a holomorphic submersion from X onto the unit disc $\mathbb{D} = \{t \in \mathbb{C}; |t| < 1\}$. Assume that every fiber of π is homomorphically equivalent to $\mathbb{C}$. Then π is homomorphically equivalent to the projection $\mathbb{C} \times \mathbb{D} \to \mathbb{D}$.

21 Yukitaka Abe (Univ. of Toyama)$^{\flat}$ Geometrically simple quasi-abelian varieties 15

Summary: We define the geometric simpleness for toroidal groups. We give an example of quasi-abelian variety which is geometrically simple, but not simple. We show that any quasi-abelian variety is isogenous to a product of geometrically simple quasi-abelian varieties. We also show that the $\mathbb{Q}$-extension of the ring of all endomorphisms of a geometrically simple quasi-abelian variety is a division algebra over $\mathbb{Q}$.

22 Akio Kodama (Kanazawa Univ.*)$^{\flat}$ A group-theoretic characterization of the Fock–Bargmann–Hartogs domains 15

Summary: Let M be a connected Stein manifold of dimension N and let D be a Fock–Bargmann–Hartogs domain in $\mathbb{C}^N$. In this talk, we announce the following result: If the identity component of $\mathrm{Aut}(M)$ is isomorphic to $\mathrm{Aut}(D)$ as topological groups, then M is biholomorphically equivalent to D. As a consequence of this, we obtain a fundamental result on the topological group structure of $\mathrm{Aut}(D)$.

23 Satoru Shimizu (Tohoku Univ.)$^{\flat}$ A semi-local characterization of homogeneous bounded domains 15

Summary: In geometry of complex bounded domains, it is an interesting theme to characterize locally the domains with some global characteristic. In this talk, we give a semi-local characterization of homogeneous bounded domains. As applications, we obtain a characterization of bounded symmetric domains as well as a characterization of certain nonsymmetric homogeneous bounded domains.

13:15–14:20

24 Hiroaki Masaoka (Kyoto Sangyo Univ.) On a Heins-type theorem on open Riemann surfaces 15

Summary: Let F be an open Riemann surface which admits Green's function on F, Δ_1 the minimal Martin boundary of F, and D a non-compact and regular subdomain of F whose relative boundary ∂D of D is not compact. $\Delta_1(D) := \{\zeta \in \Delta_1 \mid F \setminus D\text{is minimally thin at } \zeta\}$. Suppose that every difference between two non-negative harmonic functions on D vanishing ∂D has the same minimal fine limit at every point $\Delta_1(D)$. Then, we prove that $\Delta_1(D)$ consists of only one point.

Summary: In this talk, we give a simple proof for the boundary Schwarz lemma for pluriharmonic mappings between Euclidean unit balls. We also give some generalization to C^1-mappings between domains with smooth boundaries.

Summary: In this talk, we prove a Schwarz lemma at the boundary for holomorphic self-mappings f of finite dimensional irreducible bounded symmetric domains without assuming the boundary regularity of f. Our result generalizes the previous results obtained for holomorphic self-mappings f of the Euclidean unit ball, or of the classical Cartan domains of type I and of type II which are smooth up to the boundary.

Summary: In this talk, we first generalize the boundary Schwarz lemma for holomorphic mappings f to infinite dimension by assuming the existence of the radial limit $\lim_{r\to 1-0} Df(rz_0)z$ for each $z \in H_1$. Next, by applying the boundary Schwarz lemma for holomorphic mappings between the Euclidean unit balls, we obtain two distortion theorems for various subclasses of the class of normalized starlike mappings.

Summary: In this talk, we obtain a boundary rigidity theorem for holomorphic self-mappings of Hilbert balls in the case that there exists an interior fixed point.

Functional Equations

September 24th (Mon) Conference Room I

9:15–12:00

1 Hiroshi Ogawara (Kumamoto Univ.) On solutions for a system of functional equations with triangular operators 10

Summary: Poincaré investigated relationships between analytic properties of a system of q-difference equations and that of its solutions. In this talk, we extend the relationships to a system of functional equations with more general operators called convergent triangular operators, which act on formal power series as infinite triangular matrices.

2 Saiei-Jaeyeong Matsubara-Heo (Kobe Univ.) Residue current approach to Ehrenpreis–Malgrange type theorem for linear partial differential equations with constant coeffiecients and commensurate time lags 10

Summary: We consider a system of linear linear partial differential equations with constant coefficients and commensurate time lags (DΔ-system) and show that compatibility condition is the necessary and sufficient for the solvability of the system. Moreover, we show that solutions of a homogeneous DΔ-system can be approximated by exponential polynomial solutions. The proof is essentially reduced to a problem in complex harmonic analysis: division with bounds. The key technique is the division formula of M. Andersson whose integration kernel is expressed by residue currents. Another important tool is the use of a non-Nötherian ring of DΔ-operators introduced by H. Glüsing-Lürßen.

3 Saiei-Jaeyeong Matsubara-Heo (Kobe Univ.) Euler integral representations of GKZ hypergeometric functions and intersection theory of twisted cycles 10

Summary: Regular GKZ hypergeometric functions are known to have Euler integral representations. In this talk, we give a basis of twisted cycles under a generic assumption of parameters with the aid of regular triangulations. Since this basis can easily be related to a basis consisting of Γ-series, we can also determine intersection matrix when the regular triangulation is unimodular.

4 Koki Hirota (Ritsumeikan Univ.)$^{\flat}$ Real eigenvalues of the semiclassical Zakharov–Shabat operator with $\mathcal{PT}$-like symmetry 10

Summary: We study the eigenvalues of the self-adjoint Zakharov–Shabat operator corresponding to the defocusing nonlinear Schrödinger equation in the inverse scattering method. Real eigenvalues exist when the square of the potential has a simple well. We derive two types of quantization condition for the eigenvalues by using the exact WKB method, and show, moreover, that the eigenvalues stay real for a sufficiently small non-self-adjoint perturbation when the potential has some $\mathcal{PT}$-like symmetry.

5 Hideaki Matsunaga (Osaka Pref. Univ.) Rina Suzuki Classification of global behavior of a system of rational difference equations 10

Summary: This talk deals with a two-dimensional rational difference system which is related to the Riccati difference equation. The purpose of this talk is to give a representation formula of solutions and to classify global behavior of solutions when no initial values belong to the forbidden set of the system.

6 Hiroyuki Usami (Gifu Univ.)* Kazuhiro Aoki (Gujo High School) Inverse problems for generalized cycloids 10

Summary: Let C be a given smooth planar curve, and let us roll a unit circle around it. Then a point on the perimeter of the circle traces a new curve G. We call such G a generalized cycloid generated by C. We consider the following inverse problems: (i) what kind of planar curves are realized as generalized cycloids? and (ii) for a given curve G how can we find the curve which generates G as a generalized cycloid?

Summary: We consider minimization problems associated with best constants of the generalized critical Hardy inequalities. Especially, we consider an open problem mentioned by Horiuchi and Kumlin in 2012, and give a partial answer to it. Note that we can not apply the rearrangement technique since our potential functions are not radially decreasing in general.

Summary: We report on the Hardy–Leray and the Rellich–Leray inequalities with best constants for curl-free vector fields. Costin–Maz'ya proved the sharp Hardy–Leray inequality for axisymmetric divergence-free vector-fields. In two dimensional case the optimal constant coincides with that for curl-free vector fields. Our aim is to see how the best constant changes in higher dimensions if the condition of divergence-free is replaced by that of curl-free.

Summary: We study Hardy's inequality in a limiting case on a bounded domain Ω in $\mathbb{R}^N$ with $R = \sup_{x\in\Omega} |x|$. We study the attainability/non-attainability of the best constant in the inequality in several cases.

Summary: The best constant of the Sobolev inequality in the whole space is attained by the Aubin–Talenti function, but not in bounded domains since the dilation invariance is breaking. We investigate a new scale invariant form of the Sobolev inequality in a ball, and show that its best constant is attained by Aubin–Talenti type functions.

Summary: In this talk, we consider ground states for a class of quasilinear Schrödinger equation. We give the precise asymptotic behavior of ground states when the nonlinearity has H^1-critical growth.

Summary: In this talk we study a functional associated with the mean filed limit of the point vortex distribution, that is,

$$J_\lambda(v) = \frac{1}{2}\|\nabla v\|_2^2 - \lambda \int_{I_+} \log\Big(\int_\Omega e^{\alpha v} dx\Big)\mathcal{P}(d\alpha), \quad v \in H_0^1(\Omega)$$

where $\lambda > 0$ is a constant, $\Omega \subset \mathbb{R}^2$ is a smooth bounded domain and $\mathcal{P}(d\alpha)$ is a Borel probability measure on $I_+ = [0, 1]$. We show the boundedness of J_λ from below with the extremal case for λ when $\mathcal{P}(d\alpha)$ is continuous and satisfies the suitable assumptions.

Summary: Generalized J-integral is the tool which is effective to study the shape optimization of singular points (containing boundary) with respect to various cost functions in boundary value problems for partial differential equations. I will talk shape sensitivity analysis of the energy using the sensitivity analysis of saddle point and propose Generalized J-integral in Stokes problem.

14:15–16:15

Summary: The uniqueness of solutions for a given initial value problem is one of the fundamental problems in the theory of differential equations. For ordinary differential equations without time lag, Okamura gave a necessary and sufficient condition for the uniqueness by using the so-called "Okamura's distance function." The important fact is the following: the function is continuously differentiable, and therefore, the condition for the uniqueness is given by information of the differential equation. In this talk, I give a condition for Okamura's distance function for delay differential equations in view of a unified theory of well-posedness by prolongations given by the author. A concrete function is also given under the assumption of local Lipschitz about C^1-prolongations. We also consider the relationship with Winston's uniqueness claim.

Summary: In this talk, we deal with a system of linear differential equations with discrete delays. We derive the necessary and sufficient conditions concerned with the absolutely stable for the stability problem of the system.

Summary: We study the eigenvalue problem of the second order elliptic operator which arises in the linearized model of the periodic oscillations of a homogeneous and isotropic elastic body. The square of the frequency agrees to the eigenvalue. Therefore, analyzing the properties of the eigenvalue we can retrieve information on the frequency of the oscillations. Particularly, we deal with a thin rod with non-uniform connected cross-section in several cases of boundary conditions. We see that there appear many small eigenvalues corresponding to the bending mode of vibrations of the thin body. We investigate the asymptotic behavior of these eigenvalues and obtain a characterization formula of the limit equation when the thinness parameter tends to 0.

Summary: This talk is concerned with L^q-Lyapunov inequality for the one-dimensional p-Laplacian. We have known the best inequalities for $q = 1$ or $p = 2$, and we will deal with the case $q > 1$ and $p \neq 2$. In particular, we will calculate the best constant of this inequality by the generalized trigonometric functions with two parameters.

Summary: We study the asymptotic behavior of bifurcation diagrams of nonlinear ordinary differential equations, which contain some oscillatory nonlinearities. In our case, λ is a continuous function of the maximum norm $\alpha = \|u_\lambda\|_\infty$ of the solution u_λ associated with λ. So we write $\lambda = \lambda(\alpha)$. In this talk, we consider the case where $\lambda(\alpha) \to \pi^2/4$ as $\alpha \to \infty$. Then the precise asymptotic formulas for $\lambda(\alpha)$ as $\alpha \to \infty$ and $\alpha \to 0$ with the exact second terms are established. By these formulas, the global and local structures of the bifurcation curves are clearly understood.

19 Shoichi Hasegawa (Tokyo Tech) Intersection property of solutions to semilinear elliptic equations and its application to a Liouville-type result ····· 10

Summary: In this talk, we shall study intersection and separation properties of solutions to semilinear elliptic equations. In particular, in order to investigate the properties of solutions, we make use of the stability of solutions. Indeed, for unstable solutions, including non-radial solutions, we obtain an intersection property of solutions. Moreover, focusing stable radial solutions, we derive a separation property of radial solutions. Furthermore, applying the result on the intersection property of solutions, we shall show a Liouville-type result for positive solutions.

20 Satoshi Tanaka (Okayama Univ. of Sci.)
Ryuji Kajikiya (Saga Univ.)
Inbo Sim (Univ. of Ulsan)
Symmetry-breaking bifurcation of positive solutions to the Moore–Nehari differential equation ····· 10

Summary: The bifurcation problem of positive solutions for the Moore–Nehari differential equation $u'' + h(x,\lambda)u^p = 0$ in $(-1,1)$ with $u(-1) = u(1) = 0$ is considered, where $p > 1$, $h(x,\lambda) = 0$ for $|x| < \lambda$ and $h(x,\lambda) = 1$ for $\lambda \le |x| \le 1$ and $\lambda \in (0,1)$ is a bifurcation parameter. The problem has a unique even positive solution $U(x,\lambda)$ for each $\lambda \in (0,1)$. It is shown that there exists a unique $\lambda_* \in (0,1)$ such that a non-even positive solution bifurcates at λ_* from the curve $(\lambda, U(x,\lambda))$, where λ_* is explicitly represented as a function of p.

21 Yūki Naito (Ehime Univ.)
Yasuhito Miyamoto (Univ. of Tokyo)
Singular extremal solutions for supercritical elliptic equations in a ball ····· 10

Summary: We study positive singular solutions to the Dirichlet problem for the semilinear elliptic equation in the unit ball. We first show the uniqueness of the singular solution to the problem, and then study the existence of the singular extremal solution. In particular, we show a necessary and sufficient condition for the existence of the singular extremal solution in terms of the weak eigenvalue of the linearized problem.

22 Yuta Ishii (Tokyo Metro. Univ.)
Kazuhiro Kurata (Tokyo Metro. Univ.)
Construction and stability analysis of one-peak symmetric stationary solutions for the Schnackenberg model with heterogeneity ····· 10

Summary: In this talk, we consider stationary solutions of the one-dimensional Schnackenberg model with heterogeneity. We are interested in the effect of the heterogeneity on the stability. First we construct symmetric one-peak stationary solutions. Furthermore, we give stability analysis of the solutions in details and reveal the effect of heterogeneity on the stability.

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

Katsuhisa Mimachi (Osaka Univ.) Classical hypergeometric functions and related topics

Summary: The classical hypergeometric functions here include Appell's hypergeometric functions F_1, F_2, F_3, F_4, Lauricella's hypergeometric functions F_A, F_B, F_C, F_D, and the generalized hypergeometric function ${}_{n+1}F_n$. The corresponding differential equations will be denoted by $E_1, E_2, E_3, E_4, E_A, E_B, E_C, E_D$, and ${}_{n+1}E_n$.

We talk about the recent development of the study on the systems of differential equations associated with the classical hypergeometric functions and their related topics —monodromy representations, connection formulas, Wronskian formulas, reducibility and irreducibility, invariant Hermitian forms, rigid Fuchsian systems, integral representations of solutions, regularizations of twisted cycles, intersection forms, Even-Odd family, Yokoyama-list, Dotsenko–Fateev equation, Knizhnik–Zamolodchikov equations, twisted de Rham theory etc.

September 25th (Tue) Conference Room I

9:15–12:00

23 Patrick van Meurs (Kanazawa Univ.) Evolutionary convergence of positive and negative dislocations in 2D 10

Summary: The starting point is the gradient flow of non-locally interacting particles. Our main result is the rigorous limit passage as the number of particles goes to infinity. The limiting model is a non-local and nonlinear PDE. The proof relies on the theory of Wasserstein gradient flows and embedding results of Orlicz spaces.

24 Shota Tateyama (Tohoku Univ.), Shigeaki Koike (Tohoku Univ.) On L^p-viscosity solutions of bilateral obstacle problems with unbounded ingredients 10

Summary: The global Hölder continuity estimates on L^p-viscosity solutions of bilateral obstacle problems with unbounded ingredients is established when obstacles are merely continuous. The existence of L^p-viscosity solutions is obtained for continuous obstacles. The local Hölder continuity estimates on the first derivatives of L^p-viscosity solutions is shown when the obstacles belong to $C^{1,\alpha}$, and $p > n$.

25 Jumpei Inoue (Univ. of Electro-Comm.), Kousuke Kuto (Univ. of Electro-Comm.) Optimal distribution of a species in the stationary logistic equation 10

Summary: We discuss a stationary diffusive logistic equation in an interval. In particular, this talk focuses on Ni's conjecture that the supremum of the ratio of a total population to total resources is 3. Recently, Bai–He–Li settled the conjecture by finding a special sequence of diffusion coefficients and carrying functions. The main question is the following: What is a profile of the solution corresponding to the special sequences? We give a partial answer to this question.

26 Kousuke Kuto (Univ. of Electro-Comm.), Yaping Wu (Capital Normal Univ.) Bifurcation from infinity in a shadow system for the Shigesada–Kawasaki–Teramoto model 10

Summary: This talk is concerned with the Neumann problem of a shadow system for the Lotka–Volterra competition model with cross-diffusion (the so-called SKT model). We study the global bifurcation structure of positive solutions. Among other things, we show that a bifurcation curve blows up as a parameter approaches the least positive eigenvalue of the minus Laplacian with homogeneous Neumann boundary condition.

27 Hiroshi Matsuzawa (Numazu Nat. Coll. of Tech.), Yuki Kaneko (Waseda Univ.) Spreading and vanishing in a free boundary problem for nonlinear diffusion equations with a given forced moving boundary 10

Summary: We will study a free boundary problem of the nonlinear diffusion equations of the form $u_t = u_{xx} + f(u)$, $t > 0$, $ct < x < h(t)$, where f is C^1 function satisfying $f(0) = 0$, $c > 0$ is a given constant and $h(t)$ is a free boundary which is determined by a Stefan condition.
When $f(u) = u(1-u)$ (logistic nonlinearity), this problem was considered by [Matsuzawa, 2018].
In this talk, we will extend the results in the previous work to general monostable, bistable and combustion types nonlinearities. We show that the long-time dynamical behavior of solutions can be expressed by unified fashion, that is, for any initial data, the unique solution exhibits exactly one of the behaviors, spreading, vanishing and transition. We also give the asymptotic profile of the solution over the whole domain when spreading happens. The approach here is quite different from that used in the previous work.

28 Yuki Kaneko (Waseda Univ.)
Yoshio Yamada (Waseda Univ.)
Asymptotic profiles and speeds on spreading solutions to a free boundary problem for a reaction-diffusion equation 10

Summary: We consider a free boundary problem for a reaction-diffusion equation modeling the spreading of species, where unknown functions are population density and spreading front of species. Moreover, the dynamical behavior of the free boundary is determined by a Stefan-like condition. The purpose of this talk is to show sharp estimates of the asymptotic profile of solutions and the spreading speed of the free boundary.

29 Toshikazu Kuniya (Kobe Univ.)
Jinliang Wang (Heilongjiang Univ.)
Asymptotic behavior of an SIR epidemic model with nonlocal diffusion 10

Summary: In this study, we formulate an SIR epidemic model with nonlocal diffusion and study the asymptotic behavior of it. We define the basic reproduction number R_0 by the spectral radius of the next generation operator, and show that the trivial equilibrium is globally asymptotically stable if $R_0 < 1$. Furthermore, under an additional assumption that only infective individuals can diffuse, we prove that a positive equilibrium is globally asymptotically stable if $R_0 > 1$. This is a collaborative work with Dr. Jinliang Wang in Heilongjiang University.

30 Isamu Ohnishi (Hiroshima Univ.)
A mathematical study of the one-dimensional Keller and Rubinow model for Liesegang bands 10

Summary: The purpose is to start understanding from a mathematical viewpoint a famous regularized structures with spatially distinct bands or rings of precipitated material are exhibited, with clearly visible scaling properties. Such patterns are known as Liesegang bands or rings. In this paper, we study a one-dimensional version of the Keller and Rubinow model and present conditions ensuring the existence of Liesegang bands.

31 Isamu Ohnishi (Hiroshima Univ.)
On mathematical standard structure of a binary digit of memory in a cell and its application to biological or life science phenomena 10

Summary: A mathematical standard structure of a binary digit of memory in a cell is presented. This is based on a kind of frequency model with scale effect. This model has ability of "on-off" switching property, and moreover, this is affected by scale effect to make the memorable ability be reinforced. This property is derived from multiple covalent modification cites inducing important enzyme reaction, which is represented by the Michaelis–Menten type nonlinearity.
[1] "Standard model of a binary digit of memory with multiple covalent modifications in a cell", J. Pur Appl Math Vol 2 No 1 April (2018) [2] "Memory Reinforcement with Scale Effect and its Application to Mutual Symbiosis among Terrestrial Cyanobacteria of Nostochineae, Feather Mosses and Old Trees in Boreal Biome in Boreal Forests", Global Science Chronicle, Vol 1(1): 1–7 (2017)

32 Masahiko Shimojyou (Okayama Univ. of Sci.)
Jong Shenq Guo (Tamkang Univ.)
Arnaud Ducrot (Univ. de Bordeaux)
Shadow system of a singular prey-predator system 10

Summary: We study the asymptotic behaviors and quenching of the solutions to the shadow system of a two-component reaction-diffusion system modeling prey-predator interactions in an insular environment. First, we give a global existence result for the solutions. Then, by constructing some suitable Lyapunov functionals, we characterize the asymptotic behaviors of global solutions. Also, we give a finite time quenching result.

33 Masahiko Shimojyou (Okayama Univ. of Sci.)
Jong Shenq Guo (Tamkang Univ.)
Asymptotic behavior of global solutions to a singular prey-predator model 10

Summary: We study an initial boundary value problem for a reaction-diffusion system arising in the study of a singular predator-prey system. First, convergence to a stationary solution of global solution under some parameter condition is given. Next, under an assumption on the growth rates and initial data, we show that the unique co-existence state is a center for the kinetic system by the method of Darboux's theory of algebraic integrability. Then we prove that solutions of the diffusion system with equal diffusion become spatially homogeneous and are subject to the kinetic part asymptotically.

34 Masaharu Taniguchi (Okayama Univ.)
Axially non-symmetric traveling fronts in balanced bistable reaction-diffusion equations 10

Summary: For a balanced bistable reaction-diffusion equation, axially symmetric traveling fronts have been recently studied. For this equation, the existence of axially non-symmetric traveling fronts with non-zero speed has been an interesting open problem. This work proves that axially non-symmetric traveling fronts with non-zero speed exist in balanced bistable reaction-diffusion equations.

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

Tatsuki Kawakami (Ryukoku Univ.) A semilinear elliptic equation with a dynamical boundary condition

Summary: We consider a semilinear elliptic equation with a dynamical boundary condition in a unbounded domain Ω. In this talk we first consider the case Ω is the N-dimensional half-space and discuss results on existence, nonexistence and large time behavior of small positive solutions. Furthermore, we show that local solvability of this problem is equivalent to global solvability of this problem and solvability of the stationary problem. Next we consider the case Ω is the exterior of the unit ball and discuss the effects of the change of the domain. Finally, as preparation for nonlinear problem of diffusion equations, we consider the large diffusion limit for the heat equation on a half-space with a dynamical boundary condition.
This talk is based on series of joint works with M. Fila and K. Ishige.

September 26th (Wed) Conference Room I

9:15–12:00

35 Naoto Kajiwara (Univ. of Tokyo)
Global solvability of the Cahn–Hilliard equations with dynamic boundary conditions 10

Summary: We consider the strong solutions of the Cahn–Hilliard equations in a bounded domain with permeable walls, which is a dynamic boundary conditions. From the maximal L_p regularity result of the linear equations with the dynamic boundary conditions, the fixed point theorem and a priori estimate, we prove that the solution exists uniquely and globally in time.

36 Fumihiko Onoue (Univ. of Tokyo)
Yoshikazu Giga (Univ. of Tokyo)
Keisuke Takasao (Kyoto Univ.)
A varifold formulation of mean curvature flow with Dirichlet or dynamic boundary conditions 10

Summary: We consider the sharp interface limit of the Allen–Cahn equation with Dirichlet or dynamic boundary conditions and give a varifold characterization of its limit which is formally a mean curvature flow with Dirichlet or dynamic boundary conditions. In order to show the existence of the limit, we apply the phase field method under the assumption that the discrepancy measure vanishes on the boundary. For this purpose, we extend the usual Brakke flow under these boundary conditions by the first variations for varifolds on the boundary.

Summary: Several inequalities concerning the isoperimetric ratio for plane curves are derived. In particular, we obtain interpolation inequalities between the deviation of curvature and the isoperimetric ratio. These hold only for functions representing closed plane curves, but give better estimates than Gadliardo–Nirenberg inequalities. As applications, we study the large-time behavior of some geometric flows of closed plane curves without a convexity assumption. We do not assume convexity of the initial curve, instead we assume global existence of the flow. A global solution of non-local curvature flow considered by Jiang–Pan converges exponentially to a circle. The same result still holds for the area-preserving curvature flow and the length-preserving curvature flow.

Summary: We consider critical dissipative estimates for a heat semigroup with the inverse square potential. It is proved by Metafune–Okazawa–Sobajima–Spina that the Schrödinger operator generates a semigroup under suitable restriction on its domain. Ioku–Metafune–Sobajima–Spina proved decay estimates of the semigroup in Lebesgue spaces. However the endpoint case is remained. In this talk we use Lorentz spaces instead of Lebesgue spaces, and show the endpoint decay estimate in a suitable Lorentz space.

Summary: Let $L := -\Delta + V$ be a nonnegative Schrödinger operator on $L^2(\mathbf{R}^N)$, where $N \geq 2$ and V is a radially symmetric inverse square potential. In this paper we assume either L is subcritical or null-critical and we establish a method for obtaining the precise description of the large time behavior of $e^{-tL}\varphi$, where $\varphi \in L^2(\mathbf{R}^N, e^{|x|^2/4}\,dx)$.

Summary: In my talk, we obtain necessary conditions and sufficient conditions on the initial data for the solvability of the Cauchy problem

$$\partial_t u + (-\Delta)^{\frac{\theta}{2}} u = u^p, \qquad x \in \mathbf{R}^N,\ t > 0, \qquad u(0) = \mu \geq 0 \quad \text{in} \quad \mathbf{R}^N,$$

where $N \geq 1$, $0 < \theta \leq 2$, $p > 1$ and μ is a Radon measure or a measurable function in $\mathbf{R}^N$. Our necessary conditions and sufficient conditions lead the strongest singularity of the initial data for the solvability.

Summary: I will report recent results on blow-up of a semilinear heat equation $u_t = \Delta u + u^p$ with $p > 1$, focusing on the supercritical nonlinearity in the Sobolev sense. Blow-up of solution is called of Type I if the blow-up rate is the same as of the self-similar solutions and of Type II otherwise. The previous results on classification of Type II blow-up solutions is restricted in the case where a certain linearized operator doesn't have neutral eigenvalues due to the lack of a particular solution whose blow-up is driven by a neutral eigenvalue. Based on matched asymptotics, we prove the existence of particular solutions associated to a neutral eigenvalue in the most representative case where $p = 1 + 6/(N - 10)$, so called, Lepin exponent.

Summary: The initial value problem for the quasi-geostrophic equation is studied. Particularly, the critical and the super-critical dissipation is considered. For those problems, far field asymptotics of solutions are given.

Summary: In this talk we consider a Keller–Segel-fluid system with singular sensitivity. In the system existence of global classical solutions was shown under some conditions in the previous work (Black–Lankeit–M., J. Evol. Equ.). In this talk we address the question, what conditions derives existence of global generalized solutions, which is one of weak concepts?

Summary: We show the existence of global-in-time solutions depending on the initial data in the Morrey space to the Keller–Segel system of parabolic-parabolic type. We solve this system by the successive approximation based on the estimation of the heat semigroup in the Morrey space and on the fractional power of the Laplace operator.

Summary: We show the solutions to the drift-diffusion equation with initial data in homogeneous Besov space is in L^p. Moreover it is analytic by use of Hölder condition of solutions

Summary: We consider large time behavior of weak solutions to a degenerate drift-diffusion system related to Keller–Segel system with the mass supercritical cases under relaxed weight condition. It is known that the large time behavior of solutions is classified by the invariant norms of initial data. For the mass supercritical case, the sufficient condition for unboundedness is given by Kimijima–Nakagawa–Ogawa with the initial data decaying fast at spacial infinity. In this talk, we prove unboundedness of solutions to our problem with more slowly decaying initial data under same assumptions in Kimijima–Nakagawa–Ogawa.

Summary: We study the large time asymptotics of solutions to the Cauchy problem for the generalized Korteweg–de Vries–Burgers–Kuramoto equation where the far field states are prescribed. Especially, we deal with the case when the convective flux is fully convex. 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.

48 Natsumi Yoshida (Ritsumeikan Univ.) Decay structure of solutions toward rarefaction waves to the Cauchy problem for the scalar conservation law with nonlinear viscosity ····· 10

Summary: We study the decay structure of solutions to the Cauchy problem for a one-dimensional scalar conservation law with nonlinear viscosity where the far field states are prescribed. Especially, we deal with the case when the convective flux 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. We investigate that the decay rate in time of the corresponding solutions. The proof is given by a technical time-weighted energy method.

14:15–16:15

49 Fumihiko Hirosawa (Yamaguchi Univ.) On the energy estimate for Klein–Gordon type equations with time dependent singular mass ····· 10

Summary: We consider the energy estimate of the solution to the Cauchy problem of Klein–Gordon type equation with time dependent mass $M(t)$, in particular $M(t)$ has a singularity. The main purpose of this paper is to give sufficient conditions to $M(t)$ for the energy to be asymptotically stable.

50 Hironori Michihisa (Hiroshima Univ.) Expanding methods for evolution operators of strongly damped wave equations ····· 10

Summary: We obtain asymptotic profiles of solutions to the linear strongly damped wave equations in $\mathbf{R}^n$ ($n \geq 1$) by expanding evolution operators in the low frequency regions in the Fourier space.

51 Hiroyuki Takamura (Tohoku Univ.)* Ning-An Lai (Lishui Univ.) Wave-like blow-up and lifespan estimate for solutions of nonlinear wave equations with strong time-decaying damping ····· 10

Summary: We are focusing on the upper bound of the lifespan of solutions of nonlinear wave equations with the scattering damping. All the result should be wave-like, namely the same as non-damped case. In this talk, I will introduce new results which cover most part of the expected one in semilinear case.

52 Motohiro Sobajima (Tokyo Univ. of Sci.) Masahiro Ikeda (RIKEN/Keio Univ.) On a test function method for blowup of solutions to semilinear damped wave equations ····· 10

Summary: In this talk, we consider sharp upper bounds of lifespan of solutions to the semilinear damped wave equation with nonlinearity $|u|^p$. Here we introduce an "improved" test function method to derive sharp upper bounds for the critical case $p = 1 + 2/N$. Several applications of this technique will be also discussed.

53 Motohiro Sobajima (Tokyo Univ. of Sci.) Sharp lifespan estimates for solutions to two-dimensional semilinear heat equation in exterior domains ····· 10

Summary: In this talk, we consider global existence and blowup of solutions to the semiliear heat equation with the nonlinearity u^p in two-dimensional exterior domain. We give sharp lifespan estimates of blowup solutions in the case of two-dimensional exterior domain, which is quite different from that in the case of $N \geq 3$.

54 Takiko Sasaki (Meiji Univ.) The blow-up curve for semilinear wave equations with small spatial velocity ····· 10

Summary: We study one dimensional wave equation $\partial_t^2 u - \epsilon^2 \partial_x^2 u = F(\partial_t u)$. The solution blows-up on a curve $t = T_\epsilon(x)$. We define the blow-up curve corresponding to $v'' = F(v')$ by $t = T(x)$. It is proven that $|T_\epsilon(x) - T(x)| \to 0$ as $\epsilon \to 0$.

55 Haruya Mizutani (Osaka Univ.) Strichartz estimates for Schrödinger equations with slowly decaying potentials 10

Summary: We prove global-in-time Strichartz estimates for the Schrödinger equation with positive real-valued potentials which decay slowly and satisfy a virial type condition at infinity. The repulsive Coulomb potential in three space dimensions is particularly included in our admissible class of potentials.

56 Noriyoshi Fukaya (Tokyo Univ. of Sci.) Masahito Ohta (Tokyo Univ. of Sci.) Strong instability of standing waves for nonlinear Schrödinger equations with attractive inverse power potential 10

Summary: We study the strong instability of standing waves $e^{i\omega t}\phi_\omega(x)$ for nonlinear Schrödinger equations with an attractive inverse power potential, where $\omega \in \mathbb{R}$ and $\phi_\omega \in H^1(\mathbb{R}^N)$ is a ground state of the corresponding stationary equation. In this talk, we prove that if $\partial_\lambda^2 S_\omega(\phi_\omega^\lambda)|_{\lambda=1} \leq 0$, then the standing wave is strongly unstable, where S_ω is the action, and $\phi_\omega^\lambda(x) := \lambda^{N/2}\phi_\omega(\lambda x)$ is the L^2-invariant scaling.

57 Hiroyuki Hirayama (Univ. of Miyazaki) Masahiro Ikeda (RIKEN/Keio Univ.) Well-posedness for the nonlinear fourth order Schrödinger equations 10

Summary: We consider the Cauchy problem of the nonlinear fourth order Schrödinger equations with derivative nonlinearity, which contains second derivative with respect to the spatial variable. The well-posedness of this equation in the Sobolev space H^s is obtained by Hao, Hisao, and Wang (2006) for general settings. We improve this result by using the maximal function norm introduced by Pornnopparath (preprint). Our results contain the well-posedness of the model of the vortex filament treated by Segata (2003, 2004).

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

Neal Bez (Saitama Univ.)♭ Geometric estimates arising in the analysis of Zakharov systems

Summary: In recent years, certain multilinear convolution estimates have arisen and played an important role in the development of the well-posedness theory of Zakharov systems. In 2008, Bejenaru, Herr and Tataru observed that if one is given three transversal hypersurfaces in $\mathbb{R}^3$, then the convolution of two L^2 functions supported on two of these hypersurfaces has a well-defined restriction to the third hypersurface as an L^2 function. For three coordinate hyperplanes, this fact follows from the Loomis–Whitney inequality in $\mathbb{R}^3$, which is not difficult to prove. However, curved hypersurfaces cause substantial difficulty, and one is led to the nonlinear Loomis–Whitney inequality first proved by Bennett, Carbery and Wright in 2004. In 2009, Bejenaru, Herr, Holmer and Tataru used quantitative forms of such singular convolution estimates in their work on the Zakharov system in two spatial dimensions, where a local well-posedness result was established for large data in very low regularity Sobolev spaces. Similar use of multilinear singular convolution estimates has appeared in work of Bejenaru and Herr on the three-dimensional Zakharov system (2010), and more recently in work of Kinoshita on a Klein–Gordon–Zakharov system (2016) and Hirayama and Kinoshita on a system of quadratic derivative nonlinear Schrödinger equations (2018). This talk will include discussion of recent progress on the nonlinear Brascamp–Lieb inequality which substantially extends earlier work on the nonlinear Loomis–Whitney inequality.

September 27th (Thu) Conference Room I

9:15–12:00

58 Masaru Hamano (Saitama Univ.) Long time behavior of the solutions for the Schrödinger system with quadratic nonlinear terms in 5d 10

Summary: We consider the nonlinear Schrödinger system with quadratic interaction in five dimensions. We determine the long time behavior of the solutions to this system with data below the ground state. More precisely, we give conditions for the solutions scatter and conditions for the solutions blow-up or grow-up. Under the condition blowing-up or growing-up, if we additionally assume some conditions, we can prove that the solutions blow-up.

59 Tomoyuki Tanaka (Nagoya Univ.) On the local well-posedness of the third order Benjamin–Ono equation 10

Summary: In this talk, we prove that the third order Benjamin–Ono equation

$$\partial_t u - 4\partial_x^3 u + 3u^2\partial_x u - 3H\partial_x(u\partial_x u) - 3\partial_x(uH\partial_x u) = 0, \quad x \in \mathbb{T}$$

is locally well-posed in $H^s(\mathbb{T})$ for $s \in \mathbb{N}$ and $s \geq 3$. Here, H is the Hilbert transform. The above equation arises from the Benjamin–Ono hierarchy. Nonlinearities in the equation may yeild two derivative losses, which is one difficulty of this problem. The proof is based on the energy method, adding a correction term into the energy so as to overcome the difficulty.

60 Mamoru Okamoto (Shinshu Univ.) Asymptotic behavior of solutions to a higher-order KdV-type equation with critical nonlinearity 10

Summary: We consider the Cauchy problem of a higher-order KdV-type equation with critical nonlinearity in the sense of long-time behavior. Using the method of testing by wave packets, we prove that there exists a unique global solution of the Cauchy problem satisfying the same time decay estimate as that of linear solutions. Moreover, we show that the long-time behavior of the solution is determined by a self-similar solution.

61 Felipe Linares (IMPA) The initial value problem for the generalized KdV equation with low degree of nonlinearity 10
Hayato Miyazaki (Tsuyama Nat. Coll. of Tech.)
Gustavo Ponce (UCSB)

Summary: We consider the initial value problem for the generalized KdV equation with lower degree of nonlinearity than that of the KdV equation. The nonlinearity of our equation is non-Lipschitz continuous in the Sobolev spaces or the weighted Sobolev spaces which are basically considered as the class of solutions, so that the local well-posedness can not be established in these classes. In this talk, we prove the local well-posedness in an appropriate class, and give properties for the propagation of regularity in the right hand side of the data for positive times of real valued solutions in the class.

62 Yohei Yamazaki (Hiroshima Univ.) Center stable manifolds around line solitary waves of Zakharov–Kuznetsov equation 10

Summary: We consider the Zakharov–Kuznetsov equation on a cylindrical space which is one of a high dimensional generalization of KdV equation. The orbital and asymptotic stability of the one soliton of KdV equation on the energy space was proved by Benjamin'72, Pego and Weinstein'92, Martel and Merle'01. We regard the one soliton as a line solitary wave of Zakharov–Kuznetsov equation on a two dimensional space. In the case of the cylindrical space, I showed the stability of the line solitary wave with the traveling speed less than the critical speed c_* and the instability with the traveling speed larger than c_*. In this talk, we show the existence of a center stable manifolds around unstable line solitary wave.

63 Shinya Kinoshita (Nagoya Univ.) Sharp bilinear estimates and its application to a system of quadratic derivative nonlinear Schrödinger equations 10
Hiroyuki Hirayama (Univ. of Miyazaki)

Summary: We consider the Cauchy problem of the system of quadratic derivative nonlinear Schrödinger equations for the spatial dimension $d = 2$ and 3. This system was introduced by M. Colin and T. Colin (2004). The well-posedness of this system in the Sobolev space H^s was obtained by Hirayama (2014). But under some condition for the coefficient of Laplacian, this result is not optimal. We improve the bilinear estimate by using a nonlinear version of the classical Loomis–Whitney inequality and prove well-posedness in H^s for $s \geq 1/2$ if $d = 2$, and $s > 1/2$ if $d = 3$.

Summary: We consider the Cauchy problem of quasilinear thermoelastic Kirchhoff-type plate equations where the heat conduction is modeled by either the Cattaneo law or by the Fourier law. Additionally, we take into account possible inertial effects. The main task consists in proving sophisticated a priori estimates leading to obtaining the global existence of solutions for small data.

Summary: To analyze the dissipative structure of the regularity-loss type, we need more concrete examples and have to study more detailed properties. To this end, we consider the Cauchy problem for a couple of wave and heat equations as one concrete example in this talk.

Summary: This talk is concerned with the weak dissipative structure for linear symmetric hyperbolic systems with relaxation. We had already known the new dissipative structure called the regularity-loss type. Compared with the dissipative structure of the standard type, the regularity-loss type possesses a weaker structure in the high-frequency region in the Fourier space. Under this situation, we introduce new concepts and extend our previous results to cover complicated models.

Summary: In this talk, we introduce a new approach to obtain the property of the dissipative structure for a system of differential equations. If the system has a viscosity or relaxation term which possesses symmetric property, Shizuta and Kawashima in 1985 introduced the suitable stability condition for the corresponding eigenvalue problem and derived the detailed relation between the coefficient matrices of the system and the eigenvalues. However, there are some complicated physical models which possess a non-symmetric viscosity or relaxation term and we can not apply this condition to these models. Under this situation, our purpose is to extend classical stability condition for complicated models.

Summary: We will talk on the hydrostatic approximation on the Primitive equation and its justification from the Navier–Stokes equations. First we will introduce some previous results on the Primitive equation and the Navier–Stokes equations. After that we will show our results and essence of the proof.

Summary: We consider the diffusion and heat systems on an evolving surface with boundaries from an energetic point of view. We employ an energetic variational approach to derive our diffusion and heat systems on the evolving surface. Moreover, we study the boundary conditions for our systems to investigate both conservation and energy laws of the systems.

70 Hajime Koba (Osaka Univ.) Mathematical modeling of compressible fluid system on an evolving surface with boundaries ····· 10

Summary: We consider compressible fluid flow on an evolving surface with boundaries from an energetic point of view. We employ both an energetic variational approach and the first law of thermodynamics to derive our compressible fluid systems on the evolving surface. Moreover, we investigate the boundary conditions in co-normal direction for our system to study conservation and energy laws of the system.

71 Kazuki Sato (Osaka Univ.) Energetic variational approaches for non-Newtonian fluid systems ···· 10
Hajime Koba (Osaka Univ.)

Summary: We consider the dominant equations for the motion of the non-Newtonian fluid in a domain from an energetic point of view. A non-Newtonian fluid is a fluid that does not follow Newton's law of viscosity. In this lecture, we focus on several energies dissipation due to the viscosities of the non-Newtonian fluid to study the dominant equations for the motion of the fluid. We apply our energetic variational approaches to make a mathematical model of the non-Newtonian fluid flow. Although the system is abstract, our results make it possible to give some previous models of non-Newtonian fluid flow to a mathematical validity.

14:15–16:15

72 Ryosuke Nakasato (Tohoku Univ.) A regularity criterion for the density-dependent magnetohydrodynamics system in critical Besov spaces ····· 10

Summary: Density-dependent magnetohydrodynamics system describes the coupling between the density-dependent Navier–Stokes equation and the Maxwell equation. For the Euler equation, Beale–Kato–Majda proved the regularity criterion for the local solutions. That is a smooth solution of the Euler equation u in $\mathbb{R}^3$ on $[0,T)$ is regular after $t \geq T$, provided that rot $u \in L^1(0,T;L^\infty(\mathbb{R}^3))$. In this talk, we study the Beale–Kato–Majda type criterion for the solution of density-dependent magnetohydrodynamics system.

73 Ken Abe (Osaka City Univ.) Vanishing viscosity of axisymmetric flows ····· 10

Summary: We report some result on existence of global weak solutions of the Euler equations in an infinite cylinder.

74 Ryo Kanamaru (Waseda Univ.) Brezis–Gallouet–Wainger type inequalities and a priori estimates of time local strong solutions to Navier–Stokes equations ····· 10

Summary: We shall find the largest normed space (or the weakest norm) that satisfies the Brezis–Gallouet–Wainger type inequality. As an application of such an inequality, we shall establish the new a priori estimate of strong solutions to Navier–Stokes equations which has an almost single exponential growth form with respect to the scaling invariant quantity of the vorticity. Our method is based on the double logarithmic type inequality by means of the Morrey space.

75 Mitsuo Higaki (Kyoto Univ.) On stationary two-dimensional flows around a fast rotating disk ····· 10
Yasunori Maekawa (Kyoto Univ.)
Isabelle Gallagher (École Norm. Sup.)

Summary: We study the two-dimensional stationary Navier–Stokes equations describing flows around a rotating disk. The existence of unique solutions is established for any rotating speed, and qualitative effects of a large rotation are described by exhibiting a boundary layer structure and an axisymmetrization of the flow.

76 Hiroyuki Tsurumi (Waseda Univ.) Ill-posedness of the stationary Navier–Stokes equations in scaling invariant homogeneous Besov spaces 10

Summary: We consider the stationary Navier–Stokes equations in $\mathbb{R}^n$ for $n \geq 3$ in the scaling invariant Besov spaces. It is proved that if $n < p \leq \infty$ and $1 \leq q \leq \infty$, or $p = n$ and $2 < q \leq \infty$, then some sequence of external forces converging to zero in $\dot{B}^{-3+\frac{n}{p}}_{p,q}$ can admit a sequence of solutions which never converges to zero in $\dot{B}^{-1}_{\infty,\infty}$, especially in $\dot{B}^{-1+\frac{n}{p}}_{p,q}$. Our result may be regarded as showing the borderline case between ill-posedness and well-posedness, the latter of which Kaneko–Kozono–Shimizu proved when $1 \leq p < n$ and $1 \leq q \leq \infty$.

77 Shuichi Jimbo (Hokkaido Univ.) Hadamard variational formula for the multiple eigenvalue of the Stokes equations with friction slip boundary conditions
Erika Ushikoshi (Yokohama Nat. Univ.) 10

Summary: We consider the eigenvalue problem of the Stokes equations with slip boundary conditions. More precisely, under a smooth domain perturbation, we analyze the domain dependency of the multiple eigenvalue of the Stokes equations with such a boundary condition. We succeeded to prove the differentiability of the eigenvalues for the perturbation parameter, and to clarify the representation for that.

78 Hirokazu Saito (Tokyo Univ. of Sci.) Local solvability of the Navier–Stokes–Korteweg equations in the maximal regularity class 10

Summary: In this talk, we would like to consider the Navier–Stokes–Korteweg equations on general domains under the non-slip boundary condition. We prove the local solvability of the Navier–Stokes–Korteweg equations in the maximal regularity class.

79 Yoshihiro Shibata (Waseda Univ.) Global well-posedness for the Navier–Stokes–Korteweg system in $\mathbb{R}^N$
Miho Murata (Kanagawa Univ.) 10

Summary: In this talk, we consider the compressible fluid model of Korteweg type which was introduced by J. E. Dunn and J. Serrin in 1985. It is shown that the system admits a unique, global strong solution for small initial data in $\mathbb{R}^N$, $N \geq 2$. For the purpose, the main tools are the maximal L_p-L_q regularities and L_p-L_q decay properties to the linearized equations. This talk is based on a joint work with Professor Yoshihiro Shibata in Waseda University.

80 Ryo Takada (Kyushu Univ.) Strongly stratified limit for the 3D inviscid Boussinesq equations 10

Summary: We consider the initial value problem of the 3D inviscid Boussinesq equations for stably stratified fluids. We prove the long time existence of classical solutions for large initial data when the buoyancy frequency is sufficiently high. Furthermore, we consider the singular limit of the strong stratification, and show that the long time classical solution converges to that of 2D incompressible Euler equations in some space-time Strichartz norms.

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

Reika Fukuizumi (Tohoku Univ.) Temperature effects in Bose–Einstein condensation

Summary: The stochastic Gross–Pitaevskii equation is used as a model to describe Bose–Einstein condensation at positive temperature. The equation is a complex Ginzburg–Landau equation with a trapping potential and an additive space-time white noise. In this talk, we present an answer to two important questions for this system: the global existence of solutions in the support of the Gibbs measure, and the convergence of those solutions to the equilibrium for large time. In order to prove the convergence to equilibrium, we use the associated purely dissipative equation as an auxiliary equation, for which the convergence may be obtained using standard techniques. Global existence is obtained for all initial data, and not almost surely with respect to the invariant measure.

Real Analysis

September 26th (Wed) Conference Room II

9:00–12:00

1 Yoshifumi Ito (Tokushima Univ.*) Axiomatic method of measure and integration (III). Definition and existence theorem of the Lebesgue measure ····· 15

Summary: This paper is the part III of the series of the articles of the axiomatic method of measure and integration. In this paper, we define the Lebesgue measure on $\boldsymbol{R}^d, (d \geq 1)$ by prescribing the complete system of axioms. Then we prove the uniquness and existence theorem of the Lebesgue measure. This is a new result.

2 Yoshifumi Ito (Tokushima Univ.*) Axiomatic method of measure and integration (IV). Definition of the Lebesgue integral and its fundamental properties ····· 15

Summary: This paper is the part IV of the series of the articles of the axiomatic method of measure and integration. In this paper, we define the Lebesgue integral of the Lebesgue measurable functions on $\boldsymbol{R}^d, (d \geq 1)$. Then we study the method of calculation of the Lebesgue integral. Further we clarify the convergence properties of the Lebesgue integral completely. These facts are the new results.

3 Yōhei Yamasaki Non-oriented volume and non-oriented integral in the C^0 class ····· 15

Summary: The author discussed the oriented and non-oriented volumes in the C^0 class. It was found, however, an example which violates the property, "The non-oriented volume exceeds the oriented volume". This definition estimates the desired value of the non-oriented volume too small, if it exists. So this talk proposes a new definition of the non-oriented volume to avoid this counter example. Our new definition gives an upper estimate for the desired value, if it does exist. We may conclude that it is not the fault of this definition, even if the property above does not hold.

4 Yōhei Yamasaki Minkowski content, the volume that admits the cartesian product property ····· 15

Summary: Minor dimensional measures were proposed by many authors for a subset of an euclidean space. These measures, however, did not assure the property, "The value of product set is given by the product of the value of it's component". This talk points out that this property holds for Mincowski content, though it is not sigma-additive.

5 Ryoji Fukuda (Oita Univ.)
Aoi Honda (Kyushu Inst. of Tech.)
Yoshiaki Okazaki
(Fuzzy Logic Systems Inst.) Convergence theorems for Pan and Lehrer integrals ····· 15

Summary: In this talk we discuss some convergence theorems for Pan and Lehrer integrals. A fuzzy measure is a monotone set function, and this may be non-additive. There are several integrals with respect to fuzzy measures and some of them are defined using distribution functions. For such integrals, a unified discussion was given by J. Kawabe. Our target Integrals: Pan and Lehrer integrals are not defined using distribution functions. We give some sufficient conditions for some convergence theorems.

6 Ryoji Fukuda (Oita Univ.)
Aoi Honda (Kyushu Inst. of Tech.)
Yoshiaki Okazaki
(Fuzzy Logic Systems Inst.) Convergence theorem of algebraic product inclusion-exclusion integral ····· 15

Summary: In this talk, we discuss a convergence theorem for the algebraic product inclusion-exclusion integral, which is a non-linear integral with respect to a non-additive measure. We show a monotone uniform convergence theorem for this integral under the assumption that the measure is continuous from below.

Summary: We will talk about contractive conditions on mappings on metric spaces.

Summary: The equiliburium problem is one of the nonlinear problems including various problems in convex analysis, and a large number of researchers has been investigating it in the setting of Hilbert and Banach spaces. In this work, we deal with this problem defined on a complete geodesic space and consider the existence of the resolvent operator and its properties with several results concerning the approximation to the solutions of this problem.

Summary: Convex minimization problem is one of the nonlinear optimization problems. We study this problem by using various approches in the setting of a complete CAT(1) space. It is known that the set of fixed points of the resolvent of a convex function coincides with its minimizers. Hence we find a fixed point of the resolvent instead of a minimizer of the convex function. To find a solution to this problem, we consider Mann type iteration for two resolvents, and prove its convergence property. We introduce this theorem and several properties of the resolvents.

Summary: We prove the existence and uniqueness of solutions of boundary value problems for differential equations of order α where $3 < \alpha \leq 4$.

Summary: In this talk, we study attractive points of normally generalized hybrid mappings. Using the idea of attractive points, we prove weak convergence theorems for the mappings. We also prove some convergence theorems for nonlinear mappings.

14:15–16:30

Summary: We construct a subset of $\mathbb{R}^d$ which asymptotically and omnidirectionally contains arithmetic progressions but has Assouad dimension 1. More precisely, we say that F asymptotically and omnidirectionally contains arithmetic progressions if we can find an arithmetic progression of length k and gap length $\Delta > 0$ with direction $e \in S^{d-1}$ inside the $\epsilon\Delta$ neighbourhood of F for all $\epsilon > 0$, $k \geq 3$ and $e \in S^{d-1}$. Moreover, the dimension of our constructed example is the lowest-possible because we prove that a subset of $\mathbb{R}^d$ which asymptotically and omnidirectionally contains arithmetic progressions must have Assouad dimension greater than or equal to 1. We also get the same results for arithmetic patches, which are the higher dimensional extension of arithmetic progressions.

13 Takeshi Iida (Fukushima Nat. Coll. of Tech.)
Yoshihiro Sawano (Tokyo Metro. Univ.)
Orlicz-fractional maximal operators on weighted L^p spaces 15

Summary: In this talk, we consider the weak-boundedness of the fractional Orlicz maximal operators $M_{B,\alpha}$. If $\alpha = 0$, the weak-boundedness for the Orlicz maximal operator M_B is characterized by condition $B(t) \leq Ct^p$. Condition $B(t) \leq Ct^p$ characterizes the weak-boundedness for the fractional cases too. Amazingly, the condition unifies the Hardy–Littlewood–Sobolev type and the Sawyer type: Given the appropriate conditions of indices, the weak-boundedness of the Hardy–Littlewood–Sobolev type is equivalent to the weak-boundedness of the Sawyer type.

14 Minglei Shi (Ibaraki Univ.)
Ryutaro Arai (Ibaraki Univ.)
Eiichi Nakai (Ibaraki Univ.)
Campanato spaces and commutators of generalized fractional integral operators on Orlicz spaces 15

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

15 Ryota Kawasumi
Eiichi Nakai (Ibaraki Univ.)
Pointwise multipliers on weak Orlicz spaces 15

Summary: In this talk we give the characterization of pointwise multipliers on weak Orlicz spaces. To do this we first prove a generalized Hölder's inequality for the weak Orlicz spaces. Next, to characterize the pointwise multipliers, we use the fact that all pointwise multipliers from a weak Orlicz space to another weak Orlicz space are bounded operators

16 Ryutaro Arai (Ibaraki Univ.)
Eiichi Nakai (Ibaraki Univ.)
Gaku Sadasue (Osaka Kyoiku Univ.)
Fractional integrals on martingale Orlicz spaces 15

Summary: It is well known as the Hardy–Littlewood–Sobolev theorem that the fractional integral operators I_α on the Euclidean space $\mathbb{R}^n$ is bounded from L_p to L_q for $1 < p < q < \infty$, $0 < \alpha < n$ and $-n/p + \alpha = -n/q$. In martingale theory, based on the result by Watari (1964), Chao and Ombe (1985) proved the boundedness of the fractional integrals for H_p, L_p, BMO and Lipschitz spaces of the dyadic martingales. These fractional integrals were defined for more general martingales by Sadasue (2011). On the other hand, martingale Morrey spaces and their generalization were introduced by Nakai and Sadasue (2012) and Nakai,Sadasue and Sawano (2013), respectively, and the boundedness of fractional integrals as martingale transforms were established. In this talk we investigate the boundedness of fractional integrals on martingale Orlicz spaces.

17 Hiroyuki Tsurumi (Waseda Univ.)
Counter examples of the bilinear estimates of the Hölder type inequality in homogeneous Besov spaces 10

Summary: We consider the bilinear estimates of a product of functions in homogeneous Besov spaces showed by Bony. It is seen that if we change the condition of indices denoting differential orders, then we can find examples of functions that never satisfy the bilinear estimates. Such examples can be constructed due to those used in the ill-posedness problem of the Navier–Stokes equations, such as Bourgain–Pavlović and Yoneda.

Summary: In the theory of orthogonal polynomials, (non-trivial) probability measures on the unit circle are parametrized by the Verblunsky coefficients. Baxter's theorem asserts that such a measure is absolutely continuous and has positive density with summable Fourier coefficients if and only if its Verblusnky coefficients are summable. This talk presents a version of Baxter's theorem in the matrix case from a view point of the Nehari problem.

Summary: In this talk, we investigate the composition of the fractional maximal operators with the d-dimensional weighted Hausdorff content H^d_ω. In the special case, it is shown that the iterated Hardy–Littlewood maximal operators M^N is bounded from $L^p(M\omega)$ to $L^p(\omega)$ with an arbitrary weight ω and any $N \in \mathbb{N}$.

Summary: A sparse bound for local smoothing operators related to maximal Riesz means is given.

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

Jun Kawabe (Shinshu Univ.) A unified approach to convergence theorems of distribution-based nonlinear integrals

Summary: The Lebesgue integral is used to aggregate an infinite number of inputs into a single output value, and gives a continuous aggregation process as a result of the Lebesgue convergence theorem.
The Choquet, Šipoš, Sugeno, and Shilkret integrals may be considered as a nonlinear aggregation functional $I\colon \mathcal{M}(X) \times \mathcal{F}^+(X) \to [0,\infty]$, where $\mathcal{M}(X)$ is the set of all nonadditive measures $\mu\colon \mathcal{A} \to [0,\infty]$ on a measurable space $(X,\mathcal{A})$, and $\mathcal{F}^+(X)$ is the set of all $\mathcal{A}$-measurable functions $f\colon X \to [0,\infty]$. For this functional, its continuity corresponds to a convergence theorem of integral, which means that the limit of the integrals of a sequence of functions is the integral of the limit function. Many attempts have thus been made to formulate the monotone, the bounded, the dominated, and the Vitali convergence theorems for the Choquet, Šipoš, Sugeno, and Shilkret integrals, all of which are nonlinear integrals determined by the μ-decreasing distribution function $G_\mu(t) := \mu(\{f \geq t\})$.
The purpose of this talk is to present a unified approach to those convergence theorems of such distribution-based nonlinear integrals, in other words, an approach that does not depend on the types of nonlinear integrals. A crucial ingredient is a perturbation of functional that manages the change in the functional value $I(\mu, f)$ when the integrand is slightly shifted from f to $f+\varepsilon$ and the μ-decreasing distribution function is slightly shifted from $G_\mu(f)$ to $G_\mu(f)+\delta$.

September 27th (Thu) Conference Room II

9:15–12:00

21 Masaaki Mizukami (Tokyo Univ. of Sci.)
Hirohiko Otsuka (Tokyo Univ. of Sci.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Boundedness in a chemotaxis-haptotaxis system with signal-dependent sensitivity · · · · · 15

Summary: In this talk we consider a chemotaxis-haptotaxis system with signal-dependent sensitivity. In the previous works by Cao (2016), Tao (preprint) and Tao–Winkler (2014) it was shown that the system without signal-dependent sensitivity possesses a global classical solution some conditions; however, the system with signal-dependent sensitivity has not been studied. The purpose of this talk is to establish globlal existence and boundedness in the system with signal-dependent sensitivity.

22 Shunsuke Kurima (Tokyo Univ. of Sci.) A nonlocal Cahn–Hilliard equation on an unbounded domain · · · · · 15

Summary: This talk deals with a nonlocal Cahn–Hilliard system on an unbounded domain with smooth bounded boundary. In the case of bounded domains, this system has been studied by using a Faedo–Galerkin approximation scheme considering a compactness. However, in the case of unbounded domains, the compactness breaks down. The present work establishes existence and energy estimates of weak solutions for the above system on an unbounded domain.

23 Keiichiro Kagawa (Waseda Univ.)
Mitsuharu Ôtani (Waseda Univ.)
Initial boundary value problem of the viscous Cahn–Hilliard equation · · · · · 15

Summary: We consider the initial boundary value problem for the viscous Cahn–Hilliard equation. In 2014, Bui, et al. proved the existence of strong solutions under the condition that the nonlinear term $\varphi(u)$ satisfies $\varphi(u)u \geq 0$ for all $u \in \mathbb{R}$ and Sobolev subcritical growth condition. In this talk, we exclude these conditions by decomposing the nonlinear term $\varphi(u)$ into the sum of a monotone function and a locally Lipschitz perturbation and show the existence of global solutions. In physics, $\varphi(u) = u^3 - u$ is often used as a typical example. However, the previous result cannot cover this case. Our framework can cover not only this case but also more general cases $\varphi(u) = |u|^{p-2}u - |u|^{q-2}u$ with $p > q \geq 2$.

24 Kosuke Kita (Waseda Univ.)
Mitsuharu Ôtani (Waseda Univ.)
Bounds for global solutions of a reaction diffusion system · · · · · 15

Summary: We consider the uniform boundedness for global solutions of a reaction diffusion system arising from a nuclear reactor model with the Robin boundary condition, which consists of two real-valued unknown functions. Since this system has no variational structure, we cannot apply the standard methods relying on the Lyapunov functional in order to obtain a priori estimates of global solutions. To cope with this difficulty, we make use of the weighted L^1 norm characterized by the first eigenfunction of Laplacian with the Robin boundary condition.

25 Takanori Kuroda (Waseda Univ.)
Mitsuharu Ôtani (Waseda Univ.)
Periodic solutions for complex Ginzburg–Landau equations in bounded domains · · · · · 15

Summary: We are concerned with the existence of time periodic solutions for the following complex Ginzburg–Landau equation, (CGL):

$$u_t(t,x) - (\lambda + i\alpha)\Delta u + (\kappa + i\beta)|u|^{q-2}u - \gamma u = f(t,x) \quad \text{on } [0,T] \times \Omega,$$

where $\lambda, \kappa > 0$; $\alpha, \beta, \gamma \in \mathbb{R}$; i denotes the imaginary unit; $T > 0$; $f : [0,T] \times \Omega \to \mathbb{C}$ is a given external force and Ω is bounded domains with smooth boundaries. Our approach to (CGL) is to regard it as a parabolic equation governed by $-\lambda\Delta u + \kappa|u|^{q-2}u$. Since (CGL) has a monotone perturbation $-i\alpha\Delta u$ and a non-monotone one $i\beta|u|^{q-2}u$, it is hard to directly apply general theories for periodic problems of parabolic equations.

Summary: In this talk we discuss an initial boundary value problem describing a real experiment related to the Soret effect on a bounded domain in a plane. Our aim is to present a numerical method for the problem by using a dummy variable, since the shape of the domain is rather complex. Here, we shall show the idea and prove a existence and uniqueness of a solution to the approximation problem given by the dummy variable.

Summary: In this talk, we consider a system of parabolic type PDEs. Each constituent system is based on the mathematical model of grain boundary motion, proposed by [Kobayashi-et. al, Physica D., 140 (2000), 141–150], and the principal part of the system consists of a quasilinear diffusion equation of singular type, subject to the dynamic boundary condition. The objective of this study is to obtain a uniform mathematical method for the models of grain boundary motions including dynamic boundary conditions. On this basis, we here address three issues. The first is to show the existence of solutions to the systems, including the rigorous expressions of solutions. The second is to show the continuous associations among the different systems. The final is to show the large time behavior of solutions. The three issues will be demonstrated in forms of the Main Theorems of this talk.

Summary: We consider the existence and uniqueness of solutions to the initial value problem for a scalar conservation law with a flux function which is discontinuous with respect to the unknown function. For the initial value problem, we generalize the shock admissibility condition introduced by Oleinik. Using the wave front tracking method constructed by shock waves which satisfy the generalized shock admissibility condition, we prove the existence of weak solutions to the initial value problem. Moreover, for the initial value problem, we generalize the well-posedness theory introduced by Liu and Yang. Using the generalized theory, we derive an L^1 contractive estimate concerned with weak solutions to the initial value problem.

Summary: Systems for parabolic-hyperbolic conservation laws are interesting research object in the sense of mathematics and applications. In a mathematical point of view, the systems have both properties of hyperbolic equations and those of parabolic equations. Therefore, it has discontinuous solutions in general. From this, the unified well-posedness theory is not given. In application point of view, the systems can be applied to many mathematical models (fluid dynamics, traffic flow, aggregation phenomena, crowd dynamics and so on). In this talk, we formulate initial value problems for the systems with anisotropic diffusion terms and discuss the well-posedness for the problem.

Summary: We study the definition of the semigroup generated by the Dirichlet Laplacian of fractional order on an arbitrary open set and its properties. It will be shown that we obtain the boundedness, the smoothing effects and the maximal regularity estimates in the homogeneous Besov spaces as well as whole space case.

14:15–16:00

31 Yutaka Tsuzuki (Hiroshima Shudo Univ.) Initial-boundary value problems for Vlasov–Poisson equations with angle error in a half-space ····· 15

Summary: We deal with initial-boundary problems for Vlasov–Poisson equations in a half-space with magnetic. In 2013, Skubachevskii gives local-in-time solvability to the system. Moreover, in 2017, existence result with waeker condition were obtained by effectively using the magnetic force whose direction is horizontal to the wall. This talk provides an existence result for the equation where the magnetic force has angle error in the vertical direction.

32 Risei Kano (Kochi Univ.) The existence of solutions for the non-linear hardening models ····· 15

Summary: In this talk, we discuss the parabolic problem form the hardening phenomena. The unknown functions u and σ describe the displacement and stress, respectively in the one-dimensional interval $(0, L)$. Our problem means the hardening problem that the materials are harden by plasticity. That is derived from the hardening model by Visintin (2006), and the perfect plasticity model by Duvaut–Lions (1976).
In the perfect plasticity model, the function that is threshold value in the plastic deformation, is a constant. In this talk, we discuss the solvability for the above model with the threshold function depending upon time or unknown function, based on the idea of Duvaut–Lions (1976). The problem equipped with the constraint set depend on the unknown function, is called quasi-variational inequality. The solvabilities of quasi-variational inequality have been dealt with in some papers.

33 Kota Kumazaki (Nagasaki Univ.)
Adrian Muntean (Karlstad Univ.) Existence of a global solution for a moving boundary problem describing swelling ····· 15

Summary: In this talk, we propose a mathematical model describing water swelling in porus materials. Water swelling is a important issue to investigate frost damage which is a nonlinear phenomenon to give rise to crack on the concrete surface. Our model consists of a diffusion equation for water content in a one microscopic hole inside of concrete and a ordinaly differential equation describing the growth rate of the front of the water content region. In this talk, we discuss the existence and uniqueness of a time local and global solution for this problem.

34 Ken Shirakawa (Chiba Univ.)
Noriaki Yamazaki (Kanagawa Univ.)
Harbir Antil (George Mason Univ.) A class of optimal control problems for one-dimensional Kobayashi–Warren–Carter type systems ····· 15

Summary: In this talk, we consider a class of optimal control problems for state problems of one-dimensional parabolic PDE systems. Each state problem is denoted by $(\mathrm{S})_\varepsilon$, with $\varepsilon > 0$, and is associated with the phase-field model of grain boundary motion, proposed by [Kobayashi et al.; Phys. D, 140 (2000), 141–150]. In this regard, each optimal control problem is denoted by $(\mathrm{OCP})_\varepsilon$, with $\varepsilon > 0$, and it is prescribed as a minimization problem of a cost. Additionally, the problems $(\mathrm{S})_\varepsilon$ and $(\mathrm{OCP})_\varepsilon$ are supposed to admit limiting profiles as $\varepsilon \downarrow 0$, and then, the limiting problems are supposed to contain no little singularityies. In this talk, the main interest is in the case when $\varepsilon > 0$ (regular case), and the mathematical results concerned with 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.

35 Noriaki Yamazaki (Kanagawa Univ.)
Nobuyuki Kenmochi (Univ. of Warsaw)
Ken Shirakawa (Chiba Univ.)
Double quasi-variational evolution equations governed by time-dependent subdifferentials 15

Summary: In this talk, we show the existence of solutions to the following double quasi-variational evolution equations governed by time-dependent subdifferentials in a uniformly convex Banach space V^*:

$$\partial_*\psi^t(u;u'(t)) + \partial_*\varphi^t(u;u(t)) + g(t,u(t)) \ni f(t) \text{ in } V^* \text{ for a.a. } t \in (0,T).$$

Here, the time-dependent function $\psi^t(v;z)$ is proper, lower semi-continuous (l.s.c.), and convex in $z \in V$. Also, $\varphi^t(v;z)$ is a time-dependent, non-negative, continuous convex function in $z \in V$. Note that $(t,v) \in [0,T] \times C([0,T];H)$ is a parameter that determines the convex functions $\psi^t(v;\cdot)$ and $\varphi^t(v;\cdot)$ on V. In addition, the subdifferentials $\partial_*\psi^t(v;z)$ of $\psi^t(v;z)$ with respect to $z \in V$ is a multivalued operator in V^*, and $\partial_*\varphi^t(v;z)$ of $\varphi^t(v;z)$ with respect to $z \in V$ is a single-valued linear operator in V^*.

36 Akio Ito
Evolution inclusion on a real Hilbert space with quasi-variational structure for inner product —Existence of global-in-time solutions— 15

Summary: We consider a Cauchy problem of an abstract evolution inclusion on a real Hilbert space associated with subdifferentials of time-dependent proper l.s.c. convex functions. The abstract evolution inclusion, which is treated in this paper, contains not only convex functions but also inner products of the Hilbert space depending upon unknown functions. Especially, we call such structures for convex functions and inner products quasi-variational structures for convex functions and inner products. The main purposes of this paper are to show the existence of global-in-time solutions to the Cauchy problem, which has the quasi-variational structures.

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

Toshiyuki Suzuki (Kanagawa Univ.)
Semilinear Schrödinger evolution equations with inverse-square potentials

Summary: We consider the nonlinear Schrödinger equations with inverse-square potentials (NLS)

$$i\frac{\partial u}{\partial t} = \Big(-\Delta + \frac{a}{|x|^2}\Big)u + g_0(u) \quad \text{in } \mathbb{R}\times\mathbb{R}^N,$$

where $i = \sqrt{-1}$, $N \geq 3$, and $a \geq a(N) = -(N-2)^2/4$. The condition of a is derived from the selfadjointness of $P_a := -\Delta + a|x|^{-2}$ (in the sense of form-sum). For instance, we suppose $g_0(u) := \pm|u|^{p-1}u$ or $g_0(u) := \pm u\,(|x|^{-\gamma} * |u|^2)$; so that (NLS) conserves the charge and energy. The perturbed operator P_a has a lot of interesting properties both in physical and mathematical sides. In this talk we solve the Cauchy problems for (NLS) in the energy class and analyze the global solutions to (NLS). If $a > a(N)$, the energy class is just equal to $H^1(\mathbb{R}^N)$ (L^2-type Sobolev space). But if $a = a(N)$, the energy class is a little wider than $H^1(\mathbb{R}^N)$. Thus it is difficult to apply the usual contraction principle to solve (NLS). Hence we need to apply another approach: energy methods. If we have time, we generalize the perturbed potential $a|x|^{-2}$ as inverse-square singular potentials $V(x)$: $V(\mu x) = \mu^{-2}V(x)$ ($\mu > 0$); for example, $V(x) = (b\cdot x)|x|^{-3}$.

Functional Analysis

September 24th (Mon) Conference Room III

10:30–12:00

1 Hiroshi Inoue (Daiichi Univ. of Pharm.) Non-self-adjoint Hamiltonian based on generalized Riesz systems (1) 10

Summary: In this talk, I shall introduce my studies and ideas about non-self-adjoint Hamiltonian and some physical operators constructed from biorthogonal sequences in a Hilbert space. The notion of generalized Riesz system plays an important rule such studies. From this reason, I introduce under what assumptions a biorthogonal sequence is a generalized Riesz system and construct some well-defined physical operators.

2 Hiroshi Inoue (Daiichi Univ. of Pharm.) Non-self-adjoint Hamiltonians based on generalized Riesz systems (2) 10

Summary: In this talk, I shall introduce my studies about relationships between generalized Riesz systems and D-quasi bases. The notion of D-quasi bases is an important rule for constructing non-self-adjoint hamiltonian and physical operators in case that D_φ and D_ψ are not dense in H.

3 Takeo Kamizawa (Tokyo Univ. of Sci.) Criteria for the reducibilities of linear systems 10

Summary: In this presentation, we will study two approaches for the reducibility of linear ordinary differential equations: algebraic reducibility and the Lyapunov reducibility. For those aspects, several criteria of reducibility will be introduced and discussed. Especially, the generalised Shemesh criterion can be used to check the existence of a common eigenspace, so it can determine if a Fedorov type solution exists.

4 Shuji Watanabe (Gunma Univ.)* The second-order phase transition in the BCS-Bogoliubov model of superconductivity and its operator-theoretical proof 15

Summary: We give an operator-theoretical proof of the statement that the transition from a normal conducting state to a superconducting state is a second-order phase transition in the BCS-Bogoliubov model of superconductivity. Here we have no magnetic fields.

5 Kazuyuki Wada (Nat. Inst. of Tech., Hachinohe Coll.) Absence of wave operators for quantum walks 15

Summary: We consider 1-dimensional quantum walks on the line. It is known that if a coin operator rapidly converges to a unitary matrix, then the wave operator exists. We consider the coin operator which slowly converges to a unitary matrix. It is shown that the wave operator does not exist.

6 Hisashi Morioka (Doshisha Univ.) Etsuo Segawa (Tohoku Univ.) Detection of edge defects by embedded eigenvalues of quantum walks 15

Summary: We derive a detection method of edge defects for position-dependent quantum walks using eigenvalues embedded in the continuous spectrum of time evolution operators. The localization occurs if the initial state has an overlap with an eigenfunction of the time evolution operator. However, we cannot detect the existence of edge defects by the existence of the localization. The existence of edge defects is distinguished by the location of eigenvalues of the time evolution operator.

14:15–16:15

7 Shu Nakamura (Univ. of Tokyo) Kouichi Taira (Univ. of Tokyo) Essential self-adjointness of pseudodifferential operators on Euclidean spaces 15

Summary: In this talk, we prove the essential self-adjointness of real principal type pseudo-differential operators in Eucliedan spaces under null non-trapping condition. For a proof, we employ microlocal propagation estimates in a interior region and a exterior region respectively. This is joint work with Shu Nakamura.

Summary: We consider discrete Schrödinger operators on the 2-dimensional hexagonal lattice, which is a tight-binding model of Hamiltonian on a graphene sheet. In this talk, we construct Isozaki–Kitada modifiers for a pair of the discrete Schrödinger operator without potential and that with a long-range potential.

Summary: We consider the stableness for time-dependent propagator generated by the Klein–Gordon system with time dependent homogeneous electric fields, such a system can be described thorough the time-dependent non-selfadjoint operator.

Summary: We study the resonances of a two-by-two semiclassical system of one dimensional Schrödinger operators, near an energy where the two potentials intersect transversally, one of them being bonding, and the other one anti-bonding. We obtain estimates on the location and on the widths of these resonances. Our method relies on the construction of fundamental solutions for the two scalar unperturbed operators, and on an iterative procedure in order to obtain solutions to the system.

Summary: We propose a refined trace theorem which shows that the Fourier transform of weighted $L^2(\mathbf{R}^n)$ functions can be regarded as L^2 functions on each sphere $|x| = r$ $(n \geq 2)$ for a wide class of weighted functions. We discuss also about the Hölder continuity with respect to r. As the application we consider uniform resolvent estimates of Dirac operators for the massive or massless case.

Summary: We consider a generalized pair-interaction model $H(\lambda)$ in quantum field theory with a coupling constant $\lambda \in \mathbb{R}$. We talk about the spectrum of $H(\lambda)$ for all $\lambda \in \mathbb{R}$. In this talk, we introduce the operator $H(\lambda)$ is diagonalized by a proper Bogoliubov transformation for some $\lambda \in \mathbb{R}$. In particular, $H(\lambda)$ has bound states for some λ.

Summary: The existence of the ground state of the so-called semi-relativistic Pauli–Fierz model is proven. Let A be a quantized radiation field and $H_{\mathrm{f},m}$ the free field Hamiltonians which is the second quantization of $\sqrt{|k|^2 + m^2}$. The semi-relativistic Pauli–Fierz Hamiltonian is given by
$H_{\mathrm{SRPF}} = \sqrt{(-i\nabla \otimes 1 - A)^2 + M^2} + V \otimes 1 + 1 \otimes H_{\mathrm{f},m}$
for $(m, M) \in [0, \infty) \times [0, \infty)$. We emphasize that our results include a singular case $(m, M) = (0, 0)$.

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

Tadahiro Miyao (Hokkaido Univ.) Magnetism and operator inequalities

Summary: In this talk, I will review recent studies on the Hubbard model, which is expected to describe metallic ferromagnetism in strongly correlated electron systems. I will begin with a description of the physical background, then I will present a list of open problems in this field.
As an attempt to solve the problems, a new viewpoint of universality is introduced in strongly correlated electron systems. Our description relies on the operator theoretic correlation inequalities. I explain the Marshall–Lieb–Mattis theorem and Lieb's theorem from a viewpoint of universality. In addition, from the new perspective, I prove that Lieb's theorem still holds true even if the electron-phonon and electron-photon interactions are taken into account. I also study Nagaoka–Thouless' theorem and its stabilities in terms of universality.

September 25th (Tue) Conference Room III

9:15–12:00

14 Junichi Fujii (Osaka Kyoiku Univ.) On PM-property for the representing functions of power difference means ····· 15

Summary: The class of power difference means, which is closely related to that of Stolarsky ones, includes typical operator means in the sense of Kubo–Ando. On the other hand, Wada pointed that the property 'PMI' implies the Ando–Hiai inequality, which becomes recently the remarkable one in the theory of multivariate operator means. In this talk, we restrict ourselves to representing operator monotone functions and discuss when the power difference means satisfy PMI or PMD.

15 Yuki Seo (Osaka Kyoiku Univ.) Quantum Tsallis relative entropy of negative order ····· 10

Summary: In this talk, we show some fundamental properties of the quantum Tsallis relative entropy of negative order based on the properties of the quasi geometric mean of positive semidefinite matrices. Moreover, we show matrix trace inequalities on the quantum Tsallis relative entropy of negative order, which includes the quasi geometric mean of positive definite matrices.

16 Masatoshi Ito (Maebashi Inst. of Tech.) Estimations of the weighted power mean by the Heron mean ····· 10

Summary: For positive real numbers a and b, the weighted power mean $P_{t,q}(a,b)$ and the weighted Heron mean $K_{t,q}(a,b)$ are defined as follows: For $t \in [0,1]$ and $q \in \mathbb{R}$, $P_{t,q}(a,b) = \{(1-t)a^q + tb^q\}^{\frac{1}{q}}$ and $K_{t,q}(a,b) = (1-q)a^{1-t}b^t + q\{(1-t)a + tb\}$. These means generalize the arithmetic and the geometric ones. In this talk, we get estimations of the weighted power mean by the Heron mean. In other words, we obtain the greatest value $\alpha = \alpha(t,r)$ and the least value $\beta = \beta(t,r)$ such that the double inequality $K_{t,\alpha}(a,b) < P_{t,r}(a,b) < K_{t,\beta}(a,b)$ holds for $t, r \in (0,1)$. We can also obtain operator inequalities for bounded linear operators on a Hilbert space.

Summary: Let A and B be bounded positive invertible operators on a Hilbert space $\mathcal{H}$, $n \in \mathbb{N}$ and $x \in \mathbb{R}$. We define the n-th version of the Tsallis relative operator entropy $T_x(A|B)$ by $T_x^{[1]}(A|B) \equiv T_x(A|B)$, $T_x^{[n]}(A|B) \equiv \frac{T_x^{[n-1]}(A|B) - T_0^{[n-1]}(A|B)}{x}$ $(x \neq 0)$ and $T_0^{[n]}(A|B) \equiv \lim_{x\to 0} T_x^{[n]}(A|B)$ $(n \geq 2)$. In particular, $T_0^{[n]}(A|B)$ is called the n-th relative operator entropy, and is denoted by $S^{[n]}(A|B)$. In this talk, we show some properties of $T_x^{[n]}(A|B)$ and $S^{[n]}(A|B)$. Moreover, we try to introduce operator divergences defined by the differences between the n-th relative operator entropies, and show the properties and a relation between them.

Summary: For C^1-function $f(t)$ on an interval J and for $t_0 \in J$, $K_f(t, t_0) := \frac{f(t)-f(t_0)}{t-t_0}$. We will show that $K_f(t, t_0)$ is strongly operator convex if and only if f is operator monotone.

Summary: We give a limit formula for alpha determinants of a certain parametric deformation of normalized Laplacian matrices of complete graphs K_n. We also calculate the normalized immanants of the same matrices, which allows us to obtain a limit formula for them. Further, we give a biclique-analog of the results above.

Summary: We describe an invariant theory using the Cayley–Hamilton theorem of higher order (given by Y. Agaoka). We need this Cayley–Hamilton type theorem to describe the relations of generators of invariants as an ideal, though these relations can be described simply as an ideal with trace (as reported in the last MSJ meeting held in the spring 2018).

Summary: Let G be a connected complex reductive Lie group with Lie algebra $\mathfrak{g}$ and let (π_μ, V_μ) be a minuscule representation of G. The space $\mathcal{P}(\mathfrak{g}) \otimes V_\mu$ of V_μ-valued polynomials on $\mathfrak{g}$ is naturally a module of a commutative algebra $\mathcal{I}_\mu$ containing $\mathcal{P}(\mathfrak{g})^G$ (A. A. Kirillov's family algebra). In this talk, we define the space $\mathcal{H}_\mu$ of V_μ-valued harmonic polynomials and show the separation of variables formula "$\mathcal{P}(\mathfrak{g}) \otimes V_\mu = \mathcal{I}_\mu \otimes \mathcal{H}_\mu$" as a generalization of Kostant's well-known result. We also discuss a natural system of generators for $\mathcal{H}_\mu$, "restrictions" of $\mathcal{H}(\mathfrak{g})$ to various G-orbits in $\mathfrak{g} \times V_\mu^*$, and a generalization of the Hesselink–Peterson formula on graded multiplicities.

Summary: We consider the realization of a minimal representation as the kernel of an intertwining differential operator from the space of smooth sections of an associated bundle over a flag manifold. It is shown that for the connected split real simple Lie groups of type D_n, E_6, E_7 and E_8, the space for an associated line bundle admits such realization if and only if the annihilator of an irreducible highest weight module for the corresponding Lie algebra is the Joseph ideal.

23 Nobukazu Shimeno (Kwansei Gakuin Univ.) Hobson's formula in Dunkl analysis and its applications 15

Summary: Classical Hobson's formula describes how a differential operator with constant coefficients acts on radial functions on an Euclidean space. We give an analogue of Hobson's formula for Dunkl operators and its applications.

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

Akihito Wachi (Hokkaido Univ. of Edu.) Capelli identities and b-functions of prehomogeneous vector spaces

Summary: To compute the b-function of the determinant $\det(x_{ij})$ is one of the purposes that the Capelli identity was established. Since then a deep relation with the representation theory of Lie group has been understood, and finally the abstract Capelli problem was proposed and settled completely in the paper of Howe and Umeda in 1991. The abstract Capelli problem is a problem asking if every invariant differential operator on V comes from $\mathfrak{g}$ or not, where $\mathfrak{g}$ is a Lie algebra, and V is a representation space of a finite-dimensional representation of $\mathfrak{g}$.

If the abstract Capelli problem holds for a prehomogeneous vector space, then the b-function can be computed easily by using invariant differential operators. But the abstract Capelli problem fails for most of the prehomogeneous vector spaces. Even in such a case there may be a "Capelli identity", and the b-function is computed by using it. Thus it is still important to study Capelli identities for prehomogeneous vector spaces where the abstract Capelli problem does not hold.

In this talk I introduce such Capelli identities for some prehomogeneous vector spaces, that is, Capelli identities of "odd" type, which help compute the b-functions of prehomogeneous vector spaces associated with quivers, Capelli identities for the prehomogeneous vector spaces of parabolic type, which are generalization of those for quivers, and Capelli identities with zero entries, which are related to non-reductive prehomogeneous vector spaces.

September 26th (Wed) Conference Room Ⅲ

9:30–12:00

24 Kengo Matsumoto * (Joetsu Univ. of Edu.) Flow equivalence of topological Markov shifts and extended Ruelle algebras 15

Summary: We study discrete flow equivalence of two-sided topological Markov shifts by using extended Ruelle algebra, which is defined by a groupoid C*-algebra of an étale groupoid constructed from the Markov shift. We characterize flow equivalence of two-sided topological Markov shifts in terms of conjugacy of certain actions weighted by ceiling functions of two-dimensional torus on the stabilized extended Ruelle algebras for the two-sided topological Markov shifts.

25 Yuhei Suzuki (Nagoya Univ.) Eigenvalue set for etale groupoids and constructions of distinguished minimal actions 15

Summary: Minimal free topological dynamical systems are one of the major source to construct a natural simple C*-algebras (via the crossed product construction). In this talk, we clarify that for every pair of a non-torsion exact group and a compact space in a certain large class (e.g., the product of the Cantor set and topological closed manifold) there are continuously many minimal free actions which associate pairwise non-isomorphic groupoids. Moreover one can choose these actions to have a nice crossed product. Based on Appendix B of my paper arXiv:1702.04875.

26 Norio Nawata (Osaka Kyoiku Univ.) Infiniteness of central sequence C*-algebras 15

Summary: Let $\mathcal{W}$ be the Razak–Jacelon algebra, which is a certain simple separable nuclear stably projectionless C*-algebra having trivial K-groups and a unique tracial state and no unbounded traces. In this talk, we show that the central sequence C*-algebra $F(\mathcal{W})$ of $\mathcal{W}$ is infinite.

27 Masatoshi Enomoto * A bounded isomorphic invariant of two subspace systems ····· 15
Yasuo Watatani (Kyushu Univ.)

Summary: We study two subspace systems up to bounded isomorphism. For this purpose, it is crucially important to investigate operator ranges. It is related to a Hilbert representation of a Dynkin quiver. We introduce a bounded isomorphic invariant of two subspace systems constructed from graphs of Schatten class operators. We also point out that algebraic isomorphism and bounded isomorphism are different in these two subspace systems.

28 Yusuke Sawada (Nagoya Univ.) On the constructions of minimal dilations of CP_0-semigroups ····· 15

Summary: We clarify the relation between the constructions by Bhat–Skeide and Muhly–Solel of minimal dilations of CP_0-semigroups.

29 Michiya Mori (Univ. of Tokyo) Isometries between projection lattices of von Neumann algebras ····· 15

Summary: Since Wigner's unitary-antiunitary theorem, there have been many researches on isometries between collections of projections in $B(H)$. Recently, G. P. Gehér and P. Šemrl gave a complete description of surjective isometries (with respect to the operator norm) from the collection of all projections in $B(H)$ onto itself. In this talk, we consider a further generalization of this result. Namely, we give a characterization of surjective isometries between projection lattices of two von Neumann algebras.

30 Hiroshi Ando (Chiba Univ.) Structure of bicentralizer algebras and inclusions of type III factors
Uffe Haagerup ····· 15
Cyril Houdayer (Univ. Paris-Sud)
Amine Marrakchi (Univ. Paris-Sud)

Summary: We investigate the structure of the relative bicentralizer algebra $\mathrm{B}(N \subset M, \varphi)$ for inclusions of von Neumann algebras with normal expectation where N is a type III_1 subfactor and $\varphi \in N_*$ is a faithful state. We first construct a canonical flow β on the relative bicentralizer algebra and we show that the W^*-dynamical system $(\mathrm{B}(N \subset M, \varphi), \beta^\varphi)$ is independent of the choice of φ up to a canonical isomorphism. In the case when $N = M$, we deduce new results on the structure of the automorphism group of $\mathrm{B}(M, \varphi)$ and we relate the period of the flow β^φ to the tensorial absorption of Powers factors. For general irreducible inclusions $N \subset M$, we relate the ergodicity of the flow β^φ to the existence of irreducible hyperfinite subfactors in M that sit with normal expectation in N. When the inclusion $N \subset M$ is discrete, we prove a relative bicentralizer theorem and we use it to solve Kadison's problem when N is amenable.

31 Reiji Tomatsu (Hokkaido Univ.) On minimal actions of compact groups on full factors ····· 15

Summary: We discuss the fullness of the crossed product von Neumann factor associated with a minimal action of a compact group on a factor.

14:15–15:00

32 Shizuo Miyajima (Tokyo Univ. of Sci.) Characterization of closed balls via metric projections, II ····· 10
Isao Saito (Tokyo Univ. of Sci.)

Summary: A closed ball with its center at the origin in a real Banach space X has the following property (P): For every $x \in X$, a positive-scalar multiple of x gives a nearest point in C to x. In MSJ Spring Meeting 2018 at The University of Tokyo, we reported that a converse of this fact holds in the sense that a bounded closed convex set $C \subset X$ with $0 \in \operatorname{Int} C$ possessing property (P) is a closed ball with center 0, provided X is *smooth* and $\dim X > 1$
In this talk we prove that the above result holds without the assumption of smoothness.

Summary: We prove a geometric inequality for positive operators in the Banach algebra of all bounded linear operators on a Hilbert space. As an application we exhibit a several examples of a generalized gyrovector spaces (GGV) which consists of positive operators. We describe a surjective isometry for Thompson-like metric on these GGVs.

Summary: We present Cauchy–Bunyakovsky–Schwarz type inequalities related to the Möbius addition.

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

Takeshi Miura (Niigata Univ.) Surjective isometries on function spaces

Summary: Let $(M, \|\cdot\|_M)$ and $(N, \|\cdot\|_N)$ be normed linear spaces. A mapping $S\colon M \to N$ is an isometry if and only if

$$\|S(f) - S(g)\|_N = \|f - g\|_M$$

holds for all $f, g \in M$. Here, we note that isometries need not be linear maps. If an isometry is surjective, then we see that it is essentially real linear by the Mazur–Ulam theorem. Even if surjective isometries are real linear, they need not be complex linear nor conjugate linear. For example, let $\mathbb{T}$ be the unit circle in the complex number field. Then the complex linear space of all linear functions $az + b$ on $\mathbb{T}$ with the supremum norm on $\mathbb{T}$ has a surjective real linear isometry that maps $az + b$ to $az + \bar{b}$, where $\bar{b}$ denotes the complex conjugate of b. It is neither complex linear nor conjugate linear isometry. To the best of my knowledge, the structure of surjective isometries on function spaces remains obscure.

To investigate surjective isometries on function spaces, we first examine C^1 space of all continuously differentiable functions defined on the closed unit interval $[0, 1]$ with respect to several norms. We also show the structure of surjective isometries on a Banach space of analytic functions on the open unit disc.

Statistics and Probability

September 24th (Mon) Conference Room IX

9:30–12:00

Summary: We formulate parameters of interest, nuisance parameter, and sufficient statistics as σ-algebra. We determine them in the case of $\mathcal{A}$-hypergeometric distribution.

Summary: Khinchin proved that the arithmetic mean of continued fraction digits of Lebesgue almost every irrational number in (0,1) diverges to infinity. Hence, none of the classical limit theorems such as the weak and strong laws of large numbers or central limit theorems hold. Nevertheless, we prove the existence of a large deviations rate function which estimates exponential probabilities with which the arithmetic mean of digits stays away from infinity. This leads us to a contradiction to the widely-shared view that the Large Deviation Principle is a refinement of laws of large numbers.

Summary: We study the word counting problem. In Regnier and Szpankowski (1998), generating functions of the number of pattern occurrences are shown. In Bassino et.al (2010), simplified form of generating functions of the number of pattern occurrences are shown in combination with inclusion-exclusion principles. In this paper, we show a new inclusion-exclusion formula in multivariate generating function form on partially ordered sets, and show a simpler expression of generating functions of the number of pattern occurrences in finite samples, which is also easy to implement in computer program. The advantage of our method is that it is easy to compute other statistics based on the statistics of the number of pattern occurrence, e.g., statistics of the number of occurrence of subset patterns.

Summary: We consider the bond percolation problem on the square lattice. Our main object is the lowest open crossing r_n of a box $[0,n]^2$. On the event an open crossing of $[0,n]^2$ exists, we define the width ξ_n of the lowest open crossing by the maximum height of points on r_n. We show that as $n \to \infty$, $\xi_n/(\log n)$ converges to a constant in probability when the system is in the supercritical regime. This improves the previous result obtained by Y. C. Zhang (1999).

Summary: In this talk, we show a modified logarithmic Sobolev inequality for canonical Lévy processes. We provide a direct, intrinsic proof of a modified logarithmic Sobolev inequality. Moreover, we derive several previously known inequalities as corollaries of main theorem. As an application of main theorem, we also get a concentration inequality for canonical Lévy processes.

6 Naoto Shimaru (Okayama Univ. of Sci.)
Keizo Takashima (Okayama Univ. of Sci.)
Partial sum of irrational rotations: mean 15

Summary: We consider the distributions of the sum $\sum_{i=1}^{n}\left(\{i\alpha\}-\frac{1}{2}\right)$ of irrational rotations, which were studied by Hardy–Littlewood, Ostrowski, Hecke, Khintchine, and Beck. We give an exact formula for the first-order sums, by using Ostrowski expansion, rational rotation approximation and cancellation techniques to derive our results. We also give some mathematical explanations for the effects on the distributions of the sum, caused by large partial quotient in the continued fraction expansion of irrational number α.

7 Naoto Shimaru (Okayama Univ. of Sci.)
Keizo Takashima (Okayama Univ. of Sci.)
Partial sum of irrational rotations: variance 10

Summary: We consider the distributions of the second-order partial sum $\sum_{i=1}^{n}\left\{\left(\{i\alpha\}-\frac{1}{2}\right)^2-\frac{1}{12}\right\}$, which was originally studied in Behnke. We give estimates for the second-order sums by using rational rotation approximation, which explain their cubic-function-like behaviors. We also give some mathematical explanations for the effects on the distributions of the sum, caused by large partial quotient in the continued fraction expansion of irrational number α.

8 Kiyoiki Hoshino (Osaka Pref. Univ.)
Identification from the SFCs of random functions Ogawa-integrable with respect to regular basis 15

Summary: We consider the question whether and how a random function is identified from the stochastic Fourier coefficients (SFCs). We give an affirmative answer when random functions are Ogawa-integrable with respect to regular CONS and the SFCs are given by Ogawa integral.

9 Takuya Murayama (Kyoto Univ.)
Chordal Komatu–Loewner equation for a family of continuously growing hulls 15

Summary: In this talk, I discuss the chordal Komatu–Loewner equation on standard slit domains in a manner applicable not just to a simple curve but also a family of continuously growing hulls. Especially a conformally invariant characterization of the Komatu–Loewner evolution is obtained. As an application, we can extend the locality of the stochastic Komatu–Loewner evolution with coefficients $(\sqrt{6}, -b_{\mathrm{BMD}})$ in a full generality.

14:15–15:00

10 Tomoko Takemura (Nara Women's Univ.)
Dirichlet forms corresponding to diffusion processes in a tube and the time changed process 15

Summary: We discussed Convergence of diffusion processes in a tube which is direct product diffusion processes $\mathbb{Y}$ of one dimensional diffusion processes $X^{(1)}$ and skew product diffusions Ξ, or the time changed process $\mathbb{X}$ which is based on a positive continuous additive functional $\Phi(t)$. The skew product Ξ are given by one dimensional diffusion processes R and a spherical Brownian motion Θ by means of positive continuous additive functional $\mathbf{f}(t)$. We show Concrete expressions of the Dirichlet forms corresponding to time changed processes, which may be of non-local type caused by degeneracy of the underlying measures.

11 Atsushi Takeuchi (Osaka City Univ.)
Convergence rates of extreme value distributions via the Stein equations 15

Summary: Consider the maximum of independent and identically distributed random variables. The classical result says that the renormalized sample maxima converges to the extreme value distributions, under certain conditions on the distribution function. In this talk, we shall study the uniform rate of the convergence on the Kolmogorov distance in the framework of the Stein equations.

12 Yuji Hamana (Kumamoto Univ.) On the first hitting time of the radial Ornstein–Uhlenbeck process ··· 10

Summary: We investigate the first hitting times of the radial Ornstein–Uhlenbeck processes. In this talk we will give an explicit form of the distribution function of the hitting time by means of the confluent hypergeometric function and its zeros with respect to the first parameter.

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

Kaneharu Tsuchida (Nat. Defense Acad. of Japan) Large deviation principles of additive functionals for symmetric Markov processes

Summary: We consider large deviation principles of continuous or discontinuous additive functionals generated by symmetric Markov processes. As a useful approach in proving the large deviation, the Gärtner–Ellis theorem is well-known. The Gärtner–Ellis theorem implies that the large deviation holds if there exists the logarithmic moment generating function of additive functional and it is differentiable. In the first half of this presentation, we introduce some examples which large deviations are obtained by proving the differentiability of the logarithmic moment generating function directly. But in many cases, it is known that logarithmic moment generating functions are not differentiable. In the second half, we consider the large deviation in a quite general setting. We can not expect to directly apply the Gärtner–Ellis theorem to the large deviation in such a situation. Especially, we show that the large deviation holds for joint additive functionals with continuous and discontinuous parts generated by Borel right processes on Lusin spaces.

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

Masato Hoshino (Kyushu Univ.) A relation between regularity structures and paracontrolled calculus

Summary: In the field of singular SPDEs, two prominent theories are recently established: the theory of regularity structures by Hairer and the paracontrolled calculus by Gubinelli, Imkeller, and Perkowski. They are written by different mathematical tools, so that we can use either of them according to the situation. However, the GIP theory applies to less number of equations, because the GIP theory is less algebraic. In this talk, we discuss how to fill this gap. Our goal is to show the equivalence of the Hairer's theory and the "higher order" version of the GIP theory introduced by Bailleul and Bernicot, on the d-dimensional torus.

September 25th (Tue) Conference Room IX

9:30–11:30

13 Yuki Chino (Leiden Univ.) Random walk in cooling random environment ····· 15

Summary: In this talk, I will show some asymptotic behaviour of the random walk in cooling random environment (RWCRE). First we will give an introduction of the RWCRE, which is an environment resampled along some increasing time sequence according to some prescribed probability measure. Next, we show some ergodic theorem for the cooling environment which yields the strong law of large numbers and the quenched large deviation principle. The point is to understand the connection between the RWRE and the RWCRE. In the end of the talk, I will present the remaining open problems. This talk is based on a joint work with L. Avena, C. da Costa and F. den Hollander.

14 Takahiro Mori (Kyoto Univ.) Large deviations for intersection measures of some Markov processes ····· 15

Summary: Consider an intersection measure of p independent (possibly different) m-symmetric Hunt processes up to time t in a metric measure space E with a Radon measure m. We derive a Donsker–Varadhan type large deviation principle for the normalized intersection measure on the set of finite measures on E as $t \to \infty$. This extends earlier work by W. König and C. Mukherjee. We also obtain the asymptotic behaviour of logarithmic moment generating function, which is related to the results of X. Chen and J. Rosen. Our results rely on assumptions about the heat kernels of the processes, hence include rich examples.

15 Yuki Ueda (Hokkaido Univ.)
Junki Morishita (Hokkaido Univ.)
Free infinite divisibility for the class of Generalized Power distributions with Free Poisson term ····· 15

Summary: We talk about free infinite divisibility for the class of Generalized Power distributions with Free Poisson term (GPFP) by methods of complex analysis. More specifically, we show that the class of GPFP satisfies the univalent inverse Cauchy transform property and the free regular property under some conditions. The class of GPFP contains important distributions in classical and free probability which are Marchenko-Pastur distributions, free Generalized Inverse Gaussian distributions, beta distributions, shifted semicircle laws and free positive stable laws with index 1/2. Thus, we lead some results of free infinite divisibility for these important distributions.

16 Toshiyuki Katsuda (Kwansei Gakuin Univ.)
Stability condition for a multiclass single-server queue with abandonment ····· 15

Summary: In this study we consider a multiclass single-server queue with customer abandonment and establish a sufficient condition for the stability of the queue under the first-come, first-served service discipline. Our condition is a generalization of the corresponding condition of such a queue in the single-class case. To obtain the condition, we extend the methodology of fluid-limit stability for the stability of multiclass queueing networks to our multiclass queue with abandonment.

17 Yushi Hamaguchi (Kyoto Univ.)
Finite-dimensional approximation of solutions of infinite-dimensional BSDEs ····· 12

Summary: We consider Lipschitz-type backward stochastic differential equations (BSDEs) driven by cylindrical martingales on the space of continuous functions. We show the existence and uniqueness of the solution of such infinite-dimensional BSDEs and prove that the sequence of solutions of corresponding finite-dimensional BSDEs approximates the original solution.

18 Masayuki Kageyama (Nagoya City Univ.)
MDPs with some risk utility functions ····· 15

Summary: We investigate some risk functions to evaluate risk over a finite or infinite horizon by Markov decision processes (MDPs).

11:30–12:00 Research Section Assembly

September 26th (Wed) Conference Room IX

9:40–12:00

19 Masanori Sawa (Kobe Univ.)
Kazuki Yoshida (Kobe Univ.)
Shohei Satake (Kobe Univ.)
A construction of circulant almost orthogonal arrays of strength 3 and its applications in functional MRI experiments ····· 15

Summary: Event-related functional Magnetic Resonance Imaging (efMRI) is an imaging technique that enables one to estimate the shape of the hemodynamic response function (HRF), describing changes in the blood oxygen level dependent (BOLD) to neural activity in response to mental stimuli. Although efficient designs are useful for statistical inference on HRF, there are only a few publications on systematic constructions of such designs. Lin et al. (2017) thus introduced a new class of integer sequences to generate highly efficient designs, which produces a certain statistical concept called circulant almost orthogonal array (CAOA), and laid the foundation on a theory of systematic constructions of CAOA with strength 2 and bandwidth 1. In this talk, we establish a method for constructing CAOA with strength 3 and bandwidth 1, and thereby provide a number of infinite families of such CAOA.

Summary: fMRI designs have been researched to be applied to investigate brain activity. In 2017, Lin, Phoa and Kao defined circulant almost orthogonal arrays (CAOAs) as a kind of fMRI designs. Recently, Satake, Yoshida and Sawa gave a systematic construction of CAOAs with strength 3 by using the idea of Hadamard 3-design in combinatorial design theory. Here we can only get families of CAOAs with constant constraints. In this talk, by combining our construction and a combinatorial observation, we show the existence of families of CAOAs with non-constant constraints.

Summary: The concept of a splitting-balanced block design, denoted by $(v, u \times k, \lambda)$-SBD, has been defined with some applications for authentication codes in Ogata et al. (2004). On the other hand, the result on graph decompositions given in Fu and Mishima (2002) implies that there exists a 1-rotationally resolvable $(v, 2 \times 2, 2)$-SBD if and only if $v \equiv 0 \pmod 4$. In this talk, a new direct construction of a cyclically near-resolvable $(v, 2 \times 2, 2)$-SBD is provided. Finally, it is shown that there exists a cyclically near-resolvable $(v, 2 \times 2, 2)$-SBD if and only if $v \equiv 1 \pmod 4$.

Summary: Dropout is used in deep learning. It is a method of learning by invalidating nodes with randomly for each layer in the multi-layer neural network. This is useful for over-learning which excessively adapts to training data. It becomes difficult for the model to generalize to new data which were not in the training set. A random sample of nodes cause more irregular frequency of dropout edges. We propose a combinatorial design of dropout nodes from each partite which balances frequency of edges. In this talk, we introduce the design called dropout design and give some its constructions.

Summary: The proportional hazards model proposed by D. R. Cox in a high-dimensional and sparse setting is discussed. The regression parameter is estimated by the Dantzig selector, which will be proved to have the variable selection consistency under some appropriate regularity conditions. This fact enables us to reduce the dimension of the parameter and to construct asymptotically normal estimators for the regression parameter and the cumulative baseline hazard function. In this talk, the simple model which satisfies the regularity conditions and some numerical results of the variable selection consistency of the Dantzig selector for the proportional hazards model are provided.

Summary: In the Bayesian analysis, it is well-known that ordinary Bayes estimator is not robust against outliers. Ghosh and Basu (2016) and Nakagawa and Hashimoto (2017) proposed robust Bayesian inferences against outliers using the density power divergence and γ-divergence, respectively. On the other hand, the selection of priors is also an important problem in the robust Bayesian inference. In this talk, we propose the two type objective priors for the robust Bayesian inference.

25 Ayaka Yagi (Tokyo Univ. of Sci.)
Takashi Seo (Tokyo Univ. of Sci.)
Yasunori Fujikoshi (Hiroshima Univ.*)
Estimation of parameters in the growth curve model with monotone missing data pattern 15

Summary: We consider the maximum likelihood estimators (MLEs) of the mean parameter vector and the covariance matrix in the growth curve model when the data set has a monotone missing pattern. Throughout this talk, we assume that the data are missing completely at random (MCAR). As a result, we present the MLE of the mean parameter vector when the covariance matrix is known, and the MLE of the covariance matrix when the mean parameter vector is known. That is, we give the determining equation to obtain the MLEs of the mean parameter vector and the covariance matrix.

26 Koji Tsukuda (Univ. of Tokyo)
Shuhei Mano (Inst. of Stat. Math.)
Fisher information of multiple samples from the Poisson–Dirichlet populations 15

Summary: The Poisson–Dirichlet distribution $\mathsf{PD}(\theta)$ is a statistical model of random distributions with the scalar parameter θ, where the parameter corresponds to the diversity of realized distributions. The following two sampling schemes are considered: (i) drawing s samples of n elements from corresponding s populations which follow $\mathsf{PD}(\theta)$ independently, and (ii) drawing a single sample of ns elements from a population which follows $\mathsf{PD}(\theta)$. In this presentation, we demonstrate that the magnitude relation of the two Fisher information, which sample partitions converted from samples in (i) and (ii) possess, can change depending on the parameters n, s, and θ.

12:15–12:30 Presentation Ceremony for the 2018 MSJ Analysis Prize

14:15–15:05

27 Hirofumi Wakaki (Hiroshima Univ.)
Laplace approximation of the distribution function of the Bartlett–Nanda–Pillai test 15

Summary: We show the null distribution function of the Bartlett–Nanda–Pillai test (BNP test) can be shown as a ratio of expectations of some functions of several independent beta random distributions. Using the Laplace's approximation method we obtain the limiting distribution of BNP test and its computable error bound when the sample size and the dimension tend to infinity.

28 Yoshihide Kakizawa (Hokkaido Univ.)
Gaku Igarashi (Univ. of Tsukuba)
Bias correction of asymmetric kernel density estimators revisited 15

Summary: Asymmetric kernel density estimation is recently well-studied in the literature. Actually, applying several bias reduction methods for the classical (location-scale type) standard kernel density estimator, some asymmetric kernel density estimators can be bias-corrected in an additive or multiplicative way. In this talk, we revisit additive bias reduction method to reduce the bias up to the higher-order.

29 Yoshihiko Maesono (Kyushu Univ.)
Rizky Reza Fauzi (Kyushu Univ.)
Mean residual life function estimators for nonnegative data by logarithmic transformation 10

Summary: In this talk we discuss the kernel-type estimators of mean residual life function $m_X(t) = E(X - t|X > t)$. New estimators that can eliminate the boundary bias effect are proposed. Let $X_1, X_2, ..., X_n$ be independently and identically distributed nonnegative random variables with an absolutely continuous survival function S_X and a density f_X. We study asymptotic properties of a kernel estimatior of $m_X(t)$.

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

Shuhei Mano (Inst. of Stat. Math.) Partitions, hypergeometric systems, Dirichlet processes, and their statistical inferences

Summary: This talk is on statistical inferences on some combinatorial stochastic processes. Especially, it discusses the intersection of three subjects: partitions, hypergeometric systems, and Ferguson's Dirichlet processes. It is shown that these three subjects related to a common structure called exchangeability. Then, based on the algebraic nature, direct samplers with use of homogeneity of polynomials and dualities in Markov processes, and estimation with information geometry of polytopes will be presented.

16:40–17:40 Talk Invited by Statistics and Probability Section

Yan Liu (Kyoto Univ.) From prediction and interpolation problem to parameter estimation problem of time series

Summary: We consider prediction and interpolation problem of stationary processes and their application to parameter estimation problem. In a naive approach to defining linear prediction, the independence between the predictor and the prediction error is assumed, which turns out to be useful only for the Gaussian stationary process. Instead of independence, the concept is extended to the least prediction error, which is evaluated in an adequate normed space. This refinement of the definition makes the prediction problem available for a much richer class of stationary processes, such as harmonizable stable process. The interpolation problem for the class is defined along the same line. On the other hand, the estimation problem is to determine the parameters in the model, a parametric spectral density, from observations. The Whittle likelihood is introduced to estimate parameters of the Gaussian stationary process as an approximate Gaussian likelihood. In addition, the Whittle likelihood could also be interpreted as a method which minimizes the prediction error explained above. In this connection, we regard the prediction error and the interpolation error as a contrast between the Fourier transform of observations and the parametric spectral density. The parameters of the stationary process are estimated by the minimum contrast estimation. To precisely understand the estimation procedure, we first investigate the fundamental properties of the contrast functions. The new functions are not contained in the class of either location or scale disparities. Afterward, we discuss the asymptotic behaviors of the minimum contrast estimator applied to the different types of stationary processes. The estimator is shown to be asymptotic consistent. The asymptotic distribution of the estimator depends on the assumptions on the stochastic process. In particular, the estimator is robust against the fourth order cumulant when the process is Gaussian. Although it is shown that the Whittle estimator is asymptotically efficient in the sense that the family of parametric spectral densities is truly specified, the new class contains robust members to the randomly missing observations from the stationary process. We discuss this phenomenon in much more details.

September 27th (Thu) Conference Room IX

9:40–11:30

30 Yuichi Goto (Waseda Univ.) Asymptotic theory and robustness of zero crossings estimator ····· 10
Masanobu Taniguchi (Waseda Univ.)

Summary: Zero Crossing (ZC) statistic is the number of zero crossings observed in a time series. In this talk, a strictly stationary ellipsoidal ϕ-mixing processes with mean zero, finite variance is discussed. We consider the estimation problems of the autocorrelation of a time series by using zero crossing. First, we will elucidate the joint asymptotic distribution of the ZC estimator. Next, we show that the ZC estimator has a good robustness when the spectral density of the process is contaminated by a sharp peak.

Summary: Binary time series is after having been converted a some time series into 0 and 1. In this presentation, we propose a classification method based on binary time series. We will show that the misclassification probability tends to zero when the number observation tends to infinity. Next, we evaluate the asymptotic misclassification probability when the two categories are contiguous. Finally, we show that our classification method based on binary time series has a good robustness when the spectral density of the process is contaminated by a sharp peak.

Summary: The empirical Bayesian shrinkage (EBS) estimator is expressed in terms of a shrinkage function $\phi(\cdot)$, and includes the sample mean and the James–Stein estimator as special cases. We evaluate the mean squared error (MSE) of EBS estimator for the mean of a Gaussian vector stationary process. Then a sufficient condition for the proposed EBS estimator to improve the sample mean is given in terms of $\phi(\cdot)$ and the spectral density matrix of the process. We also seek $\phi(\cdot)$ which gives the largest improvement for the difference of MSE's between EBS and the sample mean. The results have a potential to improve the a lot of estimators in various time series data.

Summary: In this talk, we consider asymptotic properties of support vector machine (SVM) for high-dimensional imbalanced data.
We show that SVM holds a consistency property in which misclassification rates tend to zero as the dimension goes to infinity under certain severe conditions. We show that the performance of SVM is affected by the imbalance and the tuning parameter. In order to overcome such difficulties, we propose a robust SVM (RSVM). We show that RSVM gives preferable performances for high-dimensional data. Finally, we check the performance of RSVM by numerical simulations.

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

Summary: In this talk, we consider estimation of mean vectors in high-dimensional settings. First, we show that the sample mean vector is not a consistent estimator of the true mean vector in high-dimension, low-sample-size (HDLSS) settings. With the help of a threshold method, we propose a new estimation method for the mean vector. We show that it holds the consistency property even in HDLSS settings. We apply the new method to multi-sample problems. Finally, we demonstrate the new method by using actual microarray data sets.

Summary: This paper deals with a variable selection procedure in a multivariate linear regression model with normality assumption, which is called a normal multivariate linear regression model, by minimizing a generalized C_p (GC_p) criterion. The GC_p criterion used in this paper is defined by adding a penalty term to the multivariate standardized residual of sum of squares. A purpose of this paper is to clarify a sufficient condition of the penalty term in the GC_p criterion to satisfy an asymptotically loss efficiency property from the large sample and high-dimensional asymptotic framework, such that $n \to \infty$ under the condition $p/n \to c_0 \in [0, 1)$. Then, we can propose an asymptotically loss efficient GC_p criterion under any noncentrality parameter matrix.

14:15–15:05

Summary: This talk considers a nonparametric test for directional data. Most of classical density functions on the unit spheres share the common important feature called rotational symmetry. However, recently we found real data which do not satisfy this condition, and Ley and Verdebout (J. Multivariate Anal. 2017, 159:67–81) proposed a family of skew-rotationally-symmetric distributions on spheres. On the other hand, it is often severe to assume certain parametric family for real data. To overcome such hurdle, this talk employees the measure of skewness proposed by Mardia (Biometrika 1970, 57(3):519–530), and constructs the generalized empirical likelihood statistic for the null hypothesis of rotational symmetry. The proposed statistic is shown to converge to standard chi-squared distribution, and some simulation experiments illustrate finite sample performance of the proposed method.

Summary: Circular data are a set of observations which can be expressed as angles $[-\pi, \pi)$. Bivariate circular data, comprised of pairs of circular observations $[-\pi, \pi)^2$, arise in numerous contexts. In this talk we propose a general Fourier series based approach to obtaining the bivariate circular analogues of copulas recently coined 'circulas'. As examples of the general construction we consider some classes of circulas arising from different patterns of non-zero Fourier coefficients. The shape and sparsity of such arrangements are found to play a key role in determining the properties of the resultant models. All the special cases of the circulas we consider have simple closed-form expressions for their densities and display different dependence structures from the existing circulas.

Summary: Discrete multivariate probability models are examined in this presentation. Consider the hypothesis H_2 where some parameters from the first sample and those from the second sample are proportional, and the hypothesis H_1 where H_2 is not satisfied. In two sample problems under the hypothesis H_2, the null hypothesis where the samples are from the same population is tested against the hypothesis where the samples are from the different population. It is found that the total information is equal to the sum of the within information and the between information in some case,but not equal in several cases. To investigate this phenomenon, we calculate the Kullback information based on H_2 against H_1. Some interesting results are presented.

Applied Mathematics

September 24th (Mon) Conference Room IV

9:00–12:00

1 Sho Fujimura (Fukuoka Univ.) On the number of perfect matchings of line graphs II 10
Shuji SHIRAISHI (Fukuoka Univ.)

Summary: For any general graphs, we provide a formula for the number of perfect matchings in line graphs.

2 Kohei Tanaka (Shinshu Univ.) Topological and combinatorial methods in motion planning problem 15

Summary: The topological complexity is a numerical invariant closely related to the robotic motion planning problem. I will present topological and combinatorial methods for calculating the topological complexity of a finite space and the associated simplicial complex.

3 Shohei Satake (Kobe Univ.) On quadratic residues and circulant almost orthogonal arrays 15

Summary: fMRI designs have been researched to be applied to investigate brain activity. In 2017, Lin, Phoa and Kao defined circulant almost orthogonal arrays (CAOAs) as a kind of fMRI designs. Recently, Satake, Yoshida and Sawa gave a systematic construction of CAOAs by using the idea of Hadamard 3-design. In their construction from Paley matrices, one must know the distribution of quadratic residues (QRs) modulo primes. The disribution of QRs has been attracted many mathematicians, however, many unknown parts are remained. In this talk, we give an observation of the distribution of QRs. From this result, a necessary conditon for existence of CAOAs, consructed from Paley matrices, can be obtained.

4 Takuya Ikuta (Kobe Gakuin Univ.) Butson-type complex Hadamard matrices and association schemes on
Akihiro Munemasa (Tohoku Univ.) Galois rings of characteristic 4 10

Summary: We consider nonsymmetric hermitian complex Hadamard matrices belonging to the Bose–Mesner algebra of commutative nonsymmetric association schemes. We give nonsymmetric association schemes of class 6 on Galois rings of characteristic 4, and classify hermitian complex Hadamard matrices belonging to the Bose–Mesner algebra of its association schemes. It is shown that such a matrix is again necessarily a Butson-type complex Hadamard matrix whose entries are 4-th roots of unity.

5 Sho Suda (Aichi Univ. of Edu.) The maximum number of diamonds in tournaments 10
Gary Greaves (Nanyang Tech. Univ.)

Summary: In 1984, Frankl and Füredi asked what is the maximum number of hyperedges in an r-uniform hypergraph with n-vertices such that every set of $r+1$ vertices contains 0 or exactly 2 hyperedges. We consider this problem for the case that $r = 4$ and hypergraphs are obtained from tournaments.

6 Tsuyoshi Miezaki (Univ. of Ryukyus) On the complete cycle index 10
Manabu Oura (Kanazawa Univ.)

Summary: In this talk, we introduce the concept of the complete cycle index and discuss a relation with the complete weight enumerator in coding theory.

Summary: We introduce the concept of the Tutte polynomials in genus g and discuss some properties. We note that the Tutte polynomials in genus one are well-known the Tutte polynomials. It is known that the Tutte polynomials are matroid invariants and we claim that the Tutte polynomials in genus g are also matroid invariants. The main result of this talk is to give inequivalent matroids which have same Tutte polynomial, and have different Tutte polynomials in genus 2.

Summary: Let G be a graph. A mapping $c : E(G) \to \mathbb{N}$ is called an *edge-coloring* of G and $c(e)$ is called the *color* of an edge e. A subgraph H of G is called *properly colored*, or shortly *PC*, if every pair of adjacent edges in H have distinct colors. Gallai gave a structure of edge-colored complete graphs which has no PC cycle of length three. For edge-colored complete bipartite graphs, Axenovich, Jiang and Tuza showed that if every vertex is incident with at least three edges whose colors are mutually distinct, then the complete bipartite graph contains a PC cycle C_4 of length four. In this talk, we will discuss structures of edge-colored complete bipartite graphs which has no PC C_4.

Summary: An edge of a k-connected graph is said to be k-contractible if the contraction of the edge results in a k-connected graph. For a graph G and a vertex x of G, let $G[N(x)]$ be the subgraph induced by the neighborhood of x. We prove that if $G[N(x)]$ has less than $\lceil \frac{k}{2} \rceil$ edges for any vertex x of a k-connected graph G, then G has a k-contractible edge. We also show that the bound $\lceil \frac{k}{2} \rceil$ is sharp.

Summary: An n-coloring $c : V(G) \to \{1, \ldots, n\}$ of a graph G on a surface is a *facial t-complete n-coloring* if every t-tuples of colors appears on the boundary of some face of G. The maximum number n such that G has a facial t-complete n-coloring is called the *facial t-achromatic number*. They are expansion of a complete coloring and the achromatic number, respectively. In this talk, we will show some results of a facial 3-complete coloring and the facial 3-achromatic number of even triangulations on the sphere.

Summary: A seminal theorem of Tutte states that planar 4-connected graphs are Hamiltonian. Applying a result of Thomas and Yu, one can show that every 4-connected graph with crossing number 1 is Hamiltonian. In this talk, we continue along this path and prove the titular statement. We also discuss the traceability 4-connected graphs with small crossing number.

Summary: Let G be a (finite, simple, undirected) graph with vertex set V. Let $N(A; B)$ denote the set of all the vertices which are adjacent to every vertex in A but no vertex in B for disjoint $A, B \subseteq V$. Let n be a positive integer. If $N(A; B) \neq \emptyset$ for any pair of disjoint $A, B \subseteq V$ (possibly empty) with $|A \cup B| = n$, the graph G is said to be n-existentially closed (n-ec). Moreover, if $N(A; B)$'s never coincide for different choices of such (A, B), then G is said to be n-separably existentially closed (n-sec). In this talk, I will introduce the relation between n-ec graphs, n-sec graphs, and some explicit constructions.

14:20–16:30

13 Yusuke Yoshie (Tohoku Univ.)
Yusuke Higuchi (Showa Univ.)
Etsuo Segawa (Tohoku Univ.)
Mohamed Fuard Mohamed Sabri (Tohoku Univ.)
Stationary state of quantum walks on distance-regular graphs ····· 15

Summary: In this talk, we treat a quantum walk model on a finite connected graph with infinite tails with supplying infinite energy. In this model, we can construct the stationary state of quantum walk corresponding to the stationary distribution of random walks and observe convergence to the state like random walks. We consider the stationary state for this model on some graphs with useful properties. In particular, we give the explicit expression of the stationary state of this model on hyper cubes and Hamming graphs, classes of distance-regular graphs, by using a property of the stationary state.

14 Seiken Saito (Nagoya Bunri Univ.)
The inequalities of the radii of convergence of Ihara zeta-functions ··· 10

Summary: We prove the inequalities among the spectral radius $\rho(A)$ of a finite graph X, the radius of convergence R of its Ihara zeta-function $Z_X(u)$, and the average degree $\bar{d_X}$ of X. These inequalities are posed by A. Terras in her book (2011) as research problems. Relating to Terras' inequalities, we propose a new conjecture between R and some Rayleigh quotients.

15 Yusuke Higuchi (Showa Univ.)
Mohamed Fuard Sabri (Tohoku Univ.)
Etsuo Segawa (Tohoku Univ.)
Yusuke Yoshie (Tohoku Univ.)
A dynamical system induced by discrete-time quantum walk ····· 15

Summary: We set a dynamical system on a finite and connected graph induced by the Grover walk. To this end, we add additional infinite length tails to the original graph and keep providing an external energy at each time step from them. Then we obtain i) a uniquely existence of a fixed point; ii) the scattering way from the temporal and spatial global view point in the long time limit. The total mass in the long time limit of the internal graph is evaluated by the number of edges.

16 Yusuke Ide (JAIST)
Choon-Lin Ho (Tamkang Univ.)
Norio Konno (Yokohama Nat. Univ.)
Spectral analysis of discrete-time quantum walks on cycle and path graphs ····· 15

Summary: We consider discrete-time quantum walks on cycle graph and path graph with isospectral (but not need the same) coin operators. By using spectral analysis of the time evolution operators for the quantum walks, we have fundamental results for the two cases. For the cycle graph cases, we find a classification criterion of quantum walks from the point of the periodicity. On the other hands, for the path cases, we find a formula for the time-averaged distribution which consists of the information of the corresponding random walk and eigenvalues of the coin operators.

17 Daiju Funakawa (Hokkai-Gakuen Univ.)
Toru Fuda (Kokushikan Univ.)
Satoshi Sasayama (Hokkaido Univ.)
Akito Suzuki (Shinshu Univ.)
About the resonance of a 2-dimensional split-step quantum walk ····· 15

Summary: We consider the 2-dimensional 4-states quantum walk. This quantum walk is an extension of the 1-dimensional split-step quantum walk. The time evolution operator U is defined by the multiplication of the shift operator S and the coin operator C. In this talk, we introduce the condition of C for resonance of U. Moreover, we show that the resonance vector belongs to L^∞ space.

18 Noriaki Teranishi (Hokkaido Univ.) A note on time operators with respect to a unitary operator ····· 15
Itaru Sasaki (Shinshu Univ.)
Akito Suzuki (Shinshu Univ.)
Daiju Funakawa (Hokkai-Gakuen Univ.)
Yasumichi Matsuzawa (Shinshu Univ.)

Summary: We define a time operator with respect to a unitary operator. This definition is similar to that of strong time operator. We establish a general existence theorem on such a time operator. We construct a time operator with respect to the unitary operator of the Hadamrd walk.

19 Sho Kubota (Tohoku Univ.) Periodicity of Grover walks on some trees ····· 10
Yusuke Yoshie (Tohoku Univ.)

Summary: The Grover walk is kind of quantum walks and it is defined by a graph. This is studied in many fields and has many applications. Also, there are recently studies on periodicity of Grover walk on many graphs. For example, Higuchi–Konnno–Segawa–Sato determine the periodic strongly regular graphs in 2017 and Kubota–Segawa–Taniguchi–Yoshie determine periodic graphs in the generalized Bethe trees in 2018. Periodic graphs are extremely rare and it is hard to find them. On the other hand, by through search by MAGMA, we found some new periodic graphs and consider families including them and determine periodic graphs of those. In this talk, we especially talk examples of periodic trees and introduce an infinite family including them. This talk is based on joint walk with Yusuke Yoshie (Tohoku university).

20 Takashi Komatsu (Yokohama Nat. Univ.) Stationary measure induced by eigenvalue problem of quantum walk ····· 10
Norio Konno (Yokohama Nat. Univ.)

Summary: Recently, quantum walks are intensively studied in quantum physics and quantum computing. The behavior of the quantum walk is quite different from that of classical random walk, e.g., ballistic spreading and localization. In this talk, we give the stationary measures by using transfer matrices induced by eigenvalue problem for quantum walks on the one-dimensional. For example, there are three classes of the stationary measures. First one is the set of the measures with exponential type. Second one is the set of the measures with quadratic polynomial type. Last one is the set of the measures with periodicity. Especially, we discuss the condition to have periodicity.

16:40–17:40 Talk Invited by Applied Mathematics Section

Norio Konno (Yokohama Nat. Univ.) Quantum walk 2.0

Summary: Quantum walk (QW) is a quantum version of random walk and has been extensively studied since around 2000. A striking property of QW is the spreading property. The standard deviation of the walker's position grows linearly in time, quadratically faster than random walk, i.e., ballistic spreading. On the other hand, a walker stays at the starting position: localization occurs. Moreover, due to the rapid development of quantum computer by huge IT companies recently, it has become a reality that programs based on QWs run on quantum computers. Therefore, my title is "Quantum Walk 2.0". In this talk, after an overview of the history of QW, I explain the recent trends.

September 25th (Tue) Conference Room IV

9:00–12:00

21 Chie Nara (Meiji Univ.)
Jin-ichi Itoh (Sugiyama Jogakuen Univ.)
Continuous flatenning of the 2-skeleton of the square faces in a hypercube 15

Summary: It is known that we can continuously flatten the surface of a 3-dimensional cube onto any of its faces by moving creases to change the shapes of some faces successively, following Sabitov's volume preserving theorem. Let C_n be an n-dimensional cube with $n > 3$, and S be the set of its 2-dimensional faces, in other words, the 2-dimensional skeleton of the square faces in C_n. We show that S can be continuously attened onto any face F of S such that the faces of S that are parallel to F do not have any crease, that is, they are rigid during the motion.

22 Atsuhiro Nakamoto (Yokohama Nat. Univ.)
Naoki Matsumoto (Seikei Univ.)
Gen Kawatani (Tokyo Univ. of Sci.)
Jorge Urrutia (UNAM)
Geometric quadrangulations of a polygon 15

Summary: Let P be a polygon on the plane and we consider a geometric quadrangulation of P, that is, a geometric plane graph with each finite face quadrilateral which is obtained from P by adding straight segments in the interior of P. Introducing a new notion for P, called the spirality, we give a sufficient condition for P to admit a geometric quadrangulation. Moreover, we give a condition for P such that any two geometric quadrangulations of P can be transformed into each other by flipping edges.

23 Kenta Noguchi (Tokyo Univ. of Sci.)
Connectivity and Hamiltonicity of 1-planar graphs 15

Summary: A graph is called 1-planar if it can be drawn in the plane such that each edge has at most one crossing point against the other edges. We consider connectivity and Hamiltonicity of 1-planar graphs. On the relationship between planar graphs and Hamiltonicity, very famous Tutte' theorem states that every 4-connencted planar graph G is Hamiltonian (i.e., G has a spanning cycle). In this talk, we shall state an analogous result for 4-connected maximal 1-planar graphs.

24 Naoki Matsumoto (Seikei Univ.)
Atsuki Nagao (Ochanomizu Univ.)
Feedback game on Eulerian graphs 15

Summary: We consider a new impartial game, called a feedback game, on Eulerian graphs. In this talk, we introduce some known results and our results about the time-complexity of the game and the game on toroidal grid graphs.

25 Syun Hiranuma (Yokohama Nat. Univ.)
Gen Kawatani (Tokyo Univ. of Sci.)
Naoki Matsumoto (Seikei Univ.)
Domatically full graphs obtained from Cartesian products of graphs 15

Summary: A dominating set of a graph $G = (V, E)$ is a subset D of V such that every vertex not in D adjacent to some vertex in D. The maximum number of disjoint dominating sets in a dominating set partition of a graph G is called domatic number $d(G)$ of G. G is said to be domatically full graph if $d(G) = \delta(G) + 1$ where $\delta(G)$ is the minimum degree of a vertex of G. We give a constraction of domatically full graphs by using Cartesian products of graphs.

26 Shinya Fujita (Yokohama City Univ.)
Tommy Jensen (Aarhus Univ.)
Boram Park (Ajou Univ.)
Tadashi Sakuma (Yamagata Univ.)
On the weighted safe set problem on paths and cycles 10

Summary: Some recent results on safe set problems in vertex-weighted graphs will be reviewed.

27 Hideo Mitsuhashi (Hosei Univ.)
Norio Konno (Yokohama Nat. Univ.)
Iwao Sato (Oyama Nat. Coll. of Tech.)
Left eigenvalues of quaternionic quantum walks on graphs ····· 15

Summary: We investigate left eigenvalues of quaternionic quantum walks on finite graphs. We apply the second weighted zeta function of a graph to obtain some left eigenvalues of quaternionic Grover walks. A quaternionic version of Sato's determinant formula for the second weighted zeta function plays a important role in our results.

28 Kei Saito (Yokohama Nat. Univ.)
Periodicity for the Fourier quantum walk on regular graphs ····· 15

Summary: Quantum walks on the graph have extensively studied from various perspectives. Several results are known for cases where the Grover matrix is adopted as the coin operator. However, when adopting the Fourier matrix as the coin operator, there are almost no corresponding results. In this talk, we focus on the periodicity and present a necessary condition for quantum walks to have a finite period. As an application of this result, we showed that the quantum walks do not have any finite period for some specific graphs: complete graph, cycle graph with selfloops.

29 Kei Saito (Yokohama Nat. Univ.)
Analysis of the stationary measure of quantum walk by position-evolution process ····· 15

Summary: The stationary measure of the 2-state quantum walk in one dimension has intensively investigated and given some examples by Konno and Takei (2015), Kawai, Komatsu and Konno (2017). In the quantum walk in one dimension, we discovered that the states of quantum walker at positions $x-1$ and $x+1$ can be completely described by the state at position x. In other words, by taking the state at the origin for all times as the initial state, all the quantum states are obtained. In this talk, we introduce such a position-evolution process and present some results given by this process.

30 Iwao Sato (Oyama Nat. Coll. of Tech.)
Norio Konno (Yokohama Nat. Univ.)
Yusuke Ide (JAIST)
The spectral analysis of the unitary matrix of a 2-tessellable staggered quantum walk on a graph ····· 15

Summary: Recently, the staggered quantum walk (SQW) on a graph is discussed as a generalization of coined quantum walks on graphs and Szegedy walks. We present a formula for the time evolution matrix of a 2-tessellable SQW on a graph, and so directly give its spectra. Furthermore, we discuss about the property of the eigenvalues of the discriminant for the time evolution matrix of a 2-tessellable SQW on a graph, and present eigenvectors for some of its eigenvalues.

September 26th (Wed) Conference Room IV

10:00–12:00 Special Session "Mathematical problems in machine learning —focusing on the theory of deep learning"

Sho Sonoda (RIKEN)
Recent developments on deep neural network theory ····· 45

Summary: Despite the success of deep learning in practice, a lot of open problems remain in theory. For example, why deep learning succeeded to estimate a good neural network in spite of the large number of parameters, or what a neural network does in its "black-box" network. In this talk, I review recent developments on deep neural network theory; and explain how neural networks approximate functions from the viewpoint of the integral representation theory and ridgelet analysis; and what functions neural networks approximate from the viewpoint of the optimal transport theory and Wasserstein geometry.

Taiji Suzuki (Univ. of Tokyo) Generalization error theory of deep learning and its application to model analysis · · · 45

Summary: In this talk, we overview the recent developments of deep learning theory especially from the point of view of generalization and representation ability, and give some generalization error analysis from kernel methods and its applications to the model determination analysis. Along with rapid development of deep learning applications, its theoretical analysis has been developed extensively these days. In the first part, we overview the recent progress of deep learning theories. Second, we show what kind of quantity determines the generalization error. To do so, we define an intrinsic dimensionality from a kernel method perspective. Based on the quantity, we derive a generalization error bound. As an application of the theory, we show an approach for model structure determination, especially, model compression method. Finally, we analyze representation ability of deep learning using wavelet analyses.

14:15–16:20

31 Jun O'Hara (Chiba Univ.) Regularization of the self-inductance · · · 15

Summary: We introduce several methods to define the self-inductance of a single loop as the regularization of divergent integrals which we obtain by applying Neumann (or Weber) formula for the mutual inductance of a pair of loops to the case when two loops are identical.

32 Akane Kawaharada (Kyoto Univ. of Edu.), Takao Namiki (Hokkaido Univ.) Relation between spatio-temporal patterns generated by a nonlinear cellular automaton and a singular function · · · 10

Summary: In this talk, we give results about the spatio-temporal patterns generated by a nonlinear two-dimensional symmetrical elementary cellular automaton. By using pre-fractal sets we show the relation between the spatio-temporal pattern and a singular function. We also calculate the fractal dimension of the boundary of its limit set.

33 Tatsuki Mori (Osaka Univ.), Takashi Suzuki (Osaka Univ.), Shoji Yotsutani (Ryukoku Univ.) Numerical approach to existence and stability of stationary solutions to a SKT cross-diffusion equation · · · 15

Summary: The SKT cross-diffusion equation is proposed by N. Shigesada, K. Kawasaki and E. Teramoto in 1979 to investigate segregation phenomena of two competing species with each other in the same habitat area. Y. Lou and W.-M. Ni derived limiting equations to see whether this effect may give rise to a spatial segregation or not, and to clarify its mechanism. It has been thought that the number of solutions of a stationary limiting equation seems to be at most two. However, we have found several parameter values numerically for which there exist three solutions. In this talk, we show numerical overviews of existence, non-existence, multiplicity and stability of solutions to the stationary limiting equation.

34 Kazunori Matsui (Kanazawa Univ.) A pressure-Poisson problem with mixed boundary conditions · · · 15

Summary: A pressure-Poisson problem is used in numerical schemes such as MAC (marker and cell), projection and particle methods for solving the Navier–Stokes equations. We introduce the Stokes problem and a corresponding pressure-Poisson problem, and compare between the two solutions using boundary data.

35 Yuki Chiba (Univ. of Tokyo)
Norikazu Saito (Univ. of Tokyo)
Nitsche's method for Poisson equations with a Robin boundary condition in a smooth domain ····· 15

Summary: In the case of finite element approximation for PDEs in a smooth domain, we calculate numerical solution in a polygonal domain approximating the original domain. Then, it may occur that we calculate approximate solution of another problem. In particular, we need to be more careful with boundary condition including derivatives like reduced-FSI model. For standard FEM, there are many study for numerical calculation with several boundary conditions in a smooth domain, but few studies exist for another method like Nitsche's method and DG method. In this study, we show the analysis and some numerical results of Nitsche's method for Poisson equations with a Robin boundary condition in a smooth domain.

36 Toru Nakanishi (Univ. of Tokyo)
Norikazu Saito (Univ. of Tokyo)
Numerical analysis for the radially symmetric solutions of multidimensional semilinear heat equations by finite element method ····· 15

Summary: This paper presents error analysis of the finite element method for computing spherically symmetric solutions of semilinear heat equations. In particular, we establish optimal order error estimates in a weighted L^2 norm for the symmetric formation and in the L^∞ norm for the non-symmetric formulation.

37 Akitoshi Takayasu (Univ. of Tsukuba)
Kaname Matsue (Kyushu Univ./Kyushu Univ.)
Numerical validation of blow-up solutions for differential equations with exponential nonlinearity ····· 15

Summary: We provide a numerical validation methodology for the finite difference discretization of $u_t = u_{xx} + e^u$ with 0-Dirichlet boundary condition. The main ideas are compactification of phase spaces and time-scale desingularization. In the current case, treatment of numerical validations with exponential growth is the main issue. Fortunately, under a kind of exponential homogeneity of vector field, we can treat the problem in the same way as polynomial vector fields. In particular, we can validate blow-up solutions of differential equations with such exponential nonlinearity as in previous works.

38 Yoshitaka Watanabe (Kyushu Univ.)
Takehiko Kinoshita
Mitsuhiro T. Nakao (Waseda Univ.)
An improvement for verifying the existence and bounds of the inverse of second-order elliptic operators ····· 15

Summary: We consider second-order elliptic operators with Dirichlet boundary condition. This talk presents some improvements for our previous approaches for determining the existence and bounds of the inverse of the operators. Our proposed approaches are based on constructive L^2-norm estimates of Laplacian and applications of the authors' previous result related to a posteriori estimates of inverse operators which use projection and a priori error estimations.

16:40–17:40 Talk Invited by Applied Mathematics Section

Takeshi Fukao (Kyoto Univ. of Edu.)
Abstract approach of evolution equation to partial differential equations with total mass conservation

Summary: In this talk, we discuss the well-posedness of Cahn–Hilliard system with dynamic boundary condition. In this model, a characteristic property of conservation holds which is related to the sum of the volume in the bulk and on the boundary. By virtue of the effective usage of this property we can prove the existence and uniqueness of the solution and its continuous dependence. Moreover, we also treat a degenerate parabolic equations as asymptotic limits of Cahn–Hilliard systems.

September 27th (Thu) Conference Room IV

10:00–11:40

39 Takeshi Gotoda (Hokkaido Univ.) Convergence of the filtered solutions to the 2D Euler equations with vortex sheet initial data ····· 15

Summary: We study the 2D filtered Euler equations, which are the regularized 2D Euler equations derived by a spatial filtering method, and focus on the vortex sheet solution that is a weak solution with locally finite kinetic energy and vorticity in the space of Radon measure. We show that vortex sheet solutions of the 2D filtered Euler equations converge to those of the 2D Euler equations in the limit of the regularization parameter.

40 Yuuki Shimizu (Kyoto Univ.)
Koya Sakakibara (Kyoto Univ.) Point vortex dynamics on minimal surfaces: 1. Theoretical analysis ····· 15

Summary: We introduce a theoretical analysis for point vortex dynamics on minimal surfaces. First, we gives both a minimal surface spanned by a given boundary configuration and its uniformizing map to obtain a global isothermal coordinate. Second, we compute the evolution of point vortices on the coordinate. Finally, we discuss how the boundary configuration and shapes of the minimal surface affects the dynamics of point vortices.

41 Koya Sakakibara (Kyoto Univ.)
Yuuki Shimizu (Kyoto Univ.) Point vortex dynamics on minimal surfaces: Numerical analysis ····· 15

Summary: The method of fundamental solutions (MFS for short) is a meshfree numerical solver for linear homogeneous partial differential equations with constant coefficients, and it has been applied to various problems in the plane. In this talk, we extend MFS to a surface being conformally equivalent to a flat surface in the plane. Moreover, we apply it to point vortex dynamics on minimal surfaces and construct efficient numerical scheme based on MFS.

42 George Miyake (Ube Nat. Coll. of Tech.)
Yuji Katsuta (Ube Nat. Coll. of Tech.) An analysis of four coupled oscillators circuits in a ring by using the symmetry of the circuits ····· 10

Summary: The symmetry of coupled oscillator circuits consisting of four identical oscillators expressed by an odd function is studied. The equations derived by converting coordinate system are analyzed, because the symmetry of the circuit is a dihedral group representation provided that the coupling characteristics are expressed by an odd function. From the symmetry of the equations derived by converting coordinate system, it is shown that there exist the origin whose eight values of the coordinate are zero, and there exist two types of equilibrium points: one is the equilibrium point whose six values of the coordinate are zero, and the other is the equilibrium point whose four values of the coordinate are zero. An analysis is performed for these equilibrium points.

43 Fuminori Sakaguchi (Univ. of Fukui) An improvement of integer-type algorithm for eigenvalues of differential operators by means of the elimination of eigenfunctions ····· 15

Summary: Several years ago, we proposed an integer-type high-accuracy method for calculating the eigenvalues of M-th order differential operators. This methods utilizes the discontinuity of the $M-1$-th order derivatives of the solutions of characteristic functions, which is allowed under the multiplication by a factor from the left. In this study, an improvement of this method is proposed, where we eliminate the true eigenfunction components from the solutions of characteristic equations and we calculate the eigenvalues by analyzing only the error components caused by the singularities. Moreover, we give some numerical examples which show that we are successful in reducing to a large extent the computational quantity.

Summary: We show that a nonlinear delay differential equation, which is a Hutchinson–Wright equation with distributed delay, has a periodic solution of period two when the steady state is unstable. To find the periodic solution, we study an integrable system of ordinary differential equations, following the idea by Kaplan and Yorke (1974). The periodic solution is expressed in terms of the Jacobi elliptic functions. An implication for a related disease transmission dynamics model is discussed.

14:15–15:50

Summary: We consider a wide class of randomly perturbed systems subjected to stationary Gaussian processes and show that chaotic orbits exist almost surely under some nondegenerate condition, no matter how small the random forcing terms are. This result is very contrasting to the deterministic forcing case, in which chaotic orbits exist only if the influence of the forcing terms overcomes that of the other terms in the perturbations. We illustrate our theory for the Duffing oscillator subjected to the Ornstein–Uhlenbeck process parametrically.

Summary: We discuss nonintegrability of parametrically forced nonlinear oscillators which are represented by second-order homogeneous differential equations with trigonometric coefficients and contain the Duffing and van der Pol oscillators as special cases. Specifically, we give sufficient conditions for their rational nonintegrability in the meaning of Bogoyavlenskij, using Kovacic's algorithm as well as an extension of the Morales–Ramis theory due to Ayoul and Zung. In application of the extended Morales–Ramis theory, for the associated variational equations, the identity components of their differential Galois groups are shown to be not commutative even if the differential Galois groups are triangularizable. The obtained results are very general and reveal their rational nonintegarbility for the wide class of parametrically forced nonlinear oscillators.

Summary: Dynamical reconstruction by using delay embedding is studied. This embedding method can be used for direct inference of a dynamical system by using time-series only. This reconstruction procedure can be interpreted as derivation of a single equation with respect to the particular embedded variable. Focusing on polynomial dynamical systems, Gröbner basis plays an important role to characterise this methodology. Corresponding members of the resultant Gröbner basis hold information of the target dynamical system. This framework using Gröbner basis can also represent availability of dynamical reconstruction by using delay embedding.

Summary: The motion and spatial organization of subnuclear domains has been extensively studied by microscopy, but an understanding of the underlying mechanisms remains elusive. In this study, we used mathematical modeling and an in vitro cell system to investigate the mechanism underlying genomic architecture reorganization, a process commonly observed during cellular differentiation. We found that dynamic nuclear deformation provides a driving force for this reorganization by using a new approach of mathematical model based on multi-phasefield method. This study makes a significant contribution toward a better understanding of the mechanisms underlying the reorganization of nuclear architecture, a fundamental question of long-standing interest in genome and developmental biology.

49 Takeshi Gotoda (Hokkaido Univ.) Mathematical modeling for epidermal desquamation ····· 15
Masaaki Uesaka (Hokkaido Univ.)
Yusuke Yasugahira (Hokkaido Univ.)
Yasuaki Kobayashi (Ochanomizu Univ.)
Hiroyuki Kitahata (Chiba Univ.)
Mitsuhiro Denda (Shiseido Co., Ltd.)
Masaharu Nagayama (Hokkaido Univ.)

Summary: The proteases celled Kallikrein-related peptidase (KLKs) play critical role in epidermal desquamation. KLKs are expressed by keratinocytes in the stratum granulosum and secreted to the intercellular space within lamellar granules. Proteolytic activity induced by KLKs are essential for the desquamation process to occur since desquamation involves the degradation of corneodesmosomes which are the main adhesive structure in the stratum corneum. KLKs act on the protein components that comprise corneodesmosomes and the progress of corneodesmosome degradation loosens adhesion among corneocytes so that they shed off the surface of the stratum corneum. On the basis of experimental studies, we propose a mathematical model for the desquamation process.

50 Takashi Suzuki (Osaka Univ.) Modeling angiogenesis —resolution of chemotactic pardox ····· 5

Summary: A model adaptive to three factors of angiogenesis, chemotactic gradient, chemotactic velocity, and chemotactic gradient variance, is realized by local activation and global inhibition.

51 Takashi Suzuki (Osaka Univ.) Modeling cell deformation —free boudaries and Liouville's theorem ··· 5

Summary: Cell deformation driven by the ECM degradation on plasma membrane is formulated as a Stefan-like free boundary problem which is reduced to a degenerate parabolic equation by Liouville's transport theory.

16:10–17:10 Talk Invited by Applied Mathematics Section

Ippei Obayashi (RIKEN/Tohoku Univ.) Persistent homology —Analysis of the shape of data by the combination of mathematics and computer science

Summary: Persistent homology is a mathematical tool to characterize the shape of data quantitatively and efficiently. Persistence diagrams are used to visualize the information about persistence diagram and they are good descriptors of the shape of data. In the last decade, persistent homology is rapidly developed from theories and algorithms, to the applications to life scieces, sensor network, and materials science. From the viewpoint of mathematics, persistent homology is the homology theory on filtrations, and its generalization. However, to solve the practical problems, we require the power of computers and we need the ideas from computer science. In this presentation, I will talk about inverse analysis on a persistence diagram. The main topic is volume optimal cycles. The topic relates many mathematical and computational concepts, such as algebraic topology, linear programming, sparseness, etc. We also show the ability of inverse analysis combined with machine learning.

Topology

September 24th (Mon) Conference Room VI

9:20–12:00

Summary: Let n be a positive integer. Dabkowski and Przytycki introduced the nth Burnside group of links which is preserved by n-moves, and proved that for any odd prime p there exist links which are not equivalent to trivial links up to p-moves by using their pth Burnside groups. This gives counterexamples for the Montesinos–Nakanishi 3-move conjecture. In general, it is hard to distinguish pth Burnside groups of a given link and a trivial link. In this talk, we give a necessary condition for which pth Burnside groups are isomorphic to those of trivial links. The necessary condition gives us an efficient way to distinguish pth Burnside groups of a given link and a trivial link. As an application, we show that there exist links, each of which is not equivalent to a trivial link up to p-moves for any odd prime p.

Summary: For each positive integer n we introduce two local moves $V(n)$ and V^n, which are generalizations of the virtualization move. We give a classification of welded links up to $V(n)$-move. In particular, a $V(n)$-move is an unknotting operation on welded knots for any n. On the other hand, we give a necessary condition for which two welded links are equivalent up to V^n-move. This leads to show that a V^n-move is not an unknotting operation on welded knots except $n = 1$. We also discuss relations among V^n-moves, associated core groups and the multiplexing of crossings.

Summary: It is well known that any knot group has weight one, that is, it is normally generated by a single element. Such an element is called a weight element of the knot group. A meridian is a typical weight element, but it is known that the knot group of any non-trivial torus knot, hyperbolic 2-bridge knot, cable knot, or hyperbolic knot with unknotting number one admits other weight elements. We show that for a few infinite classes of 3-strand pretzel knots and all prime knots up to 8 crossings, the knot groups admit weight elements that are not automorphic images of meridians.

Summary: Let K, K' be two-bridge knots of genus k, k' respectively. We show the necessary and sufficient condition of k in terms of k' that there exists an epimorphism from the knot group of K onto that of K'.

Summary: It is known that there is a fundamental inequality related to tunnel number of a knot and tangles obtained by its tangle decomposition. The inequality gives an upper bound for tunnel number of the knot, and there exists a knot in the 3-sphere so that the inequality is non-strict. This talk will discuss a slight generalization of those.

Summary: We study $2n$-moves and the Γ-polynomial for knots. In this talk, we show that $4k$-move is not an unknotting operation for any integer $k \geq 2$ by using the Γ-polynomial and if $\Gamma(K;-1) = 9 \pmod{16}$ then the knot K does not become the unknot by a single 4-move.

Summary: Okada and the author showed that the sets of Alexander polynomials of knots obtained from 5_1 and 10_{132} by a single crossing change does not coincide. In this talk, we give those of the granny knot and the square knot coincide.

Summary: The interior polynomial is an invariant of (signed) bipartite graphs, and the interior polynomial of a plane bipartite graph is equal to a part of the HOMFLY polynomial of a naturally associated link. The HOMFLY polynomial $P_L(v,z)$ is a famous link invariant with many known properties. For example, the HOMFLY polynomial of the mirror image of L is given by $P_L(-v^{-1},z)$. This implies a property of the interior polynomial in the planar case. We prove that the same property holds for any bipartite graph. The proof relies on Ehrhart reciprocity applied to the so called root polytope. We also establish formulas for the interior polynomial inspired by the knot theoretical notions of flyping and mutation.

Summary: We construct a 2-representation of the quiver Hecke (KLR) algebra of $U_q(\mathfrak{gl}_m)$ on a bimodule category over a deformation of Webster algebra of type A_1 categorifying the symmetric Howe representation of $U_q(\mathfrak{gl}_m)$. As a consequence, we obtain a braid group action on the homotopy category of the bimodule category.

Summary: We give the classification of the $2g+1$-dimensional complex linear representations of the pure mapping class groups of compact orientable surfaces of genus g with or without boundary/punctures, for sufficiently large g. The classification is up to conjugation and is described in terms of certain twisted 1-cohomology group of the pure mapping class group in question.

Summary: A branched covering surface-knot is a surface-knot in the form of a branched covering over an oriented surface-knot, where we include the case when the number of branch points is zero. We can simplify a branched covering surface-knot by an addition of 1-handles with chart loops to a form such that its chart is the union of edges whose end points are vertices of degree 1, and 1-handles with chart loops. The simplifying number is the minimum number of 1-handles necessary to obtain such a simplified form. We give upper estimates of simplifying numbers for the case when branched covering surface-knots have a non-zero number of branch points.

12 Mizuki Fukuda (Tohoku Univ.) Gluck twist along branched twist spins ····· 10

Summary: A branched twist spin is a 2-knot in the four sphere and it is a generalization of twist spun knot. In the study of four dimensional topology, the Gluck twist that is a surgery along a 2-knot is well-studied. It is known that the Gluck twist along a twist spun knot does not changed the four sphere. In this talk, we show the Gluck twist along a branched twist spin also does not changed the four sphere and construct a branched twist spin from another branched twist spin by Gluck twist along it.

13 Motoo Tange (Univ. of Tsukuba)$^{\flat}$ 4-manifolds with E_8 intersection form and their correction terms ····· 15

Summary: We give examples of Brieskorn homology spheres with E_8-genus $g_8 = 1$, including $\Sigma(2,5,9)$. This construction is a twisting method of well-known plumbing 4-manifolds. Our result contributes to Scaduto's classification of intersection form of definite 4-manifolds which bound $\Sigma(2,5,9)$.

14:15–14:55

14 Sukuse Abe (Osaka City Univ.) Quantum $U_q(\mathfrak{g})$ invariants of genus 2 handlebody-knots ····· 15

Summary: Let $\mathfrak{g}$ be a semi-simple lie ring. We define quantum $U_q(\mathfrak{g})$ invariant and perturbative $\mathfrak{g}$ invariant of genus 2 handlebody-knots by an arithmetic expansion of quantum $U_q(\mathfrak{sl}_2)$ type invariant. It is effectively easy to calculate the perturbative invariant $\mathfrak{g} = \mathfrak{sl}_2$, which is a significantly stronger invariant than the previous conventional invariant. A handlebody-knot is an embedding of a handlebody in the 3-sphere S^3. Even for two types of handlebody knots, this can only be classified in up to six crossings. This information can be applied primarily to the 7-crossing-classification problem. Further, we aim to define universal perturbative invariants and introduce extensions upto such invariants.

15 Wataru Yuasa (Kyoto Univ.) A_2 colored polynomials of rigid vertex graphs ····· 10

Summary: The Kauffman–Vogel polynomials are three variable polynomial invariants of 4-valent rigid vertex graphs. A one-variable specialization of the Kauffman–Vogel polynomials for unoriented 4-valent rigid vertex graphs was given by using the Kauffman bracket and the Jones–Wenzl idempotent with the color 2. Bataineh, Elhamdadi and Hajij generalized it to any color with even positive integers. We give another generalization of the one-variable Kauffman–Vogel polynomial for oriented and unoriented 4-valent rigid vertex graphs by using the A_2 bracket and the A_2 clasps. These polynomial invariants are considered as the $\mathfrak{sl}_3$ colored Jones polynomials for singular knots and links.

16 Wataru Yuasa (Kyoto Univ.) A_2 skein representations of pure braid groups ····· 10

Summary: We define a family of representations $\{\rho_n\}_{n\geq 0}$ of a pure braid group P_{2k}. These representations are obtained from an action of P_{2k} on a certain type of A_2 web space with color n. The A_2 web space is a generalization of the Kauffman bracket skein module of a disk with marked points on its boundary. We also introduce a triangle-free basis of such an A_2 web space and calculate matrix representations of ρ_n about the standard generators of P_{2k}.

15:10–16:10 Talk Invited by Topology Section

Tadayuki Watanabe (Shimane Univ.) Characteristic classes for $\mathrm{Diff}(S^4)$ and clasper surgery for families

Summary: This talk is concerned with the rational homotopy groups of the group $\mathrm{Diff}(S^4)$ of self-diffeomorphisms of S^4. We present a method to prove that there are many 'exotic' non-trivial elements in $\pi_*\mathrm{Diff}(S^4) \otimes \mathbb{Q}$ parametrized by trivalent graphs. The proof utilizes Kontsevich's characteristic classes for smooth sphere bundles and a version of clasper surgery for families, and is quite elementary. In fact, these are analogues of Chern–Simons perturbation theory in 3-dimension and clasper theory due to Goussarov and Habiro. We explain how the results in 3-dimension can be modified for 4-dimension and review some related problems, including the 4-dimensional Smale conjecture.

September 25th (Tue) Conference Room VII

10:10–10:25 Presentation Ceremony for the 2018 MSJ Geometry Prize

10:30–11:30 Award Lecture for the 2018 MSJ Geometry Prize

Shouhei Honda (Tohoku Univ.) Geometric analysis on metric measure spaces with Ricci bounds from below

Summary: In this talk we will discuss the recent developments on the study of metric measure spaces with Ricci bounds from below and applications to Riemannian geometry. In particular it is explained how to construct nontrivial geometric/analytic quantities which are continuous with respect to measured Gromov–Hausdorff convergence.

September 25th (Tue) Conference Room VI

13:15–14:15

17 Yoshikazu Yamagishi (Ryukoku Univ.), Takamichi Sushida (Hokkaido Univ.) Voronoi tilings on Archimedean spiral lattices 10

Summary: We study the transition of the number of spirals in a Voronoi tiling for an Archimedean spiral lattice. The cut-and-project structure of the 'grain boundaries' is proved, by considering the continuous space of the parameters.

18 Shunsuke Ichiki (Yokohama Nat. Univ.) Characterization of generic transversality 15

Summary: In this talk, the notion of generic transversality and its characterization are given. The characterization is also a further improvement of the basic transversality result and its strengthening which was given by John Mather.

19 Takahiro Yamamoto (Tokyo Gakugei Univ.) Apparent contours of stable maps of compact surfaces with boundary into the plane 15

Summary: In this talk, for a smooth map $f_0 \colon M \to \mathbb{R}^2$ of a compact surfaces with boundary into the plane, we determine the minimal number of the total of the number of cusps and the number of nodes among stable maps $f \colon M \to \mathbb{R}^2$ which are homotopic to f_0 by using some formula.

20 Keisuke Teramoto (Kobe Univ.) On signs of cusps of Gauss maps of cuspidal edges with certain properties 15

Summary: We treat cuspidal edges with certain properties. We show relationships between signs of cusps appearing on Gauss maps of such cuspidal edges and geometric invariants of cuspidal edges.

September 26th (Wed) Conference Room VI

10:20–12:00

21 Takashi Shimomura (Nagoya Univ. of Economics) Applications of the Bratteli–Vershik model for zero-dimensional homeomorphisms 10

Summary: There exist basic sets for all zero-dimensional homeomorphisms: here the basic sets satisfy the following conditions: (1) they are closed sets, (2) an arbitrary orbit passes the basic sets at most once, (3) an arbitrary orbit passes every neighborhood of the basic set, (4) every periodic orbit passes them exactly once. For some cases of zero-dimensional homeomorphic systems, it seems possible to show the existence of non-atomic invariant measures. We propose another application. We used graph covering method when we constructed Bratteli–Vershik models. When we consider graphs whose edges have lengths, we can study classification of some portion of substitution subshifts.

22 Takashi Shimomura (Nagoya Univ. of Economics) * Characterization of substitution map for minimal substitution subshifts 10

Summary: The question what is the condition of the substitution maps that generate minimal substitution subshifts is very basic. However, we could not find the answer to this question. We would like to report that we have found an answer to this question.

23 Hiroki Kodama (Univ. of Tokyo) Derivatives of flat functions 15
Kazuo Masuda
Yoshihiko Mitsumatsu (Chuo Univ.)

Summary: We remark that there is no smooth function $f(x)$ on $[0,1]$ which is flat at 0 such that the derivertive $f^{(n)}$ of any order $n \geq 0$ is positive on $(0,1]$. Moreover, the number of zeros of the n-th derivertive $f^{(n)}$ grows to the infinity and the zeros accumulate to 0 when $n \to \infty$.

24 Mariko Ohara (Shinshu Univ.) On graded E-infinity rings and projective schemes 15

Summary: In this talk, I pick up some main points and talk my results for grading on spectra and notion of projective schemes. I will tell about definition of N-graded (resp. Z-graded) E-infinity-rings, by using an infinity-operad constructed from N (resp. Z) and spectral projective schemes.

25 Koichi Inoue (Tokyo City Univ.) Symmetric polynomial and $Q_m(w_n)$ 15

Summary: Milnor operation Q_m of Stiefel–Whitney class w_n is written explicitly as a certain determinant of 2^m-dim matrix of w_n's.

26 Tadayuki Haraguchi (Naragakuen Univ.) Homotopy structures of smooth CW complexes 15

Summary: In this talk we present the notion of smooth CW complexes and study their homotopy structures on the category of diffeological spaces. It is clear that the horn $J^{n-1} = \partial I^{n-1} \times I \cup I^{n-1} \times \{1\}$ is a continuous retract of the n-cube I^n. The fact contribute to the development of topological homotopy theory. But J^{n-1} is not a smooth retract of I^n. Thus we introduce the notion of tame property such that J^{n-1} is an approximate retract of I^n. We study smooth homotopy theory by using their properties.

14:15–14:50

27 Takahiro Matsuyuki (Tokyo Tech) Characteristic classes of fibrations and graph complexes 15

Summary: We construct a double chain complex generated by certain graphs and a chain map from that to the Chevalley–Eilenberg double complex of the dgl of symplectic derivations on a free dgl. It is known that the target of the map is related to characteristic classes of fibrations. We can describe some characteristic classes of fibrations whose fiber is a 1-punctured even-dimensional manifold by linear combinations of graphs though the cohomology of the dgl of derivations.

28 Takefumi Nosaka (Tokyo Tech) de Rham theory and cocycles of cubical sets from smooth quandles 15

Summary: We show a de Rham theory for cubical manifolds, and study rational homotopy type of the classifying spaces of smooth quandles. We also show that secondary characteristic classes produce cocycles of quandles.

15:10–16:10 Talk Invited by Topology Section

Shizuo Kaji (Kyushu Univ.) On equivariant loop product

Summary: Algebraic structures on the homology of free loop spaces have been studied under the name of string topology, the term first coined by Chas and Sullivan in their paper in 1999. Among various algebraic operations, the most fundamental is the *loop product* in homology. There are different requirements for a space X to admit a loop product on the homology of the free loop space LX over it. For example, Chas–Sullivan's loop product is defined when $X = M$ is a closed oriented manifold, while Chataur–Menichi's loop product is for $X = BG$ the classifying space of a group. We define a loop product when $X = M_G$ is the Borel construction of a closed oriented manifold M acted by a Lie group G. This provides a uniform treatment to the above two cases. We adopt a homotopy theoretic approach, which allows us to define a secondary version of the loop product and reveals an interesting connection to group homology. This is joint work with H. Tene.

Infinite Analysis

September 24th (Mon) Conference Room V

9:15–10:50

1 Masaki Kato (Kobe Univ.) An addition type formula for the elliptic digamma function 15

Summary: Eisenstein derived the addition formula for the Weierstrass zeta function from the addition formula for the cotangent function and the fact that the Weierstrass zeta function can be represented as an infinite series of the cotangent function.
In this talk, we apply this Eisenstein's idea to the addition type formula for the double cotangent function, established by the speaker. We show that the elliptic digamma function, defined by the logarithmic derivative of the elliptic gamma function, satisfies an addition type formula. This formula includes the addition formula for the Weierstrass zeta function, evaluation formulas for the double Eisenstein series introduced by Tsumura and the double shuffle relations for the double Eisenstein series, proved by Gangl–Kaneko–Zagier.

2 Takanori Ayano (Osaka City Univ.)
Victor Matveevich Buchstaber (Steklov Math. Inst.) Solutions of KdV-equation obtained by the degeneration of meromorphic functions on the sigma divisor of hyperelliptic curves of genus 3 15

Summary: Buchstaber and Mikhailov constructed the polynomial dynamical systems on the basis of commuting vector fields on the symmetric square of hyperelliptic curves. The zero set of the sigma function in the Jacobian of a curve is called sigma divisor. We constructed solutions of the systems for genus 3 in terms of the meromorphic functions on the sigma divisor of the hyperelliptic curves of genus 3. In this talk, we derive a partial differential equation from the dynamical systems, which is integrable by the meromorphic functions on the sigma divisor of the hyperelliptic curves of genus 3. When the curves degenerate to certain singular curves, the solution of the partial differential equation tends to that of the KdV-equation.

3 Takao Suzuki (Kindai Univ.) A similarity reduction of the Drinfeld–Sokolov hierarchy of type A corresponding to the partition of natural number $(n+1, n+1, n+1)$ 15

Summary: The Drinfeld–Sokolov hierarchy is an extension of the KP hierarchy for the affine Lie algebra. In the case of type A, it can be characterized by partitions of natural numbers. In the previous work, we investigated the hierarchy corresponding to the partition $(n+1, n+1)$ and expressed its similarity reduction as the polynomial Hamiltonian system. In this talk, we will consider the Drinfeld–Sokolov hierarchy of type $A^{(1)}_{3n+2}$ corresponding to the partition $(n+1, n+1, n+1)$.

4 Kouichi Takemura (Chuo Univ.) On q-deformations of the Heun equation 15

Summary: The q-Heun equation and its variants arise as degenerations of Ruijsenaars–van Diejen operators with one particle. We investigate local properties of these equations. In particular we characterize the variants of the q-Heun equation by using analysis of regular singularities. We also consider the quasi-exact solvability of the q-Heun equation and its variants. Namely we investigate finite-dimensional subspaces which are invariant under the action of the q-Heun operator or variants of the q-Heun operator.

5 Yousuke Ohyama (Tokushima Univ.) q-Stokes phenomenon on a difference equation satisfied by q-hypergeometric series ${}_3\phi_2(a_1, a_2, a_3; 0, 0; q, x)$ 15

Summary: We give a connection formula of a difference equation satisfied by q-hypergeometric series ${}_3\phi_2(a_1, a_2, a_3; 0, 0; q, x)$. This equation has an irregular singular point at the origin, we need a resummation of a divergent power series. We also study other connection formulae of q-hypergeometric equations.

6 Masahiko Ito (Univ. of Ryukyus) Masatoshi Noumi (Kobe Univ.) Elliptic extension of Gustafson's q-beta integral of type G_2 and its infinite product expression ····· 15

Summary: We would like to talk about a way to extend Gustafson's q-beta integral of type G_2 to its elliptic form. We will also present the explicit expression for its infinite product in terms of Ruijsenaars' elliptic gamma functions.

11:00–12:00 Talk Invited by Infinite Analysis Special Session

Kohei Iwaki (Nagoya Univ.) Exact WKB analysis and topological recursion

Summary: Exact WKB analysis, initiated by Voros, is an effective method to study the global properties of Schrödinger-type linear ODEs with a small parameter $\hbar$. A fundamental result in exact WKB analysis established by Aoki–Kawai–Takei–Sato claims that monodromy matrices of (Borel resumed) WKB solutions are described combinatorially by period integrals over a Riemann surface defined as the classical limit of the Schrödinger-type ODE. Such period integrals are called Voros coefficients, and they play important role in the theory of exact WKB analysis. On the other hand, topological recursion, introduced by Eynard–Orantin, is a remarkable algorithm which computes certain correlation functions and free energy (of matrix models) from a given spectral curve. Correlation functions and free energy are expected to encode information of various geometric or enumerative invariants, and τ-functions of integrable hierarchies.
A surprising connection between WKB analysis and topological recursion was discovered recently by many people including Gukov–Sulkowski, Dumitrescu–Mulase and Bouchard–Eyanrd. They claim that a generating functions of the correlation functions gives the WKB solution of a Schrödinger-type equation whose classical limit coincides with the spectral curve for the topological recursion, and hence the resulting Schrödinger-type equation is called "quantum (spectral) curve". In my talk, I'll give brief introductions to exact WKB analysis, topological recursion and quantum curves. After that, I'll explain our recent result on the realization of Voros coefficients in terms of the free energy of topological recursion, obtained in a joint work with T. Koike (Kobe) and Y. Takei (Kobe). If time allows, I'll also show results on Painlevé equations.

14:15–16:25

7 Yuma Mizuno (Tokyo Tech) Jacobian matrices of Y-seed mutations and mutation networks ····· 15

Summary: We study the Jacobian matrices associated with sequences of Y-seed mutations in universal semifields. For the case where these mutations occur at least once for all indices, we present a formula for a special value of their characteristic polynomials using mutation networks, which are combinatorial objects that describe the data of mutation sequences.

8 Masanori Ando (Naragakuen Univ.) Inferior regular partitions and Glaisher correspondence ····· 15

Summary: We define r-inferior regular partition which is a restriction of partition. Its generating function equals to that of the number of operations in Glaisher correspondence. Using this result, we prove Mizukawa–Yamada's identity. And extend this identity to m-tuple version.

9 Ayumu Hoshino (Hiroshima Inst. of Tech.) Jun'ichi Shiraishi (Univ. of Tokyo) Matrix inversion for Koornwinder polynomials with one-column diagram ····· 15

Summary: We introduce a matrix inversion for Koornwinder polynomials with one-column diagram.

Summary: It is a well-known fact that the KZ equation which relates the differential to the algebraic action can be obtained from the representation theory of the Kac–Moody algebra. We show that the same idea can be applied to the quantum toroidal algebra and propose the difference analogue, namely the (q,t)-KZ equation. Furthermore, we can prove that the solution to the (q,t)-KZ equation is the Nekrasov function for the instanton counting of the super symmetric gauge theory. This story realizes the celebrated AGT correspondence.

Summary: We give a detailed proof of the existence of evaluation map for affine Yangians of type A to clarify that it needs an assumption on parameters. This map was first found by Guay but a proof of its well-definedness and the assumption have not been written down in the literature.

Summary: A conjectural formula expressing the generating series of three-partition Hodge integrals in terms of topological vertex of topological string theory is proved. The proof is given by utilizing the recent result on quantum torus symmetry of random skew plane partition, which is a generalization of the previous study on random plane partition or melting crystal.

Summary: We formulate a quantized reflection equation in which q-boson valued L and K matrices satisfy the reflection equation up to conjugation by a solution to the Isaev–Kulish 3D reflection equation. By forming its n-concatenation along the q-boson Fock space followed by suitable reductions, we construct families of solutions to the reflection equation in a matrix product form connected to the 3D integrability. They involve the quantum R matrices of the antisymmetric tensor representations of $U_p(A^{(1)}_{n-1})$ and the spin representations of $U_p(B^{(1)}_n)$, $U_p(D^{(1)}_n)$ and $U_p(D^{(2)}_{n+1})$. Similar results on the G_2 reflection equation will also be presented.

Summary: The generalized quantum group of type A is an affine analogue of quantum group associated to a general linear Lie superalgebra, which appears in the study of solutions to the tetrahedron equation. We construct Kirillov–Reshetikhin (KR) modules of this algebra, that is, a family of irreducible modules which have crystal bases. We also give a combinatorial description of the crystal structure, the combinatorial R matrix, and energy function on their tensor products.

16:40–17:40 Talk Invited by Infinite Analysis Special Session

Takeshi Ikeda (Okayama Univ. of Sci.) K-theoretic Paterson isomorphism

Summary: The K-homology ring of the affine Grassmannian of $SL_n(\mathbb{C})$ was studied by Lam, Schilling, and Shimozono. It is realized as a certain concrete Hopf subring of the ring of symmetric functions. On the other hand, a presentation for the quantum K-theory of the flag variety Fl_n is given by Anderson–Chen–Tseng and Koroteev–Pusukar–Smirnov–Zeitlin. We construct an explicit birational morphism between the spectrums of these two rings. Our method relies on Ruijsenaars's relativistic Toda lattice with unipotent initial condition. From this result, we obtain a K-theory analogue of the so-called Peterson isomorphism for (co)homology. We provide a conjecture on the detailed relationship between the Schubert bases, and, in particular, we determine the image of Lenart–Maeno's quantum Grothendieck polynomial associated with a Grassmannian permutation.